GPS Specifications
Standard Operating Procedure

Revision Log

Revision	Description of Change	Author	Effective Date
1	Original	G. Sanders	Oct. 1, 2005

Purpose

This standard operating procedure (SOP) describes the procedures used to collect Global Positioning System (GPS) data of acceptable quality in the field. This document also provides information on instrument settings, field operations, and standards in the recording of positional data.

Scope and Applicability

GPS is a constellation of 24 Department of Defense satellites that orbit the earth approximately every 12 hours, emitting signals to earth at precisely the same time. The position and time information transmitted by these satellites is used by GPS receivers to trilaterate a location coordinate on the earth using three or more satellites.

The standards described in this SOP pertain to all data collected with hand-held or backpack GPS receivers. This document focuses upon field operations and instrument settings to be used when collecting GPS data, and includes some recommended standards for collecting positional data. This document is not intended to serve as a training manual for those new to GPS data collection. For more detailed information regarding the collection of GPS data, please consult the Reference Documents.

Reference Documents

- A reference manual for creating quality GIS data with GPS technology is available at http://www.nps.gov/gis/gps/gps4gis/
- Operating manuals for each individual device.

Procedures and General Requirements

All GPS Units

Always do differential corrections. Post-process all data, even if real-time differential correction is used in the field.

Check the graphics data collection screen regularly to see if you are getting multi-path or other apparent distortions to the data. Garmin and PLGRs require the user to monitor the screen and stop data collection during poor PDOP or SNR windows. Trimble receivers set to the appropriate mask (see above) will stop collecting data automatically.

Be aware of the possibility of multi-path interference, and use offsets or other methods to keep the antenna away from building overhangs, tall fences or walls, and heavy canopy whenever possible.

If maximum accuracy is required, it is important to sync the collection rate with the base station logging rate. Stations log anywhere from 1 to 30 second data. It is recommended that logging rates be in multiples of 1 or 5 for best differential corrections. Setting logging rates other than 1 and 5 may reduce the number of positions that are in sync with base data and reduce accuracy.

Map all features in a single area on a single day or on consecutive days.

Be aware of the ambient conditions and how they may affect the unit. The LCD screen may be hard to see in bright sunlight or if the user is wearing polarized lenses. Extreme temperatures may affect the display as well. Most LCD displays will "black out" due to extreme temperatures.

Garmin

Estimated Horizontal Error (EHE) should be less than or equal to 12 meters. This will keep you just within National Map Accuracy Standards for a 1:24,000 scale map – which defines the maximum acceptable error.

Use a minimum of 4 satellites (3D) for every position.

For point data, collect 90-120 positions at 1-2 second intervals and average.

For line or polygon data, use a 2-5 second interval for walking and road driving, depending upon the road type and speed of the vehicle. Force (e.g., wait for) a position at each corner and use a minimum of 3 positions to define any curve or change in direction.

GPS projection settings should match the projection requirements used by the park where the data is being collected.

PLGR

Estimated Horizontal Error (EHE) should be less than or equal to 12 meters. This will keep you just within National Map Accuracy Standards for a 1:24,000 scale map – which defines the maximum acceptable error.

Use a minimum of 4 satellites (3D) for every position.

For high accuracy point data use the average mode (AVG). Collect data at a single point for at least 60 seconds but preferably two minutes. Be sure to switch to continuous mode (CONT) when moving the unit.

GPS projection settings should match the projection requirements used by the park where the data is being collected.

GPS Specifications
Standard Operating Procedure

Trimble Pathfinder Unit (PRO XRs, Recons, and GeoExplorers) Settings

Positional dilution of precision (PDOP) should be less than or equal to 6. Start with a maximum PDOP setting of 4, and shift to 5 if data collection is not successful. This will meet National Map Accuracy Standards for a 1:5,000 scale map.

Use a minimum of 4 satellites (3D) for every position.

Signal to Noise Ratio (SNR) should be less than or equal to 5.

Set Elevation Mask to 15.

Be sure to check the Antenna Height setting – which should be the typical height at which the antenna will be carried. If the antenna is attached to a pole, it must be located above the user's head and the antenna height setting should be the height at the top of the pole. Whenever possible, the antenna should be clear of any obstructions.

For point data, collect a minimum of 30 positions at 1-second intervals and average.

For line or polygon data, use a 2-5 second interval for walking and road driving, depending upon the road type and speed of the vehicle. Force (e.g., wait for) a position at each corner and use a minimum of 3 positions to define any curve or change in direction.

Data should be exported in the projection used by the park where data was collected.

Park Unit Data Standards

All digital geospatial data should reference the coordinate system appropriate for its use and it should be documented in the metadata. When collecting GPS data in the field, the projection used will depend on the park where data is being collected. A list of standard park projections is included at the end of this SOP.

Horizontal/Vertical Accuracy and Precision

All spatial data collected will be analyzed for spatial accuracy and will meet or exceed the National Map Accuracy Standards for the intended scale and use (for more information, please see http://mapping.usgs.gov/standards). Any calculations done with location data should be done at double precision with the results rounded or truncated to the appropriate propagated error limits. All calculations and processing completed on the spatial data will be reported in the metadata.

Positional coordinate data should NOT be recorded in NAD27 in the field. Datum conversions should be done as an office, post-processing activity using software that applies a full NADCON datum conversion in order to assure accuracy and precision.

Real-time differential correction techniques should be employed whenever possible for efficiency and time savings. The distance between the base station and the remote GPS receiver should be kept to a minimum, preferably less than 150 miles.

GPS Specifications
Standard Operating Procedure

Responsibilities

Data Collectors

Be certain that you understand how to use the GPS unit, data logger, and any study-specific data collection forms prior to going into the field and collecting data. Ask questions or request training as needed. There is nothing worse than wasting a day, or more, of field work due to improper use of the equipment. Plan your trips to the field in advance, and target times of the day when the most satellites will be overhead (check the latest almanac at http://www.trimble.com/gpsdataresources.html) to get the most of your time in the field. Also, spend time (at the beginning of the project) going over the data you are collecting and differentially correcting to make sure you are collecting everything that is needed, in a proper way. Don't wait until the end of the project to do this or an entire field season may be wasted when errors could have been corrected early on. If something doesn't seem right to you, please ask.

Data or Project Manager

Provide data collection personnel with training and/or instruction in the use of all GPS units, data loggers, and any study-specific data collection forms prior to sending them out into the field to collect data. If possible, accompany all new data collectors in the field until you both are certain about and comfortable with all data collection procedures. Be available to answer questions from data collection personnel, and require that early data collection efforts be thoroughly analyzed to minimize systemic mistakes that could greatly diminish the usefulness of the data collected. If possible, examine data from initial data collection efforts as soon as possible, to catch any systemic errors that need correction.

GPS Specifications
Standard Operating Procedure

Standard Park Projections:

ANTI
UTM – meters
GRS 1980
Zone 18N
NAD 83

CATO
UTM – meters
CLARK 1866
Zone 18N
NAD 27

CHOH
MD STATE PLANE
(feet)
GRS 1980
Zone 4126 (FIPS zone
1900)
NAD 83

GWMP
VA STATE PLANE (feet)
GRS 1980
Zone 4501 (north)
NAD 83

HAFE
WV STATE PLANE
(feet)
CLARKE 1866
Zone 5651N
(FIPS Zone 4701)
NAD 27

MANA
UTM – meters
GRS 1980
Zone 18N

MONO
UTM –meters
GRS 1980
Zone 18N
NAD 83

NACC
MD STATE PLANE (meters)
GRS 1980
Zone 4126
NAD 83

NACE
MD STATE PLANE (meters)
GRS 1980
Zone 4126
NAD 83

PRWI
UTM – meters
Clarke 1866
Zone 18N
NAD 27

ROCR
MD STATE PLANE (meters)
GRS 1980
Zone 4126
NAD 83

WOTR
UTM – meters
GRS 1980
Zone 18N
NAD 83