SUPPLEMENT G

GPS INSTRUCTIONS

INTRODUCTION

It has become necessary for the Forest Inventory and Analysis (FIA) crews to collect precise position coordinates of inventory sample plot centers. The purposes are 1) to allow FIA data to be accurately incorporated into GIS applications and other data bases and 2) to enhance plot recovery.

The purpose of this manual is to provide the operator with a brief history of the technology and with the procedures used by FIA crews to obtain position coordinates, calculate a coordinate, navigate to a coordinate, and other field applications.

THE GLOBAL POSITIONING SYSTEM

The concept for a Global Positioning System (GPS) dates back to the early days of space exploration. U.S. scientists tracking the Soviet Union's Sputnik satellite in the 1950s used the dobbler effect of the satellite's radio beacon to determine its orbit. They realized that they could use the same process to determine a position on the earth. Development of the system began in 1973. The first satellites were launched in 1978. Today's system utilizes accurate clocks and measures the time required for a radio signal to travel between the satellite and receiver.

Previously, collecting accurate positions was limited because of the bulk and inconvenience of GPS receivers. These early versions had low accuracy and could not obtain a position fix in real time. Recent developments have provided a methodology capable of accurate position estimates (± 12 meters) in a small, handheld, lightweight receiver. With the aid of a base station, accuracies of less than 0.5 centimeter are obtainable.

The Global Positioning System is a space-based radio positioning system designed to provide suitably equipped users with highly accurate positioning, velocity, and time data. It is comprised of three segments:

The space segment consists of a constellation of GPS satellites in orbit around the earth. There are 21 operational satellites. There are three or four operational satellites in each of the six orbital planes. Additionally, there are up to three spare satellites. The satellites orbit the earth twice each day at an altitude of 10,900 miles.

The control segment is comprised of a Master Control Station (MCS) and a number of monitoring stations located around the world. The MCS tracks, monitors, and manages the satellite constellation. It also updates the navigation data messages transmitted by the satellites.

The user segment consists of a variety of radio navigation receivers designed to receive, decode, and process the GPS satellite signals.

The system is managed by the Department of Defense (DOD). To prevent enemy forces from utilizing our GPS system, an intentional error is introduced, Selective Availability (SA). SA is the largest source of error within the system. SA induces up to a 100-meter error into any position estimate. To overcome SA, military GPS units have a special chip with a decoding "key" installed that removes the SA. Recently, the U.S.

Department of Agriculture (USDA) and the U.S. Department of the Interior (USDI) have been granted authority to purchase GPS receivers with this chip. There are two models available to these agencies: the Trimble Centurion and the Rockwell Precise Lightweight GPS Receiver (PLGR). Receivers equipped with the decoding chip are revered to as Precise Positioning Service (PPS).

In May 2000, SA was deactivated by the DOD. All GPS units have the same ± 12 meter accuracy. The DOD has, however, reserved the right to activate SA whenever national security dictates.

SECURITY

PPS receivers because of the security module installed within them are very sensitive security items. As an operator of these receivers, you are assuming a great responsibility, one far and above that of just having signed for another piece of expensive equipment. The security and accountability of your receiver must be your first priority. **Any incident or violation of the restrictions will immediately involve the National Security Agency (NSA) and the FBI.** If they determine that the incident may have compromised key security, the Department of Defense can press for criminal prosecution. They are serious about this. A compromise of the "key" code within your receiver could cause the changing of all keys world-wide, a very expensive and disruptive procedure.

The use of this receiver is authorized by Memorandum of Understanding (MOU) between the Department of Defense and the Department of Agriculture. The continued use of this receiver and the Precise Positioning Service is at the sole discretion of the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence.

Pursuant to the MOU, the Federal Radionavigation Plan, and current guidance from the National Security Agency and the Department of Defense Space Command, **the use of PPS receivers is limited to permanent or temporary Federal employees, who are U.S. citizens, or state government employees who are U.S. citizens and are under the supervision of Federal employees.** The use of PPS receivers by others than those mentioned above is currently considered detrimental to security.

The internal security module and cryptographic keys remain the property of the National Security Agency. As such, PPS receivers must be returned to the Agency GPS-PPS Coordinator in a timely manner, upon demand. Requests for return of equipment may also come from the Federal GPS-PPS Coordinator or the controlling authority at Space Command. However, you should never surrender any PPS receiver without first checking with the Agency GPS-PPS Coordinator.

The PPS receiver is considered unclassified by the DOD. However, the receiver contains cryptographic logic which makes the receiver a DOD "High Value Item". **As such, any loss, theft, tampering, or destruction of a receiver must be reported by the custodian to the Agency GPS-PPS Coordinator immediately.** Serious infractions which may constitute

sabotage, loss through negligence, theft, or espionage are punishable under various sections of the United States Code.

The custodian is responsible for all property accounting, including prompt response to the annual inventory by the Federal GPS-PPS Coordinator. The receiver cannot be processed as excess property. The receiver must be returned to the Agency GPS-PPS Coordinator for proper disposal.

When not in use, PPS receivers should be kept in a secure location such as a locked drawer, cabinet, or storage space. Receivers should never be stored in vehicles.

Shipping of PPS receivers must be via traceable mail such as FedEx, UPS, etc.

PPS equipment cannot be shipped or hand-carried outside of the United States (encrypted or not encrypted), without prior approval from the controlling authority at DOD. Outside of the United States is considered to be any other place besides the conterminous United States, Alaska, and Hawaii. The Agency GPS-PPS Coordinator must be contacted prior to any shipping or carrying of PPS receivers outside of the United States, as defined.

When traveling, receivers should be carried in carry-on luggage rather than checked luggage on commercial transport. That carry-on luggage should be in your possession at all times. The receiver cannot be inspected or handled by anyone out of your sight. Do not leave a receiver in plain sight in a locked vehicle. Do not leave a receiver in an unlocked vehicle.

All Forest Service receivers must have a property tag attached. Compliance will be checked each time the unit is sent in to be rekeyed.

THE ROCKWELL PLGR

FIA has chosen to purchase the Rockwell PLGR (pronounced “plugger”). One of the reasons for its selection was its ability to obtain a position fix under a forest canopy. The PLGR is capable of far more than simply calculating the desired position and elevation. Cruisers quickly learned it can be used to navigate to the plot, determine the course to plot, obtain a photo reference azimuth, and determine areas.

REPORTABLE INCIDENTS

If any of the following incidents happens to the PLGR, **report it immediately to the SRS GPS Coordinator or to the Missoula Technology and Development Center (MTDC):**

1. **Lost receiver**: Know where your receiver is at all times. If you lend it to someone, keep that information in a notebook.
2. **Stolen receiver**: Keep your receiver locked-up, even in the office.
3. **Appears to have been tampered with**: Do not attempt to repair or for any other reason attempt to get into the receiver case. NSA will consider that a possible compromise of the code module.

4. **Damaged**. Regardless of the extent, a damaged unit must be returned to MTDC.

If loss or damage to the unit is determined to be the result of negligence, you will be held financially responsible in addition to facing possible criminal charges.

Do not place the PLGR or other equipment on the top of your vehicle after completing a plot. Too many PLGRs and data recorders have been lost or damaged when the driver pulls away.

For future reference:

SRS GPS Coordinator:
Bobby L. Morris
Southern Research Station
200 Weaver Blvd.
Asheville, NC 28804
Phone: 828-257-4366
Fax: 828-257-4894
Pager: 1-800-333-2337, then enter 555-0228 when prompted
E-Mail: blmorris@fs.fed.us

National GPS Coordinator:
Bill Kilroy
USDA Forest Service -- MTDC
5785 Highway 10 West
Missoula, MT 59808
Phone: 406-329-3925
E-Mail: bkilroy@fs.fed.us

In addition to the property tag mentioned earlier, all SRS FIA PLGRs must have a tag instructing the finder to call 828-257-4350.

When transferring a PLGR to another person, an Acknowledgement of Receipt of PLGR GPS Unit must be completed by the receiving party and sent to the SRS GPS Coordinator. An example of this form appears at the end of this manual.

COSTS

This technology does not come cheap:

Item	Cost ($)
PLGR	2000
NiCad Battery	56
NiCad Charging Station	281
12v. Cell Phone Battery	35
3.6v. Memory Battery	5
External Antenna	188
External Antenna Cable	75
External Power Cable	26
AC/DC Power Adapter	30

CRYPTOGRAPHIC KEY

The PLGR will need to be keyed annually by the MTDC. This usually occurs during the last quarter of the calendar year. With overnight shipping, this procedure will require three business days. Therefore, cruisers need to schedule their work so as to have the use of another PLGR while theirs is being rekeyed, or be prepared to return to plots to obtain coordinates when the PLGR has been returned.

SHIPPING

The PLGR must be shipped via traceable mail. Because of the excellent service and corporate account, SRS prefers to use FedEx. The account number will be provided when required.

When shipping the PLGR to MTDC for rekeying, include a paid, return shipping label.

POWER MANAGEMENT

The PLGR requires 12 volts to operate. External power sources must be between 12 and 32 volts DC. For field operations, there are three power source options:

AA battery pack: Utilizes eight AA batteries. Cruisers report the AA batteries will power the unit for about four hours, sometimes more, usually less. The short life expectancy and cost of AA batteries makes this an expensive option.

Rechargeable NiCad battery: A good NiCad battery is rated for about fours of use. Cruisers report the NiCad battery lasts up to six hours. However, the useful life decreases as the battery develops a memory with age. An external charger is provided with the battery for overnight charging. Connecting an external power source to the PLGR recharges the NiCad battery within 36 hours. The initial cost of the battery and charger make this is a relatively expensive option.

Cell phone battery: This is a 12-volt, lead-acid battery that is used as an external power source. This battery can power the unit for 16 hours easily. The battery requires nine hours to charge. This option is relatively inexpensive and is recommended if the PLGR is used for several hours each day.

Two sources of power should be taken into the field at all times. Most cruisers use either the cell phone battery or the NiCad battery as their primary power source and the AA battery pack as a reserve.

When installing the AA battery pack or the NiCad battery, **do not drop the pack into the battery compartment.** The contacts at the bottom of the compartment can be broken. Gently slide the battery into the compartment.

The PLGR also uses a 3.6-volt lithium battery to maintain the data, setup information and cryptographic key. This battery is similar in size to a AA battery. Don't get them confused. The memory battery is replaced annually. The GPS Coordinator will provide one as needed. Instructions are provided with the replacement battery.

While operating the PLGR, you may receive one or more power warning messages:

Low Primary Power: Your AA/NiCad battery is low. Replace the battery.

Lost External Power: You have lost external power. This is most likely the result of a loose connection or low external battery power. However, a frayed power cord or a blown fuse in the external power cord is also a possibility.

Low Memory Battery: The memory battery is low. Replace the memory battery.

It is recommended that you maintain a fresh primary battery, whether for overnight or extended storage. The PLGR will attempt to operate using the memory battery if there is no other power source. The unit will begin the startup cycle when turned ON. But after a few seconds the screen goes blank. **Do not continue pressing the "ON" button when this occurs.** Continued attempts to turn the unit ON will drain the memory battery. You risk losing the key and any stored data.

You may monitor your battery's performance on the Battery Status Page.

1. Press MENU, STATUS will be blinking
2. Press the Down-arrow. The bottom line of the first STATUS page displays the source of power: Battery or Vehicle
3. Press the Down-arrow. The Battery Status page is now displayed.
4. The first line displays the type of battery installed. You will need to change this if the type battery installed is not correctly displayed. If a NiCad battery is installed, the PLGR will automatically sense it and display: "NiCad". If you are using a AA-pack, you will need to tell the PLGR the type of battery being used. Press the right-arrow. Use the up-/down-arrow to scroll between the battery options: AA-Alk, BA-5800, and AA-Lith.
5. The third line displays the elapsed time the battery has been used.
6. If you have just installed a fresh battery, you will want to reset (RST) the time used. Press the left-/right-arrow until RST is blinking. Pressing the up-/down-arrow will reset the time used to zero.
7. The fourth line displays the calculated time left on the battery. This figure is notoriously overly optimistic.

MAINTENANCE AND TESTING

With the exception of replacing batteries, the PLGR requires little maintenance. Inspect the gasket inside the battery cover for damage and dirt. Clean if necessary.

The PLGR has two tests:

The self-test is run every time the unit is turned ON. The self-test results can be seen by pressing the MENU key and selecting STATUS. If the self-test failed, press the up-arrow key to see the self-test failure page. See paragraph 2.7.1 of the Operations and Maintenance Manual for self-test messages.

A second, more comprehensive test is run at the command of the operator. Press the MENU key and select TEST. This test requires several minutes to complete. During this time, the PLGR cannot perform any navigation functions or provide any position coordinates.

Do not attempt to repair a malfunctioning PLGR. Return it to your GPS Coordinator.

OPERATION

There are two iron-clad rules for operating the PLGR. If these rules are not complied with, the receiver will be disabled.

Do not press the "CLR/MARK" and the "NUM LOCK" keys simultaneously! This will erase (zeroize) all stored data and destroy the key. This feature was incorporated for use by the military. In the event of imminent capture, soldiers can prevent the enemy from using the technology against us.

Do not remove the memory battery plug on the bottom of the unit! Removing the battery plug will disconnect the memory battery. It will zeroize the unit if there is no other power source. When replacing this battery, the unit must be connected to an outside power source.

You can easily determine if the PLGR is keyed. On the second page of MENU options, "CRYPTO" should be displayed in the lower left-hand corner. If it is not displayed, then the unit is no longer keyed and must be returned to MTDC for rekeying.

KEYPAD

Left/Right-Arrow Keys

The Left-arrow (←) and Right-arrow (→) keys move the cursor from field to field in the display. Press the right-arrow key, and the cursor moves right across the display. It then moves down to the next line as if the display were a single line. As the last field on the bottom is reached, the cursor wraps to the first selectable field on the top of the display. Pressing the left-arrow key causes the cursor to move to the left, then up to the previous display line.

Up-/Down-Arrow Keys

The Up-arrow (▲) and Down-arrow (▼) keys are used to change display pages, change number/alpha field values, and activate functions. The operation performed depends on what field is selected when the keys are depressed

When the cursor is on an option field, pressing the up-/down-arrow key scrolls through the options.

When the cursor is on a changeable value field, pressing the up-/down-arrow keys increases or decreases the field to the next higher/lower available value. When held, the key causes scrolling to speed up.

When the cursor is on the paging (P) field in the lower right-hand corner of the display, pressing the up-/down-arrow keys scrolls to additional pages.

MENU Key

The MENU key displays the system menu pages. The menu consists of display pages that allow you to monitor PLGR operation and control operating functions and interfaces with other equipment

WP Key

Pressing the WP key brings up the waypoint menu display. The waypoint functions allow you to manage waypoint data, calculate coordinates of a waypoint, and determine routes and distance data from one waypoint to another.

POS Key

Pressing the POS key brings up the position display. The position display pages display current position, time, speed, satellite tracking status, current datum, magnetic variation, operator identification, and bullseye position. Pressing the POS key while in another display displays the last-used position page.

Pressing and holding the POS key for approximately five seconds causes the operating mode to toggle between averaging and continuous tracking modes.

NAV Key

Pressing the NAV key brings up the navigation information displays. The first page selects the display mode, navigation method, and destination waypoint. More pages are available to display the various waypoint navigation information. Pressing the NAV key while in another display displays the last-used navigation page.

MARK Key

The MARK key is used to activate the MARK (marking present position) and Man Overboard (MOB) waypoint selection page. On this page, the first unused waypoint is automatically selected for storage. The waypoint may be changed to any waypoint number and can be used with either MARK or MOB selection.

NUM LOCK Key

Pressing the NUM LOCK key toggles the keypad between control mode and numeric mode. An N is displayed at the lower right of the display in the numeric mode.

0 thru 9 Keys

In the numeric mode, pressing a 0 thru 9 enters its numeric value into the selected field. If a nonnumeric field is selected, keypad operation is the same as described for the control mode.

CLR Key

The CLR key moves the cursor to the left. This allows wrong entries to be reentered.

PLGR SETUP

The first time you use the PLGR and after rekeying, you'll need to set several parameters. These parameters make the information specific to your location and needs. Once these values are set, they become the default values.

1. Turn the unit on. The PLGR goes through a self-test routine for a few seconds, briefly displays the battery status, and then displays the Position screen.
2. Press the MENU key. STATUS will be blinking.
3. Press the RIGHT-ARROW key. SETUP will be blinking
4. Press the DOWN-ARROW key. The first page of the setup menu is now displayed.
5. Press the LEFT-ARROW key so the field value for SV-TYPE is blinking. Press the DOWN-ARROW so "mixed" is displayed. Press the RIGHT-ARROW. Note the double-arrow beside the "P" in the lower right corner.
6. Press the DOWN-ARROW to move to the next page.
7. Press the RIGHT-ARROW so the field value for SETUP UNITS is blinking. Use the DOWN-ARROW to scroll between the options. Stop when "L/L-dms" is displayed. "L/L-dms" signifies latitude/longitude-degrees, minutes, seconds.
8. Press the RIGHT-ARROW to set the units for Distance and Elevation. Use the DOWN-ARROW to scroll between the options. Stop when "ENGLISH" is displayed.
9. Press the RIGHT-ARROW so the value for Elev is blinking. Use the DOWN-ARROW to toggle to "feet".

10. Press the RIGHT-ARROW. Use the DOWN-ARROW to toggle to “MSL”.
11. Press the RIGHT-ARROW so the value for ANG is blinking. Scroll through the options until “DEG” is displayed.
12. Press the RIGHT-ARROW. Scroll through the options until “Mag” is displayed. This parameter is used when calculating coordinates. Since our compasses are not set for declination, we want to use magnetic North rather than true or grid North.
13. Press the RIGHT-ARROW and DOWN-ARROW to go to the next page. This is the Magnetic Variation page.
14. Press the RIGHT-ARROW. The value for TYPE should be blinking. Scroll through the options until “Calc” is displayed.
15. Press the RIGHT-ARROW. Scroll through the options until “deg” is displayed.
16. Press the RIGHT-ARROW and DOWN-ARROW to proceed to the next page.
17. Press the RIGHT-ARROW to move to the “WAGE” field. WAGE should be “on”. “WAGE” signifies Wide Area GPS Enhancements. When ON, the PLGR process enhanced clock correction signals from the satellites.
18. Press the RIGHT-ARROW to move to the “ELHold” field. ELHold should be “automatic”.
19. Press the RIGHT-ARROW to move to the “TIME” field. Use the DOWN-ARROW to scroll to the correct time zone correction for your locality:
    EST LOC=Z-0500 EDT LOC=Z-0400
    CST LOC=Z-0600 CDT LOC=Z-0500
    This parameter is not critical to PLGR operations. When set correctly, the time displayed on the second Position page will be the correct local time.
20. Move the cursor to the “ERR:” field. Use the DOWN-ARROW to scroll to “EHE” for the two-dimensional error.
21. Press the RIGHT-ARROW and DOWN-ARROW to move to the next page.
22. Press the RIGHT-ARROW and scroll through the options for “DTM:” Stop when “NAR” for North American Datum 1983 is displayed.
23. Press the RIGHT-ARROW to move to the “AUTOMATIC OFF TIMER:”. Scroll to select “20 min”. This function is used to save battery power. It is enabled only when battery power is being used. This function starts when a good solution is obtained and resets every time a keystroke is entered.
24. Press the RIGHT-ARROW.

Your PLGR is now set up and ready to calculate your position. Press the “POS” key.

After the PLGR has run its self-tests and displays the Position screen, the PLGR downloads the daily almanac and verifies the cryptographic key. These processes are automatic and require 12 to 25 minutes. You will get the quickest position lock and most precise solutions with the current almanac. You may get a solution before the almanac has been updated; but it will likely have a higher error estimate. Therefore, it is recommended that you turn the unit on while you are driving to your work area. You can

connect the PLGR to the vehicle's electrical system using the external power cord. This will preserve your battery power. Use the external antennae or place the unit on the dashboard (safety permitting) while driving to the work area.

OBTAINING A POSITION FIX

When the PLGR is turned on, the default screen is the Position screen. You need do nothing to get a position fix. You must track four satellites to obtain a position fix. However, if after 20 to 25 minutes you have not obtained a fix, turn the unit OFF and back ON. Sometimes the unit gets hung-up trying to track a satellite. Cycling it OFF and ON forces it to look at other satellites.

Several factors influence satellite reception. Satellite signals can be blocked by terrain, vegetation, and the human body. Although weather is not supposed to effect PLGR operations, cruisers have reported difficulty obtaining a position fix on overcast days. Orienting the PLGR's antennae vertically aids in signal reception.

The tracking mode is displayed in the upper left corner of the screen. The error estimate is displayed in the upper right corner. The Latitude and Longitude are displayed on the second and third lines. Finally, the elevation is displayed in the lower left corner.

The default operating mode for the PLGR is continuous (CONT). "CONT" is displayed in the upper left corner of the first Position screen. In this mode the PLGR continually calculates and displays the current position estimate. Once the PLGR has a fix on the position, you will note that the seconds of latitude and longitude constantly change. If you were to plot these coordinates, you would find that they are clustered around a central location. It is that central location we want to record. To determine that central location, the PLGR can calculate the running average of these coordinates.

There are two methods used to switch from continuous mode to averaging mode.

1. While the first Position screen is displayed, press and hold the POS key for five seconds. This toggles between the two modes. "AVG 00000" will replace "CONT" in the upper left corner of the screen.
2. This second method can be used to improve performance in very low signal environments, such as under dense foliage.
   a) Go to the SETUP menu.
   b) Change the SETUP MODE to "STBY",
   c) Press MENU and return to the Setup menu.
   d) Now change the SETUP MODE to "AVG".
   e) Press the POS key.

   For a brief instant, you will see "STBY" in the upper left corner before it changes to "AVG 00000".

While in averaging mode, **do not move the PLGR.** The PLGR must obtain a valid position fix for 13 seconds before averaging will begin. This may require some time. Solutions will be averaged once per second. The first

position screen displays the averaged value and the sample counter. Although there is no established rule for determining the sample number required to ensure an accurate estimate, FIA has selected 180 samples as the minimum required.

The maximum allowable error estimate is ± 70 feet. The PLGR routinely has error estimates in the low-20s. The error estimate is a function of the satellites relationship to the receiver. As the satellites orbit the Earth, this relationship, or geometry, changes. Consequently, the error estimate is constantly changing.

Occasionally, you may want to reset the sample counter. For example, the satellite geometry has changed, and you are now receiving a lower error estimate.

1. Press the left-/right-arrow, and the sample counter will begin to blink.
2. Press the up-/down-arrow key to reset the counter.
3. Pressing the left-/right-arrow key a second time returns the cursor to the paging (P) field in the lower right corner.

On the rare occasion that you cannot obtain a position fix, there are two options. You can try again at a different time of day when the satellite geometry has changed. Or, you can obtain a position fix off the plot center, determine the bearing and distance to the plot center, and use the PLGR's range-calc feature (discussed later).

Once you have the required number of samples, record the error estimate and the number of samples on your form(s) or data recorder. The error estimate and number of samples are not stored electronically in the PLGR. You have the option to record the coordinate on paper or data recorder, or you can save the coordinate in the PLGR's memory for entry onto the data recorder and form(s) at a later time.

SAVING A POSITION FIX

The PLGR can store up to 999 waypoints, 1 – 999.

MARK saves the current position's coordinates. To save a position fix or waypoint (WP), press MARK. The PLGR will automatically assign the first available WP to that position. At this time you may change the WP number, by pressing the NUM LOCK key and entering the desired WP number, or using the up-/down-arrow key to scroll to the desired WP number. Once the desired WP number is displayed, pressing MARK a second time saves the entry. If you used the NUM LOCK feature, remember to press NUM LOCK again to return to the control mode before pressing MARK a second time. If the waypoint you have selected is already assigned, pressing MARK a second time overwrites the previously stored coordinate.

There is no rule for assigning waypoints. However, most cruisers assign the waypoint the same number as the plot number. Other waypoints used in association with that plot receive waypoint number(s) beginning or ending with the plot number. For example, plot 36 would be assigned WP

36. Associated waypoints, such as the SP, would be assigned WP 361, 362, 363,… or 136, 236, 336,….

MANUALLY ENTERING A WAYPOINT

It will be necessary to manually enter a coordinate occasionally. SRS recently adopted a hexagon design for plot locations. If there is an existing plot located in the hexagon, that plot is used to represent the hex. In the event there is no plot in the hex, an empty hex, coordinates will be provided for the new plot's location. These coordinates must be manually entered into the PLGR.

1. Press WP, select ENTER, and press NUM LOCK.
2. Press the right-arrow and enter the desired waypoint number.
3. Pressing the right-arrow once allows you to name the waypoint if you want. Otherwise, press the right-arrow a second time.
4. Press the right-arrow a third time. The PLGR defaults to North latitude. All of our coordinates are North latitude.
5. Enter the degrees, minutes, and seconds north latitude.
6. Press the up-/down-arrow to toggle the longitude to "W". All of our longitudes are West longitude.
7. Press the right-arrow and enter the degrees, minutes, and seconds west longitude.
8. There is no elevation to enter. Press the right-arrow twice.
9. Press the up-/down arrow. You will see "WAYPOINT STORED"
10. Press any control mode key: POS to go to the position screen, NAV to navigate to a waypoint, WP to work with waypoints, etc. To enter additional waypoints, press the down arrow to return to the entry screen (step 2).

CALCULATING A WAYPOINT

On occasion it will be necessary to calculate a waypoint. Rather than occupy a nonforest plot, we will calculate its coordinates. Having found the plot starting point (SP), you may want to calculate the plot center (PC) coordinate and use the PLGR to facilitate finding the plot.

Before you can calculate a waypoint, you must first have a waypoint stored in the PLGR. This waypoint may be a saved (marked) WP or a manually entered waypoint. This will usually be a marked WP that represents the SP. You must also have an azimuth and distance from the stored WP to the PC. This you will obtain from having drawn-up the photo or be provided by the previous crew.

1. Press WP and select RNG-CALC.
2. Use the right-arrow to move the cursor to the first numeric field.
3. Enter the waypoint number for the beginning point.
4. Move the cursor to the RNG field, and enter the distance and units to the desired location.
5. Move the cursor to the AZ field, and enter the azimuth to the desired location.
6. Move the cursor to the paging (P) field in the lower right corner. For our purposes, we do not need to enter an elevation.

7. Press the down-arrow to go to the next page. The calculated coordinate is now displayed. You can record the calculated coordinate on your data recorder or form(s).
8. To save the calculated coordinate as a waypoint:
    a) Press the down arrow to go to the next page. This page is similar to the MARK page. Change the waypoint assignment if you desire.
    b) Press the left-/right arrow key to move the cursor so STORE is blinking.
    c) Pressing the up-/down-arrow while STORE is blinking will save the calculated coordinate as the assigned waypoint.

NAVIGATING TO A WAYPOINT

You will want to use the PLGR to locate a point. This may be the PC of an established plot or a new plot, in the case of an empty hex.

The PLGR has several navigation scenarios pre-programmed. These navigation programs contain a number of parameters that are not needed for our application. Many of these functions require a minimum ground speed (approximately 1.5 kph) before they can be used. Also, the parameters of interest do not appear on one screen. The user must select one page to get the distance and another page to get the azimuth to plot. It is recommended that you enter a custom navigation program.

To enter a custom navigation screen, go to the CUSTOM NAV option in the MENU. You may select any parameter(s) that you feel will be useful. However, there are three parameters that are considered minimal: Waypoint and Error Estimate (WP/EHE), Azimuth to Waypoint (AZ), and Distance to Waypoint (RNG). A fourth parameter 2-Dimensional Steering (STR2d) is useful. After displaying the desired parameter, going to the next line selects that parameter. When you have selected all of the desired parameters, press any function key (MENU, POS, NAV, etc.) to exit and save your custom navigation screen.

1. Press MENU three times.
2. Select CUSTOM NAV.
3. Press the right-arrow and use the up-/down-arrow to scroll through the options until WP/EHE is displayed.
4. Press the right-arrow to go to the next line
5. Select AZ.
6. Press the right-arrow.
7. Select RNG.
8. Go to the next line.
9. Select STR2d.

These four items will be displayed on a single screen. Any other parameters you may choose would be displayed on the second and subsequent screens. Other parameters might include Ground Speed (GS), Slope Range (SR), Tracking (TRK), and Tracking and Ground Speed (TRK/GS),

To navigate to a waypoint, you first must configure the display mode and navigation method.

1. Press NAV.
2. Use the arrow keys to select CUSTOM (if you have defined a custom navigation screen) or SLOW as the display mode. SLOW navigation mode is used when traveling on foot over rough or difficult terrain.
3. Use the arrow keys to select DIRECT as the navigation method. DIRECT is used to navigate from the present position directly to the destination. Other methods require a predefined course or route.
4. Use the arrow keys to move to the second line and select the destination waypoint.
5. Move the cursor to the paging field, and go to the next page.
6. The navigation parameters are displayed on the second and subsequent screens.

You may use the PLGR to establish a plot. In the case of an empty hex, you will be provided with coordinates. Plot the location on your county map to determine the location and the appropriate photo. Use the map and photo to approach the area. Use the PLGR to direct you when you are close. When navigating to the plot, the position mode must be continuous. When you are prepared to set the plot, switch to the averaging mode. Before setting the PC, you must have the minimum 180 samples. Use a compass and tape to close the remaining bearing and distance to the plot.

DETERMINE THE COURSE TO PLOT

This feature is used to determine the bearing and distance from the SP to the PC. For distances less than 500 feet, it is recommended that you use the PDRS traverse program. The PLGR's solution may not be within the quality assurance tolerance level for these shorter distances.

1. Obtain and MARK the coordinates for the SP and PC.
2. Press WP and select DIST.
3. Enter he waypoint that represents the SP.
4. Enter the waypoint that represents the PC.
5. The distance (RNG) and azimuth (AZ) are calculated and displayed.

You may also use the NAV function. This requires either the SP or PC coordinate be marked.

1. Obtain and mark the coordinate for the SP/PC.
2. Obtain the coordinate of the SP/PC.
3. Press the NAV key and enter the waypoint representing the marked SP/PC.
4. Go to the second NAV screen and obtain the distance and azimuth to the destination waypoint. If the marked coordinate is the SP, record the reverse azimuth of the solution.

DETERMINE AREAS

One acre is the minimum size requirement for forest, nonforest, and within forest conditions. Therefore, accurately determining areas is essential. The PLGR calculates areas to the nearest 0.1 acre. If the calculated area is 1.0 acre, you may want to use the DIST function to obtain the azimuth and distances between waypoints and use the PDRS area feature to ensure the area is not 0.95 to 1.0 acres.

1. Obtain and mark coordinates around the perimeter of the area in question. Up to 26 waypoints can be used to define a single route. If you require more than 26 waypoints to define the perimeter, divide the area into two or more parcels.
2. Press WP and select ROUTE
3. Select ENTER
4. The PLGR defaults to the first unassigned route number. Assign a route number and name if desired.
5. Enter the waypoints corresponding to the perimeter.
6. To save the route, either scroll through to the end of the route list and select the SAVE option, or press one of the major function keys (MENU, POS, WP, etc.).
7. After the route has been saved, select the POLY option of the ROUTE menu. This displays the circumference and the area of the defined polygon.

DETERMINE PHOTO REFERENCE AZIMUTH

In hilly/mountainous and undeveloped areas, finding a linear feature that can be used as a reference azimuth is difficult. The PLGR can be used to obtain an azimuth between two identifiable points. However, using the PLGR to obtain a Reference Azimuth should not become an everyday practice.

1. Identify two points on the photo that you will be able to locate on the ground. These points should be widely spaced, further is better.
2. Obtain and mark coordinates of the first point. Because of the scale of the photos, it is not necessary to use averaging mode for this application.
3. Obtain coordinates for the second point.
4. Use the procedures described above to determine the azimuth between the two points.

CLEAR WAYPOINTS

Periodically, you will want to clear stored waypoints.

1. Press WP and select CLEAR.
2. Using the arrow keys, select the range of waypoints you want to delete.
3. Pressing the up-/down-arrow while “ACTIVATE” is blinking will begin the process.
4. The PLGR now needs confirmation that you want to delete the waypoints. If the range is correct, use the arrow buttons to select CONFIRM. If the range is incorrect, select CANCEL to stop the operation.

OTHER USEFULL SCREENS

Information contained on a number of screens will help you monitor the PLGR's performance.

STATUS

Page 1 displays the GPS Status, Self-Test Results, Antenna Source, and Power Source.

Page 2 displays the Battery Type, Recharge Status, Time Battery Used, and Time Battery Left.

Page 4 is the Satellite Tracking Status and shows the signal status of the satellites being tracked. Pressing the left-/right-arrow toggles the first column to display a fifth satellite.

- Line 1 displays the number of the satellite (SV) being tracked/searched
- Line 2 displays the signal strength (CN). 34 dB is considered nominal.
- Line 3 displays the code type (CD) being transmitted by the satellite.
- Line 4 displays the satellite status (ST): I=interference, R=recovery, S=search, and T=Track

Page 5 shows the satellite status information:

- Line 1 displays the number of the visible satellite (SV).
- Line 2 displays the satellite's health: OK or BAD.
- Line 3 displays the azimuth to each satellite (AZ).
- Line 4 displays the elevation angle of each satellite and whether the satellite is ascending or descending.

POSITION

Page 1 displays the current position information
Page 2 displays the Time, Date, Track, and Ground Speed.
Page 3 displays the satellite usage summary that includes the almanac age.
Page 4 displays the current datum, the magnetic variation, and the operator ID.

ACKNOWLEDGEMENT OF RECEIPT OF PLGR GPS UNIT

UNIT #_____ SERIAL #_____

PROPERTY #_____

NAME _____ STATE_____

THIS IS TO ACKNOWLEDGE RECEIPT OF THE ABOVE GPS UNIT. THIS IS ALSO TO ACKNOWLEDGE THAT I BEEN BRIEFED OF THE SECURITY INVOLVED WITH THIS UNIT BEING IN MY POSSESSION.

_____ _____

(signature) **(date)**

ACKNOWLEDGEMENT OF RECEIPT OF PLGR GPS UNIT

UNIT #_____ SERIAL #_____

PROPERTY #_____

NAME _____ STATE_____

THIS IS TO ACKNOWLEDGE RECEIPT OF THE ABOVE GPS UNIT. THIS IS ALSO TO ACKNOWLEDGE THAT I BEEN BRIEFED OF THE SECURITY INVOLVED WITH THIS UNIT BEING IN MY POSSESSION.

_____ _____

(signature) **(date)**