Watershed Monitoring Section
TRIMBLE GNSS/GPS
Basics Manual

Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection

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GNSS/GPS Basics

The term Global Navigation Satellite System (GNSS) is used to describe receivers that can pick up signals from multiple types of navigation satellites. Example of these navigation satellites include the United States' GPS (Global Positioning System), the Russian GLONASS (Globalnaya navigatsionnaya sputnikovaya sistema), Chinese BeiDou, and the European Galileo systems. GNSS is very useful in conditions where there are a lot of obstructions, such as tree canopy, blocking the receiver's view of the sky.

Getting Started

To turn on the GeoExplorer 6000 series or Geo 7x unit, press the power button below the screen (Figure 1). If the unit won't start up, refer to the troubleshooting tips on page 28. After the unit is turned on, select the **GNSS** icon in the lower right corner of the screen or tap the TerraSync icon in the center of the screen to open the TerraSync™ software (Figure 2).

Figure 1. Trimble GeoExplorer 6000 Series GNSS unit.

Figure 2. Screenshots illustrating GNSS unit home screen for the GeoExplorer 6000 (left) and Geo 7x (right).

Data Transfer Utility

Information is transferred between the Trimble GNSS / GPS unit and a computer using the Data Transfer software. The Data Transfer software can be downloaded from the Watershed Monitoring Section (WMS) FTP site (http://publicfiles.dep.state.fl.us/dear/watershed%20monitoring/Data_Transfer_Software/). DEP staff should contact the Service Desk for assistance installing this software.

Once the Data Transfer software has been installed, connect the Trimble GNSS / GPS unit to the computer using the USB cable. Windows Mobile will detect that the unit has been connected, and prompt you to select a connection type (Figure 3). Select the **Connect without setting up your device** option. After establishing the connection settings, Windows Mobile will display a list of options for managing the content on the Trimble GNSS / GPS unit (Figure 3). These options are useful for managing photos or other files that may be stored on the unit, but do not provide a means for interacting with the TerraSync software on the unit.

Interacting with the TerraSync software require use of the Data Transfer utility software. Once the connection with the GNSS / GPS unit has been established, open the Data Transfer software from the Windows Start Menu (Figure 4). Once the Data Transfer software is open, check the device status displayed near the top of the window to ensure that the software recognizes that the Trimble GNSS / GPS unit is connected (Figure 5).

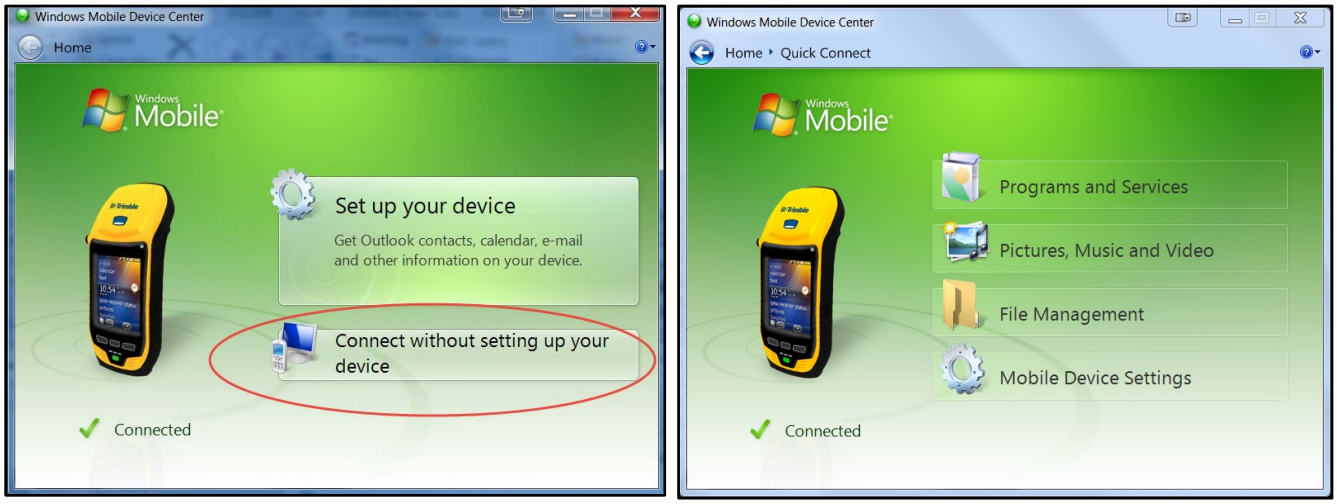

Figure 3. Screenshots illustrating device setup options in Windows Mobile Device Center (left), and mobile device content management options (right).

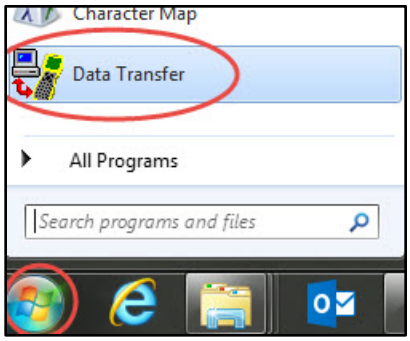

Figure 4. Screenshot illustrating Data Transfer Software icon in the Windows Start menu.

Figure 5. Screenshot illustrating the device connection status displayed at the top of the Data Transfer software window.

Sending Items to the GNSS / GPS Unit

Before using a Trimble GNSS / GPS unit to collect data for the Status Network, the current Status Network data dictionary must be transferred onto the unit. The use of the data dictionary facilitates collecting field data consistently statewide. Status Network data dictionaries can be downloaded from the WMS FTP site (http://publicfiles.dep.state.fl.us/dear/watershed%20monitoring/GPS%20Data%20Dictionaries). Save a copy of the appropriate data dictionaries to a computer and use the Data Transfer software to load them onto the Trimble GNSS / GPS unit.

The Data Transfer software can also be used to transfer pre-populated data files onto the unit for use during navigation. Using pre-populated data files for navigation increases efficiency in the field, and eliminates the possibility of transcription errors associated with manually entering the coordinates for each navigation target. Pre-populated data files for Status Network projects can be downloaded from the WMS FTP site (http://publicfiles.dep.state.fl.us/dear/watershed%20monitoring/GPS_Import_Files/).

Once the data dictionary file and / or pre-populated data files have been downloaded and saved on a computer, open the Data Transfer software and select the **Send** tab. Click the **Add** button and select the appropriate file type (either **Data Dictionary** (Figure 6) or **Data File** (Figure 7)). Navigate to the folder on the computer where the files are stored, select the appropriate files and click the **Open** button. The selected files will appear in the Data Transfer software's list of files to send. Once all files to be transferred appear in the **Files to Send** list, click the **Transfer All** button to send the files to the Trimble GNSS / GPS unit (Figure 8).

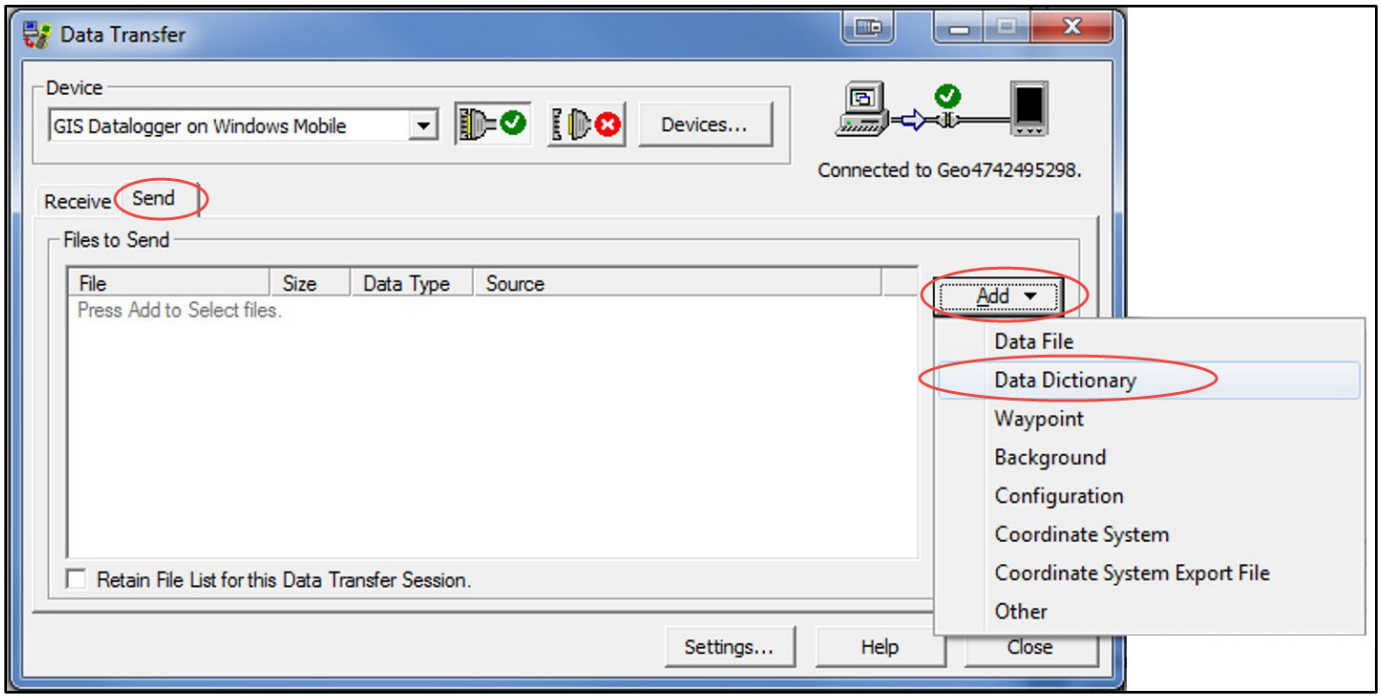

Figure 6. Screenshot illustrating use of the Data Transfer software to select Data Dictionary files to send to the Trimble GNSS / GPS unit.

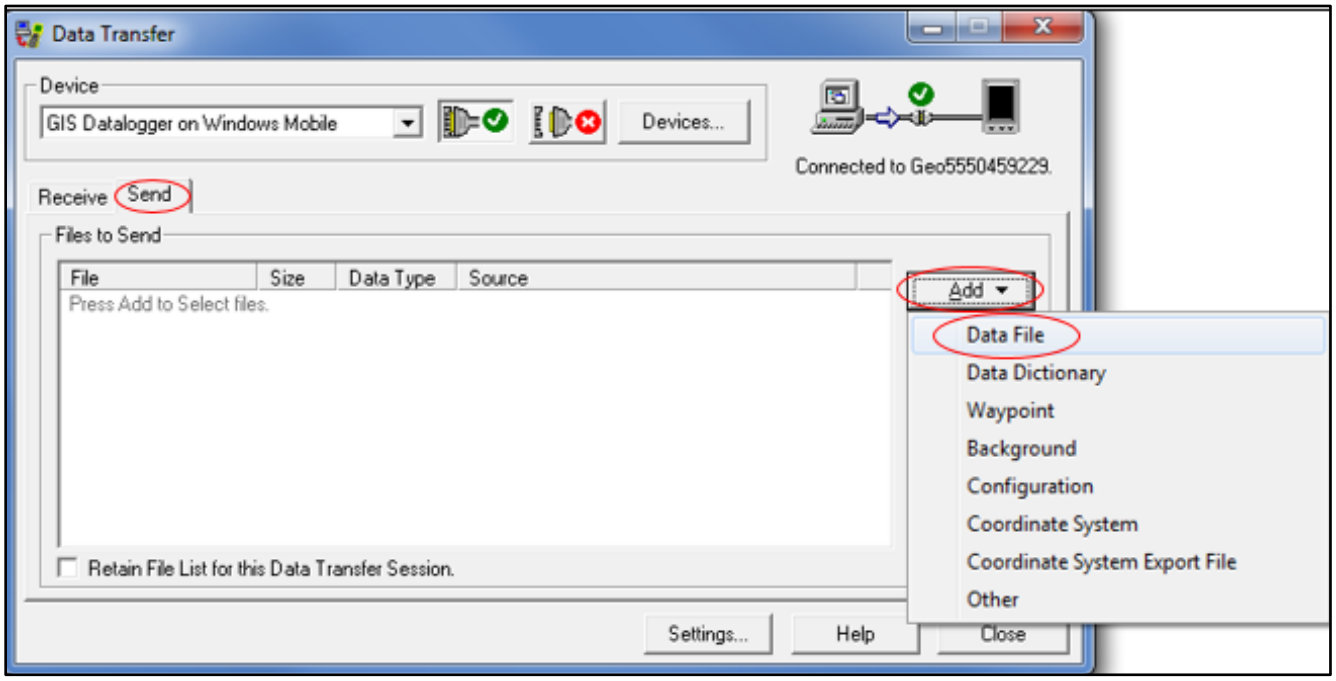

Figure 7. Screenshot illustrating use of the Data Transfer software to select pre-populated data files to send to the Trimble GNSS/ GPS unit.

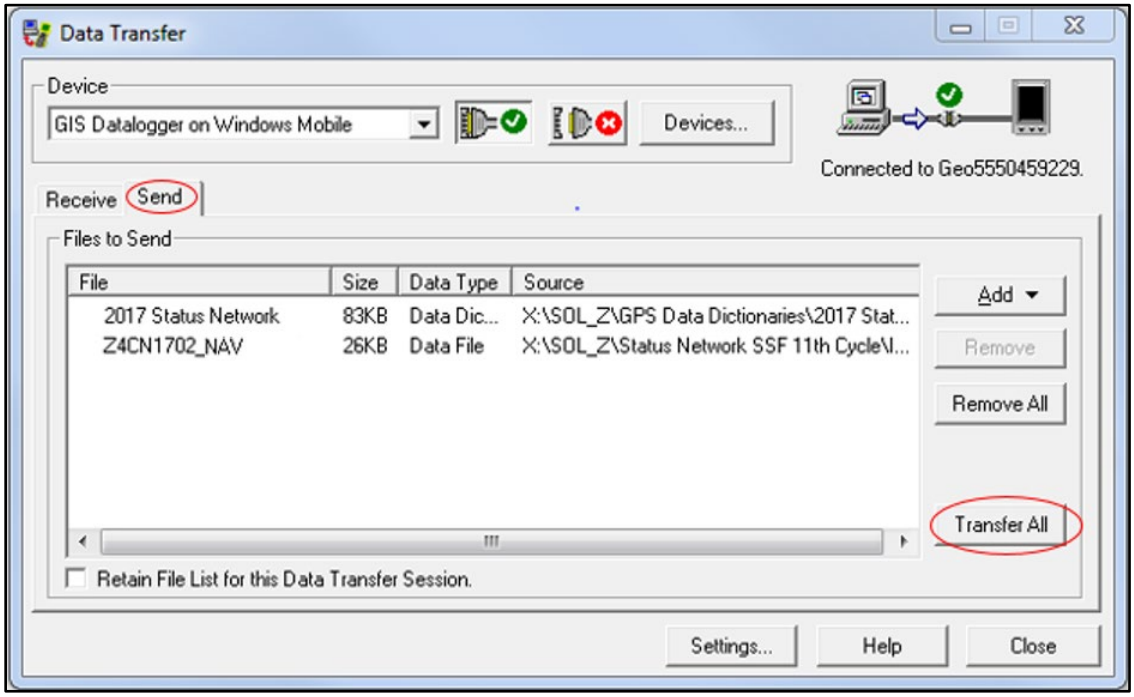

Figure 8. Screenshot illustrating use of the Data Transfer software to send a data dictionary and data file to the Trimble GNSS / GPS unit.

Receiving Data from the GNSS / GPS Unit

After data have been collected using the Trimble GPS / GNSS unit, the data files must be retrieved from the unit and sent to the DEP Water Quality Monitoring Program (WQMP) GNSS / GPS Coordinator for post-processing. Connect the GNSS / GPS unit to a computer and open the Data Transfer software as described on page 4.

Once the Data Transfer software is open, select the **Receive** tab. Click the **Add** button and select **Data File** (Figure 9). Select the data file(s) to transfer, click the **Browse** button to specify the destination folder on the computer, then click the **Open** button (Figure 10). The selected data files will appear in the Data Transfer software's list of files to receive. Click the **Transfer All** button to send the files to the computer (Figure 11). The files that are transferred to the computer are commonly called "SSF Files", a reference to their .ssf file extension.

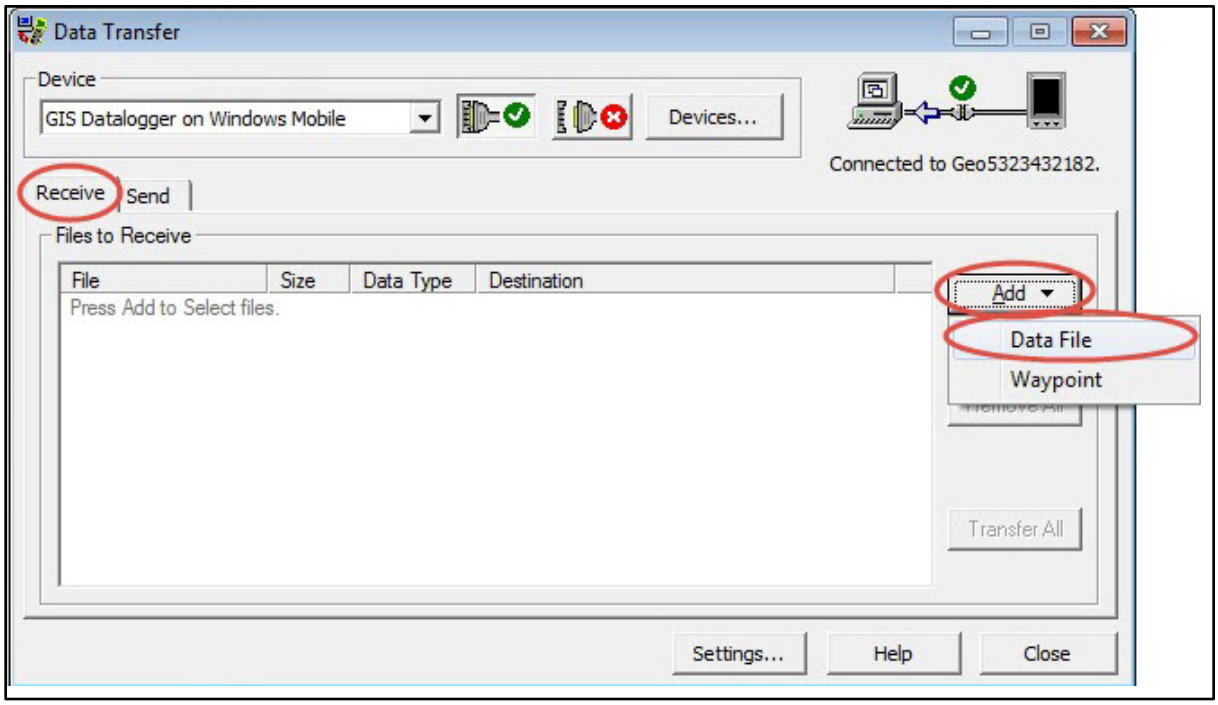

Figure 9. Screenshot illustrating use of the Data Transfer software to select Data Files to transfer from the Trimble GNSS / GPS unit to the computer.

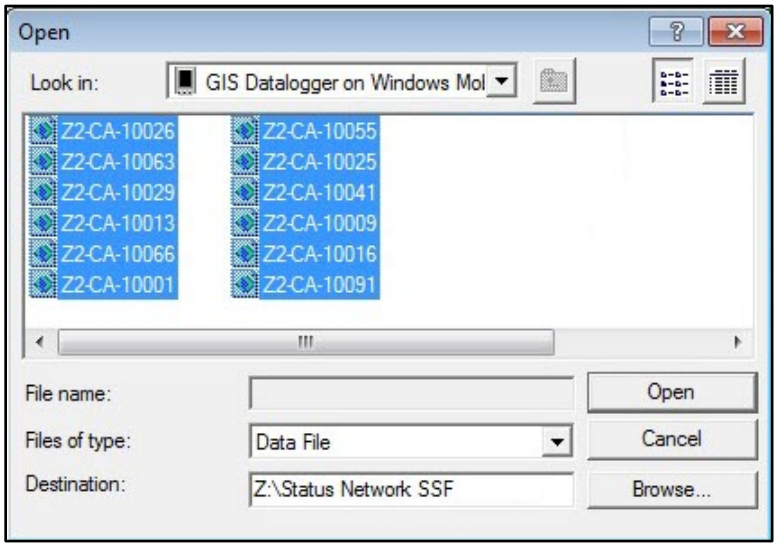

Figure 10. Screenshot illustrating selection of Data Files to transfer from the Trimble GNSS / GPS unit to the computer.

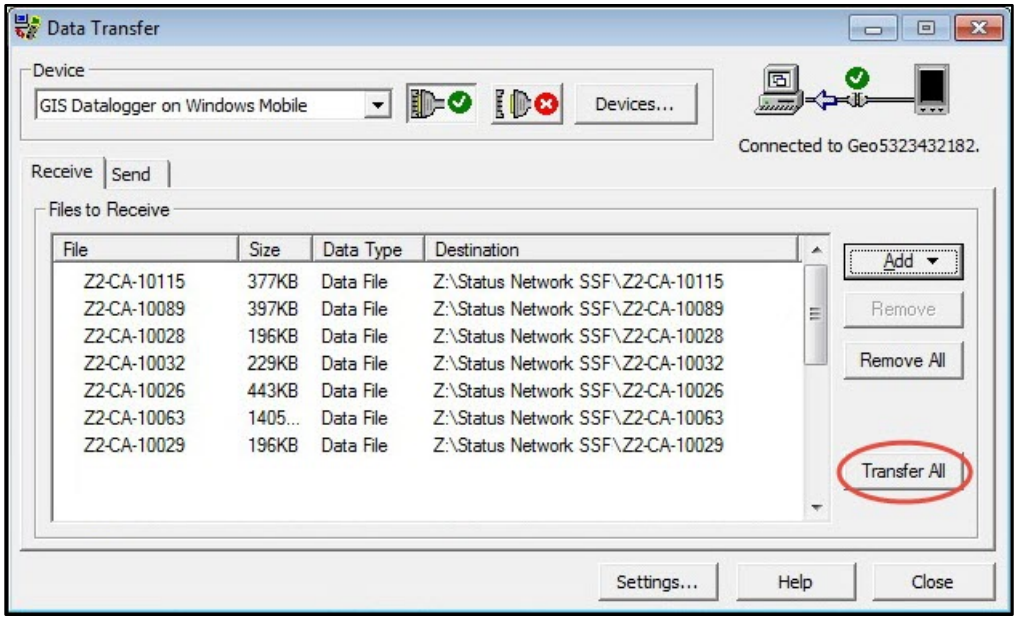

Figure 11. Screenshot illustrating use of the Data Transfer software to transfer data files from the Trimble GNSS / GPS unit to the computer.

TerraSync™ Basics

There are five sections to the Trimble GPS / GNSS unit's TerraSync software: Map, Data, Navigation (Nav), Status, and Setup. The section button in the upper left corner of the screen is used to move between the different sections (Figure 12). The section button is also used to exit the software. One of the five sections is always active and visible. The section button displays the name of the section that is currently active. The section button can be used to move between sections at any time without closing any open forms or screens. Some sections have subsections. The subsection list button is located below the section button (Figure 12).

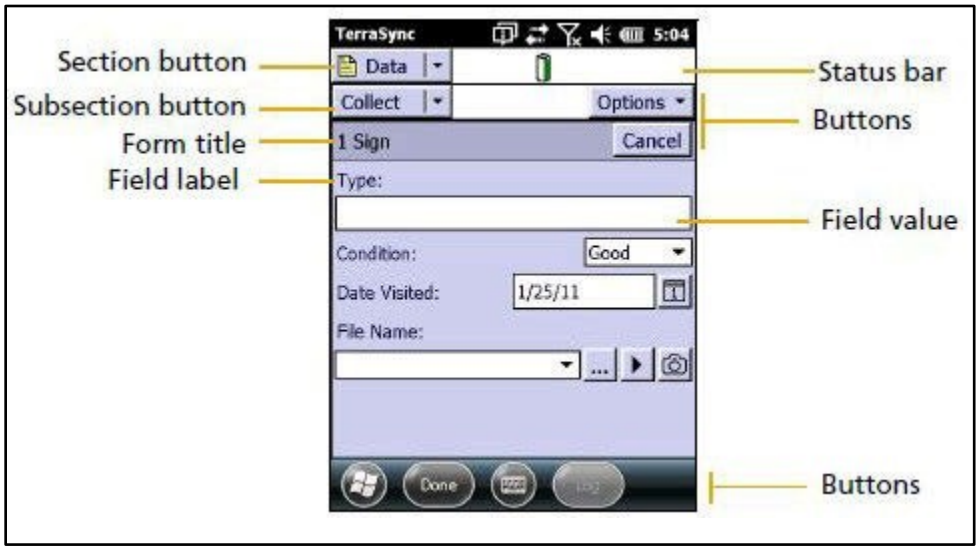

Figure 12. Image illustrating TerraSync software user interface.

The status bar at the top of the screen displays the number of satellites being tracked, whether real-time correction input is being picked up, whether data is being logged, and the battery status (Figure 13).

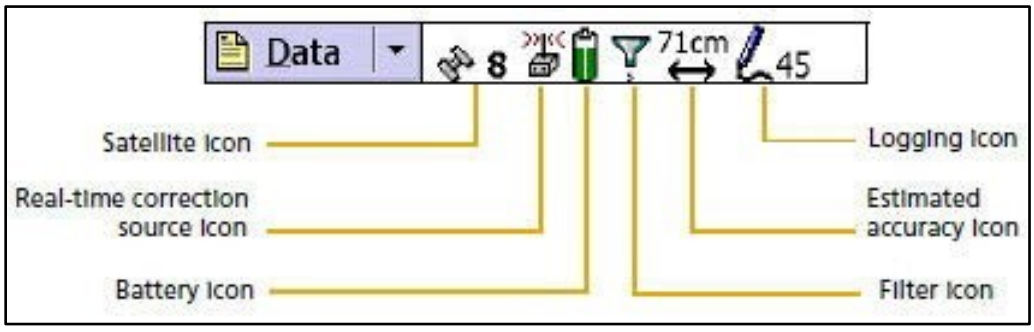

Figure 13. Image illustrating TerraSync software status bar icons.

TerraSync™ Software Receiver Settings

To open the Setup section, tap the section button and select **Setup** (Figure 14). Use the Setup section (Figure 14) to configure the TerraSync software. The GNSS / GPS unit's configuration may be reset to factory default settings by tapping the **Reload** button.

To connect to the GNSS receiver, tap the **GNSS** button in the upper right corner of the Setup section's main screen. Once connected, the GNSS receiver will begin to track visible satellites and calculate the receiver's current position. If the GNSS receiver is already connected and the GNSS button is tapped, you will be asked "Are you sure you want to disconnect from the GNSS receiver?" Selecting **No** will maintain the current connection.

The following paragraphs describe the required settings for collecting data for the Status Network and Trend Network.

Figure 14. Screenshots illustrating use of the section button to open the Setup section (left), and the Setup section main screen (right).

Logging Settings

Logging settings control what data are stored, and how.

The **Point/Vertex Auto-pause Count** sets the minimum number of epics that will be collected and averaged for each point feature. The required setting for Status and Trend Network data collection is 30 (Figure 15). The number 30 does not appear in the drop-down list of choices for this setting, so you must select the keyboard icon at the bottom of the screen (between the 'Done' and 'Cancel' buttons) and then manually enter the number "30".

The **antenna height** stores the height above the ground / water surface that the unit will be held during data collection. The default setting of 3.5 feet is a good generalization for data being collected by a user of average height standing on the ground and holding the unit at waist height. This setting can be adjusted to more accurately reflect the actual position of the unit in the field.

The **Filename Prefix** and **Waypoint Filename Prefix** settings can be adjusted to avoid potential filename duplication.

Between Feature Logging is a useful feature when navigating in unfamiliar terrain. However, for Status and Trend Network data collection, this feature must be turned off (Figure 15). If this feature is not turned off, orphan points will be collected while traveling between sites. These positions are logged in the same file as the point feature and they cause problems during post-processing of the data. Between feature logging is turned off by selecting OFF in the drop-down list for Interval.

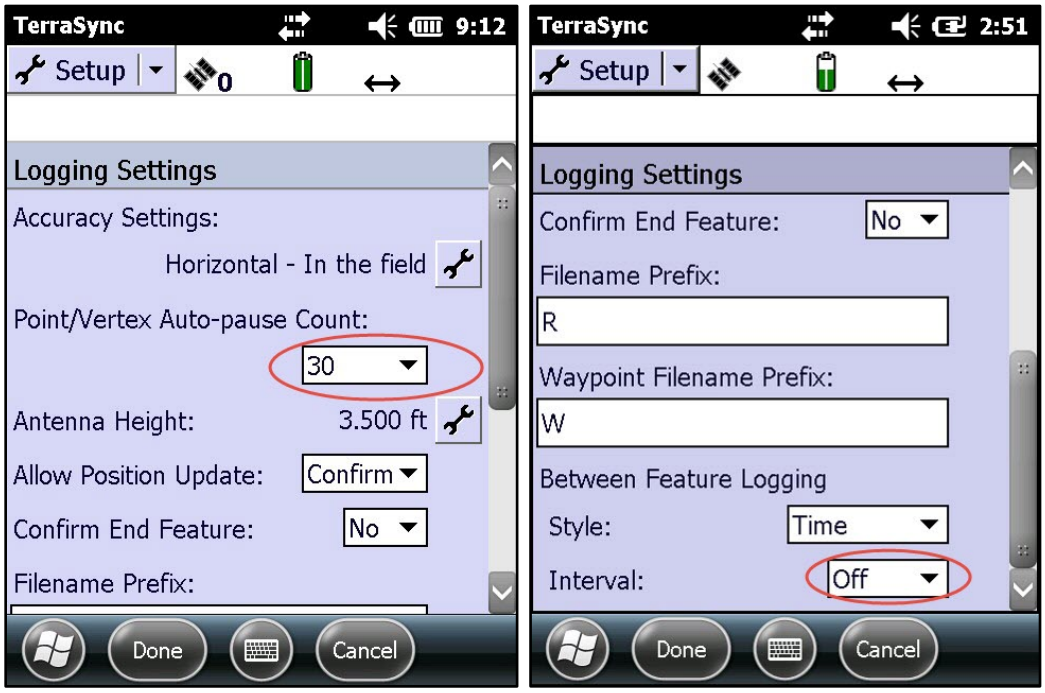

Figure 15. Screenshots illustrating first half (left) and second half (right) of the Logging Settings subsection of the TerraSync Setup section.

GNSS / GPS Settings

GNSS / GPS settings affect the quality of the GNSS / GPS positions. The default settings generally provide accuracy sufficient to meet National Map Accuracy Standards. These settings are acceptable for use when collecting data for the Status and Trend Networks.

Real-Time Settings

To achieve the highest level of navigational accuracy, select **Integrated SBAS** (satellite-based augmentation system) as Choice 1 (Figure 16). When working in an area with dense canopy cover, it may be difficult to find an SBAS signal. In this scenario, it is acceptable to select **Use Uncorrected GNSS**. Select Use Uncorrected GNSS as Choice 2 and set the Real-time Age Limit to 4 min. If an Integrated SBAS signal cannot be found after 4 minutes of searching, the unit will switch to using an uncorrected GNSS signal.

Figure 16. Screenshot illustrating Real-Time Settings subsection of the TerraSync Setup section.

Coordinate System

Coordinate system settings designate the format and reference model that are used for data collection. When collecting data for Status and Trend Network projects, select **Latitude/Longitude** from the system menu and select **WGS 1984** from the datum menu (Figure 17).

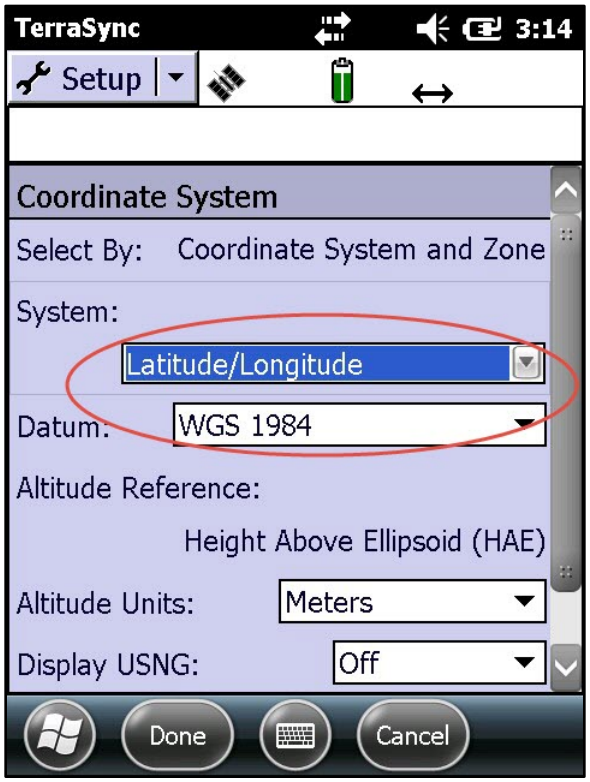

Figure 17. Screenshot illustrating Coordinate System Settings subsection of the TerraSync Setup section.

Units

Units affect on-screen display of various data items. There are no required settings in this subsection because these settings do not impact the accuracy of the data being collected. You may adjust the unit's settings as desired and click the **Done** button when finished.

External Sensors

External sensors include items like laser range finders and bar code wands. Status and Trend Network data collection does not typically involve use of these items, so the boxes next to all sensor items should be unchecked.

Navigation

Trimble GNSS / GPS units should be used to navigate to the randomly selected Latitude / Longitude for Status Network sites. These units can also be used for navigation to Trend Network sites or other points of interest.

Navigation Using Pre-Populated Data Files

If a pre-populated data file has been transferred onto the unit (see page 6) for use during navigation, tap the section button and select **Data** (Figure 18). Select **Open Existing File** from the subsection menu or click the **Open** button near the bottom of the screen. (Note that if

another data file is already open, that file will first need to be closed first.) You will then be prompted to select the data file to be opened.

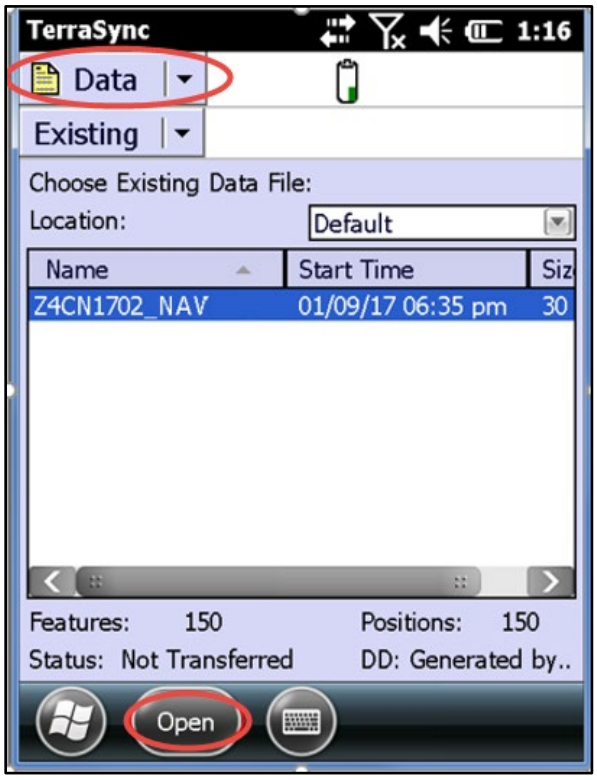

Figure 18. Screenshot illustrating opening a pre-populated data file.

Once a pre-populated data file has been opened, the list of its point features will be displayed. To navigate to one of these features, it must be designated as the navigation target. Tap the desired feature to select it (Figure 19). Then, tap the **Options** button and select **Set Nav Target** (Figure 19). The selected feature number and file name will be displayed in a small submenu. Tap the small submenu to confirm that this is the desired navigation target (Figure 20). In the list of features, the icon next to the feature that has been set as the navigation target will look like two crossed flags (Figure 20).

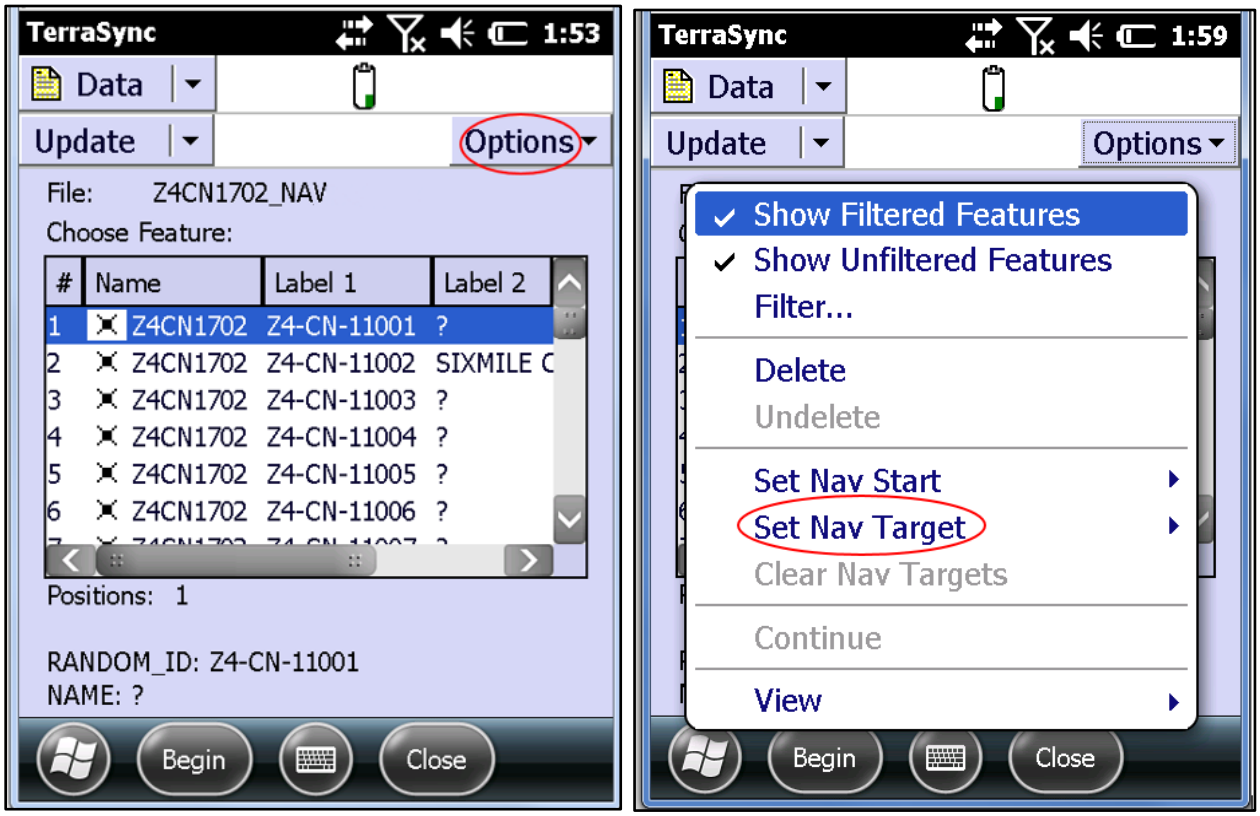

Figure 19. Screenshots illustrating selecting a feature to designate as the navigation target (left), and using the options menu to set that feature as the navigation target (right).

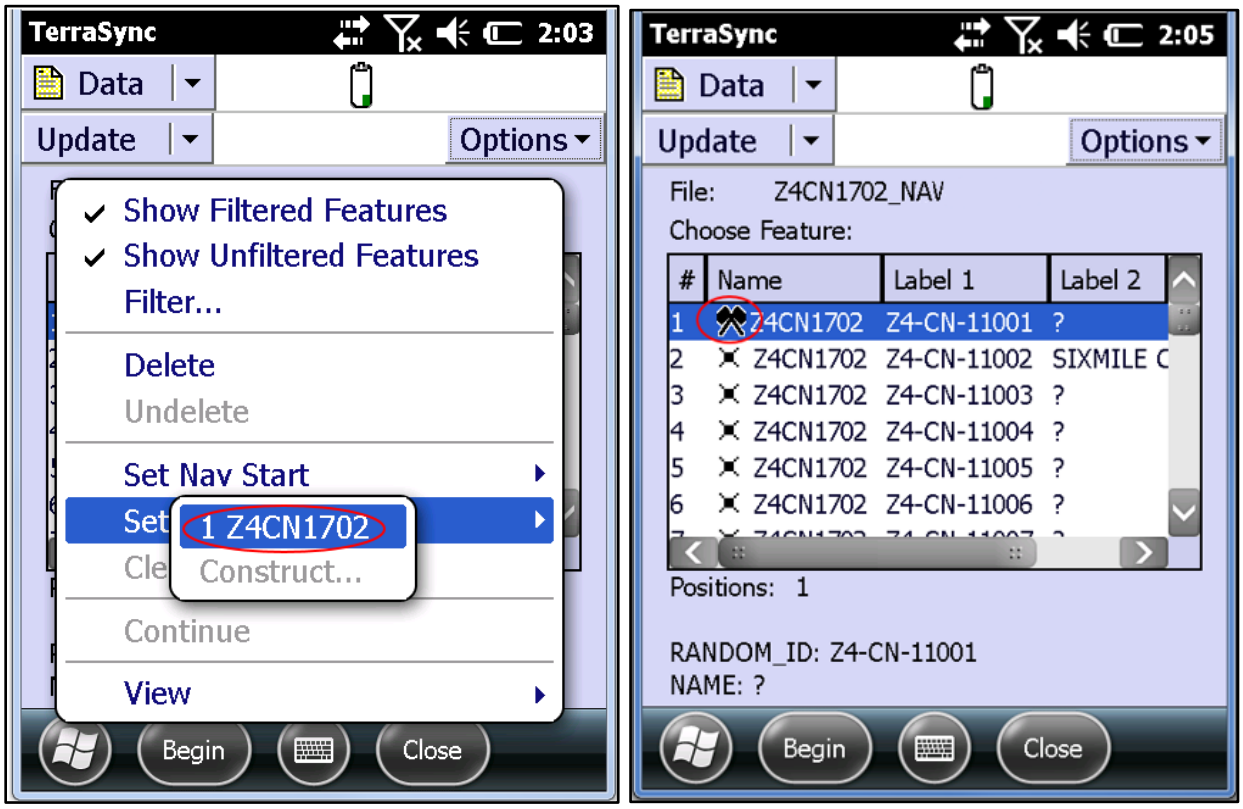

Figure 20. Screenshots illustrating confirming the desired navigation target (left), and the crossed flags icon that is used to identify the current navigation target (right).

Once the navigation target has been set, tap the section button and select **Navigation**, and select **Navigate** from the subsection menu to display the navigation screen (Figure 21). The distance and bearing to the selected navigation target will be displayed near the bottom of the screen, and the compass image in the center of the screen will point in the direction of the navigation target.

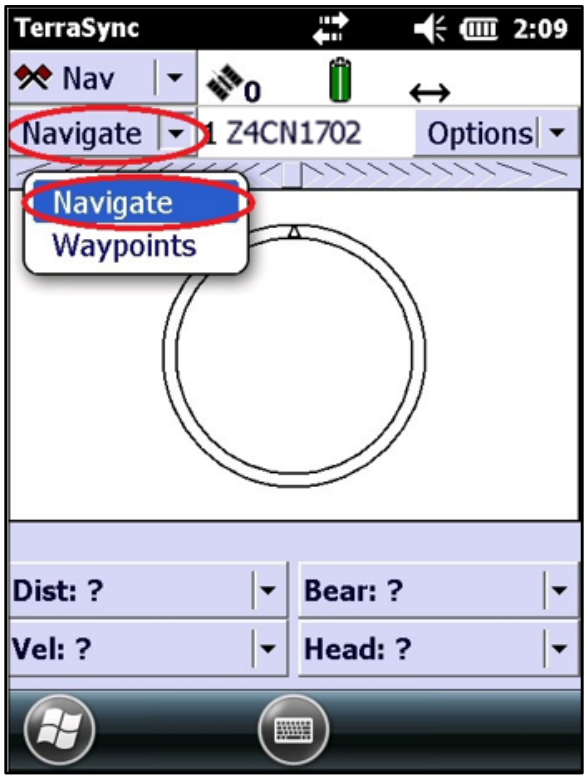

Figure 21. Screenshot illustrating the navigate subsection of the TerraSync Navigation section.

Creating New Waypoints For Navigation

If a pre-populated data file is not available for use during navigation, a waypoint can be created by manually entering the latitude and longitude for the desired site. Note that navigation using this method is no longer recommended for use when navigating to Status Network sites. Pre-populated data files should be used for navigation instead (see page 14), as they reduce transcription errors.

Tap the section button and select **Navigation,** and select **Waypoints** from the subsection menu. Click the **New** button near the bottom of the screen to creating a new waypoint file (Figure 22). Enter the Unique resource ID as the waypoint file name and tap the **Done** button (Figure 23). The main screen for the newly created waypoint file will then be displayed, and it will resemble an empty folder / list (Figure 23).

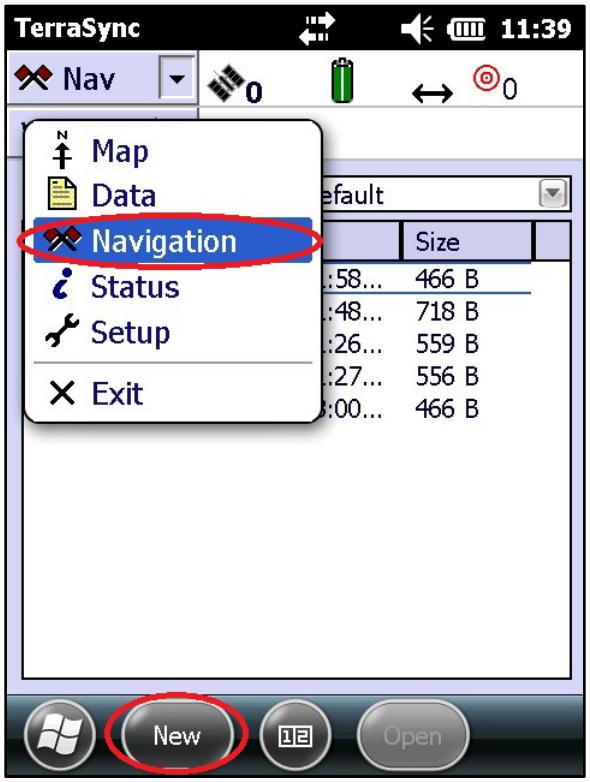

Figure 22. Screenshot illustrating use of the section button to open the Navigation section. New waypoints can be created by clicking the “New” button near the bottom of the screen.

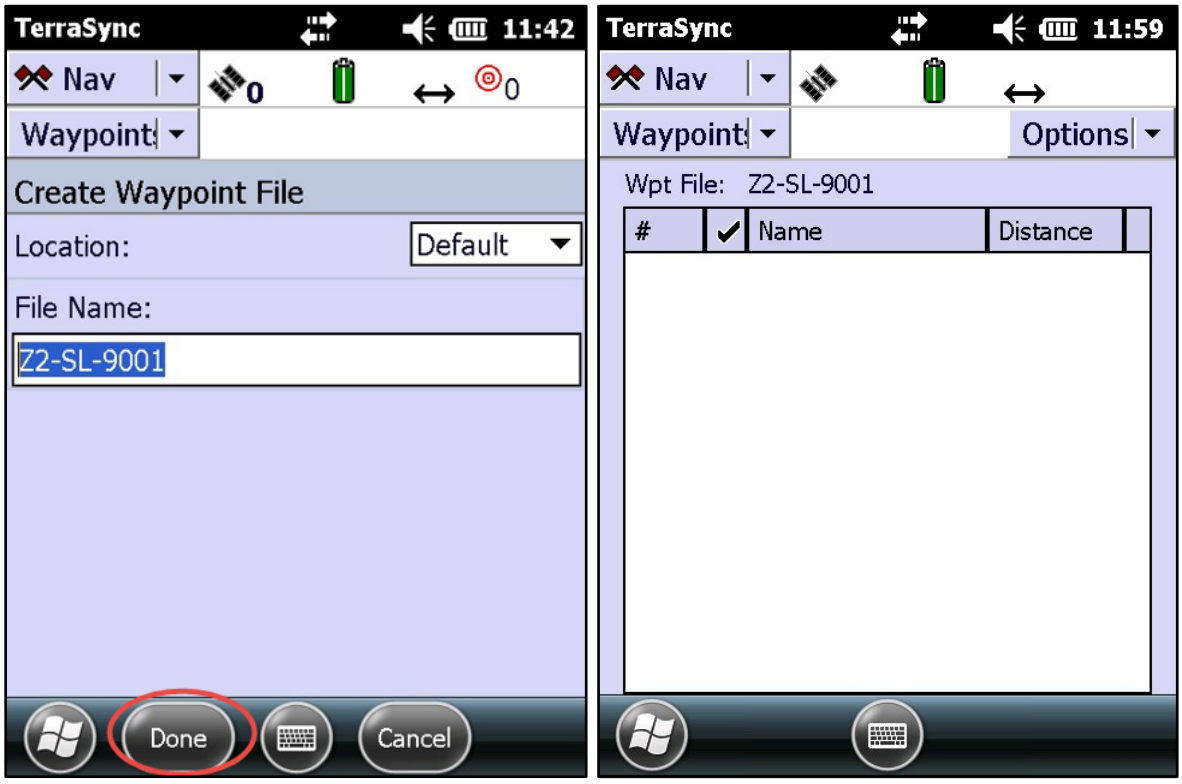

Figure 23. Screenshots illustrating creation of a new waypoint file (left) and the new (empty) waypoint file (right).

After the waypoint file has been created, create a new waypoint within the waypoint file. Tap the **Options** button and select **New** (Figure 24). Enter the Waypoint Name, latitude, longitude, and altitude (Figure 24). The elevation does not change enough in Florida to impact the navigational accuracy, so it is acceptable to use 30 meters as a generic altitude value for use anywhere in the state. Tap the **Done** button when all required information has been entered. The newly created waypoint will appear in the list of waypoints stored within the waypoint file (Figure 25).

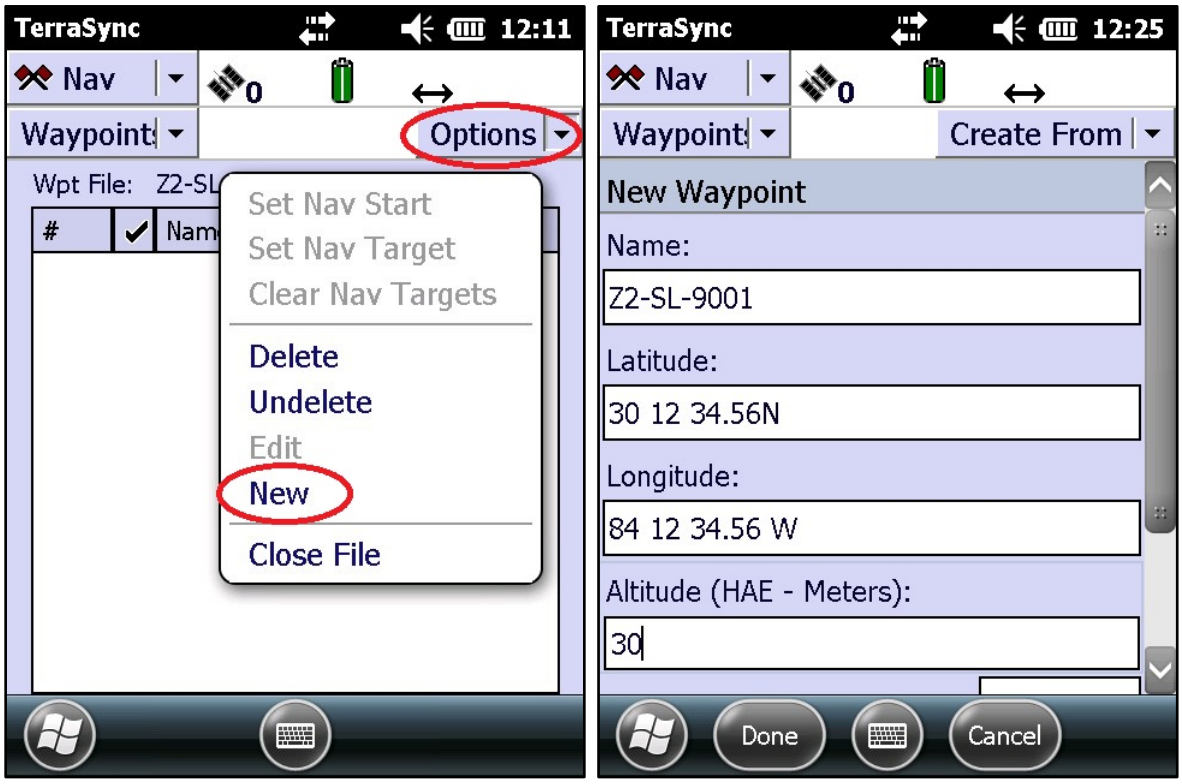

Figure 24. Screenshots illustrating creation of a new waypoint (left) and entering the name, latitude, longitude, and altitude of a new waypoint (right).

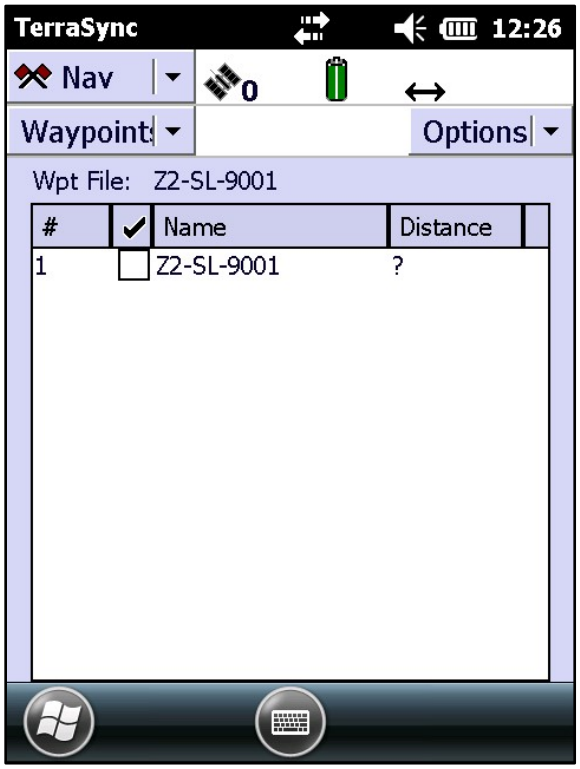

Figure 25. Screenshot illustrating a newly created waypoint in the waypoint file.

To navigate to a waypoint, designate it as the navigation target. Tap the square next to the desired waypoint to place a check mark inside the square (Figure 26). Then, tap the **Options** button and select **Set Nav Target** (Figure 26).

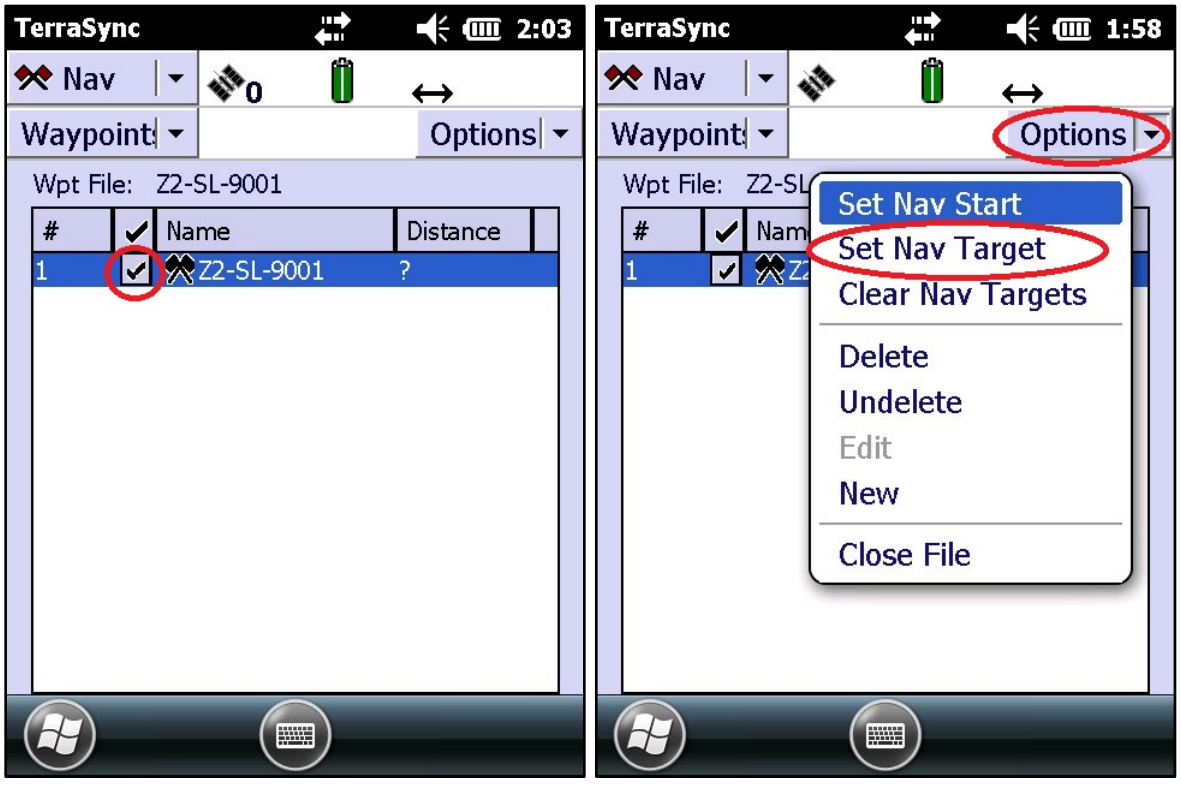

Figure 26. Screenshots illustrating selecting a waypoint to designate as the navigation target.

Once the navigation target has been set, tap the subsection menu and select **Navigate** to display the navigation screen (Figure 21). The distance and bearing to the selected waypoint will be displayed near the bottom of the screen, and the compass image in the center of the screen will point in the direction of the waypoint.

Data File Creation

To open the data logging section, tap the section button and select **Data** (Figure 27). To create a new data file, select **New** from the subsection menu (Figure 27). The default values can be used for the **File Type** and **Location** field. Enter the unique resource ID (e.g. Z2-SL-9001) in the **File Name** field, using all capital letters and including the hyphens. Select the appropriate **Dictionary Name** (e.g. "2017 Status Network" or "generic" for use with the Trend Network), and tap the **Create** button.

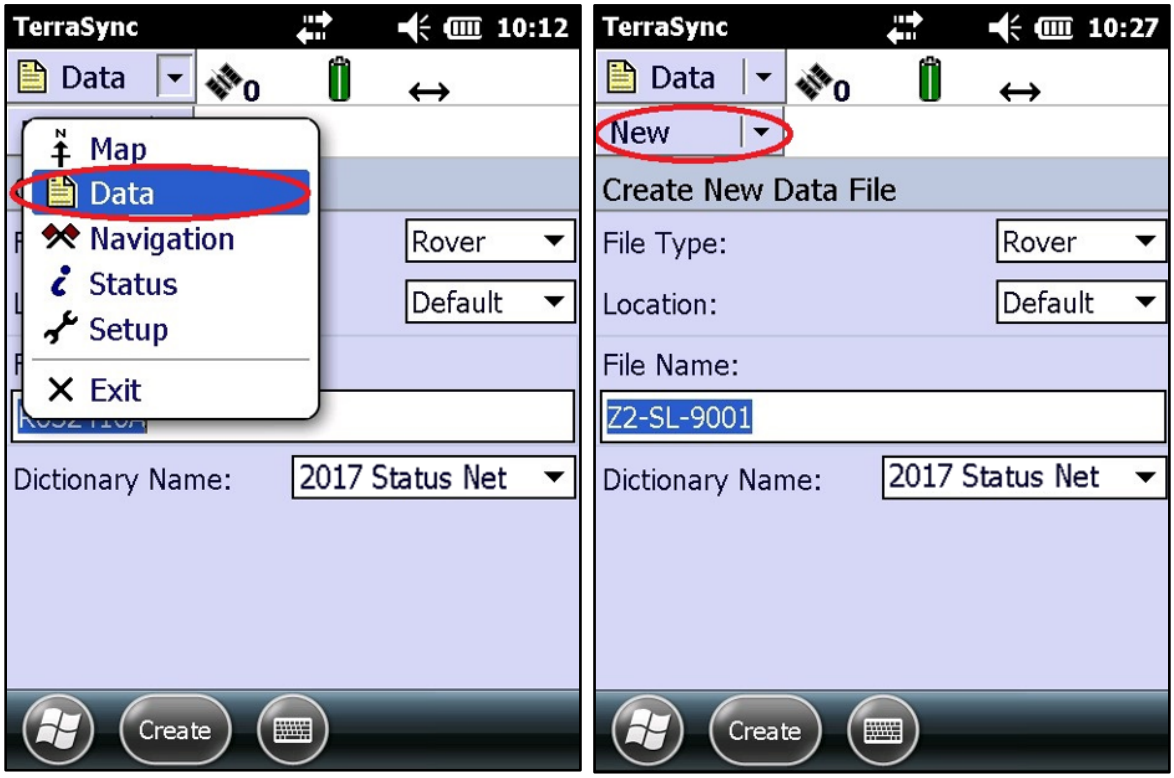

Figure 27. Screenshots illustrating use of the section button to open the Data section (left) and creation of a new data file (right).

Once the data file has been created, the feature type selection screen will be displayed. Before creating a feature, it is good practice to check the logging settings for each feature type. Tap the **Options** button and select **Logging Interval** (Figure 28). The interval for all Status Network feature types should be set to 1 second (Figure 28).

To begin collecting data for a new feature, select the **Feature Type** (water resource type) and record information about the site being sampled in the data dictionary fields (Figure 29). Use the scroll bar on the right side of the screen to access all fields in the Status Network data dictionary.

When logging GNSS positions for a feature, the logging icon  appears. The number beside the icon indicates the number of positions that have been logged. After collecting enough positions for the point (at least 30), tap the **Pause** button at the bottom of the screen if more time is needed to complete the data dictionary fields, or tap the **Done** button at the bottom of the screen to close the form and stop logging data for that point. You will be asked to confirm that you want to close the current feature. If you are finished, tap **OK**. To continue collecting more data, tap **Cancel**. If **Cancel** is selected, you may need to tap the **Resume** button at the bottom of the screen to continue logging GNSS positions. After tapping **OK**, you will be returned to the feature type selection screen.

Note: After data collection is finished at a site, exit the data file by tapping the **Close** button in the lower right corner of the screen. A new data file can then be created, as described on page 21, after arriving at the next site.

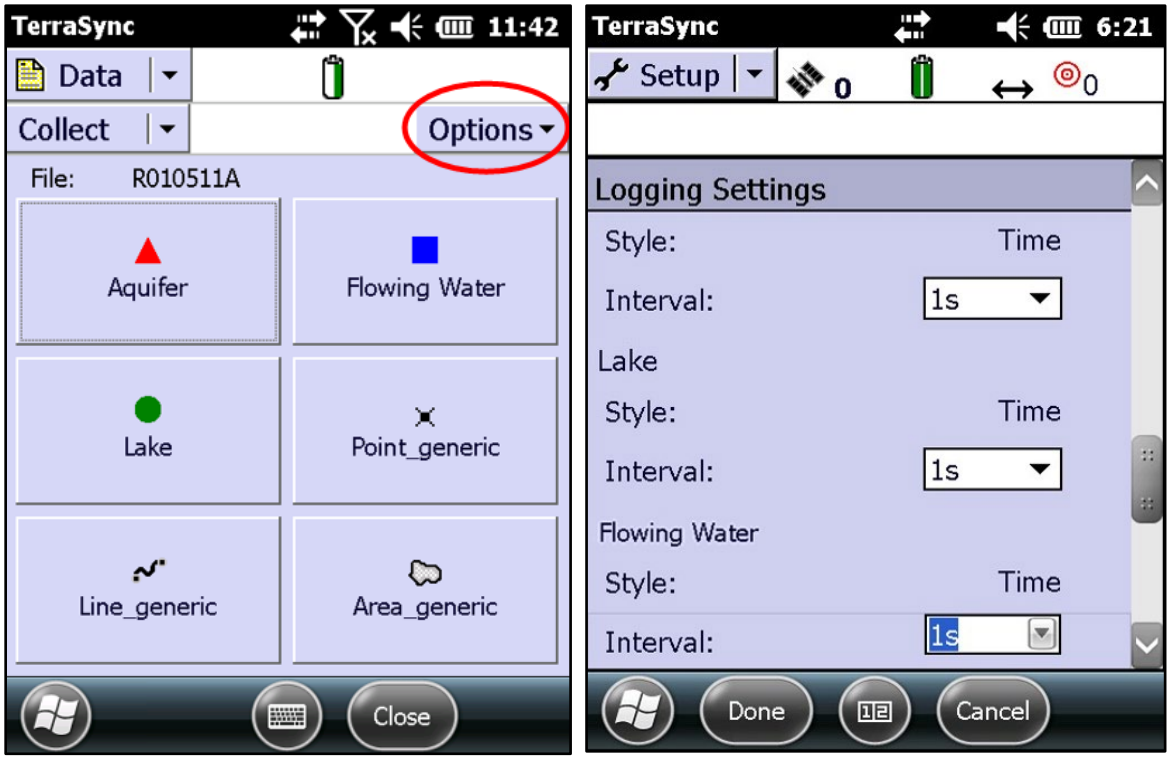

Figure 28. Screenshots illustrating the feature screen (left) and adjusting the logging interval settings for each feature type in the Status Network data dictionary (right).

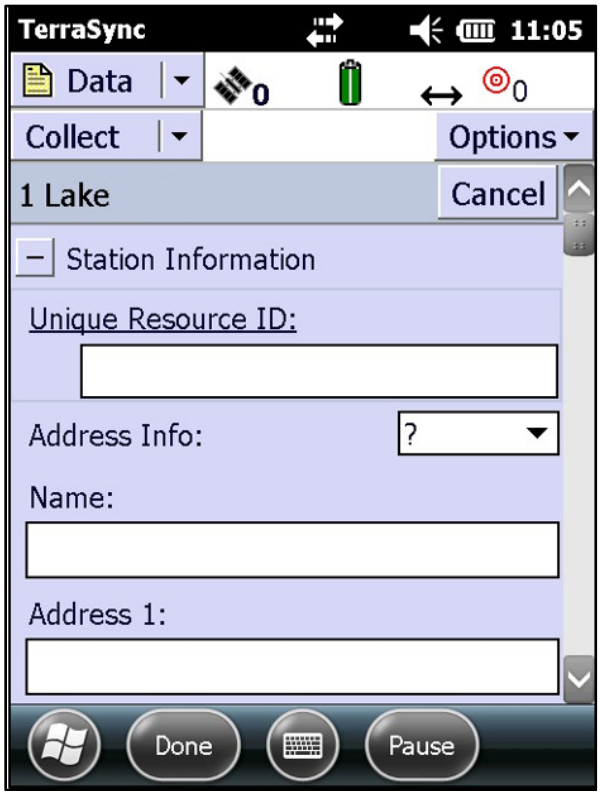

Figure 29. Screenshot illustrating an example of the required information about the site being sampled in the Status Network data dictionary.

Offsets

An offset may be needed if a site is located under a roof or other signal blocking object. The GNSS / GPS location data must be collected in an open area near the site, and an offset of the location must be applied.

In the data section, tap the **Options** button, then select **Offset** (Figure 30). Select **Distance – Bearing** as the type of offset (Figure 30). Use a compass and measuring tape to measure the bearing and distance from the water quality data collection site to the location where the GNSS / GPS data will be collected, and enter the information into the **Bearing** and **Horizontal Distance** fields (Figure 31). For Status Network data collection, the **Vertical Distance** field can be left at the default value of 0.00 feet.

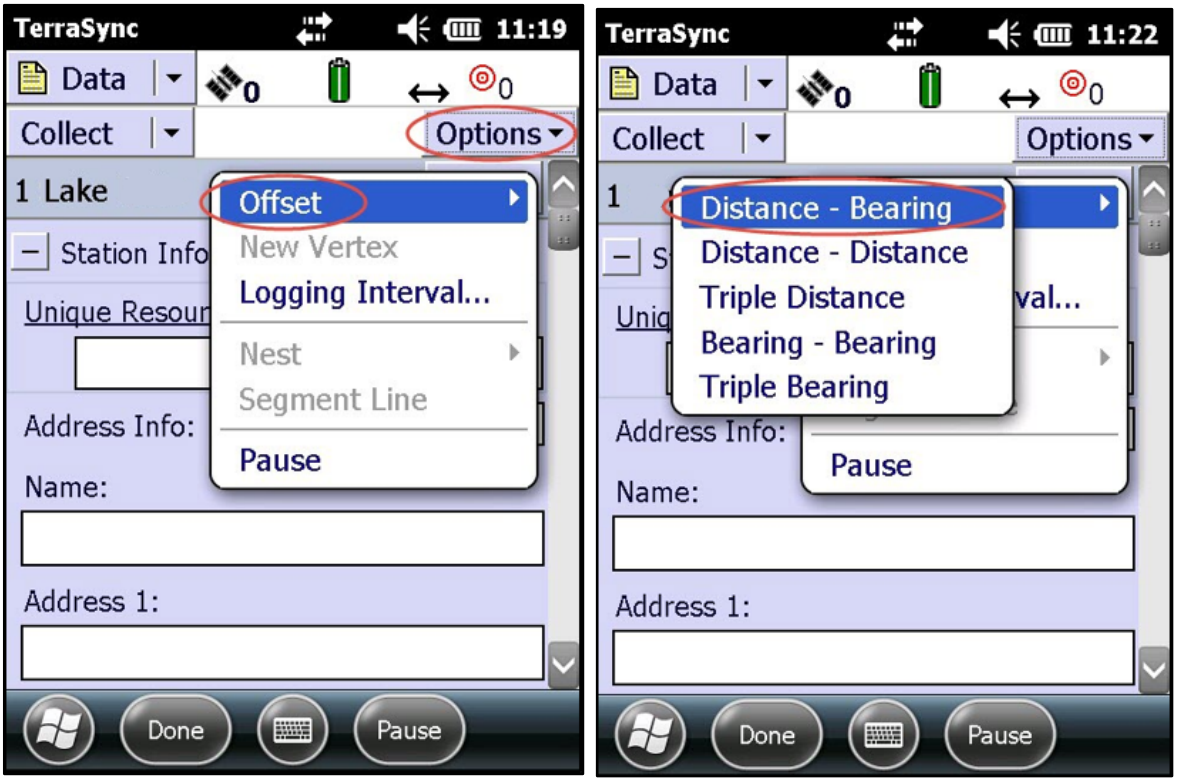

Figure 30. Screenshots illustrating creating an offset (left) using the Distance – Bearing method (right).

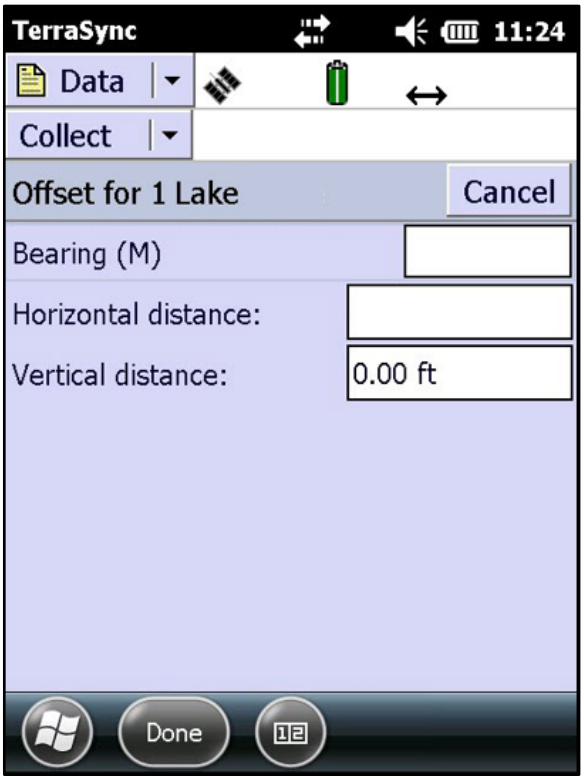

Figure 31. Screenshot illustrating the required information that must be entered when creating an offset.

Updating an Existing File

To add or edit data in an existing file, select **Existing File** in the Data section subsection menu. Select the desired file from the list of data files, and tap the **Open** button. The "Confirm Antenna Height" window will open. Tap **OK** to continue. The **Update Features** option will open automatically. This option can be used to update the attributes, offsets, and GNSS positions or to delete features. To update a feature, highlight it in the **Choose Features** list and tap the **Begin** button. To delete a feature, highlight it, then tap the **Options** button and select **Delete**. To add more features to the existing file, tap the subsection menu button and select **Collect Features**. Note that new features cannot be added to a file that is more than one week old because of the way that GNSS times are stored.

Closing TerraSync™

To close TerraSync, use the Section button to select **Exit**.

Warning: Failure to close TerraSync before turning the unit's power off may result in corrupt data.

Removing Files from the Trimble GNSS/GPS Unit

Each year, after completing all Status Network projects, it is recommended that you clean up the Trimble GNSS / GPS unit by deleting old files that are no longer needed. It is important to

make sure that all Status Network data files have been transferred to a computer (see page 8) **before** attempting to remove them from the unit. **Once a file has been removed from the unit, it cannot be recovered or transferred to a computer.**

It is also recommended that any old versions of the Status Network data dictionary are removed from the unit whenever a new version is installed. Removal of data dictionary files, waypoint files, and data files are all accomplished using the File Manager.

To access the File Manager, tap the section button and select **Data**. Select **File Manager** from the subsection menu (Figure 32). Select the type of file to remove (either data dictionary, waypoint, or data file) from the menu near the top of the screen. All files of the selected type that are stored on the unit will be displayed as a list. Tap on the desired file to select it, and select **Delete** from the options menu (Figure 33 and Figure 34).

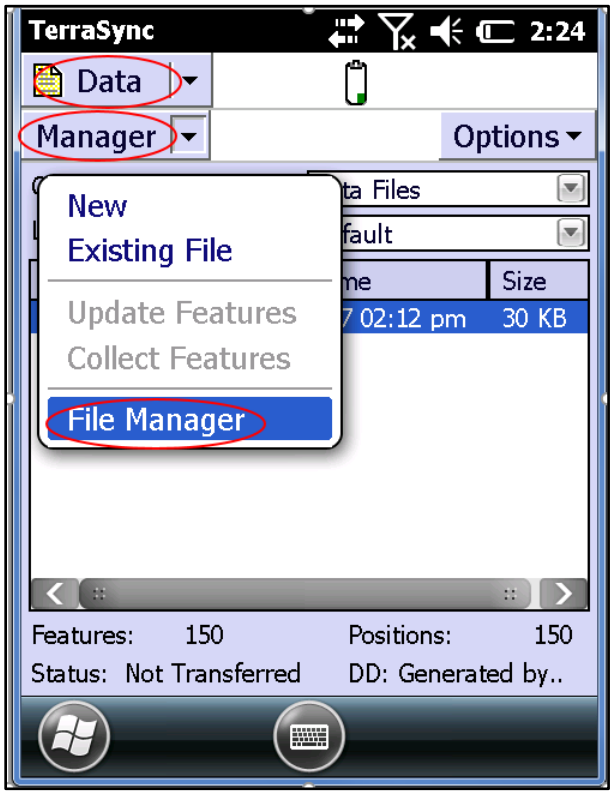

Figure 32. Screenshot illustrating use of the section button to open the Data section and File Manager subsection.

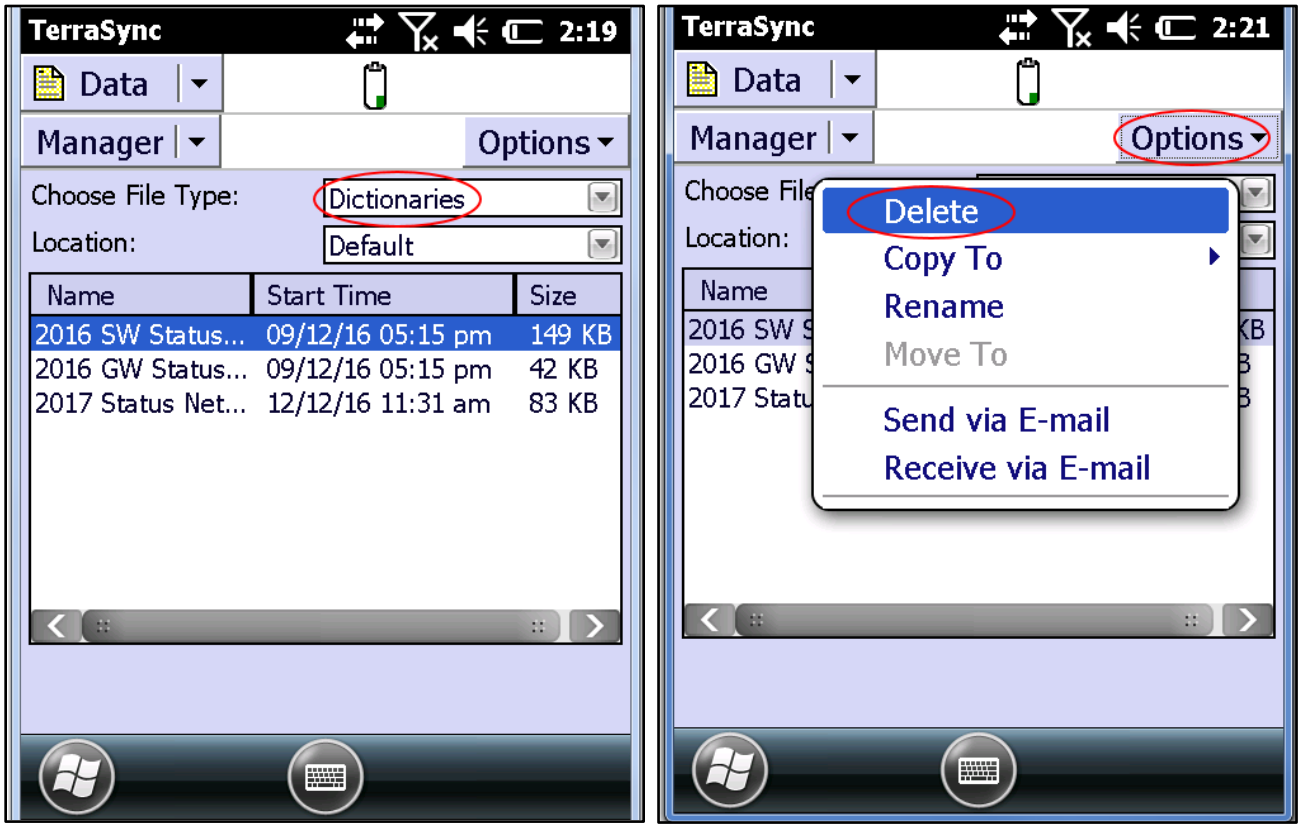

Figure 33. Screenshots illustrating selecting Dictionaries from the file type list (left) and deleting a Data Dictionary file (right).

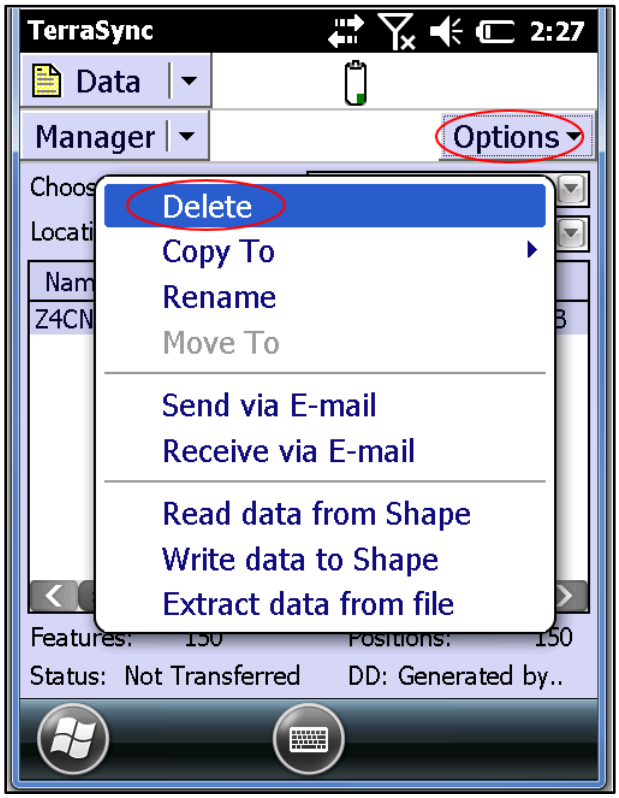

Figure 34. Screenshot illustrating deleting a data file.

Best Practices / Troubleshooting

Antenna Orientation: Keep the GNSS antenna correctly oriented to the sky. If the antenna is aimed at the ground, it will pick up reflected signals and degrade accuracy. This includes the time spent traveling between features.

Weather Issues: The Trimble GNSS / GPS units are designed to be water resistant, dustproof, and shock resistant. They can be used between -4 and 140 degrees Fahrenheit and can be stored between -22 and 158 degrees Fahrenheit. Despite their ruggedness, there are a few things to keep in mind.

- In hot weather (> 90 degrees F), the screen protectors may mark up more easily. This could make it more difficult to see the screen. Notify the DEP WQAP GNSS / GPS Coordinator if the screen protector needs to be changed.
- The units are not waterproof. Do not submerge in water.
- Do not use the GNSS receiver when lightning is imminent. Seek shelter instead.

Suspend Mode: The unit may go into Suspend mode when it has been idle for a specified period of time (3 minutes by default). This is a low-power mode that makes the unit appear to be turned off. If the screen suddenly goes blank, try pressing the Power button first to take the unit out of Suspend mode.

Nonresponsive Screen: If the unit stops responding to the stylus, try the following:

- The touch screen may be incorrectly aligned. If this happens, tap the **Windows** icon in the lower left corner of the screen. Go to **Settings**, and select **System**, then select **Screen**. Tap the **Align Screen** button and follow the instructions.
- Touch screens can be sensitive to cold, and the plastic screen covers can cause a problem in these situations. Try taking the screen protector off.
- The main screen has an option to lock the screen. To unlock the screen, slide the **Unlock** icon.
- Reset the unit (see below).

Resetting the Unit: A soft reset may be the solution if the unit will not turn on, if the screen goes blank, or if the unit becomes unresponsive to the stylus. If a soft reset does not work, contact the DEP Water Quality Monitoring Program's GNSS / GPS Coordinator.

- Soft Reset: Press the **Power** button for about 10 seconds. The unit will then automatically perform a soft reset.

  A soft reset will retain all the settings and device data that have been previously saved on the unit. The unit will lose any unsaved data.

Dead Battery: If the screen goes blank and the unit is not in Suspend mode, and a reset does not work, the problem may be that the battery is completely depleted. Try letting the unit recharge. A full charge may take up to 5 hours.

Additional Information

For Information about this manual or for GNSS/GPS guidance, please contact the DEP Water Quality Monitoring Program's GNSS / GPS Coordinator:

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Tallahassee, FL 32399-2600
Office Phone: (850) 245-8515
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Glossary / Acronyms

Term	Definition
Almanac	A rough location of all satellites.
Autonomous	Collecting positions with any GNSS/GPS receiver without any correction. Produces inaccuracies up to 100 meters.
Azimuth	The horizontal direction expressed as the angular distance between a position and the position of a satellite.
Channel	The circuitry required to collect individual satellite signals. Each signal is collected on a different channel.
Clock Bias	The difference between the clocks internal time and true universe time.
Differential Beacon	A radio transmitter that broadcast a signal around 300 KHz that carries the GNSS/GPS data correction for that instant in time.
Elevation mask	The lowest elevation above the horizon at which a receiver can use a satellite to calculate data.
Ellipsoid	A 3D mathematical figure formed by rotating an ellipse around its minor axis. Earth's minor axis is the polar axis and the major is the equatorial.
Ephemeris	The precise location of a satellite.
Geodetic Datum	A scaling system used to calculate the Latitude/Longitude coordinate structure onto a chart.
GIS	Geographic Information Systems. A computerized database system designed to manage spatial data.
GLONASS	Globalnaya navigatsionnaya sputnikovaya sistema (GLObal NAvigation Satellite System).
GNSS	Global Navigation Satellite Systems.
GPS	Global Positioning System.
HDOP	Horizontal Dilution Of Precision. The multiplicative factor that modifies ranging error. It is caused solely by the geometry between the GNSS/GPS receiver and the set of satellites used.
Ionosphere	The band of charged particles found 80 to 120 miles above the earth's surface.
Latitude	Angular measure of 0^{o} - 90^{o} North and South from the equator. Latitude lines on a chart run from left to right.
Longitude	Angular measure of 0^{o} - 180^{o} East and West of the prime meridian (0°) at Greenwich, England. Longitude lines on a chart run up and down.
LOP	Line Of Position. The hyperbolic lines formed by points where the time measured between the receipt of the signal from several satellites are always the same.
PDOP	Position Dilution Of Precision. A measure of the strength of the satellites geometry. Better accuracies are obtained when using satellites that are a greater distance apart.

Term	Definition
Post-processed	Data that is corrected by base station data that had been taken at the same time as the field data. The base station is located at a known position and the errors can then be subtracted from the computer software.
Real time correction	A correction that is applied to data at the same time it is collected. The correction is collected by a differential receiver.
Rover	The name given to a GNSS/GPS unit in the field.
Satellite Constellation	The arrangement of a set of satellites in space.
SNR	Signal to Noise Ratio. A ratio of the signal to noise is a measure of how strong a signal is.
SV	Satellite Vehicle
Triangulation	A position calculated by measuring the angles between points. Normally used with LORAN-C chains.
Trilateration	A position calculated by measuring the distance from a group of satellites. The SVs act as precise reference points.
VDOP	Vertical Dilution Of Precision. VDOP is an indication of the vertical accuracy of a GNSS/GPS position.
Waypoint	Any position that is stored in the GNSS/GPS receiver's memory.
WGS-84	World Geodetic System (1984). The mathematical ellipsoid used by GNSS/GPS since January 1987.