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OPERATING INSTRUCTIONS MANUAL FOR THE ACOUSTIC-BASED SUBMERSED AQUATIC PLANT MAPPING SYSTEM

Prepared by: Bruce M. Sabol
Environmental Laboratory

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Prepared for: South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406

Introduction

This brief instruction set is intended to serve as a guide for the use of the ERDC-developed Submersed Aquatic Vegetation Early Warning System (SAVEWS) embodied in the Biosonics DT-X sounder with a Leica MX-420 DGPS Navigation System and a Panosonic Toughbook computer. Instructions are written around the Biosonics Visual Acquisition software (version 5.0.3), Biosonics EcoSAV software (version 1.0) which contains the windows SAVEWS software, and the Leica MX-420 software (version 1.5). These instructions are not intended to replace the separate instruction manuals for these components. Rather, the user is encouraged to study these separate manuals and to use this instruction set as a reminder during field operations.

Parts List

- Biosonics DT-X Sounder (grey Pelican case with external connectors)
- Biosonics DT-X transducer (420 kHz, 6-degree single beam)
- Biosonics DT-X transducer cable
- Biosonics GPS cable with mil-spec metal and DB-9 connectors
- Biosonics power cables (AC and DC)
- Biosonics ethernet cable (blue)
- Panasonic Toughbook PC (with touch screen)
- Panasonic AC power cable
- Leica MX-420 DGPS
- Leica DGPS Smart Antenna
- Leica DGPS cable (3 signal connectors and 1 cigarette-lighter 12-volt plug)
- Colored ribbon cable with DB9 connectors (only used for uploading and downloading data between GPS and PC)

Connecting Equipment

1. Connect DT-X transducer cable to the transducer. Verify that the rubber O-ring is in place on the cable end (replacements are taped inside the sounder case). Hand-tighten the plastic connector (NEVER user pliers to tighten or loosen).

2. Connect other end of the transducer cable to TRANSDUCER 1 slot (TRANSDUCER 2 slot is not active) on the back side of the DT-X sounder. The plug should be rotated so that the grooves match, then pushed it in place while tightening the threaded ring to secure the connection.

3. Connect a DT-X sounder power cable using either the AC or the DC cable, but NOT both. Power connectors on the back of the sounder are labeled and each has a unique number of pins. Biosonics recommends using AC power, but in its absence DC works

fine for a fully charged 12-volt battery (recommend monitoring battery voltage and swapping batteries when voltage drops below 12.3 volts).

4. Connect Biosonics GPS cable to GPS slot on back of DT-X sounder.

5. Connect blue ethernet cable to DT-X sounder (mil-spec connector on left out side of sounder box) and to the PC (forward-most slot on right side of computer).

6. Connect AC power supply cable to PC (slot on right rear side of PC).

7. Connect 18-pin plastic connector on Leica GPS cable to the back of the MX-420 GPS deck unit. Hand-tighten only.

8. Connect the 10-pin plastic connector on GPS cable to Leica DGPS Smart Antenna. Hand-tighten only. Suggest taping the wire near the connector to the attached pipe to keep tension off the plastic connector.

9. Connect GPS cable power plug to 12-volt power supply with cigarette-lighter plug.

10. Attach connectors on Leica cable and Biosonics GPS cable. Put electrical tape over the connection to seal out water.

11. Attach DT-X transducer to its mounting bracket and lower transducer into the water to submerse the entire transducer.

12. DGPS antenna should be mounted with the white disk oriented horizontally with an unobscured view of the sky. It is desirable to place the antenna as close as possible to directly above the transducer.

Power Up Sequence

1. GPS. Power up GPS by pressing the button on the lower right face of the GPS - button is marked with a while circle containing a while vertical line. A red light will appear on the upper left face of the GPS. As satellites are acquired the light will change to orange. When the GPS is fully operational the color will change to green. It may take up to 15 minutes to become fully operational.

2. PC. Power up PC by depressing the silver knob on the right front of the PC. Windows XP will be initiated.

3. Sounder. Power up the sounder by toggling the black ON/OFF switch inside the sounder box on the right side. A red light will illuminate above the switch. Wait about 30 seconds for a 3-beep tone to sound indicating that the sounder is operational.

4. Visual Acquisition software. On the PC select (double click or touch the screen) the Visual Acquisition icon. Next, select "INIT DTX" (button on upper left of PC screen), a system information window will appear. This contains transducer information and requires no input other than selecting "OK." If you get the message "Could not identify transducer," recheck the transducer connections (steps 1 and 2 of Connecting Equipment). Next, select "CONFIG DTX" - the Configure Echo Sounder window will appear. Specific input parameters are required in this window which are critical to plant detection operations. These are contained in a file which is called by clicking on LOAD. Select file SFWMD_01 (10 m depth limit) or SFWMD_02 (6 m depth limit) depending on maximum depth of area to be surveyed. Open this file then select OK. If other depths are required these may be manually typed into the configuration window. Parameter settings necessary for plant detection are listed below:

WINDOW	PARAMETER	VALUE OR SETTING
Receiver	Operating Mode	Single Beam
Data Collection Parameters	Start Range	0 m (CRITICAL)
	End Range	slightly greater than maximum depth
	Threshold Level	-130 dB (CRITICAL)
	Threshold Mode	squared
Environmental Parameters	Temperature	Water quality measurements needed to compute speed of sound and adsorption. Set to midrange of values expected for sampling excursion. Use of exact values is not critical for shallow water SAV surveys. Select COMPUTE, then OK
	Depth	
	pH	
	Salinity	
Data Logging Options	Automatic Data File Creation	By Time, every 30 minutes
	Datafile Naming	Time Stamped (CRITICAL) , select OK
Pulse Control	Pulse Rate	10 pings/sec (suggested)
	Pulse Duration	0.1 ms (CRITICAL)
Acoustic Mode	Mode	Active Transmission (CRITICAL)
	Transmit Power Reduction	0 dB

5. Check GPS Signal. Latitude and longitude should be displayed in a widow on the lower right of the PC screen and the slash mark should be moving back and forth, indicating that an active stream of data is being read. If hash mark not moving, check GPS connections and restart GPS.

6. Activate Sounder. Select START PINGS button. The program will ask you to verify that transducer is in water. After checking select YES. An echo intensity graphic will appear on the left side of the screen and an oscilloscope graphic will appear on the right side. The system is now fully operational and ready for use. While transiting to the survey site it maybe desirable to take transducer out of the water. Before doing so, select PAUSE PINGS.

Data Collection Operations

1. Positioning Transducer. Place transducer in water fully submersing it. Depth should depend on water roughness and the shallowest depth you plan to survey. Measure the distance between the transducer face (bottom) and the water's surface and record it in the field book for later use by the tide-correction post-processing program.

2. Begin Pinging. Start pinging, either by selecting START PINGS or RESUME PINGS.

3. Logging Data. Select LOG DATA when the GPS navigation indicates that the data start waypoint has been reached. Record the filename (data/time in lower left window of PC) and the associated reach and transect number. Files are named using a 15-character date/time convention, which is needed for the post-processing program.

4. Closing Data File. When GPS navigation indicates the stop data waypoint has been reached, select CLOSE LOG (but do not take transducer out of the water). Optionally, you may want to select PAUSE PINGS and remove the transducer from the water if the next measurement station is far away.

5. Collecting Tide Data. Always measure and record the local tide data immediately before and after conducting a survey. Additionally, if the survey runs for more than 2 hours, it is advisable to record a mid-point tide measurement. These measurements will be used by the post-processing program to make depth corrections.

6. Data Integrity Check. Before leaving an area, it is recommended that you quickly verify that the DT4 files are present and of the right size. This can be examined using Windows Explorer or, better yet, using the replay option within the Visual Acquisition software.

Power Down Sequence

1. PC. Select STOP PINGS.

2. PC. Select "Setup" from top list in window, then select "Shutdown Embedded Controller" from the menu list. Wait for window to tell you it is ready to power down the DT-X sounder unit. Select YES to acknowledge shutdown.

3. DT-X Sounder. Turn off DT-X sounder power switch.

4. PC. Select "Setup" from top list in window, then select "Exit Visual Acquisition."

5. GPS. Turn off GPS.

EcoSAV Processing

The EcoSAV software processes the raw binary acoustic file (DT4) to ASCII files (ODF) containing a series of position-referenced attributes, including depth, plant coverage, and plant height. Parameters used in this processing are specified by an INI file which is tailored for the particular environment sampled. Since SAVEWS was developed and refined on the Caloosahatchee, these parameters are well known for this site and are contained in the file SFWMD_*nn*.INI (Figure 1). Even so, it will be necessary to adjust a few parameters from time to time, and for different locations within the Caloosahatchee. Adjustments to the INI file may be made outside of EcoSAV using any text editor, or interactively within the EcoSAV program. A full discussion of these parameters may be found in the Biosonics EcoSAV User's Guide.

1. Select Files to Process. Select the EcoSAV icon on the PC screen. The BioPlant window appears. Select File/Open. Acoustic survey data are stored in the C:\Biosonics\DTx\Data directory (default) as DT4 files. Select single or multiple files (control/click) and select OPEN. These files appear in the INPUT QUEUE window.

2. Select Processing Parameter File. A generic INI file, suitable for the Caloosahatchee (SFWMD_01.INI), has been set as the system default, so generally it will not be necessary to change processing INI files and the user can proceed directly to step 3, below. However, occasionally changes will be necessary. Following instructions are for substitution of an alternate INI file. Double click on first file in the queue window. The JOB PARAMETERS window appears select the Job Parameters tab. Within INI SOURCE select SPECIFY AN INI and select BROWSE. Select SFWMD_nn (or other pre-edited INI file) and select OPEN. Within OUTPUT FILE select "Append output extension to the source filename." Within OUTPUT NAMING RULES select "Overwrite output filename if it exists." Select OK.

3. Initiate Processing. At the bottom of the BioPlant Window select START PROCESSING FILE. The selected filename will appear in the Processing Queue window to indicate that processing is underway. When complete, the same filename with an ODF extension will appear in the Output Queue.

4. Viewing Output. Double click on the ODF file in the Output Queue and the contents will be displayed in the OUTPUT REPORT window (Figure 2). The upper portion of this window shows the Configuration Data used in the selected INI file. This is important because output results may change considerably by changing the parameter values within the INI file. Actual output is shown below the configuration data.

Position and time/date variables are derived from the GPS and represent whatever coordinate system and time zone specified within the GPS. All remaining variables are derived from the processing of the acoustic data. Time and date will be needed in post processing to correct for tide. The BOTTOM depth is the distance between the transducer face (bottom of transducer) and the detected bottom. Post-processing corrections are required to account for the depth of the transducer and tides. A full discussion of the output variables may be found in the Biosonics EcoSAV User's Guide.

5. Editing Processing Parameter File. It will be necessary from time to time to make changes to the processing parameters in the INI file. The most likely parameter to change would be the MAXIMUM PLANT DEPTH. This serves to prevent the algorithm from looking for plants at depths exceeding the maximum depth of plant colonization, which serves to minimize false alarms. For the Caloosahatchee a value around 2.3 m is about right under all conditions except exceedingly high tides. This and other parameters can be changed using an editor outside of the EcoSAV environment. Another approach is to make the change interactively within EcoSAV. To do this, select SETTINGS then EDIT AN INI FILE. Select and open the INI file to edit. Four tab windows will appear (Figure 3). The SITE SPECIFIC folder controls output suppression and maximum plant depth limits (most likely screen to need changing). No changes would likely need to be made to the SYSTEM SPECIFIC screen unless a different transducer was used. Conditions may arise requiring some changes to ADVANCED and ADDITIONAL PARAMETERS screens, but it is not recommended to change these without consulting Biosonics or Bruce Sabol. After all changes have been made select SAVE and proceed with processing as described above.

Figure 1. Default setting of SFWMD_01.INI optimized for Caloosahatchee estuary.

```
[System Related Parameters]
Signature = Aquatic Plant Software
Version = 2
Output Control = Rename

[Site Specific Parameters]
Gps Qualifier = 1
Noisy Pings = 3
Out of Water = 2
Maximum Plant Depth = 2.200000

[System Specific Parameters]
Layer Height = 0.018000
Calibration Correction = 0.000000
Attenuation = 0.000000
Near Field = 0.200000

[Advanced Parameters]
Threshold for Noise Checking and Plant Detection = -65
Noise Checking Distance = 10
Plant Detection Distance = 5
Plant Height Threshold = 4
Bottom Thickness Threshold = 12

[Additional Parameters]
Maximum Bottom Change = 0.110000
B1 = -50
B2 = 6
B3 = 5
B4 = 6
P2 = -50
P3 = 5
P4 = -60
P5 = 2
P6 = -60
Q1 = -125
Q2 = 2
R1 = 8
```

Figure 2. Output report window.

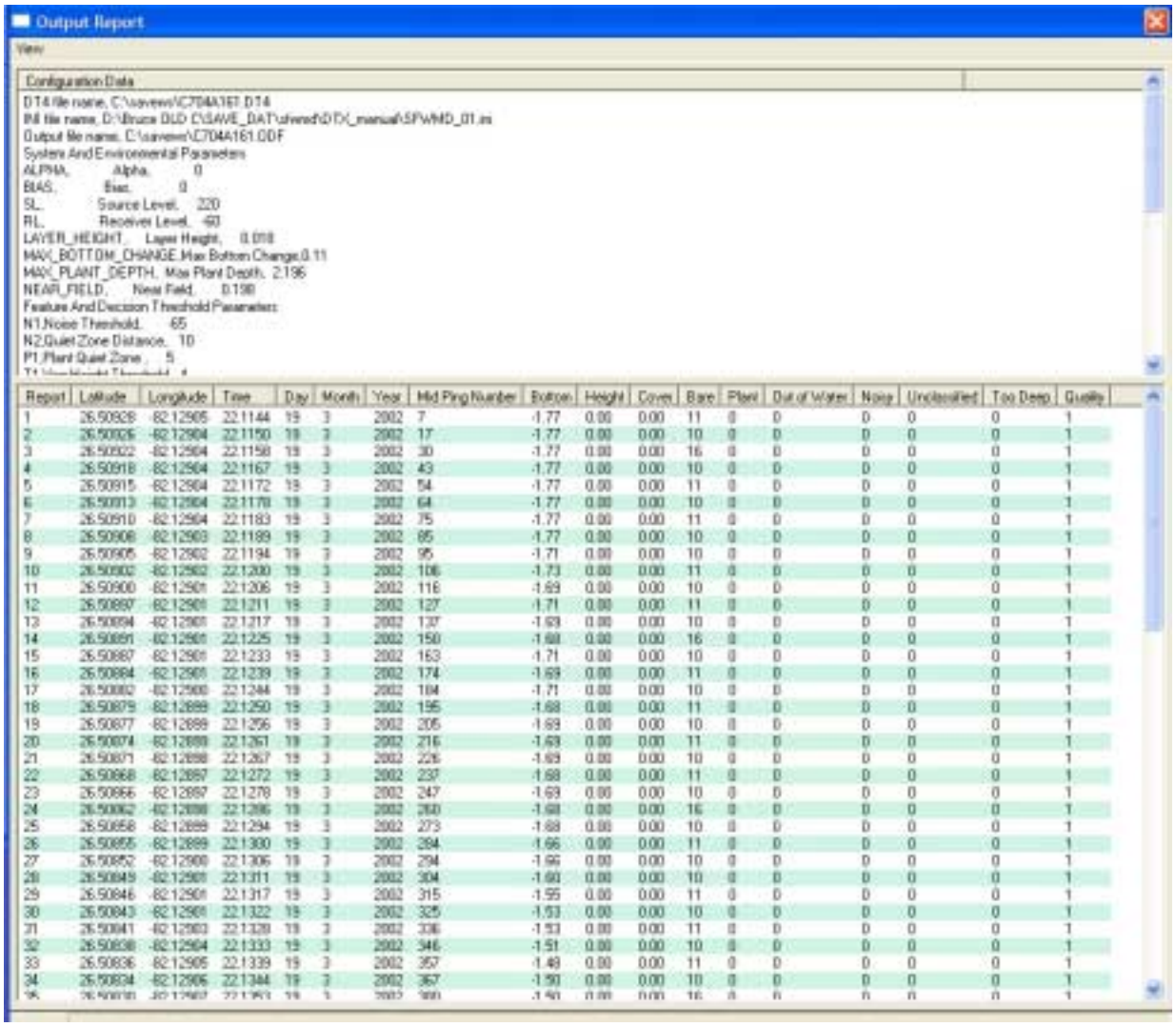
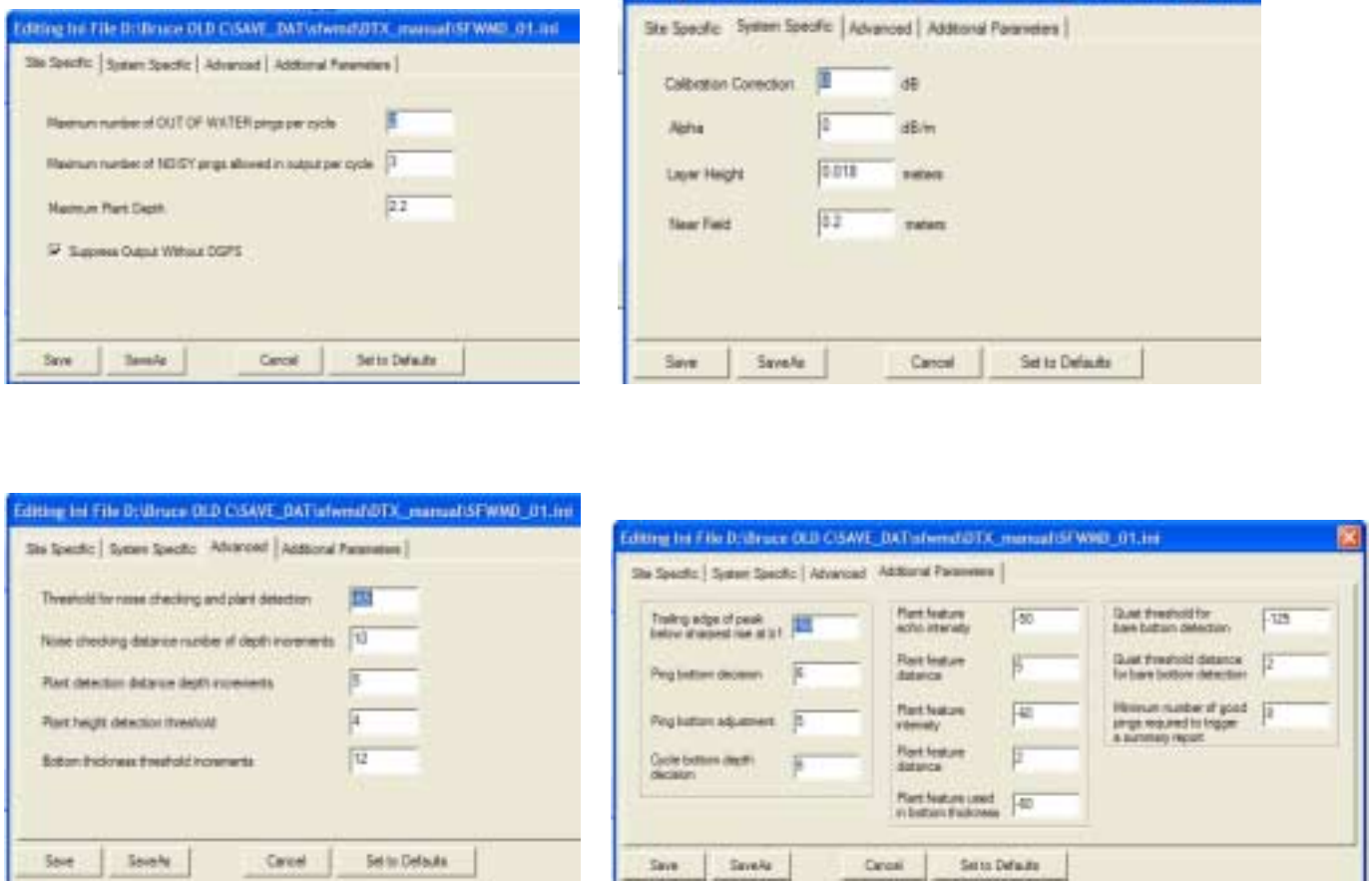


Figure 3. Editing an INI within EcoSAV.



Post Processing

The post-processing program FINALIZE makes depth corrections, based on tide and transducer depth, and concatenates individual ODF files into a single, space-delimited, ASCII text file formatted in accordance with the metadata for the Caloosahatchee Estuary project. In addition to the ODF files to be included, the program requires a data file of tide measurements and a file of ODF filenames with their associated reach, transect number, transducer depth and replicate number. Steps in creating these files and running FINALIZE are described below.

1. Tide data file. An example tide file is contained in Figure 4. This ASCII space delimited text file can be generated using any text-editing program, such as Microsoft Wordpad or Notepad. The first line is for documentation only. Each subsequent line contains the reach number, integer month, integer day of month, time (decimal hours local time), and tide (feet) relative to the selected reference plane. For each reach, the first line entry must contain a tide measurement BEFORE the first recorded ODF file. The last line entry for a given reach must contain a tide measurement AFTER the last recorded ODF file at that reach. If this condition is not met, the program will give a warning message and halt execution. If a tide measurement was not made at the correct time during data collection, it will be necessary to estimate one and enter it. If the time spent at a reach exceeds 2 hours, it is recommended (but not imperative) that a mid-time tide measurement be added to the file.

Figure 4. Tide data file must contain reach number, month, day, decimal hour local time, and tide (feet, NGVD29).

```
{tide data SFW_21 6-9 Oct 2003: reach, mm, dd, hh.hh, tide}
4  10  6  11.15  1.85
4  10  6  13.50  1.85
3  10  6  14.33  1.75
3  10  6  15.90  1.50
1  10  6  16.75  1.55
1  10  6  17.60  1.45
8  10  7  10.00  1.90
8  10  7  12.10  2.25
7  10  7  14.33  1.85
2  10  7  16.00  2.05
2  10  7  17.80  1.70
6  10  8   9.15  1.25
6  10  8  10.25  1.75
5  10  9  11.33  1.75
5  10  9  13.25  2.05
5  10  9  14.25  2.00
```

2. File listing ODF files. An example file is contained in Figure 5. Each line of the file corresponds to a single ODF file and its associated reach, transect number, depth of the transducer face (meters), and replicate number. It is not critical to have this list ordered in any particular way, but it is convenient and customary to order the list by reach then transect number - making it easier to find data from a given reach and transect in the output file. The easiest was to generate this file without having to type all the 15-character filenames is to enter the COMMAND PROMPT program (DOS emulator) and type: dir *.ODF > filelist.txt from within the proper directory. This will make a list of the ODF files in the current directory. Any text editor can then be used to discard everything but the 15-character filenames. These should then be put in the proper order with a reach and transect number. Be careful to eliminate any aborted files from the list.

Figure 5. The list file must contain ODF filename, reach number, transect number, transducer depth (m) and replicate number.

```
20031006_165545  1  1   0.25   1
20031006_170321  1  2   0.25   1
20031006_170916  1  3   0.25   1
20031006_171231  1  3   0.25   2
20031006_171559  1  4   0.25   1
20031006_172327  1  5   0.25   1
20031006_173050  1  6   0.25   1
20031007_165843  2  1   0.25   1
20031007_170446  2  2   0.25   1
20031007_171143  2  3   0.25   1
20031007_171909  2  4   0.25   1
20031007_172711  2  5   0.25   1
20031007_173510  2  6   0.25   1
20031007_174258  2  7   0.25   1
20031007_162633  2  8   0.25   1
20031007_163354  2  9   0.25   1
20031007_164054  2  10  0.25   1
20031006_143924  3  1   0.30   1
20031006_144934  3  2   0.30   1
20031006_145555  3  3   0.30   1
20031006_150130  3  4   0.30   1
20031006  150739  3  5   0.30   1
```

3. Running FINALIZE. Double click on the FINALIZE icon. The program will query the user for the integer survey number (reference Caloosahatchee metadata documentation). The FORM1 window then appears; click *Create Output File of Corrected Data.* Specify the desired filename and directory location of the output file, then click *Open.* Select the filename and location of the file containing the list of ODF files; click *Open.* Select the filename and location of the tide measurement data, then click *Open*.

Numbers in the FORM1 window will scroll by as the program executes. A successful completion message window will appear when the program is done; click *OK*. Finally, close the FORM1 window to exit the program.

4. Output file format. The format of the output ASCII space delimited .DAT file is in accordance with the current metadata standard for the Caloosahatchee estuary project. Note that the metadata standard changed after survey 19 (March 2003) to include depth corrected to the National Geodetic Vertical Datum (NGVD) 1929 reference plane. An example output .DAT file is illustrated in Figure 6.

Figure 6. Output file.

```
82.12839  26.50698  2002  206  14.8694  17  7  5  1 -1.88  40.00  0.35
82.12840  26.50695  2002  206  14.8700  17  7  5  1 -1.88  45.45  0.40
82.12840  26.50692  2002  206  14.8706  17  7  5  1 -1.85  40.00  0.35
82.12840  26.50690  2002  206  14.8711  17  7  5  1 -1.81  27.27  0.27
82.12842  26.50687  2002  206  14.8717  17  7  5  1 -1.81  50.00  0.26
82.12843  26.50683  2002  206  14.8725  17  7  5  1 -1.81  43.75  0.19
82.12843  26.50679  2002  206  14.8733  17  7  5  1 -1.81  20.00  0.16
82.12844  26.50677  2002  206  14.8739  17  7  5  1 -1.76  45.45  0.31
82.12845  26.50674  2002  206  14.8744  17  7  5  1 -1.74  30.00  0.29
82.12845  26.50672  2002  206  14.8750  17  7  5  1 -1.72  90.00  0.45
82.12845  26.50669  2002  206  14.8756  17  7  5  1 -1.67  81.82  0.49
82.12845  26.50666  2002  206  14.8761  17  7  5  1 -1.63  80.00  0.44
82.12845  26.50664  2002  206  14.8767  17  7  5  1 -1.59  90.91  0.42
82.12845  26.50661  2002  206  14.8772  17  7  5  1 -1.52  80.00  0.36
```

As per the metadata description, each record contains the following variables:

longitude -	decimal degrees W longitude in NAD83
latitude -	decimal degrees N latitude in NAD83
year -	four digit year
day -	Julian day
time -	decimal hours Greenwich Mean Time
survey -	sequential survey number
reach -	reach number (1-8)
transect -	transect number
replicate -	replicate number
depth -	depth of detected bottom in meters relative to NGVD29
coverage -	estimated plant coverage in percent
height -	mean plant height (m)

5. Documentation on FINALIZE. Finalize is written in Visual Basic 6.0 and should work well with any PC running Windows XP. The installation CD (attached to this report) contains the source code (directory FINALIZE_source) and installation software

(directory FINALIZE). The source code will allow the user to modify the program as necessary. Julian day is computed based on month, day, and year, and takes leap year into account. Tide corrections are determined by time-based linear interpolation using the date/time within the ODF filename; that is, all depths within a single transect are tide corrected by a single value.

6. Installing FINALIZE. Insert the installation CD and open the FINALIZE directory. Click on SETUP.EXE and follow the installation instructions. It may be convenient to generate a shortcut icon to activate the program. Click Start\Programs then right click FINALIZE. Select *Create Shortcut*. Next, select the created shortcut file and drag and drop it on the PC screen.

GPS Setup

The MX-420 GPS has been initially configured for work properly with the DT-X sounder for plant mapping operations. Information below is provided to enable the user to reset these configuration parameters should they get changed or be erased. All parameter setting is performed using the configuration screens activated by pressing the CFG key on the lower right of the GPS panel. This activates a split window with items listed on the left and corresponding configuration values on the right. Press the CFG key and scroll (large button with 4 arrows) to a specific item. To make a change to a configuration value press the E key (editor), make the appropriate change, then press the E key again to exit. The following settings are required for operation with SAVEWS.

DATUM/Datum = WGS-84
NAVIGATION/WPT Pass Distance = 0.02km
NMEA OUT 1/Not Active
NMEA OUT2/Port Active (yes), set GGA, GLL, ZDA output sentences to ON, all others OFF
POSITION/Reference System = Lat/Lon
POSITION/Alarm if no update –> YES
SERIAL I/O/4800 Baud for all
TIME/Time System = UTC
WPT&RTE In/External WPT Inputs –> YES

Navigating with GPS

The Leica MX-420 GPS may be used to navigate a stored route (sequence of waypoints). This involves selecting the route (each sampling reach has a route with the same identification number) then navigating the route. Select a route using the following sequence of commands on the GPS.

1. Push the RTE button to display the RTE1 window.

2. Enter the edit mode by pressing the E button.

3. Press INSERT softkey (far left).

4. Press INSERT ROUTE softkey (far right).

5. Select the desired route number by scrolling down the list of routes with the cursor button.

6. Press INSERT FORWARD softkey.

7. Exit the edit mode by pressing the E key.

Navigation may be performed using either the NAV or PLOT windows. The NAV3 window (press NAV button 3 times) provides a runway display with cross-track error bar. The PLOT1 window (press PLOT button once) provides a plan view of the route and boat path. If it becomes necessary to repeat a transect, repeat the route selection procedure described above. Enter the NAV3 window and enter the edit mode (E key). Repeatedly press the SKIP WAYPOINT softkey until the desired waypoint appears in the NEXT POINT box on the NAV3 window.

Manipulating GPS Waypoints

Waypoints may be moved between the GPS and the PC. Waypoints and routes used in the Caloosahatchee Estuary study have been loaded onto the GPS. Waypoints are stored on the PC in C:\Leica_GPS\WayPts01.txt. These data are in NMEA 0183 Standard Waypoint Location format (WLP) described on pp. 60-61 of the GPS operator's manual. Uploading or downloading waypoints requires altering the cable connections, temporarily reconfiguring the GPS, and running the **WayPtIO** program, stored in C:\Leica_GPS.

1. Connections. Undo the connection between the GPS and the DT-X sounder. Connect the GPS cable to the colored ribbon cable and connect the other end of the ribbon cable to the COM1 port on the back of the PC (only place it will connect).

2. GPS Reconfiguration. Reconfiguration steps (p. 62 GPS Operator's Manual) include the following:

   CFG\NMEA Out2, enter edit mode (press E key)
   Turn OFF all output sentences
   Turn ON WPL output sentence
   Select "Details" using the softkey, set *Checksum* Yes for download
   set *Checksum* No for inital upload
   set *Include Waypoint name* to YES,

set *Decimals* to 4
press *Done* softkey

Turn OFF WPL output sentence
The port remains active (PORT ACTIVE= yes)

3. Downloading Data (GPS to PC). Run the executable program **WayPtIO** stored on the PC in C:\Leica_GPS. Select Setup/COM Port - set Serial Port to COM1, and Baud to 4800, select OK. Select Setup/Operational Settings - set the following:

   Output Interval =1
   Sentences per Interval = 1
   Checked boxes: *Echo Transmit Data, Repeat Transmit Data, Display Received Data, Save Received Data*
   Select *Save Receive Data File* and designate a location and filename for the downloaded data.
   Select OK

   "Push" the green button on the PC program screen, then push the SEND ALL sortkey (on GPS), then "push" the red button on the PC program screen. Exit the program and verify that the file has been received.

4. Uploading Data (PC to GPS). Run the executable program **WayPtIO** stored on the PC in C:\Leica_GPS. Select Setup/COM Port - set Serial Port to COM1, and Baud to 4800, select OK. Select Setup/Operational Settings - set the following:

   Output Interval =1
   Sentences per Interval = 1
   Checked boxes: *Transmit, Echo Transmit Data, Display Received Data*
   Select *Select File,* and designate location and filename of uploaded data.
   Select OK

   "Push" the green button on the PC program screen. After the transmitted data has stopped scrolling across the PC screen, exit the program and verify that the waypoint list (WPT key) on the GPS is correct. If correct, lock them in place by entering the editor within the Waypoint window (press the E key). Press the *More* softkey on the GPS until the *Lock all WPT* softkey appears, press it, then exit the editor (press E key).

5. Restore GPS Configuration. Remember to restore the NMEA Out 2 configuration as described in GPS Setup, above (NMEA OUT2/Port Active (yes), set GGA, GLL, ZDA output sentences to ON, all others OFF).

Entering GPS Routes

Routes may likewise be entered via the PC using the NMEA Standard R*nn* and RTE formats in a procedure similar to that described above. However, because of the limited number of routes used in the Caloosahatchee study, we have opted to enter them manually on the GPS using the procedure described on p. 34 of the GPS operator's manual. Steps required to enter multiple-waypoint routes are summarized below.

1. Press the RTE key twice to get to the RTE 2 window which displays route banks. Scroll down to the route number to be populated or changed.

2. Enter edit mode by pressing the E key. To populate a new route with previously entered waypoints press the *Insert by numb.* softkey.

3. Enter the first waypoint number then press the *Insert this WPT* softkey. Repeat this procedure for each waypoint in the route.

4. After the final waypoint has been entered (followed by pressing the *Insert this WPT* softkey) exit the edit mode by pressing the E key. Next, press the E key again. Inspect the waypoints just entered. If they are correct press the *Lock Route* softkey. Route entry is now complete.

Suggestions

1. Daily data archiving, write .DT4 files to an archival medium such as a CD, using the CD writer on the Toughbook PC.

2. Periodically remove RTP, NME, and DT4 files from the data directory, after having archived them.

3. Daily processing and quick graphic display of collected data, suggest using Surfer or other low end PC mapping software.

4. Care and maintenance of equipment. All connectors are very fragile. A broken connector can cost a day's work. Suggest taking extreme care of cables and connectors, including getting a toolbox with spare parts and tools to repair connectors and damages cables. This should include pin-out diagrams for all equipment. Damage to the transducer cable requires a factory repair because it must be recalibrated.

Point of Contact

Please provide comments or corrections to:

Mr. Bruce Sabol, ATTN: CEERD-EE-C
U.S. Army Engineer Research and Development Center
3909 Halls Ferry Rd.
Vicksburg, MS 39180-6199
601-634-2297
Bruce.M.Sabol@erdc.usace.army.mil