Standard Operating Procedure for:

Static Positioning with Bad Elf

Missouri State University

and

Ozarks Environmental and Water Resources Institute (OEWRI)

Prepared by: _____ Date: _____
OEWRI Laboratory Manager

Approved by: _____ Date: _____
OEWRI Director

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1 Identification of the method

Getting static locations for accurate monument positions in the field for surveying.

2 Scope of the method

This standard operating procedure provides Ozarks Environmental and Water Resources (OEWRI) field personnel with guidance on the procedure for completion of static data collection in the field and post processing.

3 Summary of method

This SOP describes the infield raw data collection procedures using the Bad Elf GNSS Surveyor to get one static location. The post processing procedure is also explained using the program RTKPost, CORS, and GEOID computation to achieve an accurate static location for all monument and known point locations.

4 Definitions

4.1 GNSS: Global Navigation Satellite System

4.2 CORS: Continuously Operating Reference Station Network

5 Health and safety

There are no health or safety concerns when using this procedure.

6 Personnel qualifications

This procedure should be followed by OEWRI field and processing personnel who have received appropriate training and have field experience regarding surveying techniques and post processing of GPS points.

7 Equipment and supplies

7.1 Bad Elf GNSS Surveyor: real time GPS

7.2 iPad: run Raw Logging on the Bad Elf

7.3 Posts, flagging: for permanent monument locations in the field

7.4 Tape measure: measure the distance the bad elf is off the ground

8 Procedure

The form is comprised of two sections; data collection procedure section and the post processing.

8.1 Use Bluetooth to connect the Bad Elf GNSS Surveyor to the iPad.

8.2 Place Bad Elf on top of the designated monument. This can be a known location on aerial photography or use a stake/post that can be permanently placed into the surveying area for future work at the site. Wait until Bad Elf or iPad says **WAAS + PPP**

8.3 A minimum of 2 monuments are needed, 3 monuments are recommended in case of a data sharing error.

8.4 Open the Bad Elf App and select Raw Logging on the left column (Figure 1). Raw logging is what is used to get a static location on the ground. Make sure the

Auto-stop is set to at least **20 min**. More time can be added if the area is dense. When ready, tap the switch to begin logging data. (If you are running out of time only 15 minutes of recording is required.

8.5 When the raw logging is complete, it will automatically stop recording and save the file as Untitled. Enter the Marker Name (i.e. Site_Mon1). If it is a new monument, measure the height of the stake that the Bad Elf was placed on and put height (m) under Antenna height in the Raw Log Details.

8.6 When you are out of the field and have wifi connection. Click the download button at the bottom of the Raw Log Details Screen.
Export Selected Raw Log As: ZIP'd RINEX Files

8.7 Email the ZIP'd RINEX File, so it can be downloaded for later use. Each file has to be emailed individually.

9 Post Processing

9.1 Download CORS Data (RINEX) https://www.ngs.noaa.gov/UFCORS/ and input (Figure 2):

- 9.1.1 Start Date (Day Raw Log was collected)
- 9.1.2 Start Time (An hour before the Raw Log was Collected)
- 9.1.3 Time Zone: GMT – 6 (Central Standard)
  GMT – 5 (Central Daylight Savings)
- 9.1.4 Duration in Hours (Add an hour to when the Raw Log was done collecting, 2-4 hours)
- 9.1.5 Site ID: use **CORS Map** to select a site (i.e. for Big Barren its site MOVB)
- 9.1.6 Sampling Rate: As Is
- 9.1.7 Available Satellite Systems check GPS (L1+L2+L2C+L5) and GLO+GAL+BEI
- 9.1.8 Click *get CORS data file*

9.2 Setting up the RTKPost processing https://bad-elf.com/pages/post-processing-gnss-data-with-rtklib-introduction

9.3 RTKPost Options… (Figure 3)

- 9.3.1 Setting1: Ensure Positioning Mode is set to *static* and filter type is set to *Forward*. Elevation mask set to *15* degrees.
- 9.3.2 Setting2: Ensure setting for Integer Ambiguity Resolution is set to *Fix and Hold*
- 9.3.3 Ouput: For static recordings, set Datum/Height to *WGS84/Ellipsoidal* and Solution for Static Mode to *Single*
- 9.3.4 Positions: Under Base Station, ensure *RINEX Header Position* is selected

9.4 In RTKPOST ver.2.4.2 input (Figure 4):

- 9.4.1 Click on the ellipses "…" next to RINEX OBS: Rover. Select the RINEX (.obs) file downloaded from your Bad Elf App
  Ex: Mon 3.obs
- 9.4.2 Click on the ellipses "…" next to RINEX OBS: Base Station. Select the RINEX (.19o) file downloaded from your CORS base station
  Ex: movb1970.19**o**
- 9.4.3 Under RINEX *NAV/CLK, SP3… click on the ellipses "..." on the first line and select the NAV (.19n) file from your base station.
  Ex: movb1970.19**n**

9.5 Click "Execute" to have RTKLIB process your data files.

9.6 Click on “View” to see a text file containing the solution. The position file (.pos) will automatically be saved in the folder where your the RINEX file was saved from your Bad Elf App.

9.7 GEOID Computations: After the Lat/Long/Height is established from RTKPOST, the GEOID needs to be subtracted from the Height to get the Ortho Height (Figure 5).

9.7.1 Go to https://www.ngs.noaa.gov/GEOID/GEOID12B/computation.html

9.7.2 Enter Latitude, Enter Longitude (no negative), select West

9.7.3 Click Perform GEOID12B Computation for single location

9.7.4 Subtract the N meters (Ex: -29.708) from the Height (m) given from the RTKPOST .pos file to get the Ortho Height

9.8 If needed subtract the Antenna Height from the Ortho Height to get the final elevation.

9.9 All of the monuments can be saved in an excel spreadsheet and saved as a .csv file. The .csv file can be exported as XY data in ArcGIS (using the WGS84 coordinate system) to be mapped and compared to the LiDAR for accuracy.

10 References

Bad Elf. 2019. "Post-processing GNSS Data with RTKLIB." Bad Elf. https://bad-elf.com/pages/post-processing-gnss-data-with-rtklib-introduction.

NOAA. 2018. "Computation of GEOID12B Geoid Height." National Geodetic Survey. June 27. https://www.ngs.noaa.gov/GEOID/GEOID12B/computation.html.

NOAA. 2019. "Download Custom CORS data files." User Friendly CORS (UFCORS) Data (RINEX). April 24. https://www.ngs.noaa.gov/UFCORS/.

11 Tables, diagrams and flowcharts

There are no tables, diagrams or flowcharts for this method.

Figure 1. Screen shot of Bad Elf App on iPad showing sections needed to run raw logging/static positioning.

Figure 2. CORS Base Station Data

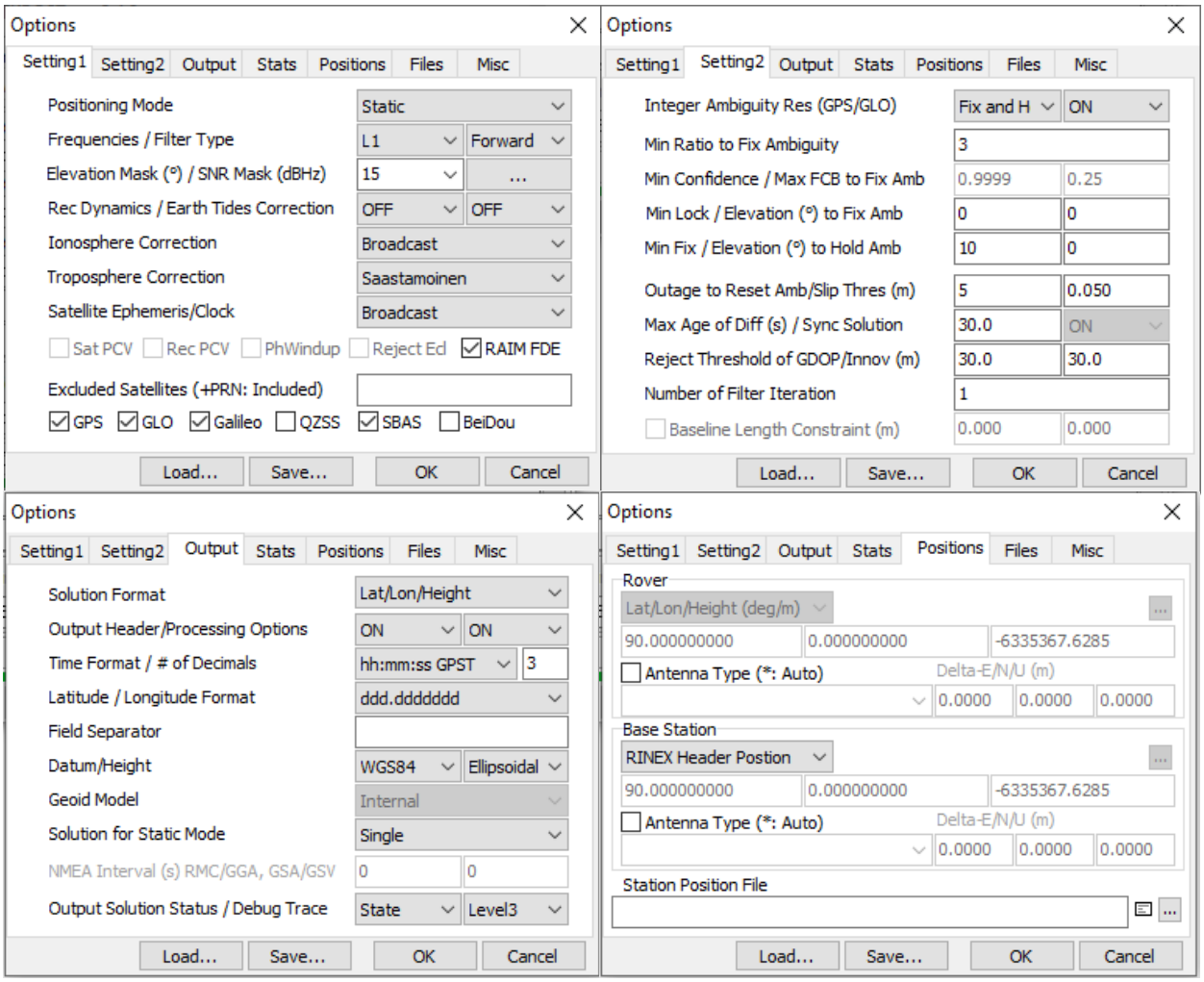

Figure 2. RTKPOST Option changes for static processing

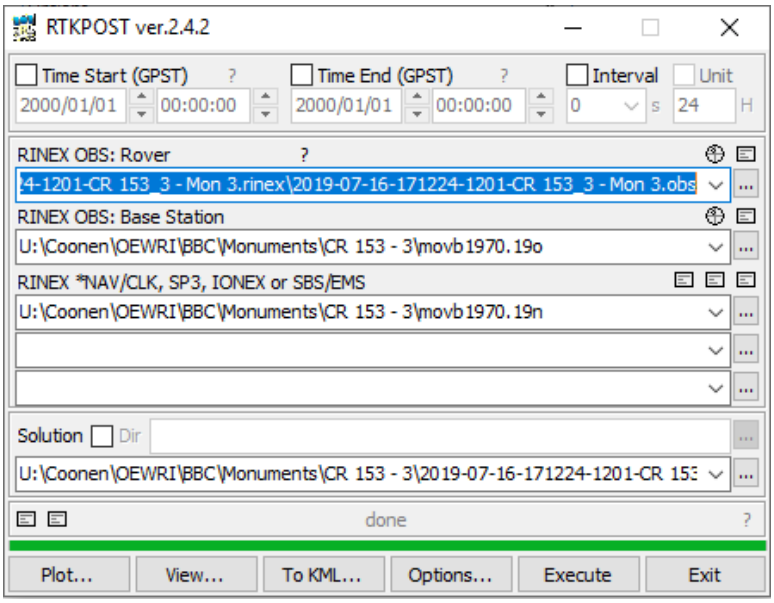

Figure 4. RTKPOST data entry inputs

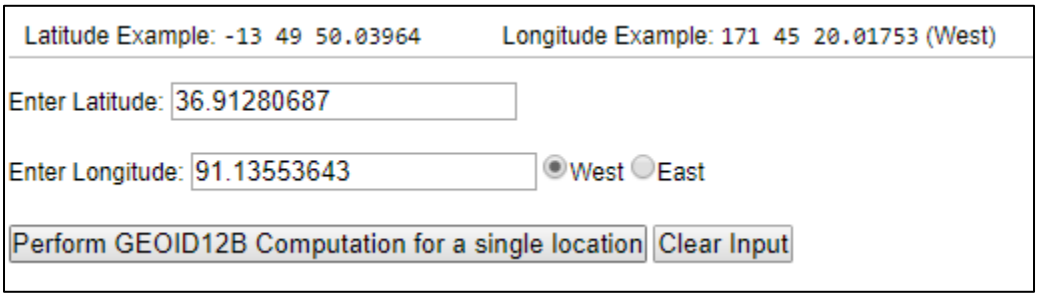

Figure 5. GEOID Computation