

Gulf Coast Network

National Park Service
Inventory and Monitoring Division



Standard Operating Procedure SHR05

Conducting the Survey—Version 1.0

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Summary

This standard operating procedure (SOP) details the procedure for identifying and systematically recording the position of the shoreline. To reduce the effects of short-term variations in shoreline position, the optimal shoreline is collected during a period of low tidal range (neap-tide) and during non-stormy conditions (SOP SHR03—*Survey Timing and GPS Mission Planning*; Bracewell 2017a). Therefore, the target shoreline, for this protocol, is the neap high-tide swash line (Figure 1). This line is the representative qualitative feature that identifies a water/land surface intercept (a shoreline).

Revision Log

Revision Date	Author	Changes Made	Reason for Change	New Version #

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Overview

A preliminary part of the shoreline monitoring program is the selection of a survey window using the procedure in GULN SOP SHR03—*Survey Timing and GPS Mission Planning* (Bracewell 2017a). Unless constrained by a storm event or very high spring tides, the survey is scheduled for the first convenient high tide during neap tide period in April (Gulf Islands NS) or May (Padre Island NS). The shoreline data collection will begin soon after high tide (30–60 minutes), allowing sufficient time for the water level to recede. This will expose sufficient beach face for collection to be possible and leave a clearly identifiable high-tide swash mark.

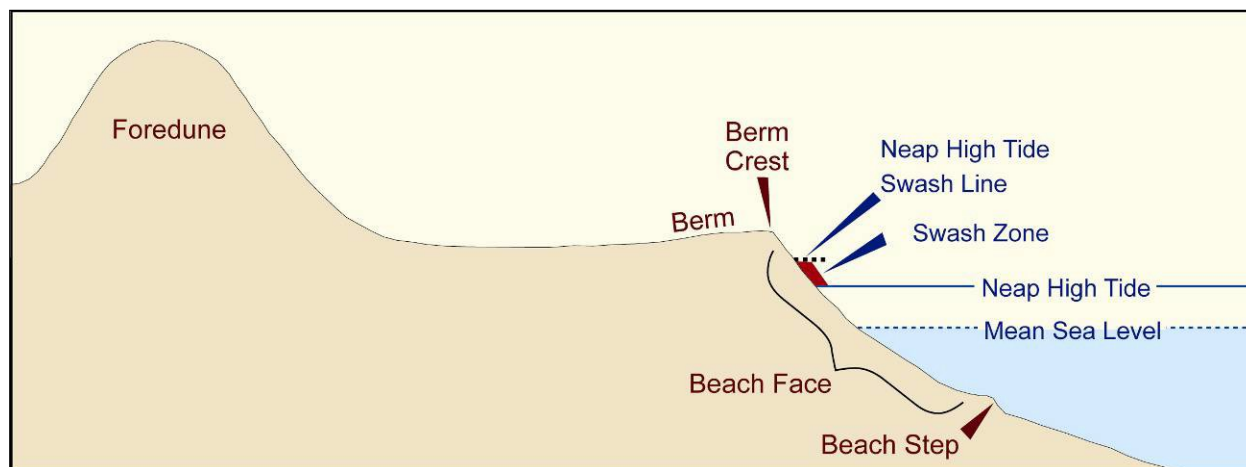


Figure 1. Conceptual dune-beach profile showing the juxtaposition of water level, topographic features, and the identification of the neap high-tide swash line. Figure and caption from Psuty et al. (2010).

This SOP consists of four components. The first component is the initial preparation procedures that include the visual identification of the line, initialization of the data form, and collection of the optional benchmarks. The second component is the survey of the shoreline with the GPS/GNSS data logger. The third component deals with natural or artificial perturbations to the shoreline, including natural features (e.g., cusps, scarps), hard structures (e.g., groins, jetties), and human interference (e.g., anglers). The fourth component addresses procedures for ending the survey.

Component 1: Preparatory Procedures:

Before beginning data collection, go to the beach and visually confirm that the swash line is identifiable and on the beach face. The line may be a damp sand and shell hash line, a debris line, or some combination of these characteristics (Figure 2). The swash line's presence on the beach face assures that no unusual wave or water levels were present. If the swash line is landward of the berm crest, it is likely that the surge and tides that created this line exceeded the threshold for a neap tide and/or non-stormy conditions. Therefore, the survey must be rescheduled using the procedures described in GULN SOP SHR03 (Bracewell 2017a).

There may be more than one shell hash/debris line on the beach face. The more recently deposited high-tide swash lines are more distinctive than older, more muted lines (Figure 2). Less distinct lines will

also be deposited as the tide recedes (Figure 3). It is essential to survey the most recent and highest of the shell hash lines on the beach face.



Figure 2. This high-tide swash line (dashed red line), on the beach face, is composed of the upper limit of damp sand, shell hash, and small amounts of debris. Figure and caption from Psuty et al. (2010).



Figure 3. This recent high-tide swash line (dashed red line) is a damp sand and shell hash line with debris. There are older more muted lines landward and there are lower lines seaward. Figure and caption from Psuty et al. (2010).

Initiate the Field Data Form

The Field Data Form (FDF) is used for all field notations (Figure 4). Guidance for completing the FDF can be found in the Data Dictionary section below. This information is necessary for post-processing of the data and facilitates the generation of accurate metadata. Once the shoreline has been visually identified on the beach face, fill in all fields (except for End time) in the “Event Information” section of the FDF.

GULN 'Monitoring Shoreline Position' Field Sheet: <u>1</u> of <u>1</u>			
Location: GUIS Fort Pickens		Surveyor/s: Jeb S Bracewell Whitney J Granger	
#Start Time: 9:00		End Time: 13:50	+Survey Date: 4/16/2016
GPS Type: Trimble Geo 7x		GPS SN: 2157	
Event Comments: No OTU available - shoreline was walked.			
Time of Note:	*Photo Pt ID:	Comment:	
9:05	Pt-1	Begin Survey - long-shore photos E & W.	
11:00	Pt-2	occupied NW corner of Fort Structure (survey mark)	
11:30	Pt-3	wet/dry line ambiguous - followed shell hash	
12:15	/	Survey interrupted @ fishing pier	
13:45	Pt-4	End Survey - long-shore photos E & W.	
+Date as mm/dd/yyyy; #Time as 13:00; *IF location is recorded on datalogger			

Figure 4. Example of entries on the Field Data Form.

The data dictionary explains format and content of fields included in the field data form.

Location	Select one: GUIS PetitBois, GUIS Horn, GUIS PerdidoKey, GUIS FortPickens, PAIS.
Surveyor/s	Surveyor's or surveyors' first name, middle initial and last name. (e.g., Jeff S Bracewell or Whitney J Granger).
Survey Date	Date that the survey is being conducted (mm/dd/yyyy).
Start Time	Time that the survey commences (24 hour clock). This should be relatively concurrent with the first feature that is collected on the GNSS data logger.
End Time	Time that the survey ends (24 hour clock). Time should reflect the conclusion of shoreline position survey. This will commonly be the time immediately preceding closing the GNSS data logger file.
GPS Type	Brand and model of the GPS/GNSS data logger (e.g., Trimble Geo7x).
GPS SN	The last four characters of the data logger's serial number. (e.g., 0257).
Event Comments	Event related comments that apply to the entire survey event. (e.g., "Rained overnight. Wet/dry line difficult to determine. Survey follows the recent shell hash line.")
Time of Note	Record the time when a feature based comment is recorded (24- hour clock). This should be the time displayed on the GNSS data logger.
Photo Pt ID	If a point is recorded on the data logger, the sequential number assigned to the point should be recorded. (e.g., photoPt1).
Comment	Comment about the feature being recorded. Common classes of feature-based comments include: survey interruptions, survey Monuments, and casual observations.

Many of these initial values may be entered prior to going into the field. Additional items on the FDF (e.g., Start Time, End time, Survey Notes, Download options) will be logged later in the survey or can be derived from the GPS file in the post-processing phase. Any notes regarding equipment problems, obstacles encountered, etc., should be logged in the Survey Notes section, and the time from the GPS/GNSS unit noted. Either the FDF or the comment/note function of the data logger will be used to record observations and notes during the survey. A copy of any comments stored on the data logger should be provided to the GULN project leader, and then attached to the FDF (either digitally or with a hard copy) for storage.

Initialize GPS/GNSS

1. Start TerraSync and load the 'gulnShorelineSurvey' Data Dictionary (Figure 5)

TerraSync 11:22

Data | ▾

New | ▾

Create New Data File

File Type: Rover ▾

Location: Default ▾

File Name:

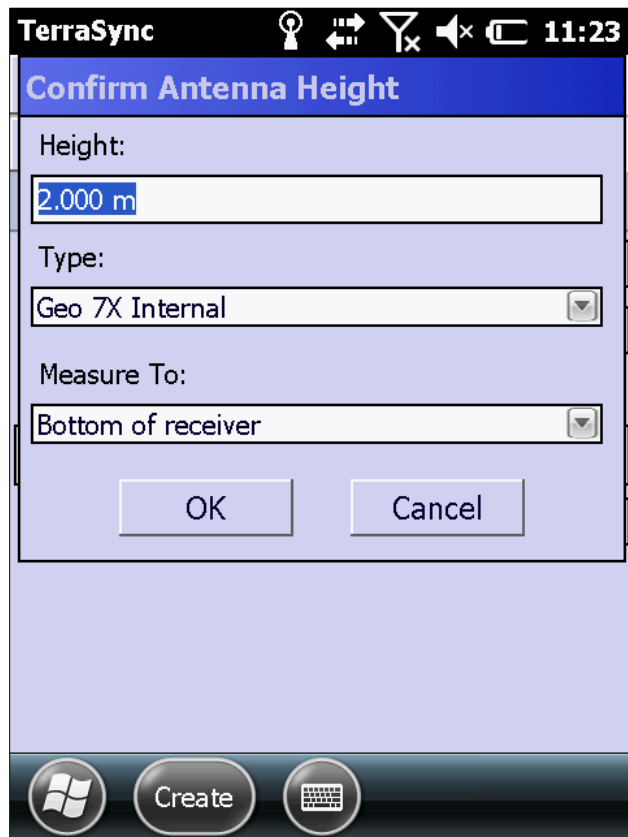
R121511A

Dictionary Name: gulnShorelineSurvey ▾

Create

Figure 5. Load data dictionary.

Ensure the antenna is set to its approximate height above the ground (Figure 6). Height will generally be between 1 and 2 meters (3.28 and 6.56 feet [ft]) depending on whether the data logger is mounted on a UTV or handheld, and uses a range pole or backpack.



The screenshot shows the TerraSync application interface. At the top, there is a status bar with the text 'TerraSync' and several icons (location, network, signal, volume, battery) along with the time '11:23'. Below this is a blue header bar with the text 'Confirm Antenna Height'. The main area is a light blue form with three input fields: 'Height:' with a text box containing '2.000 m', 'Type:' with a dropdown menu showing 'Geo 7X Internal', and 'Measure To:' with a dropdown menu showing 'Bottom of receiver'. Below these fields are two buttons: 'OK' and 'Cancel'. At the bottom of the screen is a dark blue bar with three circular icons: a Windows logo, a 'Create' button, and a 'Survey' button.

Figure 6. Confirm antenna height.

Incorporating Benchmarks into the Survey

Collecting reference locations (benchmarks) at a variety of locations and times can help to verify the continued accuracy of GPS/GNSS measurements. Benchmarks can serve as high quality reference points and can be collected when available as a check for accuracy both during and following the survey. Occupation of an established survey monument such as an NGS benchmark is ideal. However, in remote areas where official geodetic benchmarks are unavailable, choose an object that will be clearly visible in current aerial imagery, such as trail intersections or corners of parking lots.

Collecting Benchmarks:

To collect a reference point, position the GPS/GNSS antenna directly over the benchmark and begin point feature collection. The data logger records the position of the antenna, so do not begin collection until the antenna is directly over the feature to be recorded. Store the benchmark and log the benchmark information on the FDF or make comments in the data logger. Be sure to include the benchmark ID, if available, or description of physical marker (e.g., “wooden telephone post mile post marker 10 at PAIS.”)

In the Field Accuracy Checks:

It is also a good practice to load benchmark points on the data logger as background files prior to the survey to serve as a field-level quality control measure (Figure 7). The horizontal accuracy of these QC benchmarks should not exceed 0.03 meters (0.09 ft) as prescribed in Data Quality Standards (Bracewell 2017b). When holding the data logger directly over the physical benchmark, the measurement between the current position and the benchmark should not exceed 1.03 meters (3.37 ft), provided that the pre-loaded benchmark accuracy meets or exceeds 0.03 meters (0.09 ft) and current real-time accuracy does not exceed 1 meter (3.28 ft).

The expected post-processed accuracy, as indicated in the upper right-hand portion of the data logger screen, should not exceed 1 meter (3.28 ft) during data collection throughout the survey (Figure 8). This threshold will provide the accuracy warranted for change calculation. If this tolerance is exceeded, the survey should be paused until the satellite geometry provides better accuracy.



Figure 7. Navigate to previously recorded benchmark such as this utility meter.

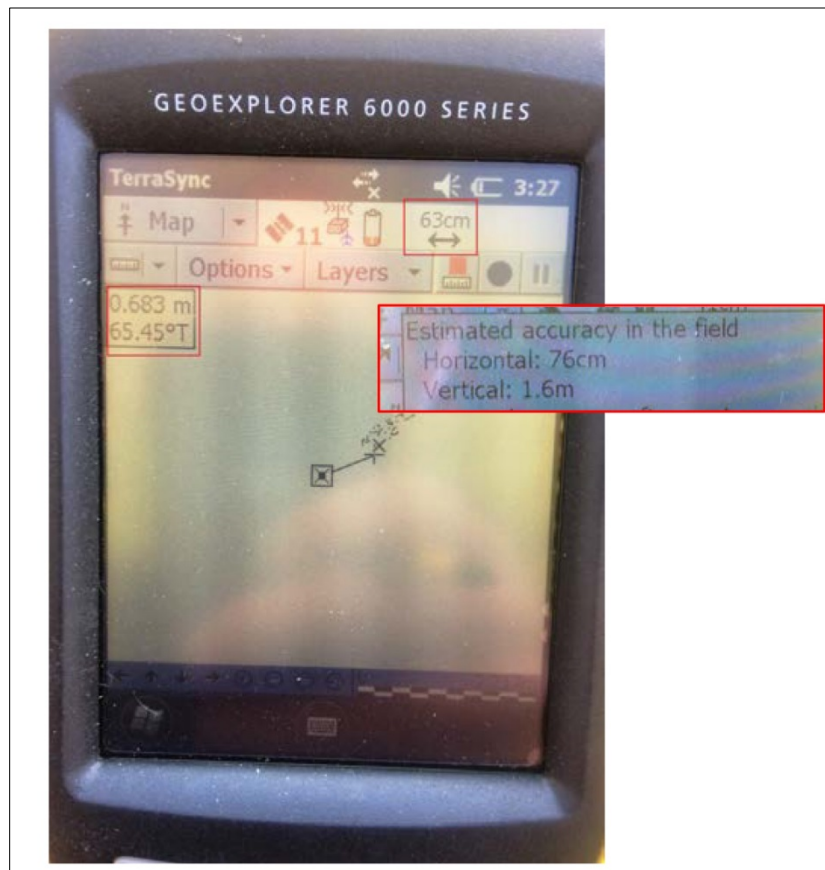


Figure 8. Use measure tool to ensure close proximity between data logger antenna position and benchmark. A post-processed accuracy of 63 centimeters (24.8 inches) is displayed in the upper right-hand corner of the screen. Tapping on the accuracy estimate will cause the 'Estimated accuracy in the field' popup to be displayed – in this case 76cm horizontal.

Component 2: Shoreline Survey Procedure

Recording Point Features

The procedure for recording a point is guided through the use of a data dictionary, thus ensuring that key data fields are captured. To record a point feature on the GPS data logger:

1. Tap 'pt shoreline' (Figure 9).

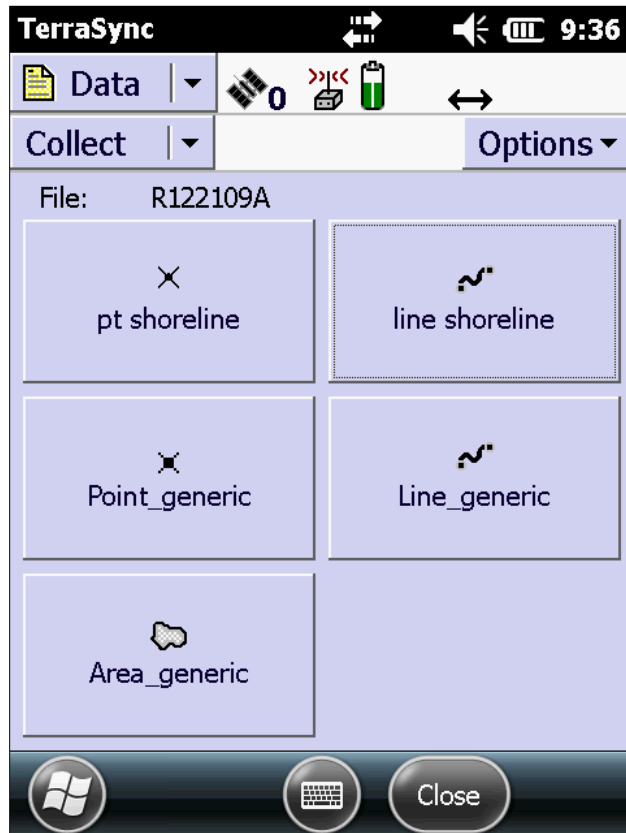


Figure 9. Collecting point feature.

2. If making notes on the FDF, record 'GPS/GNSS Time' (Figure 10).
3. Enter the serial number of the data logger. The SN is located on the back of Trimble GPS/GNSS units (Figure 10).
4. Enter surveyor's initials (Figure 10).

TerraSync 9:14

Data ▾

Collect ▾ Options ▾

1 pt shoreline Cancel

GPS/GNSS Time: 9:13:18 am ▾

[-] surveyor Id

last 4 characters of gps serial num:

0952 ▾

surveyor initials - like 'jsb':

jsb

[+] observation notes

Done Log

Figure 10. Collecting point feature: surveyor info.

5. Record point feature type (Figure 11).

The screenshot shows the TerraSync mobile application interface. At the top, the status bar displays 'TerraSync', signal strength, battery level, and the time '2:22'. Below the status bar, there is a 'Data' dropdown menu and a 'Collect' dropdown menu. The 'Collect' menu is open, showing '1 pt shoreline' and a 'Cancel' button. Below this, there is a section for 'feature type - eg casual obs:' with a list of radio button options: 'survey start', 'interuption', 'survey monument', 'casual observation', 'survey end' (which is selected), and 'other'. Below the feature type section, there is a section for 'was a photo taken:' with 'yes' (selected) and 'no' radio buttons. At the bottom, there is a section for 'photo point name:' with a text input field. The bottom of the screen features a navigation bar with icons for a Windows logo, 'Done', a keyboard icon, and 'Log'.

Figure 11. Collecting point feature: feature type.

6. If photos are taken, follow the procedure in the ‘Photographs’ section of this document.

Photographs

Take a photograph at sites along the survey that have an identifiable geographical reference, such as a prominent natural or cultural feature. Similar views will allow for visual comparison between surveys. A GPS point should be taken with each photo location. If several photos are taken from a single point, then a single point feature is sufficient. It is also necessary to synchronize the camera clock to the GPS clock, within a few seconds, as synchronized time information can be helpful in linking photos to their location. Take a photograph in areas of special concern or anytime some irregularity occurs on the beach, such as the presence of scarps. The photo record should include the neap high-tide swash line that is being followed.

The following steps outline the procedure for taking photos during the shoreline survey:

1. Record point on data logger and note the 'photo point name' (Figure 12).

The screenshot shows the TerraSync mobile application interface. At the top, the status bar displays 'TerraSync', signal strength, a speaker icon, battery level, and the time '2:23'. Below the status bar is a navigation bar with a 'Data' dropdown menu, a satellite icon, a battery icon, and a double-headed arrow icon. The main screen has a 'Collect' dropdown menu and an 'Options' dropdown menu. The 'Collect' menu is open, showing '1 pt shoreline' and a 'Cancel' button. Below this, there is a section for 'was a photo taken:' with radio buttons for 'yes' (selected) and 'no'. Below that is a section for 'photo point name:' with a text input field containing 'photoPt_1'. Below that is a section for 'comment:' with a text input field containing 'end survey, photos east then west'. At the bottom of the screen is a dock with four buttons: a Windows logo, 'Done', a keyboard icon, and 'Log'.

Figure 12. Collecting point feature: photo and comment.

Record photo point name, time, and comment on FDF (Figure 13).

2. Take a photo of the FDF with the active record showing. These photos will help to positively relate notes and GPS points to photos, or sets of photos, and serve as a delimiter between photos (Figure 13).

GULN 'Monitoring Shoreline Position' Field Sheet: <u>1</u> of <u>1</u>			
Location: GUIS Fort Pickens	Prot. Ver: 2016.01	Surveyor/s: Jeb S Bracewell Whitney J Granger	+Survey Date: 4/16/2016
#Start Time: 9:00	End Time: 13:50	GPS Type: Trimble Geo 7x	GPS SN: 2157
Event Comments: no JTV available - shoreline was walked.			
Time of Note:	*Photo Pt ID:	Comment:	
9:05	Pt-1	Begin Survey - long-shore photos E & W.	
11:00	Pt-2	occupied NW corner of Fort Structure (survey mark)	
11:30	Pt-3	wet/dry line ambiguous - followed shell hash	
12:15	/	Survey interrupted @ fishing pier	
13:45	Pt-4	End Survey - long-shore photos E & W.	

Figure 13. Open/Close photo sequence with photo of FDF.

3. Take photos of the noteworthy feature (Figure 14).



Figure 14. Photographed features. Shown here are east and west facing photos at end of survey.

4. Close the photo sequence by taking a closeout photo of the FDF, similar to step 2 (Figure 13).

Beginning the Shoreline Survey

UTV surveys: Mount the GPS/GNSS antenna on the UTV or 4×4 vehicle. Position the vehicle at the starting point for the shoreline collection. Ensure that the antenna is placed between the observer's position and a front tire (or over the driver's side tire on a 4×4 vehicle) to make it easier for the operator to accurately drive the shoreline (Figure 15). Regardless of the placement of the antenna on the vehicle, the GPS/GNSS always records the position of the antenna.



Figure 15. Data logger antenna mounted on a 4x4 vehicle. Red/dashed arrow indicates path of vehicle (simulated swash line).

UTV or walking surveys: Once the antenna is directly over the shoreline, collection can begin. Make a note on the FDF of the starting point number and time, or obtain this information from the GPS file after the survey. Notes should be as detailed as possible, and, if applicable, must include the GPS time that the point was recorded (Figure 16) and detailed descriptions. These notes are crucial in the QA/QC procedure and may be the only documentation for decisions made in the field.

The screenshot shows the TerraSync mobile application interface. At the top, the status bar displays 'TerraSync' and the time '9:14'. Below the status bar, there is a navigation bar with 'Data' and 'Collect' tabs. The 'Collect' tab is active, showing a form for data collection. The form has a header '1 pt shoreline' and a 'Cancel' button. Below the header, there is a 'GPS/GNSS Time:' label and a dropdown menu showing '9:13:18 am'. There are two expandable sections: '+ surveyor Id' and '+ observation notes'. At the bottom of the screen, there is a dock with four buttons: a Windows logo, 'Done', a keyboard icon, and 'Log'.

Figure 16. GPS time should be recorded on field data form.

To begin data collection:

1. Open a data file using the shoreline Data Dictionary.
2. Record a point feature and photograph the shoreline being surveyed.
3. Open a line feature and, once again ensuring the data logger antenna is positioned over the shoreline, select 'Log' to begin collecting the line feature (Figure 17).

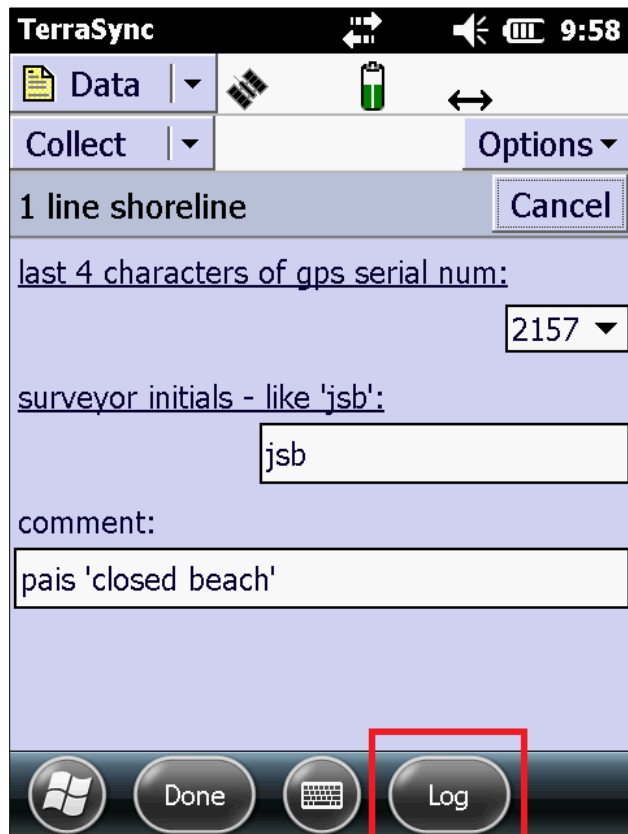


Figure 17. Tap 'Log' to start recording.

4. Ensure that the positions are being collected by observing the point count increasing and/or hearing the audible clicks (depending on one's unit / settings).
5. Once logging is verified, proceed to drive the shoreline, maintaining the antenna's position over the high-tide swash line.

Tracking the Shoreline

The natural shape of the shoreline may be linear, it may be cusped (scalloped), or there may be broad sweeping curvilinear forms in the beach (Figure 18). These configurations may be indicative of a change in processes and are important to the shoreline collection. Make every effort possible to maintain antenna position over the high-tide swash line while following these features.



Figure 18. Example of a cusped shoreline where the high-tide swash line tracks the shape of the cusps. Cusp dimensions are approximately 10–15 meters (32.8–49.2 ft) alongshore and the swash line should be followed as part of the shoreline survey. Figure and caption from Psuty et al. (2010).

If the features are very small (on the order of a few meters), driving the line will naturally average these features because it would be impractical to position the antenna to follow every nuance of the line. The dashed line in Figure 19 shows the path that should be taken in surveying the very irregular swash line on a nearly linear beach face. These small-dimensioned irregularities are related to the micro-topography of the beach and are therefore representative of short-term conditions, rather than long-term (seasonal and longer) trends. Large dimension cusps, on the order of 50 meters (164 ft) or greater, may be indicative of sediment budget processes that are representative of trends of seasonal and annual time scales, and therefore their location should be recorded. Cusps greater than 10 meters (32.8 ft) alongshore should be followed wherever possible.



Figure 19. The high-tide swash line (red dashed line) has small irregularities that will be smoothed, recording the average position of the line. Figure and caption from Psuty et al. (2010).

Verification of the Survey

Every 15–20 minutes, visually verify that points are still being collected, and visually note the location. Verification of the data logger’s functionality reduces the potential loss of data. If points are no longer being collected, rectify the problem and return to the previous verification point and resume shoreline collection. These brief stops provide an opportunity to survey supplemental benchmarks if they are available and nearby. Anytime logging is stopped and restarted, a note should be made on the Field Data Form or in the data logger. The stop will also give the surveyor a chance to check that the reported accuracy of the instrument is still under 2 meters (6.56 ft).

During any stop:

1. Confirm points are still being collected.
 - a. If points are being collected, continue survey.
 - b. If points are not being collected, rectify problem, and return to last known verified point location and resume shoreline survey.
2. (Optional) If a benchmark is nearby and convenient, record the position of the benchmark as a point feature.
3. (Optional) End and store the line feature, and start a new line feature in the same data file. Any time the survey is stopped there is an opportunity to store the feature to help prevent loss of data.

Component 3: Interruption Procedure

Interruptions to the Shoreline Survey

During the survey, a variety of landforms and obstacles may be encountered. Natural landforms such as scarps or cliffs may either temporarily impede the collection of the line, cause a break in the line (where the line has to be paused and restarted after the obstacle is passed), or cause a different collection method to be used (such as walking the shoreline). The shoreline may also be physically interrupted by artificial structures (groins, jetties, seawalls). Additionally, shoreline collection may be interrupted by human obstacles such as anglers or bathers. In these situations, or in the presence of other unusual interruptions, the field surveyor should make a note on the Field Data Form (FDF).

The shoreline, in some places, may be difficult to survey with a vehicle because the beach may become excessively steep, it may be very narrow, or there may be restricted access. For example, the swash line may be at the base of a steep scarp, or beach visitors may make it impossible to drive the beach face. In this case, pause the data logger and remove the GPS/GNSS unit from the vehicle. Position yourself on the swash line location, and re-start the data logger. Walk the shoreline recording the swash line location until the shoreline can be reoccupied using a vehicle (Figure19). Pause the data logger until the vehicle is brought to that point.



Figure 20. Conducting the survey and holding the GPS/GNSS data logger. The operator walks along the wet/dry line on the beach face to capture the position of the neap high-tide swash line. Figure and caption from Psuty et al. (2010).

Hard Structures: Physical obstacles may impede the collection of a continuous shoreline. In this case, the data logger must be paused so that only the dynamic sandy portion of the shoreline is collected. This guarantees the shoreline collected is comparable to other data sets and prevents the need for portions of the shoreline to be interpreted differently. If the static structure at the shoreline is collected, the feature must be coded separately or collected as a separate feature to ensure it is not misinterpreted. Make detailed and specific field notes on the FDF to aid subsequent processing, editing, and metadata notations. If the structure causes an offset in the shoreline, such as the displacement of the shoreline on the updrift and downdrift sides of a groin (Figure 20), pause and store the line feature, go around the obstacle, and start a new line feature (in the same file) once the antenna has been repositioned over the shoreline. Any time the GPS/GNSS is removed from the vehicle there is an opportunity to add a supplemental benchmark.



Figure 21. This aerial view of GATE-SHU demonstrates the offset of the shoreline at an interruption. Figure and caption from Psuty et al. (2010).

Anglers: Anglers tend to congregate near the high-tide swash line. Their fishing lines and equipment can create a hazard to a surveyor in a UTV or vehicle. Also, GPS/GNSS equipment can cut or break fishing lines. If anglers are encountered and the shoreline cannot be walked, follow the same procedure that is underlined in the previous section (Hard Structures).

Inlets: When an inlet is encountered during the course of a survey, the inlet shoreline should be followed for a distance of at least 30 paces (approximately 30 meters [98.4 ft]) along the inlet margin past the opening. This extent will sufficiently indicate the presence of an inlet and can be used to identify positional shifts of the opening across time. Complete the line feature, and then safely proceed to the other side of the inlet. On the opposite shore, start logging a new line feature at a point that is approximately perpendicular to the general orientation of the inlet, directly across from end point of the last line feature (Figure 21).



Figure 22. Mapping shoreline inlets. The solid red line represents the surveyed shoreline. The orange dotted triangle indicates a line that is perpendicular to the general orientation of the inlet. The surveyor should capture approximately 30 meters of the inlet margins at its opening.

Component 4: Completion of the Survey

After the spatial extent of the shoreline survey is completed, pause and store the line and collect the ‘end of survey’ benchmark.

1. Pause and store the survey shoreline while stopped on the swash line. Make a note on the FDF of the End Time. Use the time displayed on the GPS/GNSS data logger, not a watch. 24-hour (military) time should be used, in local standard time. For example, 0800 and 1350 for 8:00 a.m. and 1:50 p.m., local time, respectively.
2. Store the line feature.
3. Record end point of survey and photograph the shoreline.
4. Log a point at the nearest benchmark.
5. Close the data file and turn off data logger.

Upon return to the office, download the data and make a backup copy (GULN SOPSHR06—*Initial Post Process*; Bracewell 2017c). If the data are not downloaded immediately there is a chance they could be lost due to an equipment malfunction.

Literature Cited

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Appendix A: Field Data Forms

GULN 'Monitoring Shoreline Position' Field Sheet: ___ of ___			
Location:	Surveyor/s:		+Survey Date:
#Start Time:	End Time:	GPS Type:	GPS SN:
Event Comments:			
Time of Note:	*Photo Pt ID:	Comment:	
+Date as mm/dd/yyyy; #Time as 13:00; *IF location is recorded on datalogger			

GULN 'Monitoring Shoreline Position' Field Sheet: ___ of ___			
Location:	Surveyor/s:		+Survey Date:
#Start Time:	End Time:	GPS Type:	GPS SN:
Event Comments:			
Time of Note:	*Photo Pt ID:	Comment:	
+Date as mm/dd/yyyy; #Time as 13:00; *IF location is recorded on datalogger			

Figure A-1. Examples of Field Data Forms.