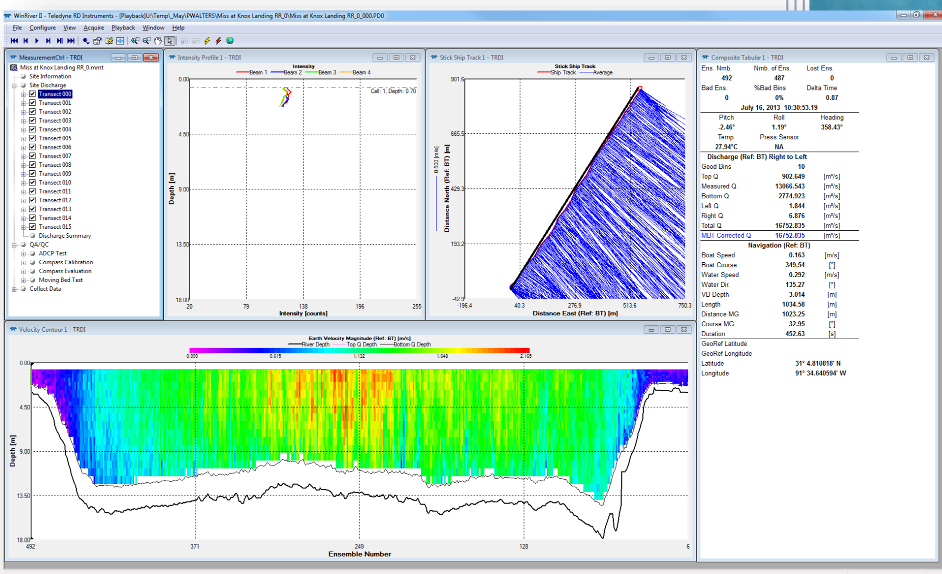
WinRiver II

Software User's Guide



TELEDYNE MARINE
Everywhereyoulook™

P/N 957-6231-00 (July 2023)

https://www.teledynemarine.com

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Revision History

July 2023

- Updated website address
- Updated software requirements

January 2023

- Updated EAR statement
- Updated Software Installation
- Removed software history appendix. See firmware Readme file for software history.

August 2022

- Updated the link for PD0Decoder.

February 2022

- Removed note about what version the manual covers. When software changes affect the manual, the manual is updated.

August 2021

- Updated the Contacting TRDI table.
- Added link to PD0Decoder.

March 2020

- Updated the Configure QAQC screen capture. Now includes a check box to use text instead of the icon.

February 2020

- Added note about you may need to run the Computer Management app as an Administrator before changes can be made to the **Device Manager** in the Alternate Procedure for Setting Latency section.
- Updated the Global Parameters screen and added how to use the High Definition contour plots.

January 2020

- Updated the ASCII Output screen capture for the Output Format Selection. Screen now includes a Column Headers selection box.
- Added the QAQC window to the Available Displays section.
- Updated the Acquire Edge dialog screen captures to show manually entered edge discharges instead of shore distances when you know the edge discharge from another method (StreamPro, Wading rod, etc.).
- Updated Table **8**. WinRiver II ASCII Output Variable List, page 188. Added lines 607 to 610.

September 2019

- Updated how to access the configuration pages, see Chapter 8 – Configuration Node Properties

July 2019

- Added How to Check for Possible GPS Delay
- Updated logo to Teledyne Marine

May 2018

- Updated the note/warning on pin codes. The pin code is 0 for systems shipped prior to August 2017 and 0000 for systems shipped after August 2017. If your system is sent in for repair and the Bluetooth module is replaced, the pin code will change from 0 to 0000.
- Updated Table **8**. WinRiver II ASCII Output Variable List, page 188.
- Updated General NMEA message body structure.
- Updated the software history section.
- Added Export Administration Regulations (EAR) footers

August 2016

- Added Verifying the ADCP is Receiving GPS Data section.
- Added chapter 11, Using Locations.
- Updated Output Filename Options screen and Recording page with Geographic Current Survey option.
- Added GPS offset to GPS/DS/EH page.
- Added Dashboard to Available Displays section.
- Updated Table 8. WinRiver II ASCII Output Variable List, page 188.
- Added Dynamic Residual Analysis section.
- Updated screen captures to show 2.18 screens.
- Updated the software history section.

February 2016

- Updated the Set Clock screen capture. Added warning about clicking OK only will not set the clock.
- Updated the Processing page with new Composite (BT) option.

August 2015

- Updated the screen captures to show WinRiver II version 2.16.
- Added the RioPro ADCP.
- Updated the SD1000U Bluetooth device set up.
- Updated the WinRiver II ASCII Output Variable List (Table 8).
- Updated the software history section.

August 2014

- Updated the Properties Dialog.
- Updated the DS/GPS/EH Properties tab.
- Added the RiverPro changes to wizard and GPS displays.
- Added Q-View information to Figure 1 - Overview.
- Added Vertical Beam display.
- Updated the Support Files section with information on new **.nc* file format.
- Added warning that measurement file format has changed in version 2.14.
- Updated the classic ASCII output Table 7, page 183, with RiverPro GeoReference data.

- Updated the ISM compass calibration procedure for RiverRay, RiverPro, and StreamPro.
- Updated software history section.

April 2014

- Updated software history section.

September 2013

- Updated USB Bluetooth device. Starting September 2013, TRDI is using the BTD-V201 USB Bluetooth device with Toshiba driver.
- Updated the classic ASCII output Table 7, page 183 when vertical beam is selected.
- Updated the **Processing** tab for selecting a River Depth Source.
- Updated the DS/GPS/EH Properties tab. The **Use Depth Sounder in Processing** checkbox was removed (functionality changed and moved to the **Processing** tab)
- Removed sending the AR command steps from the Rio Grande compass calibration.
- Updated software history section.

May 2013

- Updated software requirements.
- Updated software installation.
- Revised Chapter 2 Communications.
- Added Quick Measurement information to chapters 3 and 5.
- Added Control-Q to the shortcuts table.

September 2012

- Updated software history section.

August 2012

- Combined WinRiver II User's Guide and WinRiver II Quick Start Guide into one manual.
- Updated styles used in manual.
- Updated Moving Bed section and added LC and SMBA tests.
- Updated Bluetooth connection for the StreamPro and RiverRay ADCPs.
- Added Using the SD1000U Bluetooth Device.
- Added Integrated Sensor Module (ISM) compass calibration for the RiverRay ADCP.
- Updated Problems to look for in the Data section.
- Updated Integrating Depth Sounder, External Heading, and GPS Data section.
- Updated software history section.

December 2011

- Updated screen captures for Measurement Wizard Configuration Dialog.
- Updated fonts and styles used in manual.
- Added Table 5. WinRiver II ASCII Output Variable List.

How to Contact Teledyne RD Instruments

If you have technical issues or questions involving a specific application or deployment with your instrument, contact our Field Service group:

Teledyne RD Instruments	Teledyne RD Instruments Europe
14020 Stowe Drive Poway, California 92064	2A Les Nertieres 5 Avenue Hector Pintus 06610 La Gaude, France
Phone +1 (858) 842-2600	Phone +33(0) 492-110-930
Sales – rdisales@teledyne.com	Sales – rdie@teledyne.com
Field Service – rdifs@teledyne.com	Field Service – rdiefs@teledyne.com

Client Services Administration – rdicsadmin@teledyne.com

Web: https://www.teledynemarine.com

For all your customer service needs including our emergency 24/7 technical support, call +1 (858) 842-2700

Self-Service Customer Portal

Use our online customer portal at https://www.teledynemarine.com/support/RDI/technical-manuals to download manuals or other Teledyne RDI documentation.

Teledyne Marine Software Portal

Teledyne RD Instruments Firmware, software, and Field Service Bulletins can be accessed only via our Teledyne Marine software portal.

To register, please go to https://tm-portal.force.com/TMsoftwareportal to set up your customer support account. After your account is approved, you will receive an e-mail with a link to set up your log in credentials to access the portal (this can take up to 24 hours).

Once you have secured an account, use the Teledyne Marine software portal to access this data with your unique username and password.

If you have an urgent need, please call our Technical Support hotline at +1-858-842-2700.

Conventions Used in this Manual

Conventions used in this documentation have been established to help you learn how to use the system quickly and easily.

Software menu items are printed in bold: **File** menu, **Collect Data**. Items that need to be typed by the user or keys to press will be shown as **F1**. If a key combination were joined with a plus sign (**ALT+F),** you would press and hold the first key while you press the second key. Words printed in italics include program names (*WinRiver II*) and file names (*default.txt*).

Code or sample files are printed using a fixed font. Here is an example:

```
StreamPro ADCP
Teledyne RD Instruments (c) 2017
All rights reserved.
Firmware Version: 31.xx

>?
```

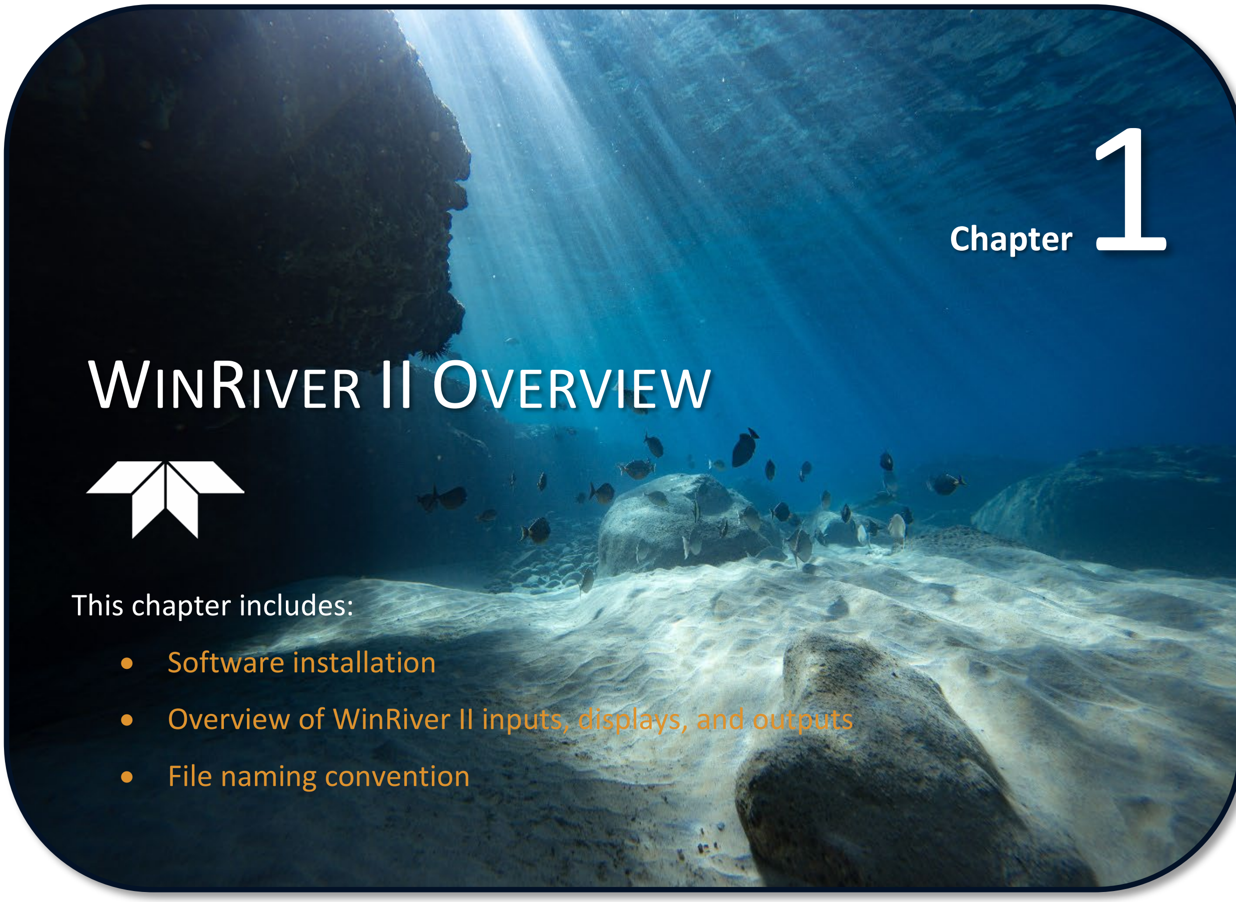
You will find three other visual aids that help you: Notes, Cautions, and Recommended Settings.

This paragraph format indicates additional information that may help you avoid problems or that should be considered in using the described features.

This paragraph format warns the reader of hazardous procedures (for example, activities that may cause loss of data or damage to the ADCP).

Recommended Setting. This paragraph format indicates additional information that may help you set command parameters.

Notes



Chapter 1

WinRiver II Overview

This chapter includes:

- Software installation
- Overview of WinRiver II inputs, displays, and outputs
- File naming convention

Introduction

WinRiver II is Teledyne RD Instrument's (TRDI) real-time discharge data collection program. This program creates a measurement file to operate the ADCP, checks each command, and verifies that the ADCP has received the commands.

Software Requirements

WinRiver II requires the following:

You must have administrator rights on the computer if you are using Windows 8®/7®/Vista®.

For versions prior to 2.19, to use the LC and SMBA Moving Bed tests, the computer must be set to the English language.

- Windows 10®, Windows 11® laptop or desktop computer
- Windows 10®, 11® Intel® compatible tablet
- .NET 2.0 SP1 or higher (latest version of .NET 3.0 recommended).
- Minimum display resolution of 1024 x 768 (higher recommended)
- Mouse or another pointing device
- One Serial Port if using a Rio Grande ADCP
- Bluetooth capability if using a RiverRay, RiverPro/RioPro, or StreamPro ADCP.

A Bluetooth mouse such as the Sculpt Touch Mouse from Microsoft (the no USB transceiver type) and/or Bluetooth keyboard can add to your tablet experience.

For Windows 7® and onward, it is important that the laptop/tablet serial port be it built in, or if there is no serial port, then use a USB/Serial adapter with a FTDI driver. An example of a good adapter is http://www.easysync-ltd.com/product/526/es-u-1001-r10.html.

Software Installation

The *WinRiver II* software is available for download.

1. Follow the instruction sheet on downloading TRDI software and manuals.
2. Software is available on https://tm-portal.force.com/TMsoftwareportal.
3. Unzip the file and double-click the *WinRiver II vX.xx.xx Setup.exe* file (where X.xx.xx is the version number) to install.

To install *WinRiver II* on a Windows 10 or 11® tablet, see the Windows Tablet Setup Card.

Overview of WinRiver II

This section includes a brief overview of the inputs, displays, and outputs provided by *WinRiver II*.

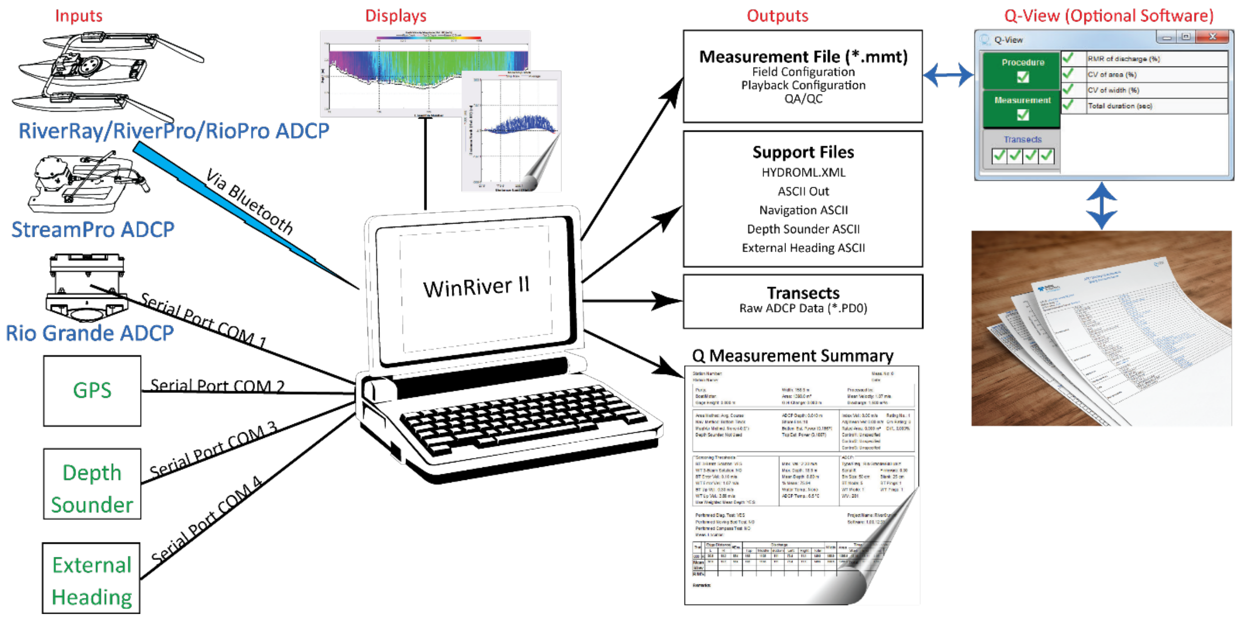


Figure 1. Overview of WinRiver II

The *Q-View* ADCP data QA/QC software is designed to operate with TRDI's *WinRiver II* program and bridges the gap between the requirement for high-quality field measurements and the time-intensive analysis that is typically required to ensure that collected data meets an organization's unique quality criteria. Utilizing customizable and flexible quality rules, *Q-View* can provide users with real-time feedback during ADCP data collection or can be implemented back in the lab during data review and analysis. Once data has been analyzed and confirmed, *Q-View* can also be used to automatically-generate professional reports in minutes. For more information, visit: teledynemarine.com/en-us/products/Pages/q-view-software.aspx.

Inputs

To use *WinRiver II*, the Workhorse ADCP must meet the following criteria.

- WorkHorse Rio Grande ADCP, Sentinel V Real-Time, or the WorkHorse ADCP **must** have the Bottom Track upgrade installed.

  The Bottom Track and High-Resolution Water Modes upgrades are available for Sentinel V Real-Time, WorkHorse Monitor, and Sentinel ADCPs (included with the Rio Grande ADCP). *This guide assumes you will be using a WorkHorse Rio Grande ADCP.*

  The Rio Grande, Monitor / Sentinel, and Mariner ADCPs can benefit from the upgrade to the High-Rate Pinging (Water Mode 12) and Shallow Bottom Mode (Bottom Mode 7). Contact your local sales representative if you are interested in upgrading your system.

- *WinRiver II* can also be used with a RiverRay, RiverPro/RioPro, and StreamPro ADCP if your computer has a Bluetooth connection.

In StreamPro Firmware version 31.07, the Long-Range mode was extended to 6 meters. For compatibility with WinRiver II v2.06 and above, existing Long-Range StreamPro users must have their firmware updated to version 31.07 (or higher).

- *WinRiver II* can also be used with Broadband Phase III systems.

ADCP Mounting Requirements

The ADCP must be mounted as follows:

- Over the side or through the hull mounted
- Downward facing
- Within 5 degrees of vertical (see note)
- Beam 3 at 45 degrees right (clockwise) of forward is recommended to minimize flow distortion effects or Beam 3 forward.

TRDI recommends using a fixed mount or float to achieve the best performance (see the ADCP Manual for recommended sources of mounts).

See the WorkHorse Commands and Output Data Format Guide for details on how the ADCP uses tilts in transformation (see the EX command).

Displays

All the *WinRiver II* displays may be saved to files or printed. For more information, see Available Displays and Print a Graph or Display.

Outputs

The "heart" of *WinRiver II* is the measurement file (**.mmt*). A measurement file is created by running the **Measurement Wizard** (see Using the Measurement Wizard). The **Measurement Control** window helps keep track of the files used in the measurement and provides a quick way to access program controls by right-clicking on items in the list. For more information about the **Measurement Control** window, see Using the Measurement Control Window.

Measurement File

- Configuration information – The **Field Configuration** for each transect contains the settings used to collect the data. No changes can be made to this information once a transect has started. A **Playback Configuration** is created when a transect is reprocessed (see Post-Processing of Discharge Data).
- QA/QC information (ADCP tests, compass calibration, Moving Bed Test)
- The **Measurement Control** window shows a list of all the transects and support files.

The measurement file format has changed in several recent *WinRiver II* versions. Some agencies are reading data directly from the **.mmt* file even though TRDI does not recommend this, and we do not document its format.

Transects

- Raw ADCP data files (**.PD0*) – These files contain all data sent from the ADCP and other devices during data collection. Refer to the WorkHorse Commands and Output Data Format guide for a complete description of the format of raw ADCP data files. For any specific measurement, raw data files contain the most information and are usually the largest.

Each time you start a transect (using the **Acquire** menu or the shortcut key **F5**), *WinRiver II* adds a transect node to the **Measurement Control** window and opens a new **.PD0* raw data file. The transect number is incremented for each transect. For more information on how to collect data, see Acquiring Discharge Data.

The raw ADCP data files are saved to the same folder as the measurement file. Other TRDI software like *TRDI Toolz* may be used with the data files as needed. For more information about the format of the raw ADCP data, see Appendix C – WinRiver II Data Formats and the WorkHorse commands and Output Data Format guide.

TRDI's software *WinADCP* is not compatible for viewing and/or exporting *WinRiver II* data, or data collected in Ship or Instrument coordinates. Using *WinADCP* to display and/or export *WinRiver II* data results in an incorrect naming structure. Data is called Earth coordinates when it is actually Ship coordinates.

Support Files

- HYDROML file – These files contain exported data in HYDROML format. HYDROML is an extension of the eXtensible Markup Language (XML) providing the Hydrologic Scientific Community with a standard definition of XML tags and concepts of structure to allow the definition of hydrologic information.
- ASCII out files – These files contain ASCII text that you can create during post-processing. During playback, you can subsection, average, scale, and process data. You also can write this data to an ASCII file. You can then use these files in other programs (spreadsheets, databases, and word processors).
- Navigation ASCII – These files contain ASCII data collected from an external navigation device during data acquisition. *WinRiver II* reads the navigation data from a user-specified serial port. These files are not used in post-processing.
- Depth Sounder ASCII – These files contain ASCII data collected from an external depth sounder device during data acquisition. *WinRiver II* reads the depth data from a user-specified serial port. These files are not used in post-processing.
- External Heading ASCII – These files contain ASCII data collected from an external heading device during data acquisition. *WinRiver II* reads the heading data from a user-specified serial port. These files are not used in post-processing.
- *WinRiver II* version 2.14 and higher creates a **.nc* file, which is used to support the *Q-View* sensitivity analysis functionality. These files have the following characteristics:
    - Will be created/updated whenever a transect is collected or reprocessed
    - Must be present for *Q-View* to function properly
    - File size will be substantially larger than the source PD0 data file
    - Do not need to be archived nor included when transferring data
    - Can be deleted by the user if desired, for example to limit the size of a data transfer file or archive, but must be re-created for full *Q-View* functionality
- Location file – These **.dat* files contain the preferred starting and stopping points for transects. The location file must be saved in the *C:\Measurements\Locations* folder and will automatically be used if the transect is within approximately 100 meters of the locations specified in the file. The ADCP must be using GPS to use locations. See Chapter 11 – Using Locations.

Q Measurement Summary

- The **Q Measurement Summary** is a printed report of the discharge. See Using the Q Measurement Summary for more information.

File Naming Convention

File names are based on information entered using the **Measurement Wizard**.

Data Files

File Name Format: prefix_meas_MMM_NNN_Date_Time__0.00000N_0.000000W.PD0

prefix	Filename prefix (see Output Filename Options)
meas	Measurement number. This is entered on the **Site Information** page (see Site Information) and is optional to be included in the file name by checking/un-checking the **Measurement Number** box on the **Output Filename Options** page of the **Measurement Wizard**.
MMM	Transect number. This number starts at 000 and increments each time you stop and then start data collection. The maximum number of transects is 999.
NNN	File sequence number. This number starts at 000 and increments when the file size reaches the user-specified limit if the **Sequence Number** box is selected and a file size entered on the **Output Filename Options** page of the **Measurement Wizard**.
Date_Time	The date and time can be added to the file name if the **Use Date/Time in Filename** is selected on the **Output Filename Options** page of the **Measurement Wizard**.
LAT/LON	The geographic location can be added to the file name if the **Geographic Current Survey** box is selected on the **Output Filename Options** page of the **Measurement Wizard**. GPS data must be present and configured on the Configuration Dialog screen first. Selecting this option will also automatically add the long date/time information to the filename.
PD0	PD0 formatted raw ADCP data file

Navigation Data Files

Navigation Data Files are ASCII files created during data collection. These files are not used to playback data.

File Name Format (*_GPS.TXT)

The external device sending the navigation data determines the format of the navigation data file. The navigation device can be any external device linked to *WinRiver II* by a serial communication port. GPS data integrated into the RiverRay data stream will NOT appear in navigation data files, as it is captured by the RiverRay rather than *WinRiver II*.

The navigation data should be ASCII, with a carriage return and line feed (CR/LF) generated after each data transmission. *WinRiver II* receives the data from the navigation device and writes it to the navigation file. Every time an ADCP ensemble is received, *WinRiver II* also writes the ensemble number and the computer time to the navigation file. Here is a sample navigation data format and program sequence.

1. Navigation device sends data to the serial port. For example:

```
$GPGGA,190140.00,3254.81979,N,11706.15751,W,2,6,001.3,00213.4,M,-032.8,M,005,0262*6F
$GPVTG,108.0,T,,,000.3,N,000.6,K*21
```

2. *WinRiver II* writes this information to the ASCII (*_GPS.TXT) navigation data file and to the *.PD0 raw data file (see Navigation Data Output Data Format). *WinRiver II* only uses the data in the *.PD0 file.
3. *WinRiver II* receives an ensemble of data from the ADCP and writes the ensemble number and computer time to the navigation data file in the following format:

```
<CR/LF>$RDENS,nnnnn,ssssss,PC<CR/LF>
```

Where: *nnnnn* = sequential ensemble number and *ssssss* = computer time in hundredths of seconds

Depth Sounder Data Files

Depth Sounder Data Files are ASCII files created during data collection. These files are not used to play-back data.

File Name Format (*_SND.TXT)

The external device sending the depth data determines the format of the depth sounder data file. The depth sounder device can be any external device linked to *WinRiver II* by a serial communication port.

The depth sounder data should be ASCII, with a carriage return and line feed (CR/LF) generated after each data transmission. *WinRiver II* receives the data from the depth sounder device and writes it to the depth sounder data file. Every time an ADCP ensemble is received, *WinRiver II* also writes the ensemble number and the computer time to the depth sounder data file. Here is a sample depth sounder data format and program sequence.

1. Depth sounder device sends data to the serial port. For example:

```
$SDDBT,0084.5,f,0025.7,M,013.8,F
```

2. *WinRiver II* writes this information to the ASCII (*_SND.TXT) depth sounder data file and to the *.PD0 raw data file (see Navigation Data Output Data Format). *WinRiver II* only uses the data from the *.PD0 file.
3. *WinRiver II* receives an ensemble of data from the ADCP and writes the ensemble number and computer time to the depth sounder data file in the following format:

```
<CR/LF>$RDENS,nnnnn,ssssss,PC<CR/LF>
```

Where: *nnnnn* = sequential ensemble number and *ssssss* = computer time in hundredths of seconds

External Heading Data Files

External Heading Data Files are ASCII files created during data collection. These files are not used to playback data.

File Name Format (*_EH.TXT)

The external heading device sending the heading data determines the format of the data file. The external heading device can be any external device linked to *WinRiver II* by a serial communication port.

The external heading data should be ASCII, with a carriage return and line feed (CR/LF) generated after each data transmission. *WinRiver II* receives the data from the external heading device and writes it to the external heading data file. Every time an ADCP ensemble is received, *WinRiver II* also writes the ensemble number and the computer time to the external heading data file. Here is a sample external heading data format and program sequence.

1. The external heading device sends data to the serial port. For example:

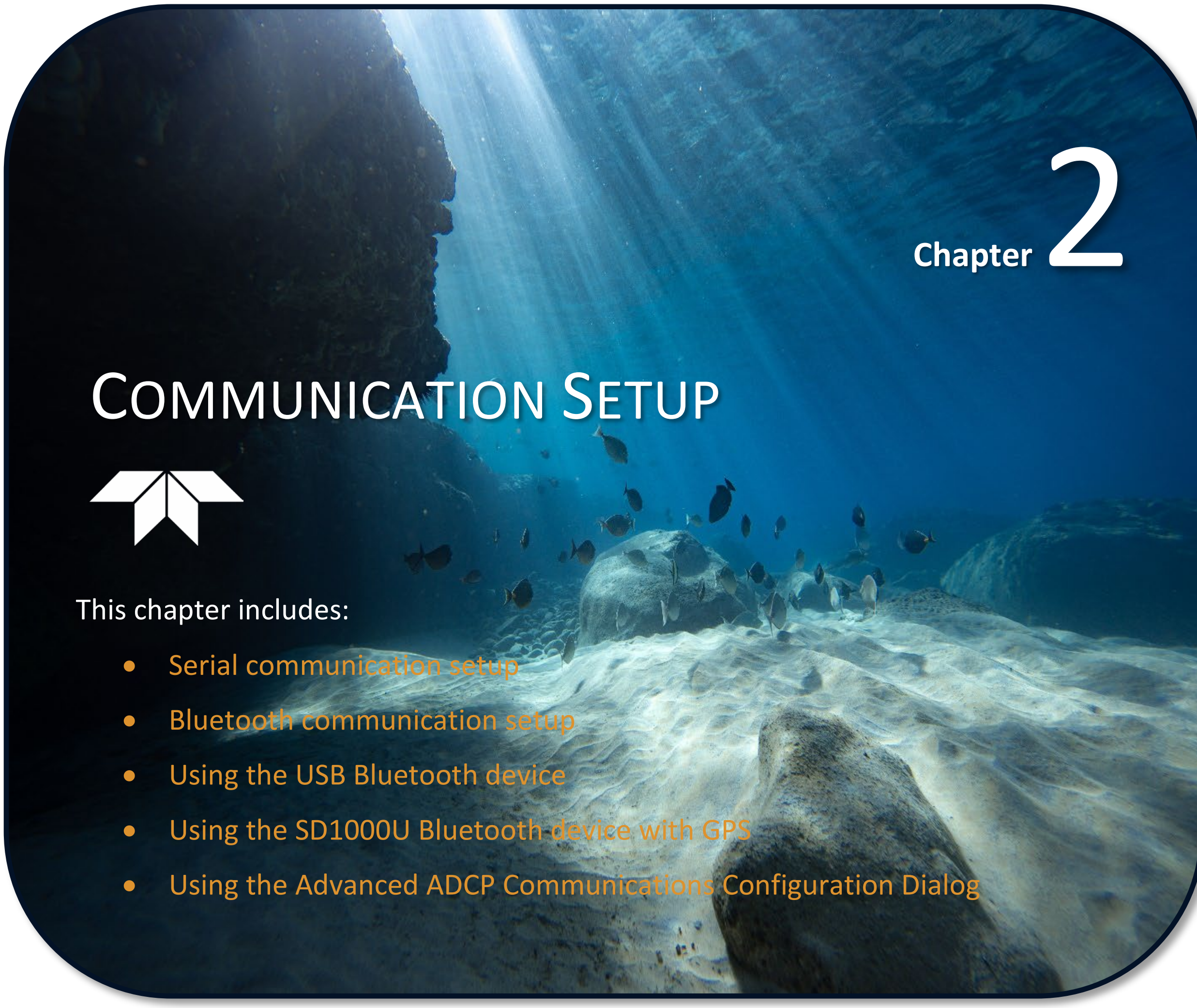
```
$INHDT,245.8,T*2E
```

2. *WinRiver II* writes this information to the ASCII (*_EH.TXT) external heading data file and to the *.PD0 raw data file (see Navigation Data Output Data Format). *WinRiver II* only uses the data from the *.PD0 file.

3. *WinRiver II* receives an ensemble of data from the ADCP and writes the ensemble number and computer time to the external heading data file in the following format:

```
<CR/LF>$RDENS,nnnnn,ssssss,PC<CR/LF>
```

Where: *nnnnn* = sequential ensemble number and *ssssss* = computer time in hundredths of seconds.



Chapter 2

COMMUNICATION SETUP

This chapter includes:

- Serial communication setup
- Bluetooth communication setup
- Using the USB Bluetooth device
- Using the SD1000U Bluetooth device with GPS
- Using the Advanced ADCP Communications Configuration Dialog

ADCP Communication Setup

The first time *WinRiver II* is first started, the serial port to be used for communications with the ADCP must be configured, whether using a direct serial connection, Bluetooth, or serial radio modems. You must also configure the serial port(s) to be used with optional external devices such as GPS, External Heading, and Depth Sounder. Once configured and the workspace saved, *WinRiver II* will remember the settings and use them each time the program is started. If you change ADCPs or external devices, you must reconfigure the communication setup as needed. The ADCP communications configuration is described below; configuration for optional external devices is similar.

Selecting **Load Last Workspace on Startup** will load the ADCP's serial port setup, user units selection, coordinate system, and navigation reference from the workspace file. Make these selections and then save the workspace to have your preferences reloaded on startup. See Tutorial - Creating Workspaces and Chapter 4 – Customizing WinRiver II for details.

The Bluetooth device configuration process results in the assignment of a serial port (COM xx) to the ADCP which is then used in the communication setup described below. Bluetooth communications require a Bluetooth adapter, installation of the appropriate driver software, and Bluetooth device configuration. Refer to the appropriate section below for details on Bluetooth setup in your application.

Serial radio modems used with ADCPs typically connect to the data collection computer via a standard serial port. USB-serial adapters may be used if your computer does not have sufficient serial ports for the number of devices you intend to use. Be aware that some USB-serial adapters are not fully compatible with *WinRiver II* and ADCP data collection. If you experience communications issues with the USB-serial adapter, first try a different device. TRDI has had good experience with the Edgeport line of multi-port USB-serial adapters and single-port adapters using the FTDI chipset and drivers. Your experience may vary.

For Windows 7® and onward, it is important that the laptop/tablet serial port be it built in, or if there is no serial port, then use a USB/Serial adapter with a FTDI driver. An example of a good adapter is http://www.easysync-ltd.com/product/526/es-u-1001-r10.html.

Using the **Measurement Wizard** (see Using the Measurement Wizard) will also prompt you to set up communications if they are not already configured.

Serial Communication Connection

To connect to a RiverRay or Rio Grande ADCP using a direct serial cable or serial radio modems:

1. Connect and power up the ADCP (and radio modems, if used) as shown in the appropriate ADCP User's Guide.
2. Start *WinRiver II*. To open the **Peripheral Configuration Dialog** box, on the **Configure** menu, select **Peripherals**.

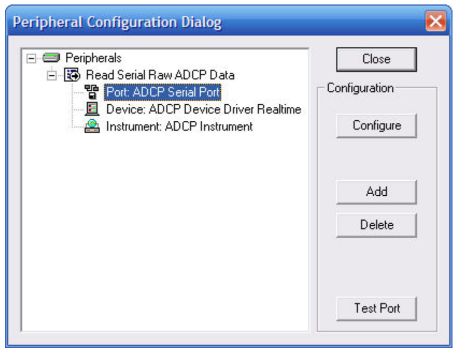
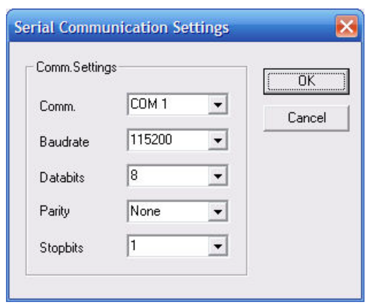


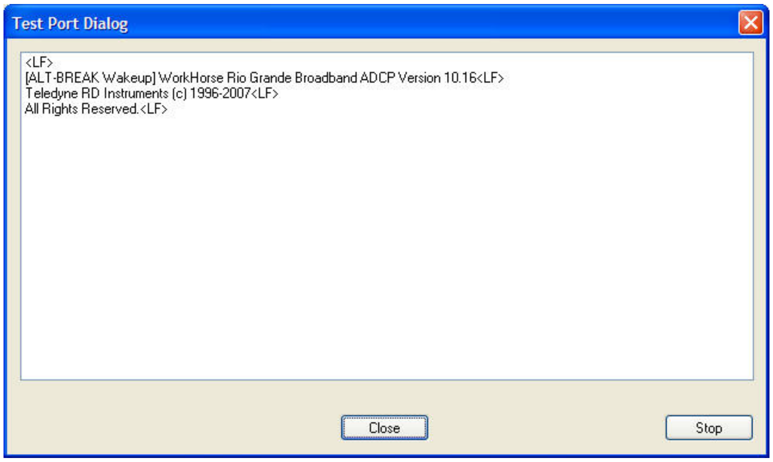
Figure 2. Peripheral Configuration Dialog

3. Click the + box next to **Read Serial Raw ADCP Data** to expand the list and then select **Port: ADCP Serial Port**. Press the **Configure** button.

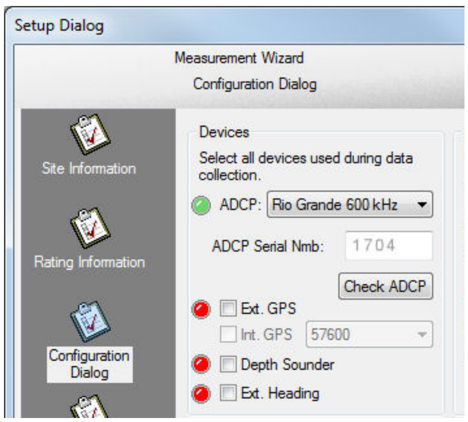


4. Select the Communication Port, Baudrate, Databits, Parity, and Stopbits. If you are unsure of the setting, click **Cancel** and right-click on **Instrument: ADCP Instrument** and select **Auto Detect**. Click **OK** to continue.

5. Click **Test Port** to have *WinRiver II* connect to the device and confirm the communication setting are working.



6. Click the **Close** button to exit the Test Port Dialog.
7. Click the **Close** button once more to exit the Peripherals Configuration Dialog.
8. Start a new measurement in *WinRiver II*.
9. On the **Configuration Dialog**, ensure the **ADCP** type matches your ADCP and the indicator next to the ADCP is green.

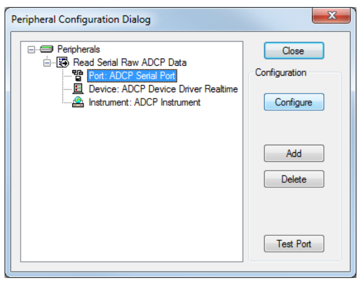


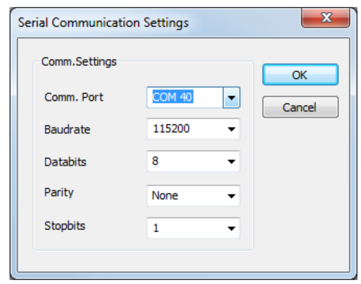
Bluetooth Communication Connection

Microsoft® Bluetooth drivers work with *BBTalk* but **not** *WinRiver II* for RiverPro/RioPro and newer StreamPro and RiverRay (Q4 2015 production and newer) ADCPs. Use the USB Bluetooth device with the driver supplied with the device for *WinRiver II*. Some users have successfully used the purchased (licensed) version of the BlueSoleil drivers with *WinRiver II* in lieu of the Microsoft drivers supplied with their USB Bluetooth adapter or the built-in Bluetooth adapter in their laptop or tablet.

To connect to a StreamPro, RiverPro/RioPro, or RiverRay ADCP using the Bluetooth port:

1. Verify what COM Port is used for the USB Bluetooth device (see SD1000U Com Port Identification and Using Other USB Bluetooth Adapters).
2. Start *WinRiver II*.
3. On the **Configure** menu, select **Peripherals**.
4. Select **Port: ADCP Serial Port** and then click the **Configure** button.



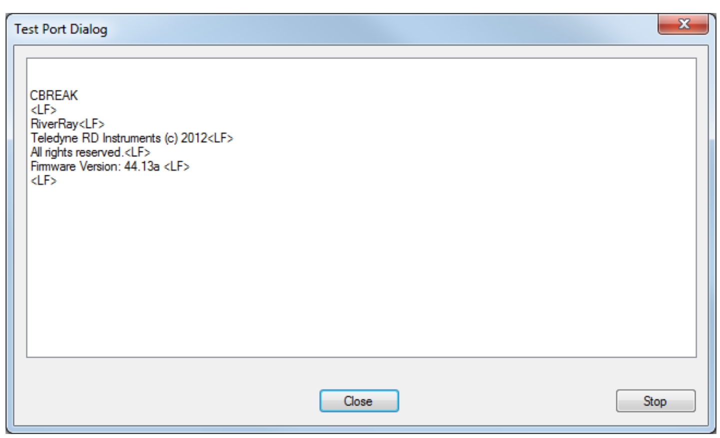


5. Select the **Comm. Port** number as noted in the Bluetooth screen from the drop down list. The **Baudrate** must be set to 115200. Leave the **Databits**, **Parity**, and **Stopbits** as shown.
6. Click **OK** to close the Serial Communication Settings screen.

Note it may take several seconds to accept the Comm. Port selection.

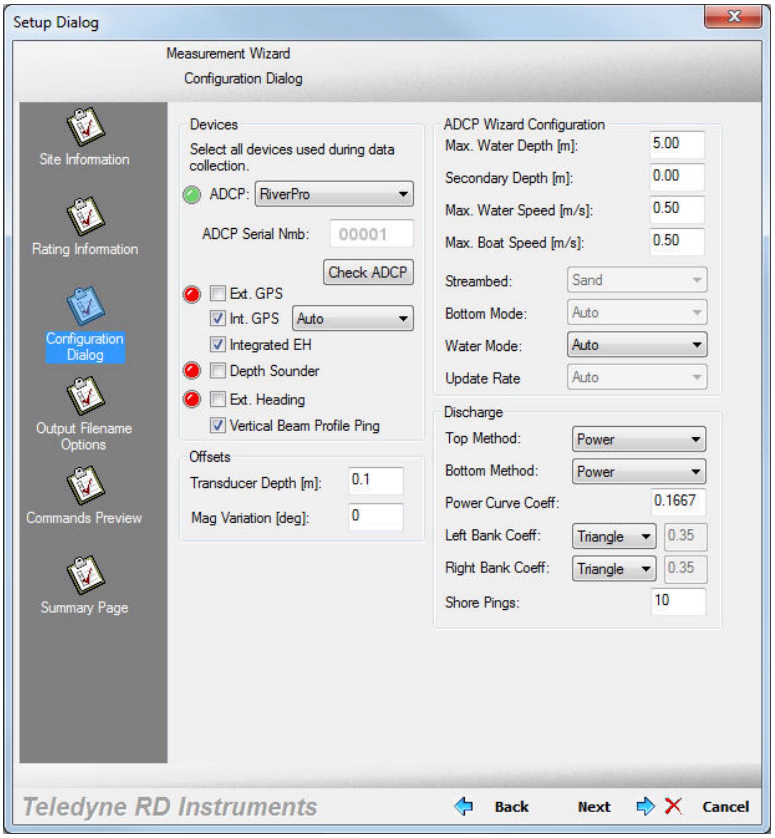
In this example, the Comm. Port is set to Com Port 40.

7. Click the **Test Port** button. The RiverRay, RiverPro/RioPro, or StreamPro wakeup message appears.



8. Click the **Close** button to exit the Test Port Dialog.

9. Click the **Close** button once more to exit the Peripherals Configuration Dialog.
10. Start a new measurement in *WinRiver II*.
11. On the **Configuration Dialog**, ensure the **ADCP** type matches your ADCP and the indicator next to the ADCP is green.



The **Configuration Dialog** screen will look slightly different for StreamPro and RiverRay ADCPs.

Using the SD1000U USB Bluetooth Adapter

TRDI is supplying the SD1000U USB Bluetooth device with all Bluetooth enabled ADCPs. The SD1000U appears as a com port to a laptop. The Bluetooth stack is in the actual adapter. It is not like the UD100 where the device driver is in the laptop. Therefore, you should NOT use any Bluetooth Manager that you might be familiar with. Use the Parani software to manage the device.

- This information was created using the SD1000U on a Windows 7® laptop.
- To set GPS low Latency, see GPS Low Latency.
- For *WinRiver II* configuration details, see WinRiver II Port Setup.
- For simplicity and best throughput, set all baud rates to 115200Kb.

TRDI has observed latency issues while collecting GPS data into *WinRiver II* when using a Bluetooth adapter other than the SD1000U. The user must take suitable precautions.

If you are using the SD1000U device to connect to a RiverRay, RiverPro/RioPro, or StreamPro ADCP, make sure the Baud rate is 115200.

In Windows XP® and later systems the driver may load automatically when you plug in the SD1000U adapter. TRDI strongly recommends that users install the drivers and test communications in a location with internet access, before proceeding to their measurement location.

SD1000U Com Port Identification

To configure the SD1000U Bluetooth Com Port:

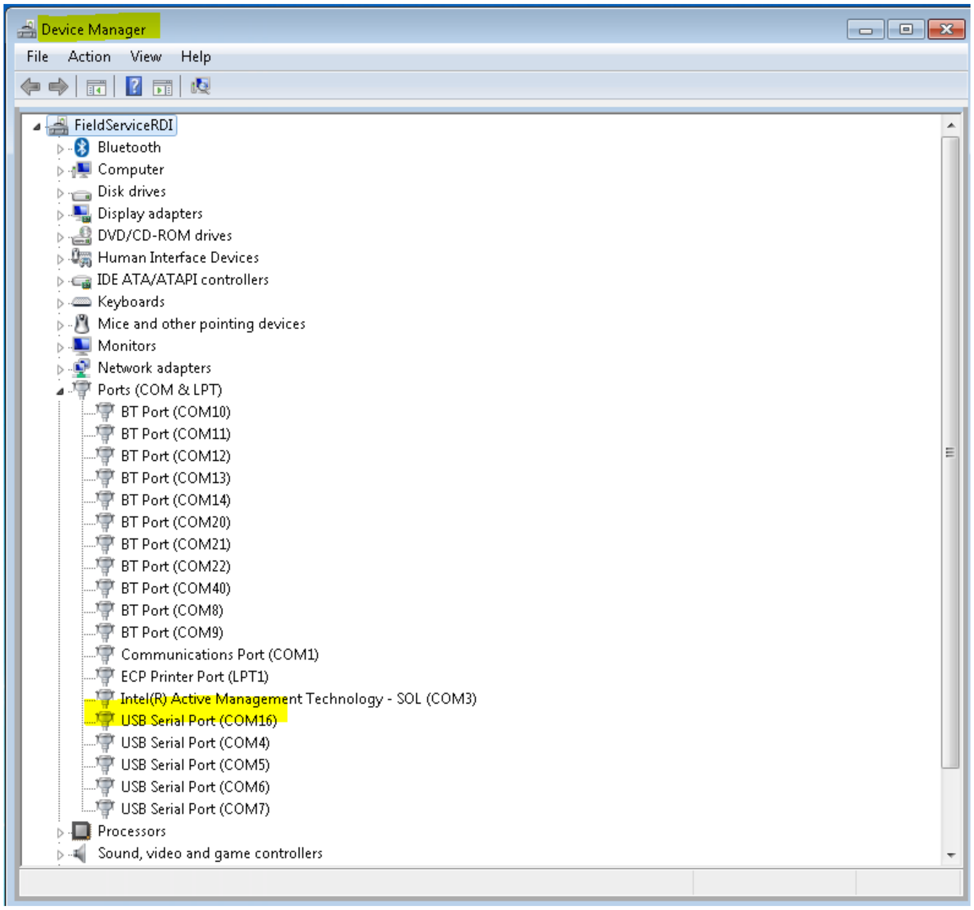
1. Refer to the Sena documentation and the diagram on the device for switch settings or use the table below. The switches are shown with the adapter held in your hand with the USB connector to the left and the antenna to the right. For the DIP switches, ON = Right; OFF = Left. The switches on the dongle determine the baud rate between the dongle and the laptop. It is best to make this the same as the ADCP which should be 115200 for RiverRay, RiverPro, RioPro, and StreamPro ADCPs.

Table 1. SD1000U DIP Switch Setting

Baud Rate	2400		4800		9600		19.2K		38.4K		57.6K		115.2K		S/W	
		ON	OFF			ON	OFF			ON	OFF			ON	OFF	
	OFF			ON		ON		ON	OFF		OFF			ON	OFF	
	OFF		OFF			ON		ON		ON		ON	OFF		OFF	

Hardware Flow Control Handshaking	No Use	Use
	OFF	ON

2. Plug in the SD1000U device to a USB port and use *Windows Device Manager*® to determine the Com port as shown in the snap shot for a Windows 7® laptop. In this case Com 16.

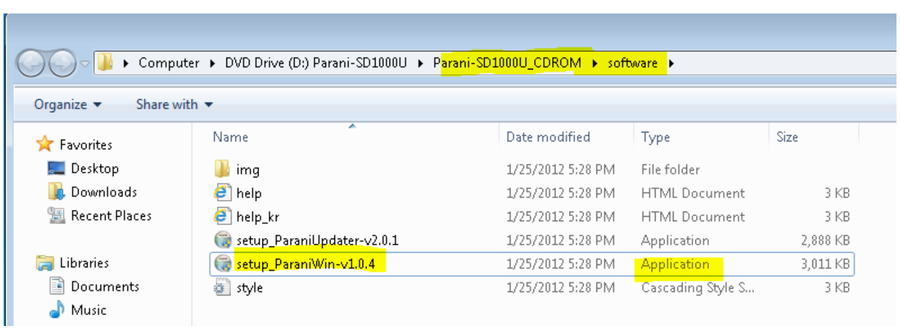


If you have many ports as shown above and are not sure of which port is the Parani one, remove the adapter, wait a moment, note the list of ports, reinsert the adapter and note the new (Parani) port.

ParaniWin Software Configuration

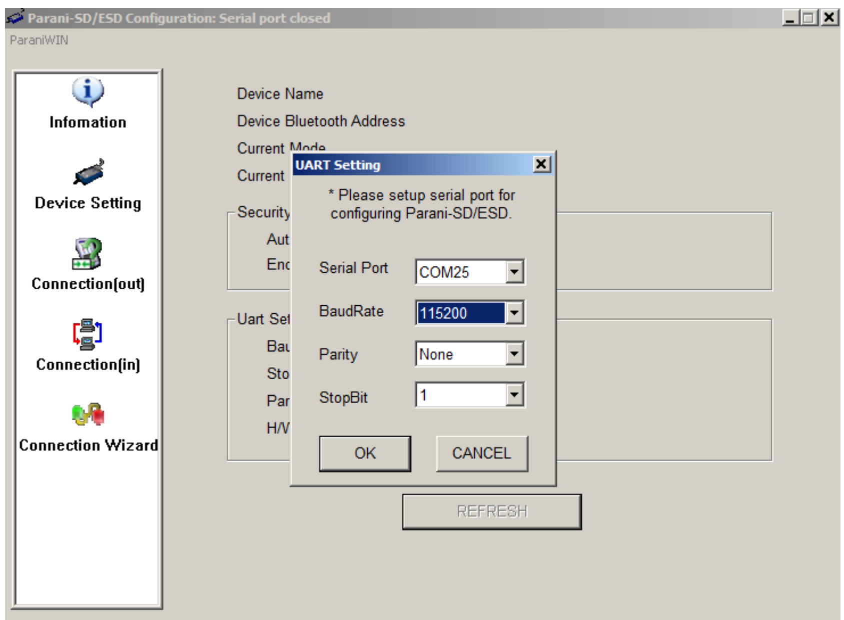
To install and configure *ParaniWin*:

1. Load the *ParaniWin®* software from the CD onto your computer.
2. Double click on **Software**.
3. Double click on *setup_ParaniWin-v1.04.exe*.



4. When the software is installed on your laptop, the desktop icon will look as shown below.

5. Run the *ParaniWin* program. It looks as follows:

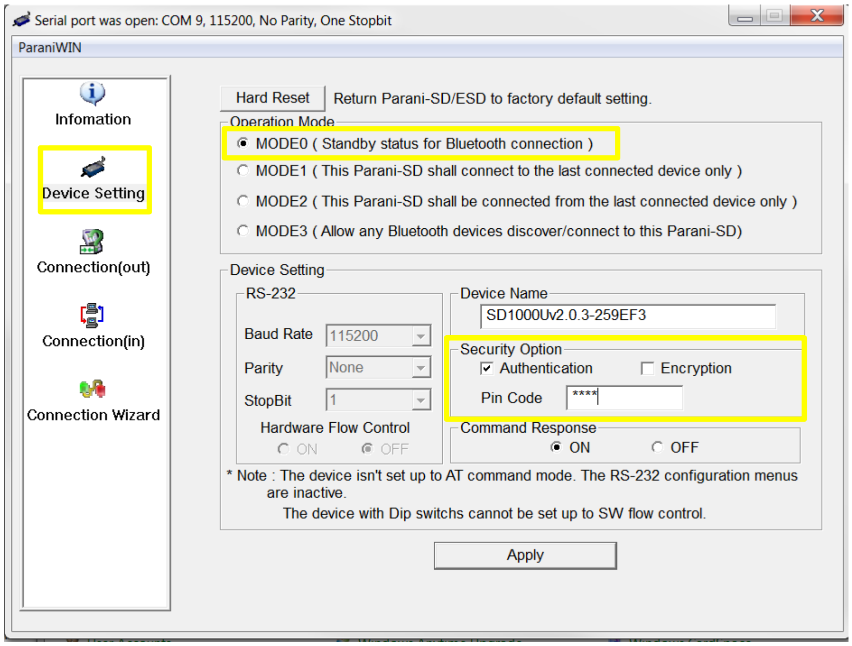


6. Remember the switches on the SD1000U dongle determine the baud rate between the dongle and the laptop. Based on the highlighted switch settings shown in Table 1, the baud rate should be 115200.

7. Enter the COM port identified in step 2 of Com Port Identification.

8. The first time you use the dongle you will need to use Mode 0. With the Bluetooth modules used since August 2017 (or a repaired older unit where the Bluetooth module was replaced) select **Mode 0** and you may or may not need to select **Authentication** (not Encryption). The **Pin Code** is 0000 (four zeros) and click **Apply**.

   Select **Mode 1** if you want the adapter to automatically connect to the last ADCP used each time you plug the adapter into your computer, and automatically reconnect if the connection is lost. You can always drop the existing connection and connect to a different ADCP using the ParaniWin software even when using Mode 1. Chose **Mode 0** if you do not want the adapter to automatically connect and reconnect to an ADCP.



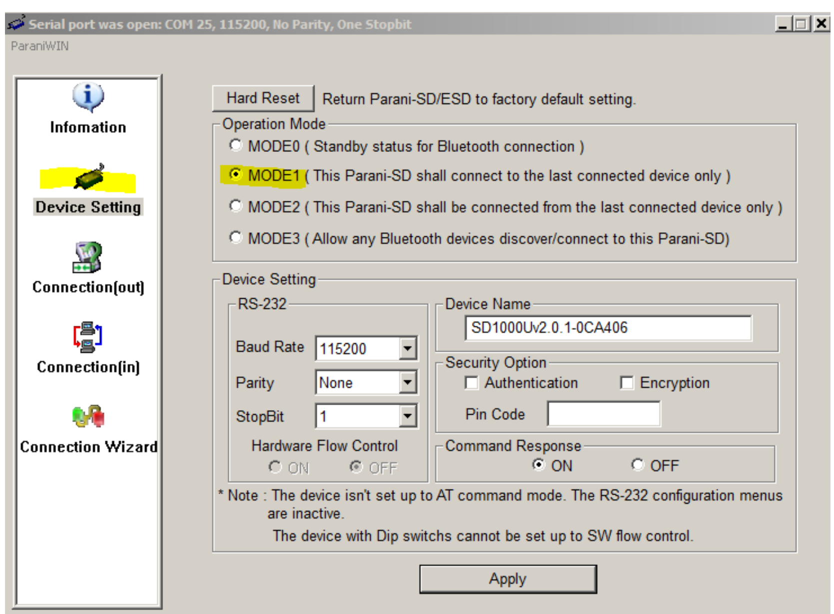
Some Bluetooth devices may ask for a Passkey, PIN code, Pair code, Pairing code, Security code, or Bluetooth code.

In all cases, the code is 0 or 0000 (zero, not the letter o).

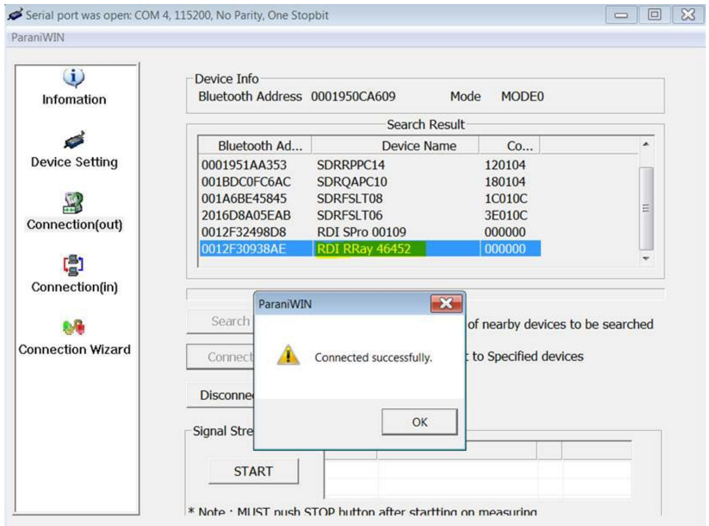
The pin code is 0 for systems shipped prior to August 2017 and 0000 for systems shipped after August 2017. If your system is sent in for repair and the Bluetooth module is replaced, the pin code will change from 0 to 0000.

The selection of Mode 0 or Mode 1 is independent of **Authentication**/no Authentication:

- Mode 1 automatically reconnects to the ADCP but is otherwise identical to Mode 0.
- You must establish an outgoing connection before you can switch to Mode 1, but once in Mode 1 you can connect to a different ADCP without switching back to Mode 0.



9. Click **Apply**. You will receive a Completed Configuration message.
10. Click **Connection (out)**.
11. Click the **Search** button.

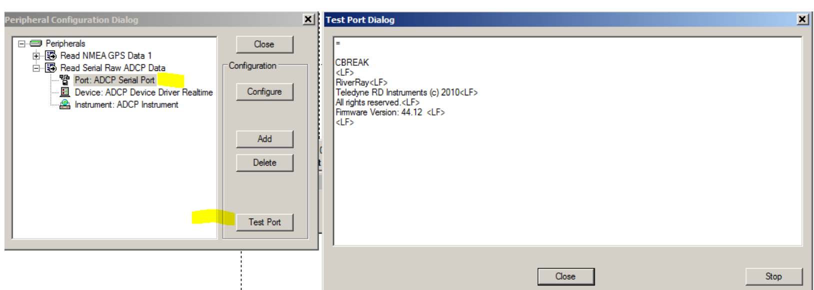


12. This example shows a RiverRay system. Click **Connect**. You will receive a "**Connected successfully**" message.
13. **Exit** the *ParaniWin* program by clicking on the X.

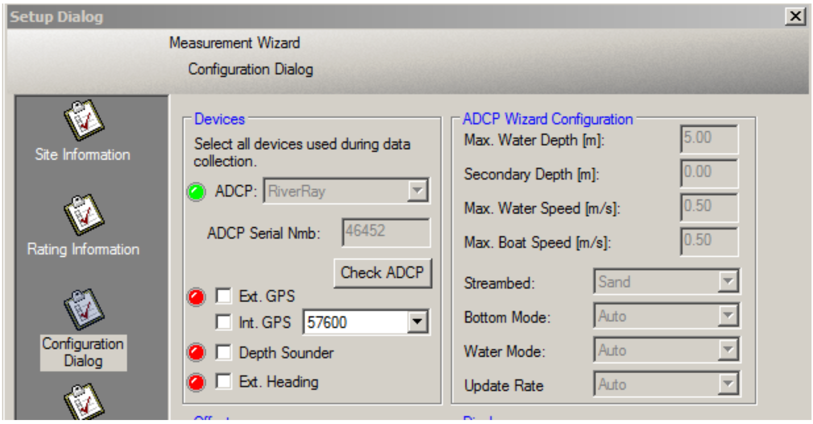
SD1000U Connection to ADCP in WinRiver II

To connect to the ADCP:

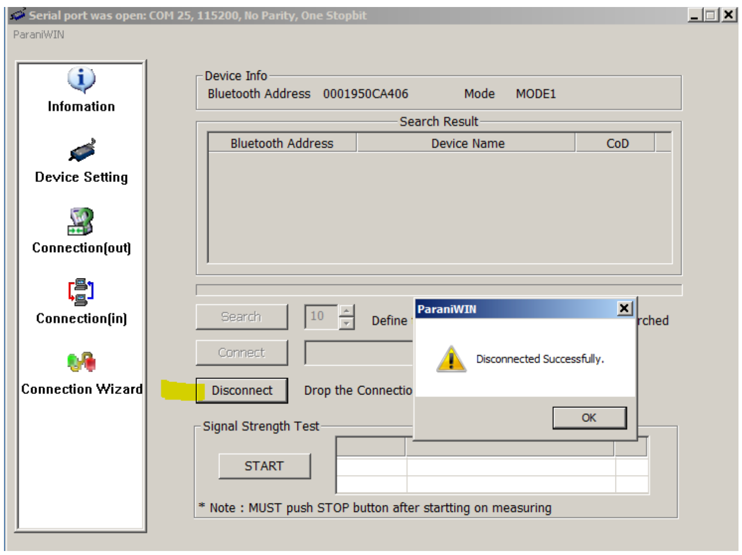
1. Run *WinRiver II*. In *WinRiver II*, on the **Configure** menu, select **Peripherals**. Select **Port: ADCP Serial Port** and then click the **Configure** button. Select the baud rate of the ADCP and click **Test Port**.



2. Click **File**, **New Measurement**. On the **Configuration Dialog**, ensure the **ADCP** type matches your ADCP and the indicator next to the ADCP is green.



3. If you want to connect to a different device, start the *ParaniWin* program and click the **Disconnect** button (first) and then connect to the new device.



GPS Low Latency Setting

If you are using the SD1000U for a StreamPro GPS connection, it is necessary to set the latency to 1 mSec.

1. Disconnect any existing connection (if applicable).
2. Exit the *ParaniWin* program.
3. Use *BBTalk* set it to the appropriate port, baud rate and set ECHO on.
4. Enter AT to get attention. Then enter ATS3=1.
5. This is an example of what you should expect.
6. Refer to the Parani documentation on the CD if necessary.

```
at

OK
ats3=1

OK
ats3?

1

OK
```

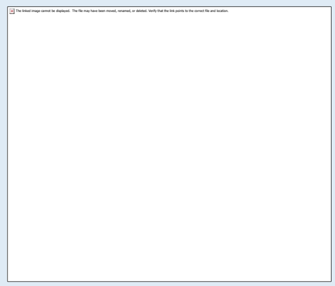
This is the relevant section of the Parani documentation:

B.2. S3: Stream UART Policy (default 0)

S3=0, the priority of UART streaming is throughput.
S3=1, the priority is latency, which minimizes the delay of data transmission. This is useful in case of transmitting very small data quickly.
When this value is 1, in order to minimize latency, Parani-SD sends the received data immediately. When this value is 0, the Parani-SD maximizes throughput, the Parani-SD stores received data for a short time and sends a large data packet. If the packet length is less than 100 bytes, having latency being the priority is recommended. If the packet length is more than 100 bytes, having throughput as the priority is recommended. Also, if you want to use high baud rate, throughput priority will be more effective. Just for reference, the buffer length for receiving data is 2 Kbytes.

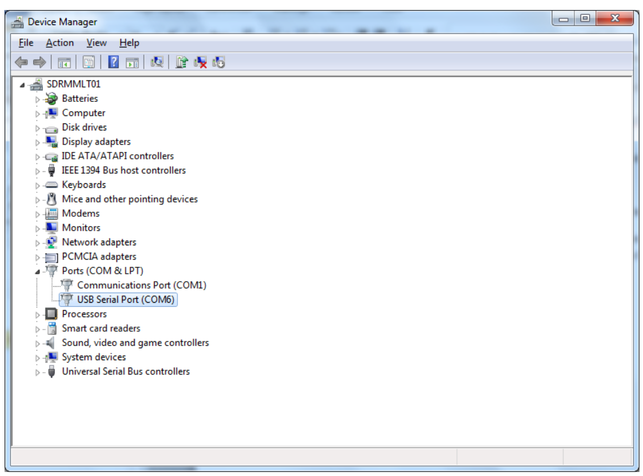
Alternate Procedure for Setting Latency

If you are not using WinRiver II version 2.22 or higher, you may need to run the Computer Management app as an Administrator before changes can be made to the Device Manager.

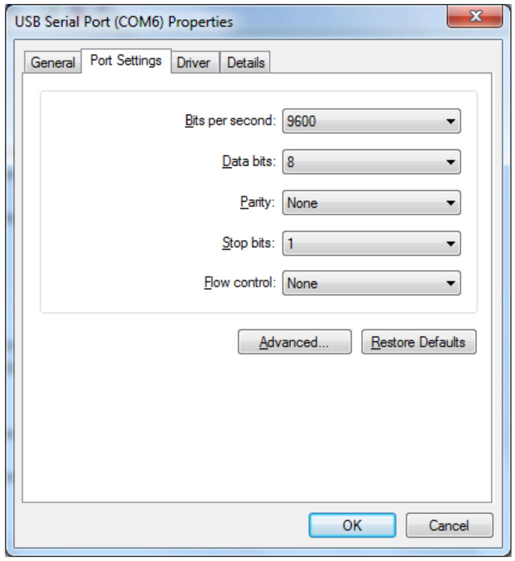


Alternatively, you can set the SD1000U latency setting in the Windows Device Manager as follows:

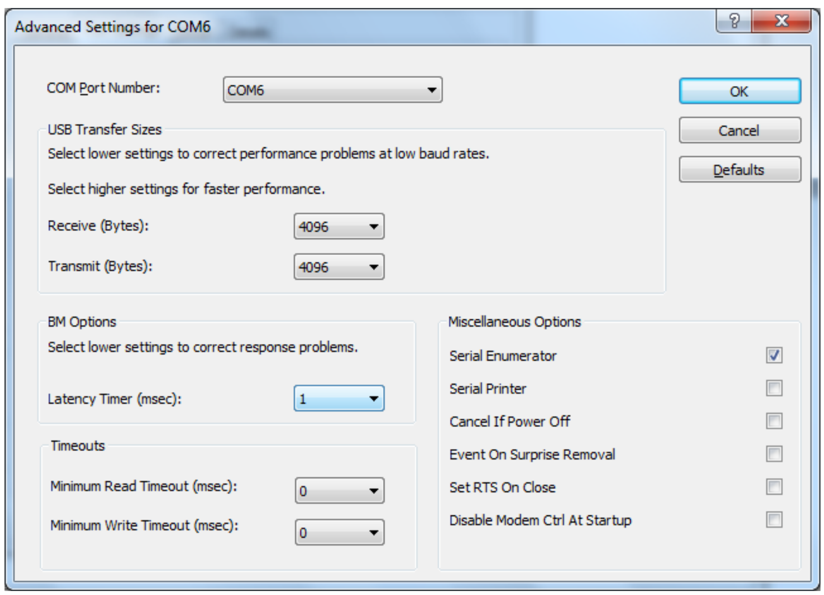
1. Start Device Manager from the control panel. When the Device Manager window opens, expand the **Ports** section and select the entry corresponding to the SD1000U.



2. Right-click the entry corresponding to the SD1000U and select **Properties**. A tabbed dialog box will open. Select the **Port Settings** tab.



3. Click on the **Advanced** button. A new dialog box will open. Set the **Latency Timer** value to the minimum value (1 msec.).



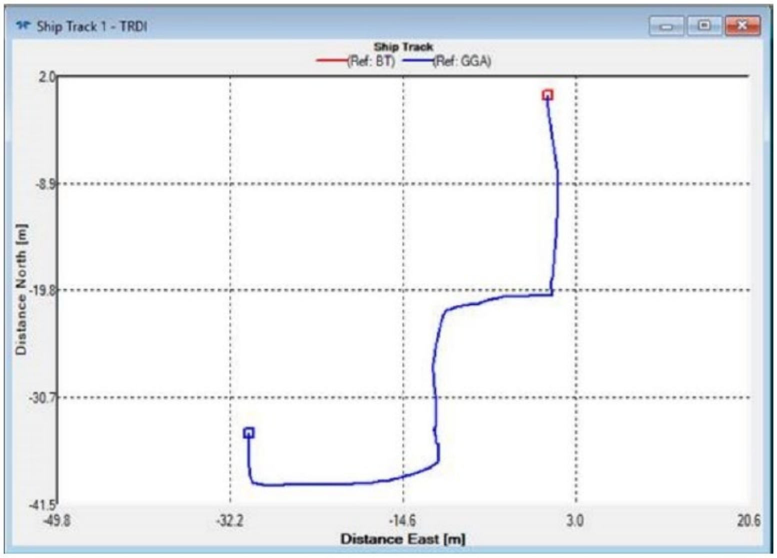
4. Click **Ok** to save the changes to the Advanced Settings dialog, and then **OK** again to close the **...Properties** dialog. Close the Device Manager and Control Panel.

How to Check for Possible GPS Delay

When using a GPS connected directly to your laptop, commonly called external GPS by TRDI, then it is recommended that you check for any possible GPS delay. It is assumed that you have set the latency as described above to 1mS.

To check for any delay, collect ensemble data (ADCP and GPS data) either on a river or more easily on land where you can have everything on a cart and wheel the cart around a parking lot.

As you are collecting the data, observe the GPS ship track. Shown below is an example of collecting data on land where sharp turns were made. Once the actual turn was made, the display showed the turn in the next second or two. This is normal and good. However, when there is delay, the display will not show the turn immediately, rather it will be some number (possibly a large number) of seconds later depending on how bad the latency is or how long the 'transect' is as it will likely get worse over time.



TRDI recommends collecting GPS, GGA, and VTG data at 5Hz and a baud rate setting of 115Kb. However, it has been found that if a ZDA (time message) is configured, it should only be configured for 1Hz. The GGA and VTG can still be 5Hz.

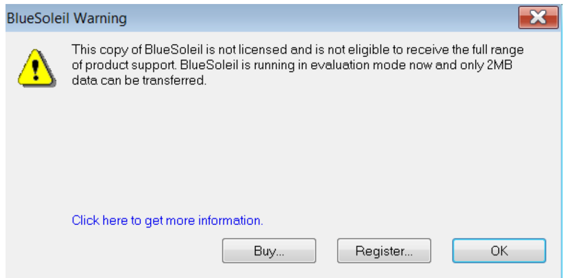
Turning off all other unnecessary messages is recommended.

If you use external heading in addition to GPS and have the GPS and heading data fed directly into *WinRiver II*, TRDI recommends that the maximum rate for GGA, VTG, and HDT should be 2Hz to obtain consistent positioning and heading data. If the GPS and heading data is integrated into the ADCP, a 5 Hz update rate is still recommended.

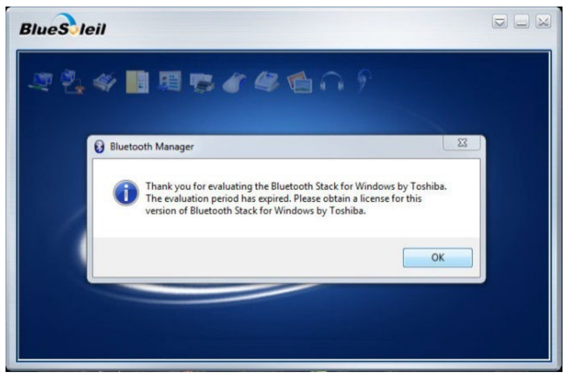
Using Other USB Bluetooth Adapters

The Azio BTD-V201 and Parani UD100 from SENA have been shipped with many RiverRay, RiverPro, and StreamPro ADCPs. The UD100 USB-Bluetooth adapter was previously available with either of two driver/software packages, BlueSoleil or Toshiba, and is serial-number keyed to work only with the appropriate driver package. The Toshiba driver was preferred by TRDI but is no longer available or supported by SENA.

If you have multiple UD100 USB Bluetooth adapters, make sure to use the matching Bluetooth driver. Look on the back of the USB device for the driver name. If an error message appears when using Bluetooth (examples shown below) it may be caused by using the wrong driver.



Example error message when using a UD100 Toshiba USB Bluetooth adapter with the BlueSoleil driver



Example error message when using a UD100 BlueSoleil USB Bluetooth adapter with the Toshiba driver

Installing the Toshiba Bluetooth Driver

Follow these instructions for the Azio BTD-V201 USB Bluetooth device or if the UD100 is compatible with the Toshiba driver.

You must install the Bluetooth software and driver.

1. First uninstall any kind of Bluetooth driver or utility already installed on the computer such as Widcomm BTW or Toshiba drivers, if any.
2. Install the Bluetooth driver.
3. Insert the Bluetooth device into an USB port.

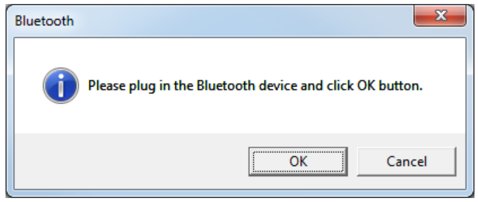
These instructions are included with the USB device.

Do not connect the Bluetooth device into a USB port until the driver is installed.

To install the Bluetooth driver:

1. Uninstall any kind of Bluetooth driver or utility already installed on your computer such as Widcomm BTW or Toshiba, if any (see Uninstalling Bluetooth Drivers).
2. Install the Toshiba Bluetooth driver from the CD included with the Bluetooth device.
3. During installation, **wait until prompted** to plug in the Bluetooth device to a USB port.

4. Click the **OK** button.



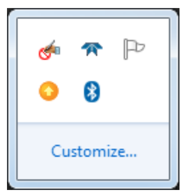
Restart the computer once the driver installation is finished.

The Bluetooth icon can be hidden or displayed using the Bluetooth driver/adapter settings. To restore hidden Bluetooth icons, from the Start menu select **All Programs**, **Toshiba**, **Bluetooth**, **Bluetooth Assistant**. Click the **Settings** button. Select the **General** tab, then choose the desired tray icon, and click the **OK** button.

Adding a Bluetooth Device

To add a Bluetooth RiverRay or StreamPro ADCP:

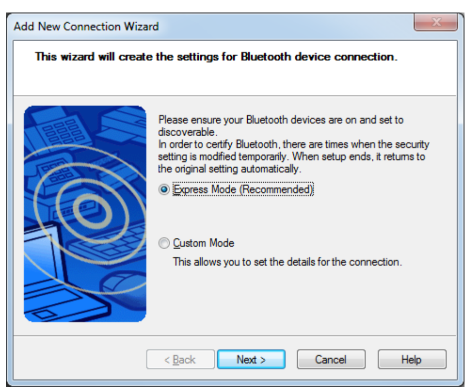
1. Start the Bluetooth Settings by double-clicking on the Bluetooth icon in the icons tray or click **Start**, **All Programs**, **TOSHIBA**, **Bluetooth**, **Bluetooth Settings**.



2. Turn on the power to the RiverRay, RiverPro/RioPro, or StreamPro ADCP.
3. If you don't have any Bluetooth connections, then the Wizard will start.

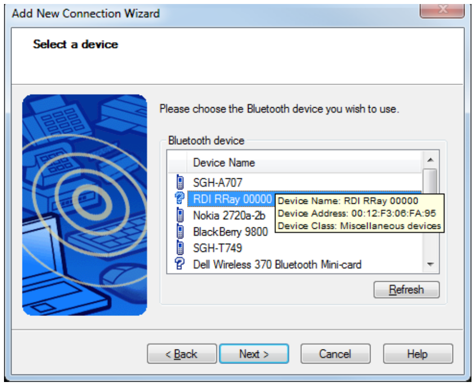
If you have already added a connection, skip to Bluetooth Settings.

4. Select **Express Mode (Recommended)**.



5. Click **Next**.
6. The Bluetooth device should locate the RiverRay, RiverPro/RioPro, or StreamPro ADCP (**RDI RRay 00xxx**, **RDI RPro 00xxx**, or **RDI SP 00xxx** where xxx is the serial number).

7. Click to select the **RDI RRay 00xxx** and click **Next**.



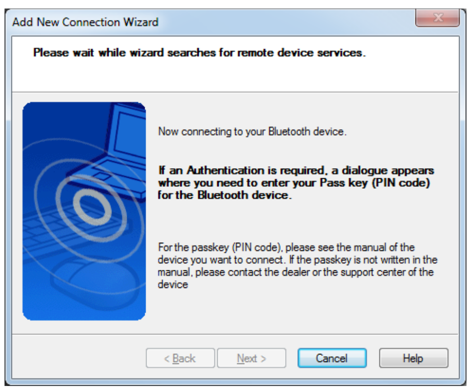
Use the **Refresh** button if the RiverRay, RiverPro/RioPro, or StreamPro ADCP was not on the list. Make sure the ADCP's power is on.

8. Wait for the Bluetooth to connect to the ADCP.

Some Bluetooth devices may ask for a Passkey, PIN code, Pair code, Pairing code, Security code, or Bluetooth code.

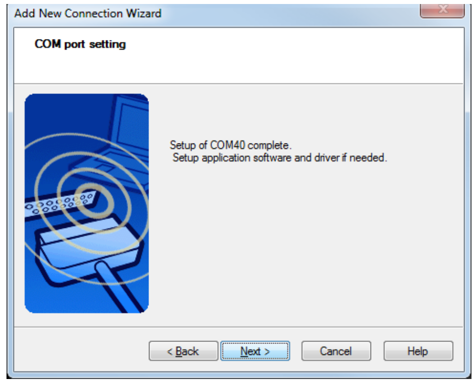
In all cases, the code is 0 or 0000 (zero, not the letter o).

The pin code is 0 for systems shipped prior to August 2017 and 0000 for systems shipped after August 2017. If your system is sent in for repair and the Bluetooth module is replaced, the pin code will change from 0 to 0000.



9. Make note of the **Com Port** number it is using. On this example, the RiverRay is connected to Com Port 40.

The LED will be blue once the Bluetooth connection is established and a break (===) has been sent to the RiverRay.



Installing the BlueSoleil Bluetooth Driver

Follow these instructions if the UD100 is compatible with the BlueSoleil driver.

You must install the Bluetooth software and driver.

1. First uninstall any kind of Bluetooth driver or utility already installed on your computer such as Widcomm BTW or Toshiba drivers, if any.
2. Install the Bluetooth driver.
3. Insert the UD100 into an USB port.

These instructions are included with the Parani-UD100.

Do not connect the Parani-UD100 Bluetooth device into a USB port until the driver is installed.

To install the Bluetooth driver:

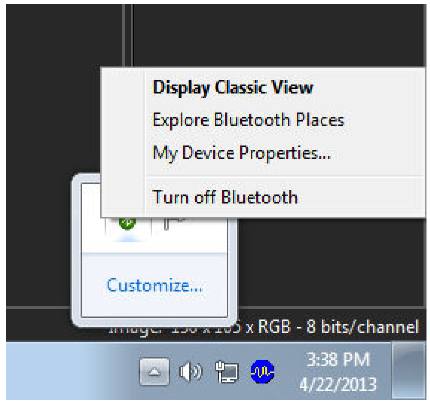
1. Uninstall any kind of Bluetooth driver or utility already installed on the computer such as Widcomm BTW or Toshiba, if any (see Uninstalling Bluetooth Drivers).
2. Install the BlueSoleil Bluetooth driver included on the UD100 CD.
3. Restart the computer once the driver installation is finished.
4. Insert the UD100 Bluetooth device into a USB port.

The notification area icon changes from grey/white when the Bluetooth adapter is removed, disabled, or off to blue/white when inserted, enabled, or on to green/white when actually connected.

The Bluetooth icon can be hidden or displayed using the Bluetooth driver/adapter settings. To restore hidden Bluetooth icons, open **Bluetooth Places** (start menu) or **BlueSoleil Space** (desktop), then right-click on **My Device**. Select **Properties** and click on the **Accessibility** tab. Check the box for **Show the Bluetooth icon in the notification area**.

Adding a Bluetooth Device

The BlueSoleil Bluetooth driver can be used with either its default Display Classic View or by using the Explore Bluetooth Places view. The general procedure for adding a new Bluetooth device is similar in both views but the screen displays are quite different. The user can set their preferred view as the default by clicking on the Bluetooth icon and selecting the **My Device Properties…** option from the available choices. Double-clicking the Bluetooth icon will bring up the user's preferred display. Either display can be selected by clicking on the Bluetooth icon and selecting the preferred option from the available choices.

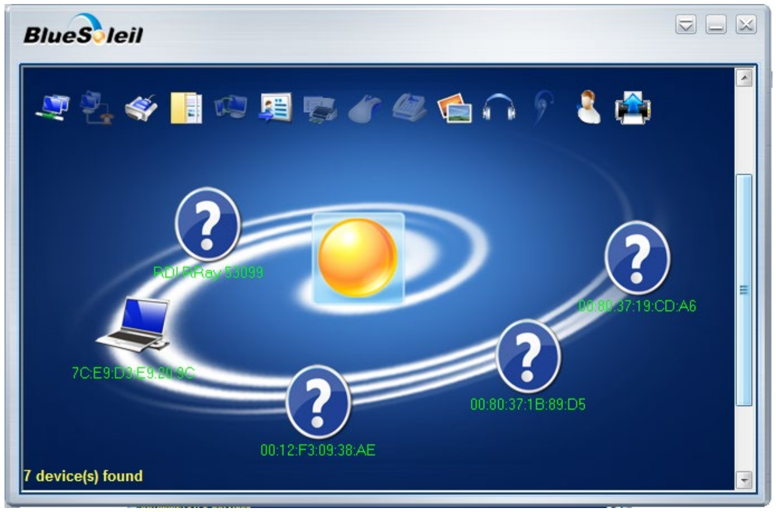


Classic View

To add a Bluetooth RiverRay or StreamPro ADCP:

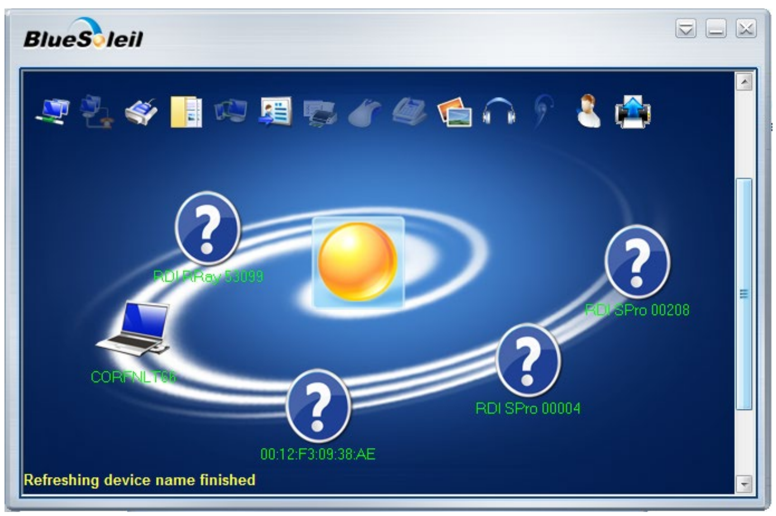
1. Click on the Bluetooth icon and select **Display Classic View** from the available options or double-click on the **BlueSoeil Space** desktop icon.

2. Double-click on the yellow icon ( ) in the center of the display to search for available Bluetooth devices to add. New devices found will initially be shown with only a question mark icon and a device hardware address. The total number of devices found (existing plus new) will be shown in the lower left corner of the display. Move the scroll bar up and down to view all devices.



Use the scroll bar to see all the devices.

3. After the driver finishes the search for new devices it will update the device names as shown. Double-clicking on an entry <u>may</u> accelerate this process, causing it to search for the name and available services for that device.



4. Double-click on the device (or right-click the device and select **Search Services** from the available choices).

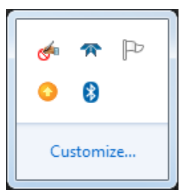
5. When the service search process is complete, right-click on the device again and select **Connect Bluetooth Serial Port** from the available options. When the Bluetooth connection is established, the device icon background will change from blue to green, with a dotted line between the yellow circle icon and the device.

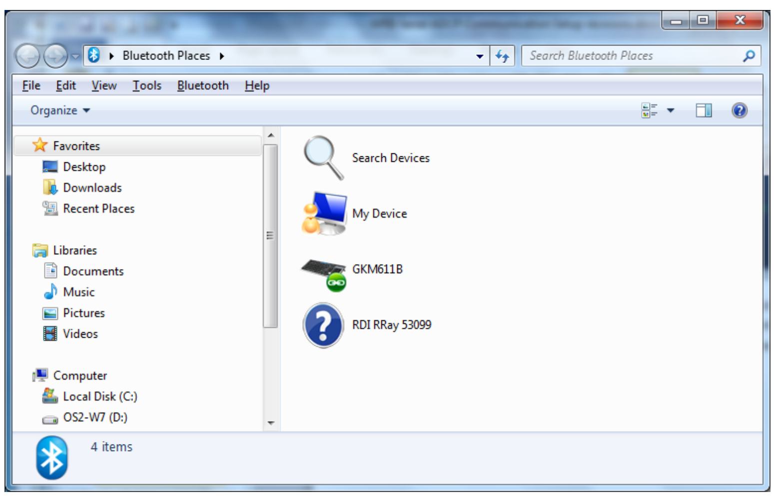
6. Right-click the device icon one more time to note the COM port number assigned. Once the COM port is assigned, it will remain fixed for that device and right-clicking the device will always display the port assignment until the device is deleted.
7. To disconnect from the device, right-click the device icon and select **Disconnect Bluetooth Serial Port (COMx)**.

Explore Bluetooth Places View

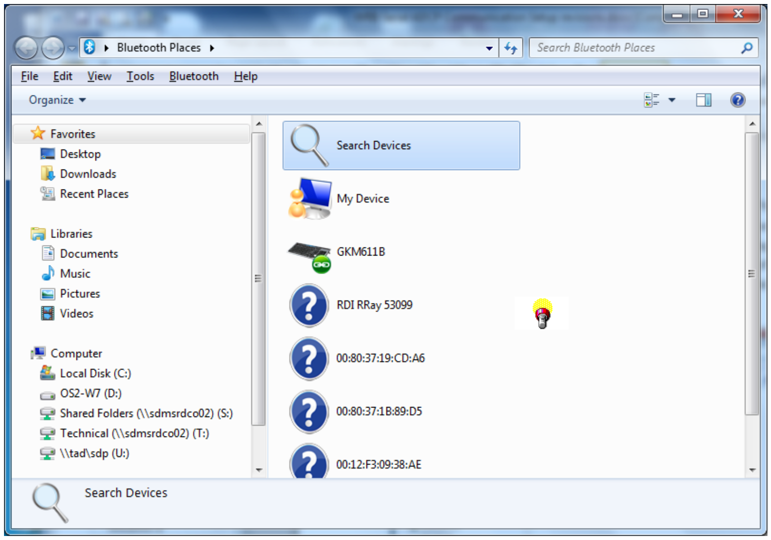
To add a Bluetooth RiverRay or StreamPro ADCP:

1. Click on the Bluetooth icon and select **Explore Bluetooth Places**. A standard Windows Explorer window will open (the new window may appear grouped with other windows of that type, depending on the current Windows configuration). If necessary, use the scroll bar to see all existing devices.

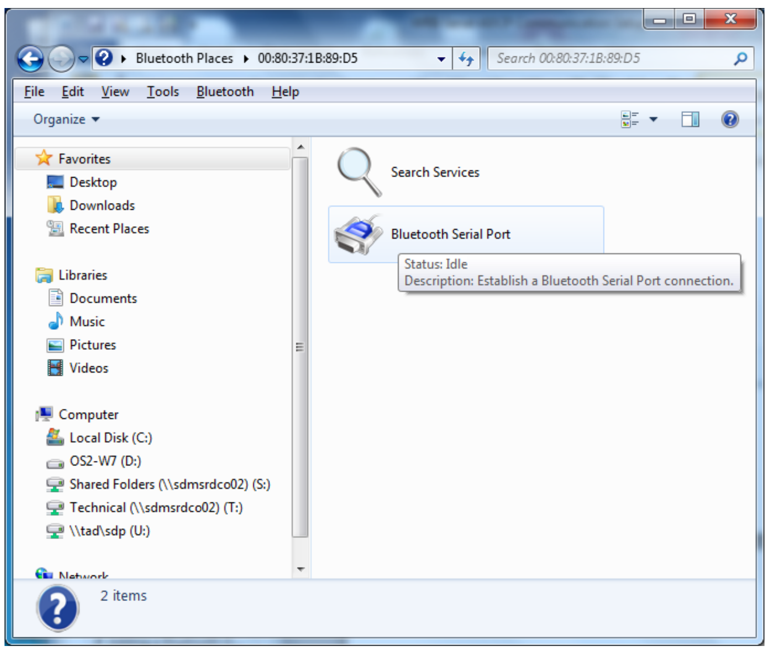




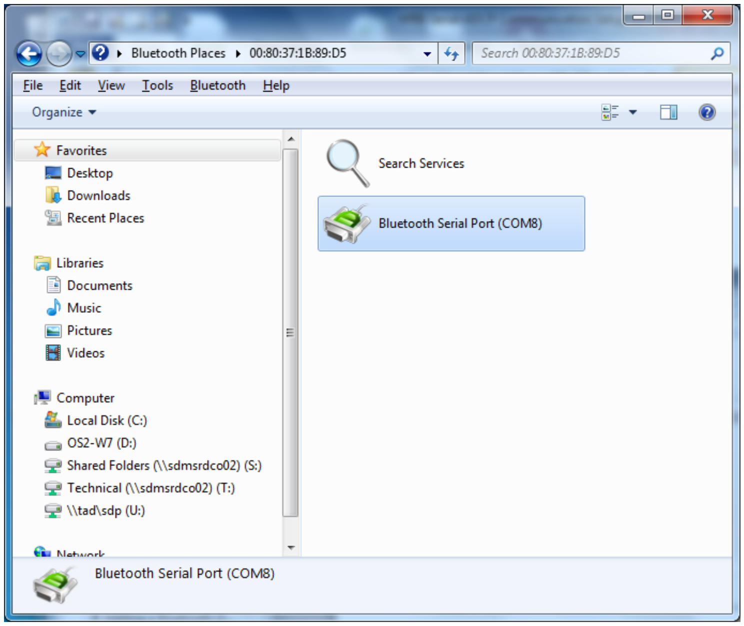
2. Double-click on the **Search Devices** icon to search for available Bluetooth devices to add. New devices found will be shown with only a question mark icon and a device hardware address. Move the scroll bar up and down to view all devices.



3. Right-click on a device and select **Properties** from the available options to see the device name. Double-click on the desired device to search for services available on the device (or right-click on the desired device and select **Open**).



4. Double-click on **Bluetooth Serial Port** (or right-click and select **Connect**) to add the device and establish a Bluetooth connection to it. The icon color will change from blue to green and the COM port assigned will be shown in the window.



Once the COM port is assigned, it will remain fixed for that device until the device is deleted.

Once a device has been added, right-clicking on the device in the **Bluetooth Places** window will allow you to review the assigned COM port number and connect/disconnect as desired.

5. If desired, right-click **Bluetooth Serial Port (COMxx)** again to disconnect, or use the **Back** arrow to return to the list of available devices and create another connection.

Using Microsoft Bluetooth Drivers

The Bluetooth module used in RiverPro/RiverRay/RioPro built after August 2017 supports the Bluetooth 2.1 Enhanced Data Rate (EDR) and the Secure Simple Pairing (SSP) protocols.

The Bluetooth module used in RiverPro/RiverRay/RioPro built between September 2015 and August 2017 supports the Secure Simple Pairing (SSP) protocol required by the Bluetooth 2.1 standard while prior systems supported only the 2.0 standard. With SSP enabled, the Microsoft Bluetooth stack will connect and pair without the need for a pair code, and will work with simple applications like *BBTalk*, and the *SxS Pro* and *WinRiver II* **Test Port** functionality. However, other Bluetooth communication functionality will not work.

You **MUST** use the USB Bluetooth device with the driver supplied with the device for SxSPro and WinRiver II for RiverPro/RiverRay/RioPro systems built between September 2015 and August 2017.

Microsoft Windows®, beginning with Windows XP Service Pack 2, includes drivers and management software for many Bluetooth adapters and devices. The use of the Microsoft Bluetooth driver versus the Toshiba or BlueSoleil driver and software is a matter of personal preference. In general, TRDI finds the BlueSoleil and particularly the Toshiba drivers easier to use. You must enter the pairing code when using the Microsoft drivers and you cannot force a reconnection of the link between the computer and Bluetooth device when using the Microsoft drivers the way you can when using the Toshiba and BlueSoleil drivers.

Some Bluetooth devices may ask for a Passkey, PIN code, Pair code, Pairing code, Security code, or Bluetooth code.

In all cases, the code is 0 or 0000 (zero, not the letter o).

The pin code is 0 for systems shipped prior to August 2017 and 0000 for systems shipped after August 2017. If your system is sent in for repair and the Bluetooth module is replaced, the pin code will change from 0 to 0000.

Some laptops and tablet computers have a built-in Bluetooth adapter which uses the Microsoft drivers, and some USB Bluetooth adapters including the Parani UD100 from SENA can also use the Microsoft Bluetooth drivers.

Built-in Bluetooth adapters may not provide as much range as USB Bluetooth adapters, cannot be located remotely from the computer using a USB extension cable (e.g. at a higher elevation for better range), and typically cannot be fitted with an external high-gain antenna.

Most laptops and tablet computers with built-in Bluetooth adapters provide some mechanism for enabling/disabling or turning the Bluetooth adapter on and off for power savings. This may be a physical switch, a keystroke combination, a BIOS setting, or a software function. Refer to your laptop or tablet documentation for instructions. Typically, USB Bluetooth adapters are simply removed to save power when not needed.

Installing the Microsoft Bluetooth Driver

To install a Microsoft Bluetooth driver, first uninstall all other Bluetooth drivers from the system, and then turn on or insert the Bluetooth adapter into the USB port. Windows should automatically detect the Bluetooth adapter and install drivers for it. You may need an internet connection during this process if Windows needs to download the drivers. When the driver installation is complete, a Bluetooth icon should appear in the notification area of the taskbar.

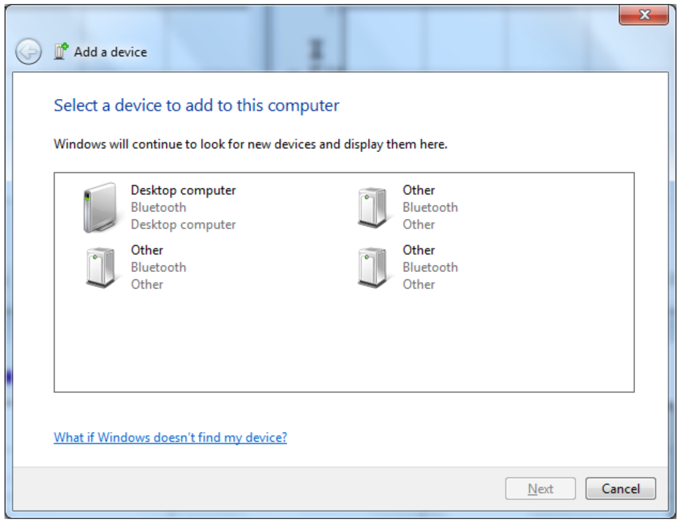
The Bluetooth icon will disappear if the Bluetooth adapter is disabled or removed.

A Bluetooth adapter inserted into a different USB port may be treated as a new adapter, resulting in changed COM port assignments or the need to re-add Bluetooth devices.

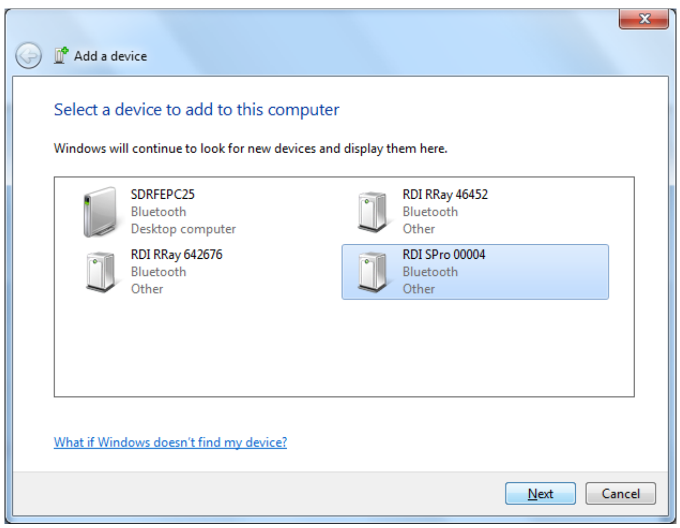
Adding a Bluetooth Device

To create a new Bluetooth connection to an ADCP:

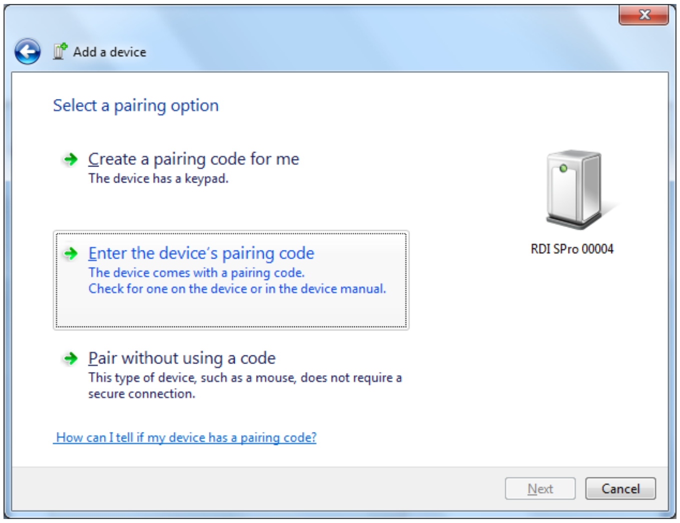
1. Click on the Bluetooth icon in the notification area of the taskbar and select **Add a device** from the list of available options. The following dialog will appear, with each available Bluetooth device appearing as it is detected. Devices for which connections already exist will not be shown.



2. When Windows finishes detecting new devices, it will update the device names as shown. You can accelerate that process by right-clicking on the device and selecting **Properties**, then cancelling the resulting dialog box when the Bluetooth services list appears.

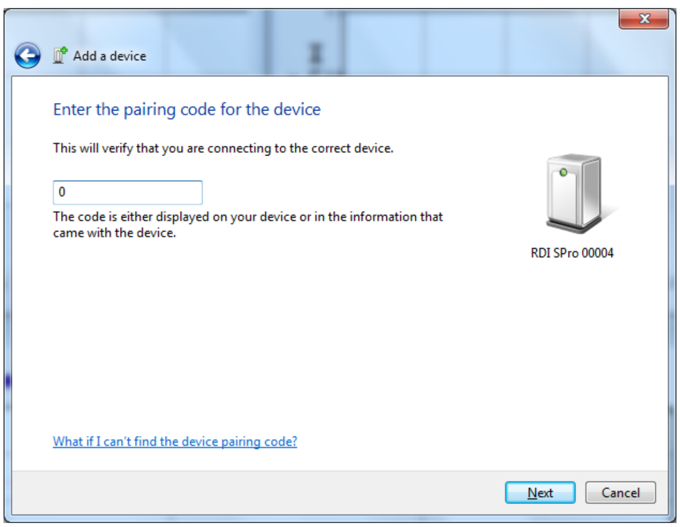


3. When the ADCP appears in the device list, select it and click **Next** to create the connection (you can also right-click and select **Add device…**). A pairing option dialog should appear.
4. Select **Enter the device's pairing code** from the list of available options.

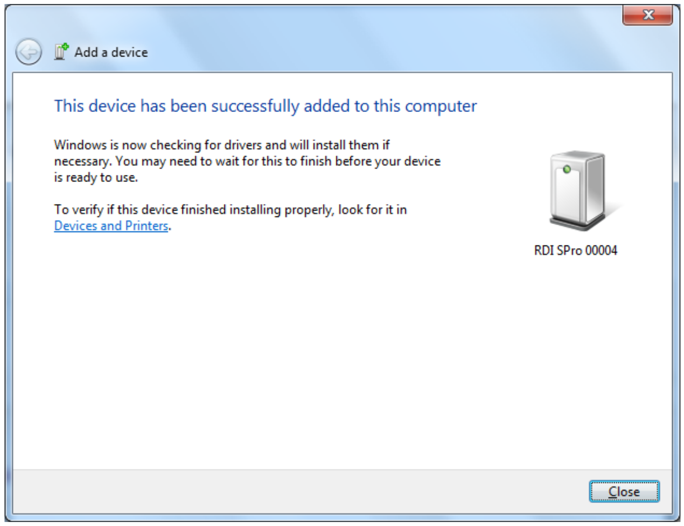


You must make the selection and enter the pairing code quickly, or the add device process will time out. If it does, simply click on the back arrow in the dialog and restart the **Add Device** process.

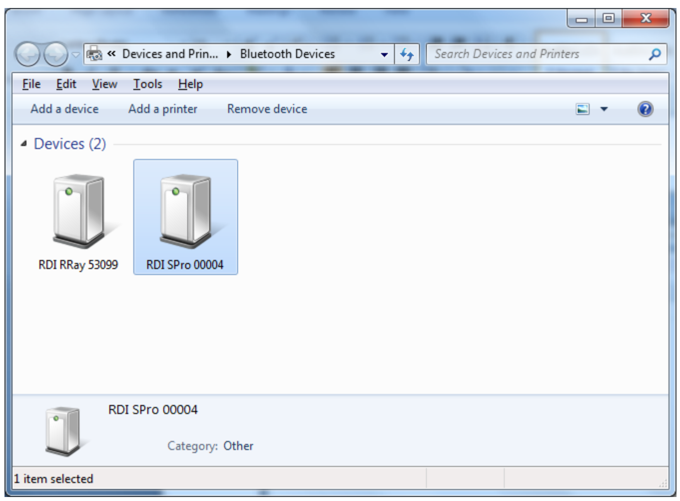
5. Enter the pairing code (always a single zero, not the letter 'o'), and click next:



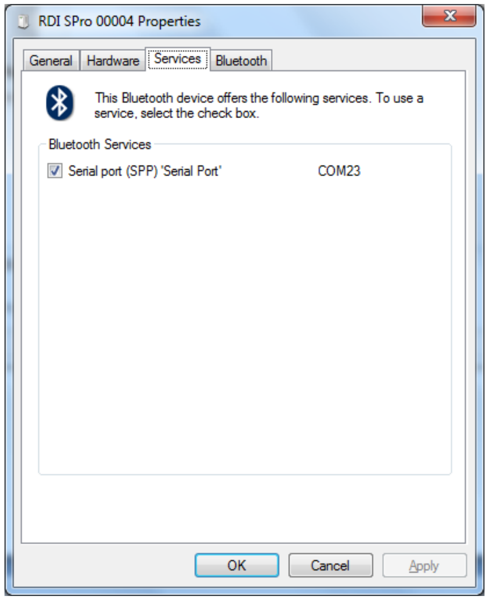
6. Windows will then create the connection and install any additional drivers required. Click **Close**.



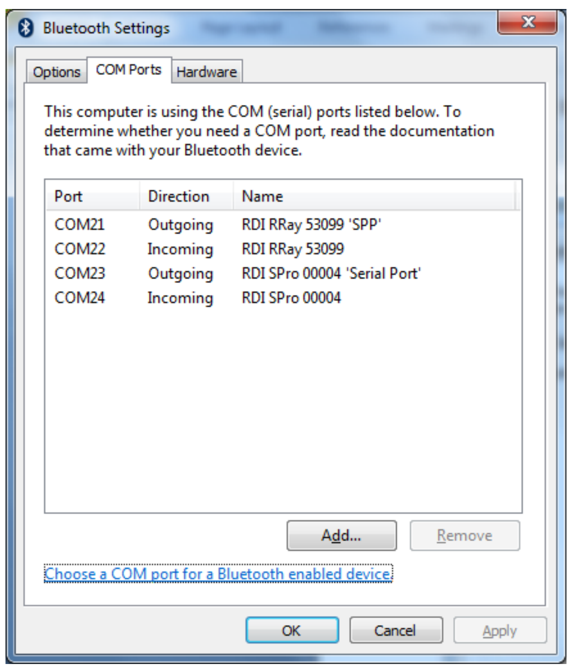
7. To ensure the connection was created and all drivers successfully installed, click again on the Bluetooth icon in the notification area of the taskbar and select **Show Bluetooth Devices** from the available options. The following dialog box will appear with all available devices listed.



8. Right-click on the icon for the device and select **Properties** from the list of available options. A tabbed dialog box will appear.
9. Select the **Services** tab, verify that the **Serial port (SPP)** service is checked, and note the number of the communications port assigned.



10. To see a list of all assigned communication ports, click on the Bluetooth icon in the notification area and select **Open Settings** from the list of available options. A tabbed dialog box will appear. Select the **COM Ports** tab to view the list of assigned ports. Note that the Microsoft Bluetooth driver will assign both an Incoming and an Outgoing COM port to each Bluetooth device. *WinRiver II* always uses the Outgoing COM port.



WinRiver II always uses the Outgoing COM port.

Using Bluetooth with Windows 8 and 10

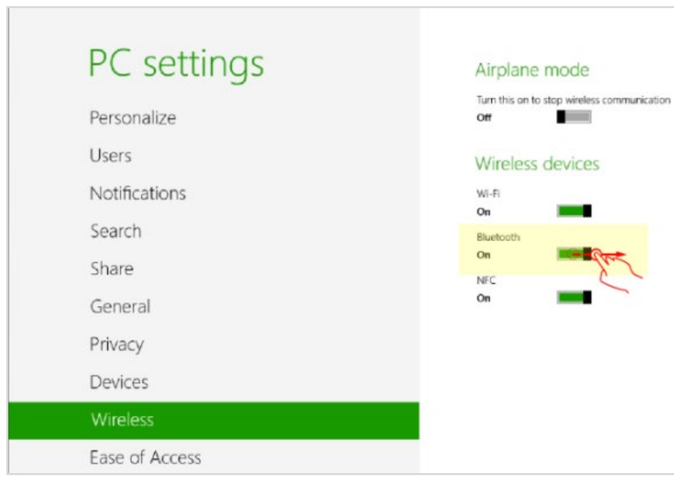
The Bluetooth module used in RiverPro/RiverRay/RioPro built after August 2017 supports the Bluetooth 2.1 Enhanced Data Rate (EDR) and the Secure Simple Pairing (SSP) protocols.

The Bluetooth module used in RiverPro/RiverRay/RioPro built between September 2015 and August 2017 supports the Secure Simple Pairing (SSP) protocol required by the Bluetooth 2.1 standard while prior systems supported only the 2.0 standard. With SSP enabled, the Microsoft Bluetooth stack will connect and pair without the need for a pair code, and will work with simple applications like *BBTalk*, and the *SxS Pro* and *WinRiver II* **Test Port** functionality. However, other Bluetooth communication functionality will not work.

You **MUST** use the USB Bluetooth device with the driver supplied with the device for SxSPro and WinRiver II for RiverPro/RiverRay/RioPro systems built between September 2015 and August 2017.

To turn Bluetooth on:

1. Swipe the right side of the display.
2. On the Charms menu, select **Settings**.
3. Tap **Change PC Settings**.
4. Tap **Wireless**.
5. Move the Bluetooth slider to **On**.



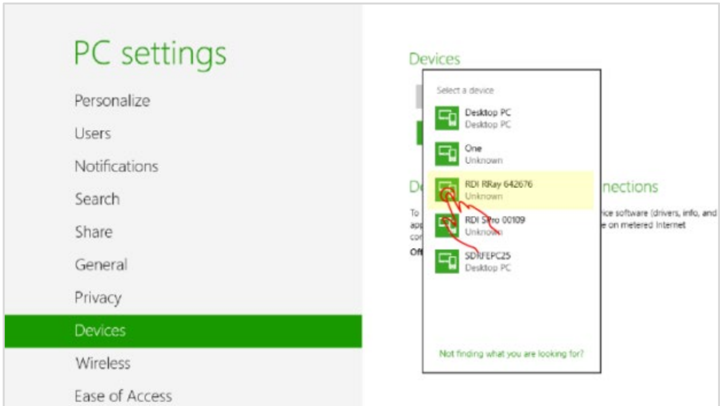
To add a StreamPro, RiverPro/RioPro, or RiverRay ADCP:

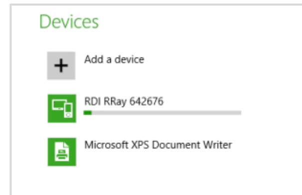
1. Connect and power up the ADCP as shown in the appropriate ADCP Operation Manual.
2. Swipe the right side of the tablet's display.
3. On the Charms menu, select **Settings**.
4. Tap **Change PC Settings**.
5. Tap **Devices**.
6. Tap the RiverRay, RiverPro/RioPro, or StreamPro ADCP icon (**RDI RRay 00xxx**, **RDI RPro 00xxx**, or **RDI SP 00xxx** where xxx is the serial number).

Some Bluetooth devices may ask for a Passkey, PIN code, Pair code, Pairing code, Security code, or Bluetooth code.

In all cases, the code is 0 or 0000 (zero, not the letter o).

The pin code is 0 for systems shipped prior to August 2017 and 0000 for systems shipped after August 2017. If your system is sent in for repair and the Bluetooth module is replaced, the pin code will change from 0 to 0000.

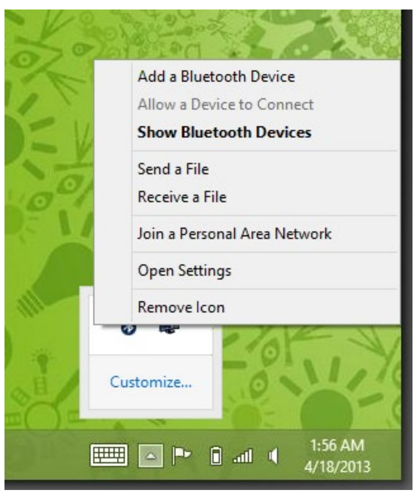


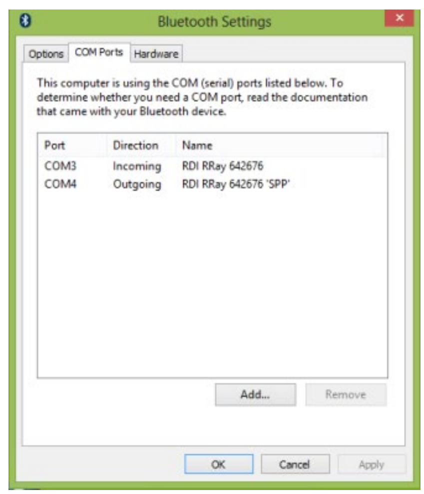


7. Be patient while the connection is established.

To verify what communication port the ADCP is using:

1. Switch to the Classic desktop.
2. Tap the ▲ icon in the lower right corner of the desktop.
3. Tap the Bluetooth icon. Select **Open Setting**.
4. Tap the **COM Ports** tab. Note what **Outgoing COM port** is used. In this example, COM4 is being used.
5. Tap **OK** to close the screen.





The Bluetooth icon will only be displayed in the Classic desktop, not the Windows 8 Start Page.

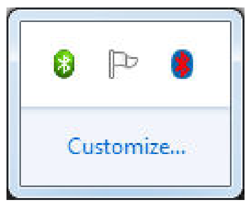
Troubleshooting Bluetooth Connections

Enable Bluetooth

Make sure Bluetooth is enabled. The computer may have a switch, a key function, or other way of turning on Bluetooth. Contact your IT department or the computer's manufacture if you are unsure how to do this.

Uninstalling old Bluetooth Drivers

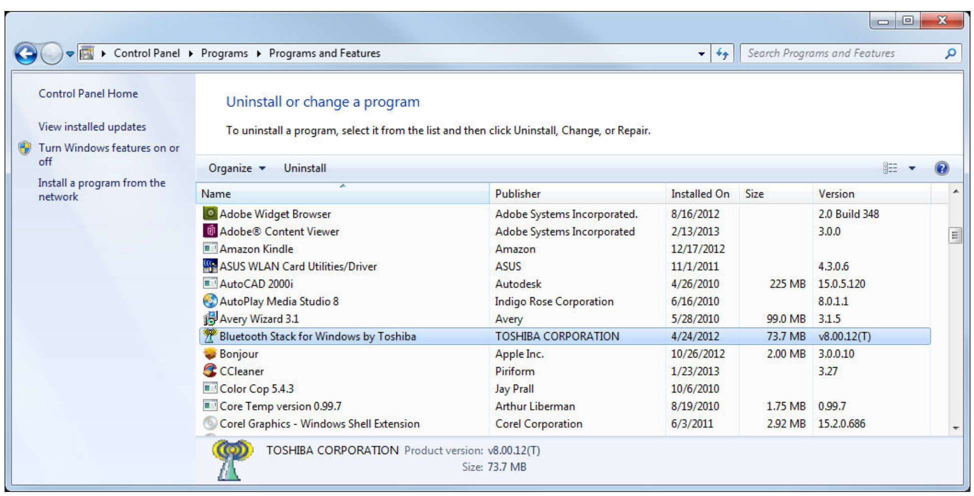
If there are multiple Bluetooth icons in the system tray, this could indicate there are multiple Bluetooth drivers installed. Use the Windows Control Panel **Add/Remove programs** and search for Bluetooth drivers. It is recommended to only have one driver installed. For example, to uninstall the Toshiba driver, search for *Bluetooth Stack for Windows by Toshiba*. To uninstall the BlueSoleil driver, search for *BlueSoleil 5.4.3143* (or other versions).



Multiple icons in the system tray when both the Toshiba and BlueSoleil drivers are installed.

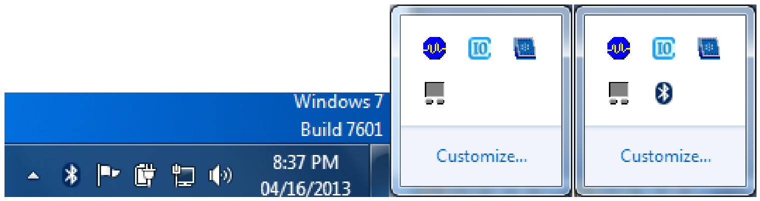
For reference, the Toshiba icon has a medium/light blue background and a red or green Bluetooth symbol. The BlueSoleil icon has a green background with a white Bluetooth symbol. The Microsoft icon has a dark blue background with a white Bluetooth symbol.

It is not recommended to have multiple Bluetooth drivers installed.

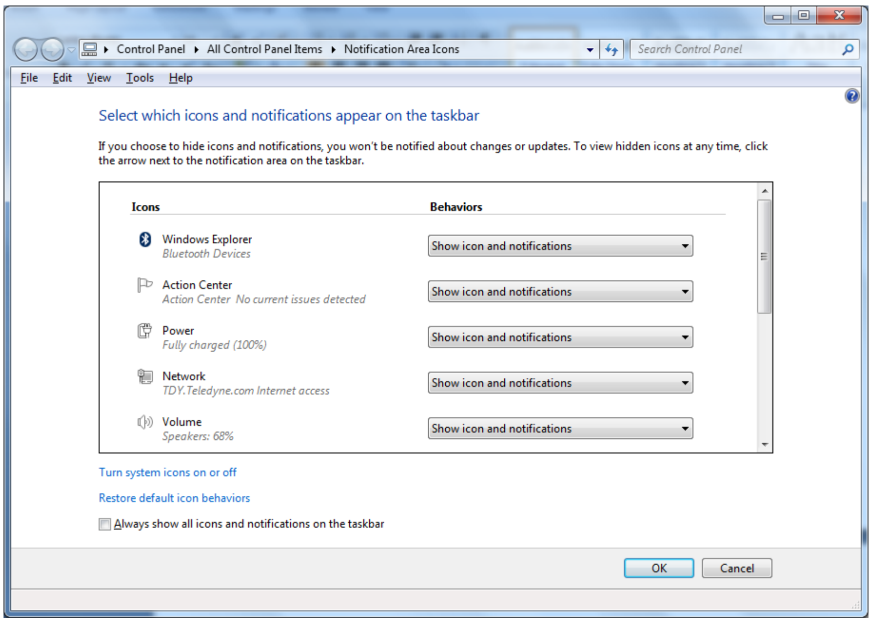


Troubleshooting Bluetooth Icons

Click on the ▲ **show hidden icons** icon in the system tray to see the Bluetooth icon if it is not already visible in the taskbar.



To make icons visible at all times, click on **Customize**, then select the checkbox for **Always show all icons and notifications on the taskbar**. To force the Bluetooth icon to always appear on the taskbar, set it's icon behavior to **Show icon and notifications** as shown below.

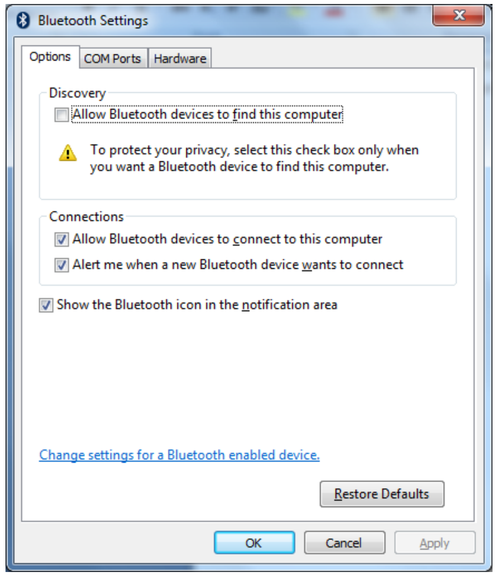


Restoring Missing Bluetooth Icons

If the Bluetooth adapter is on/enabled/inserted and the Bluetooth icon does not appear on the taskbar or in the group of hidden icons:

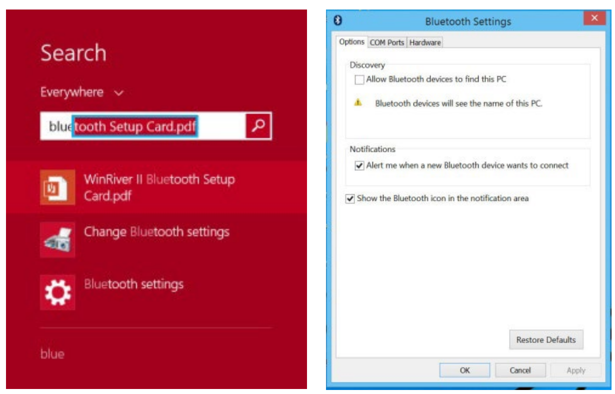
Using the Microsoft Bluetooth Driver (Windows 7):

1. Search for **Bluetooth Settings** in the **Start** menu or in **Control Panel**.
2. Select **Change Bluetooth Settings** from the search results - a tabbed Bluetooth Settings dialog box should appear.
3. Select the **Options** tab and ensure that the **Show the Bluetooth icon in the notification area** box is checked.
4. If the **Change Bluetooth Settings** choice does not appear during search, the Microsoft Bluetooth driver may-not be properly installed or the adapter is not on/enabled/inserted, or is not working properly.



Windows 8:

1. Swipe the right side of the display.
2. On the Charms menu, tap **Search**. In the search box, type **blue**.
3. Tap **Change Bluetooth settings**.
4. On the **Options** tab, select **Show the Bluetooth icon in the notification area**. Tap **OK**.

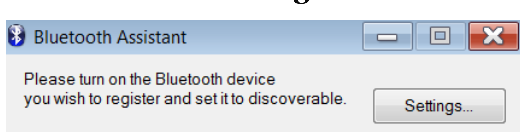


Using the BlueSoleil Driver:

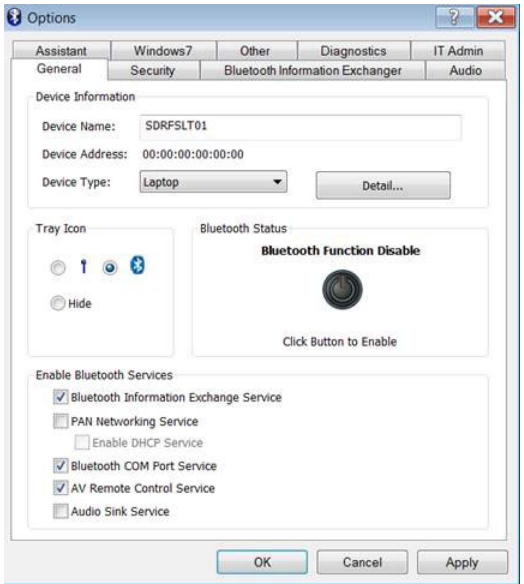
1. Click **Start**, **All Programs**, **Bluetooth Places** and locate the My Device icon. Alternatively, double-click the BlueSoleil Space icon on the desktop – the yellow sun is the My Device icon.
2. Right-click on **My Device** and click on **Properties** from the list of available options.
3. Select the **Accessibility** tab, check the box for Show the Bluetooth icon in the notification area, and click on OK.

Using the Toshiba Bluetooth Assistant:

1. If the icon disappears altogether from the taskbar, click **Start**, **All Programs**, **Toshiba**, **Bluetooth**, **Bluetooth Assistant**. Click the **Settings** button.



2. A tabbed dialog box will appear. Select the **General** tab. In the section for **Tray Icon**, select the standard Bluetooth icon, then click the **Apply** button.



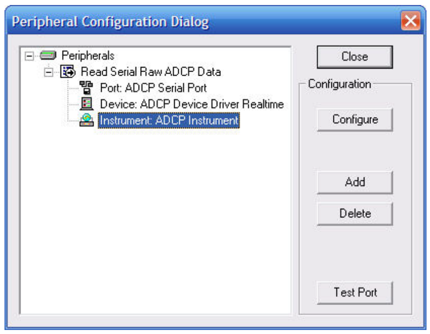
Make sure to select the Toshiba icon, not the Microsoft icon, if both are present in the notification area, either in this section or the next one. The Toshiba icon will have a medium/light blue background and a red or green Bluetooth symbol. The Microsoft icon has a dark blue background with a white Bluetooth symbol

Using the Advanced ADCP Communications Configuration Dialog

> It is not necessary to use this screen to deploy or use *WinRiver II.*

To communicate with the ADCP or verify command settings:

1. On the **Configure** menu, select **Peripherals**.
2. Click the + box next to **Read Serial Raw ADCP Data** to expand the list and then select **Instrument: ADCP Instrument**.
3. Press the **Configure** button.



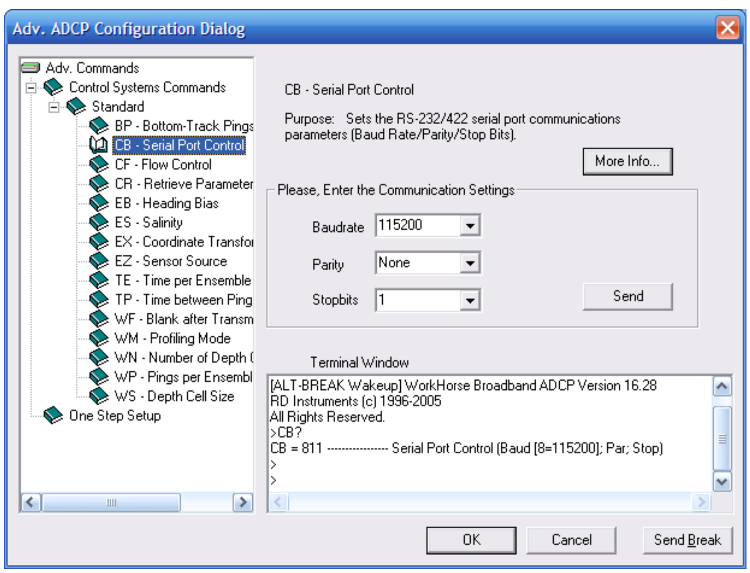


Figure 3. Advanced ADCP Configuration Dialog

4. Use the **Advanced ADCP Configuration Dialog** screen to send or verify command setting as needed. Click the **Send** button to send the command to the ADCP and view the results of the command in the **Terminal Window**.

> **Do not use this screen to deploy or configure the ADCP.** The commands will be overwritten when **Acquire**, **Start Pinging (F4)** is pressed. Only the commands generated through the wizard and sent via **Acquire**, **Start Pinging (F4)** can be used to deploy the ADCP.

5. Use the **Send Break** button to wake up the ADCP.
6. If the command you want to send the ADCP is not on the list, type it next to the ">" prompt in the **Terminal Window** and press return.

> WorkHorse Monitor/Sentinel ADCPs will go to sleep if a command is not sent within five minutes; In the **User** section (shown below) enter CL0. This will prevent the ADCP from sleeping.
>
> WorkHorse Rio Grande ADCPs do not sleep. For more information, see the CL command in the Rio Grande Technical Manual.
>
> If the ADCP happens to already be asleep (not responding to *WinRiver II* commands) then use *BBTalk* to wake it up with a hard break.
>
> Use the **Send Break** button to wake the ADCP before sending a command.

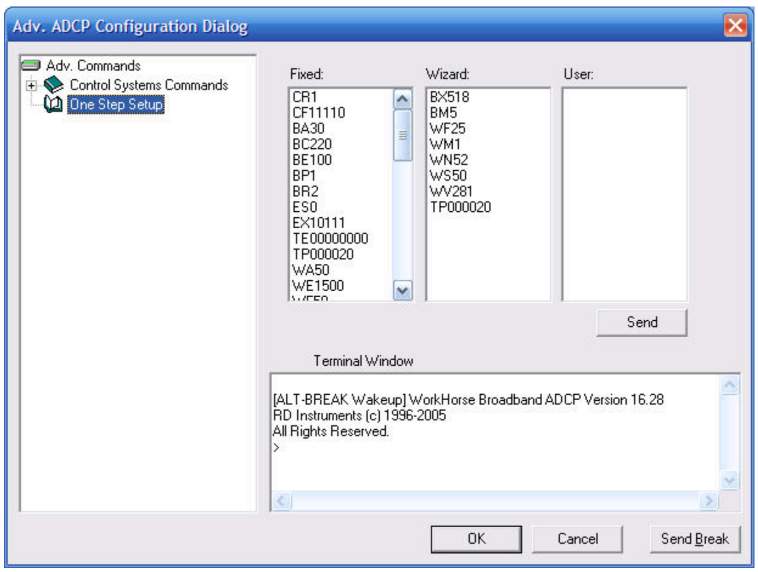


Figure 4. One Step Setup

One Step Setup

Use the **One Step Setup** to check the measurement commands sent to the ADCP after the **Measurement Wizard** has been completed (see Using the Measurement Wizard).

1. Click **One Step Setup**. This will show you the commands that have been generated by the Wizard and are ready to be sent to the ADCP when you start collecting data.
2. Click the **Send** button. If any command generates an error message, stop and correct the problem before deploying.

Do not use this screen to deploy or configure the ADCP. The commands will be overwritten when **Acquire**, **Start Pinging (F4)** is pressed. Only the commands generated through the wizard and sent via **Acquire**, **Start Pinging (F4)** can be used to deploy the ADCP.

The **One Step Setup** is a good way to check if any command generates an error message (for example, if the commands depend on the High Resolution Water Profiling upgrade but you are not sure the ADCP has this feature).

If a command generates an error, a message box will appear.

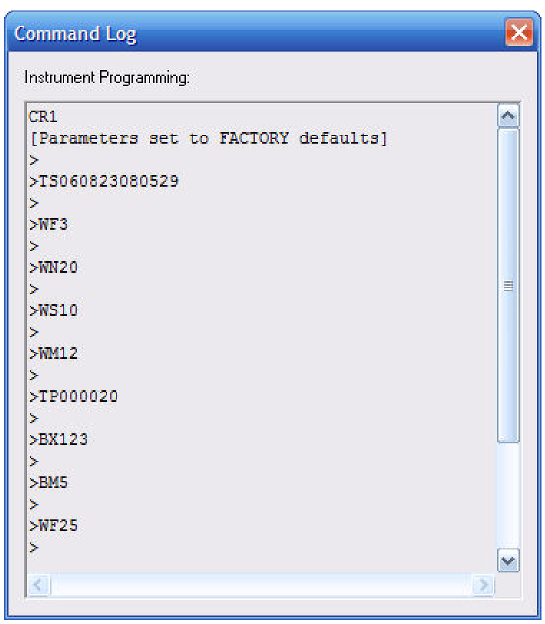
The **One Step Setup** does not check the commands for "reasonableness".

If the wizard has not been run, the **Fixed** and **Wizard** command boxes will be blank.

Commands can be entered in the **User** box or at the ">" prompt.

You can also check the measurement commands after the **Measurement Wizard** has been completed using the **Command Log**:

1. Click **Acquire**, **Start Pinging**. The **Command Log** window will open automatically and show the commands sent to the ADCP and the response from the ADCP. After the commands have been successfully sent, this window closes.
2. To view this window again on the **Configure** menu, click **Command Log**. This will show the history of the dialog between *WinRiver II* and ADCP. If any command generates an error message, stop and correct the problem before deploying.



Notes

Chapter 3

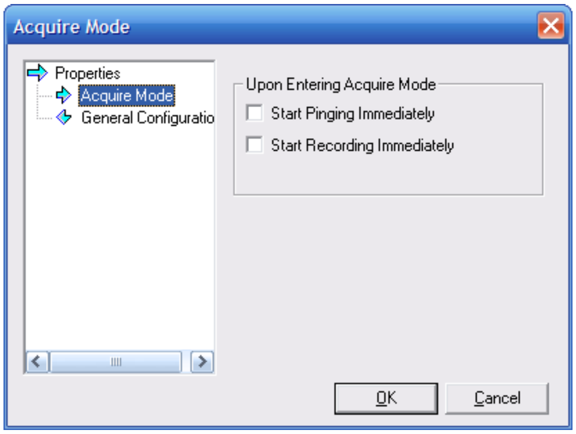
TUTORIALS

This chapter includes:

- How to Customize WinRiver II
- How to Use the RiverRay Internal GPS
- How to Collect River Discharge Data
- How to use Integrated GPS Capability
- How to use the RiverPro/RioPro Internal GPS
- How to View Data
- How to Reprocess Data
- How to Use the Q Measurement Summary
- How to Print a Plot or Display
- How to Make Screen Captures

Tutorial – How to Customize WinRiver II

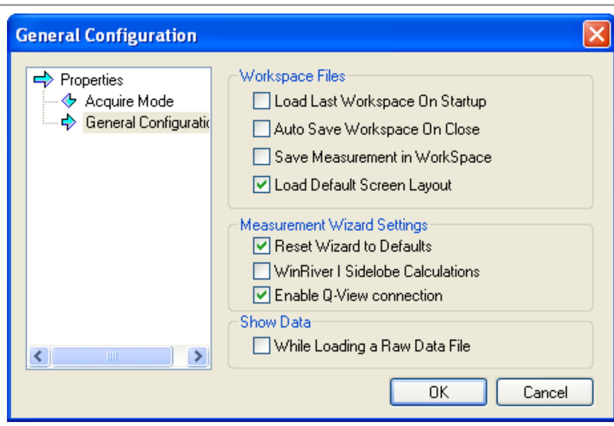
WinRiver II can be customized to look and act as you prefer. Once setup, *WinRiver II* will remember the settings and use them each time the program is started.



On the **File** menu, click **Properties**.

Check the boxes if you want the start pinging and recording whenever the acquire mode is entered.

The **Properties** dialog sets how *WinRiver II* behaves upon entering the Acquire mode.



Click on **General Configuration** to change how workspace files are loaded or saved.

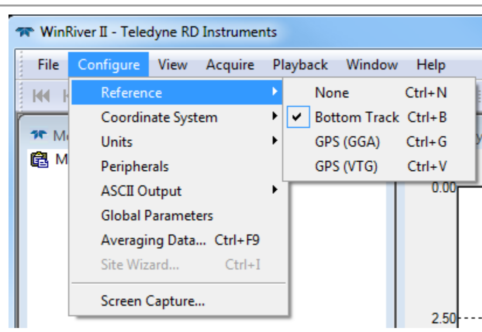
Selecting **Load Last Workspace on Startup** will load the ADCP's serial port setup, user units selection, coordinate system, and navigation reference from the workspace file.

Check the **Load Default Screen Layout** to use the default workspace when WinRiver II is started.

Check the **Reset Wizard to Defaults** box to have the measurement wizard use the default settings based on a WorkHorse Rio Grande 600 kHz ADCP.

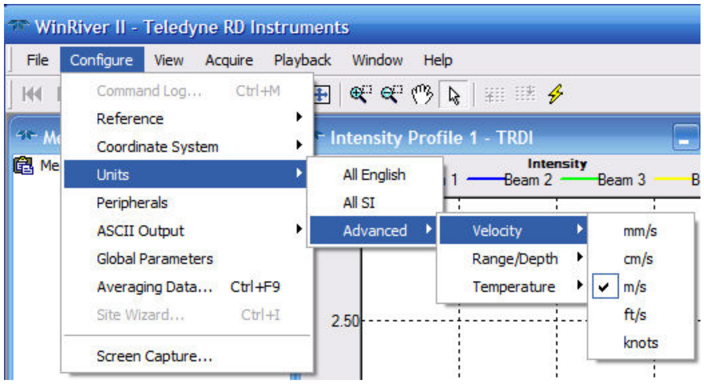
Check the **WinRiver I Sidelobe Calculations box** to calculate using an average beam depth rather than a minimum beam depth, more closely matching the calculations in the original *WinRiver*.

Check the **While Loading a Raw Data File** box to begin displaying data while the file is loading. For smaller data files, this may not be noticeable.



On the **Configure** menu, click **Reference**. Select the desired reference: **None**, **Bottom Track**, **GPS (GGA)**, or **GPS (VTG)**.

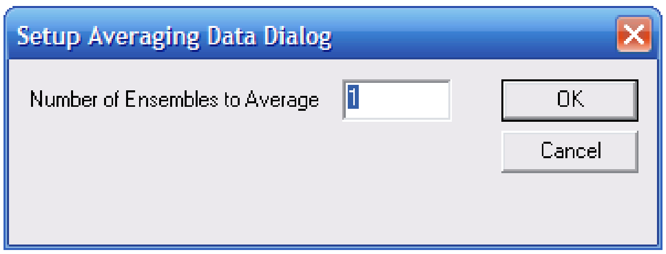
If the wrong reference is selected during Playback, data may not display. For example, if you select GPS (GGA) as the reference during Playback and this was not collected when the data file was created, no data will display.



To change the units for all displays, on the **Configure** menu, select **Units**.

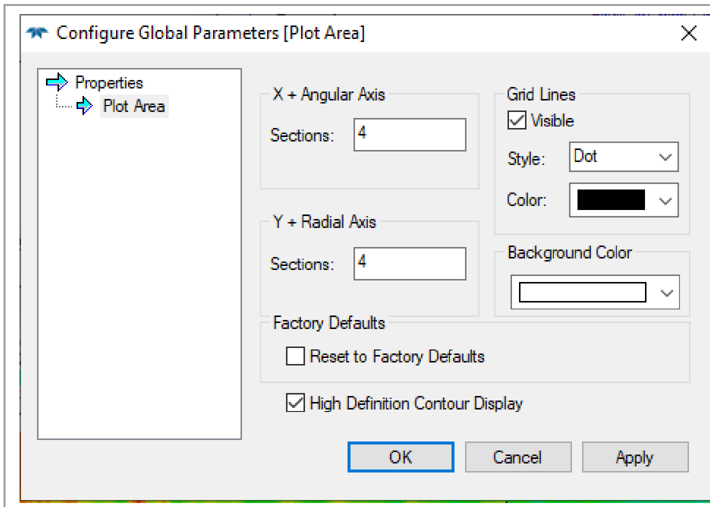
You can change units to **All English**, **All SI** or use the **Advanced** menu and select each unit for **Velocity**, **Range/Depth**, and **Temperature**.

When using a StreamPro ADCP on small streams/channels, change the Velocity units to mm/s or cm/sec. This will change the discharge to mm³/s or cm³/s.



On the **Configure** menu, click **Averaging Data…** Enter a number greater than one to average the data.

Averaging data may provide smoother plots. This does not alter the raw data in any way.



On the **Configure** menu, click **Global Parameters**.

As needed, check the **Reset to Factory Defaults** and **High Definition Contour Display** boxes.

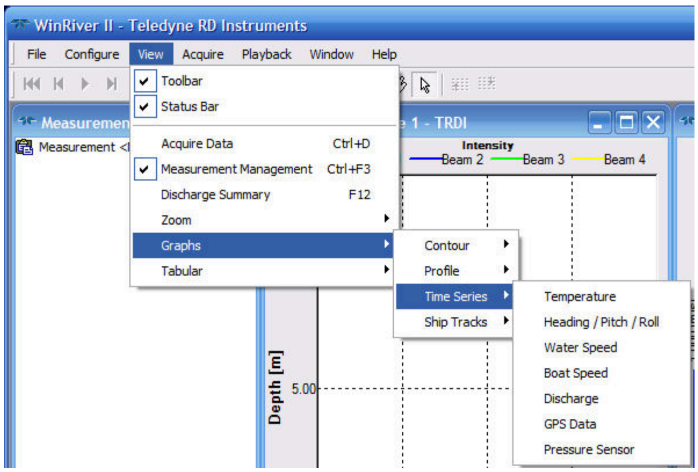
As needed adjust the number of axis, grid lines, and background color.

Click **OK**.

The **High Definition Contour Display** is reset to On (checked) each time *WinRiver II* is started.

Tutorial - Creating Workspaces

A Workspace is a collection of windows arranged and sized as you prefer and includes peripheral configuration, units, coordinate system, navigation reference, and then saved for future use as needed. It is possible to define as many different workspaces as you would like.

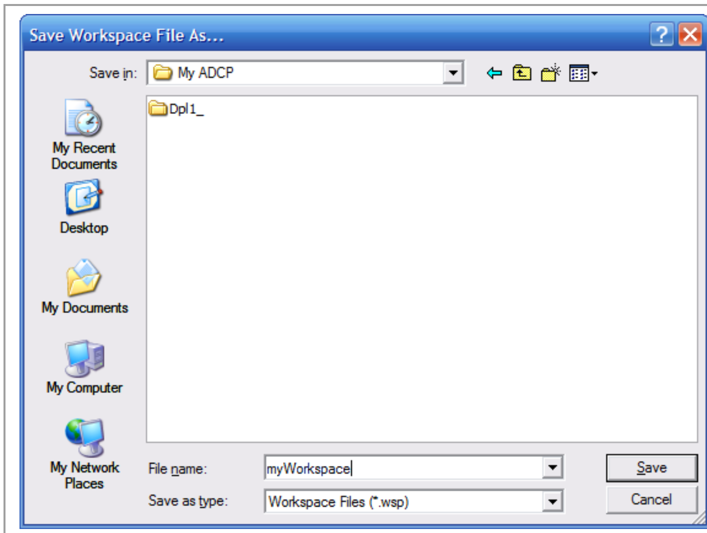


To create a Workspace file, use the **View** menu to open all the windows you want to see during data collection or playback.

Arrange the views you are interested in.

Set the peripheral configuration (see Chapter 2 – Communication Setup), units, coordinate system, and navigation reference (see Tutorial – How to Customize WinRiver II).

How workspaces are loaded and saved when starting/closing *WinRiver II* depends on the **User Options** (see Tutorial – How to Customize WinRiver II).



When you have the displays set as you prefer, on the **File** menu, click **Save Workspace File As**.

To use a workspace, on the **File** menu, click **Load Workspace**.

Selecting **File**, **Properties**, **Load Last Workspace on Startup** will load the ADCP's serial port setup, user units selection, coordinate system, and navigation reference from the workspace file. Make these selections and then save the workspace (**File** menu, **Save Workspace As…**) to have your preferences reloaded on startup.

Tutorial – How to Collect River Discharge Data

This section has instructions for a typical discharge measurement using the ADCP only (no GPS, External Heading, or Depth Sounder).

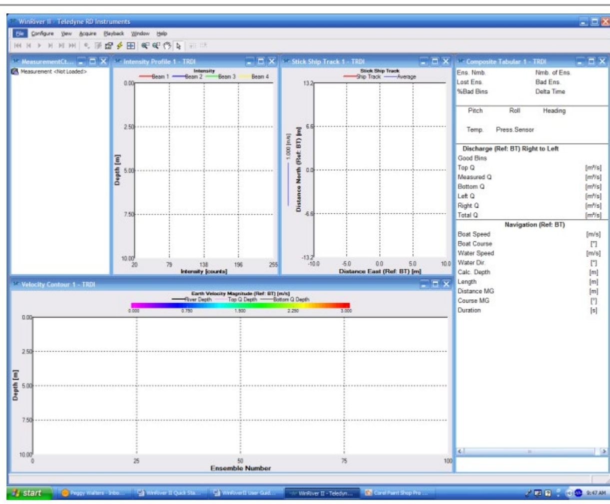
Connect the ADCP

Connect the ADCP and computer as shown in your ADCP User's Guide.

Mount the ADCP on the boat at the desired depth

See the Workhorse, RiverRay, RiverPro/RioPro, and Rio Grande Technical Manuals, Installation section for details.

Run the Measurement Wizard



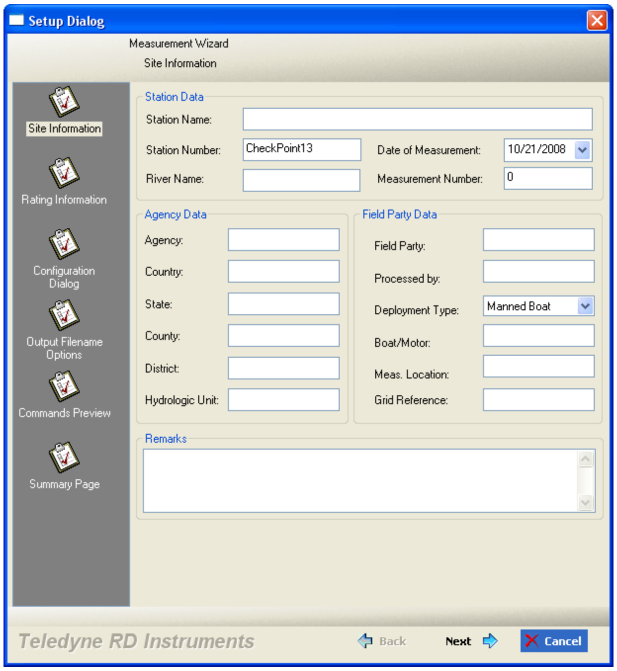
Start *WinRiver II*.

On the **File** menu, click **New Measurement** to start the Measurement Wizard.

The Measurement Wizard will create a configuration node and allow you to enter the information needed for taking measurements.

For detailed information on each screen, see Chapter 7 – Using the Measurement Wizard.

Site Information



Enter the Site Information.

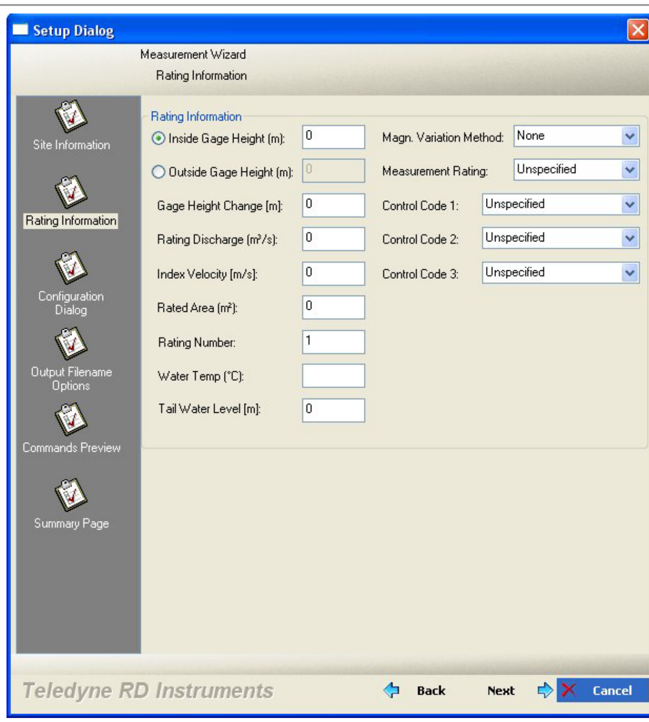
Enter a **Station Name** and **Measurement Number** (alphanumeric). This can be added to the file name (see Output Filename Options).

Click **Next**.

This information will be included in the Q Measurement Summary (see Using the WinRiver II Q Measurement Summary).

You can add/edit this information once the measurement wizard is completed by right-clicking on **Site Information** in the Measurement Control window and selecting **Site Wizard**.

Rating Information

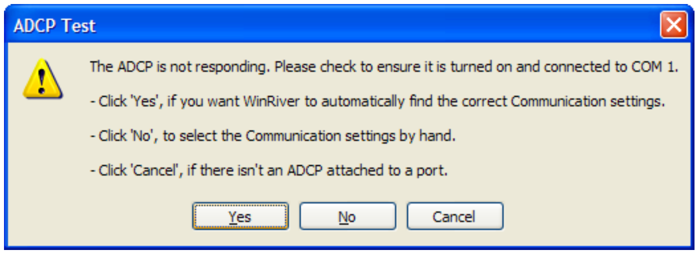


Enter the Rating Information.

Click **Next**.

This information will be included in the Q Measurement Summary (see Using the WinRiver II Q Measurement Summary).

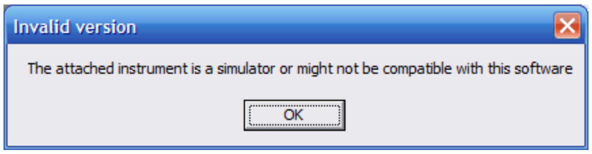
You can add/edit this information once the measurement wizard is completed by right-clicking on **Site Information** in the Measurement Control window and selecting **Site Wizard**.



If you see this screen and the ADCP is NOT attached to a serial port, click **Cancel** to continue the Measurement Wizard.

If the ADCP is attached to a serial port, click **Yes** to configure the port.

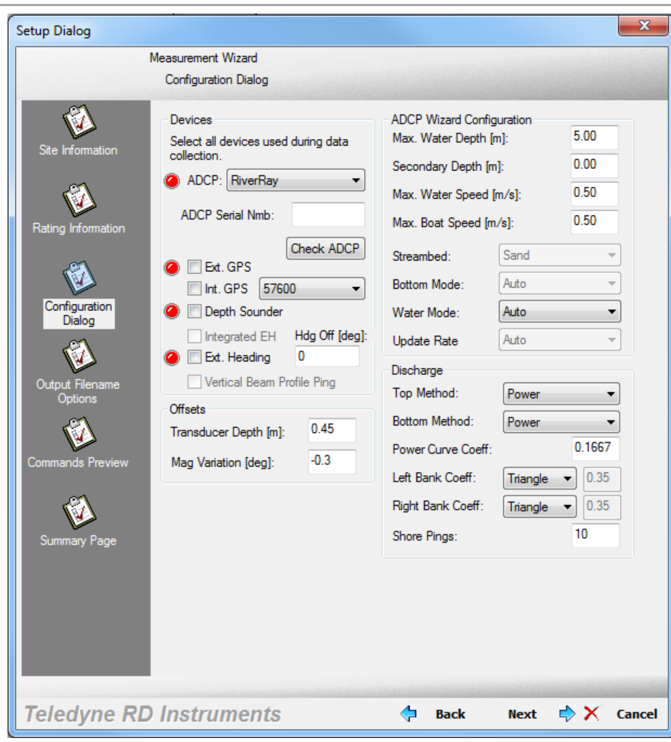
The ADCP does not need to be connected to use the wizard.



If you see the following message box, this means *WinRiver II* is not sure what type ADCP you are using.

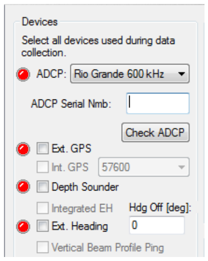
Click **OK** to continue.

Configuration Dialog

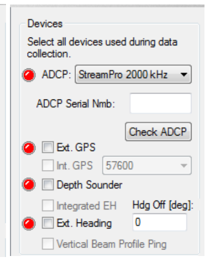


Enter your choices for how the configuration will be setup.

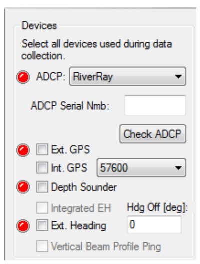
See the following tables for details.



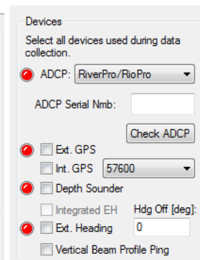
Rio Grande



StreamPro



RiverRay



RiverPro/RioPro

A green circle means that the communication port has been configured and tested. Red circles mean the device has not been configured.

Devices

Enter your choices for the **Devices** section. See Communications Setup for instructions on how to setup communications between *WinRiver II* and the ADCP.

If you are using a Rio Grande, RiverRay or StreamPro ADCP, *WinRiver II* will automatically detect and enter the **ADCP Serial Number,** otherwise enter the serial number. Use the **Check ADCP** button to verify the ADCP communications settings.

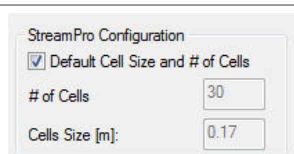
Selecting the **GPS**, **Depth Sounder**, or **Ext. Heading** boxes will prompt you to set up the communication settings for the device.

If you are configuring a RiverRay or RiverPro/RioPro system with integrated GPS, than set the **Int. GPS** baud rate. Available baud rates are 4800, 9600, 19200, 38400, 57600, 115200, and Auto (RiverPro/RioPro only).

To set the RiverPro to collect vertical beam velocity profile data and a vertical beam bottom velocity, check the **Vertical Beam Profile Ping** box.

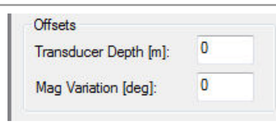
RiverPro/RioPro systems can use the heading from the integrated GPS if the **Integrated EH** checkbox is selected. This checkbox is greyed out until the **Int. GPS** checkbox is selected. Do not check both the **Int. EH** and **Ext Heading** checkboxes.

Use the **Heading Offset** field to adjust both external and integrated external heading data to the correct physical orientation relative to the instrument (not to the float/boat).



StreamPro Configuration

If you are configuring a StreamPro system, leave the **Default Cell Size and # of cells** box checked to have *WinRiver II* calculate the optimum number and size.

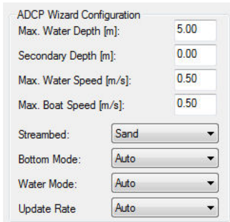


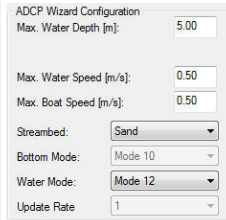
The transducer depth should be checked periodically during data collection.

Offsets

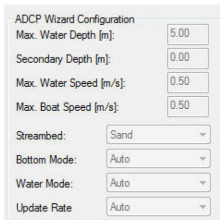
Use the **Transducer Depth** field to set the depth from the water surface to the center of the ADCP transducer faces.

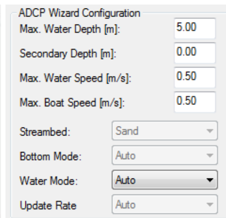
Enter the **Magnetic Variation** for the site. See Magnetic Variation Correction for details.





Rio Grande StreamPro





RiverRay RiverPro/RioPro

The **ADCP Wizard Configuration** depends on the ADCP type and frequency. Make sure you have the correct ADCP selected.

It is recommended that the boat speed be less than or equal to the water speed.

Leave the **Bottom** and **Water Mode** set to **Auto** for Rio Grande ADCPs. *WinRiver II* will select a best suited mode based on the water depth, speed, and streambed material.

ADCP Wizard Configuration

Enter your choices for the **ADCP Wizard Configuration** section. Based on the entered information, the wizard will generate the ADCP commands.

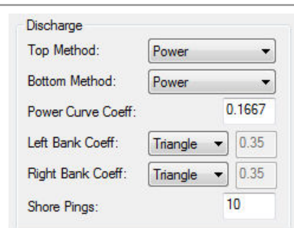
RiverRay **ADCP Wizard Configuration** options are locked.

The **Max Water Depth**, **Max Water Speed**, and **Max Boat Speed** should be defined as close as possible to the actual conditions.

Set the **Secondary Depth** (Rio Grande and RiverRay/RiverPro/RioPro WM12 only) to the minimum depth that will be measured in the river. Usually this will be a smaller value than the **Max Depth** or left at zero.

Streambed material should then be selected: this does not affect the configuration but it assists in producing relevant warnings.

Bottom Mode and **Water Mode** - See Table 11 for a recommended setup table.



For more information on the Discharge settings, see the Discharge Page.

Discharge

Enter your choices for the **Discharge** section.

Select method for calculating the discharge of the unmeasured areas (**Power**, **Constant** or **3pt Slope**). You can also select a coefficient; however, the default **Power** method is standard.

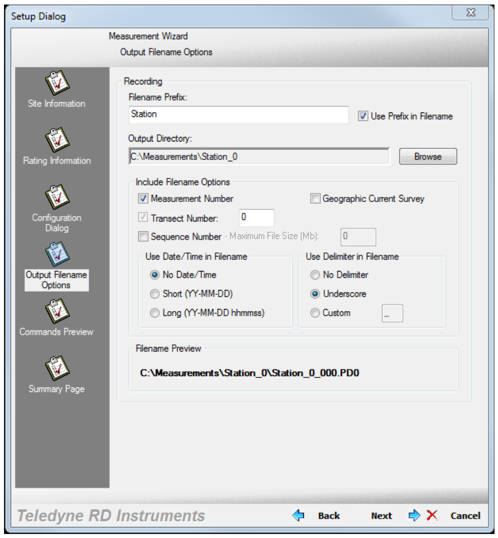
Select the style of the Left and Right banks (**Triangular**, **Square** or **User**). Banks should be selected by facing downstream.

Shore Pings dictates the amount of ensembles that will be used to calculate the edge discharge.

Click **Next**.

You should always use a minimum of 10 shore pings.

Output Filename Options



If a **Station Name** was entered on the first page of the wizard, it will be used in the **Filename Prefix** box.

WinRiver II uses the **Filename Prefix** to create the data file names made during data collection.

Use the **Output Directory** field to select where the data file will be stored.

Check the **Measurement Number** box to add it to the file name (see Site Information).

Check the **Sequence Number** box and enter a **Max File Size** if you want to limit the size of the data file. Once the file size has been reached, the sequence number will increment.

To add the Date/Time to the filename, check the **Short (YY-MM-DD)** or **Long (YY-MM-DD hhmmss)** button.

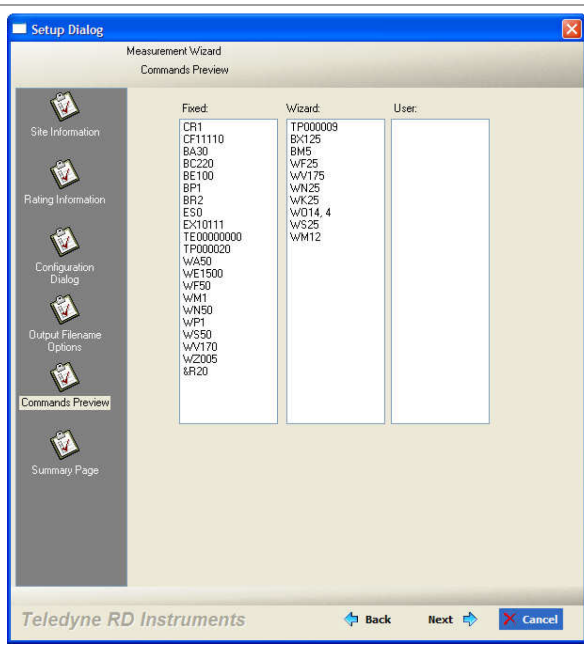
Select what type delimiter to use in the filename by selecting **No Delimiter**, **Underscore**, or **Custom**.

If you are receiving GPS data, select the **Geographic Current Survey** box to add the GPS Date/Time and Geographic Location to the filename. Note that the wizard screen will shows 0's, but the file name will use the correct values.

If GPS data is not available, Geographic Location will be all zeros.

Click **Next**.

Commands Preview



See Table 9 for a short list of ADCP commands commonly sent via *WinRiver II*.

The Commands Preview is where adjustments can be made to the commands produced by the measurement wizard.

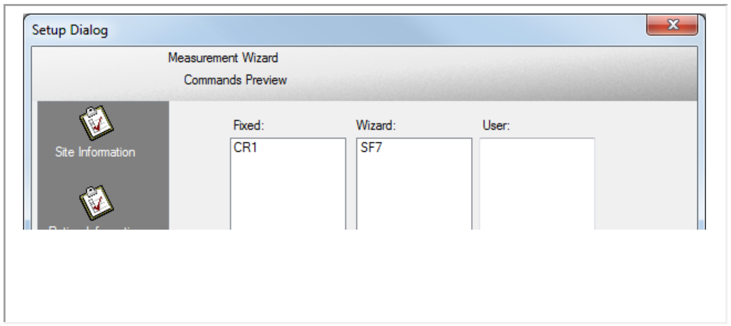
There are three columns - the first is the **Fixed** commands that are sent by default by *WinRiver II* to the ADCP.

The second column is commands that are produced by the **Wizard**; these commands will overwrite the corresponding original fixed commands.

The final column is for **User** commands; these can be added to by the user, and just as before, these commands will overwrite the previous column.

Click **Next**.

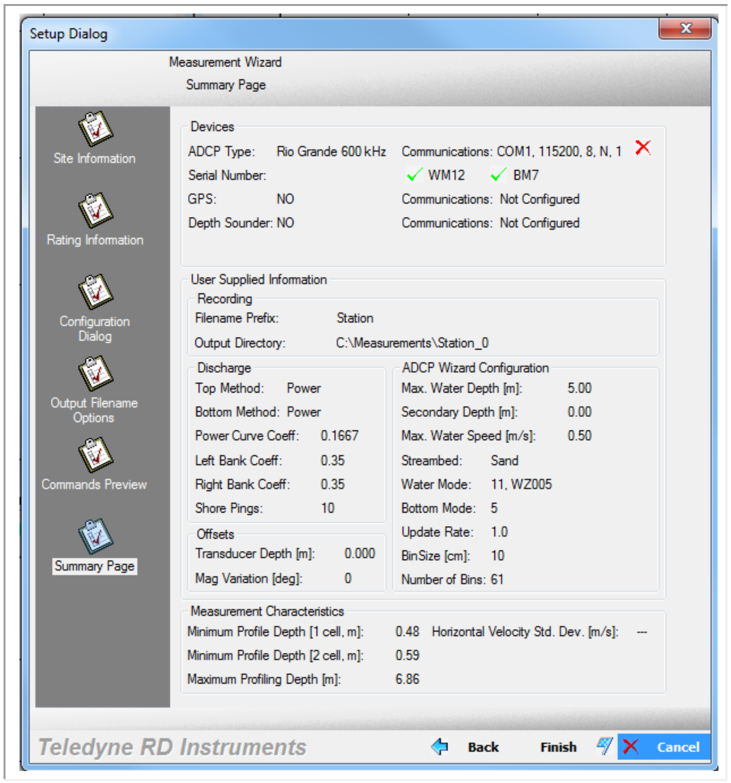
Do not enter any commands in the **User** section unless you are fully aware of what the command does.



The RiverRay, RiverPro, and RioPro ADCPs will only have the CR1 command in the **Fixed** column and SF command in the **Wizard** column. This is normal.

The default settings for the RiverRay will send CR1 (set to default) and CS to start pinging when **Start Pinging** is selected on the **Acquire** menu (or use the shortcut key **F4**). If the **Int. GPS** box is selected, then the SF command will be added to the Wizard command section.

Summary Page



Review the **Summary Page**.

When done, click **Finish**.

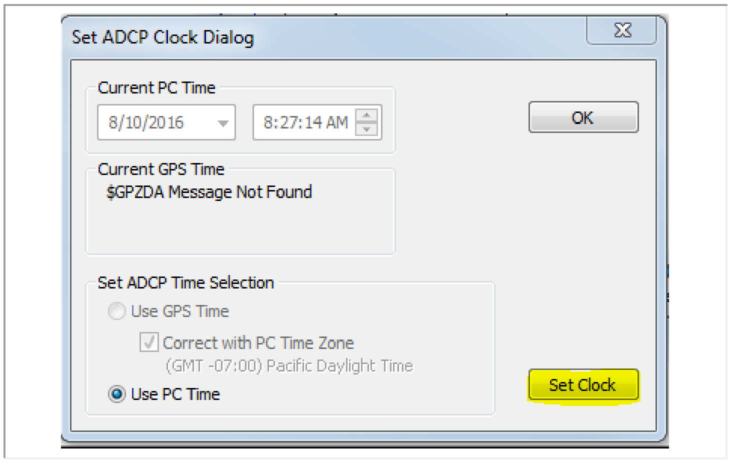
A green check mark next to **WM12** and **BM7** means that the ADCP is capable of using these modes, not that the mode is selected.

View the **ADCP Wizard Configuration** section to see what water and bottom mode is selected.

QA/QC Items

Before taking measurements, check the following items.

QA/QC - Set ADCP Clock



On the **Acquire** menu, click **Set ADCP Clock**.

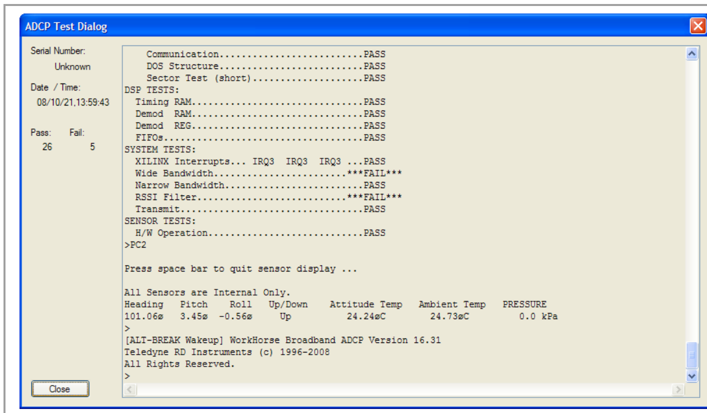
Click the **Set Clock** button to set the ADCP's time to the GPS time (if available) or the PC's time. If necessary, set the PC's clock first.

Click **OK** to exit the **Set ADCP Clock** dialog.

The first time a transect is started, the **Set ADCP Clock** dialog will open.

Only clicking the **OK** button will **NOT** set the clock. The user **MUST** click the **Set Clock** button.

QA/QC - Test ADCP

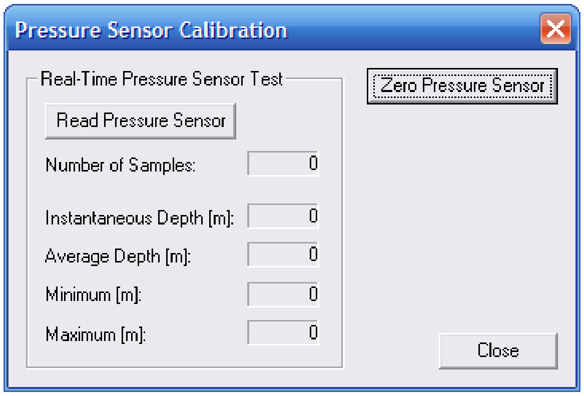


On the **Acquire** menu, click **Execute ADCP Test** to verify the ADCP is functioning properly.

Click the **Stop PC2** button to end the PC2 test. Click **Close** to exit the **ADCP Test Dialog**.

The tests should be run while the ADCP is in non-moving water. Running the test in air will not harm the ADCP, but some tests may fail in air.

QA/QC - Test Pressure Sensor



On the Acquire menu, click **Execute Pressure Sensor Test** to verify the ADCP's pressure sensor is functioning properly.

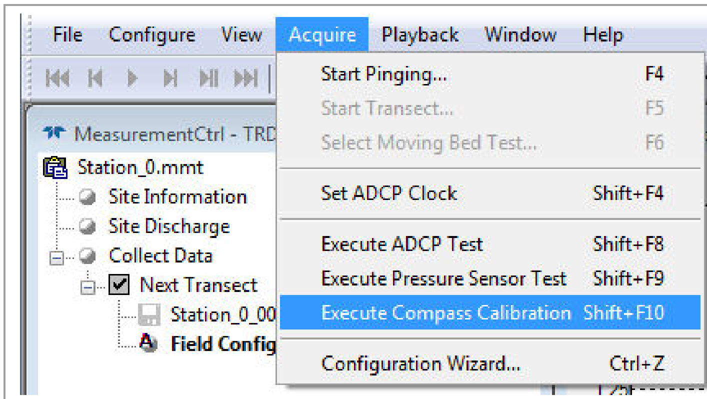
Click the **Read Pressure Sensor** button to get samples.

Click the **Zero Pressure Sensor** button to zero out the sensor.

If your ADCP does not have a pressure sensor, you will see an error message.

Do not use the **Pressure Sensor Test** on a StreamPro ADCP. StreamPro systems do not have a pressure sensor.

QA/QC - Compass Calibration



On the **Acquire** menu, click **Execute Compass Calibration**.

See the following sections for details:

Rio Grande ADCP Compass Calibration

RiverRay/RiverPro/RioPro Compass Calibration

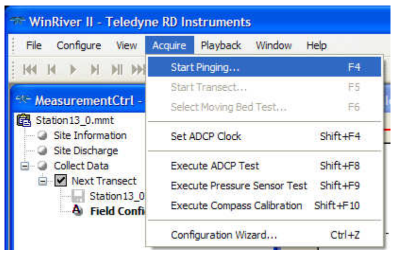
StreamPro Compass Calibration

If you can obtain valid bottom track data, and you use bottom track as your boat speed reference, there is no need to perform the compass correction procedures to obtain valid discharge data. Both the water and boat velocities are in the same coordinate system, and no rotation from one coordinate system to another is required. However, compass corrections ARE required to obtain accurate Ship Track and Flow direction data.

QA/QC -Moving Bed Test

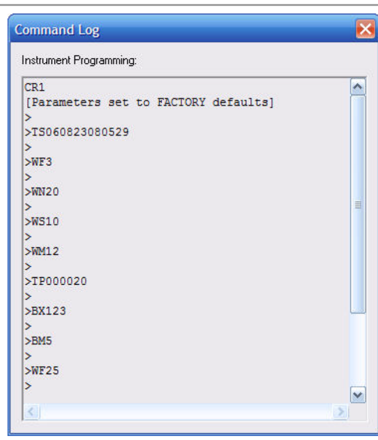
During high flow season or where the river sediment load is high, acoustic absorption and scattering interfere with the bottom tracking of ADCPs. The Moving Bed test should be performed at every site gauged and made every time the site is visited as conditions do change. The test can also act as a pre-survey; the data retrieved can be used in the Measurement Wizard to set the depth and velocity.

The Moving Bed test is to prove that the bed of the section is not in motion. If you obtain biased bottom track data at your river site, moving to a new section may help, but flood conditions may require the use of GPS.



On the **Acquire** menu click **Start Pinging** or use the shortcut key **F4**.

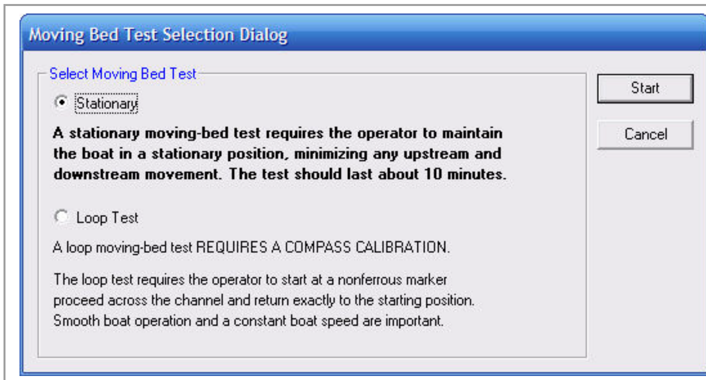
If this is the first measurement taken, *WinRiver II* will prompt for the clock to be set (see Set ADCP Clock).



WinRiver II will send the commands generated by the configuration wizard to the ADCP.

Review the **Command Log** to see if any error occurs.

If the command log closed before you finished reviewing the commands, click **View**, **Command Log…** Scroll though the log file and make sure no command generated an error message.



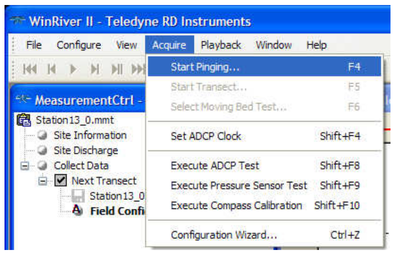
For more information, refer to the USGS document concerning the loop method at the following link: http://pubs.usgs.gov/sir/2006/5079/

On the **Acquire** menu click **Select Moving Bed Test**. Select **Stationary** or **Loop Test** and click the **Start** button.

See Moving Bed Test for more information.

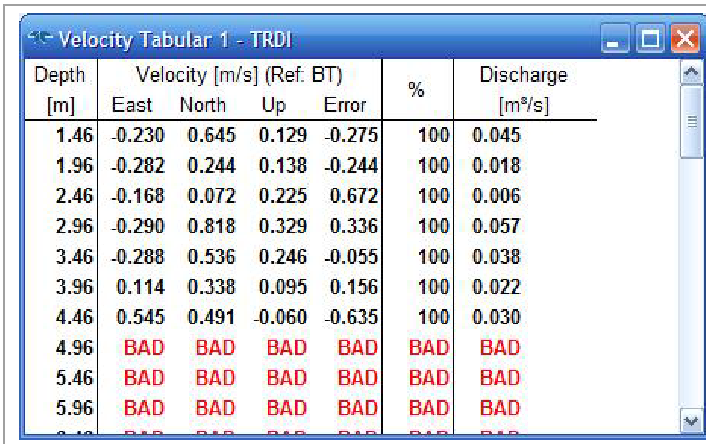
Mark Transect Start and End Points

Locate the point where a solid two-depth cell measurement can be measured on both banks. Stake or otherwise mark these locations. They represent the starting and stopping points for the transects. *WinRiver II* uses this data to extrapolate for the edges (see Figure 5, page 69). Typically, 10 shore ensembles are taken as close to the riverbank as can be measured and still read valid data at the beginning and end of each transect.



On the **Acquire** menu click **Start Pinging** or use the shortcut key **F4**.

If the ADCP is already pinging after completing the QA/QC moving bed test, skip this step.


Velocity Tabular 1 - TRDI

Depth [m]	Velocity [m/s] (Ref: BT) East	North	Up	Error	%	Discharge [m³/s]
1.46	-0.230	0.645	0.129	-0.275	100	0.045
1.96	-0.282	0.244	0.138	-0.244	100	0.018
2.46	-0.168	0.072	0.225	0.672	100	0.006
2.96	-0.290	0.818	0.329	0.336	100	0.057
3.46	-0.288	0.536	0.246	-0.055	100	0.038
3.96	0.114	0.338	0.095	0.156	100	0.022
4.46	0.545	0.491	-0.060	-0.635	100	0.030
4.96	BAD	BAD	BAD	BAD	BAD	BAD
5.46	BAD	BAD	BAD	BAD	BAD	BAD
5.96	BAD	BAD	BAD	BAD	BAD	BAD

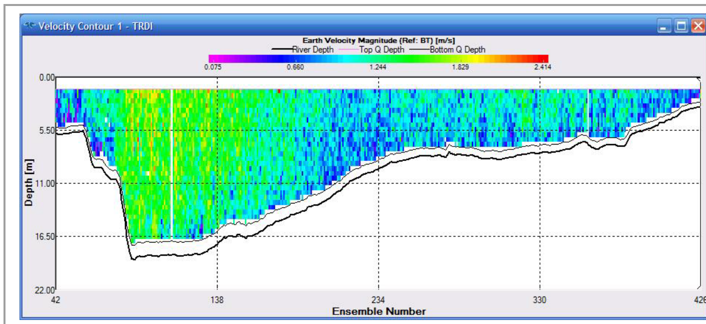
Mark the Start Point

Click **View**, **Tabular**, **Velocity** to open a **Velocity Tabular 1** display.

Move out from the shore until the water is deep enough to consistently show good values for two bins (or more depending on river conditions and how close you can get to the shore). Values of 0.0 are acceptable, but "bad" values are invalid.

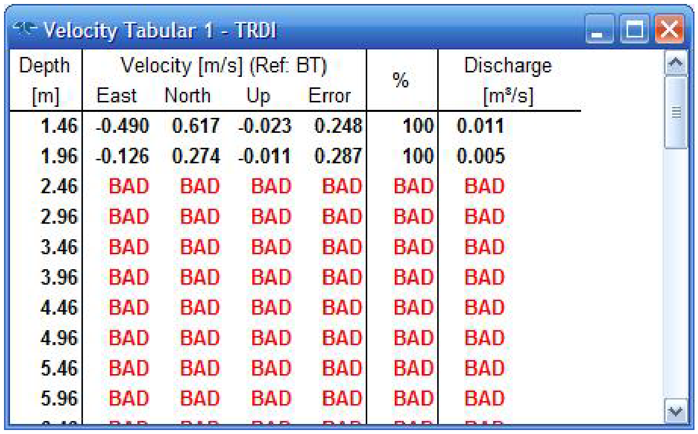
Mark this position (with a float). This is the starting/stopping position for this shore. You will later start/stop data file recording at this location depending on the direction of the transect.

Start/Stop distances from the center of the transducer to the shore should be measured as accurately as possible - at least to the nearest deci-meter. Use of marker buoys at the start and end points of transects will provide more consistent edge estimates.



Move out from the shore traveling *slowly* with the bow of the boat pointed upstream.

Use the **Velocity Magnitude Contour** display to see how the water depth changes as you make the transect. Note regions where the bottom depth changes quickly.



Depth [m]	Velocity [m/s] (Ref: BT) East	North	Up	Error	%	Discharge [m³/s]
1.46	-0.490	0.617	-0.023	0.248	100	0.011
1.96	-0.126	0.274	-0.011	0.287	100	0.005
2.46	BAD	BAD	BAD	BAD	BAD	BAD
2.96	BAD	BAD	BAD	BAD	BAD	BAD
3.46	BAD	BAD	BAD	BAD	BAD	BAD
3.96	BAD	BAD	BAD	BAD	BAD	BAD
4.46	BAD	BAD	BAD	BAD	BAD	BAD
4.96	BAD	BAD	BAD	BAD	BAD	BAD
5.46	BAD	BAD	BAD	BAD	BAD	BAD
5.96	BAD	BAD	BAD	BAD	BAD	BAD

Mark the Stop Point

Switch back to the **Velocity Tabular 1** display. When you approach the other shore, mark the closest distance to shore where two depth cells show discharge values.

This will be the start/stopping point for this shore.

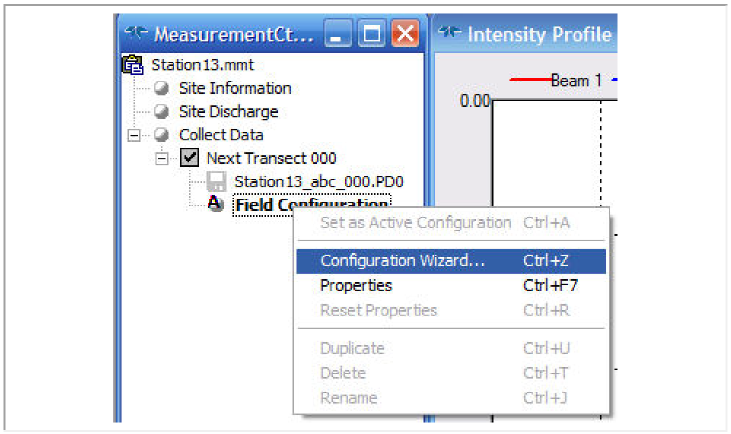
You are now ready to start collecting transects.

Start/Stop distances from the center of the transducer to the shore should be measured as accurately as possible - at least to the nearest deci-meter. Use of marker buoys at the start and end points of transects will provide more consistent edge estimates.

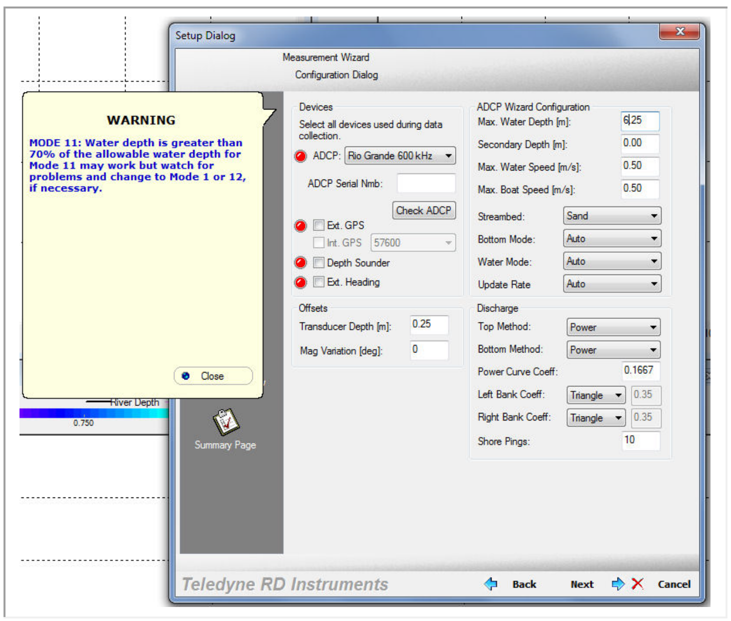
Adjust the Configuration

After the Moving Bed Test and the Start/Stop points for the transects have been determined, you may want to adjust the configuration. Perhaps you noticed that the river is deeper than originally entered or you want to use a different Water Mode or Bottom Mode than you used for the moving bed test.

You can adjust the **Field Configuration** if data has not been collected with the node (it will have **Next Transect XXX**, where XXX is the transect number and the transect check box is grey).



Right-click on **Field Configuration** and select **Configuration Wizard**.



The ADCP communication setting will be checked again and then will open at the **Configuration Dialog** page (see Configuration Dialog).

Make changes as needed and click **Next**.

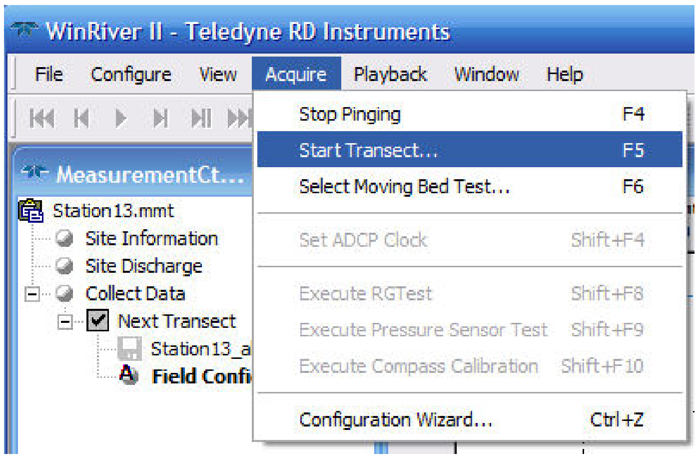
In this example, the **Maximum Water Depth** was increased to 6.25 meters. *WinRiver II* is suggesting that the Water Mode may need to be set to Mode 1 or Mode 12 for best results. If necessary, run another test transect and make further adjustments.

Continue through the wizard by clicking **Next** at each page and then select **Finish** at the **Summary** page.

Use this page to adjust the **Offsets** as needed.

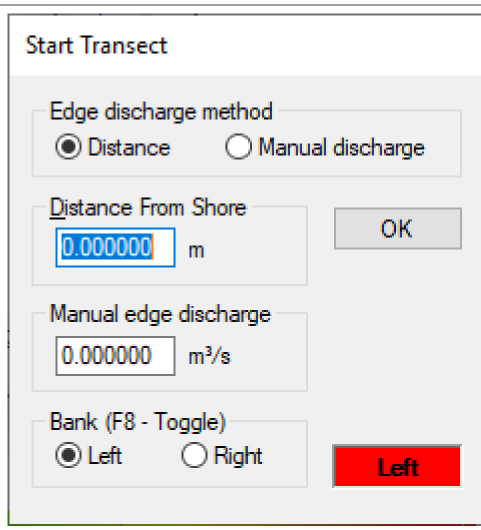
Transects

Best practices encourage a minimum of four high quality transects be collected that agree with each other to within 5% of the mean of all the samples. The following sequence must be repeated for every transect taken over the water body.



Acquire Data – Start Shore

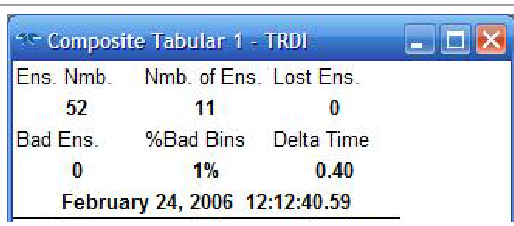
Starting at one of the edge positions determined in Mark Transect Start and End Points, on the **Acquire** menu click **Start Transect (F5)** to begin recording. You should have good velocity data in at least 2 depth cells.



When prompted, enter the beginning distance to the bank and determine if this is the left or right bank. **When facing downstream, the left bank is on your left side.** The edge distance parameters will be saved to the configuration node associated with the raw ADCP data file being recorded.

Click **OK** to start.

You can manually enter edge discharges instead of shore distances when you know the edge discharge from another method (StreamPro, Wading rod, etc.).

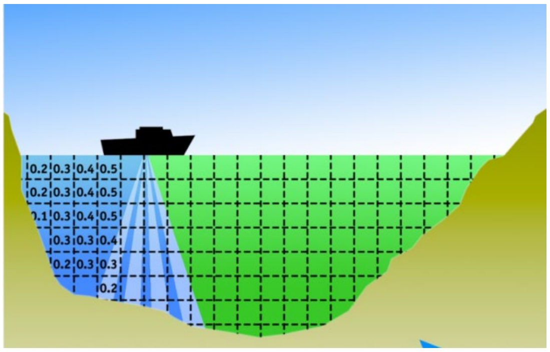


Hold this start position and view the **Composite Tabular** display.

Check if the **Nmb. of Ens.** minus any **Bad Ens.** is more (or equal) to the number of shore ensembles (the default is 10 shore ensembles).

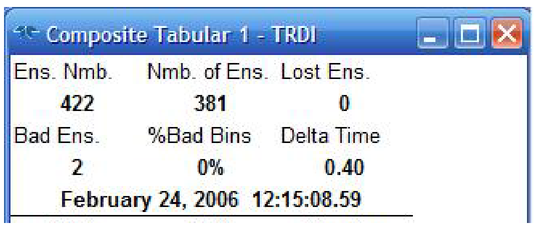
If you made a false start, click **F5** to stop recording. Restart at the edge by clicking **F5** to record to a new file. The Left/Right bank toggles at the end of each transect. Click **F8** to toggle the bank to the correct left/right side.

WinRiver II automatically saves the measurement file each time you start/stop a transect. Large numbers of transects in a measurement file may affect computer performance as the measurement file size increases.



Move across the river as *smoothly* as possible. For the best measurement results, the boat's speed over the bottom should be no greater than the water speed of the river. Pointing the bow of the boat upstream and slowly crabbing across the river will help to maintain a transect path that is perpendicular to the flow.

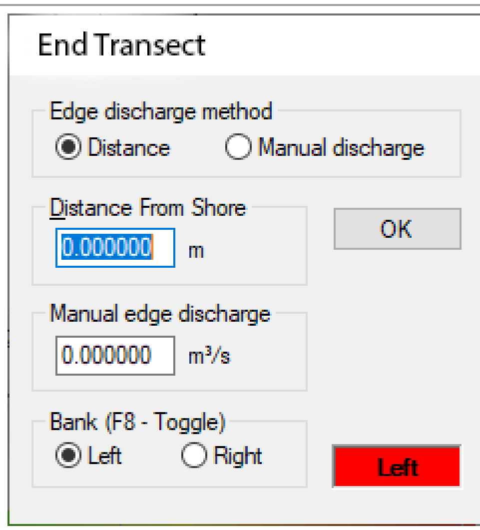
Move away from the starting point smoothly. If you can not keep the speed as slow and smooth as needed due to a large motor, use a trolling motor instead. Smoothness is most important; On large rivers speed may need to be higher than desired for many reasons.



Continue across the river until you reach the stop position determined in Mark Transect Start and End Points. Decelerate before reaching the end point such that you do not overshoot it.

You should have discharge values in at least the top two depth cells.

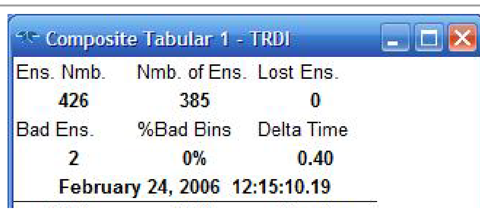
Stop at this position and wait for the Shore Ensembles measurements to be recorded.



Press **F5** to stop recording.

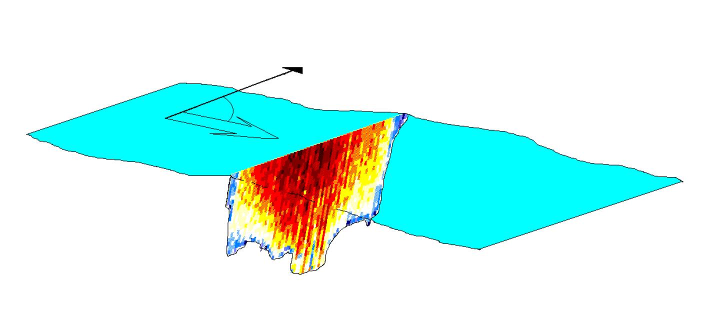
When prompted, enter the ending distance to the bank. This parameter will be saved to the configuration node.

You can manually enter edge discharges instead of shore distances when you know the edge discharge from another method (StreamPro, Wading rod, etc.).



Check **Bad Ensembles** and **% Bad Bins**. The number of Bad Bins should be less than 25%.

The velocity magnitude plot should show a good section with good bottom and velocity data.



Repeat these steps as many times as required for your application. An even number of *at least four* transects are recommended. The ADCP operator must make sure that the maximum permissible relative residual (MPRR) is met before leaving the site (see Dynamic Residual Analysis).

When you are finished acquiring the data, press **F4** to stop the ADCP pinging.

Turn off the power to the ADCP and disconnect the cable. Remember to replace the dummy plug to protect the connector.

Step by Step Data Collection

1. Open or create a measurement file.
2. Press **F4** to start pinging.
3. At the start/stop position, press **F5** to start the transect.
4. Enter the starting distance from the shore.
5. Select Left or Right bank.
6. Wait for 10 shore ensembles.
7. Move across the river.
8. At the stop/start position, wait for 10 shore ensembles.
9. Press **F5** to end the transect.
10. Enter the ending distance from the shore.
11. Repeat steps 3 through 10 to collect at least four transect that agree with each other within 5% of the mean of all the samples. The ADCP operator must make sure that the maximum permissible relative residual (MPRR) is met before leaving the site (see Dynamic Residual Analysis).

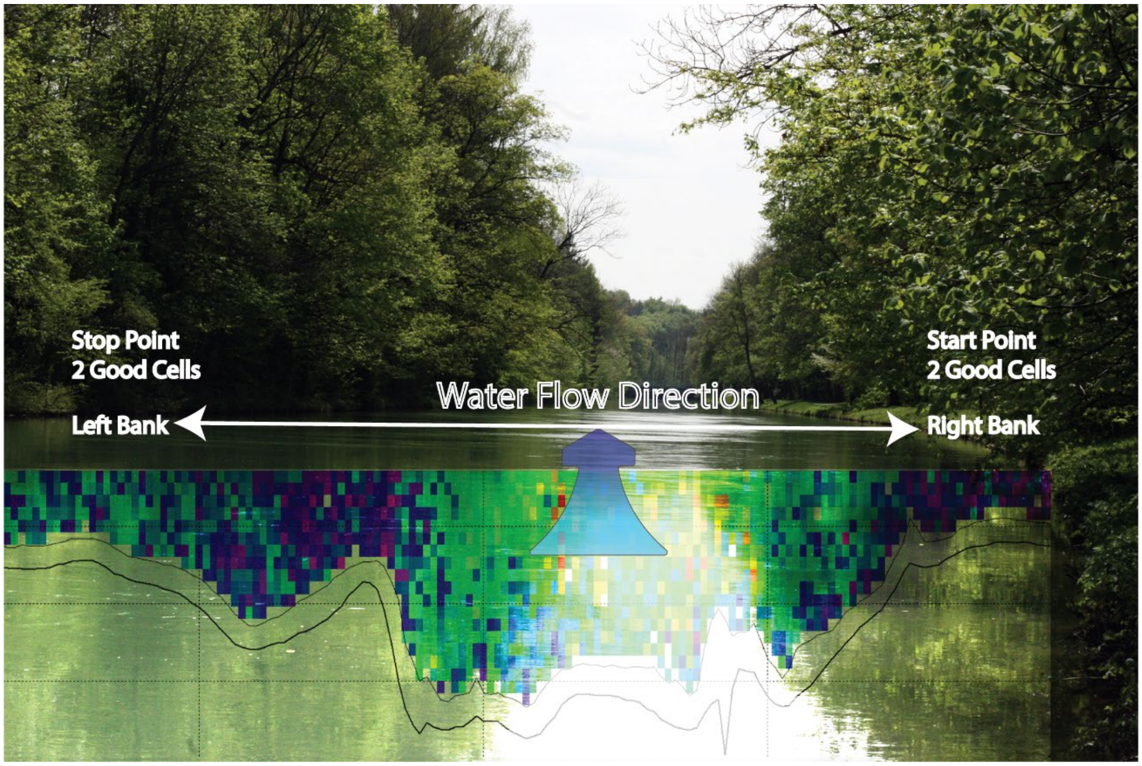


Figure 5. Overview of Data Collection

Data Collections Tips

- Locate the point where a solid two-depth cell measurement can be measured on both banks. Stake or otherwise mark these locations. They represent the starting and stopping points for the transects.
- Accurately measure and enter the **Distance from Shore** when prompted.
- Minimize the ADCP movement while Shore Ensembles are recorded.
- When departing from the edge, slowly accelerate the boat away from the edge and when approaching the other edge slowly reduce the speed such that the boat decelerates and does not overshoot the edge. The goal is to go from edge to edge and not overshoot at either edge. Doing so will allow you to obtain the most accurate measurements, in particular the area measurements.
- Move the ADCP at a slow steady pace in the water during transects.
- Collect a minimum of four transects that agree with each other to within 5% of the mean of all the samples. The ADCP operator must make sure that the maximum permissible relative residual (MPRR) is met before leaving the site (see Dynamic Residual Analysis).

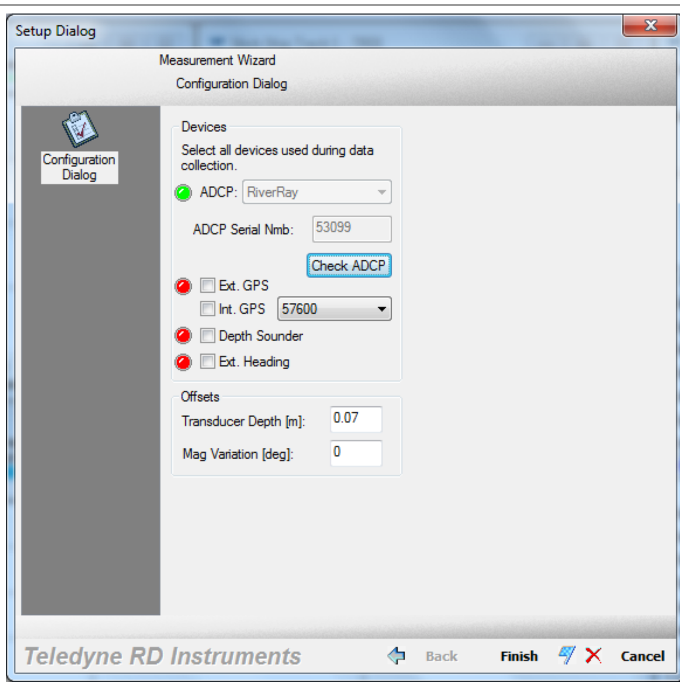
This section has instructions for using the Quick Measurement Wizard option. This wizard provides a quick and simple way to collect data at a site. The measurement name will be generated automatically and user input is limited to items needed for proper ADCP configuration at the site. The ADCP will automatically start pinging on completion of the wizard. The user can then collect moving bed tests, discharge transects, or stop pinging and execute any desired QA/QC functions.

Connect the ADCP

Connect the ADCP and computer as shown in your ADCP manual.

Mount the ADCP on the boat at the desired depth (see the Rio Grande, RiverRay, RiverPro/RioPro, and StreamPro manuals for details).

Quick Measurement Wizard



Start *WinRiver II*.

On the **File** menu, click **Quick MMT**.

The Quick Measurement Wizard will establish communications with the ADCP (see chapter 2 for details), set the ADCP type and serial number, and a default transducer depth.

Select any additional devices to be used.

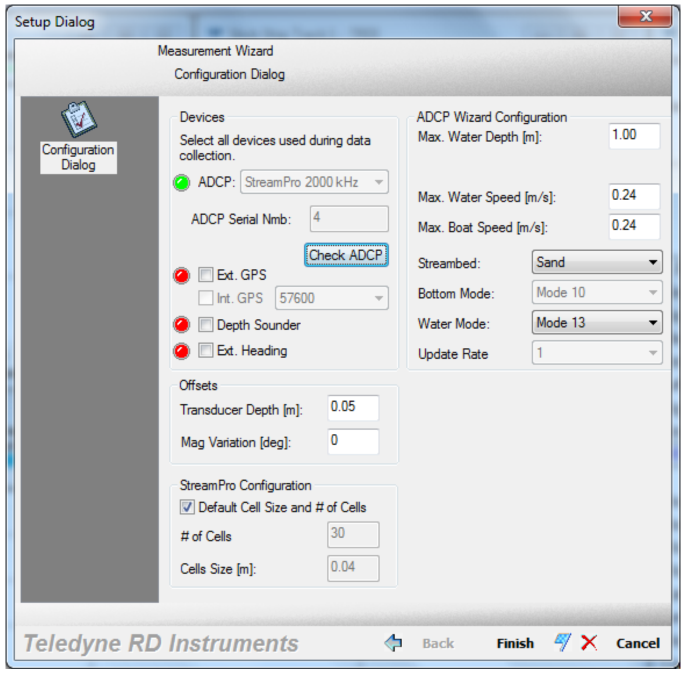
Enter/verify the **Transducer Depth and Magnetic Variation**. For StreamPro and Rio Grande, select/enter your choices for the remaining configuration dialog items such as water depth, water velocity, boat speed, and modes.

Click **Finish**.

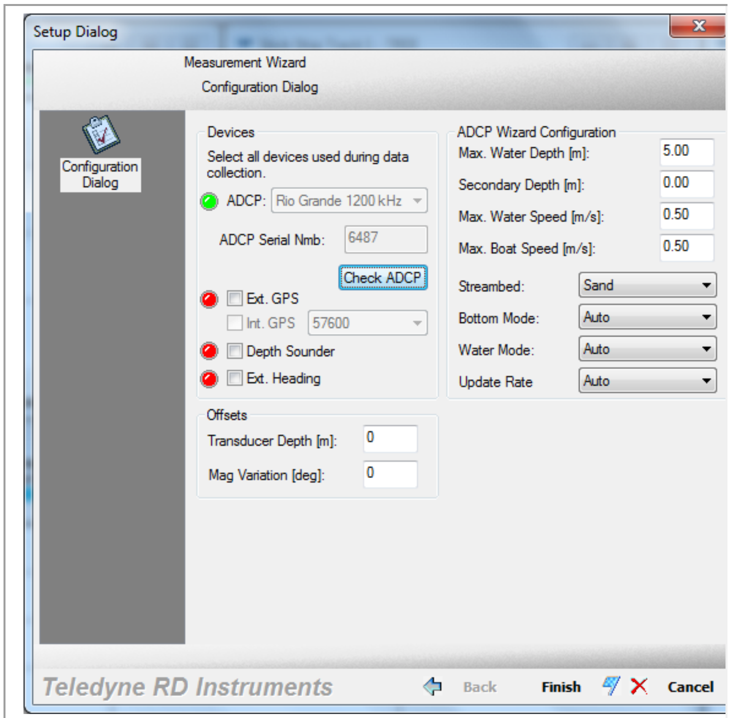
The Set Clock dialog may automatically appear, after which the ADCP will start pinging.

Collect your measurement data as described in the tutorial How to Collect River Discharge Data.

The Quick MMT icon ( ) on the toolbar will also start the wizard.



Example StreamPro Quick Measurement Configuration dialog showing the default settings.



Example Rio Grande Quick Measurement Configuration dialog showing the default settings.

Tutorial – Using Integrated GPS Capability

The RiverRay, RiverPro, and RioPro ADCPs support integration of GPS data into the ADCP data stream. This approach minimizes the potential for latency in the GPS data and does not require a dedicated communications channel between the GPS receiver and the user's computer.

Advantages

- Single input to WinRiver II
- Less potential for GPS data latency
- Simpler integration, especially with float
- Supports integration of heading data from vector GPS systems

Disadvantages

- No separate GPS text file
- Can't set ADCP time from GPS

GNSS vs GPS: GNSS stands for Global Navigation Satellite System. It is the technical terminology used to encompass all satellite based navigation systems including the US GPS system, the Russian GLONASS system, China's BeiDou system, and others. GPS (Global Positioning System) technically includes only the US system of satellites, but that distinction is generally overlooked in common usage and is more widely known and understood, thus is used exclusively in this manual.

GPS Kits for use with ADCPs

Sub-meter accuracy is generally adequate for ADCP discharge measurement purposes, but higher precision may be desirable in applications with short transect lengths, slow water and/or boat speeds, or in specific applications. A variety of GPS wiring/mounting kits and complete GPS systems are available from TRDI with support for GPS equipment from Hemisphere, Trimble, Leica, Novatel, and other manufacturers. GPS equipment ranging from single-frequency, single constellation, position-only systems to multi-frequency, multiple constellation, and vector (heading) systems can be provided. Please contact TRDI or your local sales representative for more information or recommendations.

Contact your local sales representative if you are interested in purchasing a GPS wiring/mounting kit or a complete GPS system.

To integrate GPS data into the RiverRay ADCP:

Configure the GPS receiver for operation as desired. Note the baud rate used for NMEA 0183 output.

The baud rate must be greater than 9600. The recommended baud rate is 57600 or 115,200.

Connect the GPS receiver to the RiverRay using the appropriate wiring harness and interconnect cable(s).

Trimble DSM-232 DGPS kit shown

Mount the GPS antenna above the ADCP.

Apply power to the ADCP/GPS.

Verifying the ADCP is Receiving GPS Data

```
CBREAK

RiverPro
Teledyne RD Instruments (c) 2015
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Firmware Version: 56.03


>SF0
External NMEA status: NO DATA,  baud option 3
        Baud rate 4800(3)
Usage: SF <option>
Options:
  0    help
  1    status
  2    toggle diagnostics
  3-8  baud code; 3=4800, 4=9600, 5=19200, 6=38400,
7=57600, 8=115200
  9    enable baud detection
  10   detect baud now
  -1   disable
  11   enable
  20   message list sub-menu

>
```

To verify that the ADCP is receiving GPS data:

Open *BBTalk* and connect to the ADCP. After sending a break type SF0 to show all the SF command settings.

If you know the baud rate use the appropriate SF command SF3-8 and skip the next step.

```
>sf9
External NMEA baud detection enabled (9)

>sf10
External NMEA device baud detection

Is External NMEA device attached and running...[Y]|N
Y
Try baud rate 4800(3).
Try baud rate 9600(4).
Try baud rate 19200(5).
Try baud rate 38400(6).
Try baud rate 57600(7).
Try baud rate 115200(8).
Found new baud rate 115200(8).  Save? Y|[N]. Y..
>
```

If you do not know the GPS baud rate, type SF9 (auto-dect) or SF10 (manual baud rate detection).

```
>sf2
External NMEA diagnostics ON, pinging disabled

>NMEA External NMEA (3):  Rx Buffer:$GPGGA,090307.2
NMEA External NMEA (3):  Rx
Buffer:0,3237.182754,N,11713.812833,W,2,05,2.50,5.00
,M,0.00,M,000,0111*4A<CR><LF>$GPVTG,76.222,T,,,4.509,
N,8.350,K,D*70<CR><LF>$GPDB
T,23.083,f,7.036,M,138.498,F*31<CR><LF>$GPHDT,76.2,T*
06<CR><LF>
$GPGGA,090307.20,3237.182754,N,11713.812833,W,2,05,2.
50,5.00,M,0.00,M,000,0111*4A
$GPVTG,76.222,T,,,4.509,N,8.350,K,D*70
$GPDBT,23.083,f,7.036,M,138.498,F*31
$GPHDT,76.2,T*06
$GPGGA,090307.30,3237.182787,N,11713.812685,W,2,05,2.
50,5.00,M,0.00,M,000,0111*46
$GPVTG,75.202,T,,,4.679,N,8.665,K,D*76
$GPDBT,23.032,f,7.020,M,138.193,F*32
$GPHDT,75.2,T*05
$GPGGA,090307.40,3237.182822,N,11713.812539,W,2,05,2.
50,5.00,M,0.00,M,000,0111*45
```

Type SF2 to view the data coming from the GPS; This is an example of a working GPS that is outdoors providing fixes.

```
>sf2
External NMEA diagnostics ON, pinging disabled
$GPGGA,160832.989,,,,,0,0,,,M,,M,,*4E
$GPVTG,0.00,T,,M,0.00,N,0.00,K,N*32
```

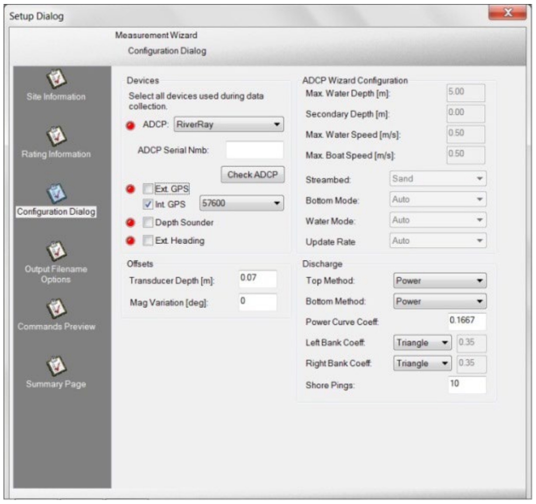
If your GPS is indoors, you will see the following NON fully populated messages. However, they should have the correct format and the checksum (*XX) at the end.

```
>sf2
External NMEA diagnostics ON, pinging disabled
NMEA External NMEA (3):  Rx Buffer:$
<01>I<86><84>e<84><a6><a5><e5><a4><84>Z
NMEA External NMEA (3):  Rx
Buffer:fX<a4>X<c7>$<a4><c5><c1>*<84><a6>w<c4><e4>DF<
86>I<c4><c2>D<c4><84><84>g@<83><01><81><c1><85><e5><a
4>*<c0><c6><e4>]<c5>-<e6><c
6><c6><c3><e0><c4><02>$<ac><c1><86>9)<95><b1>9<d5><d1
><cb><a9><8d><a9>MN<f5><a4>
7<08>{V<ab><af><c0>k'<fe>
NMEA ERROR: Second end character(\n) NOT found f
```

If the baud rate is incorrect you will **NOT** see the NMEA messages but instead the following:

If the GPS baud rate is not close to your SF baud rate setting, you may not even see this message.

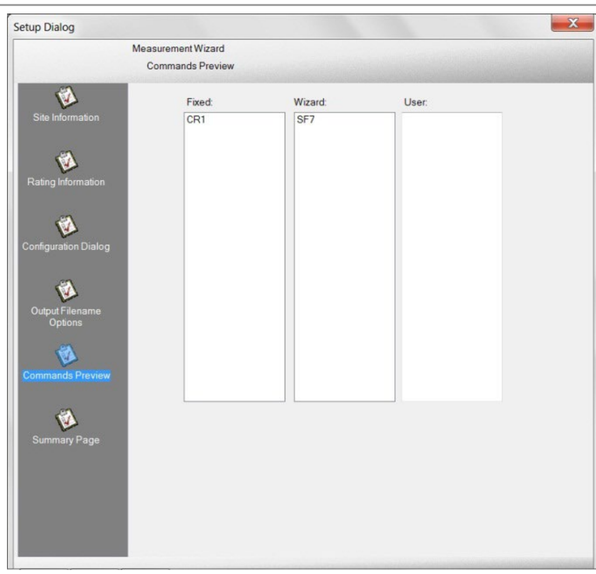
Do not proceed to using *WinRiver II* if you want to use GPS data until you can see good GPS messages in *BBTalk* as *WinRiver II* will only display properly formatted and fully populated messages.



Start WinRiver II.

Using the **Measurement Wizard** Configuration Dialog, select the checkbox for **Int. GPS** and configure the baud rate to match that of the receiver.

The baud rate must be greater than 9600. The recommended baud rate is 57600 or 115,200.



On the **Commands Preview** page, verify the SF command was added.

SF3 = 4800 baud

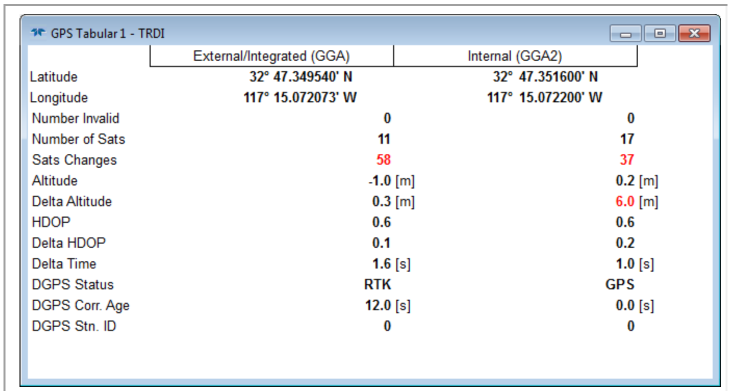
SF4 = 9600 baud

SF5 = 19200 baud

SF6 = 38400 baud

SF7 = 57600 baud

SF8 = 115200 baud

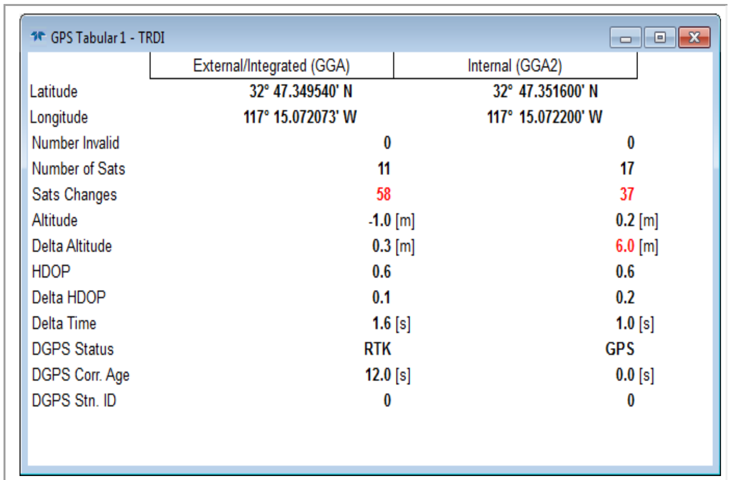


On the **Acquire** menu click **Start Pinging** or use the shortcut key **F4**.

The **GPS Tabular 1** (see Chapter 6 – Available Displays) screen will show the GPS data.

Tutorial – Using the RiverPro/RioPro Internal GPS

The RiverPro/RioPro and newer RiverRay (Q4 2015 production or newer) ADCPs incorporate an internal GPS module intended for GeoReference purposes. *WinRiver II* provides status of this module and displays the data during both data collection and playback. The ADCP captures the GGA and VTG NMEA strings from the internal GPS module and reports them in the PD0 data stream using the general NMEA format. No user action is required to obtain this data, however, the GPS module antenna inside the ADCP must have an unobstructed view of the sky in order to successfully obtain the GPS satellite signals. Metallic mounts covering the ADCP, or submersion of the ADCP below the water surface, will preclude successful operation of the internal GPS module.


GPS Tabular 1 - TRDI

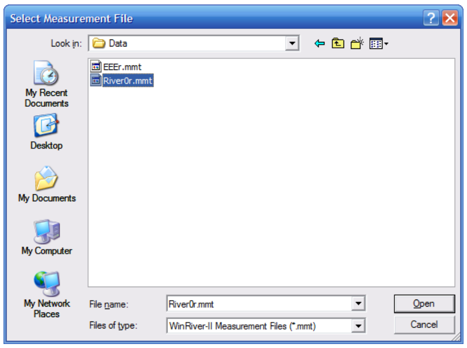
	External/Integrated (GGA)	Internal (GGA2)
Latitude	32° 47.349540' N	32° 47.351600' N
Longitude	117° 15.072073' W	117° 15.072200' W
Number Invalid	0	0
Number of Sats	11	17
Sats Changes	58	37
Altitude	-1.0 [m]	0.2 [m]
Delta Altitude	0.3 [m]	6.0 [m]
HDOP	0.6	0.6
Delta HDOP	0.1	0.2
Delta Time	1.6 [s]	1.0 [s]
DGPS Status	RTK	GPS
DGPS Corr. Age	12.0 [s]	0.0 [s]
DGPS Stn. ID	0	0

On the **Acquire** menu click **Start Pinging** or use the shortcut key **F4**.

The **GPS Tabular 1** (see Chapter 6 – Available Displays) screen will show the GeoReference GPS data .

Tutorial – How to View Data

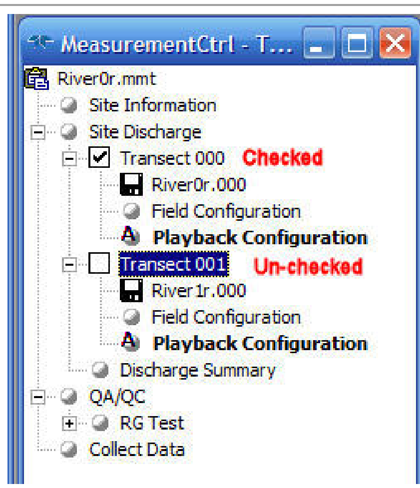
WinRiver II is used for post-processing data to get a total discharge value for the channel. After collecting four transects for each station on the water body, each file must be verified to be within 5% of the mean discharge calculated for the set. If any of the transects are outside of the tolerance, additional transects should be measured.



Start *WinRiver II*.

On the **File** menu click **Open Measurement…**

Select the measurement file (**.mmt*) to be played and click **Open**.

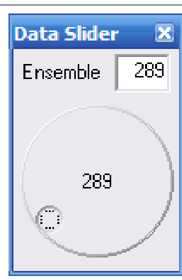


To playback a data file, use the **Playback** menu and select **Reprocess Checked Transects** (click the check box to select the files). This will create a copy of the **Field Configuration node** and creates a **Playback Configuration node**.

The data files will automatically play to the end of the file.

To playback a single data file, click the transect to select it and then use the **Playback** menu and select **Reprocess Selected Transect**.

To playback the next transect file, on the **Playback** menu and select **Reprocess Next Transect**.

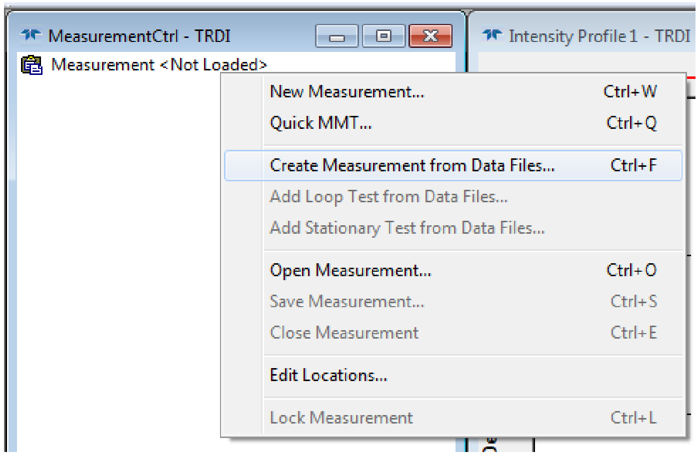


On the **Playback** menu, click **First Ensemble** to go to the beginning of the data file. Click **Play** to review the data. To quickly play through the data, on the **Playback** menu, select **Slider** or drag the ensemble marker on the contour plot.

The playback tool bar also has functions to start, stop, rewind, and go to the end of the data file.

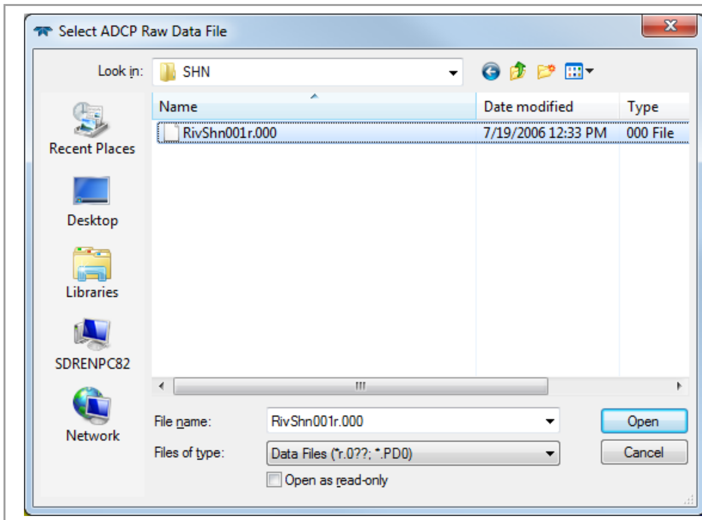
Tutorial – How to View StreamPro Data

Use this tutorial to view data collected with the handheld iPAQ and StreamPro software.



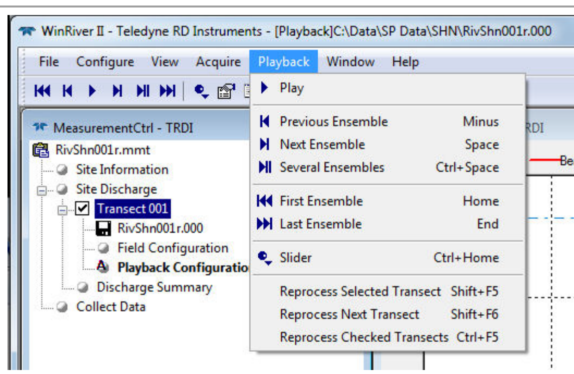
Start *WinRiver II*.

Right-click on the measurement file name and click **Create Measurement from Data Files**.



Select the StreamPro data files (**r.000*).

For every successful transect, *StreamPro* creates a raw data file in the syntax of **r.000* matched to a **r.xml* configuration file.



To playback a data file, use the **Playback** menu and select **Reprocess Checked Transects** (click the check box to select the files). This will create a copy of the **Field Configuration node** and creates a **Playback Configuration node**.

The data files will automatically play to the end of the file.

To playback a single data file, click the transect to select it and then use the **Playback** menu and select **Reprocess Selected Transect**.

To playback the next transect file, on the **Playback** menu and select **Reprocess Next Transect**.

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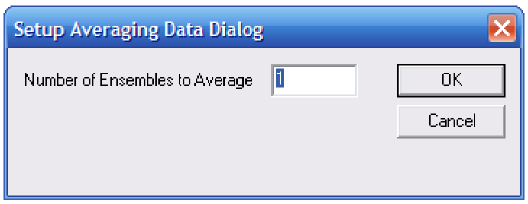
Tutorial – How to Reprocess Data

WinRiver II is used for post-processing data to get a total discharge value for the channel. Common post-processing tasks include changing your averaging interval, subsection the data to remove bad ensembles or show only a section of the river, export data for use in other programs, screen data, and make corrections to the configuration nodes.

Averaging Data



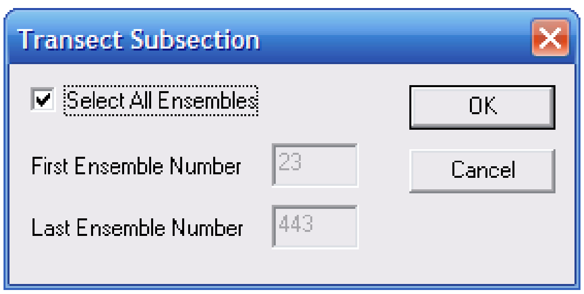
Right-click on **Site Discharge** and click **Averaging Data**.

Increase the **Number of Ensembles to Average**.

Click **OK**. Playback/reprocess the data files.

Single ping ensembles are recommended for data collection.

Transect Subsection



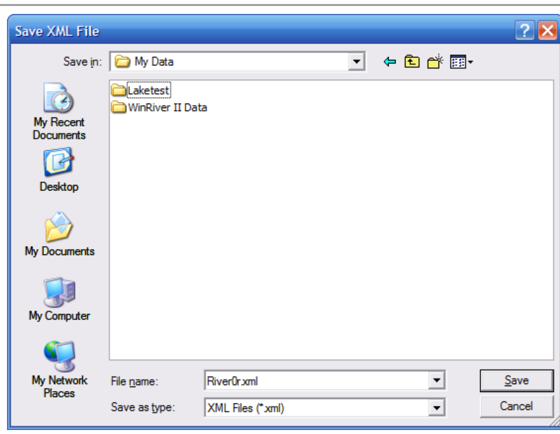
Select the transect file to be subsectioned on the **Measurement Control** window.

Right-click on **Transect** and click **Transect Subsection**.

To select a portion of the data file, uncheck the **Select All Ensembles** box. Enter the **First Ensemble Number** and **Last Ensemble Number** and select **OK**. The file will be reprocessed automatically.

To return to the entire data file, right-click on **Transect** and click **Transect Subsection**. Check the **Select All Ensembles** box. Click **OK**. The file will be reprocessed automatically.

HYDROML Export



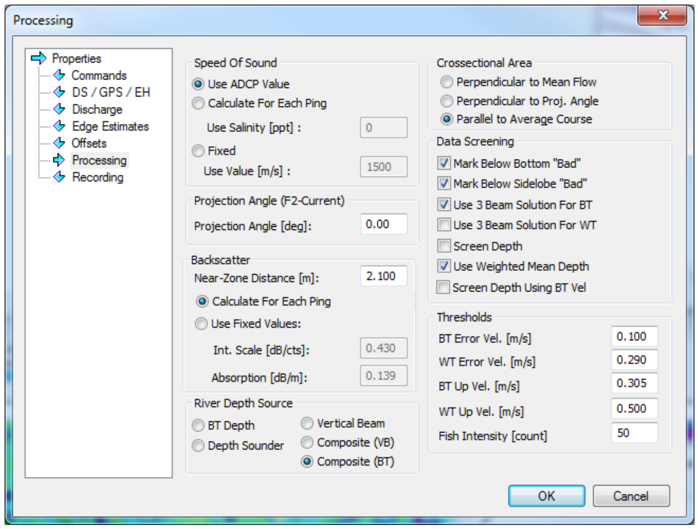
Playback/reprocess the data file.

On the **File** menu select **Export as HYDROML**.

Select where to save the file and click **Save**.

HYDROML.XML provides the Hydrologic Scientific Community with a standard structure to allow the definition of hydrologic information.

Data Screening



To change the data screening for a selected data file, right-click on the **Playback Configuration node** and select **Properties**.

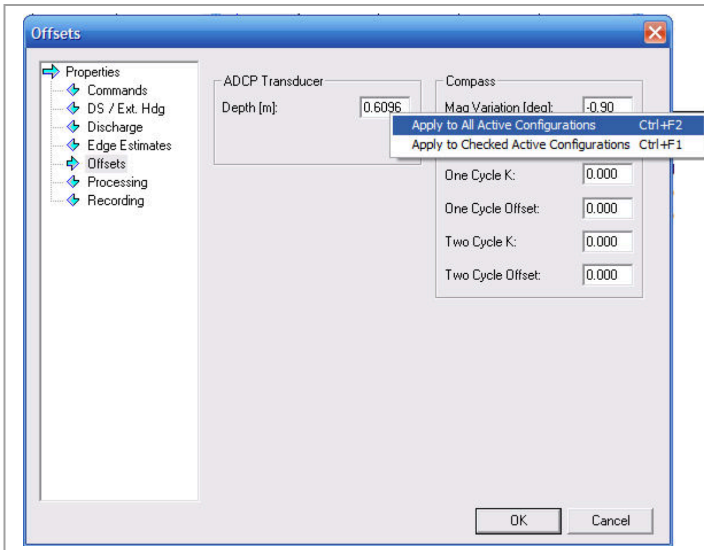
Select the **Processing** page. Change the settings as needed.

Click **OK**.

The selected data file will playback automatically.

The settings will apply only to the **Playback Configuration node**; the raw data file will not be changed.

Corrections to the Playback Configuration Node



Right-click on the **Playback Configuration node** and select **Properties**.

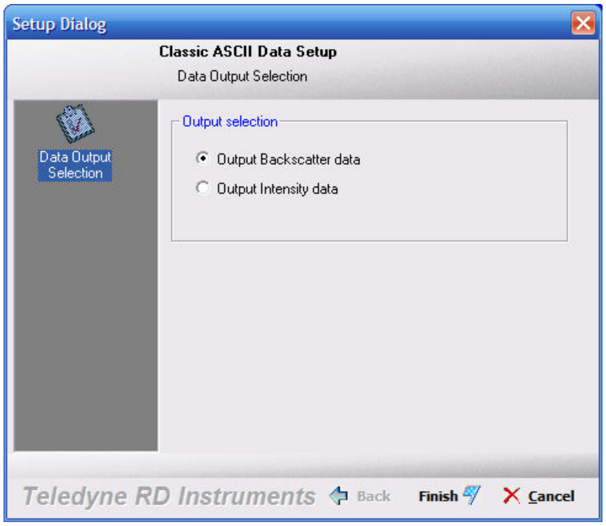
Make the correction.

If the change applies to only one **Playback Configuration node**, click **OK**.

If the change applies to multiple **Playback Configuration nodes**, then right-click the edited item and select **Apply to All Active Configurations** (this makes the correction to all of the configuration nodes: checked or not checked) or **Apply to Checked Active Configurations** (the correction applies only to checked configuration nodes).

Click **OK**.

ASCII-Out



Start *WinRiver II* and load a measurement file.

On the **Configure** menu, click **ASCII Output**, **Classic ASCII Output**.

Select **Output Backscatter** data or **Output Intensity** data.

Click **Finish**.

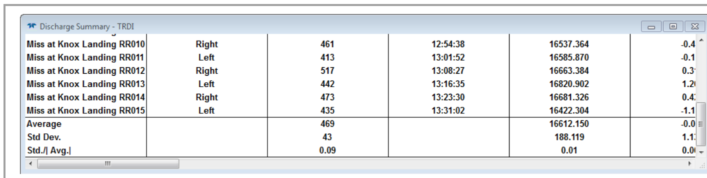
Playback / reprocess the desired transect.

You must replay the data after the first time you finish the **Classic ASCII Data Setup** (which creates a template) to create the ASCII file. If any change is made to the setup (template) you must replay the data to see the latest ASCII data.

The **Generic ASCII Output** allows you to select what ASCII data and in what order you would like it to be displayed in the file.

If you see an error message *"The File does not exist!"* when you double-click the *_ASC.TXT node, this means the file must be played / reprocessed first.

Discharge Summary



Discharge Summary - TRDI

Miss at Knox Landing RR010	Right	461	12:54:38	16537.364	-0.4
Miss at Knox Landing RR011	Left	413	13:01:52	16585.870	-0.1
Miss at Knox Landing RR012	Right	517	13:08:27	16663.384	0.3
Miss at Knox Landing RR013	Left	442	13:16:35	16820.902	1.2
Miss at Knox Landing RR014	Right	473	13:23:30	16681.326	0.4
Miss at Knox Landing RR015	Left	435	13:31:02	16422.304	-1.1
Average		469		16612.150	-0.0
Std Dev.		43		188.119	1.1
Std./| Avg.|		0.09		0.01	0.0

The **Discharge Summary** is an easy way to review transects. It is opened by selecting **View**, **Discharge Summary** or by using the shortcut key **F12.**

The discharge summary shows all recent transects that have been made and all relevant information on them. It can be used for data collection and playback and is very effective at establishing whether a measurement is good or not.

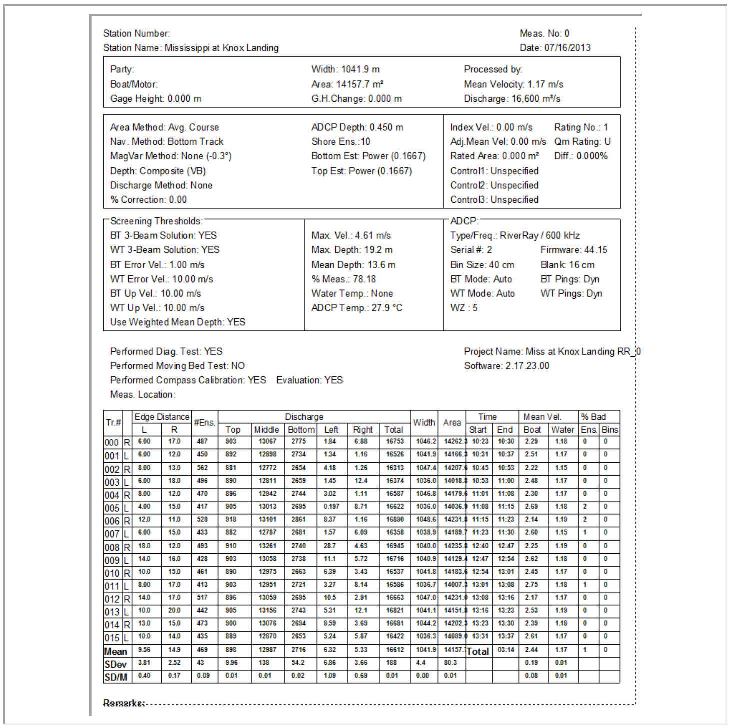
To add or remove transects from the summary, use the **Measurement Control** widow. Checking the **Transect XXX** box (where XXX is the transect number) will add the transect; un-checking the box will remove the transect from the summary.

As a standard for all ADCP users it is widely accepted that transects should be within 5% of each other assuming constant stage.

The ADCP operator must make sure that the maximum permissible relative residual (MPRR) is met before leaving the site (see Dynamic Residual Analysis).

Tutorial – How to Use the Q Measurement Summary

The Q Measurement Summary creates a summary of the measurement that can be printed.



Station Number:
Station Name: Mississippi at Knox Landing
Meas. No: 0
Date: 07/16/2013

Party:
Boat/Motor:
Gage Height: 0.000 m
Width: 1041.9 m
Area: 14157.7 m²
G.H.Change: 0.000 m
Processed by:
Mean Velocity: 1.17 m/s
Discharge: 16,600 m³/s

Area Method: Avg. Course
Nav. Method: Bottom Track
MagVar Method: None (-0.3°)
Depth: Composite (VB)
Discharge Method: None
% Correction: 0.00
ADCP Depth: 0.450 m
Shore Ens.:10
Bottom Est: Power (0.1667)
Top Est: Power (0.1667)
Index Vel.: 0.00 m/s
Rating No.: 1
Adj.Mean Vel: 0.00 m/s
Qm Rating: U
Rated Area: 0.000 m²
Diff.: 0.000%
Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: YES
BT Error Vel.: 1.00 m/s
WT Error Vel.: 10.00 m/s
BT Up Vel.: 10.00 m/s
WT Up Vel.: 10.00 m/s
Use Weighted Mean Depth: YES
Max. Vel.: 4.61 m/s
Max. Depth: 19.2 m
Mean Depth: 13.6 m
% Meas.: 78.18
Water Temp.: None
ADCP Temp.: 27.9 °C
ADCP:
Type/Freq.: RiverRay / 600 kHz
Serial #: 2
Firmware: 44.15
Bin Size: 40 cm
Blank: 16 cm
BT Mode: Auto
BT Pings: Dyn
WT Mode: Auto
WT Pings: Dyn
WZ : 5

Performed Diag. Test: YES
Performed Moving Bed Test: NO
Performed Compass Calibration: YES Evaluation: YES
Meas. Location:
Project Name: Miss at Knox Landing RR_0
Software: 2.17.23.00

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	6.00	17.0	487	903	13067	2775	1.84	6.88	16753	1046.2	14262.3	10:23	10:30	2.29	1.18	0	0
001	L	6.00	12.0	450	892	12898	2734	1.34	1.16	16526	1041.9	14166.3	10:31	10:37	2.51	1.17	0	0
002	R	8.00	13.0	562	881	12772	2654	4.18	1.26	16313	1047.4	14207.6	10:45	10:53	2.22	1.15	0	0
003	L	6.00	18.0	496	890	12811	2659	1.45	12.4	16374	1036.0	14018.8	10:53	11:00	2.48	1.17	0	0
004	R	8.00	12.0	470	896	12942	2744	3.02	1.11	16587	1046.8	14179.6	11:01	11:08	2.30	1.17	0	0
005	L	4.00	15.0	417	905	13013	2695	0.197	8.71	16622	1036.0	14036.9	11:08	11:15	2.69	1.18	2	0
006	R	12.0	11.0	528	918	13101	2861	8.37	1.16	16890	1048.6	14231.8	11:15	11:23	2.14	1.19	2	0
007	L	6.00	15.0	433	882	12787	2681	1.57	6.09	16358	1038.9	14189.7	11:23	11:30	2.60	1.15	1	0
008	R	18.0	12.0	493	910	13261	2740	28.7	4.63	16945	1040.0	14235.8	12:40	12:47	2.25	1.19	0	0
009	L	14.0	16.0	428	903	13058	2738	11.1	5.72	16716	1040.9	14129.4	12:47	12:54	2.62	1.18	0	0
010	R	10.0	15.0	461	890	12975	2663	6.39	3.43	16537	1041.8	14183.6	12:54	13:01	2.45	1.17	0	0
011	L	8.00	17.0	413	903	12951	2721	3.27	8.14	16586	1036.7	14007.3	13:01	13:08	2.75	1.18	1	0
012	R	14.0	17.0	517	896	13059	2695	10.5	2.91	16663	1047.0	14231.0	13:08	13:16	2.17	1.17	0	0
013	L	10.0	20.0	442	905	13156	2743	5.31	12.1	16821	1041.1	14151.8	13:16	13:23	2.53	1.19	0	0
014	R	13.0	15.0	473	900	13076	2694	8.59	3.69	16681	1044.2	14202.3	13:23	13:30	2.39	1.18	0	0
015	L	10.0	14.0	435	889	12870	2653	5.24	5.87	16422	1036.3	14089.0	13:31	13:37	2.61	1.17	0	0
Mean		9.56	14.9	469	898	12987	2716	6.32	5.33	16612	1041.9	14157.7	Total	03:14	2.44	1.17	1	0
SDev		3.81	2.52	43	9.96	138	54.2	6.86	3.66	188	4.4	80.3			0.19	0.01		
SD/M		0.40	0.17	0.09	0.01	0.01	0.02	1.09	0.69	0.01	0.00	0.01			0.08	0.01		

Remarks:

Start *WinRiver II* and open a measurement file.

To add or remove transects from the summary, use the Measurement Control widow. Checking the **Transect XXX** box will add the transect; un-checking the box will remove the transect from the summary.

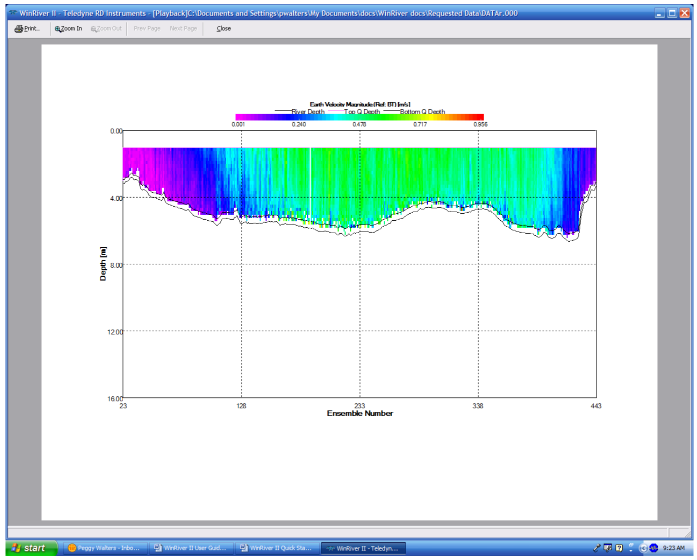
Playback / Reprocess the transects; use the **Playback** menu and select **Reprocess Checked Transects**.

Check/edit the Site Information by right-clicking on **Site Information** in the Measurement Control window and selecting **Site Wizard**.

On the **File** menu, click **Print Preview Q Measurement Summary**.

On the **Q Measurements** screen, click **Print** to print a copy of the discharge summary.

Tutorial – How to Print a Plot or Display



To print a plot or display:

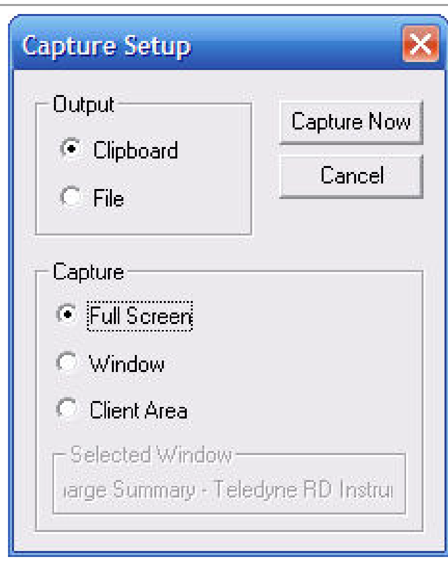
Click on the plot/display to be printed. The title bar will be highlighted.

On the **File** menu, click **Print Setup**. Select the desired setting and printer.

On the **File** menu click **Print Preview**. If the display is acceptable, click **Print**.

Choose **Landscape** for contour plots.

Tutorial – How to Make Screen Captures



To save a plot/display for use in other documents:

Click on the plot/display to be saved. The title bar will be highlighted.

On the **Configure** menu, select **Screen Capture**. This will bring up the **Capture Setup** dialog box.

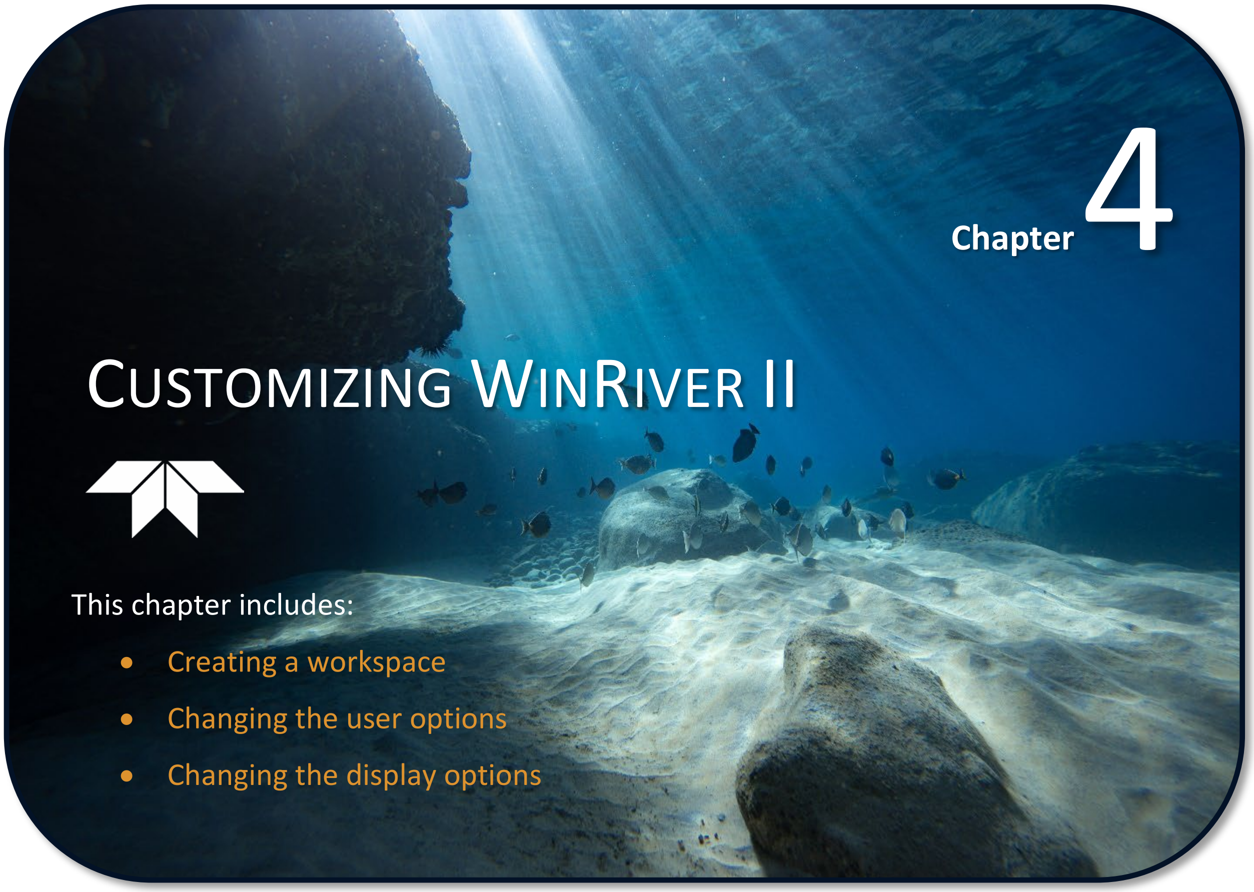
Select **Clipboard** or **File**.

Select **Full Screen**, **Window**, or **Client Area**. The **Client Area** will include all parts of the graph/plot except the title bars.

Click **Capture Now**. If you selected **File**, name the file and click **Save**.

Click **Cancel** to exit this dialog box.

NOTES



Chapter 4

CUSTOMIZING WINRIVER II

This chapter includes:

- Creating a workspace
- Changing the user options
- Changing the display options

Creating a Workspace

A Workspace is a collection of windows arranged and sized, as you prefer. A workspace also includes the Peripheral (Serial Port) configuration, Units, Coordinate System, and Navigation Reference settings. To create a Workspace file, open all the windows you want to see during data collection or post-processing. Open and arrange the views you are interested in. When you have the displays set up the way you prefer, on the **File** menu, click **Save Workspace As**. To use a Workspace file, on the **File** menu, click **Load Workspace**. How workspaces are loaded and saved when starting/closing *WinRiver II* depends on the **User Options** (see General Configuration).

Changing the User Options

On the **File** menu, click **Properties**. The **Properties** dialog sets how *WinRiver II* behaves upon entering the Acquire mode and how workspace files are loaded or saved.

Acquire Mode Properties

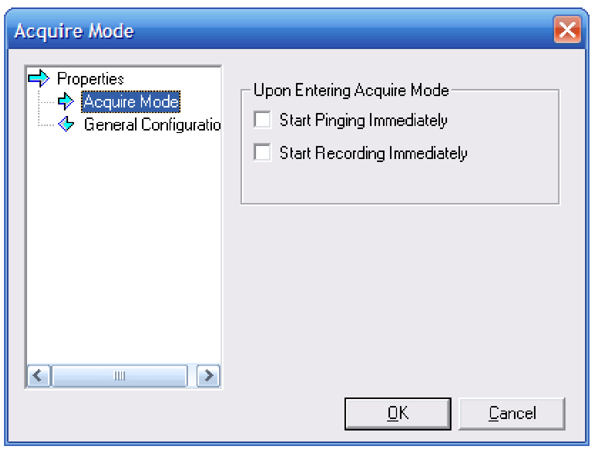


Figure 6. User Options – Acquire Mode

Upon Entering Acquire Mode

- **Start Pinging Immediately** – Select this option if you want the ADCP to begin pinging as soon as the Acquire mode is started.
- **Start Recording Immediately** – Select this option if you want the ADCP to begin recording as soon as the Acquire mode is started.

General Configuration

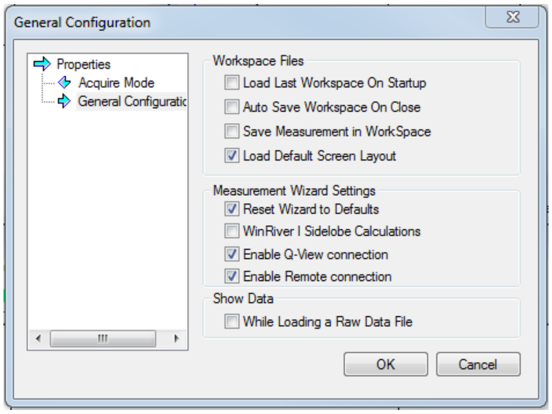


Figure 7. User Options – General Configuration

Workspace Files

- **Load Last Workspace On Startup** – Select this option if you want the same graphs and displays opened as soon as *WinRiver II* is started. This will also set the Peripheral (serial port) configuration, Units configuration, Coordinate System, and Navigation Reference to those stored in the workspace.
- **Auto Save Workspace On Close** – Select this option if you want to automatically save any changes to the workspace whenever *WinRiver II* is exited.
- **Save Measurement in Workspace** – Select this option to include the measurement file with the workspace.
- **Load Default Screen Layout** – Check this box to use the default workspace.

Measurement Wizard Settings

Check the **Reset Wizard to Defaults** box to have the measurement wizard use the default settings based on a WorkHorse Rio Grande 600 kHz ADCP.

Check the **WinRiver I Sidelobe Calculations box** to calculate using an average beam depth rather than a minimum beam depth, more closely matching the calculations in the original *WinRiver*. This option is OFF by default.

Check the **Enable Q-View connection** box to enable the generation of data used by the *Q-View software*. Unchecking this box will disable the *Q-View connection and suppress generation of the *.nc files*.

Check the **Enable Remote Connection** box to enable the use of the Acquire Dashboard. This box will be enabled by default. You may receive a Windows-generated warning dialog about accessing a port when you first run *WinRiver II* with this option selected; *WinRiver II* will function correctly whether you allow or deny that access.

Show Data

Check the **While Loading a Raw Data File** box to begin displaying data while the file is loading. For smaller data files, this may not be noticeable.

Changing the Display Options

The following options are available for all graphs.

All graph scales and font sizes are user-selectable in real-time by right-clicking on the graph and selecting **Properties**.

Changing Units

To change the units for all displays, on the **Configure** menu, select **Units**. You can change units to **All English**, **All SI** or use the **Advanced** menu and select each unit for **Velocity**, **Range**/**Depth**, and **Temperature**.

When using a StreamPro ADCP on small streams/channels, change the Velocity units to mm/s or cm/sec. This will change the discharge to mm^3/s or cm^3/s.

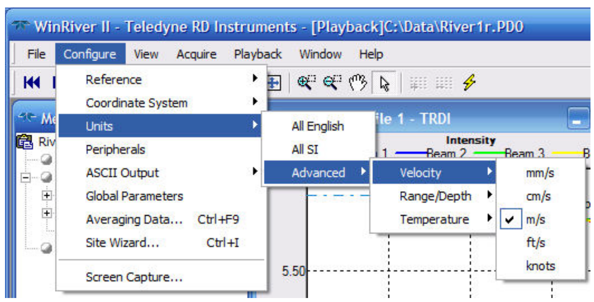


Figure 8. Changing the Units

Changing the Reference

To change the reference, on the **Configure** menu, select **Reference**. You can select one of the following references.

- **Bottom Track** – ADCP Bottom-Track velocity (standard configuration).
- **GPS (GGA)** – Differential GPS position from NMEA GGA string (*WinRiver II* will differentiate position to calculate the boat's velocity).
- **GPS (VTG)** – GPS velocity from NMEA 0183 VTG string.
- **None** – No reference is used.

If the wrong reference is selected during post-processing, data may not display. For example, if you select GPS (GGA) as the reference during post-processing and this was not collected when the data file was created, no data will display.

Coordinate System

To change the coordinate system, on the **Configure** menu, select **Coordinate System**. The default coordinate system is **Earth**. If the data were collected in another coordinate system, you can view them after reprocessing the file. The other options (**Beam**, **XYZ**, **Ship**) become available after the data are reprocessed. Most *WinRiver II* data are recorded in the **Beam** or **Ship** coordinate system.

> The equivalent coordinate system "as received from the ADCP" is to select Beam or Ship coordinates. Earth is always the default.

Global Parameters

To change the global parameters of the displays, select the **Configure** menu, and click **Global Parameters**. This menu allows changes to the number of sections on the X and Y axis, the Grid Lines (visible, style, and color), and Background Color. To return to the factory defaults and the default window layout, check the **Reset to Factory Defaults** box and select **Apply**.

To switch between the **Standard Definition Contour** and the **High Definition Contour**, check the **High Definition Contour Display** box and then click **Apply**.

> The High Definition Contour Display is reset to On (checked) each time *WinRiver II* is started. You will see High Definition in the contour chart title.
>
> The High Definition Contour display never "hides", "masks" or removes bad data.

Click **OK** to exit the screen.

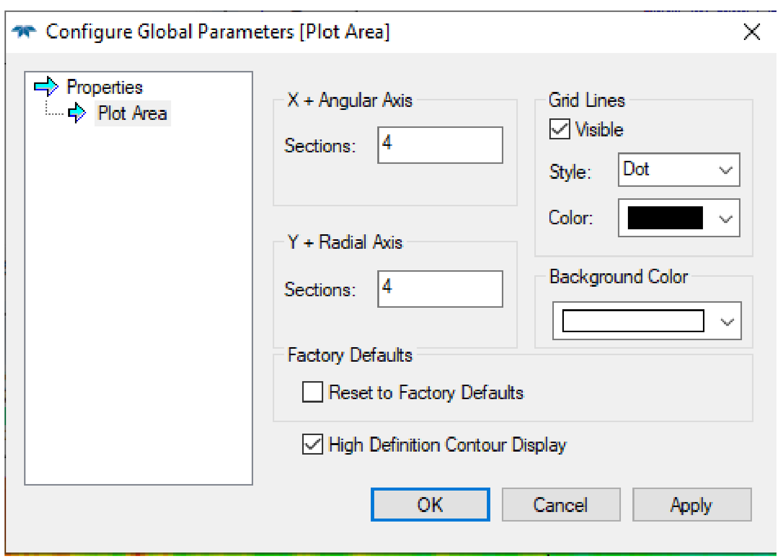
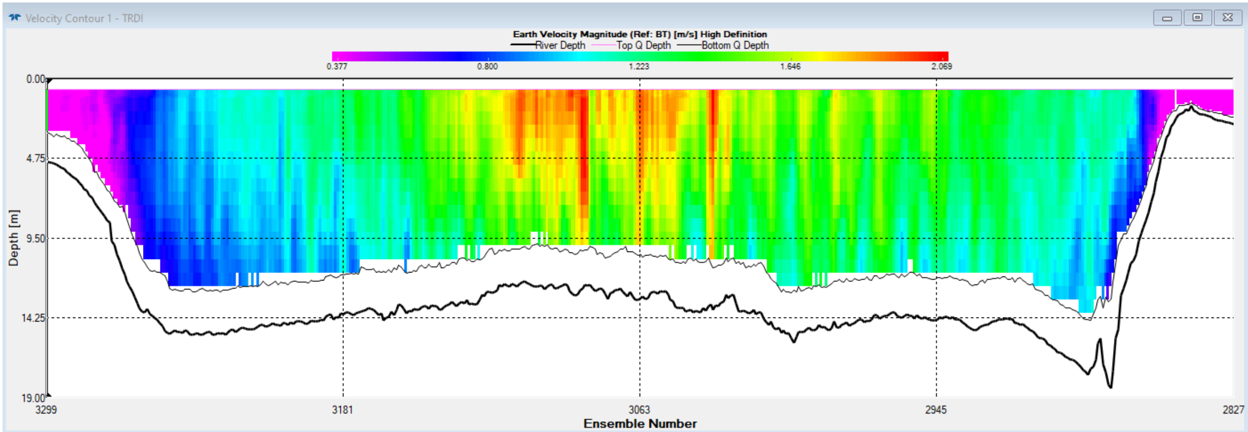
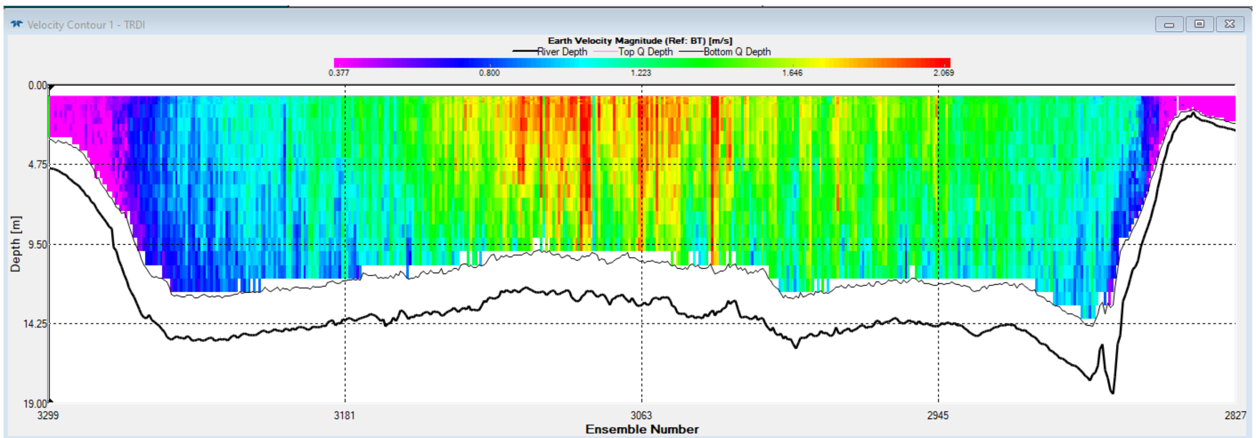


Figure 9. Global Parameters for Graphs





Comparison between the High Definition Contour (top) and the Standard Definition Contour (bottom) plots

Zoom Functions

- **Zoom to Extents** – click the blue title bar at the top of the window to select the graph and then click the **Zoom to Extents** button on the toolbar ( ). The data will be zoomed to the full graph width.
- **Zoom In** – Click the Zoom In ( ) button on the toolbar. The cursor will change to a "+" magnifying glass. Hold down the left mouse button and drag over an area on the window to zoom in. The chosen region will be zoomed to the full graph width.
- **Zoom Out** – Click the Zoom Out ( ) button on the toolbar. The cursor will change to a "-" magnifying glass. Hold down the left mouse button and drag over an area on the window to zoom out.
- **Pan** – Use the **Pan** button on the toolbar ( ) to move the graph data as needed.
- **Arrow** – Use the Arrow button on the toolbar to identify the data under the cursor point.

Chapter 5

Using the Measurement Control Window

This chapter includes:

- Using the Measurement Control menus
- Field and playback configuration nodes

The Measurement Control Window gives the user a quick and easy way to manage the files used in a measurement. It uses a tree structure; click the + box to expand the list or – to collapse. Right-clicking on a name will bring up menus to quickly access different functions.

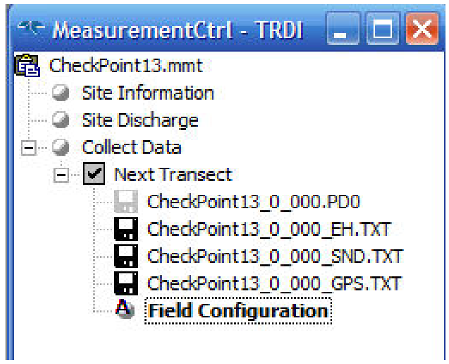


Figure 10. Measurement Control Window

Using the Measurement File Name Menu

Right-click on the measurement file name to display the following menu. If a measurement file is not already open, only the **New Measurement**, **Quick Measurement**, **Create Measurement from Data Files**, **Open Measurement** and **Edit Locations** menu items are available.

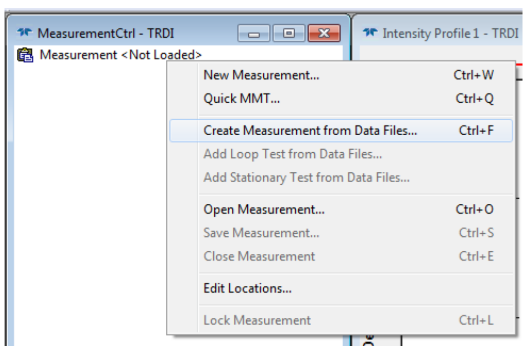


Figure 11. Measurement Control - Measurement Menu

New Measurement

Select **New Measurement** to start the Measurement Wizard (see Using the Measurement Wizard). If a measurement is already open, you will be prompted to save the current measurement.

Quick MMT

Select **Quick MMT…** to start the Quick Measurement Wizard (see Using the Quick Measurement Wizard). If a measurement is already open, you will be prompted to save the current measurement.

Create Measurement from Data Files

Use **Create Measurement from Data Files** and select one or more data files to create a measurement. This is the only way to playback data files collected with StreamPro ADCPs (see Playback StreamPro Data Files) or earlier versions of *WinRiver* (see Playback Older Data Files). Stationary and Loop Tests should not be included when creating a measurement from data files – they should be added separately as described in the following two paragraphs.

Add Loop Test from Data Files

Select **Add Loop Test from Data Files** and select one or more loop test data files to add it to an existing measurement. This is the only way to correctly playback a loop test data file collected with the StreamPro software or earlier versions of *WinRiver II*. See Moving Bed Test for more details.

Add Stationary Test from Data Files

Select **Add Stationary Test from Data Files** and select one or more stationary test data files to add it to an existing measurement. This is the only way to correctly playback a stationary test data file collected with the StreamPro software or earlier versions of *WinRiver II*. See Moving Bed Test for more details.

Open Measurement

To open a measurement file, on the **File** menu, select **Open Measurement**. On the **Select Measurement File** dialog, select the measurement file and click **Open**.

Save Measurement

Use the Measurement Wizard to setup *WinRiver II* (see Using the Measurement Wizard). Once the Measurement Wizard is completed, on the **File** menu, select **Save Measurement**. Enter the **File name** and select **Save**. *WinRiver II* will automatically add the file extension **.mmt*.

> *WinRiver II* automatically saves the measurement file each time you start/stop a transect. Large numbers of transects in a measurement file may effect computer performance as the measurement file size increases.

Close Measurement

To close a measurement file, on the **File** menu, select **Close Measurement**. On the **Close Measurement Confirmation** dialog, select **Yes** to close the measurement file.

Edit Locations

Click **Edit Locations** to open the Edit Locations screen. For more information, see Chapter 11 – Using Locations.

Lock Measurement

Use **Lock Measurement** to write protect the measurement file. If a measurement file is locked, any changes made to the playback configuration nodes will not be saved unless the measurement file is first "unlocked". This prevents accidental saving of changes made to configuration nodes while "experimenting" with different settings. To lock a measurement file, right-click on the **measurement file name** and select **Lock Measurement**. To unlock a measurement file, right-click on the **measurement file name** and select **Unlock Measurement**. The icon next to the measurement file name will change from a lock to a clipboard to let you see if it is locked or not.

Using the Site Information Menu

Right-click on **Site Information;** this opens the wizard and allows changes to the **Site Information** (see Site Information) and **Rating Information** (see Rating Information) pages of the wizard. If changes are made, save the measurement file.

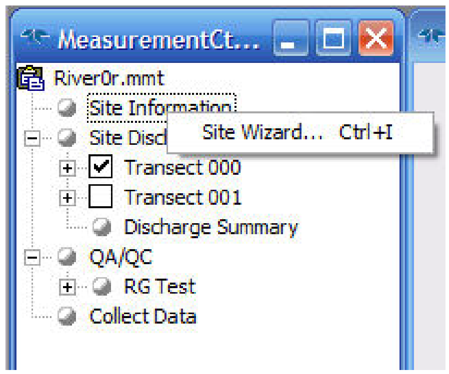


Figure 12. Measurement Control - Site Information Menu

Using the Site Discharge Menu

Right-clicking on **Site Discharge** will display the following menu.

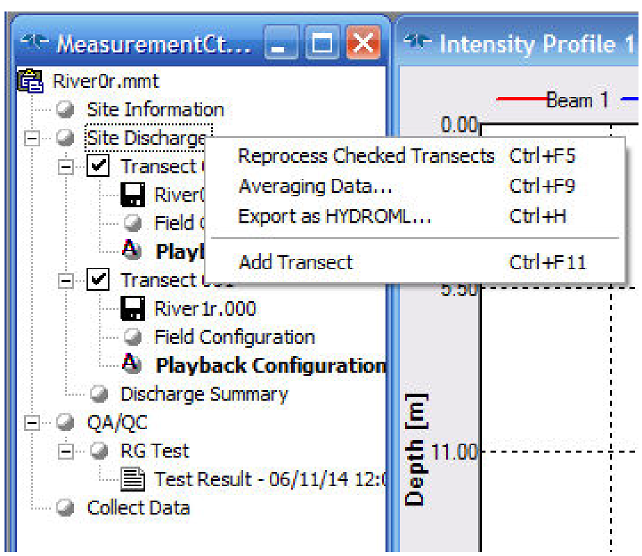


Figure 13. Measurement Control - Site Discharge

Reprocess Checked Transects

Use this function to reprocess all of the checked transects. They will playback one after the other.

Averaging Data

Use this function to select the number of ensembles to average. Single ping ensembles are recommended for data collection. During post-processing, data may be averaged by increasing the **Number of Ensembles to Average**.

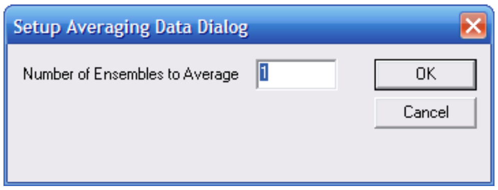


Figure 14. Averaging Data

Export as HYDROML

Use this function to export the discharge summary as the HYDROML formatted xml file. HYDROML.XML is an extension of the eXtensible Markup Language (XML) providing the Hydrologic Scientific Community with a standard definition of XML tags and concepts of structure to allow the definition of hydrologic information.

The goal of HYDROML is to:

- Enable hydrologic data to be exchanged between persons and organizations,
- Enable hydrologic data to be exchanged between data collection devices and data bases, and
- Enable hydrologic data to be served, received, and processed on the Web.
- For more information, please visit http://water.usgs.gov/nwis_activities/XML/nwis_hml.htm.

Add Transect

Use this function to add discharge transects to the measurement file. Moving bed test transects should be added by right-clicking on the measurement file name to open the menu (see Using the Measurement File Name Menu).

Using the Transect Menu

Right-clicking on **Transect** will display the following menu.

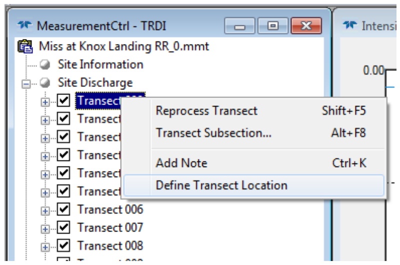


Figure 15. Measurement Control – Transect

Reprocess Transect

Use this function to reprocess only the selected transect file.

Transect Subsection

You can use the **Transect Subsection** function to subsection raw data files before display, writing to ASCII files, or printing a display. *WinRiver II* resets all elapsed data counters (Made Good, Length, Time) and total discharge values (Q) at the start of your subsection, so it computes the elapsed information or discharge for the subsection only. For example, you could subsection the middle 500-meters of a 2-km river transect. Replaying the sub-sectioned data would then show the discharge in that 500-meter section of the river.

1. Start *WinRiver II* and load a measurement file.
2. Select the transect file to be subsectioned.
3. Right-click on **Transect** and click **Transect Subsection**.
4. To select a portion of the data file, uncheck the **Select All Ensembles** box. Enter the **First Ensemble Number** and **Last Ensemble Number** and select **OK**. The file will be reprocessed automatically.
5. To return to the entire data file, right-click on **Transect** and click **Transect Subsection**. Check the **Select All Ensembles** box. Click **OK**.

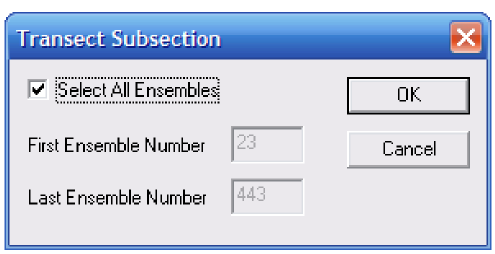


Figure 16. Transect Subsection

Add Note

Use this function to add a note to the measurement file for the selected transect. For example, you may want to record a note about the instrument setup or factors such as wind conditions, the passage of other vessels, and any other noteworthy events that occur during your transect of the channel.

Define Transect Location

Use this function to create a location file from the selected transect. The transect will process and then the Edit Locations screen displays. Name the location file and click on **Save & Close**. Location files can be shared with other users by copying the *.dat file to the *C:\Measurements\Locations* folder.

Location files will automatically be used if the transect is within approximately 100 meters of the locations specified in the file. You may need to manually scale the ship track display in order for the location line to be visible in the display. The ADCP must be using GPS to use locations. See Chapter 11 – Using Locations.

Data File

Right-clicking on a data file and selecting **Properties** will display the **Raw Data File Properties** box.

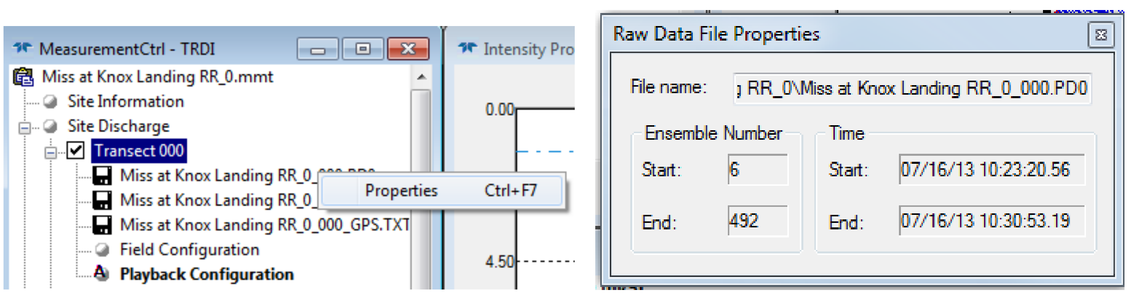


Figure 17. Measurement Control - Raw Data File Properties

Field and Playback Configuration Nodes

Once you reprocess a transect (see Reprocess Transect) or duplicate the **Field Configuration** node, *WinRiver II* creates a **Playback Configuration** node. The **Playback Configuration** is a copy of the **Field Configuration** information used to collect the data. Any editing changes made to the **Playback Configuration** are saved to the measurement file. **Playback Configuration** nodes can be **Duplicated**, **Deleted**, and **Renamed** as needed.

Configuration Node Menu Options

Right-clicking on a **Field Configuration** or **Playback Configuration** node will display the following menu.

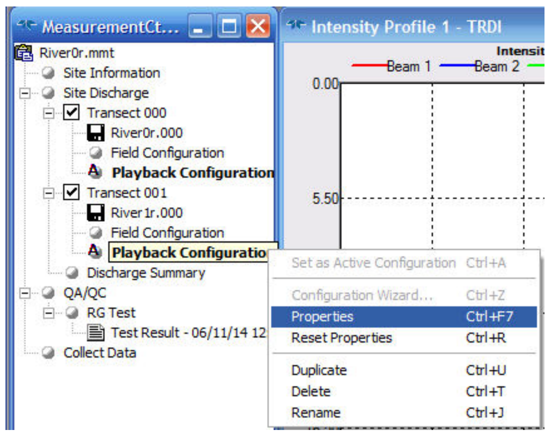


Figure 18. Managing Configuration Nodes

Set as Active Configuration

The active configuration node is in bold. To change between configuration nodes, right-click the on the configuration node name and select **Set as Active Configuration**. Only one configuration node may be active at a time.

Configuration Wizard

Use this function to start the Measurement Wizard. It will start at the Configuration Dialog page (see Configuration Dialog).

Properties

Use this function to view the configuration settings (see Configuration Node Properties). Changes to the settings are only allowed on **Playback Configuration** nodes or if data collection for the transect has not started. You can view what settings were used for the **Field Configuration**.

Reset Properties

This resets the playback configuration node back to the same parameters as the field configuration node.

Duplicate

Use this function to duplicate the configuration node. If the Field Configuration node is duplicated, it will create a new Playback Configuration node.

Delete

Use this function to delete the configuration node. The Field Configuration node can not be deleted.

Rename

Use this function to rename the configuration node. The Field Configuration node can not be renamed.

Show Summary

Right-click on the **Discharge Summary** field and select **Show Summary** to display the **Discharge Summary** (see Discharge Summary).

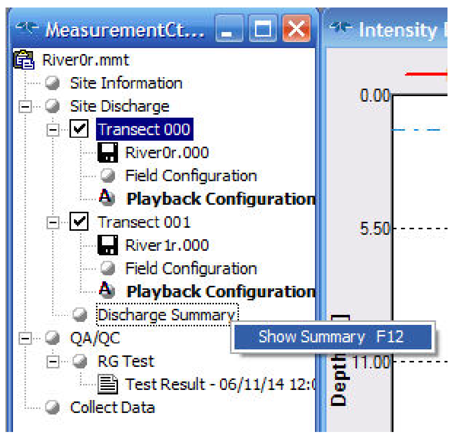


Figure 19. Measurement Control - Discharge Summary

See Using the Discharge Summary and Dynamic Residual Analysis.

NOTES

Chapter 6

Available Displays

This chapter includes:

- Using contour graphs
- Using profile graphs
- Using ship track graphs
- Using time series graphs
- Using tabular displays
- Using the dashboard
- Adding customized graphs to the menu

Using the View Menu

Use the **View** menu to select what graphs and tabular data to display. *WinRiver II* can use the following screens:

- Measurement Control Window (see Using the Measurement Control Window)
- Contour Graphs
- QAQC Window
- Profile Graphs
- Ship Track Graphs
- Time Series Graphs
- Tabular Displays

Using Contour Graphs

The **View, Graphs, Contour, Velocity** menu lets you select the type of velocity contour graph to display.

> To change the graph scale, right-click on the graph and select **Properties**.
>
> To change what data is displayed, right-click on the graph and select **Data Selection**.

The available velocity contour graphs are the four earth-referenced velocity components (East, North, Up, Error, Magnitude, and Direction) or the velocity component for a selected direction (projected).

To switch between the **Standard Definition Contour** and the **High Definition Contour**, on the **Configure** menu, click **Global Parameters**. Check the **High Definition Contour Display** box and then click **OK**.

> The High Definition Contour Display is reset to On (checked) each time *WinRiver II* is started. You will see High Definition in the chart title.
>
> The High Definition Contour display never "hides", "masks" or removes bad data.

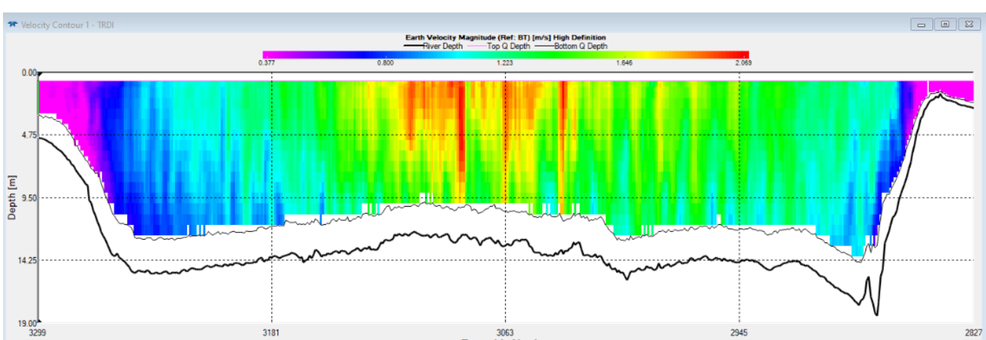


Figure 20. High Definition Contour Display

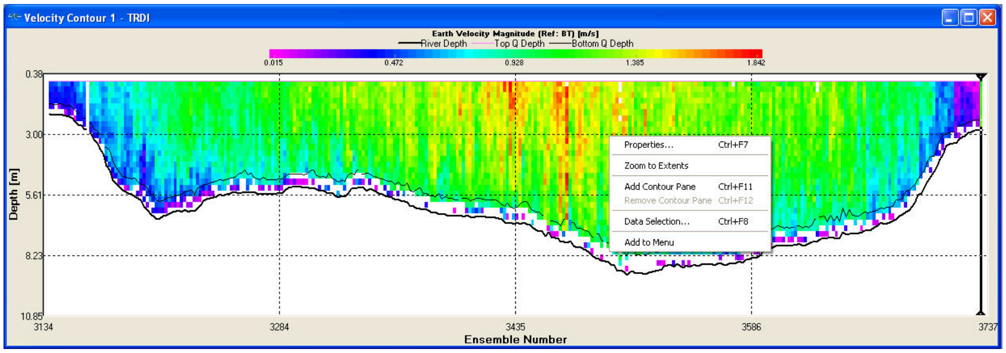


Figure 21. Standard Definition Velocity Contour Graph

The following are the velocity contour graph options.

- **East Velocity** – East is positive (west is negative).
- **North Velocity** – North is positive (south is negative).
- **Up Velocity** – Up is positive (down is negative).
- **Error Velocity** – This velocity component is a measure of "data reasonableness." There is no velocity reference for this value. The error velocity calculation depends on transducer orientation and beam pattern. See the ADCP Technical Manual for details of the velocity processing algorithm.
- **Velocity Magnitude/Direction –** The velocity magnitude and direction are clockwise with respect to North.
- **Projected** – This velocity component is a user-selected direction specified in the **Processing** tab as the **Projection Angle**. To determine a useful measurement angle, you may find it helpful to view the **Discharge Detail Tabular** view and note the Flow Direction. For example, for a transect across a river, a useful velocity component is the one perpendicular to the ship-track course, or parallel to the shoreline. By selecting a projection angle equal to this velocity component, the contour graph would show this information.

The following are other contour graph options. To change what data is displayed, right-click on the graph and select **Data Selection**.

- Click **View**, **Graphs**, **Contour**, **Intensity** to select the echo intensity contour graph. The five intensity graphs are: **Beam 1**, **Beam 2**, **Beam 3**, **Beam 4**, and **Average.**
- Click **View**, **Graphs**, **Contour**, **Intensity by Beam** to select the echo intensity contour graph for each beam.
- Click **View**, **Graphs**, **Contour**, **Backscatter** to select the type of backscatter contour graph to display. The five backscatter graphs are: **Beam 1**, **Beam 2**, **Beam 3**, **Beam 4**, and **Average.**
- Click **View**, **Graphs**, **Contour**, **Backscatter by Beam** to select the backscatter contour graph for each beam.
- Click **View**, **Graphs**, **Contour**, **Correlation** to select the type of correlation contour graph to display. The five correlation graphs are: **Beam 1**, **Beam 2**, **Beam 3**, **Beam 4**, and **Average.**

Using the QAQC Window

Use the **View**, **Graphs**, **QAQC** menu to display the QAQC window (on by default). The QAQC window displays the quality of the measurement's BT Status, WT Status, Depth Status, Ambiguity Ratio, Duration, Pitch, Roll, Boat/Water ratio, Voltage, and Beam Separation (shown by default) during data collection and playback/reprocessing. Other parameters can be added using the **Configure, QAQC** menu.

The QAQC window uses a color scale to represent the score, where green is good, orange is marginal, and red is poor. The color code is displayed from left to right or from right to left depending on the direction of travel from the river bank. Hovering the mouse over an item displays a tool tip.

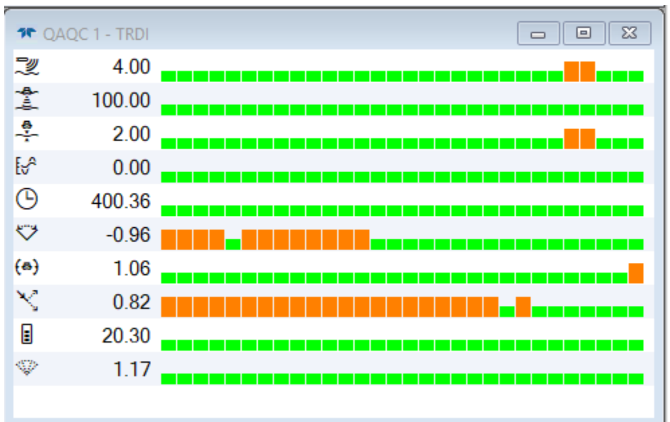


Figure 22. QAQC Window (Default Items)

Use the **Configure**, **QAQC** menu to configure the limits and select which items display in the QAQC window.

Boat Speed (Ref: BT) – Average boat speed against thresholds set in the QAQC Configuration; 2 m/s is poor; 1 m/s is marginal.

Number Bad Ensembles (Ref: BT) – Displays the number of bad ensembles against thresholds set in the QAQC Configuration; 10 ensembles is poor; 5 ensembles is marginal.

Maximum Water Speed (Ref: BT) – water speed for the water column against thresholds set in the QAQC Configuration; 2 m/s is poor; 1 m/s is marginal.

Elapsed Time – The elapsed time is accumulated and then checked against thresholds set in the QAQC Configuration; 90 seconds is poor; 180 seconds is marginal.

Delta Time – represents the change in value between two successive ensembles against thresholds set in the QAQC Configuration; 2 seconds is poor; 1 seconds is marginal.

Pitch – ADCP compass pitch in degrees against thresholds set in the QAQC Configuration; 5 degrees is poor; 1 degree is marginal.

Roll – ADCP compass roll in degrees against thresholds set in the QAQC Configuration; 5 degrees is poor; 1 degree is marginal.

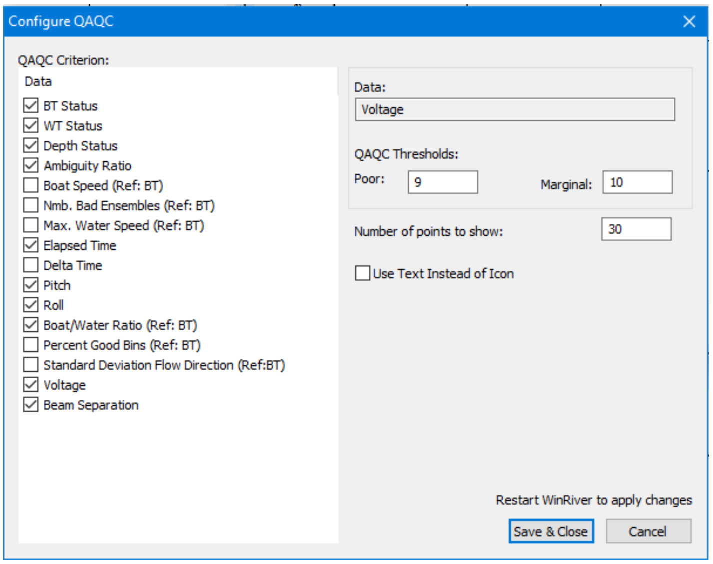
Boat speed to water speed ratio – It is important that the operator of the boat does not go too fast. The average boat speed per transect can be compared with the average of the water speed. *WinRiver II* compares this information to thresholds set in the QAQC Configuration; 2 is poor; 1 is marginal.

Percent Good Bins (Ref: BT) – Percentage of good bins against thresholds set in the QAQC Configuration; 80% is poor; 90% is marginal.

Standard Deviation Flow Direction (Ref: BT) – The Standard Deviation Flow direction against thresholds set in the QAQC Configuration; 5 degrees is poor; 1 degree is marginal.

Voltage – ADCP's battery voltage against thresholds set in the QAQC Configuration; 9 volts is poor; 10 volts is marginal for a 12VDC system.

Beam Separation – the average angle of beam separation per ensemble against thresholds set in the QAQC Configuration; 15 degrees is poor; 7.5 degrees is marginal. Increased beam separation may indicate fish (see Troubleshooting, Fish for an example showing beam separation), or a beam is fouled.



Number of points to show – Sets how many divisions are displayed on the QAQC window. The default is 30, which corresponds to approximately 30 seconds.

Use Text Instead of Icon – If selected, all the QAQC icons will use text instead of icons.

Using Profile Graphs

A profile graph is a line graph of a selected parameter versus depth. The **View, Graphs, Profile** menu lets you select the type of profile graph to display.

> To change the graph scale, right-click on the graph and select **Properties**.
> To change what data is displayed, right-click on the graph and select **Data Selection**.

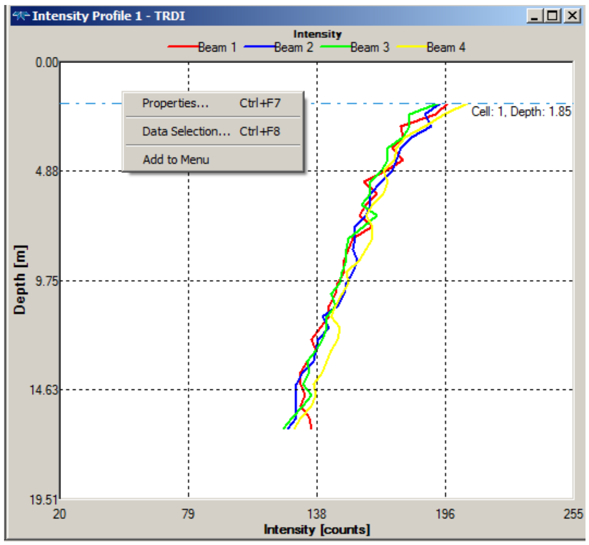


Figure 23. Intensity Profile Graph

The following profile graphs are available:

- **Intensity Profile** – *WinRiver II* displays the intensity profiles for all four ADCP beams. The echo intensity units are in counts. Non-range-normalized data are sometimes called AGC. Use the Intensity minimum/maximum scaling values to define the horizontal axes of the graph.
- **Velocity Profile** – The velocity profiles show the earth-coordinate velocity components (East, North, Up, and Error). The velocity units can be in either m/s (SI) or ft/s (English). Scaling for the top horizontal axis on the graph (Up Error Velocity) uses the minimum/maximum scale values of the Up Velocity or Error Velocity. Similarly, the bottom horizontal axis (East North Velocity) uses either the East Velocity or North Velocity scale values.
- **Backscatter Profile** – *WinRiver II* displays the backscatter profiles for all four ADCP beams. Backscatter data is range and absorption normalized and the units are in decibels (dB). Data are obtained from the receiver's received signal strength indicator (RSSI) circuit.
- **Correlation Profile** – *WinRiver II* displays the correlation profiles for all four ADCP beams. Correlation is a measure of data quality, and its output is scaled in units such that the expected correlation (given high signal/noise ratio, S/N) is 128 for Mode 1.
- **Discharge Profile** – This profile graph displays the horizontal measured discharge and corresponding power fit versus depth.

- **Vertical Beam -** To view vertical beam data, select **View, Graphs, Profile, VB**.

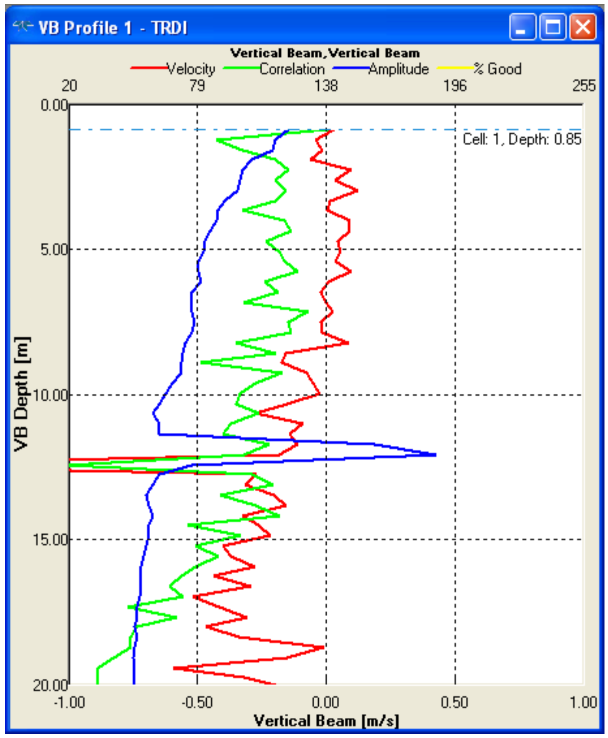


Figure 24. Vertical Beam Profile Graph

Using Ship Track Graphs

There are two ship track graphs available. The **Ship Track** graph shows only the relative ship position while **Stick Ship Track** graph are time-series graphs of relative ship position with current sticks (path overlaid with velocity magnitude for a user-selected depth or the average velocity magnitude). The default workspace uses the **Stick Ship Track** graph.

The Ship Track graph displays a X-Y graph of relative ADCP motion based on ADCP bottom-track velocities or GPS navigation data. The graph is a "dead-reckoning" graph of the boat motion based on the ADCP horizontal bottom-track velocity components or GPS navigation data. *WinRiver II* divides the ship-track axes into Displacement East and Displacement North.

Select the Ship Track graph for display reference to Bottom-Track, GPS (GGA), or GPS (VTG) through the **Configure** menu, **Reference**. If **None** is selected as the reference, the data on the Ship Track graph will automatically be referenced to Bottom-Track. On the Stick Ship Track graph, the ship positions will be referenced to Bottom-Track, but the water velocity for the current stick will not have any reference.

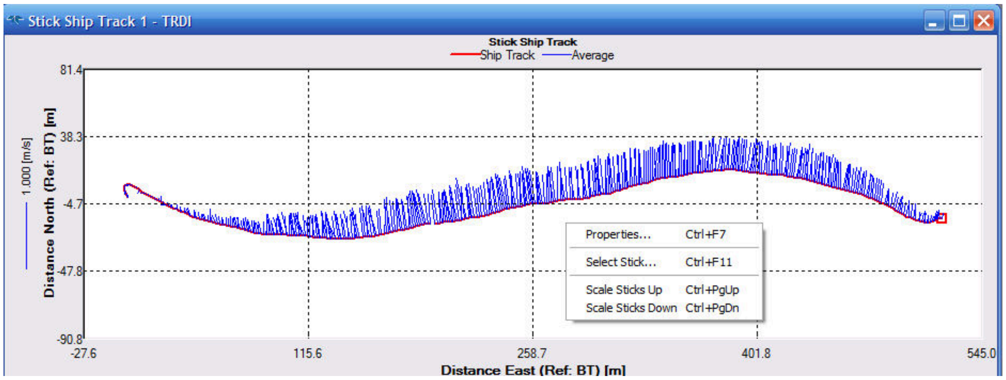


Figure 25. Stick Ship Track Graph

Ship Track Graph Options

Use the arrow keys to move the graph.

To change the graph scale, right-click on the graph and select **Properties**.

Right-click the Stick Ship Track graph and click **Select Stick** (shortcut keys **Page Up** / **Page Down** keys can also be used). This allows you to change from the average or at what depth the sticks are graphed.

To change the stick scale, Right-click the Stick Ship Track graph and select **Scale Sticks Up** or **Scale Sticks Down** (shortcut keys **Control+Page Up** / **Control+Page Down** keys can also be used).

If one or more location files are available and the ADCP is within approximately 100 meters of a location specified in the file, a black line will display across the Stick Ship Track display to help navigate from the starting and stopping points for the transect. See Chapter 11 – Using Locations.

Using Time Series Graphs

Time series graphs shows data versus time. The following are the time series graph options.

- **Temperature –** ADCP temperature.
- **Heading, Pitch, and Roll** – ADCP compass heading, pitch, and roll in degrees. All the Compass Corrections and Magnetic Variation from the Configuration Settings, **Offsets** page are applied. The scale for the heading (normally 0 to 360 degrees) is adjustable by right-clicking on the graph and selecting **Properties**, **Y-Axis Scaling**.
- **Water Speed** – Average water speed for the water column. Only the bins used to calculate the discharge will be used in this average.
- **Boat Speed** – Average boat speed.
- **Water / Boat Speed -** Combination of Average water speed and Average boat speed
- **GPS Data** – Number of Satalites in Use and HDOP.
- **Pressure Sensor** – Average pressure sensor reading.

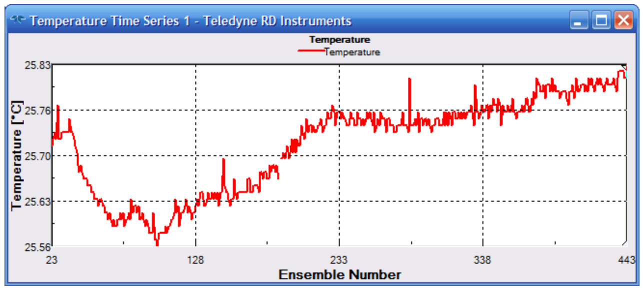


Figure 26. Time Series Graph

Using Tabular Displays

The Tabular displays show the data for the last ensemble in tabular form. *WinRiver II* displays as bad the data flagged bad by the ADCP, GPS, or Depth Sounder or marked bad by the user in the **Configuration Settings**, **Processing** page, **Mark Below Bottom "Bad"** box (see Processing Page).

Table 2: Available Tabular Displays

Display	Description
Ensemble Header	The Ensemble Header display shows information about the ADCP setup.
Composite	The Composite display lists information about the currently displayed ADCP data ensemble, Navigation, and Discharge information.
Bottom Track	The Bottom Track display lists information about the beam depths and bottom track velocities.
Standard Discharge	The Standard Discharge screen displays discharge information about the current transect.
Detailed Discharge	The Detailed Discharge screen displays detailed information about the current transect.
Compass Calibration	The Compass Calibration display shows comparisons between the GPS and Bottom Track courses.
GPS	The GPS display lists GPS data about the currently displayed ADCP data ensemble. If *WinRiver II* detects that GPS data is not being received for 3 successive seconds, the first two lines of the GPS display will read "No Data" and *WinRiver II* will beep. The lines will stay red even if data are decoded to indicate that data was lost during the transect.
Velocity	Displays the earth-referenced velocity components (East, North, Up, Error) percent good pings for the bin, and discharge. *WinRiver II* displays as bad the data flagged bad by the ADCP, GPS, or Depth Sounder or marked bad by the user in the Configuration Settings, Processing page, Mark Below Bottom "Bad" box (see Processing Page).
Earth Velocity Magnitude & Direction	Displays the earth-referenced velocity components (Magnitude, Direction, Up, Error) percent good pings for the bin, and discharge.
Intensity	Displays the echo intensities for all four beams.
Backscatter	Displays the echo intensities for all four beams.
Correlation	Displays the correlation magnitudes for all four beams.

During data collection, text color will change to blue when the file is no longer being updated.

Using the Discharge Summary

Select **View**, **Discharge Summary** to display the Discharge Summary. This screen displays detailed information and statistics about each transect. As each data file is reprocessed, the file is added to the Discharge Summary screen. To add or remove transects from the summary, use the **Measurement Control** widow. Checking the **Transect XXX** box (where XXX is the transect number) will add the transect; unchecking the box will remove the transect from the summary.

Discharge Summary - TRDI

Transect	Start Bank	# Ens.	Start Time	Total Q m³/s	Delta Q %	Top Q m³/s	Meas. Q m³/s	Bottom Q m³/s	Left Q m³/s	Left Dist. m	Right Q m³/s	Right Dist. m	Width m	Total A m²
Riv000	Right	524	12:15:54	1494.734	0.53	164.698	1135.093	110.512	73.366	30.48	11.065	15.24	158.90	1397.
Riv001	Left	385	12:12:36	1478.918	-0.53	165.732	1150.510	109.920	43.909	30.48	8.846	12.19	156.42	1384.
Average		454		1486.826	0.00	165.215	1142.801	110.216	58.638	30.48	9.956	13.72	157.66	1391.
Std Dev.		98		11.184	0.75	0.732	10.902	0.419	20.829	0.00	1.569	2.16	1.75	9.59
Std./| Avg.|		0.22		0.01	0.00	0.00	0.01	0.00	0.36	0.00	0.16	0.16	0.01	0.01

Figure 27. Discharge Summary Screen

Dynamic Residual Analysis

Dynamic Residual Analysis is a tool for in-situ measurement quality control. Version 2.18 of *WinRiver II* has implemented a newly developed residual control approach. This approach is an expansion of the existing 5% residual control, which was for four transects only. The relative residual of a transect discharge, denoted by *RR*, is defined as

$$RR = \frac{Q_i - Q_{mean}}{Q_{mean}} \times 100(\%) \qquad i = 1, 2, 3, \ldots, n \tag{1}$$

where Q_i is the ith transect discharge, and Q_{mean} is the mean of n transect discharges.

The residual control criterion is

$$\max |RR| < MPRR \tag{2}$$

where *MPRR* standards for Maximum Permissible Relative Residual. The *MPRR* values as a function of the number of transects are given in Table 3.

In the *WinRiver II* discharge summary table (shortcut **F12**), for available data of *n* transects, if the absolute value of the *RR* of a transect is greater than the *MPRR* value for *n* transects in Table 3, the transect data is shown in red; otherwise, it is shown in black. According to the residual control approach, the ADCP operator must make sure that Eq. (2) is met before leaving the site. If the criterion is not met, i.e. there is a red transect shown in the discharge summary table, additional transects are required until all transects are shown in black.

The *WinRiver II* residual control approach is equivalent to the uncertainty control approach implemented in the *Q-View* software. *Q-View* provides a comprehensive assessment of ADCP discharge measurements. For details on the residual and uncertainty control approaches, please see a paper entitled: "Statistical quality control of streamflow measurements with moving-boat acoustic Doppler current profilers" by Hening Huang, *Journal of Hydraulic Research* 53(6): 820-827.

Table 3. MPRR Values as a Function of the Number of Transects

n	MPRR (%)	*n*	MPRR (%)
		11	12.6
2	1.7	12	13.5
3	3.5	13	14.3
4	5.0	14	15.1
5	6.3	15	15.9
6	7.5	16	16.7
7	8.6	17	17.5
8	9.7	18	18.2
9	10.7	19	18.9
10	11.7	20	19.6

Acquire Control Window

Select **View**, **Acquire Data** to display the Acquire Control window. This screen gives you a quick view to see if the ADCP is recording or pinging and the GPS and Depth Sounder Status.

Figure 28. Acquire Control Window

Using the Dashboard

In addition to the **View** menu, click on the **Dashboard** icon () on the toolbar to view the Dashboard screen. This screen gives a quick overview of the system.

- The top section shows the ADCP status and data, which includes battery voltage, recording status, ADCP status, and water speed.
- The lower section shows vessel positioning status and data, which includes GPS status, Bottom Tracking status, and vessel speed.

Figure 29. Dashboard Screen

Table **4**. Dashboard Icons

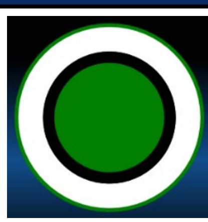
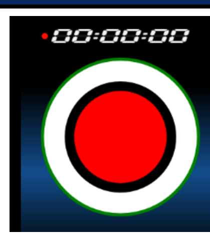
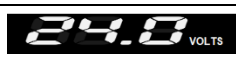
Icon #	Icon	Status	During Startup	During Normal Operation
1			Click on the green Record button to start recording. A new transect will automatically be started every 20 minutes, and you will not be presented with the opportunity to enter a starting bank or edge distances.	When recording is active, the button will be red and the timer will display the duration of the recorded measurement. The red dot next to the recording duration will flash as data is received. When not recording, the timer will not be visible.
2			The ADCP icon shows when the ADCP is pinging. Connect to the ADCP and start the system pinging for the status icon to display the ADCP. See Chapter 2 – Communication Setup. On the **Acquire** menu click **Start Pinging** or use the shortcut key **F4**.	If the ADCP loses communications, the icon will dim. Check the cables on the ADCP and the voltage reading. For further help, see Chapter 16 – Troubleshooting.

Table **4**. Dashboard Icons

Icon #	Icon	Status	During Startup	During Normal Operation
3			The Bottom Track icon shows when the ADCP is receiving valid Bottom Track data.	If the ADCP loses bottom track, the icon will dim. Check for debris or if other factors are causing bottom tracking to be lost. The bottom track mode may need to be changed. See Chapter 15 – Bottom Tracking Modes and Unable to Bottom Track. Will also dim if the ADCP connection is lost or not pinging.
4			The GPS display shows when *WinRiver II* is receiving valid GPS data. GPS data can be received either through a connection to the ADCP or directly through *WinRiver II*.	If the ADCP loses GPS, the icon will dim. Check for terrain features which would obstruct the GPS and check the GPS wiring connections. See Troubleshooting GPS. Will also dim if the ADCP connection is lost or not pinging.
5			See the ADCP Operation Manual for the voltage specifications. Typically WorkHorse ADCPs use 20 to 50 VDC. Rio Grande, RiverRay, RiverPro/RioPro and StreamPro ADCPs use 10.5 to 18 volts VDC.	Displays the ADCP input voltage.
6			Displays "-" when no data received or an invalid value.	Digital readout and speedometer for the water speed in m/s. Water speed is based on the selected reference in *WinRiver II*. See Changing the Reference.
7			Displays "-" when no data received or an invalid value.	Digital readout and speedometer for the vessel speed in m/s. Vessel speed is based on the selected reference in *WinRiver II*. See Changing the Reference.

Adding Customized Graphs to the Menu

Please note that not all available graphs are shown on the menu. For example, the profile graph **Velocity Magnitude and Direction** is not predefined graph. On the **View** menu, select **Graphs**, **Profile**, **Velocity**. Right-click on the velocity profile graph and select **Data Selection**. Select **Magnitude** and **Direction** and then click **OK**.

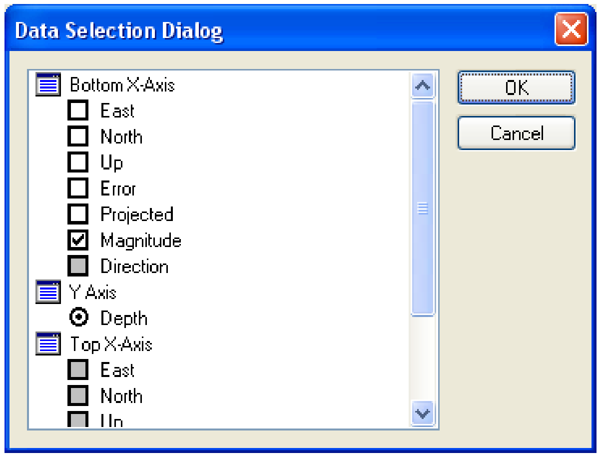


Figure 30. Data Selection Dialog

Once you have selected a graph and selected the data you want to see, right-click on the graph and select **Add to Menu**. Name the graph and click **OK**. The graph will now be available on the menu for future use with a click of the mouse button. If you want to always see the graph when *WinRiver II* starts, make sure to save the workspace by clicking **File**, **Save Workspace As**.

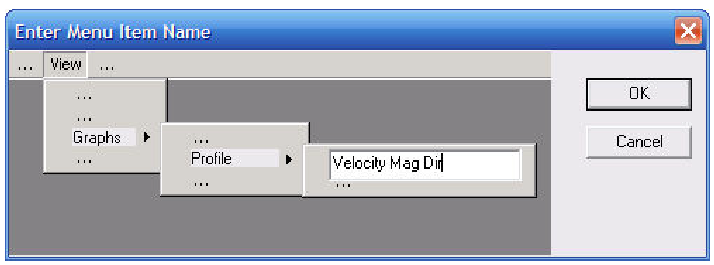
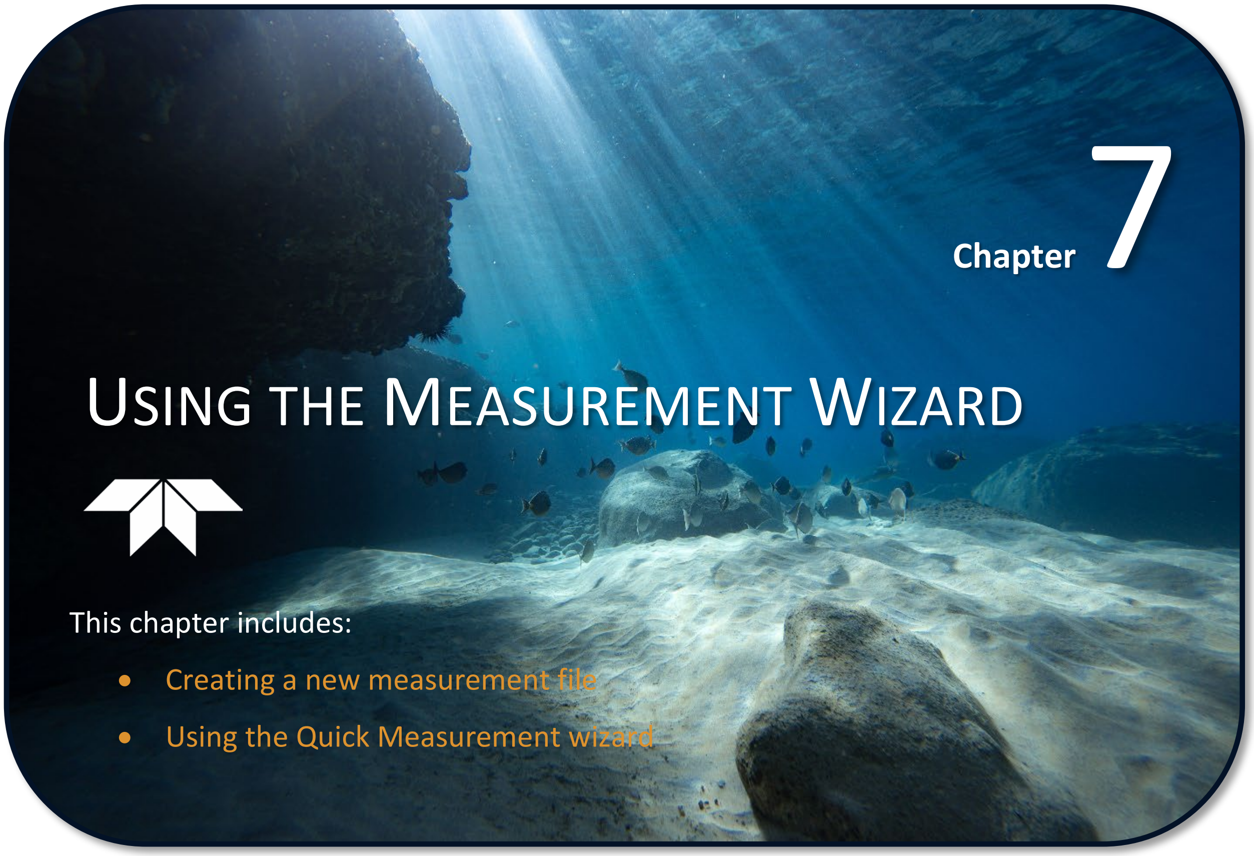


Figure 31. Adding a Graph to the Menu

There is no method to remove a graph once added to the menu except by re-installing *WinRiver II*.



Chapter 7

Using the Measurement Wizard

This chapter includes:

- Creating a new measurement file
- Using the Quick Measurement wizard

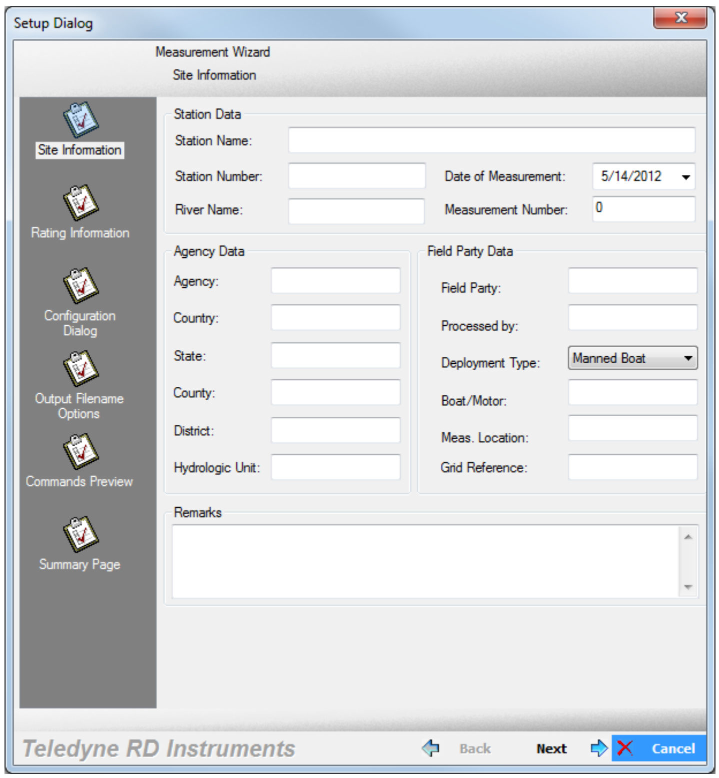
Creating a New Measurement File

WinRiver II is setup to collect or reprocess data using the **Measurement Wizard**. The Measurement Wizard gives the user the ability to create a Field Configuration node and enter the information needed for data collection and correct data display during data collection. Once set up, the measurement file can be saved and then later retrieved.

To create a new measurement file:

1. On the **File** menu, click **New Measurement**.
2. After each page of information has been entered, click **Next**.
3. After reviewing the **Summary** page, click the **Finish** button to complete the wizard.

Site Information

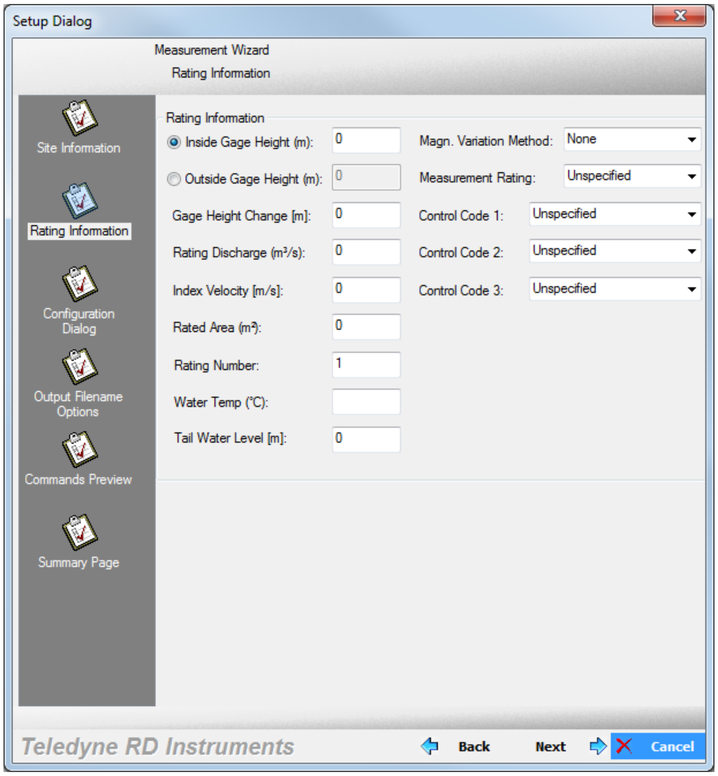


On the **Site Information** screen, enter the **Station Data**, **Agency Data** and **Field Party Data** information. Each of these fields will be included on the Q Measurement Summary file (see Using the Q Measurement Summary).

If a **Station Number** is entered, it will be used in the **Filename Prefix** box on the **Output Filename Options** page of the wizard (see Output Filename Options).

Enter a **Measurement Number** (alphanumeric). This can be added to the file name on the **Output Filename Options** page of the wizard.

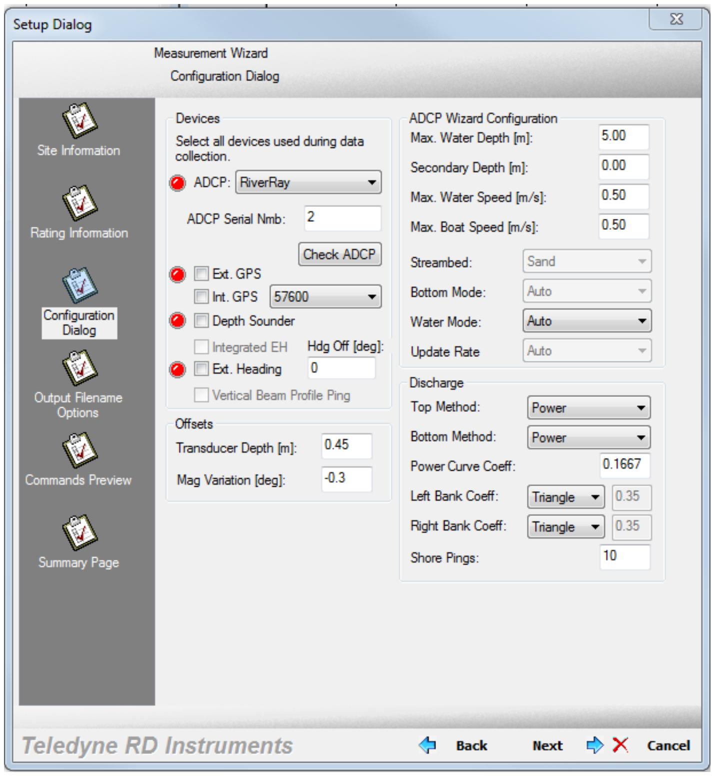
Rating Information



On the **Rating Information** screen, enter the rating information. Each of these fields will be included on the Q Measurement Summary file (see Using the Q Measurement Summary).

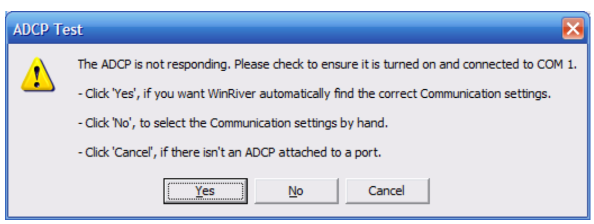
You can add/edit this information once the measurement wizard is completed by right-clicking on **Site Information** in the **Measurement Control** window and selecting **Site Wizard**.

Configuration Dialog



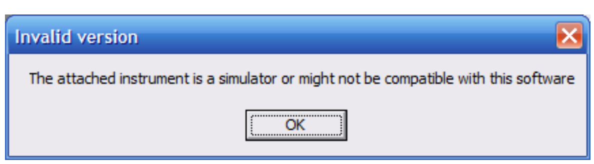
Devices

WinRiver II will attempt to connect to the ADCP when this page opens or the **Check ADCP** button is clicked. If the ADCP is not available or communications with the ADCP have not been setup, you will see the following dialog box.



Click **Cancel** to continue with the wizard, click **Yes** to have *WinRiver II* automatically detect the ADCP, or click **No** to setup the communications yourself.

If you see the following message box, this means *WinRiver II* is not sure what type ADCP you are using. Click **OK** to continue.

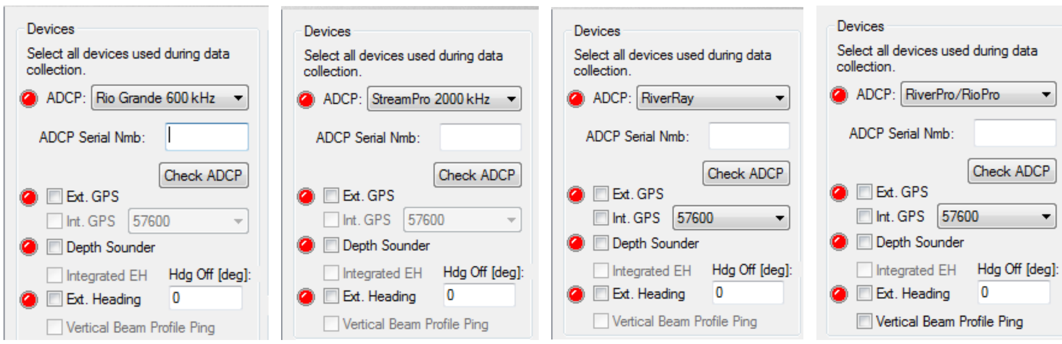


If you are connected to a Rio Grande, StreamPro, or RiverRay ADCP, *WinRiver II* will automatically detect the ADCP and enter the **ADCP Serial Number**, otherwise, enter the serial number. The ADCP serial number will be added to the Q Measurement Summary (see Using the Q Measurement Summary).

Selecting the **GPS**, **Depth Sounder**, or **Ext. Heading** boxes will prompt you to set up the communication settings and the Depth Sounder / External Heading Page.

Int. GPS – If you are configuring a RiverRay or RiverPro/RioPro system with integrated GPS, then check the **Int. GPS** box and set the Integrated GPS baud rate. Available baud rates are 4800, 9600, 19200, 38400, 57600, 115200, and Auto (RiverPro/RioPro only). If the **Int. GPS** box is selected, then the SF command will be added to the Commands Preview section. For more information on using the Integrated GPS, see Tutorial – How to Use the RiverRay Integrated GPS and Chapter 12 - Integrating Depth Sounder, External Heading, and GPS Data.

Use the **Heading Offset** field to adjust both external and integrated heading data to the desired physical orientation relative to the instrument (not the float/boat).

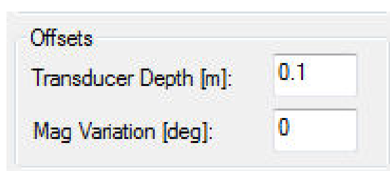


Offsets

Enter your choices for the **Offsets** section. For more information on these settings, see the Offsets Page.

Transducer Depth – Enter the depth from the water surface to the ADCP transducer faces.

Magnetic Variation (degrees) – Enter the magnetic variation (declination) at the measurement site. See Magnetic Variation Correction for details.



ADCP Wizard Configuration

Enter your choices for the **ADCP Wizard Configuration** section. Based on the entered information, the wizard will enter commands on the Commands Page. *WinRiver II* will give warning messages if the settings are not recommended. Click the **Close** button on the message box or continue making choices. Available options may vary depending on the ADCP being used for the measurement. Generic parameters and those specific to the Workhorse Rio Grande ADCP are as follows. Parameters specific to other ADCPs are presented below.

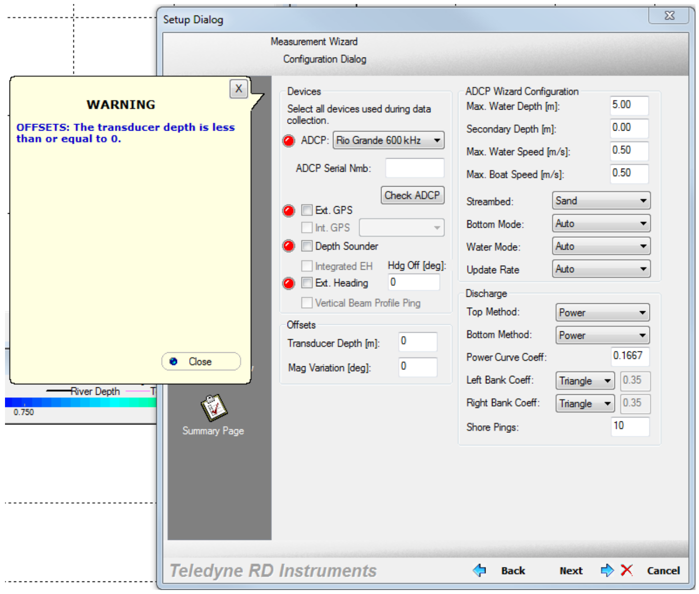


Figure 32. Warning Message

Rio Grande Configuration

The following parameters apply to the WorkHorse Rio Grande and other WorkHorse systems:

Max. Water Depth – Enter the expected maximum depth of the stream.

Secondary Depth – Enter a secondary depth, such as the minimum depth you expect to be measuring.

Max. Water Speed – Enter the expected maximum speed of the stream.

Max. Boat Speed – Enter the expected maximum speed of the boat.

Streambed – Enter the expected streambed material.

Bottom Mode – Enter the bottom mode (**Mode 5**, **Mode 7**, or **Auto**).

Recommended Setting. Use the **Auto** mode.

Water Mode – Enter the water mode (**Mode 1**, **Mode 5**, **Mode 8**, **Mode 11**, **Mode 12 Auto**, **Mode 12 Custom**, or **Auto**).

Recommended Setting. Use the **Auto** mode.

If you select **Mode 12 Custom**, the following screen appears.

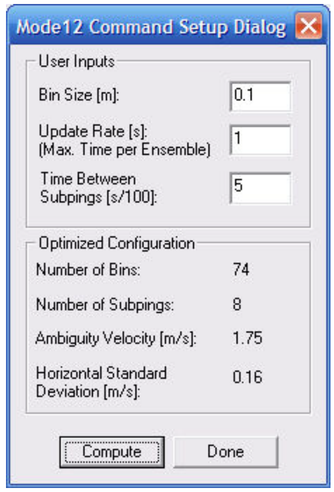


Figure 33. Water Mode 12 Options

Bin Size (meters) – Set the desired bin size. This will add the WK command to the Wizard section of the command page.

Update Rate (seconds) – Increasing the **Update Rate** will increase the number of subpings.

Time Between Subpings (100th seconds) – This set the time between sub-pings in hundredths of a second and sets the second parameter of the WO command. In the above example, the WO command would be set to WO8,5.

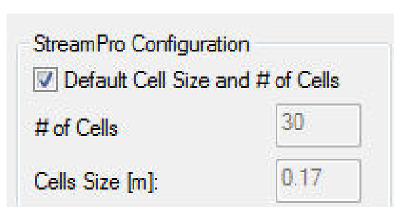
Click the **Compute** button to see the **Optimized Configuration** consequences. Click **Done** to return to the **Configuration Dialog** screen.

Your ADCP must have the High Rate Ping feature enabled in order to use Mode 12.

StreamPro Configuration

The following parameters apply to the StreamPro ADCP:

Default Cell Size and # of Cells – When this box is checked, *WinRiver II* will set the **# of Cells** to 30 and the **Cells Size** dependent on the maximum water depth. Uncheck the box to set the number of cells and cell size manually.



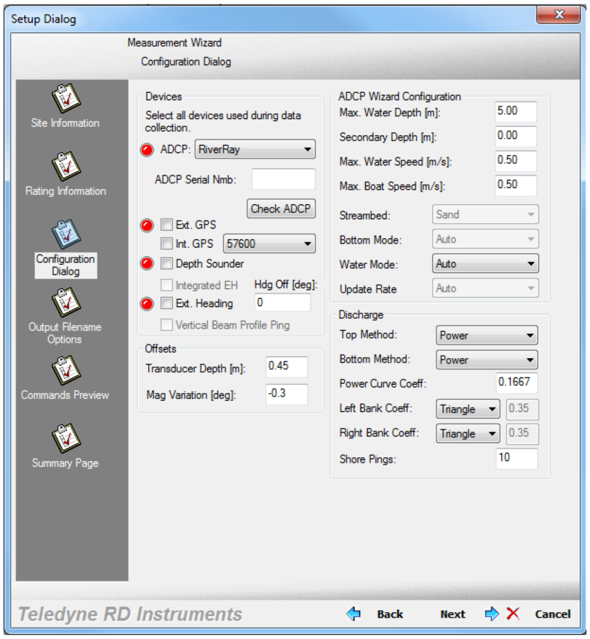
Recommended Setting. Leave the **Default Cell Size and # of Cells** box selected.

Water Mode – Enter the water mode (**Mode 12** or **Mode 13**).

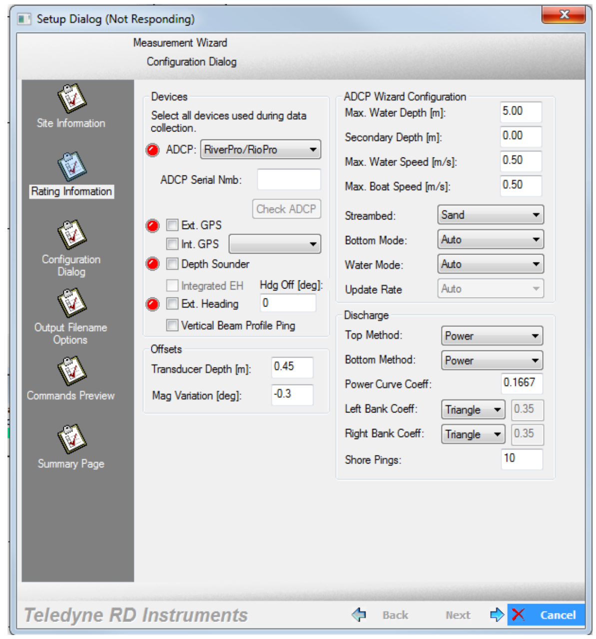
Recommended Setting. Use **Mode 12** for most streams. If the **Maximum Water Depth** is ≤ 1.0 meters and the **Maximum Water Speed** is < 0.25 m/s, then select **Mode 13.**

RiverRay and RiverPro/RioPro Configuration

RiverRay/RiverPro/RioPro pinging is automatic: the ADCP selects bin size and profiling mode automatically depending on depth and water conditions. There are no wizard or user commands required to set cell size, number of cells, profiling mode, etc. when using Water Mode=Auto. Therefore, some options in the **ADCP Wizard Configuration** section are not set on the RiverRay/RiverPro/RioPro.



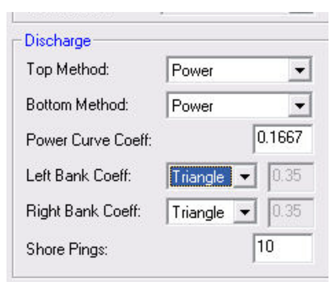
RiverRay



RiverPro/RioPro

Discharge

Enter your choices for the **Discharge** section. For more information on these settings, see the Discharge Page.



Top Method – The **Top Discharge Methods** are **Constant**, **Power**, and **3-pt Slope**.

Bottom Method – The **Bottom Discharge Methods** are **Power** and **No Slip**.

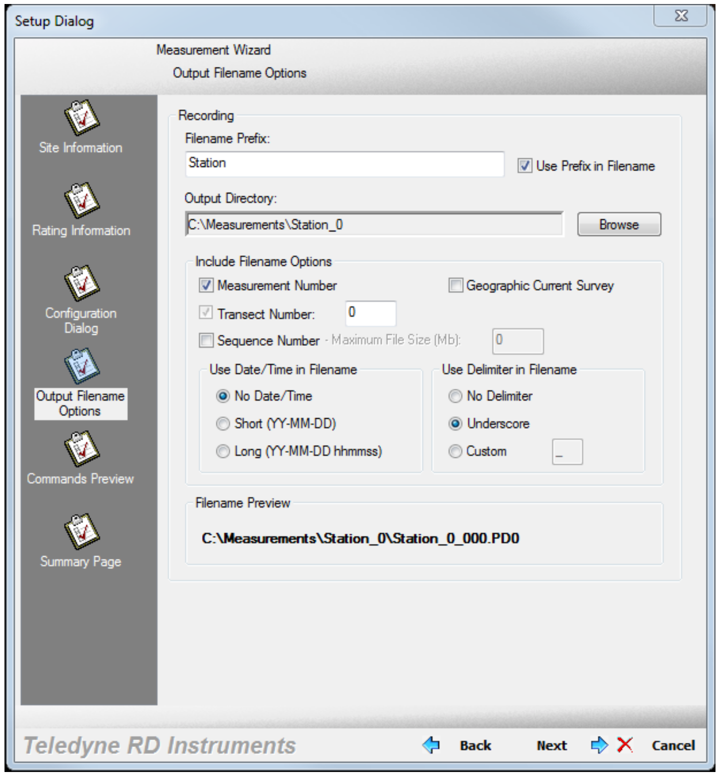
Power Curve Coefficient – The **Power Curve Coefficient** can be changed if the **Power** Method is used. The default is set to 1/6.

Left/Right Bank Coefficient – You can select a predefined shape of the area as **Triangular** or **Square**, or select **User** to set a coefficient that describes the shore.

Shore Pings – These extra ensembles help ensure that you have a good estimation of the side discharge.

Recommended Setting. Leave the Shore Pings at 10.

Output Filename Options

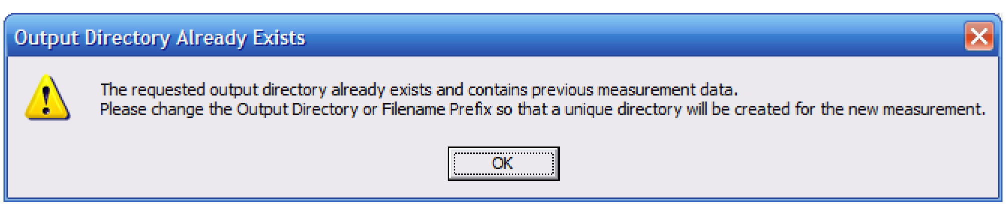


Enter your choices for the **Recording** section. The **Filename Prefix** and **Output Directory** are part of the **Recording** page (see Recording Page).

Recording

Enter a **Filename Prefix** if you did not enter one on the **Site Information** page of the measurement wizard. The **Output Directory** will default to C:\Measurements\Station. Click the **Browse** button to change the output directory.

The **Output Directory** must not already exist – You will be prompted to change the Output Directory or Filename Prefix.



Include Filename Options

- Check the **Measurement Number** box to add it to the file name.
- Check the **Sequence Number** box and enter a **Max File Size** if you want to limit the size of the data file. Once the file size has been reached, the sequence number will increment and a new file will be created.
- To add the Date/Time to the filename, check the **Short (YY-MM-DD)** or **Long (YY-MM-DD hhmmss)** button. Select **No Data/Time** to remove the Date/Time from the filename.
- Select what type delimiter to use in the filename by selecting **No Delimiter**, **Underscore**, or **Custom**. If **Custom** is selected, enter the delimiter in the box.
- If you are receiving GPS data, select the **Geographic Current Survey** box to add the GPS Date/Time and LAT/LON to the filename. If GPS data is not available, the LAT/LON will be all zeros. Selecting this option will also automatically add the long date/time data to the file name.

Review how the filename appears in the **Filename Preview** section.

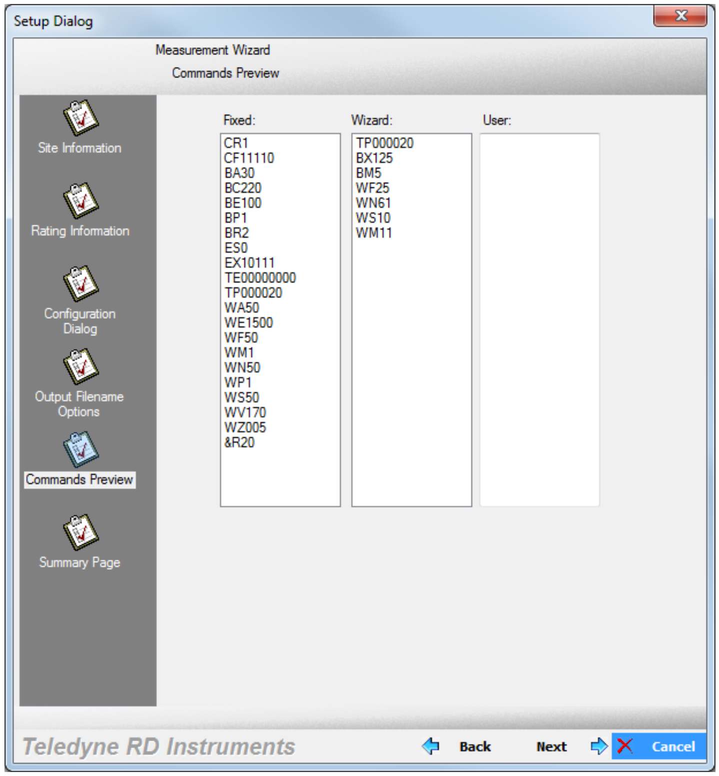
In the following example, the filename prefix is CheckPoint13, the measurement number is 0, the transect number is 003, the sequence number box, measurement number, and short date/time buttons were selected.

```
C:\Measurements\CheckPoint\CheckPoint13_0_003_000_08-10-219.PDO.
               |                |       |  |   |   |
               |                |       |  |   |   Short Date/Time
               |                |       |  |   Sequence Number
               |                |       |  Transect Number
               |                |       Measurement Number
               |                Filename Prefix
               Output Directory
```

In the following example, the filename prefix is CheckPoint13, the measurement number is 0, the transect number is 003, the sequence number box, measurement number, and the Geographic Current Survey box was selected.

```
C:\Measurements\CheckPoint\CheckPoint13_0_003_000_20150519075442__325624N_117142W.PDO.
               |                |       |  |   |   |               |
               |                |       |  |   |   |               Geographic Location
               |                |       |  |   |   GPS Date/Time
               |                |       |  |   Sequence Number
               |                |       |  Transect Number
               |                |       Measurement Number
               |                Filename Prefix
               Output Directory
```

Commands Preview



You can directly control the profiling parameters sent to the ADCP using the **User Commands** box.

Do not enter any commands in the **User** section unless you are fully aware of what the command does.

For more information on ADCP commands, see the WorkHorse Commands and Output Data Format Guide and the following sections in the *WinRiver II* manual.

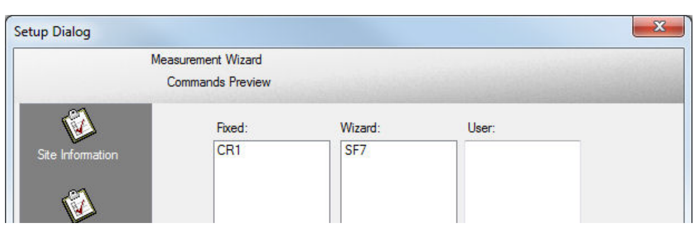
Commands Page

ADCP Commands

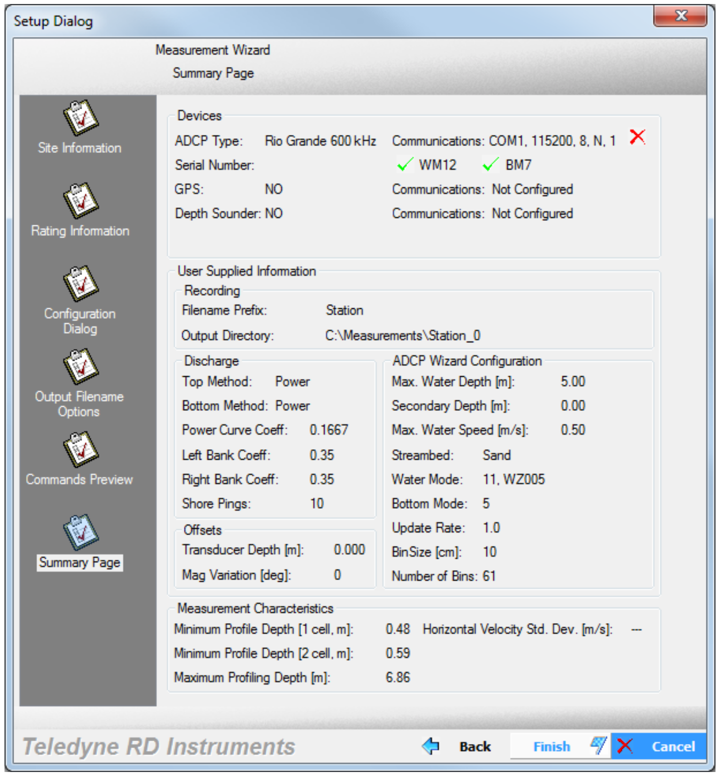
Water Profiling Modes

Bottom Tracking Modes

For the RiverRay and RiverPro/RioPro, the CR1 command (set to default) is the only **Fixed** command and a CS command will be sent to start pinging when **Start Pinging** is selected on the **Acquire** menu (or use the shortcut key **F4**). If the **Int. GPS** box is selected, then the SF command will be added to the **Wizard** command section. In rare cases, the CR1 command may be missing from the Fixed command list. If that occurs, simply add the CR1 command and any SF command to the User command list.



Summary Page



Review the **summary page;** use the **Back** button to return to previous pages and make any necessary changes. If a red X appears next to the communication settings, it means the communications were not configured yet. A green ✓ next to the WM12 and BM7 means that the ADCP is capable of using these modes, not that the mode is selected.

Click the **Finish** button to complete the wizard.

> The summary does not include consequences caused by entering any **User** commands.

Measurement Characteristics

Minimum Profile Depth (1 cell) – Shows the minimum profiling depth for one cell. This depth includes the blanking distance and transducer depth.

Minimum Profile Depth (2 cells) – Shows the minimum profiling depth for two cells. This depth includes the size of bin 1, blanking distance, and the transducer depth.

Maximum Profile Depth (meters) – Shows the maximum profiling depth for the settings used.

Horizontal Velocity Standard Deviation (Meters/second) – Not implemented at this time.

> Coefficient of Variation for *WinRiver II* is defined as (Standard Deviation of the average velocity for each ping)/(average velocity of all pings).
>
> Where the average velocity is the average of all good cells in the profile.

Using the Quick Measurement Wizard

The Quick MMT wizard provides a quick and simple way to collect data at a site. The measurement name will be generated automatically, and user input is limited to items needed for proper ADCP configuration at the site. It is based on a simplified version of the Configuration Dialog page from the standard new measurement wizard. The ADCP will automatically start pinging on completion of the wizard. The user can then collect moving bed tests, discharge transects, or stop pinging and execute any desired QA/QC functions.

Only the default wizard commands based on the Quick MMT Configuration Dialog are sent to the ADCP. The user must take the following into consideration before using the Quick MMT:

- There are no user overrides for commands sent to the ADCP.
- There is no Site Information or Rating Information entered.
- There are no Discharge options.
- The file name may not be edited. Measurements created using this wizard will be named using the following convention: *<ADCP code>_YYYY-MM-DD_<Sequential Number>.mmt*, where <ADCP Code> = RR for RiverRay, RP for RiverPro/RioPro, RG for Rio Grande, SP for StreamPro, or BB for Broadband.
- The measurement files will be saved to the *C:\Measurement* folder.

Site Information, Rating Information, and Discharge configurations can be changed during post-processing, as with any other measurement.

To create a new measurement file using the Quick Measurement Wizard:

1. On the **File** menu, click **Quick MMT** (or click the **Quick MMT** icon ( ) in the toolbar)
2. The Quick Measurement Wizard will establish communications with the ADCP and display a simplified version of the Configuration Dialog page with the ADCP type, serial number, and a default transducer depth entered.
3. Enter/change information on the page as desired. See the Configuration Dialog for more information.
4. Click **Finish**.
5. The Set Clock dialog may automatically appear, after which the ADCP will start pinging.
6. Collect the measurement data as described in the tutorial How to Collect River Discharge Data.

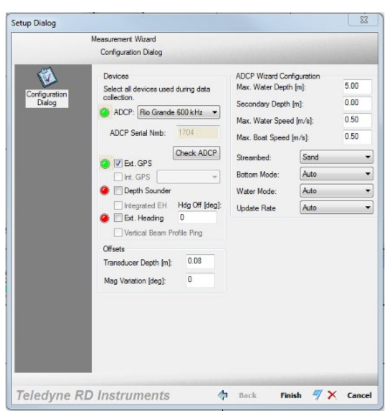
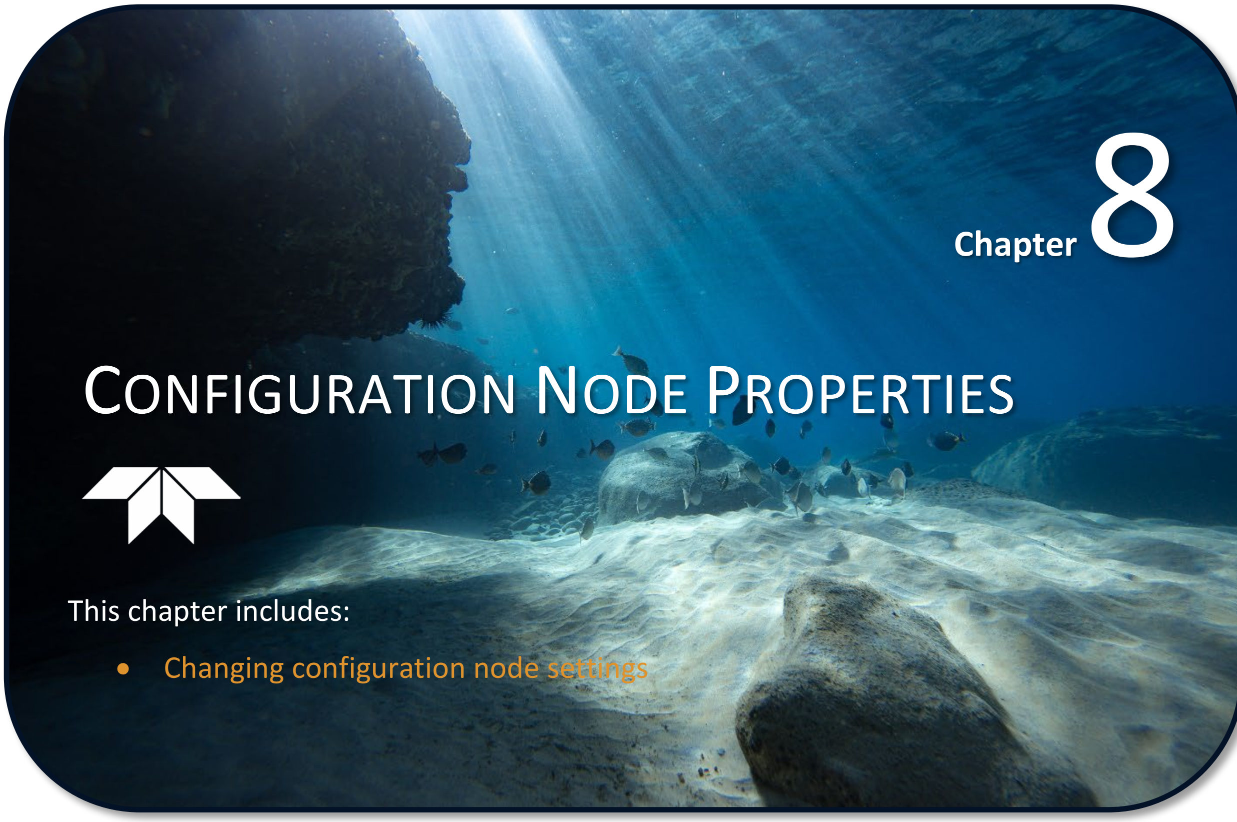


Figure 34. Quick MMT Configuration Dialog

NOTES



Chapter 8

CONFIGURATION NODE PROPERTIES

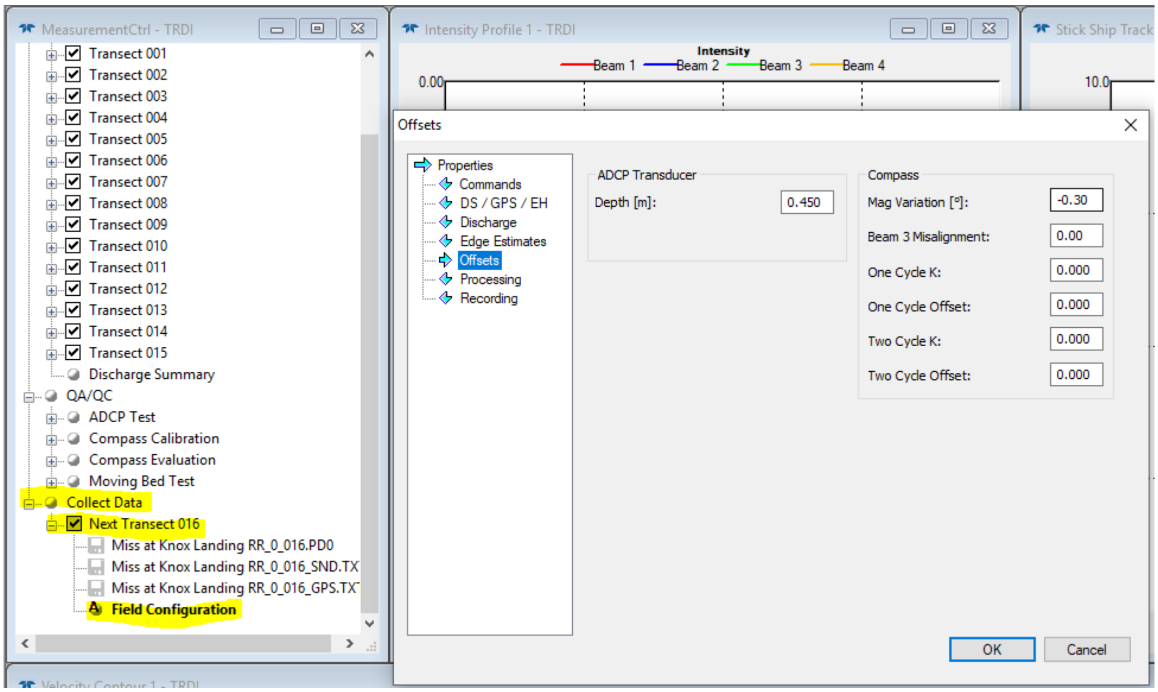
This chapter includes:

- Changing configuration node settings

Changing Configuration Node Settings

This section has detailed explanations of each of the settings contained in the configuration node. There are seven pages that configure different portions of the configuration node.

Configuration nodes can appear as either Field Configuration or Playback Configuration nodes. To view the field or playback configuration node settings, right-click on the configuration node on the **Measurement Control** window, and then select **Properties** or double-click on the Field Configuration or Playback Configuration nodes (see Using the Measurement Control Window). The configuration node presently in use will be in bold text. Configuration nodes will appear under each transect listed in the **Site Discharge** node, for each **Loop** or **Stationary** test listed in the **Moving Bed Test** node, and for the **Collect Data/Next Transect** node.



Changes to the Field Configuration node can only be made when not pinging. If you make any changes, you must change the Filename Prefix or Output Directory to create a new measurement file.

The **Commands** tab is never editable in a configuration node – the commands listed are set by the Measurement Wizard (see Commands Preview). Most of the parameters listed on the **Recording** tab are also set by the Measurement Wizard; only the checkboxes for recording GPS, External Heading, and Depth Sounder data can be modified, and only in the configuration node under the Collect Data/Next Transect node. The rest of the parameters can be changed during playback and do not influence data collection (but do affect data displays during data collection).

For correct data display while acquiring data you may wish to check/change the default settings on the DS/GPS/EH and Processing pages of the Collect Data/Next Transect configuration node, but most of the parameters will be properly set by the Measurement Wizard and/or the default settings.

ALWAYS use the Measurement Wizard to make changes where possible BEFORE making changes using that configuration node.

Recheck any settings modified in the configuration node after re-running the configuration wizard.

Commands Page

You can directly control the profiling parameters sent to the ADCP with **User Commands**. User Commands MUST be set in the Measurement Wizard; they cannot be changed in the configuration node. The **Fixed Commands** box lets you view the direct commands that will always be sent to the ADCP. The Measurement Wizard will enter the **Wizard Commands** based on information entered in the Measurement Wizard (see Using the Measurement Wizard and ADCP Commands).

The fixed commands are sent before any user commands. Sending a **User Command** will OVERRIDE the **Fixed** and **Wizard** Commands.

When the data collection is first started, the commands in the **Fixed Commands** box are sent by *WinRiver II* to the ADCP to set its profiling parameters. The **Wizard Commands** are sent next and will ***override*** some of the **Fixed Commands**. **User** Commands are sent last and will override **Fixed** and **Wizard** commands. In the following paragraphs, we will describe selected commands and give guidelines for setting these commands for acquiring reliable discharge data. Refer to the specific ADCP's manual for more detailed information about each command.

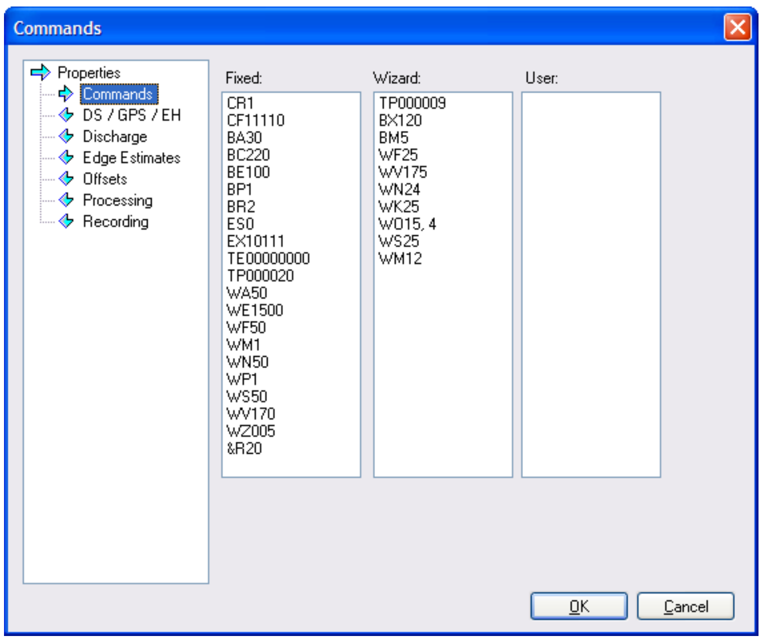


Figure 35. Commands Page

Quick Access to the Commands Page:

Click the **View** menu. Make sure the **Measurement Management** window is selected.

In the Measurement Management window, expand **Collect Data** by clicking the plus box to the left side.

Expand **Next Transect** to find **Field Configuration**.

Double-click on **Field Configuration**.

Click **Commands** to access the **Commands** window.

Table 5: Fixed Commands

Command	Choices	Description
CR1	Sets factory defaults	This is the first command sent to the ADCP to place it in a "known" state.
CF11110	Flow control	CF11110 selects automatic ensemble cycling, automatic ping cycling, binary data output, enables serial output, and disables data recording.

Command	Choices	Description
BA30	Evaluation Amplitude Minimum	Sets the minimum value for valid bottom detection to 30 counts.
BC220	Correlation Magnitude Minimum	Sets minimum correlation magnitude for valid bottom track velocity data to 220 counts.
BE100	Bottom Track Error Velocity Maximum	Sets maximum error velocity for good bottom-track water-current data to 100mm/s.
BP1	Bottom track pings	The ADCP will ping 1 bottom track ping per ensemble.
ES0	Salinity	Salinity of water is set to 0 (freshwater).
EX10111	Coordinate transformations	Sets Ship coordinates, use tilts, allow three-beam solutions, and allow bin mapping to ON.
TE00:00:00.00	Time per ensemble	Ensemble interval is set to zero.
TP00:00.20	Time between pings	Sets the time between pings to 0.2 seconds.
WA50	False Target Threshold Maximum	Sets a false target (fish) filter to 50 counts.
WE1500	Water Track Error Velocity Threshold	Sets the maximum error velocity for good water-current data to 1500mm/s.
WF50	Blank after transmit	Moves the location of the first depth cell 50 cm away from the transducer head (see Table 6).
WM1	Water mode	Sets the ADCP to Water Track mode 1.
WN50	Number of depth cells	Number of bins is set to 50 (see Table 6).
WP1	Pings per ensemble	The ADCP will ping 1 water track ping per ensemble.
WS50	Depth cell size	Bin size is set to 0.5 meters (see Table 6).
WV170	Ambiguity velocity	Sets the maximum relative radial velocity between water-current speed and WorkHorse speed to 170 cm/s.
WZ005	Mode 5 Ambiguity Velocity	Sets the minimum radial ambiguity for profiling Mode 5 (WM5) and Mode 8 (WM8) Ambiguity Velocity to 5 cm/s.
&R20	Bottom Illumination	The &R command is used to set the "Bottom Illumination". This value determines the size of the Bottom Track transmit pulse in relation to the Depth. &R is entered in percent. If you were bottom tracking in 100m of water and had &R=20, the Bottom Track transmit pulse would be 20% of 100m, or 20m. If &R=30, then the transmit pulse would be 30m.

Table 6: Wizard Commands

Command	Choices	Description
BXxxx	Maximum Bottom Search	Limits how far the ADCP will search for the bottom
WFxx	Blank after transmit	Moves the location of the first depth cell away from the transducer head.
WMx	Water Mode	Sets the Water Mode
WNxxx	Depth cell number	Based on the maximum water depth entered in the Configuration Wizard, WinRiver II will set the depth cell size and number of depth cells.
WSxxx	Depth cell size	
WVxxx	Ambiguity velocity	Sets the maximum relative radial velocity between water-current speed and WorkHorse speed.
TPxx:xx.xx	Time between pings	Sets the time between pings.
SFx	Baud Rate	Sets the Baud Rate used by the RiverRay internal GPS system. 3 = 4800, 4 = 9600, 5 = 19200, 6 = 38400, 7 = 57600, 8 = 115200, 9 = Auto

The values for the **Wizard Commands** are based on information entered in the **Measurement Wizard** (see Using the Measurement Wizard).

Depth Sounder / GPS / External Heading Page

The depth sounder is another external sensor that can be used to track the depth of the water. Areas with weeds or high sediment concentrations may cause the ADCP to lose the bottom.

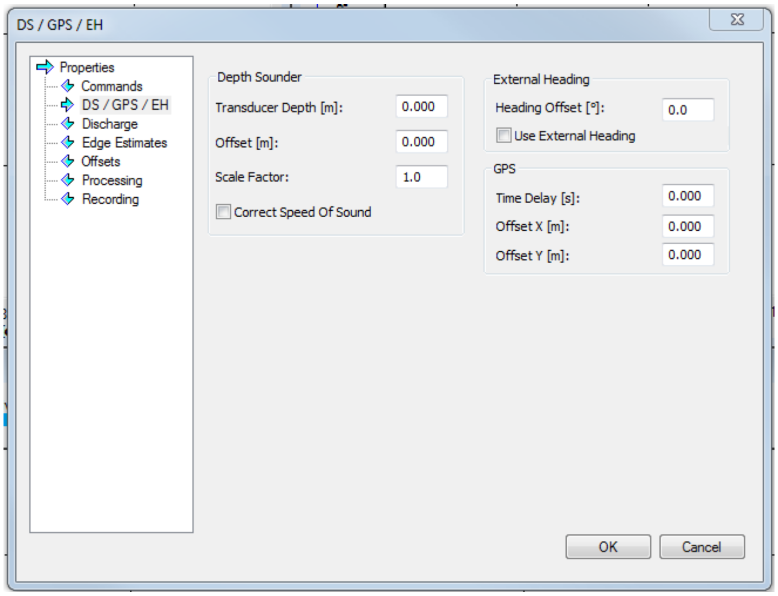


Figure 36. DS/GPS/EH Page

Quick Access to the DS/GPS/EH Page:

Click the **View** menu. Make sure the **Measurement Management** window is selected.

In the Measurement Management window, expand **Collect Data** by clicking the plus box to the left side.

Expand **Next Transect** to find **Field Configuration**.

Double-click on **Field Configuration**.

Click **DS/GPS/EH** to access the **DS/GPS/EH** window.

Depth Sounder

- **Transducer Depth** – Use the **Transducer Depth** to set the depth from the surface of the water to the Depth Sounder transducer face.
- **Offset** – In addition to the **Transducer Depth**, you can also add an additional offset to reconcile any differences between the ADCP bottom track depths and those reported by the DBT NMEA string. Entering a value in the **Offset** box enables this additional offset.
- **Scale Factor** – Many depth sounders only allow a fixed value of 1500 m/s for sound speed. You can apply a scaling factor to the raw NMEA depth sounder output by entering a number in place of the **Correct Speed Of Sound** command. Note that the depths reported by the DBT NMEA string do not include the depth of the sounder, so the scaling is applied to the range reported from the depth sounder to the bottom.
- **Correct Speed Of Sound** – *WinRiver II* can scale the depth sounder depths by the sound speed used by *WinRiver II* by selecting the **Correct Speed Of Sound** box.

The **Use in Processing** checkbox functionality has been moved to the Processing tab.

External Heading

- **Heading Offset** – ADCP Heading data is normally indexed to beam 3 of the ADCP. Use the **Heading Offset** field to adjust external heading data to the correct physical orientation relative to the ADCP beam 3 axis. This parameter will interact with the **Beam 3 Misalignment** parameter and the **Use External Heading** checkbox to affect the final heading, flow direction, and ship track direction data (see Offsets page and How to Use the External Heading). Implementation of this parameter has changed with version 2.18; measurements initially processed with a prior version may require adjustment.
- **Use External Heading** – Check this box to use the External Heading or Integrated EH if the controls are checked in the Configuration Wizard dialog. You can also check this box to ignore the ADCP's internal compass heading data if external heading data was not recorded. This may be desirable at measurement locations with bridges, powerlines, or other features which distort and bias the compass heading data but can only be used if using Bottom Track reference.

GPS

- **Time Delay** – If desired, you can allow for a lead-time between the GPS position updates and the ADCP data. Inserting a value in the **Time Delay** box does this. If you enter a value of 1, the lead is set for 1 second. This assumes GPS data is one second old compared to the ADCP.

Recommended Setting. The recommended value is zero.

Offset

- If the GPS is mounted directly above the ADCP, the **Offset X** and **Offset Y** are zero. Use the **Offset X** and **Y** fields to adjust the ADCP's physical position relative to the GPS. In the example shown below, the GPS antenna is mounted to the left (-X) and forward (+Y) relative to the ADCP. X and Y GPS offsets are normally measured relative to the boat or float axis as shown. The **Beam 3 Misalignment** parameter MUST be entered for the offsets to be correctly applied. Alternatively, the offset can be measured relative to the ADCP Beam 3 axis, leaving Beam 3 Misalignment as zero. The GPS offset will normally not have a significant impact on GPS-referenced discharge quantities but may become significant if the offset is large and the orientation of the boat changes significantly over the duration of a transect.

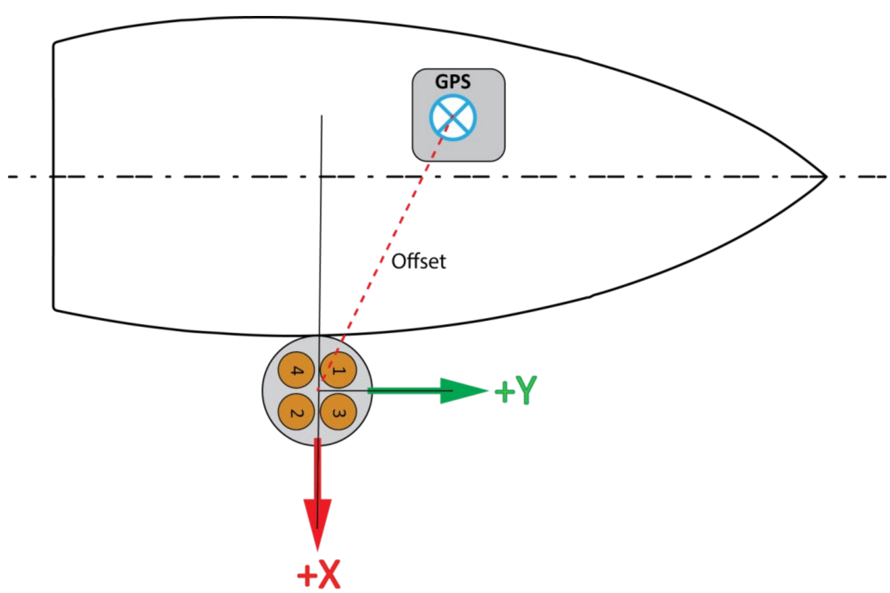


Figure 37. GPS Offset

Discharge Page

WinRiver II uses these setting to determine what formulas and calculations will be used to determine the discharge value.

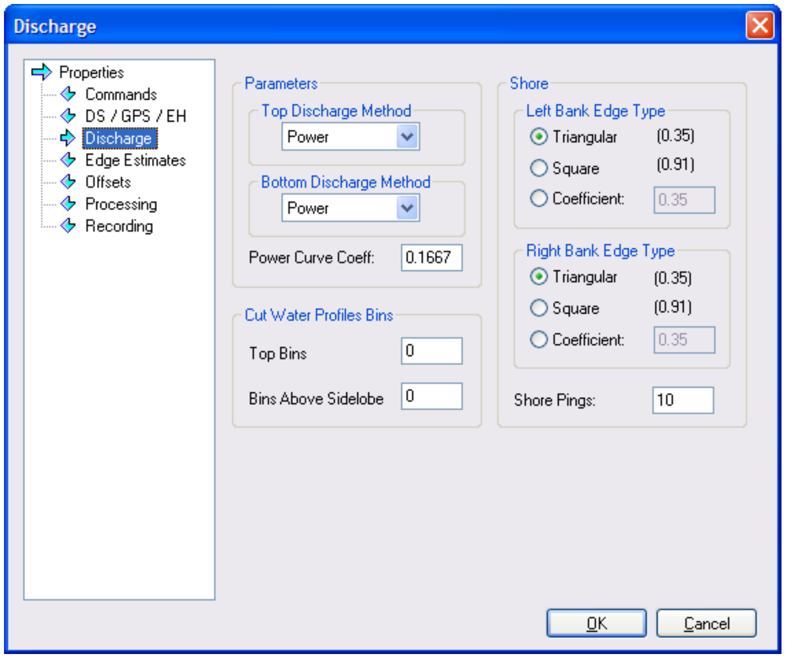


Figure 38. Discharge Page

Quick Access to the Discharge Page:

Click the **View** menu. Make sure the **Measurement Management** window is selected.

In the Measurement Management window, expand **Collect Data** by clicking the plus box to the left side.

Expand **Next Transect** to find **Field Configuration**.

Double-click on **Field Configuration**.

Click **Discharge** to access the **Discharge** window.

- **Parameters** – There are three methods available in *WinRiver II* to estimate discharge in the unmeasured top/bottom parts of the velocity profile based on the Top/Bottom Discharge Method settings. The **Top Discharge Methods** are **Constant**, **Power**, and **3-pt Slope**. The **Bottom Discharge Methods** are **Power** and **No Slip**. The **Power Curve Coefficient** can be changed if the **Power** Method is used. The default is set to 1/6. The **Power** fit is always used to fill in "missing" data in the profile if **Constant** or **Power** method is used.

  The **3 Point Slope** method for top extrapolation uses the top three bins to estimate a slope and this slope is then applied from the top bin to the water surface. A constant value or slope of zero is assumed if less than six bins are present in the profile.

  The **No Slip** method for bottom extrapolation uses the bins present in the lower 20% of the depth to determine a power fit forcing it through zero at the bed. In the absence of any bins in the lower 20% it uses the last single good bin and forces the power fit through it and zero at the bed. By making this selection the user is specifying that they do not believe a power fit of the entire profile is an accurate representation. If the **No Slip** method is selected, missing bins are estimated from the bin immediately above and below using linear interpolation.

- **Cut Water Profiles Bins** – You can select additional bins to be removed from the top or bottom measured discharge.

- **Shore** – The **Left/Right Bank Edge Type** is used in estimating shore discharges. You can select a predefined shape of the area as **Triangular** or **Square**, or set a coefficient that describes the shore. Several pings can be averaged as determined by **Shore Pings** in order to estimate the depth and mean velocity of the shore discharge.
- **Shore Ensembles** – These ensembles are recorded to the raw data file during the stationary period at each shore (edge). The selected number of ensembles is averaged for each edge to ensure that you have good depth and velocity data for estimation of the edge area and discharge.

Edge Estimates Page

This menu lets you estimate the near-shore discharge, that is, near the banks of a channel where the ADCP cannot collect data. These settings should account for the beginning and ending areas of the transect not measured by the ADCP. Shore (edge) distances are always assumed to be parallel to the direction used to compute area.

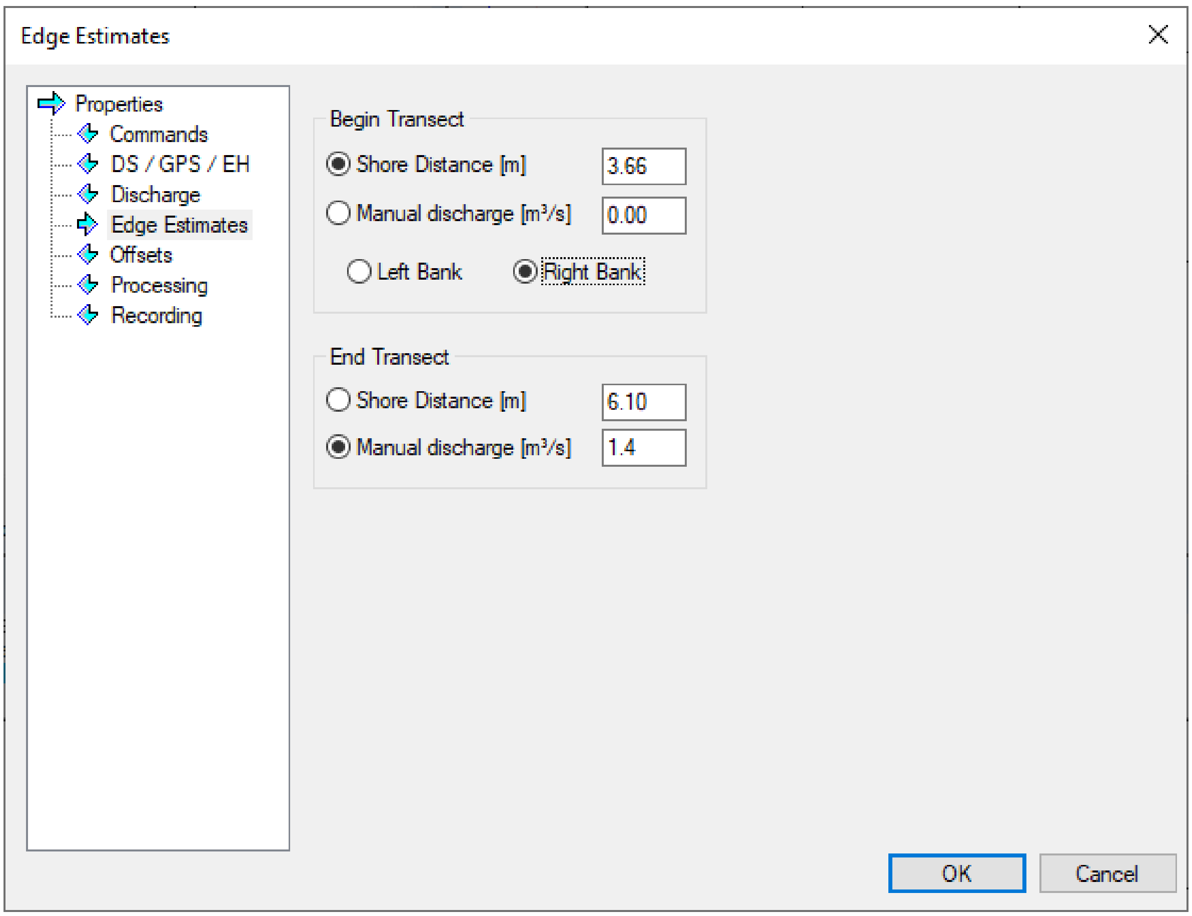


Figure 39. Edge Estimates Page

Quick Access to the Edge Estimates Page:

Click the **View** menu. Make sure the **Measurement Management** window is selected.

In the Measurement Management window, expand **Collect Data** by clicking the plus box to the left side.

Expand **Next Transect** to find **Field Configuration**.

Double-click on **Field Configuration**.

Click **Edge Estimates** to access the **Edge Estimates** window.

Begin Transect

- **Shore Distance** – Enter the distance to the shore at the beginning of the transect.
- **Left/Right Bank**. Define if the shore when you start the transect is the left or right bank. When facing downstream, the left bank is on your left side.

End Transect

- **Shore Distance** – Enter the distance to the shore at the end of the transect.

Offsets Page

The Offsets page lets you set system alignment offsets that only affect the displays, **not** the raw data files. *WinRiver II* saves these settings in the configuration node.

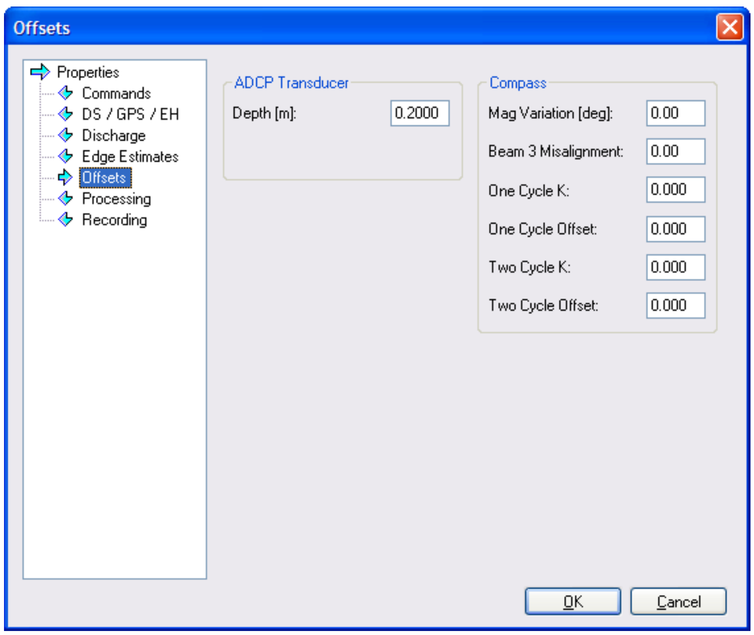


Figure 40. Offsets Page

Quick Access to the Offsets Page:

Click the **View** menu. Make sure the **Measurement Management** window is selected.

In the Measurement Management window, expand **Collect Data** by clicking the plus box to the left side.

Expand **Next Transect** to find **Field Configuration**.

Double-click on **Field Configuration**.

Click **Offsets** to access the Offsets window.

The functions of this submenu are:

- **ADCP Transducer -** Use the **Depth** field to set the depth from the water surface to the ADCP transducer faces. *WinRiver II* uses this value during data collection and post-processing to create the vertical depth scales on all displays. *WinRiver II* also uses the depth value to estimate the un-measured discharge at the top part of the velocity profile. Therefore, depth affects the estimate of total discharge on the data collection and post-processing displays. The depth value does not affect raw data, so you can use different values during post-processing to refine the vertical graph scales and discharge estimates.

The ADCP's ED-command (Depth of Transducer) is used for internal ADCP speed of sound processing and is stored in the raw ADCP file leader. The ED-command has no effect on the vertical depth scales in *WinRiver II*. For normal transect work, do not add an ED-command to the Commands page (see Commands Page).

- **Magnetic Variation** – Use the **Magnetic Variation** field to account for magnetic variation (declination) at the measurement site. East magnetic declination values are positive. West values are negative. *WinRiver II* uses magnetic variation in the data collection and Playback displays to adjust ADCP water profile velocities and bottom-track velocities from magnetic to true north. A **Magnetic Variation** value is not required when external heading data indexed to true north is used as the heading reference. Implementation of this parameter has changed with version 2.18; measurements initially processed with a prior version may require adjustment. Prior to that version the Magnetic Variation parameter was incorrectly applied to external heading data.

The ADCP's EB-command (Heading Bias) and EX-command (Coordinate Transformation) process ADCP data before creating the raw data. The Magnetic Variation field in *WinRiver II* processes the raw data received from the ADCP for data display. The magnetic variation field is not converted to an EB-command (raw data is not effected). This allows you to use the Magnetic Variation field to make changes during post-processing. **For normal transect work, do not add an EB-command to the Commands page (see Commands Page).**

The *WinRiver II* compass corrections will only be applied to the profile data when the data was collected in Beam, Instrument, or Ship coordinates.

- **Beam 3 Misalignment** – the ADCP's Beam 3 is used as the compass heading index for internal compass modules in all Teledyne RDI ADCPs, and both compass heading and external heading data is normally reported as the direction Beam 3 is pointing. The ADCP is often mounted such that Beam 3 is NOT aligned with the fore-aft centerline of the boat or other deployment platform. In some cases the heading of the boat is desired rather than the heading of ADCP Beam 3. Use the **Beam 3 Misalignment** parameter to rotate the heading data to the desired heading. **Beam 3 Misalignment** MUST be entered when using GPS Offsets measured relative to the centerline axis of the boat or other deployment platform. Implementation of this parameter has changed with version 2.18; measurements initially processed with a prior version may require adjustment.
- **Compass Correction Factors** – Ferro-magnetic materials near the ADCP can cause 1- and 2-cycle errors in the compass heading output. Modern ADCPs correct for these errors through the compass calibration process rather than by computing error correction factors for the compass module and entering them in the configuration node properties, so these parameters are normally left blank. Please refer to the section on Compass Correction for details on how to generate compass correction factors if needed.

Processing Page

The **Processing** tab lets you set several system processing options and save them to a configuration node. Most values in the **Processing** tab affect the displays during data collection and post-processing. *WinRiver II* saves these values only to the configuration node, not to the raw data files.

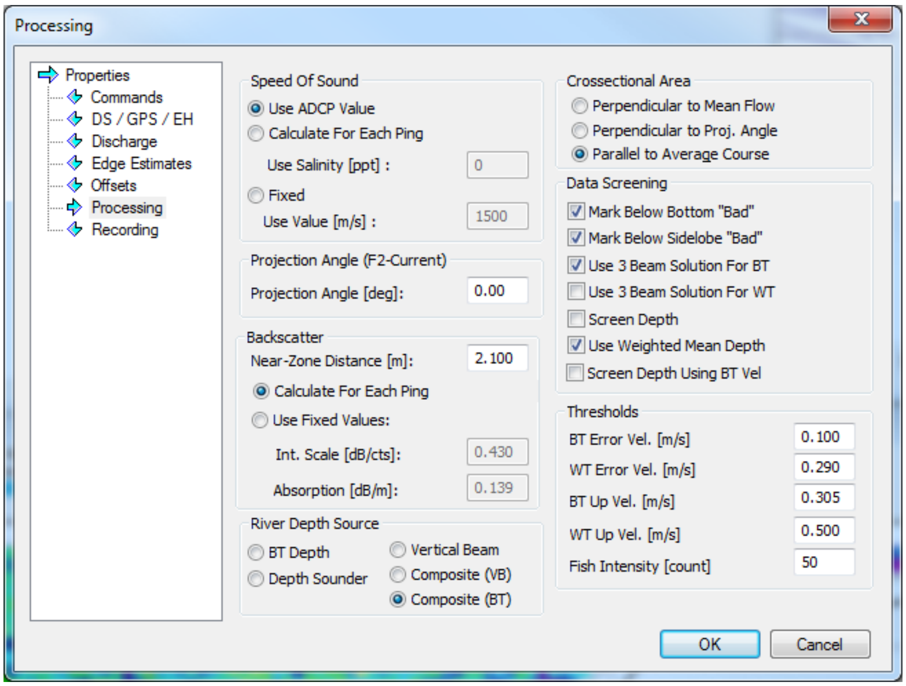


Figure 41. Processing Page

Quick Access to the Processing Page:

Click the **View** menu. Make sure the **Measurement Management** window is selected.

In the Measurement Management window, expand **Collect Data** by clicking the plus box to the left side.

Expand **Next Transect** to find **Field Configuration**.

Double-click on **Field Configuration**.

Click **Processing** to access the Processing window.

The functions of this submenu are:

Speed of Sound

The **Speed Of Sound** box lets you correct velocity data for speed of sound variations in water. *WinRiver II* can make these corrections dynamically with every ping or use a fixed speed of sound value. Select the **Use ADCP Value** option to use the value being generated by the ADCP. The EC, ED, ES, ET, and EZ-commands all can affect the ADCP's speed of sound value. Choosing the **Use ADCP Value** tells *WinRiver II* not to do any speed of sound scaling of velocity data after it is received from the ADCP.

Selecting the **Calculate For Each Ping** option uses the **Salinity Value**, ADCP transducer depth, and the water temperature at the transducer head to compute speed of sound for each raw ADCP ensemble. *WinRiver II* then uses this value to scale the ADCP velocity data dynamically. *WinRiver II* uses scaled velocity data in the displays and for discharge calculations.

Use the **Fixed** option to set a fixed value for sound speed. Select this option if you made a mistake during data collection. *WinRiver II* uses the fixed value to re-scale the velocity data from the ADCP.

The **Calculate For Each Ping** and **Fixed** options should NOT be used with RiverRay ADCPs, as the phased array transducer in the RiverRay automatically corrects horizontal velocity data (but not depth) for errors in Speed of Sound. Use of these options will result in corrected depth but biased width, area, velocity, and discharge data. Correct depth data can be obtained in RiverRay ADCPs by entering the appropriate EC, ED, ES, ET, and EZ commands as **User** commands in the Measurement Wizard if desired.

Projection Angle

This is the angle used to calculate the projected velocity that is displayed in the **Projected Velocity** contour graph.

Projected velocity is the velocity component in a specific direction. The default projection angle, set by using the F2 key, is parallel to the average flow direction and will provide the maximum average projected velocity. The projection angle can also affect the area and width reported for the transect depending on the setting selected for Cross Sectional Area.

Backscatter

The Backscatter options control the values used to convert between measured Receive Signal Strength (RSSI) to backscatter (estimated true signal strength in the water column). These parameters have no effect on discharge and only affect backscatter.

The **Near Zone Distance** ($d_{Near-Zone}$) is the distance away from the transducer where the beam transitions from cylindrical to conical (see Figure 42). The angle of the cone is the beam width. The default value (2.1 m) should be used for 600 and 1200 kHz Rio Grande. Other transducers should use the formula shown in Figure 42.

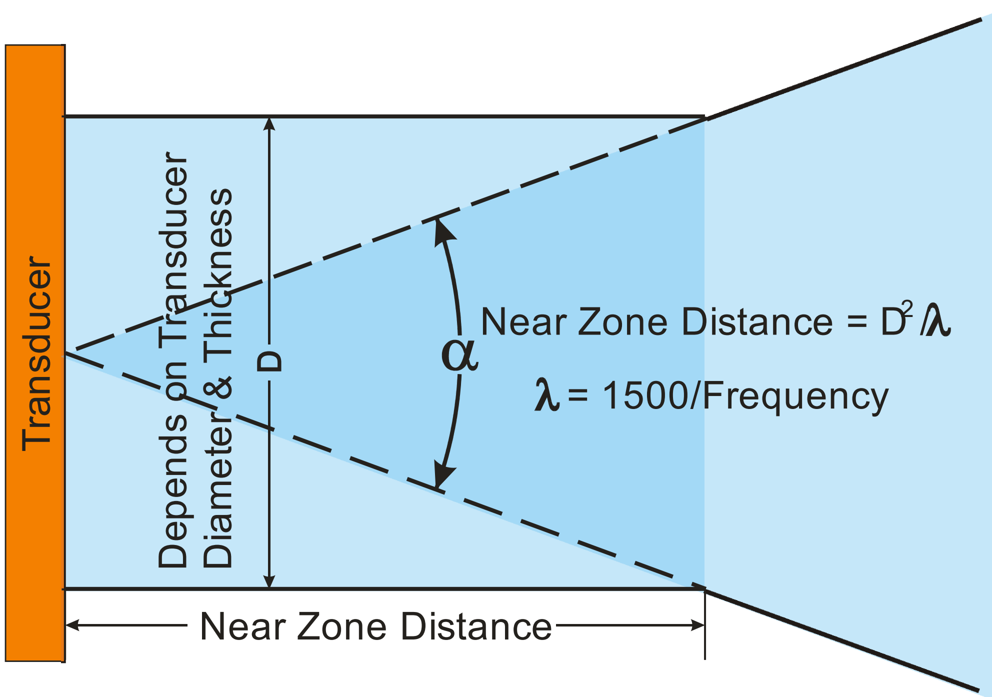


Figure 42. Near Zone Distance

WinRiver II uses the **Echo Intensity Scale** (dB per RSSI count) value to convert the ADCP signal strength (RSSI, AGC) from counts to dB before correcting it for absorption and beam spreading beyond the **Near Zone Distance**. Echo intensity in decibels (dB) is a measure of the signal strength of the returning echo from the scatterers. It is a function of sound absorption, beam spreading, transmitted power, and the backscatter coefficient. For more information on echo intensity, see TRDI's *Principles of Operation: A Practical Primer*. The echo intensity scale is temperature dependent based on the following formula. Echo intensity scale (dB per RSSI count) = 127.3 / (Te + 273) where Te is the temperature (in °C) of the ADCP electronics and is calculated by *WinRiver II* unless overridden by the user. At ambient temperature, the nominal scale is 0.43dB per count. Speed of Sound is based on temperature and salinity and uses that value unless overridden by the user.

The sound absorption coefficient, which is used to estimate echo intensity in decibels, is a function of frequency. Beyond the **Near Zone Distance** (in the distance more than $2 \cdot d_{Near-Zone}$) *WinRiver II* normalizes echo-intensity using the formula:

$$I_{dB} = C \cdot I_{counts} + 20 \cdot \log_{10}(R) + 2\alpha R - 10 \cdot \log_{10}\left(\frac{L_{Xmit}}{\cos\theta}\right)$$

Where:

$$R = \frac{r + 0.5L_{Xmit}}{\cos\theta}$$

And

r	The range from the transducer to the middle of the bin
θ	Beam angle
L_{Xmit}	The transmit length
α	Sound absorption coefficient
C	Echo intensity scale

River Depth Source

BT Depth – *WinRiver II* will use the weighted average ADCP beam depths in the discharge calculation.

Depth Sounder – This will instruct *WinRiver II* to use the depth sounder value in the discharge calculation rather than the ADCP beam depths.

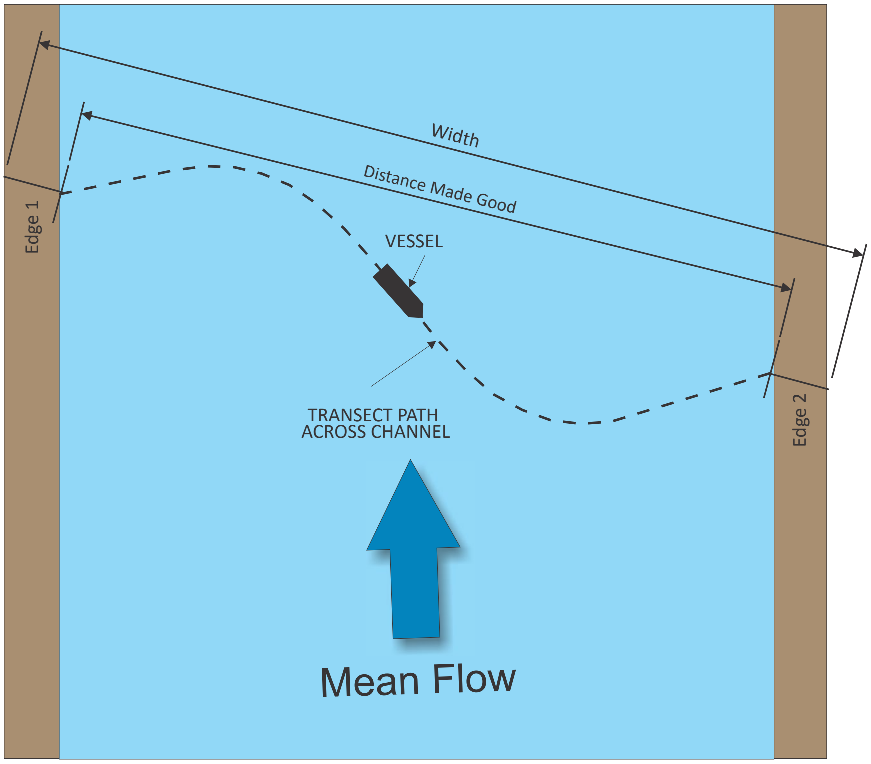
Vertical Beam – This will instruct *WinRiver II* to use the vertical beam value in the discharge calculation rather than the ADCP beam depths.

Composite (VB) – This setting preferentially selects between the three potential depth sources; with the first preference to **Vertical Beam**, second preference to **Depth Sounder**, and the third preference to Average **BT Depth**.

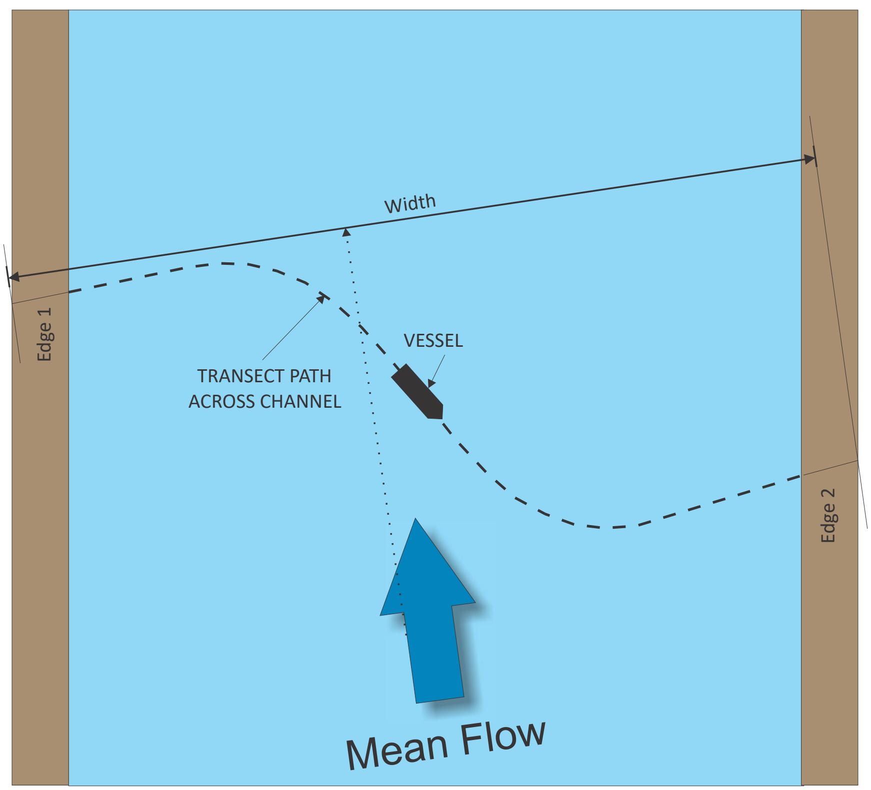
Composite (BT) – This setting will preferentially use the calculated bottom track depth, then the vertical beam depth, then the depth sounder depth. The text label in the Composite Tabular Discharge display will reflect the actual depth source used for each ensemble. **Composite (BT)** depth source is the default for all new measurements.

Cross Sectional Area

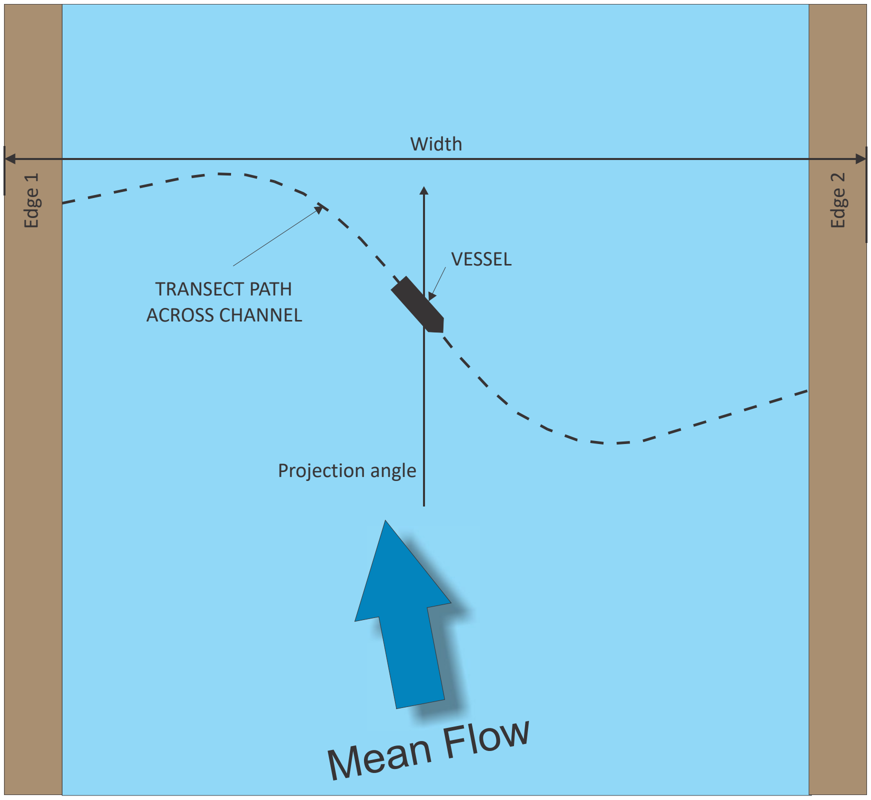
Cross Sectional Area (and Width) can be calculated using three different methods: as perpendicular to the mean flow, perpendicular to the projection angle, or parallel to the average course. The default setting is **Parallel to Average Course**, which will provide the greatest width and area. The setting **Perpendicular to Mean Flow** normally provides the best representation of the true width and cross-sectional area of the stream or river. The setting **Perpendicular to Projection Angle** will provide the width and area of the section projected in an arbitrary user-selected direction. Edge distances and areas are always assumed to be parallel to the direction used for computing width and area.



Parallel to Average Course



Perpendicular to Mean Flow



Perpendicular to Projection Angle

Data Screening

Select **Mark Below Bottom "Bad"** to mark data as bad below the ADCP-detected bottom or Depth Sounder detected bottom (if selected for processing). This only affects data displays, not discharge calculations.

Select **Mark Below Sidelobe "Bad"** to mark data as bad below the sidelobes (if selected for processing). This only affects data displays, not discharge calculations.

Check the **Use 3 Beam Solution for BT** box to allow 3-beam solutions if one beam is below the correlation threshold set by the BC command.

Check the **Use 3 Beam Solution for WT** box to allow 3-beam solutions if one beam is below the correlation threshold set by the WC command.

Check the **Screen Depth** box to allow for depth screening or if the ADCP sometimes reports the wrong depth. This can happen due to the detection of the reflection of the bottom. The beam is not used in the mean depth calculations if its depth is more than 75% different from the other beams.

Check the **Use Weighted Mean Depth** box to have *WinRiver II* calculate depth using the following formulas.

$$d = \frac{\sum_{i=1}^{n} w_i d_i}{\sum_{i=1}^{n} w_i}$$

and

$$w_i = 1 - \frac{d_i}{\sum_{j=1}^{n} d_j}$$

Where

n = Number of valid beams
d_i = Beam depth
w_i = Weight

The weighting factor for a beam is calculated by subtracting from 1.0 the ratio of the beam depth to the sum of the depths of all the valid beams.

Check the **Screen Depth Using BT Vel** box to allow depths to be filtered out when bad bottom velocity data is detected. Use of this flag could possibly remove depth spikes from the data.

Thresholds

Bottom Track Error Velocity - The ADCP uses this parameter to determine good bottom-track velocity data. If the ADCP's error velocity value exceeds this threshold, it flags data as bad for a given depth cell.

Water Track Error Velocity - The ADCP uses this parameter to set a threshold value used to flag water-current data as good or bad. If the ADCP's error velocity value exceeds this threshold, it flags data as bad for a given depth cell.

Bottom Track Up Velocity - The ADCP uses this parameter to determine good bottom-track velocity data. If the ADCP's upward velocity value exceeds this threshold, it flags data as bad for a given depth cell.

Water Track Up Velocity - The ADCP uses this parameter to set a threshold value used to flag water-current data as good or bad. If the ADCP's upward velocity value exceeds this threshold, it flags data as bad for a given depth cell.

Fish Intensity - The ADCP uses this parameter to screen water-track data for false targets (usually fish). If the threshold value is exceeded, the ADCP rejects velocity data on a cell-by-cell basis for either the affected beam (fish detected in only one beam) or for the affected cell in all four beams (fish detected in more than one beam). Enter a value of 255 to turn off the Fish Intensity screening.

Recording Page

The **Recording** page lists the parameters used to define where the data is recorded during data collection. Most of these parameters are set using the Measurement Wizard entries and cannot be changed in a configuration node. Exceptions are noted where applicable.

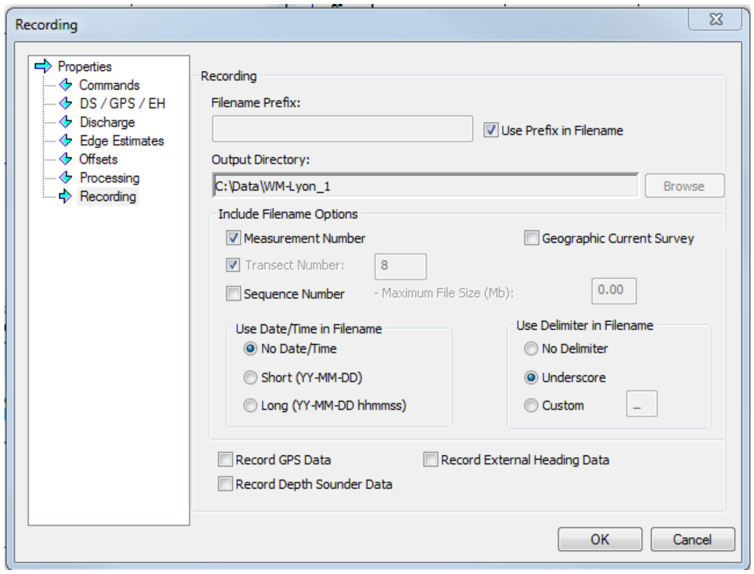


Figure 43. Recording Page

Quick Access to the Recording Page:

Click the **View** menu. Make sure the **Measurement Management** window is selected.

In the Measurement Management window, expand **Collect Data** by clicking the plus box to the left side.

Expand **Next Transect** to find **Field Configuration**.

Double-click on **Field Configuration**.

Click **Recording** to access the Recording window.

- **Filename Prefix** – *WinRiver II* uses the **Filename Prefix** to create the data file names made during data collection. Use the **Output Directory** field to select where the data file will be stored.

  During data collection, if the **Filename Prefix** is set to TEST, *WinRiver II* creates data files with the prefix TEST (TEST_000_000.PD0) and stores them in the directory specified in the **Output Directory** field until the disk is full. *WinRiver II* will then stop data collection and alert you to the disk space problem.

A file name can contain up to 255 characters, including spaces and the **Filename Prefix**. It cannot contain the following characters: \ / : * ? " < > |

- **Use Date/Time in Filename** – Check this box if you want the date and time stamp to be added to the file name.
- **Maximum File Size** – Select the **Sequence Number** box to use the **Maximum File Size** field to limit the size of a data file. The default for the maximum data file size is unlimited (**Sequence Number** box is not selected). If you set the Maximum File Size to 1.44, then when the size of the recorded data file reaches 1.44 MB, the **Sequence Number** increments.
- **Next Transect Number** – The program will start with the number specified in the **Next Transect Number** box. If the transect already exists, the next number available will be used.

- Selecting **GPS**, **Depth Sounder**, or **External Heading** as devices in the Measurement Wizard will automatically cause the data from those devices to be saved in the PD0 data file. By default, separate ASCII text files of the data from each of those devices will also be created and saved. If you do NOT want to record ASCII GPS, External Heading, and Depth Sounder data, then un-check the appropriate box in the configuration node under Data Collection/Next Transect. You may need to repeat this action every time you run the Measurement Wizard within a measurement.

Collecting ASCII GPS, External Heading, or Depth Sounder files is not required and is not used by *WinRiver II*.

The **River Depth Source** parameter on the **Processing** page is used to determine what depth data is used in area and flow calculations (see River Depth Source, Processing Page).

Chapter 9

QA/QC

This chapter includes:

- Setting the ADCP Clock
- Testing the Pressure Sensor
- Testing the ADCP
- Compass Calibration
- Moving Bed Test

Before taking measurements, check the following items:

Setting the ADCP Clock

To set the ADCP clock:

1. On the **Acquire** menu, click **Set ADCP Clock**.
2. Click the **Set Clock** button to set the ADCP's time to the GPS time (if available) or the PC's time. If necessary, set the PC's clock first.
3. Click **OK** to exit the **Set ADCP Clock** dialog.

The first time a transect is started, the Set ADCP Clock dialog will open.

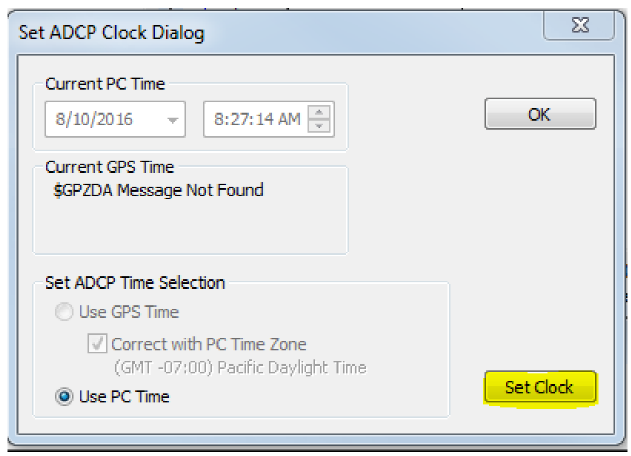


Figure 44. Set the ADCP Clock

Only clicking the **OK** button will **NOT** set the clock. The user **MUST** click the **Set Clock** button.

Testing the Pressure Sensor

To test the pressure sensor:

1. On the **Acquire** menu, click **Execute Pressure Sensor Test** to verify the ADCP's pressure sensor is functioning properly.
2. Click the **Zero Pressure Sensor** button to zero out the sensor.
3. Click **Close** to exit the **Pressure Sensor Calibration** dialog.

If your ADCP does not have a pressure sensor, you will see an error message.

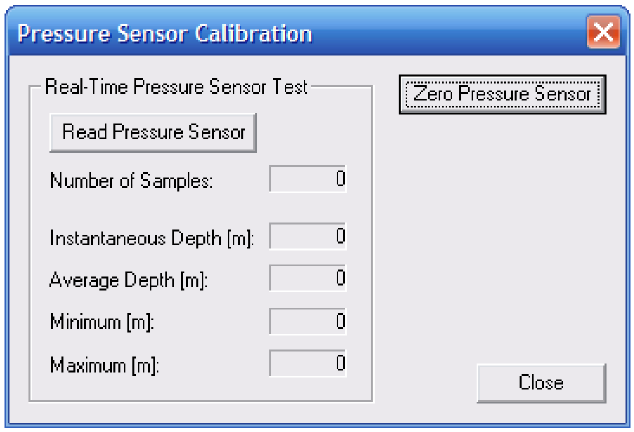


Figure 45. Test the Pressure Sensor

Testing the ADCP

To test the ADCP:

1. On the **Acquire** menu, click **Execute ADCP Test** to verify the ADCP is functioning properly. The ADCP should be in water to obtain the most accurate results. The ADCP Test for Rio Grande

ADCPs should be conducted in non-moving or very slow water velocities. StreamPro and River-Ray ADCPs can normally be tested in any flow conditions.

2. Click the **Stop PC2** button to end the PC2 test. Click **Close** to exit the **ADCP Test** dialog. The tests conducted will vary depending on the type ADCP being used.

> The tests should be run while the Rio Grande ADCP is in non-moving water. Running the test in air will not harm the ADCP, but some tests may fail in air.

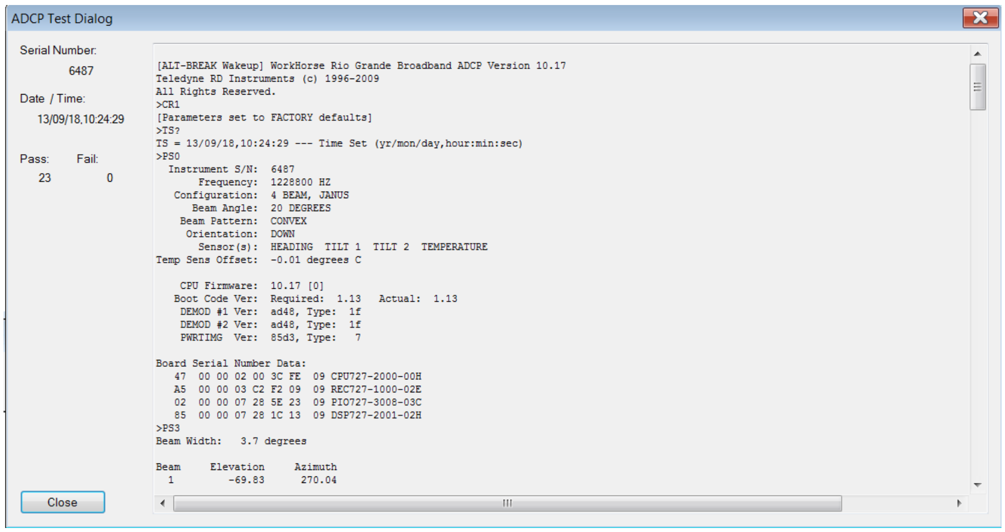


Figure 46. Test the ADCP

Compass Calibration

A compass calibration should be conducted at every new measurement location, and whenever the ADCP mounting or adjacent ancillary equipment is changed or repositioned. A properly calibrated compass is essential for conducting the Loop Moving Bed test, and for using GPS data as the navigation reference.

The following section describes the procedure to correct the ADCP's compass for use with the GPS data. The first correction is for one-cycle magnetic deviation errors and the second correction to the compass is for local magnetic variation.

> *Both of these corrections are important when using GPS as the boat speed reference because an uncorrected difference between the earth coordinate system of the GPS and the ADCP's internal magnetic compass will translate into significant errors in the discharge calculation.*

> ADCP heading data from an internal compass module is normally indexed to beam 3 of the ADCP. If External Heading data is used, or if a different heading reference orientation is desired, you must enter properly coordinated values for **Heading Offset**, **Magnetic Variation**, and **Beam 3 Misalignment** (see Using External Heading Data, GPS/EH/DS Page, and Offsets Page).

In the calibration/evaluation sequence, the user at times has the option of rejecting the new calibration and keeping the old one. In all cases:

- the **Calibration** node is intended to contain the error results for the UNUSED cal coefficients and

- the **Evaluation** node is intended to contain the error results for the USED cal coefficients.

Thus, the **Calibration** node header and footer text may vary depending on whether the new calibration was accepted or rejected:

- If the new calibration was accepted, the header should read: *Data from Prior Calibration* and the footer should read: *New Calibration with Typical Error nnn Saved*.
- If the new calibration is rejected, the header should read: *Data From This Calibration Attempt* and the footer should read: *This Calibration NOT Saved*.
- The Evaluation header doesn't change and there is no footer; the header should read: *Data for Calibration Used*.

Calibrating the ADCP's Compass

Use the correct compass correction based on system type:

- For Rio Grande systems and WorkHorse Monitor/Sentinel ADCPs, use Rio Grande ADCP Compass Calibration
- For StreamPro systems and RiverRay/RiverPro/RioPro units with the Integrated Sensor Module (ISM) compass, use StreamPro/RiverRay/RiverPro/RioPro Compass Calibration
- For RiverRay systems with the Honeywell compass, use RiverRay Compass Calibration (Honeywell compass)
- For other WorkHorse and Broadband systems, use Manual One-Cycle Compass Correction.

Rio Grande ADCP Compass Calibration

This procedure is used to correct the Rio Grande's internal flux-gate compass for one and two-cycle deviation errors. The compass correction procedure given here can be used if you are using a Rio Grande with firmware version 10.05 and higher or a WorkHorse Monitor/Sentinel ADCP with firmware version 16.30 or higher.

In the (fairly rare) event that there is an issue with the calibration, TRDI suggests sending the AR command first and then try to align the compass. The AR command can be sent using *BBTalk*.

To calibrate the Rio Grande ADCP compass:

1. Mount the Rio Grande ADCP in the boat as it will be used to acquire data.
2. Click **OK** to exit the **Advanced ADCP Configuration Dialog**, and then click **Close** to exit the **Peripherals Configuration Dialog**.

3. On the **Acquire** menu, click **Execute Compass Calibration**. Click on the **Calibrate** button to begin the compass calibration.

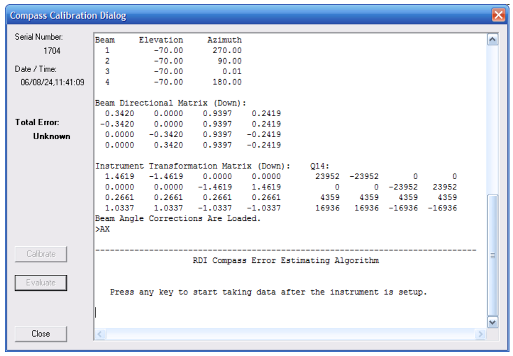


Figure 47. Compass Calibration Screen

4. During this procedure, you will drive your boat in continuous, small circles. You can accomplish this by adjusting the throttle to just above idle and steering either hard left or hard right. You will want to reduce any pitch and roll effects during the turn (do not move about the boat, this may cause the boat to change how it sits in the water) and avoid any accelerations. If you are working on a river, you will find that you drift downstream as you perform the circles. This will not affect the correction procedure.

5. While you continue to drive the boat in circles, press any key to start the compass calibration. Follow the on screen prompts.

6. Press **D** for details.

```
HEADING ERROR ESTIMATE FOR THE CURRENT COMPASS CALIBRATION:
   OVERALL ERROR:
      Peak Double + Single Cycle Error (should be < 5ø):  ñ 1.73ø
   DETAILED ERROR SUMMARY:
      Single Cycle Error:                                 ñ 1.70ø
      Double Cycle Error:                                 ñ 0.42ø
      Largest Double plus Single Cycle Error:             ñ 2.12ø
      RMS of 3rd Order and Higher + Random Error:         ñ 0.77ø
      Orientation:    Down
      Average Pitch:  -0.18ø         Pitch Standard Dev:    0.37ø
      Average Roll:    0.35ø         Roll Standard Dev:     0.45ø

Successfully evaluated compass performance for the current compass calibration.

Press C to display Percent Horizontal Field Components
     Relative to Calibration or any other key to continue....
Calibration parameters have been updated in NRAM.

>
```

7. You can now use the Rio Grande with its corrected compass and a configuration that contains the magnetic variation correction to collect discharge measurement data with integrated GPS.

Rio Grande Compass Calibration Verification

Compass calibration verification is an automated built-in test that measures how well the compass is calibrated. The procedure measures compass parameters at every 5° of rotation for a full 360° rotation. When it has collected data for all required directions, the ADCP computes and displays the results.

1. On the **Acquire** menu, click **Execute Compass Calibration**. Click on the **Evaluate** button to begin the compass verification.

2. Rotate the ADCP slowly 360 degrees (approximately 5 degrees per second). Pay particular attention to the Overall Error.

3. If the overall error is less than 2°, the compass does not require alignment. You can align the compass to reduce the overall error even more (if desired).

```
HEADING ERROR ESTIMATE FOR THE CURRENT COMPASS CALIBRATION:
   OVERALL ERROR:
      Peak Double + Single Cycle Error (should be < 5():   ( 1.55(
   DETAILED ERROR SUMMARY:
      Single Cycle Error:                                 ( 1.54(
      Double Cycle Error:                                 ( 0.07(
      Largest Double plus Single Cycle Error:             ( 1.61(
      RMS of 3rd Order and Higher + Random Error:         ( 0.31(
```

StreamPro/RiverRay/RiverPro/RioPro Compass Calibration

The StreamPro, RiverRay and RiverPro/RioPro Integrated Sensor Module (ISM) compass calibration procedure uses rotations to compute a new calibration matrix. It will not accept the new matrix unless the calibration was carried out properly, and it asks you to verify that you want to use the new calibration if it is not as good as the previous calibration.

Two compass modules have been used in the RiverRay ADCP: current production systems include an Integrated Sensor Module (ISM) compass and prior production systems use the Honeywell HMR3300 module. To see what type compass is installed, see the PS0 command in the RiverRay Operation Manual. The *WinRiver II* software will automatically detect the installed compass and configure the calibration process appropriately.

Communication errors may occur during calibration when using a slow communication Baud rate. If you receive a ***Failed to get calibration data…*** message, try increasing the Baud rate (57,600 or 115200 Baud is recommended).

If you see a compass error message "360 degrees", then that is a failed compass calibration and you need to retry.

If you are using a RiverRay, and have a GPS system connected and configured for integration of the GPS data stream into the RiverRay, you may need to disconnect or disable the GPS during compass calibration.

Computational errors may occur during calibration. If you receive an error message indicating that a computational error occurred, repeat the calibration being sure to rotate the ADCP slower and smoothly, and ensure that all points in the calibration display are of good quality. Also ensure that you are not attempting to calibrate the ADCP compass near vehicles, steel bridges, or other large ferro-magnetic masses.

The **Use Pitch/Roll** selection in the ISM compass calibration routine only affects the user interface display and the criterion for determining when data collection is complete. The same internal correction computations occur regardless of the selection setting. Having some pitch and roll variations during a "flat" calibration will not adversely affect the quality of the calibration.

To calibrate the RiverRay, RiverPro/RioPro, or StreamPro Compass:

1. On the **Acquire** menu, click **Execute Compass Calibration**.
2. Click the **Calibrate** button.
3. Select **Use Pitch/Roll?**
   - Click **No** if the RiverRay, RiverPro/RioPro, or StreamPro will not be subject to pitch and roll (i.e. calm water) (see Figure 48). This calibration requires two rotations (one for calibration and one for verification).

- Click **Yes** if RiverRay, RiverPro/RioPro, or StreamPro will be subject to pitch and roll (see Figure 49). This calibration requires up to eight rotations (four for calibration and four for verification) while pitching the system up and down.

4. If needed, click the **Factory Default** button to restore the factory calibration values.

Use the **Factory Default** button if your compass has problems calibrating or instructed to by TRDI field service.

5. Click the **Start Calibration** button.
6. As you rotate the RiverRay, RiverPro/RioPro, or StreamPro, the bars will change color. The Blue bar indicates where you are in the rotations.
   - Green – Good
   - Light Green – Acceptable
   - Yellow – Within parameters (one or two yellow bars for the entire rotation is OK)
   - Orange – Unacceptable - Rotate slower!
   - Red – Not measured
7. When the first rotation(s) are complete, click **OK** on the message box to continue with the verification samples.
8. When the second rotation(s) are complete, click **OK** on the message box. The calibration error should be less than 2 degrees.

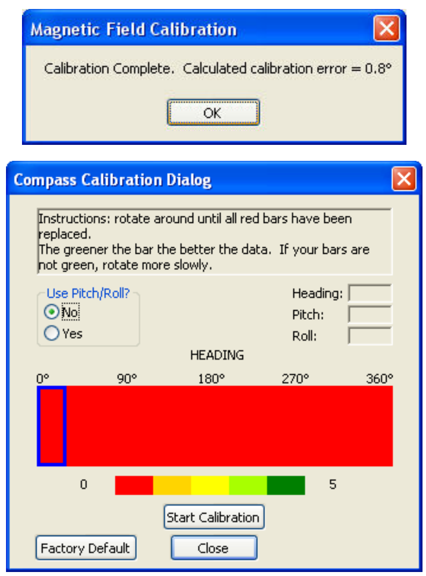


Figure 48. StreamPro/RiverRay/RiverPro/RioPro Compass Calibration Screen

The no Pitch/Roll calibration (also called a single-tilt calibration) requires two rotations while the ADCP is on a flat, level surface.

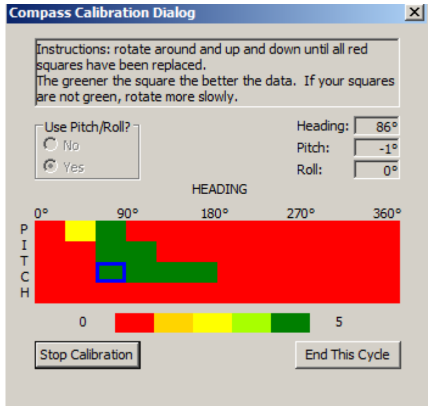


Figure 49. StreamPro/RiverRay/RiverPro/RioPro Compass Calibration Screen – Pitch/Roll

The Pitch/Roll calibration requires eight rotations while pitching the RiverRay, RiverPro/RioPro, or StreamPro up and down.

- For the bottom row of squares, pitch the ADCP between -22.5 to -45 degrees.
- For the second row, pitch the ADCP between -22.5 to 0 degrees.
- For the third row, pitch the ADCP between 0 to 22.5 degrees.
- For the top row, pitch the ADCP between 22.5 to 45 degrees.

Each row can be completed during one rotation or you can vary the pitch as you rotate. A good compass calibration requires slow, smooth movement to allow the compass to collect data at each point.

RiverRay Compass Calibration (Honeywell compass)

The RiverRay compass calibration procedure uses one or more rotations to compute and save new calibration offsets. No verification procedure is available for this compass module.

> The RiverRay ADCP must be on a flat, level surface during the compass calibration.

To calibrate the RiverRay HMR3300 Compass:

1. On the **Acquire** menu, click **Execute Compass Calibration**.
2. Click the **Calibrate** button. *WinRiver II* will enter the appropriate compass command.
3. Follow the on-screen prompts and press the "**S**" key to start the calibration.
4. Slowly rotate the RiverRay system. Each turn should take at least one minute for best accuracy.
5. A minimum of one complete rotation is required. More rotations increase the calibration accuracy. Each turn should take at least one minute to complete for best accuracy. When at least one rotation is complete, press the "D" key.
6. Press the "**A**" key to accept the new CAL offsets.
7. If the pitch and roll varied during the calibration, then press the "**P**" key to accept the new CAL offsets. This will accept new X, Y and Z CAL offsets.
8. If the CAL Offsets for X and Y are not within +/- 200, return to the original factory calibration, by pressing either the "**R**" key or the "**F**" key. Try using the Factory defaults if you have trouble calibrating your compass. In some circumstances, a defective compass calibration matrix can prevent proper calibration.

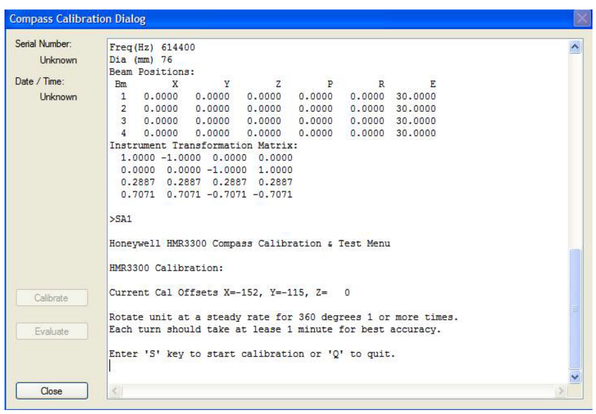


Figure 50. RiverRay Honeywell Compass Calibration Screen

Magnetic Variation Correction

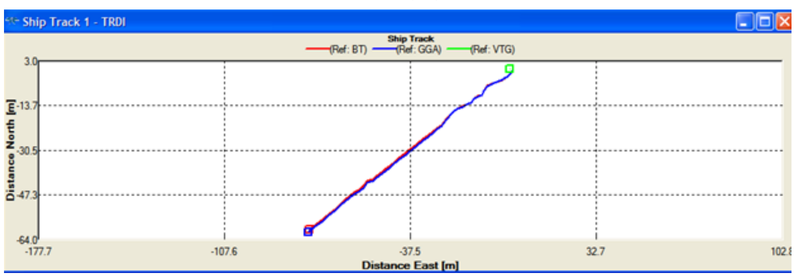
Local magnetic variation correction is normally obtained from a geomagnetic model such as provided by NOAA or similar provider, or can be estimated by referring to a chart of magnetic variation. Magnetic variation changes over time so updated values should be periodically obtained. The following field procedure can be performed to determine the local magnetic variation. If you anticipate moving bed conditions during flood season, you should determine the magnetic variation before flood season begins.

> For the greatest accuracy, TRDI recommends checking the National Geophysical Data Center website (below) to find the declination angle based on your latitude and longitude:
> http://www.ngdc.noaa.gov/geomag-web/#declination

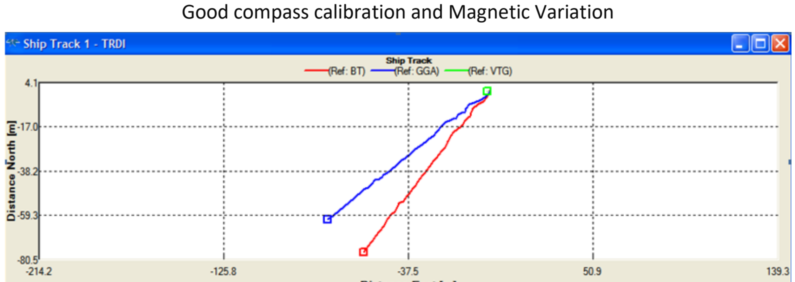
To enter the Magnetic Variation:

1. Calibrate the compass (see Calibrating the ADCP's Compass and follow the instructions for your ADCP).
2. On the Offsets Page, set the **Magnetic Variation** value. Do not adjust the **Beam 3 Misalignment** setting unless you are using an external heading device. If you have a good compass calibration and have entered the Magnetic Variation correctly, then the Ship Track display (Ref: BT) and (Ref: GGA) lines should be aligned.

Offsets page



Good compass calibration and Magnetic Variation



Poor compass calibration and/or Magnetic Variation not set correctly. Also check for Moving Bed.

> If the Ship Track display (Ref: BT) and (Ref: GGA) lines are not aligned as shown above, verify the compass calibration is good and that the Magnetic Variation setting is correct (east magnetic declination values are positive; west values are negative). Also check for Moving Bed conditions.

Moving Bed Tests

During high flow season or where the river sediment load is high, acoustic absorption and scattering interfere with the bottom tracking of ADCPs. If you obtain biased bottom track data at your river site, moving to a new section may help, but flood conditions may require the use of GPS (see Integrating Depth Sounder, External Heading, and GPS Data). Computational methods for correcting/adjusting the measured discharge such as the USGS's Loop Correction (LC) and Stationary Moving Bed Analysis (SMBA) procedures can also be used in conjunction with the results of the moving bed tests to compensate for a moving bed condition at a measurement location.

Moving Bed tests are used to determine if the bed of the section is in motion. The Moving Bed test should be performed at every site gauged, and should be conducted every time the site is visited as conditions do change. The test can also act as a pre-survey; the data retrieved can be used in the Measurement Wizard to optimize the depth and velocity settings.

WinRiver II analyzes the data collected during both stationary and loop moving bed tests to assess the moving bed characteristics of the site and to detect common error conditions which may invalidate the test. The Test Results node in the measurement control window contains an ASCII-text summary of the moving bed test summary. Results will be reported in the user units selected at the time the moving bed test was last reprocessed. To see the test results in a different set of units simply set the desired units and reprocess the test. Summary results for all moving bed tests conducted at a site are also reported in the MBT (Moving Bed Test) Summary, along with the results of correction calculations based on those moving bed tests (see Using the MBT Summary).

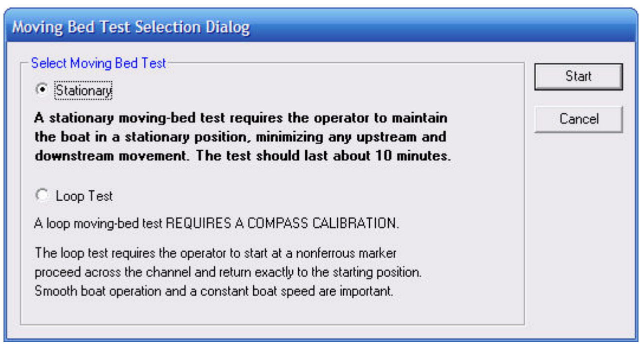


Figure 51. Moving Bed Test Dialog

Stationary Test

Use the stationary test when the compass calibration is not good, bottom tracking cannot be maintained, or when using a StreamPro ADCP without a compass. To run the Stationary moving bed test:

1. Using the **Measurement Wizard**, set an estimated depth and velocity.
2. On the **Acquire** menu click **Start Pinging** or use the shortcut key **F4**.
3. Move the ADCP to the middle of the section, or the point at which the highest velocities can be seen.
4. On the **Acquire** menu click **Select Moving Bed Test**. Select **Stationary** and click the **Start** button.
5. Hold the ADCP in position for ten minutes and try to minimize any movement.

> If a site routinely has a moving bed and GPS is always used with the ADCP, a moving-bed test is still required but need only be five minutes in length (see hydroacoustics.usgs.gov/training/webinars/Overview_TandM.ppt).

6. Keep a close eye on the **Ship Track Graph**. Any movement indicated on here above actual movement would indicate a Moving Bed.

StreamPro and other ADCPs without a compass or with the compass disabled can appear to 'swim' in the upstream direction due to rotation and translation of the ADCP during the test. The stationary moving bed test analysis will correct for this ADCP movement and report only the 'true' upstream movement.

7. On the **Acquire** menu click **Stop Moving Bed Test**.
8. Review the data (see MBT Summary Display); if this indicates bed movement, move to a more suitable section, use the Moving Bed Test results to compute a corrected discharge, or use GPS/Depth Sounders as needed.
9. Use the data to set a better configuration for transects.

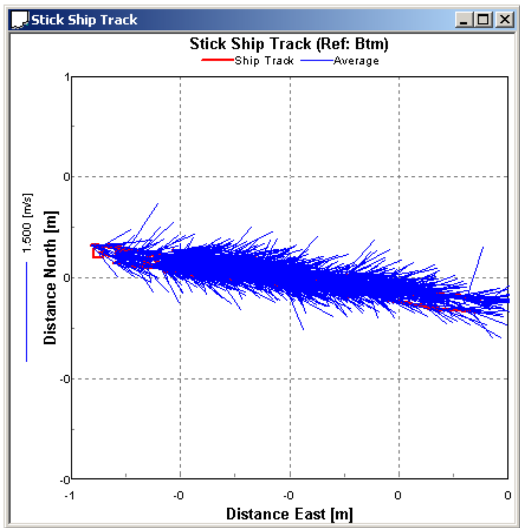


Figure 52. Ship Track Indicating NO Moving Bed

Note the small scale of the graph – overall movement of the ADCP is less than 1 meter.

Loop Test

For more information, refer to the USGS document concerning the loop method at the following link: http://pubs.usgs.gov/sir/2006/5079/

A properly calibrated heading reference such as the ADCP's internal compass is REQUIRED for a loop moving bed test, and results may be biased near steel bridges or other sources of magnetic field disturbances which cannot be compensated for in the compass calibration procedure. To run the Loop Test moving bed test:

1. On the **Acquire** menu click **Select Moving Bed Test**. Select **Loop Test** and click the **Start** button.
2. Start at one bank.
3. Mark the starting location. Move across the river to the opposite bank. Do not stop or end the transect.

4. Turn around and head back to the exact starting point.
5. On the **Acquire** menu click **Stop Moving Bed Test**.

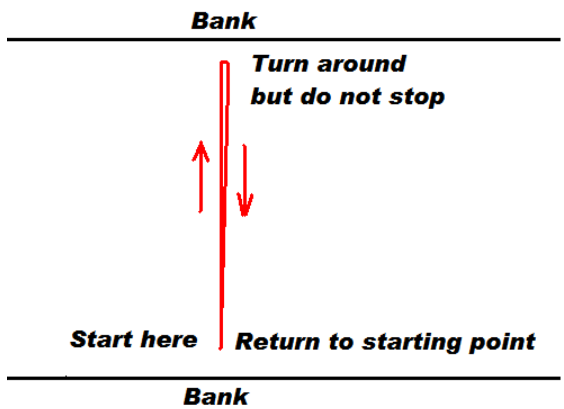
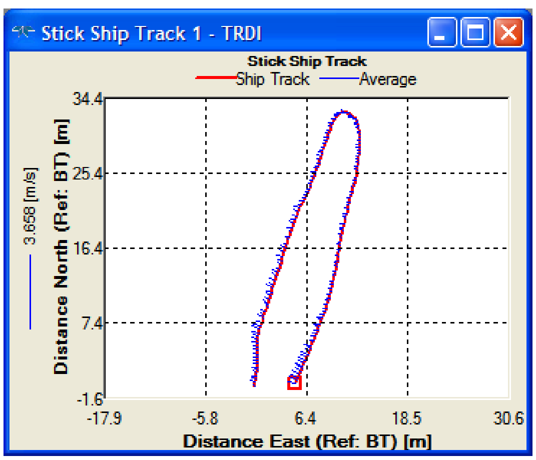
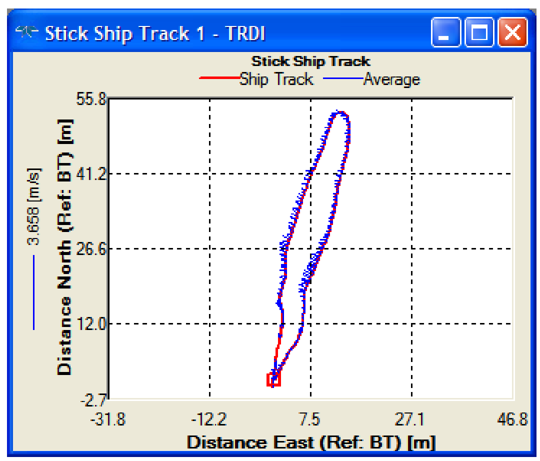


Figure 53. Loop Test

6. The bottom left example shows what the BT track looks like in the case of a loop test. The "open mouth" at the bottom of the track is caused by a moving bed. The track on the right shows that there is no 'open mouth' and therefore no moving bed. Moving bed conditions will ALWAYS cause the ship track to move upstream – if the ship track moves downstream the loop test is not valid.
7. Review the data (see MBT Summary Display); if this indicates bed movement, move to a more suitable section or use GPS and Depth Sounders as needed.
8. Use the data to set a better configuration for transects.



Moving bed

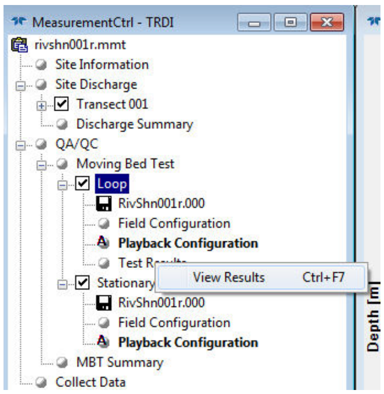


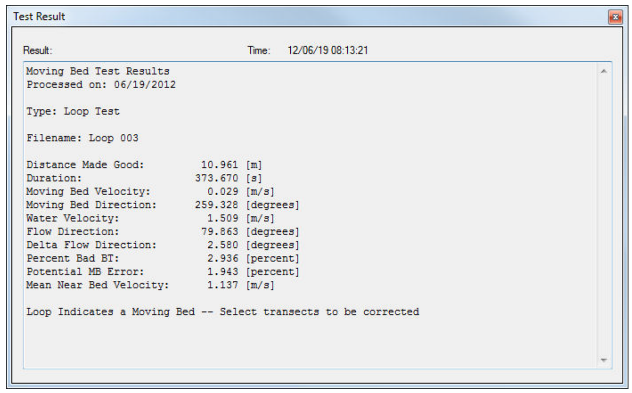
No moving bed

Add Loop Test from Data Files

To create a Loop Test from data files:

1. Start *WinRiver II*. Create or open a measurement file.
2. Right-click on the measurement file name in the Measurement Control window and select **Create Loop Test from Data Files**.
3. Right-click on **Loop** and select **Reprocess Transect**. The **Test Results** screen will automatically appear.
4. Review the data (see MBT Summary Display).

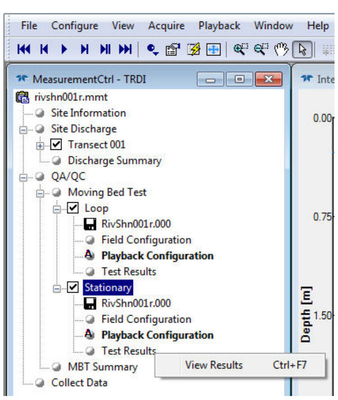


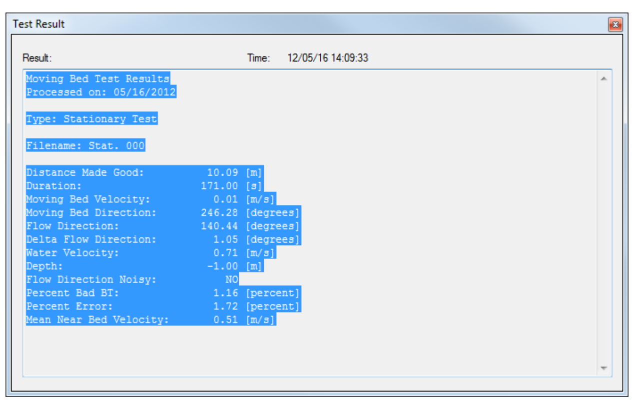


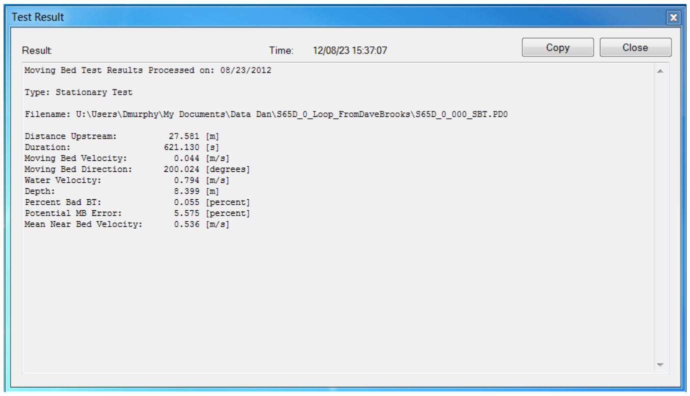
Add Stationary Test from Data Files

To create a Stationary Test from data files:

1. Start *WinRiver II*. Create or open a measurement file.
2. Right-click on the measurement file name in the Measurement Control window and select **Create Stationary Test from Data Files**.
3. Right-click on **Stationary** and select **Reprocess Transect**. The **Test Results** screen will automatically appear.
4. Review the data (see MBT Summary Display).







Using the MBT (Moving Bed Test) Summary

Moving bed tests are used to assess whether the ADCP's bottom tracking function correctly measures the movement of the ADCP over ground, or if moving sediment near the bottom of a stream or river is causing a bias in that measurement. Biased bottom track data resulting from a moving bed condition will cause the computed discharge to be low at that measurement location.

Overview of Correction Computations

The USGS has developed computational methods for analyzing moving bed test results and correcting/adjusting the measured discharge when moving bed conditions exist at a site. These methods have previously been available only as external post-processing tools such as the USGS's Loop Correction (LC) and Stationary Moving Bed Analysis (SMBA) programs. *WinRiver II* now performs the equivalent analysis and computations directly for ease of use. Moving bed test analysis is conducted automatically when collecting or reprocessing a moving bed test (see Moving Bed Tests). Documentation, formulas, and procedures for LC and SMBA are provided on the USGS Office of Surface Water (OSW) HydroAcoustics web site (http://hydroacoustics.usgs.gov/movingboat/mbd_software.shtml#usgs).

Overview of LC

The principles underlying the LC technique are documented in Scientific Investigations Report 2006-0579. Loop test analysis based on this report computes a mean moving bed velocity Vmb for a measurement location from the closure error of a loop-type transect starting at one bank, moving smoothly and steadily to the opposite bank, and returning with no loitering at the turnaround point. Several screening criteria are used to ensure the validity of the loop test:

- There are limits on the maximum permissible amount of bottom track data lost and the allowable deviation in flow direction between the outbound and return portions of the loop.
- The average moving bed velocity is also required to be the reciprocal of the average flow direction for the loop test, ± 45 degrees.
- A moving bed correction is recommended if the moving bed velocity exceeds 1% of the average water velocity and 0.04 ft/sec (0.012 m/sec).
- Loop test data failing any of these screening criteria are deemed unsuitable for use in computing corrections, or to have insufficient moving bed velocities to warrant applying corrections to the measured discharge.

This report defines two methods for applying the resulting Vmb as a correction to the measured discharge. The first is a simple mean area-velocity method, which computes the discharge correction as the moving bed velocity times the cross-sectional area (excluding edge areas), with cross-sectional area measured perpendicular to the mean river flow direction. The second computes the discharge correction by distributing the moving bed velocity to all ensembles in the transect in proportion to the ratio of the near-bed velocity for the ensemble to the average near-bed velocity of the discharge transect being corrected as a whole. This 'Distributed' method is the correction computation technique implemented in the USGS' LC program.

Overview of SMBA

The SMBA technique was initially developed to analyze the results of stationary moving bed tests for StreamPro ADCPs and other instruments without heading data where rotation and translation of the ADCP during the test resulted in the appearance of a moving bed condition even though bed movement was not truly present. The SMBA program was subsequently extended to compute discharge corrections from one or more moving bed tests.

Analysis of a Stationary Moving Bed Test using the SMBA technique assumes that the water flow direction measured by the ADCP during the test always occurs in a constant downstream direction. ADCP movement is separated into components parallel (upstream movement) and perpendicular (cross-stream movment) to the flow direction. Upstream movement is converted to a moving bed velocity (Vmb) for that point in the cross-section based on the duration of the test. The average near-bed velocity (Vnb) of the test is also computed. A moving bed correction is recommended if the moving bed velocity exceeds 1% of the average water velocity for any stationary test in the measurement.

Stationary tests are conducted at multiple points in the cross-section. SMBA currently assumes that the relationship between Vmb and Vnb is linear and passes through the origin, resulting in a simple Vmb/Vnb ratio for the measurement rather than having a Vnb 'offset' value below which no moving bed is assumed to occur. The moving bed velocity for a given ensemble is thus assumed proportional to the near-bed velocity for that ensemble. This 'Proportional' method is used to compute corrections to the measured discharge in the USGS' SMBA program.

WinRiver II Implementation

As of version 2.09, the *WinRiver II* implementation of the LC and SMBA analysis and correction computations is generally comparable to that of LC version 4.04 and SMBA version 6.12 except as noted herein. Average moving bed velocities from a loop test can (theoretically, at least) be converted to a Vmb/Vnb ratio based on the average Vnb for the loop test, and used with the 'Proportional' method to compute corrections to measured discharge. *WinRiver II* thus supports the use of multiple loop tests, multiple stationary tests, and combinations of test types in computing corrections to measured discharges. The 'Distributed' correction method is used when only loop-type moving bed tests are selected, while the 'Proportional' method is used when stationary or mixed loop and stationary moving bed tests are selected.

The LC program only supports the use of a single loop test in computing corrections to the measured discharge. The SMBA program supports the use of multiple stationary tests in computing corrections, but does not allow combinations of loop and stationary tests to be used in computing corrections. Comparing results between *WinRiver II* and LC or SMBA thus requires that the user select the moving bed tests to be used in computing corrections in a manner compatible with the equivalent USGS program. Rounding in the ASCII output used as source data for the LC and SMBA programs, and slight differences in computational techniques will likely cause the *WinRiver II* results to differ slightly, but differences are expected to be less than one percent.

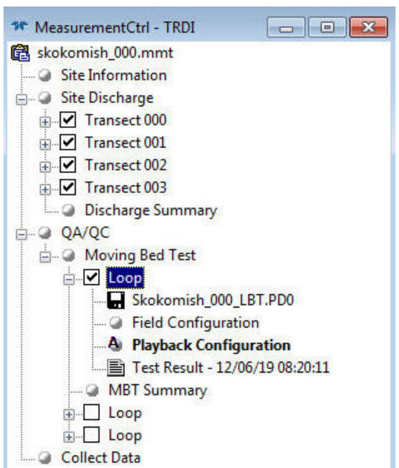
MBT Summary Display

The MBT summary display is divided into two sections. The upper section displays all moving bed tests contained in the measurement, with summary information from the test results. Moving bed tests in measurements created using prior WinRiver II versions, and moving bed tests added to the measurement using the Measurement Control Window, must be re-processed before they will appear in the MBT Summary. Parameters in a moving bed test which fail the screening criteria will be shown in red. Moving bed tests with one or more parameters failing the screening criteria, and tests not selected for inclusion in computing corrections, will have the first two columns (**Test ID** and **Used in Corrections**) displayed in red text. Refer to the Test Results node of the appropriate moving bed test for details of the screening results.

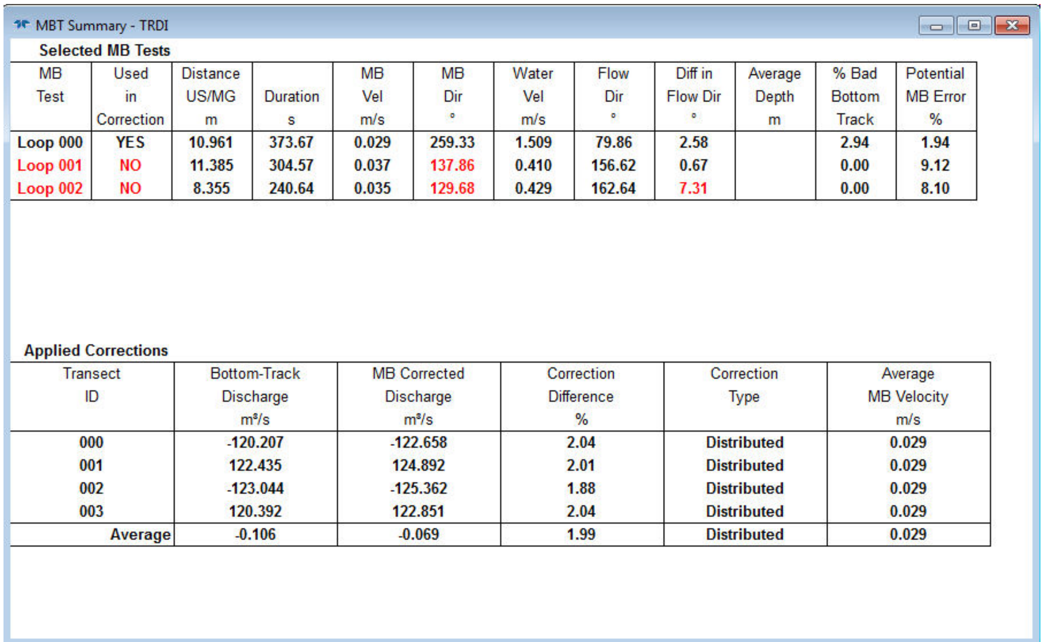
Selected MB Tests

MB Test	Used in Correction	Distance US/MG m	Duration s	MB Vel m/s	MB Dir °	Water Vel m/s	Flow Dir °	Diff in Flow Dir °	Average Depth m	% Bad Bottom Track	Potential MB Error %
Loop 000	YES	10.961	373.67	0.029	259.33	1.509	79.86	2.58		2.94	1.94
Loop 001	NO	11.385	304.57	0.037	137.86	0.410	156.62	0.67		0.00	9.12
Loop 002	NO	8.355	240.64	0.035	129.68	0.429	162.64	7.31		0.00	8.10

Moving bed tests passing all screening criteria and selected for inclusion in computing corrections to the measured discharge are shown in black text. Moving bed tests are selected and deselected using the **Measurement Control** window. Checking the **Loop** or **Stationary** box will select the test for use in computing corrections; un-checking the box will de-select the test from use in computing corrections. Moving bed tests which do not pass all applicable screening criteria should NOT be used in computing corrections. The general exception to this rule are Stationary Moving Bed Tests which fail only the minimum moving bed velocity criteria. If one or more of the stationary tests indicate the presence of a moving bed condition, all of the otherwise-valid stationary tests should be selected for consistency with the SMBA program.



The lower section of the MBT Summary display shows all discharge transects in the measurement checked for inclusion in the Discharge Summary. This display includes the transect discharge as measured referenced to Bottom Track, the corrected/adjusted discharge as computed based on the selected moving bed test results, the difference between the corrected and uncorrected discharge, and the correction type (Distributed or Proportional) and correction factor (Vmb for Distributed corrections; Vmb/Vnb for Proportional corrections). Discharge transects in measurements created using prior versions of WinRiver II, and transects added to the measurement using the Measurement Control Window, must be re-processed before they will appear in the MBT Summary.


MBT Summary - TRDI

Selected MB Tests

MB Test	Used in Correction	Distance US/MG m	Duration s	MB Vel m/s	MB Dir °	Water Vel m/s	Flow Dir °	Diff in Flow Dir °	Average Depth m	% Bad Bottom Track	Potential MB Error %
Loop 000	YES	10.961	373.67	0.029	259.33	1.509	79.86	2.58		2.94	1.94
Loop 001	NO	11.385	304.57	0.037	137.86	0.410	156.62	0.67		0.00	9.12
Loop 002	NO	8.355	240.64	0.035	129.68	0.429	162.64	7.31		0.00	8.10

Applied Corrections

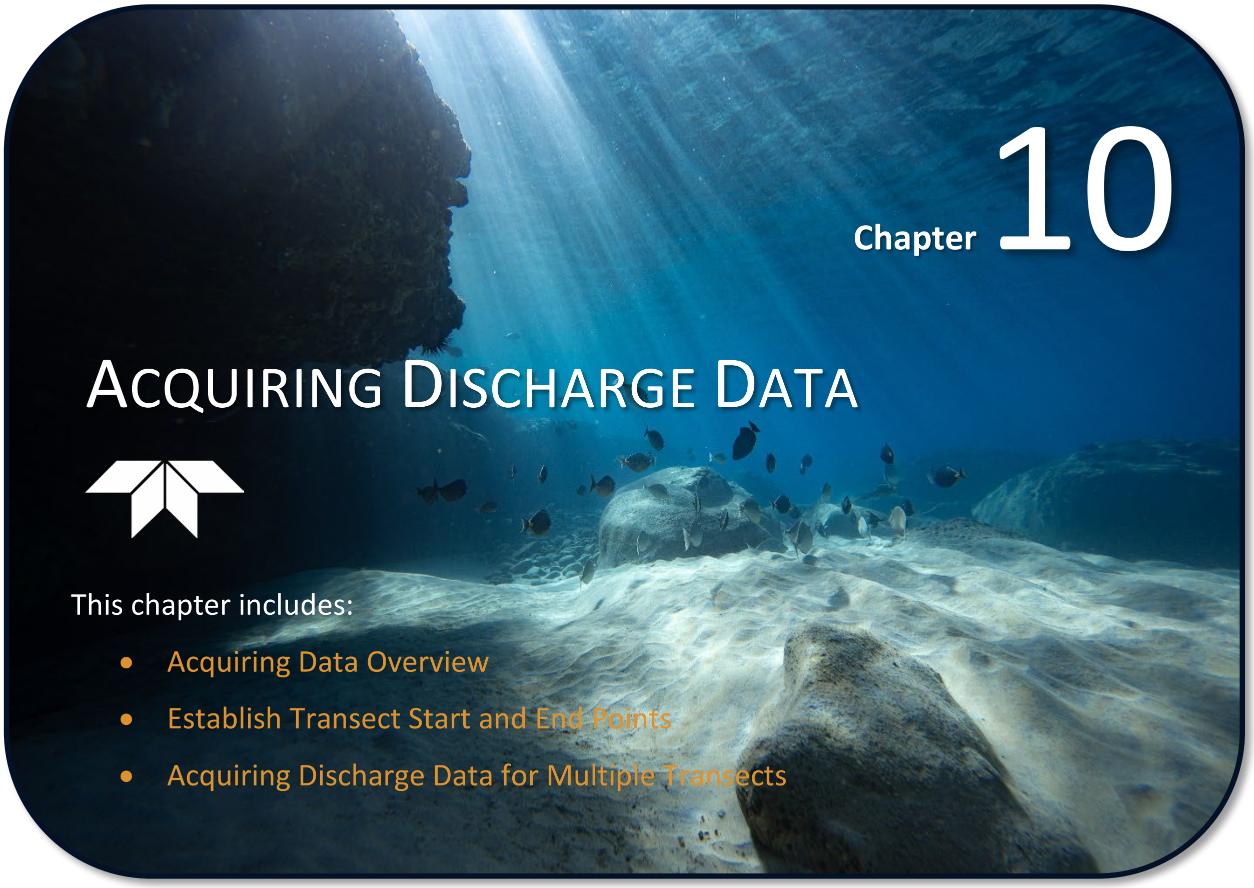
Transect ID	Bottom-Track Discharge m³/s	MB Corrected Discharge m³/s	Correction Difference %	Correction Type	Average MB Velocity m/s
000	-120.207	-122.658	2.04	Distributed	0.029
001	122.435	124.892	2.01	Distributed	0.029
002	-123.044	-125.362	1.88	Distributed	0.029
003	120.392	122.851	2.04	Distributed	0.029
Average	-0.106	-0.069	1.99	Distributed	0.029

Discharge corrections will automatically be updated as moving bed tests are selected and deselected. Internal data precision is generally greater than displayed, so discharge correction calculations may change even when the moving bed and/or near bed velocities displayed in the MBT Summary do not change.

Impacts on Other Displays and Outputs

Discharge corrections based on the results of moving bed tests are only applicable when Bottom Track is the selected navigation reference. The corrected discharge is displayed in the MBT Summary and in the Composite Tabular display, the Discharge Summary, the Total Discharge Time Series, and in HydroML output. (Q Measurement Summary). Moving bed corrections are NOT applied to any other parameters or outputs such as velocity and discharge contour, profile, and time series plots, or the Classic or Generic ASCII outputs.

NOTES



Chapter 10

ACQUIRING DISCHARGE DATA

This chapter includes:

- Acquiring Data Overview
- Establish Transect Start and End Points
- Acquiring Discharge Data for Multiple Transects

Acquiring Data Overview

When data collection is started, *WinRiver II* sends the direct commands from the configuration to the ADCP and controls data recording for acquisitions of individual transect discharge data. Data can be displayed in tabular, ship's track, profile, or contour formats. *WinRiver II* calculates discharge as it is calculated in real-time and accumulated as a transect is made across the river.

If you will be using GPS rather than Bottom Track as the reference, then the Compass and Magnetic Variation must be calibrated.

If you can obtain valid bottom track data, and you use bottom track as your boat speed reference, there is no need to perform the compass correction procedures to obtain valid discharge data. Both the water and boat velocities are in the same coordinate system, and no rotation from one coordinate system to another is required. However, compass corrections ARE required to obtain accurate Ship Track and Flow direction data.

Test the ADCP before collecting data at a particular site to verify the ADCP's operation (see QA/QC).

To acquire data:

1. Start *WinRiver II* and load or create a measurement file (see Using the Measurement Wizard).
2. You may want to record a note about the instrument setup or factors such as wind conditions, the passage of other vessels, and any other noteworthy events that occur during your transect of the channel. Right-click **Site Information** on the **Measurement Control** window to add a note to the measurement file (see Add Note).
3. Press **F4** to start the ADCP pinging. The **AcquireControl** window will now show *ADCP PINGING*.

   In a few seconds, you will see changing values in several of the data windows. The ensemble number will update, the time displayed just below the ensemble number will change to show the ADCP time of each ensemble, the position sensors will update, and so on. And, if you have the ADCP in sufficiently deep water, you will see velocity profiles on the graph. *WinRiver II* will not display meaningful data if your system is not in water.

   GPS positions will be displayed at the bottom of the **Composite Tabular** display window if enabled and valid GGA positions are being received from the GPS system. External Heading and Depth Sounder data will also be displayed in that window if enabled.

   In general, after you have started the ADCP pinging, there is no reason to stop pinging until you are finished and ready to remove the ADCP from the water. An exception would be if you were operating off of batteries with limited capacity. Then stopping pinging will conserve power.

   You can let the ADCP ping even if it is not in the water. Unlike many other acoustic devices, no damage to the ADCP will occur. It is often useful to operate the ADCP out of the water to test the configuration, practice with *WinRiver II*, or perform other tests.

4. Before going forward, on the **Configure** menu, click **Reference**. Choose **Bottom Track** from the list. This will ensure that the velocity reference for the data display is set to bottom track. When bottom track is used as the velocity reference, the speed of the ADCP over ground is subtracted from the measured relative velocity to give true Earth referenced water velocity. You can always determine what velocity reference is in use by looking at the text lines just above and below the scales at the top and bottom of the graph display. At the end of each line is an indication of what reference is being used.

Establish Transect Start and End Points

It is a good idea to perform a pre-run transect before actually acquiring data. This gives you the opportunity to ensure that the ADCP is working as expected with the loaded configuration. You will also determine the starting/stopping locations at each side of the channel. As you cross, you can monitor the depth to see if there are areas with abrupt depth changes. Later, during data acquisition, you will want to cross very slowly over these regions to help bottom tracking maintain a valid lock on the bottom.

To Establish Transect Start and End Points:

1. On the **View** menu, select the **Tabular**, **Velocity** (see Figure 54) if you are not already viewing this graph. When making an individual discharge measurement, you want to start and stop the recording of data in water sufficiently deep to allow valid data to be recorded. Use the tabular display to determine when the water is deep enough to give a discharge value in the top two depth cells (**Good Bins** = 2 or more in the **Composite Tabular** display). You will typically be using a power fit for the extrapolation of the top and bottom, and at least two depth cells with valid discharge are needed in order to compute a more accurate power fit.

Velocity Tabular 1 - TRDI

Depth [m]	Velocity [m/s] (Ref: BT) East	North	Up	Error	%	Discharge [m³/s]
1.15	0.000	0.128	-0.019	0.009	100	0.029
1.35	-0.005	0.123	-0.017	0.016	100	0.028
1.55	BAD	BAD	BAD	BAD	BAD	BAD
1.75	BAD	BAD	BAD	BAD	BAD	BAD
1.95	BAD	BAD	BAD	BAD	BAD	BAD
2.15	BAD	BAD	BAD	BAD	BAD	BAD
2.35	BAD	BAD	BAD	BAD	BAD	BAD
2.55	BAD	BAD	BAD	BAD	BAD	BAD

Figure 54. Velocity Tabular Display Showing Two Good Bins

2. Move out from the shore until the water is deep enough to show a discharge value in the top two depth cells. Mark this position with a float or other mechanism. This is the starting/stopping position for this shore. You will later start/stop data file recording at this location depending on the direction of your transect.
3. Move out from the shore traveling slowly with the bow of the boat pointed upstream. On the **View** menu, select **Graphs**, **Contour**, **Velocity** if it is not already displayed. The display will look similar to that shown in Figure 21. Use this display to see how the water depth changes as you make your transect. Note regions where the bottom depth changes quickly.
4. As you approach the other shore, change the display back to tabular, and mark the closest distance to shore where the top two depth cells show discharge values. This will be the start/stopping point for this shore.

Holding Position at the Starting Channel Edge

To enter the edge distance:

1. Starting at one of your marked edges, use the **Composite Tabular** display to ensure that you have at least two valid discharge measurements.
2. While holding position at the location where you have two valid cells of data, determine the edge distance to shore, and then press **F5** to start data recording. When prompted, enter the beginning distance to the bank and define if this is the left or right bank. When facing downstream, the left bank is on your left side. The edge distance parameters will be saved to the measurement file associated with the raw ADCP data file being recorded.

   You can manually enter edge discharges instead of shore distances when you know the edge discharge from another method (StreamPro, Wading rod, etc.).

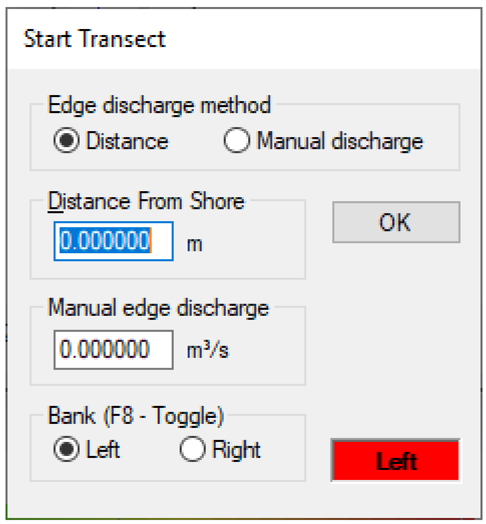


Figure 55. Enter Beginning Distance From Shore

Data processing continues while *WinRiver II* is prompting for the edge distance.

WinRiver II automatically saves the measurement file each time you start/stop a transect. Large numbers of transects in a measurement file may affect computer performance as the measurement file size increases.

3. Hold your position for 10 shore ensembles (default setting). The extra ensembles that are recorded to the raw data file during this stationary period will help to ensure that you have a good edge velocity for estimation of the edge discharge.

Shore Ensembles are set in the **Discharge** page (see Discharge Page).

Crossing the Channel

While crossing the channel:

1. Once the edge ensembles are recorded at the edge, slowly move away from the shore. Head for the desired ending point on the other side of the channel. Avoid fast accelerations, and keep the transect speed at or less than the water speed. Since you will be crossing slowly, you will be forced to point the bow nearly upriver and crab across. The slower you cross, the better your results will be.

Take at least 3 minutes to cross even the narrowest canals or rivers.

2. As you make your transect, take some time to experiment with the different display options. The display scales can be changed by right-clicking on a graph and selecting **Properties**.
3. You can see the discharge for the top, middle and bottom layers on the **Composite Tabular** screen.

Holding Position at the Ending Channel Edge

At the end of the channel:

1. Continue across the river until you reach the edge position determined during the pre-run on the opposite shore. You should have discharge values in at least two depth cells.
2. Stop at this position and wait for 10 shore pings to be recorded.
3. Press **F5** to stop recording data. You will be prompted to enter the ending edge distance. Enter the value of the distance from the ADCP to the shore.

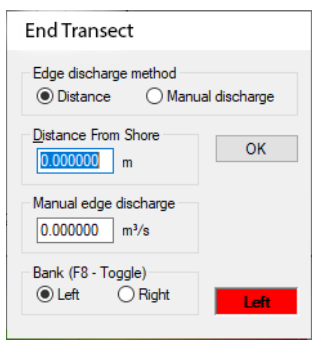


Figure 56. Enter Ending Distance from Shore

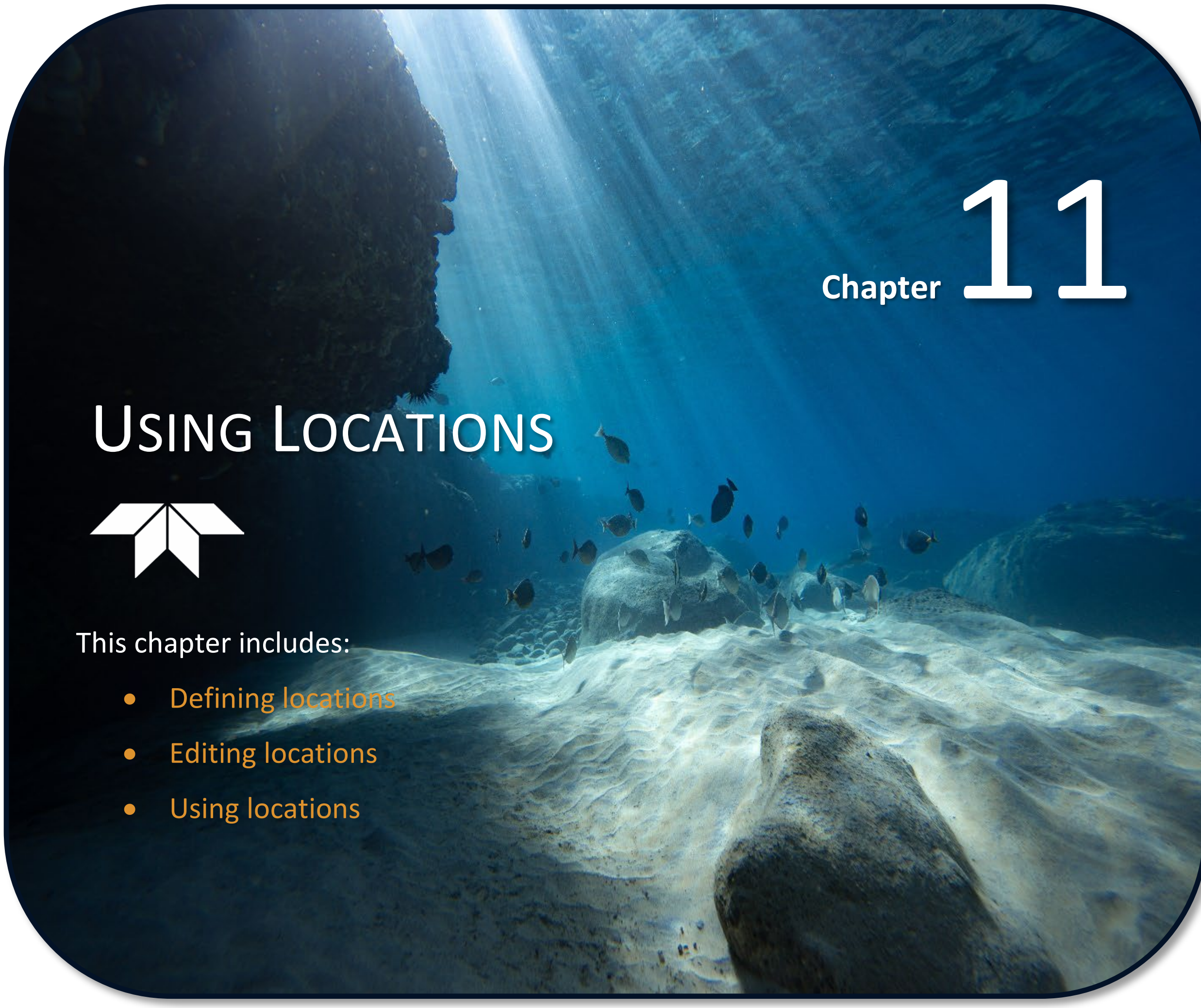
WinRiver II automatically saves the measurement file each time you start/stop a transect. Large transects in a measurement file may affect computer performance as the measurement file size increases.

Acquiring Discharge Data for Multiple Transects

Congratulations, you have just completed your first discharge measurement. You can now repeat the discharge measurement procedure to make additional transects. You will typically use **F5** to start and stop recording data for each passage across the channel while letting the ADCP ping continuously. An even number of transects is recommended, and the discharge from each individual transect can be averaged together to provide a discharge measurement for the site with lower variance than that of a single transect. A new data file and configuration node will be created each time you start and stop recording, and the starting and ending edge distances along with any entered notes will be saved in the measurement file.

When you have finished your desired number of transects and you are ready to stop data collection, press **F4** to stop pinging.

> The ADCP operator must make sure that the maximum permissible relative residual (MPRR) is met before leaving the site (see Dynamic Residual Analysis).



Chapter 11

USING LOCATIONS

This chapter includes:

Defining Locations

Location files contain the preferred starting and stopping points for transects.

To create a location file:

1. Open a measurement file that has the preferred starting and stopping points for transects at that location.
2. Use the Measurement Control window and right-click on the transect. Select **Define Transect Location**.

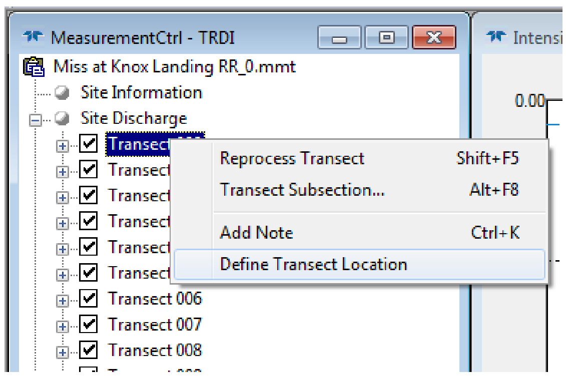
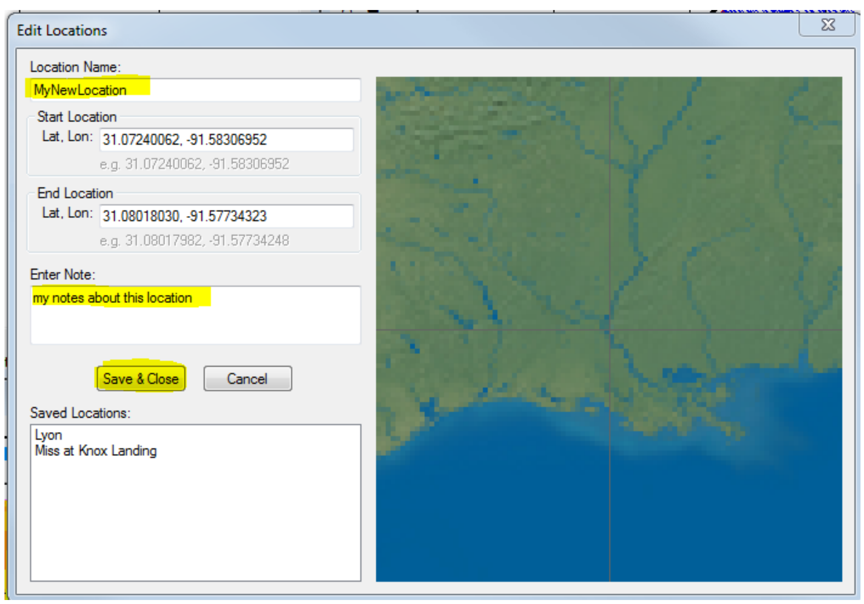


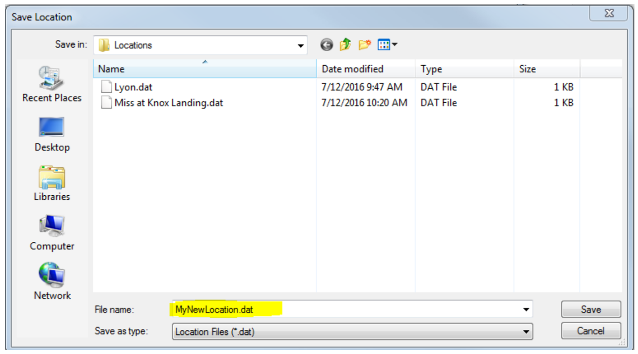
Figure 57. Defining a Location

3. The transect will process and then display the Edit Locations screen. Click on the map to zoom.
4. Enter a **Location Name**, any notes about the location as needed, and then click on the **Save & Close** button.



You MUST name the file and click the **Save & Close** button to create the location file. Clicking **Cancel** or using the **X** to exit the Edit Locations screen will NOT create the location file.

5. Click **Save** on the Save Location screen. The **.dat* location file will be saved to the *C:\Measurements\Locations* folder.

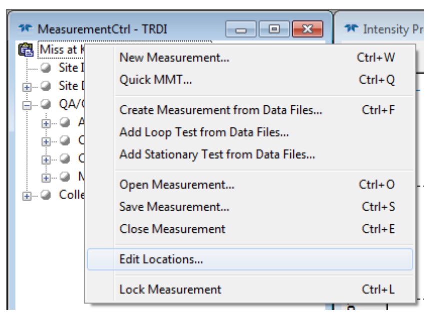


The location file must be saved in the *C:\Measurements\Locations* folder. The data file must have GPS data to create the location file.

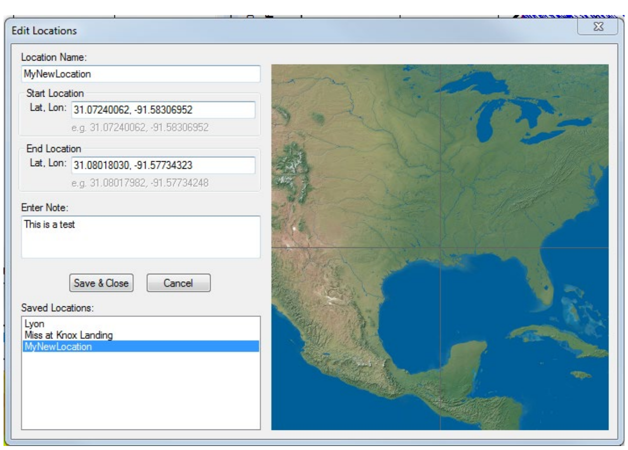
Editing Locations

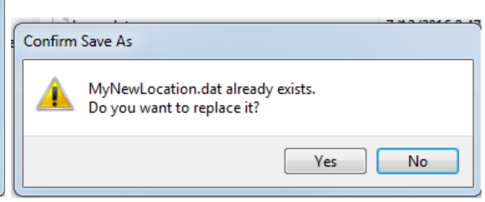
To edit a location file:

1. Use the Measurement Control window and right-click on the measurement file. Select **Edit Locations**.



2. Click on one of the files from the **Saved Locations** box to select the file to edit. Enter any changes to the file as needed.

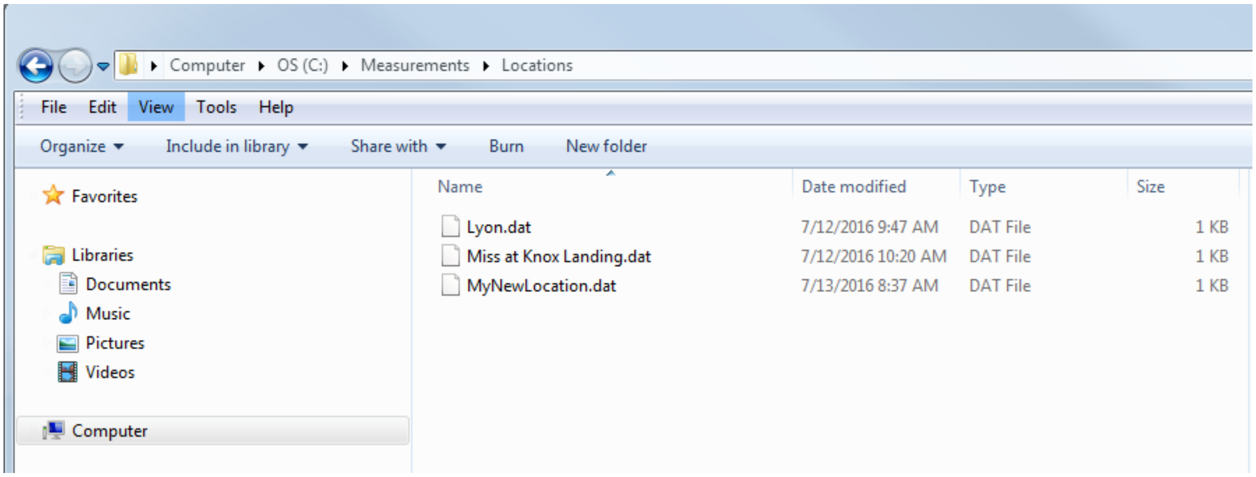




3. Click the **Save & Close** button to save the changes. If the file already exists, you will be prompted if you want to replace the file.

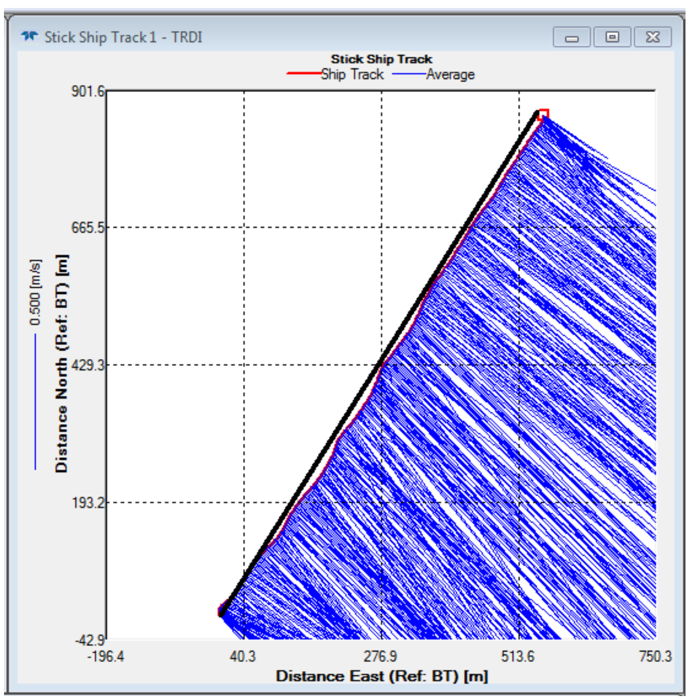
Using Locations

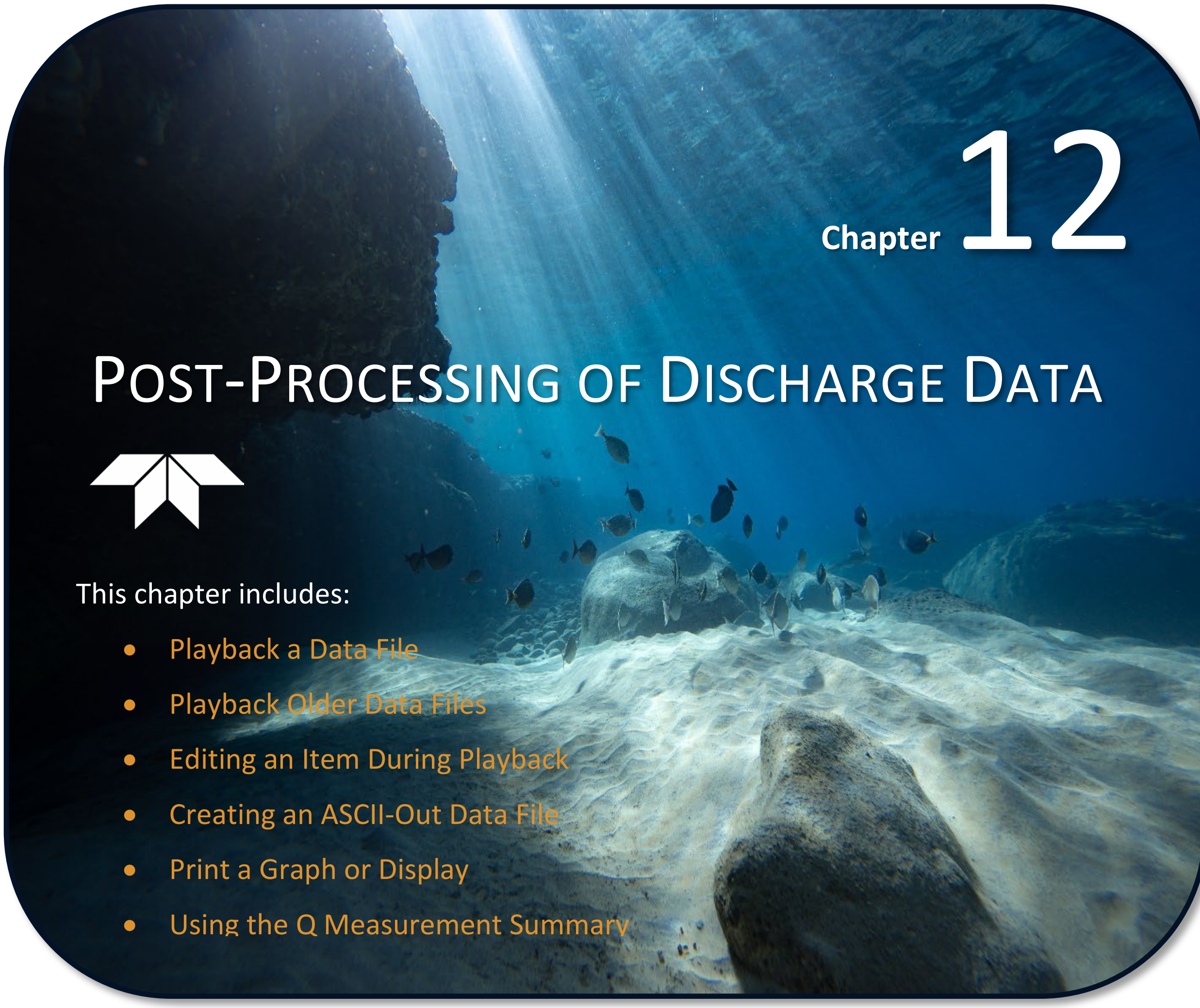
The location file (**.dat*) must be saved in the *C:\Measurements\Locations* folder and *WinRiver II* will automatically use the location file if the transect is within approximately 100 meters of the locations specified in the file. You may need to manually scale the ship track display in order to see the location line in the display, if the location line is sufficiently far from the transect position.



Users can share location files by copying the **.dat* file to their *C:\Measurements\Locations* folder.

The ADCP must be using GPS to use locations. A black line will display across the Stick Ship Track display to help navigate from the starting and stopping points for the transects.





Chapter 12

POST-PROCESSING OF DISCHARGE DATA

This chapter includes:

- Playback a Data File
- Playback Older Data Files
- Editing an Item During Playback
- Creating an ASCII-Out Data File
- Print a Graph or Display
- Using the Q Measurement Summary

Playback Overview

WinRiver II is used for post-processing data to get a total discharge value for the channel. Common post-processing tasks include sub-sectioning data to remove bad ensembles (see Transect Subsection) and creating ASCII files (see Creating an ASCII-Out Data File). For screen captures, you can change your averaging interval (see Averaging Data).

Playback a Data File

To playback a data file, use the **Playback** menu and select **Reprocess Checked Transects** (click the check box to select the files). This will create a copy of the **Field Configuration** node called **Playback Configuration**. The data files will automatically play to the end of the file.

To playback a single raw data file (one transect), click on the transect node to select it and then use the **Playback** menu and select **Reprocess Selected Transect**. You can also right-click on the transect node and choose **Reprocess Transect**.

To playback the next transect, on the **Playback** menu select **Reprocess Next Transect**.

Playback StreamPro Data Files

Use the following procedure to playback a data file created using a StreamPro ADCP. If the data files have corresponding configuration files, *WinRiver II* will load and use the **r.xml* file if it exists.

To playback StreamPro data:

1. Start *WinRiver II*. On the **File** menu click **Create Measurement from Data Files** and select the data file(s) to be played. *WinRiver II* automatically reads the *r.xml configuration file and combines them into the **Field Configuration** node.
2. To open a workspace file, click **File**, **Load Workspace**.
3. On the **Measurement Control** window, right-click on **Transect** and select **Reprocess**. The playback tool bar has functions to start, stop, rewind, and go to the end of the data file.
4. Use the **Measurement Control** window to see what files are in use (see Using the Measurement Control Window).
5. Play back the individual data files with their associated configuration nodes. After playing through the data file, press **View**, **Discharge Summary** to obtain the total discharge for each measurement.
6. As each data file is played, the file is added to the **Discharge Summary** screen. The **Discharge Summary** display will automatically calculate the average and other statistics useful in determining the discharge value.

> To add or remove a transect from the discharge summary, check or uncheck the box next to the transect.

Playback Older Data Files

To playback a data file created using an older version of *WinRiver*, on the **File** menu click **Create Measurement from Data Files** and select the data file(s) to be played. If the data files have corresponding configuration files, *WinRiver II* will load and use the *w.000 and *w.00x if it exists that was created when the transect was completed (recording stopped) that saved the configuration settings including the edge estimates. The **w.000* and **w.00x* configuration files will automatically be converted to a *WinRiver II* measurement file.

Older versions of WinRiver Filename conventions

Filename	*ddddMMMx.NNN*
dddd	Filename prefix
MMM	*TRANSECT* number. This number starts at 000 and increments each time you stop and then start data collection. The maximum number of transects is 999.
x	File type (assigned during data collection or playback in older versions of *WinRiver*) r – Raw ADCP data w – copy of the configuration file created during Acquire mode c – Unique configuration file (DOS *TRANSECT* only) n – Navigation GPS data d – Depth Sounder data t – ASCII-out data (This convention is the default for ASCII-out data, but you can use other names and extensions.)
NNN	File sequence number. This number starts at 000 and increments when the file size reaches the user-specified limit

Playback Data Display Options

The Playback data display options are the same as those for data collection.

1. On the **Playback** menu, click **First Ensemble** to go to the beginning of the data file. Click **Play** to review the data. To quickly play through the data, on the **Playback** menu, select **Slider** or drag the ensemble marker on the contour graph.
2. Right-click the display and select **Properties** to change the scaling fields of the different data displays.
3. Use the toolbar to zoom in on the **Ship Track** and **Stick Ship Track** graphs (see Zoom Functions).

Editing an Item During Playback

Most of the parameters in the **Playback Configuration** can be changed while playing back data. Only the parameters that controlled data collection (**Recording** and **Commands** pages) can not be changed.

Example – The Shore Distance for the Begin Transect was incorrectly entered for one transect file.

1. Open the measurement file.
2. On the **Measurement Control** window, right-click on **Playback Configuration** and select **Properties**. Select the **Edge Estimates** page.
3. Enter the correct shore distance.
4. Click **OK** to exit the properties dialog.
5. The data file will play automatically.

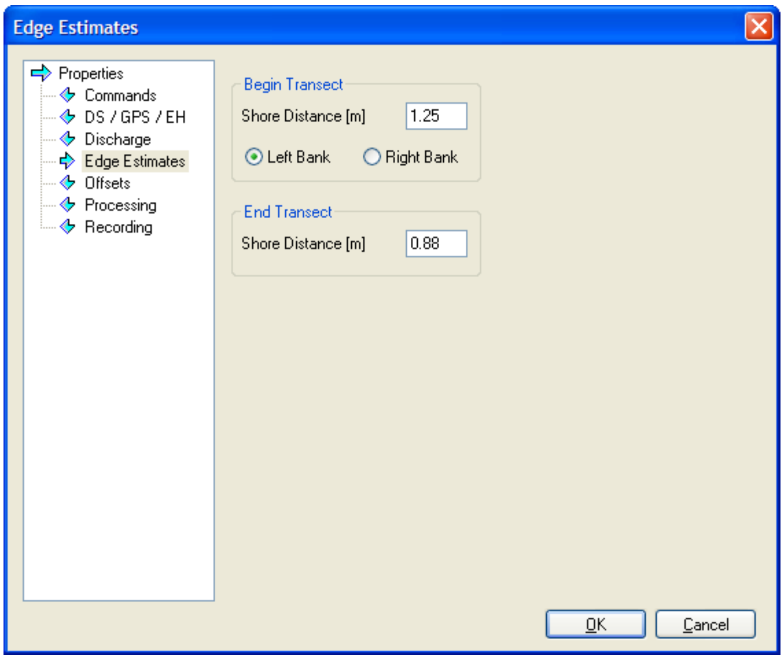


Figure 58. Editing an Item During Playback

Example – Data was collected using an ADCP depth of 0.6 meters. The correct ADCP depth was 0.6096 meters. This error applies to all of the data files collected that day.

1. Open the measurement file.
2. On the **Measurement Control** window, right-click on **Playback Configuration** and select **Properties**. Select the **Offsets** page.
3. Enter the correct ADCP depth. Right-click on the corrected entry and click **Apply to All Active Configurations**. Click **OK** to exit the properties dialog.
4. The data file will play automatically.

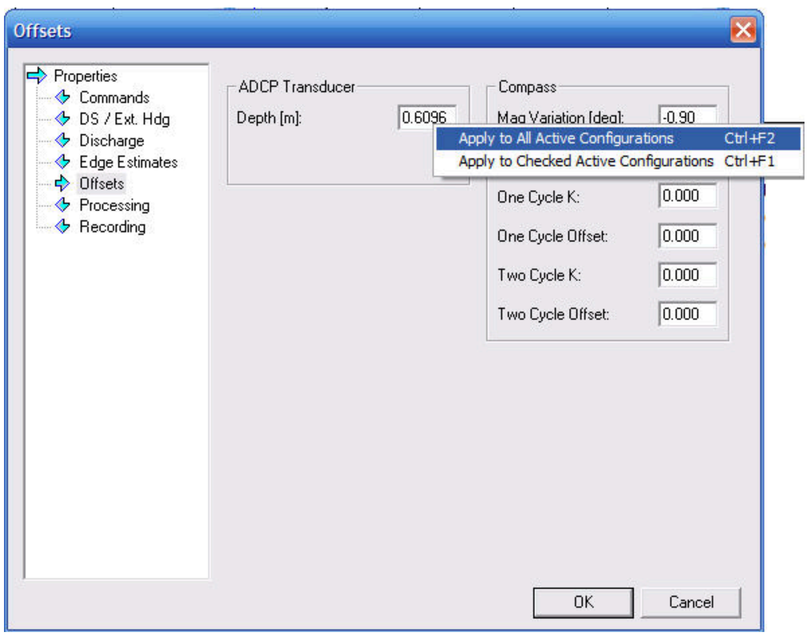


Figure 59. Applying Corrections to All Transect Files

To return the all values to the parameters as collected, on the **Measurement Control** window, right-click on **Playback Configuration** and select **Reset Properties**.

Creating an ASCII-Out Data File

ASCII-out files contain text that you can create during post-processing by using the **Configure** menu, **ASCII Output**. During playback, you can subsection, average, scale, and process data. You also can write this data to an ASCII file. You can then use these files in other programs (spreadsheets, databases, and word processors).

Sub-sectioning and averaged ensemble data will not be reflected in the ASCII outputted file:

You will receive all selected data that *WinRiver II* uses as its working set. For example, you will receive all the bins (WN setting) in the water column - even those marked bad.

You will get all of the ensembles even though the display may be set to some number of averaged ensembles.

Classic ASCII Output

To create and ASCII output file:

1. Start *WinRiver II* and load a measurement file.
2. On the **Configure** menu, click **ASCII Output**, **Classic ASCII Output**.
3. Select **Output Backscatter data** or **Output Intensity data**.
4. Click **Finish**.
5. Playback or reprocess the desired transect (see Post-Processing of Discharge Data).

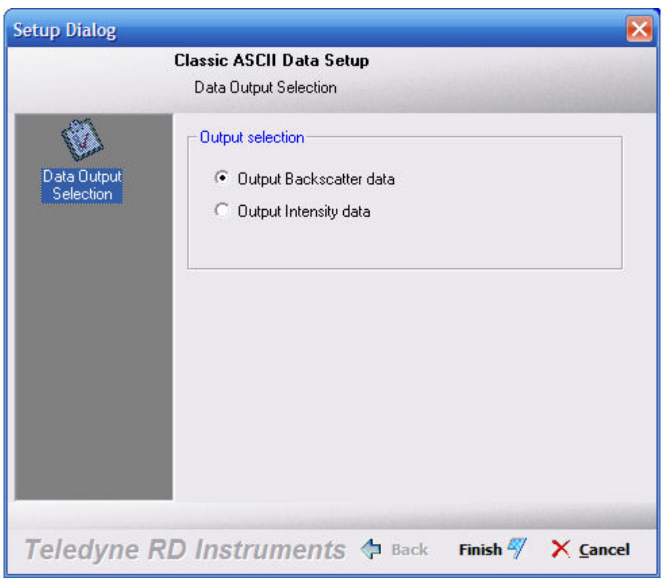


Figure 60. Classic ASCII Output

Classic ASCII Output Format

Each time *WinRiver II* opens a new ASCII-out data file, it first writes the following three lines.

Row	Field	Description
A	1	NOTE 1 – You can enter these lines by right-clicking **Transect** and selecting **Add Note** (see Add Note).
B	1	NOTE 2 – You can enter these lines by right-clicking **Transect** and selecting **Add Note** (see Add Note).
C	1	DEPTH CELL LENGTH (cm)
	2	BLANK AFTER TRANSMIT (cm)
	3	ADCP DEPTH FROM CONFIGURATION NODE (cm)

Row	Field	Description
	4	NUMBER OF DEPTH CELLS
	5	NUMBER OF PINGS PER ENSEMBLE
	6	TIME PER ENSEMBLE (hundredths of seconds)
	7	PROFILING MODE

Whenever *WinRiver II* displays a new data segment (a raw or averaged data ensemble), it writes the following data to the ASCII-out file. The first six rows contain leader, scaling, navigation, and discharge information. Starting with row seven, *WinRiver II* writes information in columns based on the bin depth. When *WinRiver II* writes the information for all bins in the current ensemble, it goes to the next ensemble and repeats the cycle starting with row one. Fields are separated by one or more spaces. *WinRiver II* does not split ensembles between files. The file size automatically increases to fit at least one ensemble. Missing data (data not sent from ADCP) are not included (no dashes or fill values). "Bad data" values: velocity (–32768); discharge (2147483647); Latitude/Longitude (30000).

Table 7: ASCII-Out File Format

Row	Field	Description
1	1	ENSEMBLE TIME -Year (at start of ensemble)
	2	- Month
	3	- Day
	4	- Hour
	5	- Minute
	6	- Second
	7	- Hundredths of seconds
	8	ENSEMBLE NUMBER (or SEGMENT NUMBER for processed or averaged raw data)
	9	NUMBER OF ENSEMBLES IN SEGMENT (if averaging ON or processing data)
	10	PITCH – Average for this ensemble (degrees)
	11	ROLL – Average for this ensemble (degrees)
	12	**CORRECTED HEADING** - Average ADCP heading (corrected for one cycle error) + heading offset + magnetic variation
	13	ADCP TEMPERATURE - Average for this ensemble (°C)
2	1	**BOTTOM-TRACK VELOCITY** – East(+)/West(-); average for this ensemble (cm/s or ft/s)
	2	Reference = BTM – North(+)/South(-)
	3	– Vertical (up[+]/down[-])
	4	– Error
2	1	**BOTTOM-TRACK VELOCITY** – GPS (GGA or VTG) Velocity (calculated from GGA String) Reference = GGA East(+)/West (-1)
	2	Reference = VTG - GPS (GGA or VTG) North(+)/South(-) Velocity
	3	- BT (up[+]/down[-]) Velocity
	4	- BT Error
	5	**GPS/DEPTH SOUNDER** - corrected bottom depth from depth sounder (m or ft) as set by user (negative value if DBT value is invalid)
	6	- GGA altitude (m or ft)
	7	- GGA Δaltitude (max – min, in m or ft)
	8	- GGA HDOP x 10 + # satellites/100 (negative value if invalid for ensemble)
	9	**DEPTH READING** - Beam 1 average for this ensemble (m or ft, as set by user)
	10	(Use River Depth - Beam 2
	11	= Bottom Track) - Beam 3
	12	- Beam 4
	9	**DEPTH READING** - Depth Sounder depth
	10	(River Depth - Depth Sounder depth
	11	= Depth Sounder) - Depth Sounder depth
	12	- Depth Sounder depth
	9	**DEPTH READING** - Vertical Beam depth
	10	(River Depth - Vertical Beam depth
	11	= Vertical Beam) - Vertical Beam depth
	12	- Vertical Beam depth
3	1	**TOTAL ELAPSED DISTANCE** - Through this ensemble (from bottom-track or GPS data; in m or ft)
See	2	**TOTAL ELAPSED TIME** – Through this ensemble (in seconds)
Note	3	**TOTAL DISTANCED TRAVELED NORTH** (m or ft, as set by user)
	4	**TOTAL DISTANCED TRAVELED EAST** (m or ft, as set by user)
	5	**TOTAL DISTANCE MADE GOOD** - Through this ensemble (from bottom-track or GPS data in m or ft)
4	1	**NAVIGATION DATA** –
See	2	- Latitude (degrees and decimal degrees)
Note	3	- Longitude (degrees and decimal degrees)
	4	- GGA or VTG East velocity (in m/s or ft/s)
	5	- GGA or VTG North velocity (in m/s or ft/s)
	6	- Distance traveled in m or ft reference to GGA or VTG
5	1	DISCHARGE VALUES - Middle part of profile (measured); m^3/s or ft^3/s
	2	(referenced to - Top part of profile (estimated); m^3/s or ft^3/s
	3	Ref = BTM - Bottom part of profile (estimated); m^3/s or ft^3/s
	4	and Use Depth - Start-shore discharge estimate; m^3/s or ft^3/s
	5	Sounder - Starting distance (boat to shore); m or ft
	6	options) - End-shore discharge estimate; m^3/s or ft^3/s

Row	Field	Description
	7	- Ending distance (boat to shore); m or ft
	8	- Starting depth of middle layer (or ending depth of top layer); m or ft
	9	- Ending depth of middle layer (or starting depth of bottom layer); m or ft
6	1	NUMBER OF BINS TO FOLLOW
	2	MEASUREMENT UNIT - cm or ft
	3	**VELOCITY REFERENCE** - BT, GGA, VTG, or NONE for current velocity data rows 7-26 fields 2-7
	4	INTENSITY UNITS - dB or counts
	5	INTENSITY SCALE FACTOR - in dB/count
	6	SOUND ABSORPTION FACTOR - in dB/m
7-26	1	DEPTH - Corresponds to depth of data for present bin (depth cell); includes ADCP depth and blanking value; in m or ft.
	2	VELOCITY MAGNITUDE
	3	VELOCITY DIRECTION
	4	EAST VELOCITY COMPONENT - East(+)/West(-)
	5	NORTH VELOCITY COMPONENT - North(+)/South(-)
	6	VERTICAL VELOCITY COMPONENT - Up(+)/Down(-)
	7	ERROR VELOCITY
	8	BACKSCATTER - Beam 1
	9	- Beam 2
	10	- Beam 3
	11	- Beam 4
	12	PERCENT-GOOD
	13	DISCHARGE

Row three fields one through five are referenced to Bottom-Track if the reference is set to Bottom-Track. If the reference is set to GGA, then Row three fields one through five are referenced to the GPS GGA string.

Beam depths are not corrected for Pitch and Roll.

Example ASCII-Out File

```
This is WinRiver II comment line #1
This is WinRiver II comment line #2
    50      25      91      50       1      16       1
0 3 27 8 18 37 26    29       1   -2.860     1.870  248.030    14.500
-0.27     0.18      0.05      0.04      0.00     15.16      0.00     11.08     31.32     25.80     28.85     30.04
2.04         7.30          1.16          -0.98          1.52
31.0098587   -91.6261329    -0.08      0.37           2.0
94.5          40.2          16.6          1299.2          50.0            0.0            0.0  6.54  22.95
15 ft BT dB 0.43  0.161
  6.54      4.20    225.21   -3.0   -3.0   -0.7    1.2   72.5   73.0   73.0   74.7  100       -3.87
  8.18      3.05    237.19   -2.6   -1.7   -0.3    0.3   80.3   82.5   81.2   82.0  100       -2.63
  9.82      3.94    236.55   -3.3   -2.2   -0.2    1.0   81.6   87.6   83.3   82.0  100       -3.41
 11.46      3.91    245.09   -3.5   -1.6   -0.4   -0.1   83.6   87.5   84.9   83.2  100       -3.13
 13.11      4.55    242.24   -4.0   -2.1   -0.3    0.9   83.6   86.6   85.8   82.7  100       -3.76
 14.75      1.94    224.59   -1.4   -1.4    0.0    0.8   88.5   92.4   85.1   82.9  100       -1.79
 16.39      3.84    175.29    0.3   -3.8    0.5    1.6   89.8   94.1   85.5   85.1  100       -2.84
 18.03      2.89    258.70   -2.8   -0.6   -0.3   -0.1   85.8   86.7   86.7   85.0  100       -1.91
 19.67      4.54    223.45   -3.1   -3.3    0.1    1.4   85.2   86.5   89.1   86.5  100       -4.20
 21.31      3.66    239.28   -3.2   -1.9   -0.2    0.2   86.2   92.2   91.8   89.6  100       -3.10
 22.95      2.08    228.31   -1.6   -1.4    0.3   -0.3   87.1   96.1   92.3   89.7  100       -1.89
 24.59    -32768    -32768 -32768 -32768 -32768 -32768   89.2   94.8   91.8   92.7    0 2147483647
 26.23    -32768    -32768 -32768 -32768 -32768 -32768   88.3    255   93.5   93.1    0 2147483647
 27.87    -32768    -32768 -32768 -32768 -32768 -32768   90.4    255  100.3   93.0    0 2147483647
 29.51    -32768    -32768 -32768 -32768 -32768 -32768   94.6    255    255    255    0 2147483647
```

Generic ASCII Output

The Generic ASCII Output allows you to select what ASCII data and in what order you would like it to be displayed in the file. The file can be saved as a template so you can use it for other measurements.

1. Start *WinRiver II* and load a measurement file. Playback/Reprocess the desired transects (see Post-Processing of Discharge Data).
2. On the **Configure** menu, click **ASCII Output**, **Generic ASCII Output**.
3. On the **Item Selection** dialog, select the items to be added to the ASCII file and press the → key. To add a **Separator**, select **Insert Separator** on the list and press the → key. To remove an item from the list, select it and use the ← key.

4. Click **Next** to continue.

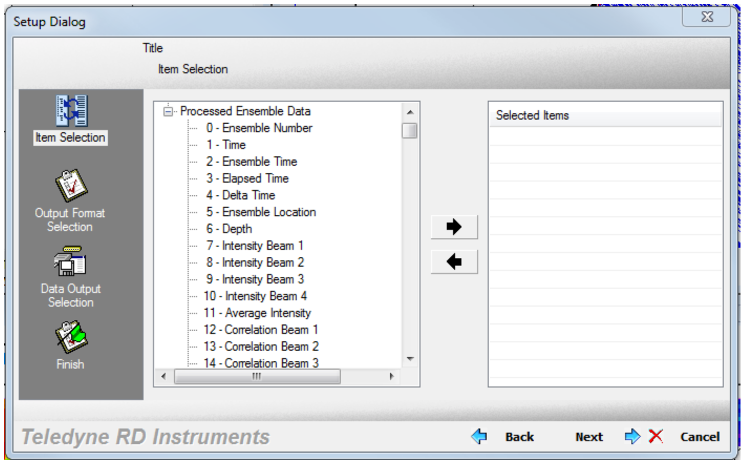


Figure 61. ASCII Item Selection

5. On the **Output Format Selection** dialog select if you want to include a **Message Header**, **Column Headers**, what type **Parameter Delimiter**, **Message Delimiter**, and if you want the **Checksum** included.
6. Click **Next** to continue.

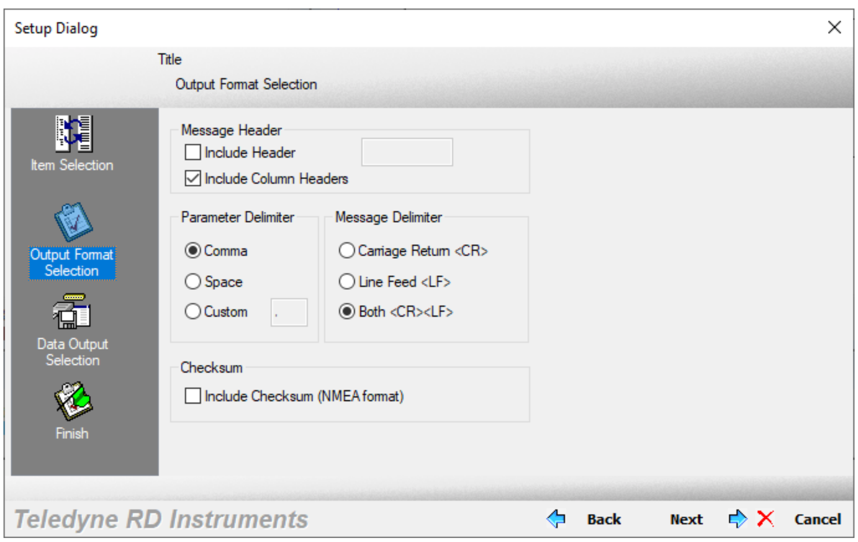


Figure 62. ASCII Output Format Selection

7. On the **Data Output Selection** dialog, select where the ASCII file will be output. If **To Comm. Port** is selected, enter the communication port parameters. Select **To File** to have the ASCII file saved with the measurement.
8. Click **Next** to continue.

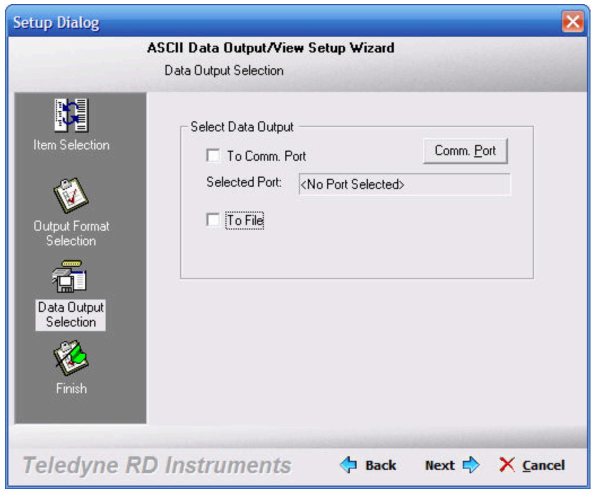


Figure 63. ASCII Data Output Selection

9. To save the ASCII Output Template, use the **Browse** button and name the file. ASCII template files are saved as *.ttf files.
10. Click **Finish**.
11. Playback or reprocess the desired transect (see Post-Processing of Discharge Data).
12. Double click on the ASCII file to view the contents.
13. If you make changes to the template, then you must replay the data again in order to see the up-dated ASCII file contents.
14. Generic ASCII output templates created in one version of *WinRiver II* will not provide the correct results in another version when new data elements have been added to the list above those being used. If this occurs, simply edit the existing template to remove the incorrect element and add the correct element.

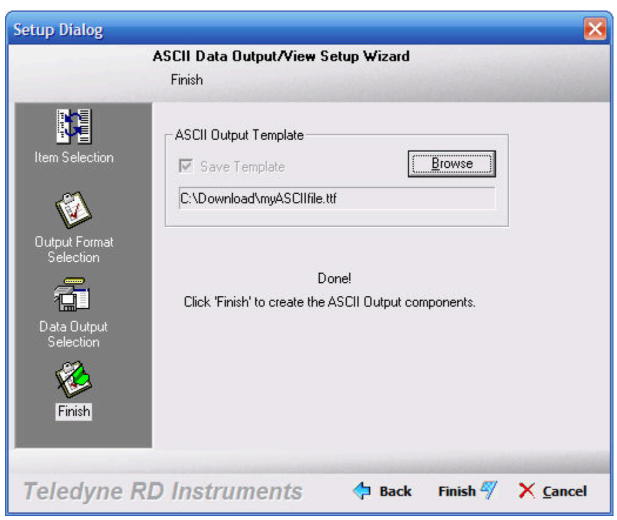
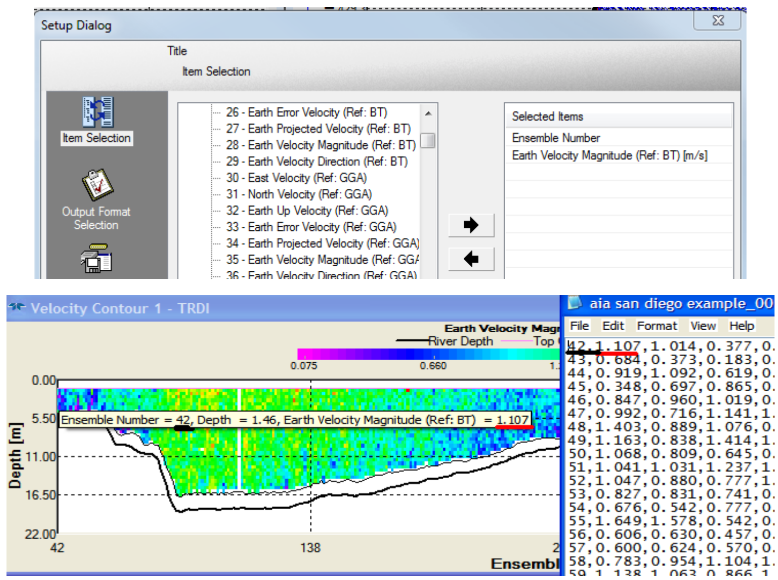


Figure 64. ASCII Output Template

Tips for Creating an ASCII file:

- Start off with one item.
- Create a subsection of one ensemble to test the ASCII file.

- Add one item at a time. Check the output against the appropriate tabular display or mouse over the velocity contour screen as appropriate.
- Reprocess each time you make a change!



The type of information added to the ASCII output file varies with the items selected. Some items will generate a single value in the ASCII file while others generate an array of values. Table **8** presents a list of the available items along with comments on the data value(s) provided by that item, an indicator of the scope of that item (bin, ensemble, or transect), and the duration of that item (discrete, incremental, or cumulative).

Scope and duration categorizations are as follows:

Scope:

- ***Bin*** – items in this category typically generate multiple ASCII output values per item selected, and each value pertains to a specific bin within a single ensemble (reading). Examples of this scope include water profile velocity, correlation, and RSSI.
- ***Ensemble*** – items in this category typically generate a single ASCII output value per item selected, and each value pertains to a single ensemble (reading). Examples of this scope include ensemble number, bottom track velocity, and discharge.
- ***Transect*** – items in this category pertain to the transect as a whole. Examples of this scope include distance, depth, area, and discharge for the left and right bank areas.

Duration:

- ***Discrete*** – Values in this category typically do not depend on any specific time duration between ensembles or from the start of the transect. Examples are the ensemble number and time.
- ***Incremental*** – Values in this category represent the change in value between two successive ensembles. Examples include Delta Time (the time from one ensemble to the next) and velocity bin Discharge. Incremental items will not be available for the first ensemble in a transect.
- ***Cumulative*** – Values in this category represent the total accumulated value from the start of the transect. Examples include Elapsed Time (time from the start of the transect to the current ensemble) and Distance Made Good (total position change from the start of the transect to the current ensemble).

ASCII output data will be scaled based on the units in effect at the time the file is generated. To generate the ASCII data file in a different set of units simply changes the units configuration and reprocess the transect. Bad or missing data typically will be output as zero (0) or the value -32768. Many of the ASCII output data types are related. Manual re-computation of related data types may not match the WinRiver II outputs exactly due to minor differences in computational techniques and/or the resolution of the ASCII output data itself.

Table **8**. WinRiver II ASCII Output Variable List

#	Name	Units Type	Bin Ensemble Transect	Discrete Incremental Cumulative	Comments
0.	Ensemble Number	None	Ensemble	Discrete	Sequential Ensemble (reading) number
1.	Time	None	Ensemble	Discrete	7 @ 2-digit values for Date/Time of ensemble: Year, Month, Day, Hour, Minute, Seconds, and Hundredths
2.	Ensemble Time	Julian Time	Ensemble	Discrete	Decimal number of seconds elapsed since 1/1/1970
3.	Elapsed Time	Time	Ensemble	Cumulative	Decimal number of seconds elapsed since start of transect
4.	Delta Time	Time	Ensemble	Incremental	Decimal seconds since previous ensemble
5.	Ensemble Location	None			Not used
Profile (Bin) data independent of coordinate system and navigation reference					
6.	Depth	Depth	Bin	Discrete	
7.	Intensity Beam 1	Counts	Bin	Discrete	
8.	Intensity Beam 2	Counts	Bin	Discrete	
9.	Intensity Beam 3	Counts	Bin	Discrete	
10.	Intensity Beam 4	Counts	Bin	Discrete	
11.	Average Intensity	Counts	Bin	Discrete	
12.	Correlation Beam 1	Counts	Bin	Discrete	
13.	Correlation Beam 2	Counts	Bin	Discrete	
14.	Correlation Beam 3	Counts	Bin	Discrete	
15.	Correlation Beam 4	Counts	Bin	Discrete	
16.	Average Correlation	Counts	Bin	Discrete	
17.	Backscatter Beam 1	Decibel	Bin	Discrete	
18.	Backscatter Beam 2	Decibel	Bin	Discrete	
19.	Backscatter Beam 3	Decibel	Bin	Discrete	
20.	Backscatter Beam 4	Decibel	Bin	Discrete	
21.	Average Backscatter	Decibel	Bin	Discrete	
22.	Percentage Good	None	Bin	Discrete	
Profile (Bin) velocity data in Earth coordinate system using various navigation data references					
23.	East Velocity (Ref: BT)	Velocity	Bin	Discrete	
24.	North Velocity (Ref: BT)	Velocity	Bin	Discrete	
25.	Earth Up Velocity (Ref: BT)	Velocity	Bin	Discrete	
26.	Earth Error Velocity (Ref: BT)	Velocity	Bin	Discrete	
27.	Earth Projected Velocity (Ref: BT)	Velocity	Bin	Discrete	
28.	Earth Velocity Magnitude (Ref: BT)	Velocity	Bin	Discrete	
29.	Earth Velocity Direction (Ref: BT)	Angle	Bin	Discrete	
30.	East Velocity (Ref: GGA)	Velocity	Bin	Discrete	
31.	North Velocity (Ref: GGA)	Velocity	Bin	Discrete	
32.	Earth Up Velocity (Ref: GGA)	Velocity	Bin	Discrete	
33.	Earth Error Velocity (Ref: GGA)	Velocity	Bin	Discrete	
34.	Earth Projected Velocity (Ref: GGA)	Velocity	Bin	Discrete	
35.	Earth Velocity Magnitude (Ref: GGA)	Velocity	Bin	Discrete	
36.	Earth Velocity Direction (Ref: GGA)	Angle	Bin	Discrete	
37.	East Velocity (Ref: VTG)	Velocity	Bin	Discrete	
38.	North Velocity (Ref: VTG)	Velocity	Bin	Discrete	
39.	Earth Up Velocity (Ref: VTG)	Velocity	Bin	Discrete	
40.	Earth Error Velocity (Ref: VTG)	Velocity	Bin	Discrete	
41.	Earth Projected Velocity (Ref: VTG)	Velocity	Bin	Discrete	
42.	Earth Velocity Magnitude (Ref: VTG)	Velocity	Bin	Discrete	
43.	Earth Velocity Direction (Ref: VTG)	Angle	Bin	Discrete	
44.	East Velocity (Ref: GGA2)	Velocity	Bin	Discrete	
45.	North Velocity (Ref: GGA2)	Velocity	Bin	Discrete	
46.	Earth Up Velocity (Ref: GGA2)	Velocity	Bin	Discrete	
47.	Earth Error Velocity (Ref: GGA2)	Velocity	Bin	Discrete	
48.	Earth Projected Velocity (Ref: GGA2)	Velocity	Bin	Discrete	
49.	Earth Velocity Magnitude (Ref: GGA2)	Velocity	Bin	Discrete	
50.	Earth Velocity Direction (Ref: GGA2)	Angle	Bin	Discrete	
51.	East Velocity (Ref: VTG2)	Velocity	Bin	Discrete	

Table **8**. WinRiver II ASCII Output Variable List

#	Name	Units Type	Bin Ensemble Transect	Discrete Incremental Cumulative	Comments
52.	North Velocity (Ref: VTG2)	Velocity	Bin	Discrete	
53.	Earth Up Velocity (Ref: VTG2)	Velocity	Bin	Discrete	
54.	Earth Error Velocity (Ref: VTG2)	Velocity	Bin	Discrete	
55.	Earth Projected Velocity (Ref: VTG2)	Velocity	Bin	Discrete	
56.	Earth Velocity Magnitude (Ref: VTG2)	Velocity	Bin	Discrete	
57.	Earth Velocity Direction (Ref: VTG2)	Angle	Bin	Discrete	
58.	East Velocity (Ref: None)	Velocity	Bin	Discrete	
59.	North Velocity (Ref: None)	Velocity	Bin	Discrete	
60.	Earth Up Velocity (Ref: None)	Velocity	Bin	Discrete	
61.	Earth Error Velocity (Ref: None)	Velocity	Bin	Discrete	
62.	Earth Velocity Magnitude (Ref: None)	Velocity	Bin	Discrete	
63.	Earth Velocity Direction (Ref: None)	Angle	Bin	Discrete	
Profile (Bin) velocity data in Ship coordinate system using various navigation data references					
64.	Stbd Velocity (Ref: BT)	Velocity	Bin	Discrete	
65.	Fwd Velocity (Ref: BT)	Velocity	Bin	Discrete	
66.	Ship Up Velocity (Ref: BT)	Velocity	Bin	Discrete	
67.	Ship Error Velocity (Ref: BT)	Velocity	Bin	Discrete	
68.	Ship Velocity Magnitude (Ref: BT)	Velocity	Bin	Discrete	
69.	Ship Velocity Direction (Ref: BT)	Angle	Bin	Discrete	
70.	Stbd Velocity (Ref: None)	Velocity	Bin	Discrete	
71.	Fwd Velocity (Ref: None)	Velocity	Bin	Discrete	
72.	Ship Up Velocity (Ref: None)	Velocity	Bin	Discrete	
73.	Ship Error Velocity (Ref: None)	Velocity	Bin	Discrete	
74.	Ship Velocity Magnitude (Ref: None)	Velocity	Bin	Discrete	
75.	Ship Velocity Direction (Ref: None)	Angle	Bin	Discrete	
Profile (Bin) velocity data in Instrument (XYZ) coordinate system using various navigation data references					
76.	X Velocity (Ref: BT)	Velocity	Bin	Discrete	
77.	Y Velocity (Ref: BT)	Velocity	Bin	Discrete	
78.	Z Velocity (Ref: BT)	Velocity	Bin	Discrete	
79.	XYZ Error Velocity (Ref: BT)	Velocity	Bin	Discrete	
80.	XYZ Velocity Magnitude (Ref: BT)	Velocity	Bin	Discrete	
81.	XYZ Velocity Direction (Ref: BT)	Angle	Bin	Discrete	
82.	X Velocity (Ref: None)	Velocity	Bin	Discrete	
83.	Y Velocity (Ref: None)	Velocity	Bin	Discrete	
84.	Z Velocity (Ref: None)	Velocity	Bin	Discrete	
85.	XYZ Error Velocity (Ref: None)	Velocity	Bin	Discrete	
86.	XYZ Velocity Magnitude (Ref: None)	Velocity	Bin	Discrete	
87.	XYZ Velocity Direction (Ref: None)	Angle	Bin	Discrete	
Profile (Bin) velocity data in Beam coordinate system using various navigation data references					
88.	Beam 1 Velocity (Ref: BT)	Velocity	Bin	Discrete	
89.	Beam 2 Velocity (Ref: BT)	Velocity	Bin	Discrete	
90.	Beam 3 Velocity (Ref: BT)	Velocity	Bin	Discrete	
91.	Beam 4 Velocity (Ref: BT)	Velocity	Bin	Discrete	
92.	Beam 1 Velocity (Ref: None)	Velocity	Bin	Discrete	
93.	Beam 2 Velocity (Ref: None)	Velocity	Bin	Discrete	
94.	Beam 3 Velocity (Ref: None)	Velocity	Bin	Discrete	
95.	Beam 4 Velocity (Ref: None)	Velocity	Bin	Discrete	
Profile (Bin) discharge data independent of coordinate system using various navigation data references					
96.	Discharge (Ref: BT)	Discharge	Bin	Incremental	Only outputs good bins – not full profile
97.	Discharge Model (Ref: BT)	Discharge	Bin	Incremental	
98.	Discharge (Ref: GGA)	Discharge	Bin	Incremental	Only outputs good bins – not full profile
99.	Discharge Model (Ref: GGA)	Discharge	Bin	Incremental	
100.	Discharge (Ref: VTG)	Discharge	Bin	Incremental	Only outputs good bins – not full profile
101.	Discharge Model (Ref: VTG)	Discharge	Bin	Incremental	
102.	Discharge (Ref: GGA2)	Discharge	Bin	Incremental	Only outputs good bins – not full profile
103.	Discharge Model (Ref: GGA2)	Discharge	Bin	Incremental	
104.	Discharge (Ref: VTG2)	Discharge	Bin	Incremental	Only outputs good bins – not full profile
105.	Discharge Model (Ref: VTG2)	Discharge	Bin	Incremental	
Bottom Track velocity data in various coordinate systems (velocity of bottom relative to ADCP)					
106.	BT East Velocity	Velocity	Ensemble	Discrete	not screened by BT error velocity property
107.	BT North Velocity	Velocity	Ensemble	Discrete	
108.	BT Earth Up Velocity	Velocity	Ensemble	Discrete	
109.	BT Earth Error Velocity	Velocity	Ensemble	Discrete	

Table 8. WinRiver II ASCII Output Variable List

#	Name	Units Type	Bin Ensemble Transect	Discrete Incremental Cumulative	Comments
110.	BT Earth Magnitude Velocity	Velocity	Ensemble	Discrete	
111.	BT Earth Direction Velocity	Angle	Ensemble	Discrete	
112.	BT Stbd Velocity	Velocity	Ensemble	Discrete	Ship coordinate
113.	BT Fwd Velocity	Velocity	Ensemble	Discrete	
114.	BT Ship Up Velocity	Velocity	Ensemble	Discrete	
115.	BT Ship Error Velocity	Velocity	Ensemble	Discrete	
116.	BT Ship Magnitude Velocity	Velocity	Ensemble	Discrete	
117.	BT Ship Direction Velocity	Angle	Ensemble	Discrete	
118.	BT X Velocity	Velocity	Ensemble	Discrete	XYZ coordinate
119.	BT Y Velocity	Velocity	Ensemble	Discrete	
120.	BT Z Velocity	Velocity	Ensemble	Discrete	
121.	BT XYZ Error Velocity	Velocity	Ensemble	Discrete	
122.	BT XYZ Magnitude Velocity	Velocity	Ensemble	Discrete	
123.	BT XYZ Direction Velocity	Angle	Ensemble	Discrete	
124.	BT Beam 1 Velocity	Velocity	Ensemble	Discrete	Beam coordinate
125.	BT Beam 2 Velocity	Velocity	Ensemble	Discrete	
126.	BT Beam 3 Velocity	Velocity	Ensemble	Discrete	
127.	BT Beam 4 Velocity	Velocity	Ensemble	Discrete	
Navigation velocity data in Earth coordinate system for various references (velocity of ADCP relative to bottom)					
128.	East GGA Velocity	Velocity	Ensemble	Discrete	
129.	North GGA Velocity	Velocity	Ensemble	Discrete	
130.	East VTG Velocity	Velocity	Ensemble	Discrete	
131.	North VTG Velocity	Velocity	Ensemble	Discrete	
132.	East GGA2 Velocity	Velocity	Ensemble	Discrete	
133.	North GGA2 Velocity	Velocity	Ensemble	Discrete	
134.	East VTG2 Velocity	Velocity	Ensemble	Discrete	
135.	North VTG2 Velocity	Velocity	Ensemble	Discrete	
136.	East BT Velocity	Velocity	Ensemble	Discrete	Arithmetic inverse of # 106 – BT East Velocity, screened by BT Error Velocity
137.	North BT Velocity	Velocity	Ensemble	Discrete	Arithmetic inverse of # 107 – BT North Velocity, screened by BT Error Velocity
Processed Navigation data in Earth coordinate system for various references					
138.	East Displacement (Ref: BT)	Distance	Ensemble	Cumulative	Total East displacement referenced to Bottom Track (Units depend on user settings)
139.	North Displacement (Ref: BT)	Distance	Ensemble	Cumulative	Total North displacement referenced to Bottom Track (Units depend on user settings)
140.	Distance Made Good (Ref: BT)	Distance	Ensemble	Cumulative	Distance made good referenced to Bottom Track
141.	Boat Course (Ref: BT)	Angle	Ensemble	Incremental	Ship Direction referenced to bottom track
142.	Distance Traveled (Ref: BT)	Distance	Ensemble	Cumulative	Distance traveled referenced to Bottom Track
143.	East Displacement (Ref: GGA)	Distance	Ensemble	Cumulative	Same as lines 138-142 except GGA reference
144.	North Displacement (Ref: GGA)	Distance	Ensemble	Cumulative	
145.	Distance Made Good (Ref: GGA)	Distance	Ensemble	Cumulative	
146.	Boat Course (Ref: GGA)	Angle	Ensemble	Incremental	
147.	Distance Traveled (Ref: GGA)	Distance	Ensemble	Cumulative	
148.	East Displacement (Ref: VTG)	Distance	Ensemble	Cumulative	Same as lines 138-142 except VTG reference
149.	North Displacement (Ref: VTG)	Distance	Ensemble	Cumulative	
150.	Distance Made Good (Ref: VTG)	Distance	Ensemble	Cumulative	
151.	Boat Course (Ref: VTG)	Angle	Ensemble	Incremental	
152.	Distance Traveled (Ref: VTG)	Distance	Ensemble	Cumulative	
153.	East Displacement (Ref: GGA2)	Distance	Ensemble	Cumulative	Same as lines 138-142 except GGA2 reference
154.	North Displacement (Ref: GGA2)	Distance	Ensemble	Cumulative	
155.	Distance Made Good (Ref: GGA2)	Distance	Ensemble	Cumulative	
156.	Boat Course (Ref: GGA2)	Angle	Ensemble	Incremental	
157.	Distance Traveled (Ref: GGA2)	Distance	Ensemble	Cumulative	
158.	East Displacement (Ref: VTG2)	Distance	Ensemble	Cumulative	Same as lines 138-142 except VTG2 reference
159.	North Displacement (Ref: VTG2)	Distance	Ensemble	Cumulative	
160.	Distance Made Good (Ref: VTG2)	Distance	Ensemble	Cumulative	
161.	Boat Course (Ref: VTG2)	Angle	Ensemble	Incremental	
162.	Distance Traveled (Ref: VTG2)	Distance	Ensemble	Cumulative	
163.	East Displacement (Ref: None)	Distance	Ensemble	Discrete	Always zero (0)
164.	North Displacement (Ref: None)	Distance	Ensemble	Discrete	Always zero (0)
Depth data from Bottom Track					
165.	Beam 1 Depth	Depth	Ensemble	Discrete	Individual processed beam depths
166.	Beam 2 Depth	Depth	Ensemble	Discrete	

Table **8**. WinRiver II ASCII Output Variable List

#	Name	Units Type	Bin Ensemble Transect	Discrete Incremental Cumulative	Comments
167.	Beam 3 Depth	Depth	Ensemble	Discrete	
168.	Beam 4 Depth	Depth	Ensemble	Discrete	
169.	Beams Average Depth	Depth	Ensemble	Discrete	Average depth for all beams, computed per processing settings
170.	Beam 1 Depth Raw	Depth	Ensemble	Discrete	Beam depth uncorrected by DS
171.	Beam 2 Depth Raw	Depth	Ensemble	Discrete	
172.	Beam 3 Depth Raw	Depth	Ensemble	Discrete	
173.	Beam 4 Depth Raw	Depth	Ensemble	Discrete	
Discharge data computed using Bottom Track navigation reference					
174.	Total Discharge (Ref: BT)	Discharge	Ensemble	Cumulative	
175.	Top Discharge (Ref: BT)	Discharge	Ensemble	Cumulative	
176.	Middle Discharge (Ref: BT)	Discharge	Ensemble	Cumulative	
177.	Bottom Discharge (Ref: BT)	Discharge	Ensemble	Cumulative	
178.	T+M+B Discharge (Ref: BT)	Discharge	Ensemble	Cumulative	
179.	Left Q (Ref: BT)	Discharge	Transect	Discrete	All Edge Data: Left and Right Edge distances will be present and included for all ensembles. Default number of shore (edge) ensembles N = 10. Remaining values will be zero (0) for the first (N-1) ensembles. Starting with the Nth ensemble, the starting edge will show constant values and the ending edge will be continuously recalculated based on a moving average of the last N ensembles through the current one. Data for both edges will be included in Total Discharge, Total Width, Total Area, and Q/Area.
180.	Left Velocity (Ref: BT)	Velocity	Transect	Discrete	
181.	Left Depth (Ref: BT)	Depth	Transect	Discrete	
182.	Left Area (Ref: BT)	Area	Transect	Discrete	
183.	Left Distance (Ref: BT)	Distance	Transect	Discrete	
184.	Left Mean Good Bins (Ref: BT)	None	Transect	Discrete	
185.	Right Q (Ref: BT)	Discharge	Transect	Discrete	
186.	Right Velocity (Ref: BT)	Velocity	Transect	Discrete	
187.	Right Depth (Ref: BT)	Depth	Transect	Discrete	
188.	Right Area (Ref: BT)	Area	Transect	Discrete	
189.	Right Distance (Ref: BT)	Distance	Transect	Discrete	
190.	Right Mean Good Bins (Ref: BT)	None	Transect	Discrete	
191.	Water Speed (Ref: BT)	Water Speed	Ensemble	Discrete	Average horizontal velocity for all good bins in ensemble
192.	Total Width (Ref: BT)	Distance	Ensemble	Cumulative	Includes both edge distances for all ensembles, computed per processing settings
193.	Total Area (Ref: BT)	Area	Ensemble	Cumulative	Includes area estimates for both edges starting with the 10th ensemble, computed per processing settings
194.	Q/Area (Ref: BT)	Velocity	Ensemble	Cumulative	Total Discharge / Total Area
195.	Flow Direction (Ref: BT)	Angle	Ensemble	Discrete	Average horizontal flow direction for ensemble
196.	Made Good Course (Ref: BT)	Angle	Ensemble	Cumulative	
197.	Boat Speed (Ref: BT)	Boat Speed	Ensemble	Discrete	Vector sum of 136 East BT Velocity and 137 North BT Velocity
198.	Boat/Water Ratio (Ref: BT)	None	Ensemble	Discrete	
199.	Nmb. of Good Bins (Ref: BT)	None	Ensemble	Discrete	
200.	Percent Good Bins (Ref: BT)	None	Ensemble	Cumulative	
201.	Nmb. Processed Ensembles (Ref: BT)	None	Ensemble	Cumulative	
202.	Nmb. Bad Ensembles (Ref: BT)	None	Ensemble	Cumulative	
203.	Nmb. Lost Ensembles (Ref: BT)	None	Ensemble	Cumulative	
204.	Max. Water Speed (Ref: BT)	Water Speed	Ensemble	Cumulative	Largest single-bin velocity magnitude
205.	Max. Water Depth (Ref: BT)	Depth	Ensemble	Cumulative	Maximum depth in this and prior ensembles in transect
206.	Mean Water Depth (Ref: BT)	Depth	Ensemble	Cumulative	Unweighted average depth for all ensembles
207.	Time Traveled (Ref: BT)	Time	Ensemble	Cumulative	same as 4 Elapsed Time
208.	First Valid Bin (Ref: BT)	None	Ensemble	Discrete	Zero-based index, -1 if no good bins
209.	Last Valid Bin (Ref: BT)	None	Ensemble	Discrete	Zero-based index, -1 if no good bins
210.	a Coeff For Power (Ref: BT)	None	Ensemble	Discrete	
211.	Coefficient A (Ref: BT)	None	Ensemble	Discrete	Only used if top extrapolation = 3 Pt Slope
212.	Coefficient B (Ref: BT)	None	Ensemble	Discrete	Only used if top extrapolation = 3Pt Slope
213.	No Slip Point (Ref: BT)	None	Ensemble	Discrete	Only used if bottom extrapolation = No-Slip
214.	a Top Coeff For No-Slip (Ref: BT)	None	Ensemble	Discrete	Not used
215.	a Bottom Coeff For No-Slip (Ref: BT)	None	Ensemble	Discrete	
216.	Q Top Model (Ref: BT)	Discharge	Ensemble	Discrete	
217.	River Direction (Ref: BT)	Angle	Ensemble	Cumulative	Average horizontal flow direction for all good bins in transect to current ensemble
218.	Mean River Velocity (Ref:BT)	Water Speed	Ensemble	Cumulative	Average horizontal velocity for all good bins in transect to current ensemble
219.	COV River Velocity (Ref:BT)	None			Not used
220.	Standard Deviation Flow Direction (Ref:BT)	Angle			Not used

Table **8.** WinRiver II ASCII Output Variable List

#	Name	Units Type	Bin Ensemble Transect	Discrete Incremental Cumulative	Comments
221.	Water Column Est. Avg. Speed (Ref: BT)	Velocity	Ensemble	Discrete	Q/A per ensemble
222.	Section Width (Ref:BT)	Distance			Not used
223.	Section Flow Angle (Ref:BT)	Angle			Not used
224.	Right Edge Type (Ref:BT)	None			Not used
225.	Left Edge Type (Ref:BT)	None			Not used
Discharge data computed using GGA navigation reference					
226.	Total Discharge (Ref: GGA)	Discharge	Ensemble	Cumulative	
227.	Top Discharge (Ref: GGA)	Discharge	Ensemble	Cumulative	
228.	Middle Discharge (Ref: GGA)	Discharge	Ensemble	Cumulative	
229.	Bottom Discharge (Ref: GGA)	Discharge	Ensemble	Cumulative	
230.	T+M+B Discharge (Ref: GGA)	Discharge	Ensemble	Cumulative	
231.	Left Q (Ref: GGA)	Discharge	Transect	Discrete	All Edge Data: Left and Right Edge distances will be present and included for all ensembles. Default number of shore (edge) ensembles N = 10. Remaining values will be zero (0) for the first (N-1) ensembles. Starting with the Nth ensemble, the starting edge will show constant values and the ending edge will be continuously recalculated based on a moving average of the last N ensembles through the current one. Data for both edges will be included in Total Discharge, Total Width, Total Area, and Q/Area.
232.	Left Velocity (Ref: GGA)	Velocity	Transect	Discrete	
233.	Left Depth (Ref: GGA)	Depth	Transect	Discrete	
234.	Left Area (Ref: GGA)	Area	Transect	Discrete	
235.	Left Distance (Ref: GGA)	Distance	Transect	Discrete	
236.	Left Mean Good Bins (Ref: GGA)	None	Transect	Discrete	
237.	Right Q (Ref: GGA)	Discharge	Transect	Discrete	
238.	Right Velocity (Ref: GGA)	Velocity	Transect	Discrete	
239.	Right Depth (Ref: GGA)	Depth	Transect	Discrete	
240.	Right Area (Ref: GGA)	Area	Transect	Discrete	
241.	Right Distance (Ref: GGA)	Distance	Transect	Discrete	
242.	Right Mean Good Bins (Ref: GGA)	None	Transect	Discrete	
243.	Water Speed (Ref: GGA)	Water Speed	Ensemble	Discrete	Average horizontal velocity for all good bins in ensemble
244.	Total Width (Ref: GGA)	Distance	Ensemble	Cumulative	Includes both edge distances for all ensembles
245.	Total Area (Ref: GGA)	Area	Ensemble	Cumulative	Includes area estimates for both edges starting with the 10th ensemble
246.	Q/Area (Ref: GGA)	Velocity	Ensemble	Cumulative	Total Discharge / Total Area
247.	Flow Direction (Ref: GGA)	Angle	Ensemble	Discrete	Average horizontal flow direction for ensemble
248.	Made Good Course (Ref: GGA)	Angle	Ensemble	Cumulative	
249.	Boat Speed (Ref: GGA)	Boat Speed	Ensemble	Discrete	Vector sum of 128 East GGA velocity and 129 North GGA velocity
250.	Boat/Water Ratio (Ref: GGA)	None	Ensemble	Discrete	
251.	Nmb. of Good Bins (Ref: GGA)	None	Ensemble	Discrete	
252.	Percent Good Bins (Ref: GGA)	None	Ensemble	Cumulative	
253.	Nmb. Processed Ensembles (Ref: GGA)	None	Ensemble	Cumulative	
254.	Nmb. Bad Ensembles (Ref: GGA)	None	Ensemble	Cumulative	
255.	Nmb. Lost Ensembles (Ref: GGA)	None	Ensemble	Cumulative	
256.	Max. Water Speed (Ref: GGA)	Water Speed	Ensemble	Cumulative	Largest single-bin velocity magnitude
257.	Max. Water Depth (Ref: GGA)	Depth	Ensemble	Cumulative	Maximum depth in this and prior ensembles
258.	Mean Water Depth (Ref: GGA)	Depth	Ensemble	Cumulative	Unweighted average depth for all ensembles
259.	Time Traveled (Ref: GGA)	Time	Ensemble	Cumulative	Same as 4 Elapsed Time
260.	First Valid Bin (Ref: GGA)	None	Ensemble	Discrete	Zero-based index, -1 if no good bins
261.	Last Valid Bin (Ref: GGA)	None	Ensemble	Discrete	
262.	a Coeff For Power (Ref: GGA)	None	Ensemble	Discrete	
263.	Coefficient A (Ref: GGA)	None	Ensemble	Discrete	Only used if top extrapolation = 3 Pt Slope
264.	Coefficient B (Ref: GGA)	None	Ensemble	Discrete	Only used if top extrapolation = 3 Pt Slope
265.	No Slip Point (Ref: GGA)	None	Ensemble	Discrete	Only used if bottom extrapolation = No-Slip
266.	a Top Coeff For No-Slip (Ref: GGA)	None	Ensemble	Discrete	Not used
267.	a Bottom Coeff For No-Slip (Ref: GGA)	None	Ensemble	Discrete	
268.	Q Top Model (Ref: GGA)	Discharge	Ensemble	Discrete	
269.	River Direction (Ref: GGA)	Angle	Ensemble	Cumulative	Average horizontal flow direction for all good bins in transect to current ensemble
270.	Mean River Velocity (Ref:GGA)	Water Speed	Ensemble	Cumulative	Average horizontal velocity for all good bins in transect to current ensemble
271.	COV River Velocity (Ref:GGA)	None			Not Used
272.	Standard Deviation Flow Direction (Ref:GGA)	Angle			Not Used
273.	Water Column Est. Avg. Speed (Ref: GGA)	Velocity	Ensemble	Discrete	Q/A per ensemble
Discharge data computed using VTG navigation reference					

Table **8**. WinRiver II ASCII Output Variable List

#	Name	Units Type	Bin Ensemble Transect	Discrete Incremental Cumulative	Comments
274.	Total Discharge (Ref: VTG)	Discharge	Ensemble	Cumulative	
275.	Top Discharge (Ref: VTG)	Discharge	Ensemble	Cumulative	
276.	Middle Discharge (Ref: VTG)	Discharge	Ensemble	Cumulative	
277.	Bottom Discharge (Ref: VTG)	Discharge	Ensemble	Cumulative	
278.	T+M+B Discharge (Ref: VTG)	Discharge	Ensemble	Cumulative	
279.	Left Q (Ref: VTG)	Discharge	Transect	Discrete	All Edge Data: Left and Right Edge distances will be present and included for all ensembles. Default number of shore (edge) ensembles N = 10. Remaining values will be zero (0) for the first (N-1) ensembles. Starting with the Nth ensemble, the starting edge will show constant values and the ending edge will be continuously recalculated based on a moving average of the last N ensembles through the current one. Data for both edges will be included in Total Discharge, Total Width, Total Area, and Q/Area.
280.	Left Velocity (Ref: VTG)	Velocity	Transect	Discrete	
281.	Left Depth (Ref: VTG)	Depth	Transect	Discrete	
282.	Left Area (Ref: VTG)	Area	Transect	Discrete	
283.	Left Distance (Ref: VTG)	Distance	Transect	Discrete	
284.	Left Mean Good Bins (Ref: VTG)	None	Transect	Discrete	
285.	Right Q (Ref: VTG)	Discharge	Transect	Discrete	
286.	Right Velocity (Ref: VTG)	Velocity	Transect	Discrete	
287.	Right Depth (Ref: VTG)	Depth	Transect	Discrete	
288.	Right Area (Ref: VTG)	Area	Transect	Discrete	
289.	Right Distance (Ref: VTG)	Distance	Transect	Discrete	
290.	Right Mean Good Bins (Ref: VTG)	None	Transect	Discrete	
291.	Water Speed (Ref: VTG)	Water Speed	Ensemble	Discrete	Average horizontal velocity for all good bins in ensemble
292.	Total Width (Ref: VTG)	Distance	Ensemble	Cumulative	Includes both edge distances for all ensembles
293.	Total Area (Ref: VTG)	Area	Ensemble	Cumulative	Includes area estimates for both edges starting with the 10th ensemble
294.	Q/Area (Ref: VTG)	Velocity	Ensemble	Cumulative	Total Discharge / Total Area
295.	Flow Direction (Ref: VTG)	Angle	Ensemble	Discrete	Average horizontal flow direction for ensemble
296.	Made Good Course (Ref: VTG)	Angle	Ensemble	Cumulative	
297.	Boat Speed (Ref: VTG)	Boat Speed	Ensemble	Discrete	Vector sum of 130 East VTG velocity and 131 North GGA velocity
298.	Boat/Water Ratio (Ref: VTG)	None	Ensemble	Discrete	
299.	Nmb. of Good Bins (Ref: VTG)	None	Ensemble	Discrete	
300.	Percent Good Bins (Ref: VTG)	None	Ensemble	Cumulative	
301.	Nmb. Processed Ensembles (Ref: VTG)	None	Ensemble	Cumulative	
302.	Nmb. Bad Ensembles (Ref: VTG)	None	Ensemble	Cumulative	
303.	Nmb. Lost Ensembles (Ref: VTG)	None	Ensemble	Cumulative	
304.	Max. Water Speed (Ref: VTG)	Water Speed	Ensemble	Cumulative	Largest single-bin velocity magnitude
305.	Max. Water Depth (Ref: VTG)	Depth	Ensemble	Cumulative	Maximum depth in this and prior ensembles in transect
306.	Mean Water Depth (Ref: VTG)	Depth	Ensemble	Cumulative	Unweighted average depth for all ensembles
307.	Time Traveled (Ref:VTG)	Time	Ensemble	Cumulative	Same as 4 Elapsed Time
308.	First Valid Bin (Ref: VTG)	None	Ensemble	Discrete	Zero-based index, -1 if no good bins
309.	Last Valid Bin (Ref: VTG)	None	Ensemble	Discrete	Zero-based index, -1 if no good bins
310.	a Coeff For Power (Ref: VTG)	None	Ensemble	Discrete	
311.	Coefficient A (Ref: VTG)	None	Ensemble	Discrete	Only used if top extrapolation = 3 Pt Slope
312.	Coefficient B (Ref: VTG)	None	Ensemble	Discrete	Only used if top extrapolation = 3Pt Slope
313.	NoSlipPoint (Ref: VTG)	None	Ensemble	Discrete	Only used if bottom extrapolation = No-Slip
314.	a Top Coeff For No-Slip (Ref: VTG)	None	Ensemble	Discrete	Not used
315.	a Bottom Coeff For No-Slip (Ref: VTG)	None	Ensemble	Discrete	
316.	Q Top Model (Ref: VTG)	Discharge	Ensemble	Discrete	
317.	River Direction (Ref: VTG)	Angle	Ensemble	Cumulative	Average horizontal flow direction for all good bins in transect to current ensemble
318.	Mean River Velocity (Ref:VTG)	Water Speed	Ensemble	Cumulative	Average horizontal velocity for all good bins in transect to current ensemble
319.	COV River Velocity (Ref:VTG)	None			Not used
320.	Standard Deviation Flow Direction (Ref:VTG)	Angle			Not used
321.	Water Column Est. Avg. Speed (Ref: VTG)	Velocity	Ensemble	Discrete	Q/A per ensemble
Discharge data computed using GGA2 navigation reference					
322.	Total Discharge (Ref: GGA2)	Discharge	Ensemble	Cumulative	
323.	Top Discharge (Ref: GGA2)	Discharge	Ensemble	Cumulative	
324.	Middle Discharge (Ref: GGA2)	Discharge	Ensemble	Cumulative	
325.	Bottom Discharge (Ref: GGA2)	Discharge	Ensemble	Cumulative	
326.	T+M+B Discharge (Ref: GGA2)	Discharge	Ensemble	Cumulative	
327.	Left Q (Ref: GGA2)	Discharge	Transect	Discrete	All Edge Data: Left and Right Edge distances will be present and included for all ensembles. Default number of
328.	Left Velocity (Ref: GGA2)	Velocity	Transect	Discrete	

Table **8**. WinRiver II ASCII Output Variable List

#	Name	Units Type	Bin Ensemble Transect	Discrete Incremental Cumulative	Comments
329.	Left Depth (Ref: GGA2)	Depth	Transect	Discrete	shore (edge) ensembles N = 10. Remaining values will be zero (0) for the first (N-1) ensembles. Starting with the Nth ensemble, the starting edge will show constant values and the ending edge will be continuously recalculated based on a moving average of the last N ensembles through the current one. Data for both edges will be included in Total Discharge, Total Width, Total Area, and Q/Area.
330.	Left Area (Ref: GGA2)	Area	Transect	Discrete	
331.	Left Distance (Ref: GGA2)	Distance	Transect	Discrete	
332.	Left Mean Good Bins (Ref: GGA2)	None	Transect	Discrete	
333.	Right Q (Ref: GGA2)	Discharge	Transect	Discrete	
334.	Right Velocity (Ref: GGA2)	Velocity	Transect	Discrete	
335.	Right Depth (Ref: GGA2)	Depth	Transect	Discrete	
336.	Right Area (Ref: GGA2)	Area	Transect	Discrete	
337.	Right Distance (Ref: GGA2)	Distance	Transect	Discrete	
338.	Right Mean Good Bins (Ref: GGA2)	None	Transect	Discrete	
339.	Water Speed (Ref: GGA2)	Water Speed	Ensemble	Discrete	Average horizontal velocity for all good bins in ensemble
340.	Total Width (Ref: GGA2)	Distance	Ensemble	Cumulative	Includes both edge distances for all ensembles
341.	Total Area (Ref: GGA2)	Area	Ensemble	Cumulative	Includes area estimates for both edges starting with the 10^{th} ensemble
342.	Q/Area (Ref: GGA2)	Velocity	Ensemble	Cumulative	Total Discharge / Total Area
343.	Flow Direction (Ref: GGA2)	Angle	Ensemble	Discrete	Average horizontal flow direction for ensemble
344.	Made Good Course (Ref: GGA2)	Angle	Ensemble	Cumulative	
345.	Boat Speed (Ref: GGA2)	Boat Speed	Ensemble	Discrete	Vector sum of 132 East GGA2 velocity and 133 North GGA2 velocity
346.	Boat/Water Ratio (Ref: GGA2)	None	Ensemble	Discrete	
347.	Nmb. of Good Bins (Ref: GGA2)	None	Ensemble	Discrete	
348.	Percent Good Bins (Ref: GGA2)	None	Ensemble	Cumulative	
349.	Nmb. Processed Ensembles (Ref: GGA2)	None	Ensemble	Cumulative	
350.	Nmb. Bad Ensembles (Ref: GGA2)	None	Ensemble	Cumulative	
351.	Nmb. Lost Ensembles (Ref: GGA2)	None	Ensemble	Cumulative	
352.	Max. Water Speed (Ref: GGA2)	Water Speed	Ensemble	Cumulative	Largest single-bin velocity magnitude
353.	Max. Water Depth (Ref: GGA2)	Depth	Ensemble	Cumulative	Maximum depth in this and prior ensembles
354.	Mean Water Depth (Ref: GGA2)	Depth	Ensemble	Cumulative	Unweighted average depth for all ensembles
355.	Time Traveled (Ref: GGA2)	Time	Ensemble	Cumulative	Same as 4 Elapsed Time
356.	First Valid Bin (Ref: GGA2)	None	Ensemble	Discrete	Zero-based index, -1 if no good bins
357.	Last Valid Bin (Ref: GGA2)	None	Ensemble	Discrete	
358.	a Coeff For Power (Ref: GGA2)	None	Ensemble	Discrete	
359.	Coefficient A (Ref: GGA2)	None	Ensemble	Discrete	Only used if top extrapolation = 3 Pt Slope
360.	Coefficient B (Ref: GGA2)	None	Ensemble	Discrete	Only used if top extrapolation = 3 Pt Slope
361.	No Slip Point (Ref: GGA2)	None	Ensemble	Discrete	Only used if bottom extrapolation = No-Slip
362.	a Top Coeff For No-Slip (Ref: GGA2)	None	Ensemble	Discrete	Not used
363.	a Bottom Coeff For No-Slip (Ref: GGA2)	None	Ensemble	Discrete	
364.	Q Top Model (Ref: GGA2)	Discharge	Ensemble	Discrete	
365.	River Direction (Ref: GGA2)	Angle	Ensemble	Cumulative	Average horizontal flow direction for all good bins in transect to current ensemble
366.	Mean River Velocity (Ref:GGA2)	Water Speed	Ensemble	Cumulative	Average horizontal velocity for all good bins in transect to current ensemble
367.	COV River Velocity (Ref:GGA2)	None			Not Used
368.	Standard Deviation Flow Direction (Ref:GGA2)	Angle			Not Used
369.	Water Column Est. Avg. Speed (Ref: GGA2)	Velocity	Ensemble	Discrete	Q/A per ensemble
Discharge data computed using VTG2 navigation reference					
370.	Total Discharge (Ref: VTG2)	Discharge	Ensemble	Cumulative	
371.	Top Discharge (Ref: VTG2)	Discharge	Ensemble	Cumulative	
372.	Middle Discharge (Ref: VTG2)	Discharge	Ensemble	Cumulative	
373.	Bottom Discharge (Ref: VTG2)	Discharge	Ensemble	Cumulative	
374.	T+M+B Discharge (Ref: VTG2)	Discharge	Ensemble	Cumulative	
375.	Left Q (Ref: VTG2)	Discharge	Transect	Discrete	All Edge Data: Left and Right Edge distances will be present and included for all ensembles. Default number of shore (edge) ensembles N = 10. Remaining values will be zero (0) for the first (N-1) ensembles. Starting with the Nth ensemble, the starting edge will show constant values and the ending edge will be continuously recalculated based on a moving average of the last N ensembles
376.	Left Velocity (Ref: VTG2)	Velocity	Transect	Discrete	
377.	Left Depth (Ref: VTG2)	Depth	Transect	Discrete	
378.	Left Area (Ref: VTG2)	Area	Transect	Discrete	
379.	Left Distance (Ref: VTG2)	Distance	Transect	Discrete	
380.	Left Mean Good Bins (Ref: VTG2)	None	Transect	Discrete	
381.	Right Q (Ref: VTG2)	Discharge	Transect	Discrete	
382.	Right Velocity (Ref: VTG2)	Velocity	Transect	Discrete	

Table 8. WinRiver II ASCII Output Variable List

#	Name	Units Type	Bin Ensemble Transect	Discrete Incremental Cumulative	Comments
383.	Right Depth (Ref: VTG2)	Depth	Transect	Discrete	through the current one. Data for both edges will be included in Total Discharge, Total Width, Total Area, and Q/Area.
384.	Right Area (Ref: VTG2)	Area	Transect	Discrete	
385.	Right Distance (Ref: VTG2)	Distance	Transect	Discrete	
386.	Right Mean Good Bins (Ref: VTG2)	None	Transect	Discrete	
387.	Water Speed (Ref: VTG2)	Water Speed	Ensemble	Discrete	Average horizontal velocity for all good bins in ensemble
388.	Total Width (Ref: VTG2)	Distance	Ensemble	Cumulative	Includes both edge distances for all ensembles
389.	Total Area (Ref: VTG2)	Area	Ensemble	Cumulative	Includes area estimates for both edges starting with the 10th ensemble
390.	Q/Area (Ref: VTG2)	Velocity	Ensemble	Cumulative	Total Discharge / Total Area
391.	Flow Direction (Ref: VTG2)	Angle	Ensemble	Discrete	Average horizontal flow direction for ensemble
392.	Made Good Course (Ref: VTG2)	Angle	Ensemble	Cumulative	
393.	Boat Speed (Ref: VTG2)	Boat Speed	Ensemble	Discrete	Vector sum of 134 East VTG2 velocity and 135 North VTG2 velocity
394.	Boat/Water Ratio (Ref: VTG2)	None	Ensemble	Discrete	
395.	Nmb. of Good Bins (Ref: VTG2)	None	Ensemble	Discrete	
396.	Percent Good Bins (Ref: VTG2)	None	Ensemble	Cumulative	
397.	Nmb. Processed Ensembles (Ref: VTG2)	None	Ensemble	Cumulative	
398.	Nmb. Bad Ensembles (Ref: VTG2)	None	Ensemble	Cumulative	
399.	Nmb. Lost Ensembles (Ref: VTG2)	None	Ensemble	Cumulative	
400.	Max. Water Speed (Ref: VTG2)	Water Speed	Ensemble	Cumulative	Largest single-bin velocity magnitude
401.	Max. Water Depth (Ref: VTG2)	Depth	Ensemble	Cumulative	Maximum depth in this and prior ensembles in transect
402.	Mean Water Depth (Ref: VTG2)	Depth	Ensemble	Cumulative	Unweighted average depth for all ensembles
403.	Time Traveled (Ref:VTG2)	Time	Ensemble	Cumulative	Same as 4 Elapsed Time
404.	First Valid Bin (Ref: VTG2)	None	Ensemble	Discrete	Zero-based index, -1 if no good bins
405.	Last Valid Bin (Ref: VTG2)	None	Ensemble	Discrete	
406.	a Coeff For Power (Ref: VTG2)	None	Ensemble	Discrete	Only used if top extrapolation = 3 Pt Slope
407.	Coefficient A (Ref: VTG2)	None	Ensemble	Discrete	Only used if top extrapolation = 3 Pt Slope
408.	Coefficient B (Ref: VTG2)	None	Ensemble	Discrete	Only used if bottom extrapolation = No-Slip
409.	NoSlipPoint (Ref: VTG2)	None	Ensemble	Discrete	Not used
410.	a Top Coeff For No-Slip (Ref: VTG2)	None	Ensemble	Discrete	
411.	a Bottom Coeff For No-Slip (Ref: VTG2)	None	Ensemble	Discrete	
412.	Q Top Model (Ref: VTG2)	Discharge	Ensemble	Discrete	Only used if top extrapolation = 3 Pt Slope
413.	River Direction (Ref: VTG2)	Angle	Ensemble	Cumulative	Average horizontal flow direction for all good bins in transect to current ensemble
414.	Mean River Velocity (Ref:VTG2)	Water Speed	Ensemble	Cumulative	Average horizontal velocity for all good bins in transect to current ensemble
415.	COV River Velocity (Ref:VTG2)	None			Not Used
416.	Standard Deviation Flow Direction (Ref:VTG2)	Angle			Not Used
417.	Water Column Est. Avg. Speed (Ref: VTG2)	Velocity	Ensemble	Discrete	Q/A per ensemble
WinRiver II Display					
418.	Total Discharge (Ref: None)	Discharge	Ensemble	Cumulative	These parameters provided for display purposes – technically, no discharge computations are possible without a navigation reference. Bottom track reference data is generally reported for these parameters – see those parameters for comments.
419.	Top Discharge (Ref: None)	Discharge	Ensemble	Cumulative	
420.	Middle Discharge (Ref: None)	Discharge	Ensemble	Cumulative	
421.	Bottom Discharge (Ref: None)	Discharge	Ensemble	Cumulative	
422.	T+M+B Discharge (Ref: None)	Discharge	Ensemble	Cumulative	
423.	Left Q (Ref: None)	Discharge	Transect	Discrete	
424.	Left Velocity (Ref: None)	Velocity	Transect	Discrete	
425.	Left Depth (Ref: None)	Depth	Transect	Discrete	
426.	Left Area (Ref: None)	Area	Transect	Discrete	
427.	Left Distance (Ref: None)	Distance	Transect	Discrete	
428.	Left Mean Good Bins (Ref: None)	None	Transect	Discrete	
429.	Right Q (Ref: None)	Discharge	Transect	Discrete	
430.	Right Velocity (Ref: None)	Velocity	Transect	Discrete	
431.	Right Depth (Ref: None)	Depth	Transect	Discrete	
432.	Right Area (Ref: None)	Area	Transect	Discrete	
433.	Right Distance (Ref: None)	Distance	Transect	Discrete	
434.	Right Mean Good Bins (Ref: None)	None	Transect	Discrete	
435.	Water Speed (Ref: None)	Water Speed	Ensemble	Discrete	
436.	Total Width (Ref: None)	Distance	Ensemble	Cumulative	

Table **8**. WinRiver II ASCII Output Variable List

#	Name	Units Type	Bin Ensemble Transect	Discrete Incremental Cumulative	Comments
437.	Total Area (Ref: None)	Area	Ensemble	Cumulative	
438.	Q/Area (Ref: None)	Velocity	Ensemble	Cumulative	
439.	Flow Direction (Ref: None)	Angle	Ensemble	Discrete	
440.	Nmb. of Good Bins (Ref: None)	None	Ensemble	Discrete	
441.	Percent Good Bins (Ref: None)	None	Ensemble	Cumulative	
442.	Nmb. Processed Ensembles (Ref: None)	None	Ensemble	Cumulative	
443.	Nmb. Bad Ensembles (Ref: None)	None	Ensemble	Cumulative	
444.	Nmb. Lost Ensembles (Ref: None)	None	Ensemble	Cumulative	
445.	Max. Water Speed (Ref: None)	Water Speed	Ensemble	Cumulative	
446.	Mean Water Depth (Ref: None)	Depth	Ensemble	Cumulative	
447.	Time Traveled (Ref:None)	Time	Ensemble	Cumulative	
448.	First Valid Bin (Ref: None)	None	Ensemble	Discrete	
449.	Last Valid Bin (Ref: None)	None	Ensemble	Discrete	
450.	a Coeff For Power (Ref: None)	None	Ensemble	Discrete	
451.	Coefficient A (Ref: None)	None	Ensemble	Discrete	
452.	Coefficient B (Ref: None)	None	Ensemble	Discrete	
453.	a Top Coeff For No-Slip (Ref: None)	None	Ensemble	Discrete	
454.	a Bottom Coeff For No-Slip (Ref: None)	None	Ensemble	Discrete	
455.	River Direction (Ref: None)	Angle	Ensemble	Cumulative	
456.	Mean River Velocity (Ref:None)	Water Speed	Ensemble	Cumulative	
457.	COV River Velocity (Ref:None)	None			
458.	Standard Deviation Flow Direction (Ref:None)	Angle			
ADCP information					
459.	Firmware Version	None	Transect	Discrete	General Information about the ADCP and setup used, not normally used for output
460.	ADCP Serial Number	None	Transect	Discrete	
461.	System Frequency	Frequency	Transect	Discrete	
462.	Beam Angle	Angle	Transect	Discrete	
463.	Orientation	None	Transect	Discrete	
464.	Transducer Pattern	None	Transect	Discrete	
465.	Sensor Configuration	None	Transect	Discrete	
466.	Coordinate System	None	Transect	Discrete	
467.	Number of Bins	None	Transect or Ensemble	Discrete	
468.	Bin Size	Distance	Transect or Ensemble	Discrete	
469.	Transmit	Distance	Transect or Ensemble	Discrete	
470.	Blank	Distance	Transect	Discrete	
471.	Bin 1 Range	Distance	Transect or Ensemble	Discrete	
472.	Transmit Lag Distance	Distance	Transect or Ensemble	Discrete	
473.	Water Profiling Mode	None	Transect	Discrete	
474.	Bottom Track Mode	None	Transect	Discrete	
475.	Water Pings	None	Transect	Discrete	
476.	Bottom Pings	None	Transect	Discrete	
477.	Pressure Sensor Available	None	Transect	Discrete	Flag for Pressure Sensor availability
Ancillary ADCP information					
478.	Pressure Sensor	Depth	Ensemble	Discrete	
479.	Heading	Angle	Ensemble	Discrete	
480.	Pitch	Angle	Ensemble	Discrete	
481.	Roll	Angle	Ensemble	Discrete	
482.	Temperature	Temperature	Ensemble	Discrete	
483.	Avg. Temperature	Temperature	Ensemble	Cumulative	Avg. Temperature (WinRiver II uses an average temperature in the discharge summary)
484.	River Depth	Depth	Ensemble	Discrete	Depth used for discharge calculations,

Table **8**. WinRiver II ASCII Output Variable List

#	Name	Units Type	Bin Ensemble Transect	Discrete Incremental Cumulative	Comments
485.	Top Q Depth	Depth	Ensemble	Discrete	Depth where Top Q ends
486.	Bottom Q Depth	Depth	Ensemble	Discrete	Depth where Bottom Q starts
487.	Avg Shallowest Bottom Q Depth	Depth	Ensemble	Discrete	Range from ADCP to Bottom Q Depth
488.	Shallowest Beam Depth	Depth	Ensemble	Discrete	
489.	Absorption	None	Ensemble	Discrete	
490.	Intensity scale	None	Ensemble	Discrete	
External Sensor Data					
491.	GGA Latitude	Coordinate	Ensemble	Discrete	
492.	GGA N/S Indicator	None	Ensemble	Discrete	
493.	GGA Longitude	Coordinate	Ensemble	Discrete	
494.	GGA E/W Indicator	None	Ensemble	Discrete	
495.	GGA Quality	None	Ensemble	Discrete	
496.	GGA Nmb Satellites	None	Ensemble	Discrete	
497.	GGA HDOP	None	Ensemble	Discrete	
498.	GGA Altitude	distance	Ensemble	Discrete	
499.	GGA Geoid	None	Ensemble	Discrete	
500.	GGA DGPS Age	Time	Ensemble	Discrete	
501.	GGA Ref Station	None	Ensemble	Discrete	
502.	GPS Delta Time	Time	Ensemble	Incremental	
503.	GPS Status	None	Ensemble	Discrete	
504.	GPS Nmb Invalid DGPS	None	Ensemble	Cumulative	
505.	GPS Nmb of Sats	None	Ensemble	Discrete	
506.	GPS Nmb of Sats Changes	None	Ensemble	Cumulative	
507.	GPS Delta Altitude	distance	Ensemble	Cumulative	Difference between maximum and minimum altitude
508.	GPS Delta HDOP	None	Ensemble	Cumulative	Difference between maximum and minimum HDOP
509.	GPS Altitude Warning	None	Ensemble	Discrete	
510.	GPS HDOP Warning	None	Ensemble	Discrete	
511.	GPS Lost Data Warning	None	Ensemble	Discrete	
512.	GPS Min Nmb of Sats	INT	1	None	
513.	GPS Max Nmb of Sats	INT	1	None	
514.	GPS Min HDOP	DOUBLE	1	None	
515.	GPS Max HDOP	DOUBLE	1	None	
516.	GeoReference Latitude	Coordinate	Ensemble	Discrete	
517.	GeoReference N/S Indicator	None	Ensemble	Discrete	
518.	GeoReference Longitude	Coordinate	Ensemble	Discrete	
519.	GeoReference E/W Indicator	None	Ensemble	Discrete	
520.	GeoReference Quality	None	Ensemble	Discrete	
521.	GeoReference Nmb Satellites	None	Ensemble	Discrete	
522.	GeoReference HDOP	None	Ensemble	Discrete	
523.	GeoReference Altitude	distance	Ensemble	Discrete	
524.	GeoReference Geoid	None	Ensemble	Discrete	
525.	GeoReference DGPS Age	Time	Ensemble	Discrete	
526.	GeoReference Status	None	Ensemble	Discrete	
527.	GeoReference Lost Data Warning	None	Ensemble	Discrete	
528.	GGA2 Latitude	Coordinate	Ensemble	Discrete	
529.	GGA2 N/S Indicator	None	Ensemble	Discrete	
530.	GGA2 Longitude	Coordinate	Ensemble	Discrete	
531.	GGA2 E/W Indicator	None	Ensemble	Discrete	
532.	GGA2 Quality	None	Ensemble	Discrete	
533.	GGA2 Nmb Satellites	None	Ensemble	Discrete	
534.	GGA2 HDOP	None	Ensemble	Discrete	
535.	GGA2 Altitude	distance	Ensemble	Discrete	
536.	GGA2 DGPS Age	Time	Ensemble	Discrete	
537.	GGA2 Ref Station	None	Ensemble	Discrete	
538.	GPS2 Delta Time	Time	Ensemble	Incremental	
539.	GPS2 Status	None	Ensemble	Discrete	
540.	GPS2 Nmb Invalid DGPS	None	Ensemble	Cumulative	
541.	GPS2 Nmb of Sats	None	Ensemble	Discrete	
542.	GPS2 Nmb of Sats Changes	None	Ensemble	Cumulative	
543.	GPS2 Delta Altitude	distance	Ensemble	Cumulative	Difference between maximum and minimum altitude
544.	GPS2 Delta HDOP	None	Ensemble	Cumulative	Difference between maximum and minimum HDOP
545.	GPS2 Altitude Warning	None	Ensemble	Discrete	
546.	GPS2 HDOP Warning	None	Ensemble	Discrete	

Table **8**. WinRiver II ASCII Output Variable List

#	Name	Units Type	Bin Ensemble Transect	Discrete Incremental Cumulative	Comments
547.	GPS2 Lost Data Warning	None	Ensemble	Discrete	
548.	DS Status	None	Ensemble	Discrete	
549.	DS River Depth	Depth	Ensemble	Discrete	
550.	DS Lost Data Warning	None	Ensemble	Discrete	
551.	VB River Depth	Depth	Ensemble	Discrete	
552.	River Depth Source	None	Ensemble	Discrete	0=Bottom Track, 1=Depth Sounder, 2=Vertical Beam
553.	VTG Status	None	Ensemble	Discrete	
554.	VTG2 Status	None	Ensemble	Discrete	
555.	EH Status	None	Ensemble	Discrete	
556.	EH Heading	Angle	Ensemble	Discrete	
557.	EH Lost Data Warning	None	Ensemble	Discrete	
Miscellaneous and Duplicate data for internal use by WinRiver II					
558.	Water Velocity (Ref: BT)	Velocity	Ensemble	Discrete	Duplicate of 191, Water Speed (Ref: BT)
559.	Boat Velocity (Ref: BT)	Velocity	Ensemble	Discrete	Duplicate of 197, Boat Speed (Ref: BT)
560.	Water Velocity (Ref: GGA)	Velocity	Ensemble	Discrete	Duplicate of 243, Water Speed (Ref: GGA)
561.	Boat Velocity (Ref: GGA)	Velocity	Ensemble	Discrete	Duplicate of 249, Boat Speed (Ref: GGA)
562.	Water Velocity (Ref: VTG)	Velocity	Ensemble	Discrete	Duplicate of 291, Water Speed (Ref: VTG)
563.	Boat Velocity (Ref: VTG)	Velocity	Ensemble	Discrete	Duplicate of 297, Boat Speed (Ref: VTG)
564.	Water Velocity (Ref: GGA2)	Velocity	Ensemble	Discrete	Duplicate of 339, Water Speed (Ref: GGA2)
565.	Boat Velocity (Ref: GGA2)	Velocity	Ensemble	Discrete	Duplicate of 345, Boat Speed (Ref: GGA2)
566.	Water Velocity (Ref: VTG2)	Velocity	Ensemble	Discrete	Duplicate of 387, Water Speed (Ref: VTG2)
567.	Boat Velocity (Ref: VTG2)	Velocity	Ensemble	Discrete	Duplicate of 393, Boat Speed (Ref: VTG2)
568.	Section Number	None			Not used
569.	Section Start Ensemble Index	None			Not used
570.	Number of Surface Bins	None	Ensemble	Discrete	
571.	Surface Bin Size	Distance	Ensemble	Discrete	
572.	Distance	Distance	Bin	Discrete	Distance from start to end of each bin
573.	Accumulated North Near Bed Velocity	Velocity	Ensemble	Cumulative	
574.	Accumulated East Near Bed Velocity	Velocity	Ensemble	Cumulative	
575.	Accumulated Normalized Discharge Ratio	Discharge	Ensemble	Cumulative	
576.	Moving Bed Good Ensemble Count	None	Ensemble	Cumulative	
577.	Accumulated Q Weighted North Velocity	Velocity	Ensemble	Cumulative	
578.	Accumulated Q Weighted East Velocity	Velocity	Ensemble	Cumulative	
579.	Accumulated Q Absolute	Discharge	Ensemble	Cumulative	
580.	Number Good Discharge Bins	None	Ensemble	Cumulative	
581.	Accumulated Discharge	Discharge	Ensemble	Cumulative	
582.	Accumulated Up Stream Distance	Distance	Ensemble	Cumulative	
583.	Accumulated Cross Stream Distance	Distance	Ensemble	Cumulative	
584.	Accumulated Up Stream Velocity	Velocity	Ensemble	Cumulative	
585.	Nmb. Bad BT Velocities	None	Ensemble	Cumulative	
586.	North Near Bed Up Stream Velocity	Velocity	Ensemble	Discrete	
587.	East Near Bed Up Stream Velocity	Velocity	Ensemble	Discrete	
588.	Largest Time Gap (Ref: None)	Time	Ensemble	Cumulative	
589.	Largest Time Gap (Ref: BT)	Time	Ensemble	Cumulative	
590.	Largest Time Gap (Ref: GGA)	Time	Ensemble	Cumulative	
591.	Largest Time Gap (Ref: VTG)	Time	Ensemble	Cumulative	
592.	Largest Time Gap (Ref: GGA2)	Time	Ensemble	Cumulative	
593.	Largest Time Gap (Ref: VTG2)	Time	Ensemble	Cumulative	
594.	STD Pitch	Angle	Ensemble	Cumulative	
595.	STD Roll	Angle	Ensemble	Cumulative	
596.	Mean Abs Pitch	Angle	Ensemble	Cumulative	
597.	Mean Abs Roll	Angle	Ensemble	Cumulative	
598.	Possible Good Bins Above Sidelobe	None	Ensemble	Discrete	
599.	Number of Vertical Beam Bins	None	Ensemble	Discrete	
600.	Vertical Beam Bin Depths	Distance	Bin	Discrete	
601.	Vertical Beam Velocity	Velocity	Bin	Discrete	
602.	Vertical Beam Correlation	Counts	Bin	Discrete	
603.	Vertical Beam Amplitude	Counts	Bin	Discrete	
604.	Vertical Beam Percent Good	Counts	Bin	Discrete	
605.	Voltage	None	Ensemble	Discrete	
606.	ADCP Heading	Angle	Ensemble	Discrete	

Table 8. WinRiver II ASCII Output Variable List

#	Name	Units Type	Bin Ensemble Transect	Discrete Incremental Cumulative	Comments
607.	Count of Ensembles with Bad Bottom Track	INT	Transect	Cumulative	
608.	Count of Ensembles with Bad GGA	INT	Transect	Cumulative	
609.	Count of Ensembles with Bad VTG	INT	Transect	Cumulative	
610.	Beam Separation	DOUBLE	Ensemble	Discrete	

Printing a Graph or Display

To print:

1. Start *WinRiver II* and open a measurement file.
2. Click on the graph/display to be printed. The title bar will be highlighted.
3. On the **File** menu, click **Print Setup**. Select the desired setting and printer.

Choose **Landscape** for contour graphs.

4. On the **File** menu click **Print Preview**. If the display is acceptable, click **Print**.

Capturing a Graph or Display

To save a graph/display for use in other documents:

1. Click on the graph/display to be saved. The title bar will be highlighted.
2. On the **Configure** menu, select **Screen Capture**. This will bring up a following dialog box.

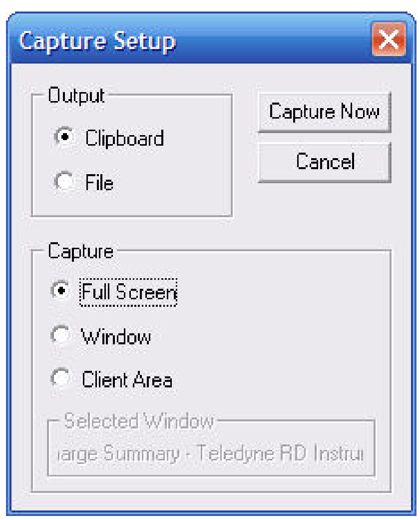


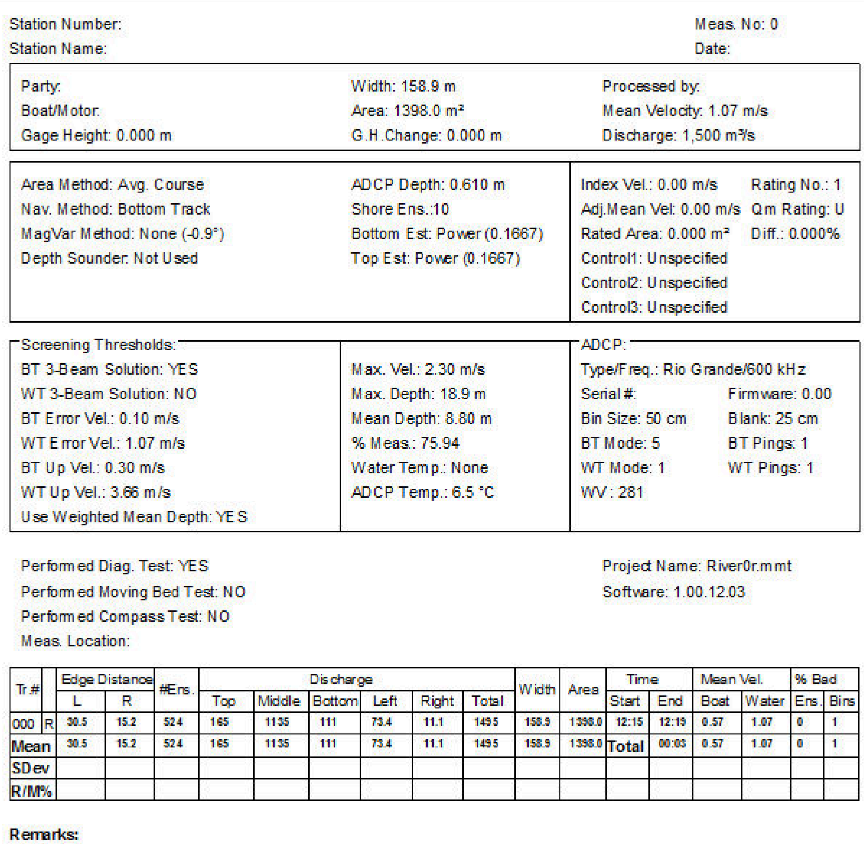
Figure 65. Capture Setup

3. Select **Clipboard** or **File**.
4. Select **Full Screen**, **Window**, or **Client Area**. The **Client Area** will include all parts of the graph/plot except the title bars.
5. Click **Capture Now**. If you selected **File**, name the file and click **Save**.

Using the Q Measurement Summary

The Q Measurement Summary creates a summary of the measurement that can be printed.

1. Start *WinRiver II* and open a measurement file.
2. On the **Measurement Control** window, select the transects to be included in the summary. Checking the **Transect XXX** box (where XXX is the transect number) will add the transect; unchecking the box will remove the transect from the summary.
3. On the **Playback** menu, select **Reprocess Checked Transects**.
4. On the **File** menu, click **Print Preview Q Measurement Summary**.
5. On the **Q Measurements** screen, click **Print** to print a copy of the discharge summary.


Station Number: Meas. No: 0
Station Name: Date:

Party: Width: 158.9 m Processed by:
Boat/Motor: Area: 1398.0 m² Mean Velocity: 1.07 m/s
Gage Height: 0.000 m G.H.Change: 0.000 m Discharge: 1,500 m³/s

Area Method: Avg. Course ADCP Depth: 0.610 m Index Vel.: 0.00 m/s Rating No.: 1
Nav. Method: Bottom Track Shore Ens.:10 Adj.Mean Vel: 0.00 m/s Qm Rating: U
MagVar Method: None (-0.9°) Bottom Est: Power (0.1667) Rated Area: 0.000 m² Diff.: 0.000%
Depth Sounder: Not Used Top Est: Power (0.1667) Control1: Unspecified
Control2: Unspecified
Control3: Unspecified

Screening Thresholds:
BT 3-Beam Solution: YES
WT 3-Beam Solution: NO
BT Error Vel.: 0.10 m/s
WT Error Vel.: 1.07 m/s
BT Up Vel.: 0.30 m/s
WT Up Vel.: 3.66 m/s
Use Weighted Mean Depth: YES

Max. Vel.: 2.30 m/s
Max. Depth: 18.9 m
Mean Depth: 8.80 m
% Meas.: 75.94
Water Temp.: None
ADCP Temp.: 6.5 °C

ADCP:
Type/Freq.: Rio Grande/600 kHz
Serial #: Firmware: 0.00
Bin Size: 50 cm Blank: 25 cm
BT Mode: 5 BT Pings: 1
WT Mode: 1 WT Pings: 1
WV: 281

Performed Diag. Test: YES
Performed Moving Bed Test: NO
Performed Compass Test: NO
Meas. Location:

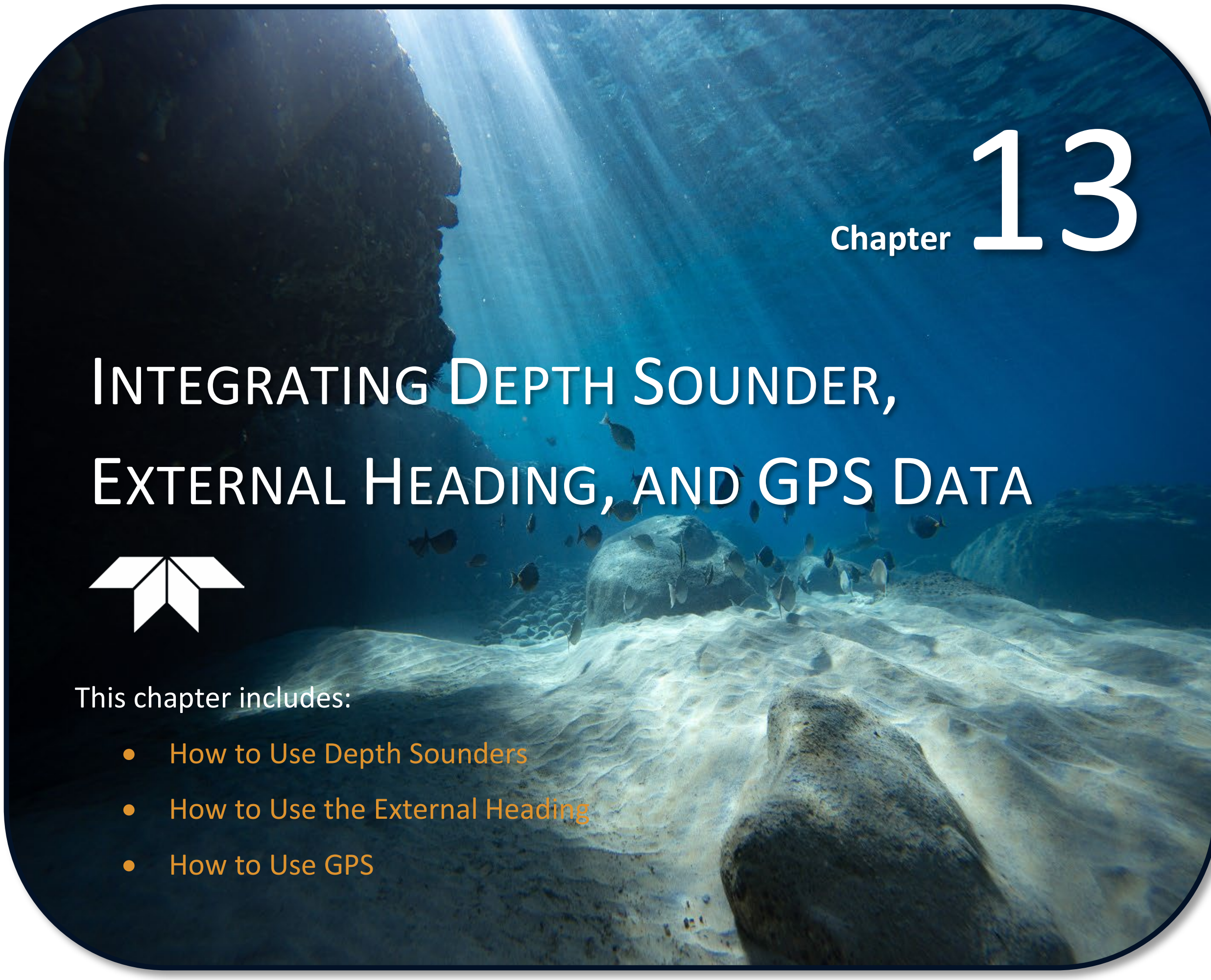
Project Name: River0r.mmt
Software: 1.00.12.03

Tr.#		Edge Distance		#Ens.	Discharge						Width	Area	Time		Mean Vel.		% Bad	
		L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens.	Bins
000	R	30.5	15.2	524	165	1135	111	73.4	11.1	1495	158.9	1398.0	12:15	12:19	0.57	1.07	0	1
Mean		30.5	15.2	524	165	1135	111	73.4	11.1	1495	158.9	1398.0	Total	00:03	0.57	1.07	0	1
SDev																		
R/M%																		

Remarks:

Figure 66. Q Measurement Summary

See Using the Discharge Summary and Dynamic Residual Analysis. The ADCP operator must make sure that the maximum permissible relative residual (MPRR) is met before leaving the site.



Chapter 13

INTEGRATING DEPTH SOUNDER, EXTERNAL HEADING, AND GPS DATA

This chapter includes:

Requirements

WinRiver II can integrate GPS data, External Heading, and depth sounder data into real-time discharge calculations. These devices are used when environmental conditions make it difficult to get unbiased boat velocity and/or depth using bottom tracking. This section addresses the Depth Sounder, External Heading, and GPS requirements for integration.

Depth Sounder Requirements

- The depth sounder must be capable of outputting the DBT data string via the NMEA0183 format.
- A third serial port is required on your computer to accept the depth sounder data if you are also acquiring GPS in addition to ADCP data.
- You can switch between using data from the depth sounder and the ADCP depth data during post processing as needed.

External Heading Requirements

- The external heading must be capable of outputting the HDT data string via the NMEA0183 format.
- Two serial ports are required on your computer to accept the external heading data in addition to the ADCP data.

GPS Requirements

- The GPS must be a mapping or survey grade, differentially corrected GPS system (submeter accuracy or better strongly recommended). The GPS should apply minimal or no filtering to the position and velocity vector data to avoid latency issues.
- The GPS must be capable of outputting GGA and/or VTG data strings via the NMEA0183 format. The GGA string contains GPS positions; the VTG string contains heading/velocity information.
- Two serial ports are required on your computer to accept both ADCP and GPS data.
- You can switch between using Bottom Track, GGA, and VTG for the boat speed reference as needed during data collection and post-processing.

> GGA is not required if VTG is used.

How to Use Depth Sounders

The depth sounder is an external sensor that can be used to track the depth of the water. Areas with weeds or high sediment concentrations may cause the ADCP to lose the bottom. *WinRiver II* will display the corrected depth (depth of water from the surface) in the **Navigation** tabular screen (See Figure 68).

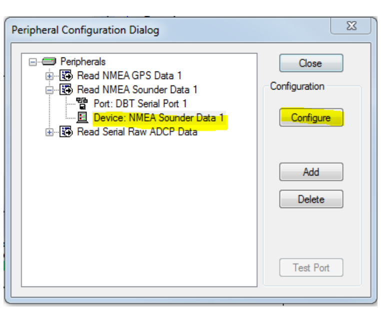
In conditions where a depth sounder is required to measure water depth, a GPS is also required to measure the boat speed.

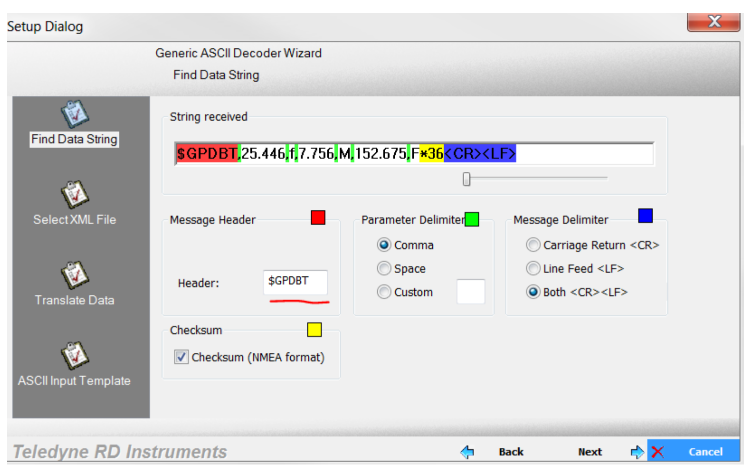
System Interconnections with the Depth Sounder

To connect the depth sounder:

1. Connect the depth sounder system to your computer using a serial interface (see your depth sounder manual for details). You must have a depth sounder capable of serial NMEA 0183 output with $__DBT format in feet.
2. Connect the ADCP system and the GPS to your computer as described in System Interconnection with GPS. Apply power to the system (see the ADCP Technical Manual for details).
3. **Three** serial ports are required on your computer to accept the depth sounder and GPS in addition to ADCP data. For laptops, two PCMCIA serial cards or USB-serial converters may be used to provide the second and third ports.
4. Configure the depth sounder to output the DBT data string via the NMEA0183 format. Select the **Configure** menu, **Peripherals**. Click the **Add** button. Choose **Depth Sounder** and select the COM port that the depth sounder is connected to.

5. Select **Device: NMEA Sounder Data 1** and then click the **Configure** button. Select the **Header** that matches your device. Click **Next** and enter the XML and Translate Data as needed. Click **Finish** when done.





Enabling the Depth Sounder Port

In order to use the depth sounder data, the depth sounder must be enabled.

To enable depth sounder communications with *WinRiver II*:

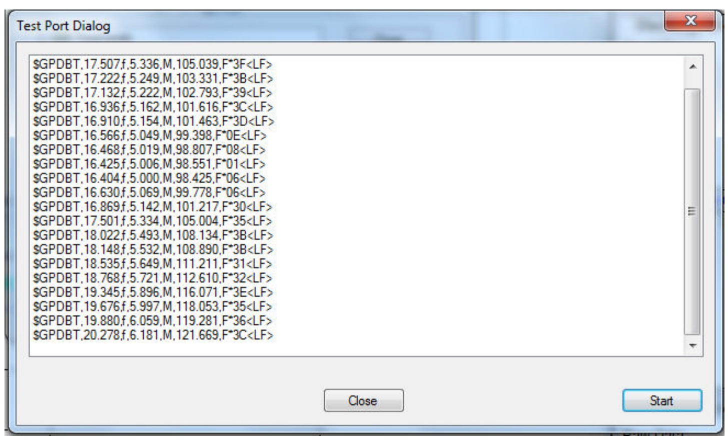
1. Stop pinging.

> You are not allowed to change communications parameters while pinging.

2. Select the **Configure** menu, **Peripherals**. Click the **Add** button.
3. Choose **Depth Sounder**, and then click **Next**. Choose the COM port that the depth sounder is connected to.

> Three serial ports are required on your computer to accept ADCP, GPS data, and depth sounder data.

4. Enter the Depth Sounder communication Baud Rate, Parity, and Stop Bit settings.
5. Click **Next**. Verify the port and communication settings. Click **Next**.
6. Click **Test Port** and observe the messages coming from the port assigned for the depth sounder. If the communication parameters are set properly you should see "$__DBT" strings on the display. Click the **Close** button.
7. Click **OK**.



Using Depth Sounder Data

Once the Depth Sounder communications port is set up the data is recorded.

To use and view the Depth Sounder data rather than the ADCP beam depths as the River Depth:

1. Stop pinging.
2. Run the Measurement Wizard. Select the Depth Sounder device on the Configuration Dialog page. Finish stepping through the Measurement Wizard.
3. Right-click on the Data Collection/Next Transect/Field Configuration node in the **Measurement Control** window, and then select **Properties**.
4. On the Processing Page, select either **Depth Sounder** or **Composite** in the **River Depth Source** box (Figure 41). The Depth Sounder data will be used to compute River Depth, area, and discharge.

5. Under the Recording Page you can select to collect depth sounder data to an ASCII file.

> The Depth Sounder data is ALWAYS recorded to the raw ADCP data file. The ASCII files are only recorded if requested and are not used by *WinRiver II*.

6. On the Depth Sounder / External Heading Page, enter the depth from the surface of the water to the depth sounder's transducer face in the **Transducer Depth** box (Figure 36).
7. In addition to the **Transducer Depth** command, you can also add an additional offset to reconcile any differences between the ADCP bottom track depths and those reported by the DBT NMEA string. Enter a value in the **Offset** box.
8. You can apply a scaling factor to the raw NMEA depth sounder output by entering a number in the **Scale Factor** box. Note that the depths reported by the DBT NMEA string do not include the depth of the sounder, so the scaling is applied only to the range reported from the depth sounder to the bottom.
9. Many depth sounders only allow a fixed value of 1500 m/s for sound speed. *WinRiver II* can scale the depth sounder depths by the sound speed used by *WinRiver II* by selecting the **Correct Speed of Sound** box.

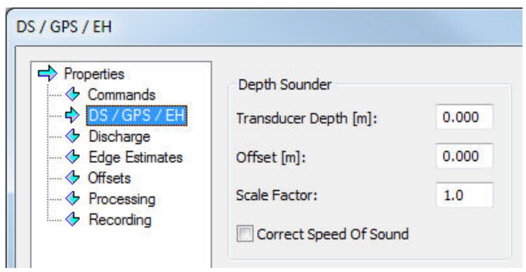


Figure 67. Depth Sounder Offsets

> The decoded data will be displayed in the **Composite Tabular 1** view if the **River Depth Source** on the Processing page is set to **Depth Sounder**, or is set to **Composite** and Depth Sounder is the preferred source.

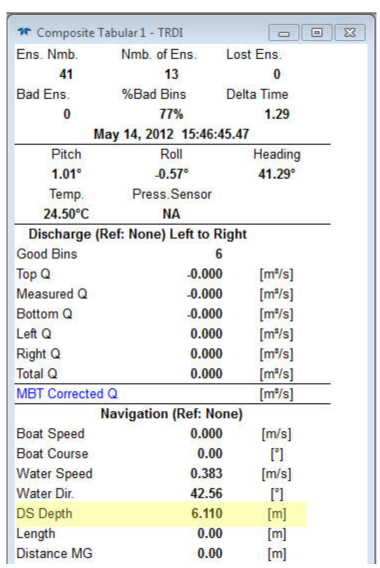


Figure 68. Viewing Depth Sounder Data

How to Use the External Heading

The external heading sensor is an external sensor that can be used to track the heading of the ADCP. Boats with steel hulls may cause the ADCP's compass to be biased and this bias cannot always be corrected during compass calibration. *WinRiver* will display the corrected heading in the **Composite Tabular 1** screen (See Using External Heading Data).

Steel hulls may cause the ADCP's compass to be biased -aluminum hulls do not affect the compass.

System Interconnections with External Heading

To connect the external heading:

1. Connect the external heading system to your computer using a serial interface (see your external heading manual for details). You must have an external heading device capable of serial NMEA 0813 output with HDT format.
2. Configure the external heading to output the data string via the NMEA0183 format similar to the System Interconnections with the Depth Sounder procedure.
3. Connect the ADCP system to your computer as described in the ADCP User's Guide. Apply power to the system.
4. **Two** serial ports are required on your computer to accept the external heading in addition to ADCP data.

Enabling the External Heading Port

In order to use the external heading data, the external heading must be enabled.

To enable external heading communications with *WinRiver II*:

1. Select the **Configure** menu, **Peripherals**. Click the **Add** button.
2. Choose **Heading**, **NMEA HDT** and then click **OK**.
3. Click **Next**. Enter the external heading communication Baud Rate, Parity, and Stop Bit settings.

Two serial ports are required on your computer to accept ADCP data and the external heading data.

4. Click **Next**. Verify the port and communication settings. Click **Next**.
5. Click **Test Port** and observe the messages. For example, you should see the following message:

```
$INHDT,245.8,T*2E
```

6. Click **OK**.

Using External Heading Data

Once the external heading communications port is set up, the data is recorded. To use and view the external heading data, do the following.

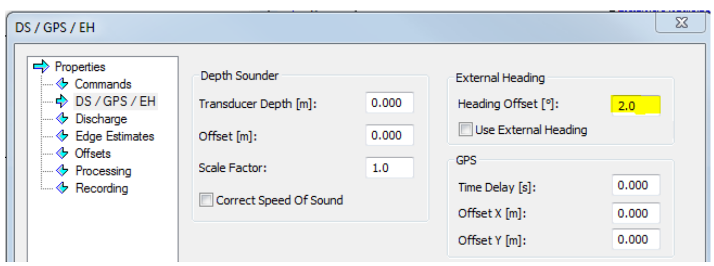
1. Using the Measurement Wizard, select the External Heading device to enable recording and use of external heading data. If desired, you can turn off collection of external heading data to an ASCII

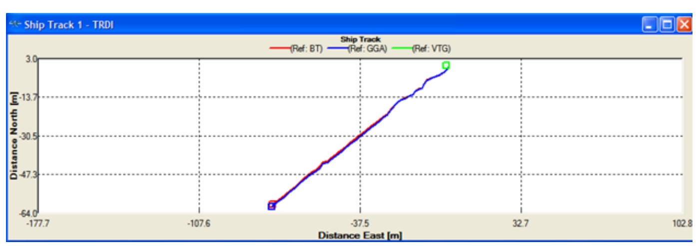
file (_EH.TXT) through the **Recording** page (see Recording Page) of the Data Collection/Next Transect/Field Configuration node.

> The External Heading data is ALWAYS recorded to the raw ADCP data file. The ASCII files (*_EH.TXT) are only recorded if requested and are not used by *WinRiver II*.

2. Check the **Use External Heading** box on the GPS/EH/DS page.
3. ADCP heading data from an internal compass module is normally indexed to beam 3 of the ADCP. External Heading sensors often are installed indexed to the boat or ship centerline, or with some other selected heading reference orientation. You must add a heading offset value to reconcile any differences between the heading reference used by the external heading sensor and Beam 3 of the ADCP. The heading offset, magnetic variation, and beam 3 misalignment interact; entries for these three values must be properly coordinated. Enter a value in the **Heading Offset** box (see GPS/EH/DS page), and values for **Magnetic Variation** and **Beam 3 Misalignment** (see Offsets Page) as needed. Implementation of these parameters has changed with version 2.18; measurements initially processed with a prior version may require adjustment.

External Heading data is assumed relative to true north and Magnetic Variation is no longer applied to the External heading data; if the external heading data is relative to some other orientation that must be factored into the heading offset value in order to obtain correct GPS referenced data and correct velocity directions when referencing to bottom track. You can use the ship track plot to assess the heading offset value for transects with no moving bed. For example, if you are using an external compass, adjust the **Heading Offset** iteratively until both tracks line up with each other.





> The decoded data will be displayed in the **Composite Tabular 1** screen.

Ens. Nmb.	Nmb. of Ens.	Lost Ens.
56	16	0
Bad Ens.	%Bad Bins	Delta Time
5	0%	0.50
October 21, 2008 14:35:01.36		
Pitch	Roll	Ext.Heading
-14.42°	-2.05°	220.00°
Temp.	Press.Sensor	
25.43°C	NA	

Figure 69. Viewing External Heading Data

How to Use GPS

In high flow (flood) or high sediment concentration conditions, the ADCP may make biased bottom track velocity measurements. The bias is caused by two different environmental sources:

- Fluid layer of sediment flowing along the bed of the stream (Moving Bottom)
- High sediment concentration in the water column near the bottom (Water Bias)

The consequences of these environmental sources and the biased ADCP bottom track are:

- Discharge computed with the ADCP is biased low
- The vessel track (shiptrack) is biased upstream

> The ADCP is not malfunctioning – but measuring the environment as designed.

The RiverRay ADCP supports direct integration of GPS data into the ADCP data stream for many common GPS systems. This entails modified wiring and *WinRiver II* configuration. See Tutorial – How to Use the RiverRay Internal GPS for an overview.

Using GPS versus Bottom Track

When the ADCP cannot make unbiased bottom track measurements, an external GPS system should be used as the boat speed reference. *WinRiver II* can integrate the GPS data, replacing the bottom track velocity to compute real-time discharge. If the ADCP can detect the bottom to obtain depth, then there is no need to use a depth sounder.

In some cases, the suspended sediment concentrations are very high, and the ADCP cannot make a valid detection of the bottom depth. In this case, a depth sounder can be used to provide the depth for the real-time discharge calculation. In conditions where a depth sounder is required to measure water depth, a GPS is also required to measure the boat speed as the ADCP cannot measure bottom track velocity without first measuring depth.

To use GPS as a boat speed reference, three conditions must be met:

1. The GPS must be a mapping or survey grade, differentially corrected GPS system (submeter accuracy or better strongly recommended). The GPS should apply minimal or no filtering to the position and velocity vector data to avoid latency issues.
2. The heading source used to rotate ADCP water velocity data to earth coordinates must be accurate and unbiased. The internal ADCP compass must be corrected for magnetic effects caused by any ferromagnetic objects, e.g. steel tools or motor, on the boat or in the nearby environment (see Compass Corrections).
3. The internal ADCP compass data must also be adjusted from magnetic to true north using the **Magnetic Variation** parameter. External heading data must be adjusted so that it is referenced to ADCP Beam 3, relative to true north. See Offsets Page, GPS/EH/DS page, and Use External Heading.

> Bottom-track must be enabled in order to use the GPS data even though it is not used as the boat speed reference.

> If you can obtain valid bottom track data, and you use bottom track as your boat speed reference, there is no need to perform the compass correction procedures to obtain valid discharge data. Both the water and boat velocities are in the same coordinate system, and no rotation from one coordinate system to another is required.
>
> However, compass corrections ARE required to obtain accurate Ship Track and Flow direction data.

System Interconnections with GPS

To connect the GPS system:

1. Connect the GPS system to your computer using a serial (RS- 232 or RS- 422) interface (see the GPS Manual for details).
2. Mount the GPS antenna horizontally as close to the center of the ADCP transducer as possible and vertically the minimum distance above the ADCP as practical to reduce parallax errors between the GPS antenna movement and the transducer movement. Apply power to the GPS.
3. Configure the GPS to output GGA and VTG (optional) data strings via the NMEA0183 format similar to System Interconnections with the Depth Sounder. The GGA string contains GPS positions. The VTG string provides velocity information calculated by the GPS. Checksums are required. See NMEA Inputs for details.
4. Connect the ADCP system to your computer using a serial (Bluetooth, RS- 232 or RS- 422) interface. Apply power to the system (see the ADCP Technical Manual for details).
5. Two serial ports are required on your computer to accept both ADCP and GPS data.

GNSS vs GPS: GNSS stands for Global Navigation Satellite System. It is the technical terminology used to encompass all satellite based navigation systems including the US GPS system, the Russian GLONASS system, China's BeiDou system, and others. GPS (Global Positioning System) technically includes only the US system of satellites, but that distinction is generally overlooked in common usage and is more widely known and understood, thus is used exclusively in this manual.

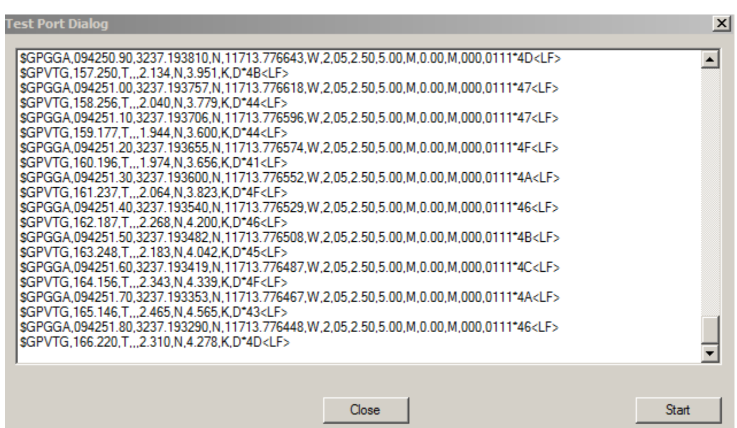
Enabling the GPS Port

To enable GPS communications with *WinRiver II*:

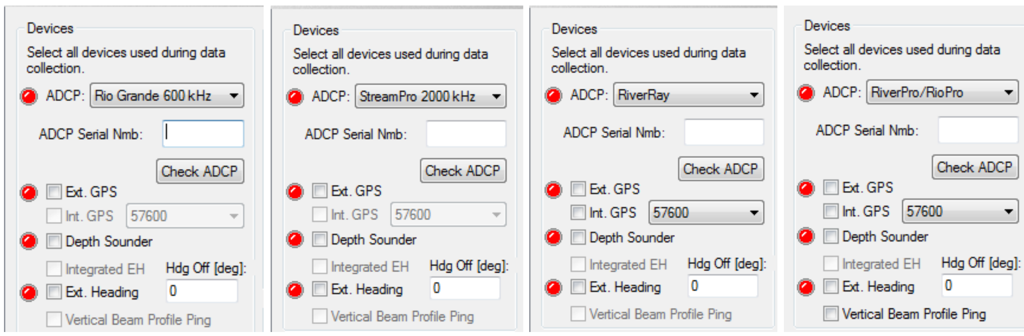
1. Select the **Configure** menu, **Peripherals**. Click the **Add** button.
2. Choose **GPS**, and then click **Next**. Choose the COM port that the GPS is connected to.

Two serial ports are required on your computer to accept both ADCP and GPS data.

3. Click **Next**. Enter the GPS communication Baud Rate, Parity, and Stop Bit settings.
4. Click **Next**. Verify the port and communication settings. Click **Next**.
5. Click **Test Port** and observe the messages.



6. Click **Finish**. The GPS data will be recorded to the raw data file.
7. If you are configuring a Rio Grande or StreamPro system with GPS, than check the **Ext. GPS** box.
8. If you are configuring a RiverRay or RiverPro/RioPro system with integrated GPS, than check the **Int. GPS** baud rate. Available baud rates are 4800, 9600, 19200, 38400, 57600, 115200 and Auto (RiverPro/RioPro only).

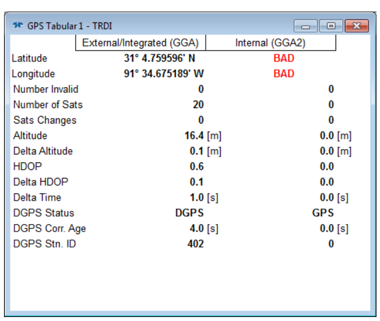


Optional Settings

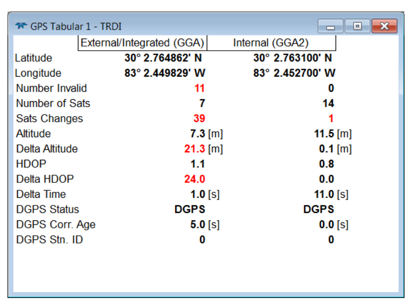
- GPS Latitude and Longitude data can be saved to a separate ASCII file by choosing **Record GPS Data** on the Recording Page.
- For best results, make sure the ADCP is using ship coordinates (EX**10***nnn* command (default value), where the *nnn* values are set to 0 or 1 as desired) in the Commands Page.

Using GPS Data

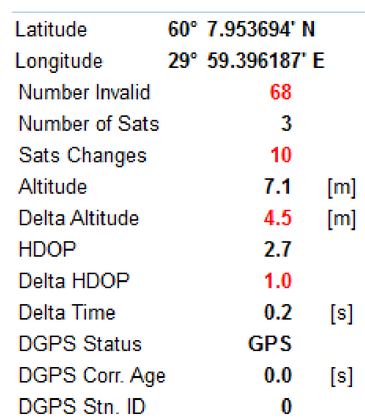
To use GPS data as the boat speed reference in *WinRiver II*, select the **Configure** menu, **Reference**, and select the desired boat speed reference from the list, or use the corresponding keyboard shortcuts. Start pinging. The **GPS Tabular 1** (see Chapter 6 – Available Displays) screen will show the GPS data.



Good GPS Data



Good GPS GeoReference Data

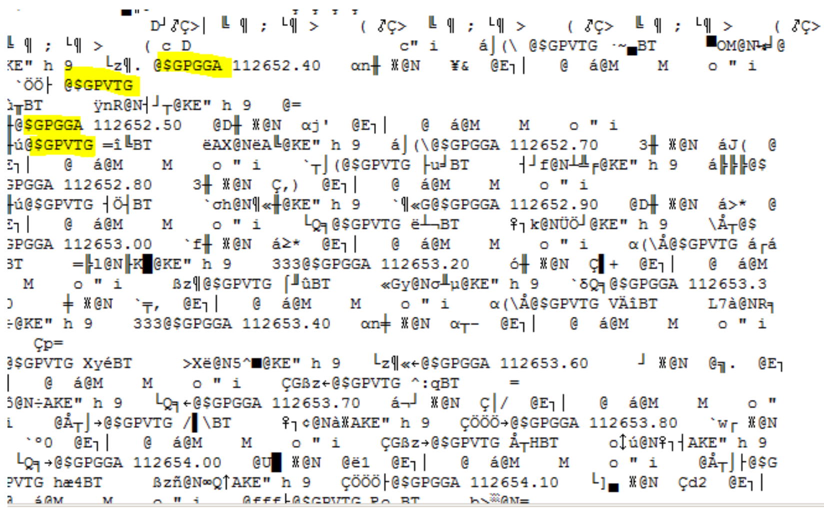


GPS Data with Errors

Troubleshooting GPS

There are two basic categories of fault cases – the first is *WinRiver II* is not seeing the GPS data. Check the following items:

- Check the GPS wiring connections.
- Check the GPS programming – baud rate, port, and NMEA messages. Use the **Test Port** button on the **Configure** menu, **Peripherals** dialog.
- For GPS integrated into the RiverRay, follow the Verifying the ADCP is Receiving GPS Data to verify the SF command and baud rate are set correctly. Check the *WinRiver II* measurement wizard settings, Internal GPS baud rate. A quick way to verify the GPS messages are present is to use *BBTalk* to send a CR1 command followed by the CS command. Look for the highlighted items as shown. The binary data will look as follows:

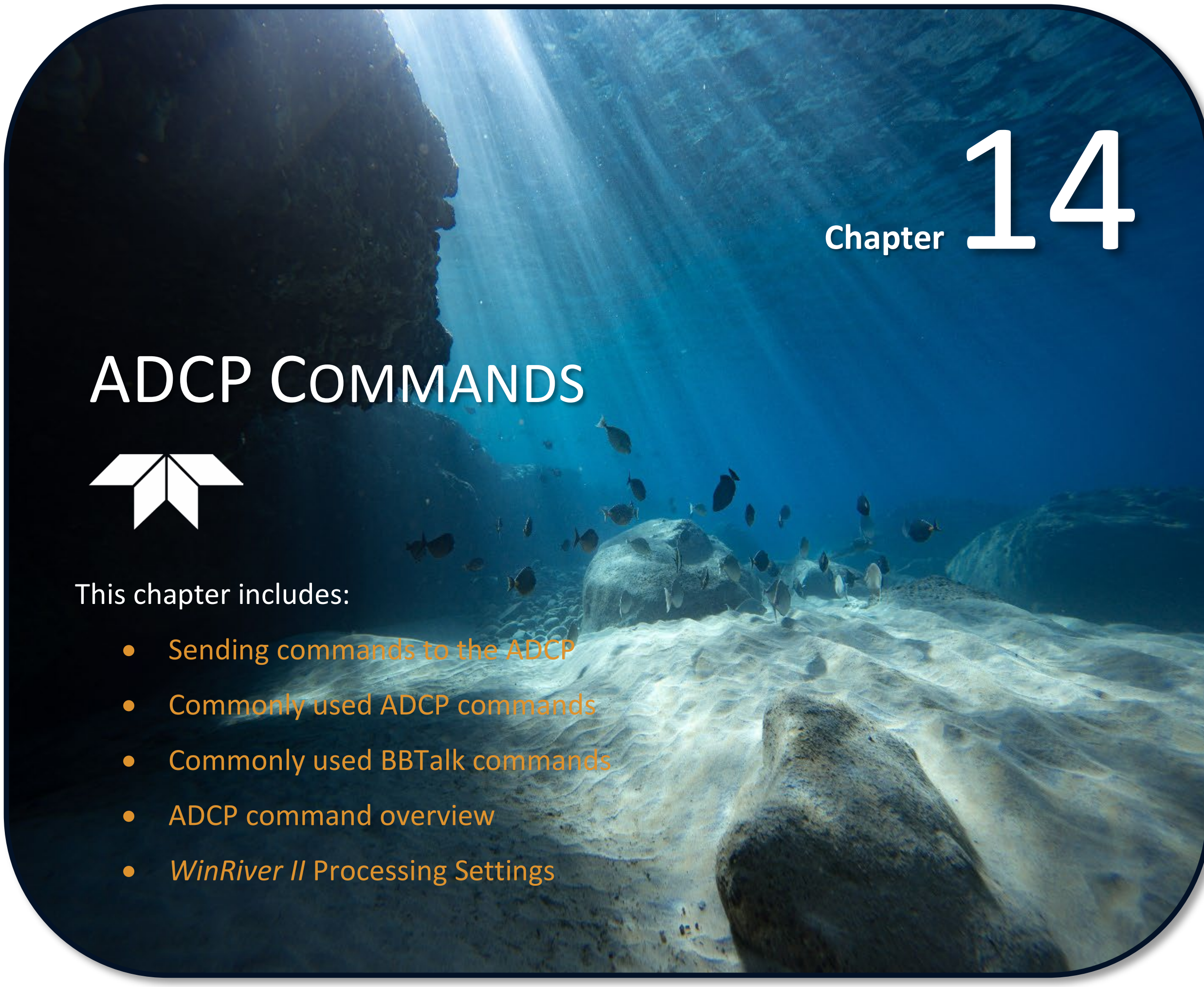


- For GPS connected direct into the computer – check the *WinRiver II* port and baud rate settings. If needed check customization of NMEA decoder templates.

The second category of fault cases is invalid data coming from the GPS. Check the following items:

- Check for terrain features which would obstruct the GPS antenna's view of the satellites and relocate as necessary. If terrain features are blocking the sky and you cannot move to another location, there is nothing you can do.
- Check for issues in the GPS receiver – antenna coax wiring (if it is not an integrated antenna/receiver).
- Follow the GPS system manufacturer's instructions for troubleshooting issues with the GPs data quality.

NOTES



Chapter 14

ADCP Commands

This chapter includes:

- Sending commands to the ADCP
- Commonly used ADCP commands
- Commonly used BBTalk commands
- ADCP command overview
- *WinRiver II* Processing Settings

Sending Commands to the ADCP

When **Acquire**, **Start Pinging** (**F4**) is selected, commands are sent by *WinRiver II* to the ADCP to set its profiling parameters. The commands are added to the measurement file in the Commands Page.

To send a command to the ADCP:

1. Start *WinRiver II* and use the Measurement Wizard to generate the basic commands (see Using the Measurement Wizard).
2. Right-click on **Field Configuration** and select **Properties** (see Configuration Node Menu Options). Select the **Commands** page.
3. Enter the commands in the **User Commands** box.

> Only enter a **User** command if you are fully aware of the command consequence.

4. Change the **Filename Prefix** or **Output directory** on the **Recording** page (see Recording Page) to save the measurement file with a unique name.
5. Click **Acquire**, **Start Pinging**. The **Command Log** window will open automatically and show the commands sent to the ADCP and the response from the ADCP. After the commands have been successfully sent, this window closes.
6. To view this window again on the **Configure** menu, click **Command Log**. This will show the history of the dialog between *WinRiver II* and ADCP.

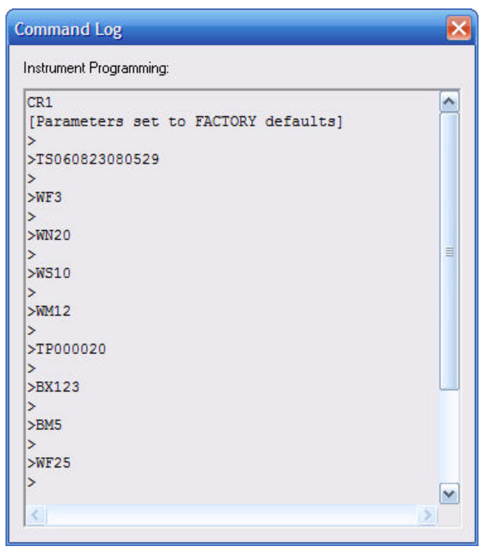


Figure 70. Command Log

Commonly Used ADCP Commands

The commands shown in Table 9 (these are only a small percentage of those available) can all be found with detailed descriptions in the WorkHorse Commands and Output Data Format guide, however below are some of the more commonly used commands.

Table 9: Commonly Used ADCP Commands

Command	Description
BX	Max depth in decimeters (meters x 10) that the ADCP will look for the bottom - set this greater than your deepest depth.
WS	Depth cell size (cm)
WN	Number of depth cells (WS x WN = BX x 10)
WF	Blanking distance (cm)
WV	Ambiguity velocity (160 to 200 is usually good) (approximately water velocity in cm/sec)
WM	Water mode 1, 5, 8, 11 or 12 (1200 Rio Grande / Zed Head)
WP	Water pings
BP	Bottom pings
CL	Sleep Between Pings (CL0 = Do Not Sleep, CL1 = Sleep Between Pings)

Commonly Used BBTalk Commands

Once *BBTalk* is running and connected to the ADCP, commands can be entered to interrogate the unit. The commands shown in Table 10 (these are only a small percentage of those available) can all be found with detailed descriptions in the WorkHorse Commands and Output Data Format guide.

Table 10: Commonly Used BBTalk Commands

Command	Description
CR1	Parameters set to FACTORY Settings
CK	Parameters saved as USER defaults
PS0	Basic Instrument Information including Serial Number, Frequency, Firmware, and Board Serial Numbers
PT200	Built in Self-Test
CB	Change baud rate
PC1	Beam Continuity Test - Rub beams when asked to do so. ADCP must be in air to run this test.
PC2	Position, direction, temperature etc. - Press any key to quit
PA	Pre-deployment Tests
?	List possible inputs. If added at the end of a command (i.e. CB?), it will list the command setting.
CS	Start Pinging. Once ADCP is pinging, send a Break to stop.
= = =	Send Break (Radio Modem)
End	Send Break (Direct Cable)

ADCP Command Overview

You can directly control the profiling parameters sent to the ADCP using the Commands Page. The **Fixed Commands** box lets you view the direct commands that will always be sent to the ADCP. The Measurement Wizard will enter the **Wizard Commands** based on information entered in the Measurement Wizard (see Using the Measurement Wizard).

The fixed commands are sent before any user commands. Sending a **User** Command will OVERRIDE the **Fixed** and **Wizard** Commands.

When data collection is first started, the commands in the **Fixed Commands** box are sent by *WinRiver II* to the ADCP to set its profiling parameters. The **Wizard Commands** are sent next and will ***override*** some of the **Fixed Commands**. Sending a **User Command** will ***override*** the **Fixed** and **Wizard Commands**.

In the following, we will describe many common commands and give guidelines for setting these commands for acquiring reliable discharge data. Refer to the appropriate ADCP Technical Manual for more detailed information about each command.

Water Mode (WM Command)

Several modes are available for water profiling in the Rio Grande and WorkHorse ADCPs with the High Resolution Water Profiling upgrade. They are Water Modes 1 (all ADCPs), 5, 8, 11, and 12. Each mode has its own envelope of operation (see Water Profiling Modes). StreamPro ADCPs support only Water Modes 12 and 13, and the user has no control over the Water Mode 12 configuration. RiverRay ADCPs normally use an auto-adaptive Water Mode which adjusts the profiling parameters on an ensemble by ensemble basis to maximize data quality at all points in the cross-section.

Bottom Mode (BM Command)

Bottom Mode 5 gives good performance in systems of all frequencies. It is the default Bottom Mode in *WinRiver II* and in the Rio Grande firmware (see Bottom Tracking Modes).

With the development of the ZedHed (1200 KHz low ringing transducer) and Water Profiling Mode 11 and Mode 12, it became possible to measure water profiles much closer to the transducer face and therefore shallower water. Bottom Mode 7 was developed to fully utilize the capability of the ZedHed and allows bottom tracking in water as shallow as 30 cm.

Maximum Bottom Depth (BX Command)

Set the maximum bottom tracking depth (BX-command) to twice the maximum expected depth. This will keep the ADCP from trying to search deeper than a realistic bottom depth.

The predicted maximum bottom tracking range is 98 m for the 600 kHz and 28 m for the 1200 kHz in water with 10°C temperature and 0.0 ppt salinity.

The default for RiverRay ADCPs is 80 meters (BX 800) but operation to greater depths is possible in many applications.

Depth Cell Size (WS Command)

This command sets the length of the water for one cell measurement. The cells size range is 0.10 to 8 m (WS10 to WS800) for the 600 kHz and 0.05 to 4 m (WS5 to WS400) for the 1200 kHz.

Number of Depth Cells (WN Command)

Set the number of water profiling depth cells (WN command) to cover the maximum expected water depth plus 2 additional cells. As a rule of thumb, WN = Maximum Expected Depth (in centimeters) / WS + 2

Blanking Distance (WF Command)

The blanking distance should be set to 25 cm (WF25) to maximize the ADCP performance and minimize the unmeasured layer thickness at the surface. If you see trouble in your data, try doubling the blanking distance.

Pings per Ensemble (WP and BP Commands)

Single ping ensembles are recommended for performing discharge measurements (WP1 and BP1). Averaging in either space or time can be done to the data by *WinRiver II* while collecting data or later during post-processing to reduce the standard deviation of the velocity measurements. The advantage of having the *WinRiver II* software do the averaging rather than the ADCP is that the raw data remains unchanged and you have the flexibility to vary the averaging interval to suit your application.

Ensemble-Out Data (WD Command)

This command selects the types of data collected by the ADCP. The default setting is WD111100000, which tells the ADCP to collect velocity, correlation magnitude, echo intensity, and percent-good status data.

If you want to maximize your ping rate, you can do so by reducing the amount of data that must be transferred serially for each ensemble. To do this, you can choose not to record percent-good status by selecting WD111000000.

Mode 1 Ambiguity Velocity (WV Command)

The Mode 1 ambiguity velocity represents the maximum relative velocity (ADCP motion plus the maximum actual water velocity) the ADCP can measure along a beam. This must be set correctly to avoid ambiguity errors. *WinRiver II* sets the value to 170 cm/s (WV170) which corresponds to a horizontal relative velocity of about 5 m/s, and an ambiguity velocity of 480 cm/s (WV480) corresponds to a maximum relative velocity of 15 m/s. Use the default ambiguity velocity for most applications. If you plan on using Mode 1 in flows faster than 5 m/s, use the following formula to set WV:

WV = Maximum Relative Water Velocity x sin (Beam Angle) x 1.5

Where Beam Angle = 20° for the Rio Grande ADCP and
1.5 = Safety factor

Mode 5 and 8 Ambiguity Velocity (WZ Command)

The ambiguity velocity for modes 5 and 8 is set using the WZ command. The default value is WZ05, and this value should be used for all moving boat applications.

Time Between Pings (TP Command)

The TP command sets the time between pings and ensures that you will not have ping-to-ping interference. This value should be set to 0.2 seconds (TP000020) for the 600 kHz system and 0.05 seconds (TP000005) for the 1200 kHz system. These values were determined by considering the travel time for the bottom track ping to travel to its maximum possible range.

Sensor Source (EZ Command)

The EZ-command selects the source of environmental sensor data. The Rio Grande default value is EZ1011101, which tells the ADCP to use internal heading, pitch, roll, and temperature sensors.

Coordinate System (EX Command)

There are four different coordinate systems that can be used for ensemble averaging: beam, instrument, ship, and earth. Refer to the EX-command in the WorkHorse Commands and Output Data Format Guide for a description of each of the coordinate systems. We recommend using ship's coordinates for your measurements. We recommend 4-beam solutions only because an error velocity will be calculated and presented for each ADCP ensemble. If you have consistent trouble with bottom tracking or are working in a location where one beam will be masked due to dam walls or pier pilings, modify the EX command to EX10111 to allow for 3-beam solutions.

WinRiver II transforms the raw data to earth's coordinates before displaying it. This transformation does not change the contents of the original raw data file.

Salinity (ES Command)

It is critical to set the salinity (ES command) to the proper value. All of the velocities and distances measured by the ADCP are proportional to the speed of sound. If ES is set to the wrong value, it can produce an error in the calculated discharge.

WinRiver II can re-scale the raw ADCP data to correct for the speed of sound if the ES command was set incorrectly in the configuration when the data was collected. The re-scaled data displayed by *WinRiver II* will reflect the corrected sound speed, though the raw data file will not be corrected.

> The discharge calculated using 35.0 ppt (ES35) is 8-10% higher than the discharge calculated using 0.0 ppt (ES0). If you obtain discharge values that are consistently too high by this margin, check the salinity setting in *WinRiver II*.

Transducer Depth (ED Command)

This value is used by the ADCP to calculate the speed of sound at the transducer face. It is not necessary to set the command if the ADCP depth is less than five meters. The default value is ED000. Enter the depth value in decimeters. For example, a 10-meter transducer depth would be entered as ED100.

WinRiver II Processing Settings

These settings affect how the raw ADCP data is displayed and how the discharge is calculated within the Acquire and Playback modes. They do not affect the raw data. When you play the data back, the velocities, depths, and discharge values will reflect whatever processing settings are contained in the loaded configuration.

ADCP Depth

Set the depth of the ADCP transducer faces below the surface on the Offsets Page. The depths of the ADCP data presented in *WinRiver II* will be determined from this value. If you need to re-scale your velocities within *WinRiver II* by recalculating the sound speed, *WinRiver II* will use the ADCP depth and the salinity you have entered along with the temperature measured by the ADCP to calculate a new sound speed value for each ensemble.

Magnetic Variation (Declination)

Use a geomagnetic model or the magnetic variation correction procedure (see Magnetic Variation Correction) to determine the local magnetic variation in your area (see the Offsets Page). If there is an eastern variation in your area, the output of the ADCP's magnetic compass when pointed to true North will read less than 360°. If the local variation is to the West, the magnetic compass will read greater than 0° if pointed to true North. East variations are positive (entered as **12.5°**) and West variations are negative (entered as **-12.5°**). The magnetic variation value does not affect the calculated discharge unless you are using GPS. This is because both the water velocity and the boat velocity (from bottom tracking) are measured in the same coordinate system (ADCP magnetic compass) while GPS positions are reported in true earth coordinates.

> For the greatest accuracy, TRDI recommends checking the National Geophysical Data Center website (below) to find the declination angle based on your latitude and longitude:
>
> http://www.ngdc.noaa.gov/geomag-web/#declination

Speed of Sound

The **Speed Of Sound** box lets you correct velocity data for speed of sound variations in water. *WinRiver II* can make these corrections dynamically with every ping or use a fixed speed of sound value (see the Processing Page). This setting directs *WinRiver II* to one of three choices:

- **Use ADCP Value** – (recommended setting) this setting will perform unity scaling to the raw ADCP velocities. The sound speed calculated by the ADCP using the ED, ES, and temperature measured at the ADCP transducer head will be used for *WinRiver II* data display. When the

ADCP depth is less than five meters the sound speed calculation is not significant and it is not necessary to set the ED command.

- **Calculate for Each Ping** – *WinRiver II* will use the salinity and transducer depth values entered in *WinRiver II* along with the ADCP measured temperature to calculate a new sound speed for each ensemble. The new sound speed will be used to scale the velocities in each ensemble before display. Note: changes only affect the processed data, not the raw data.
- **Fixed** – *WinRiver II* will use this fixed value to scale the raw ADCP velocities for display on the screen. Again, changes only affect the processed data, not the raw data.

Backscatter

The sound absorption coefficient is used to estimate the relative backscatter in dB (decibels) (see the Processing Page). The relative backscatter when expressed in dB is a measure of the intensity of the returning echo from the scatterers. It is a function of sound absorption, beam spreading, transmitted power, and the backscatter coefficient. The sound absorption coefficient itself is dependent on frequency, temperature, and salinity.

Data Screening

Select **Mark Below Bottom Bad** to mark data below the ADCP-detected bottom or Depth Sounder detected bottom (if selected for processing) (see the Processing Page). Check the **Use 3 Beam Solution for BT** box to allow 3-beam solutions if one beam is below the correlation threshold set by the BC command. Check the **Use 3 Beam Solution for WT** box to allow 3-beam solutions if one beam is below the correlation threshold set by the WC command.

The **Mark Below Bottom Bad** setting only affects the data display. Cells below the bottom and those within the side lobe layer are never used in the discharge calculation.

Thresholds

The ADCP uses these parameters to determine good data. If the ADCP's data value exceeds these thresholds, it flags data as bad for a given depth cell (see the Processing Page).

Extrapolation Method

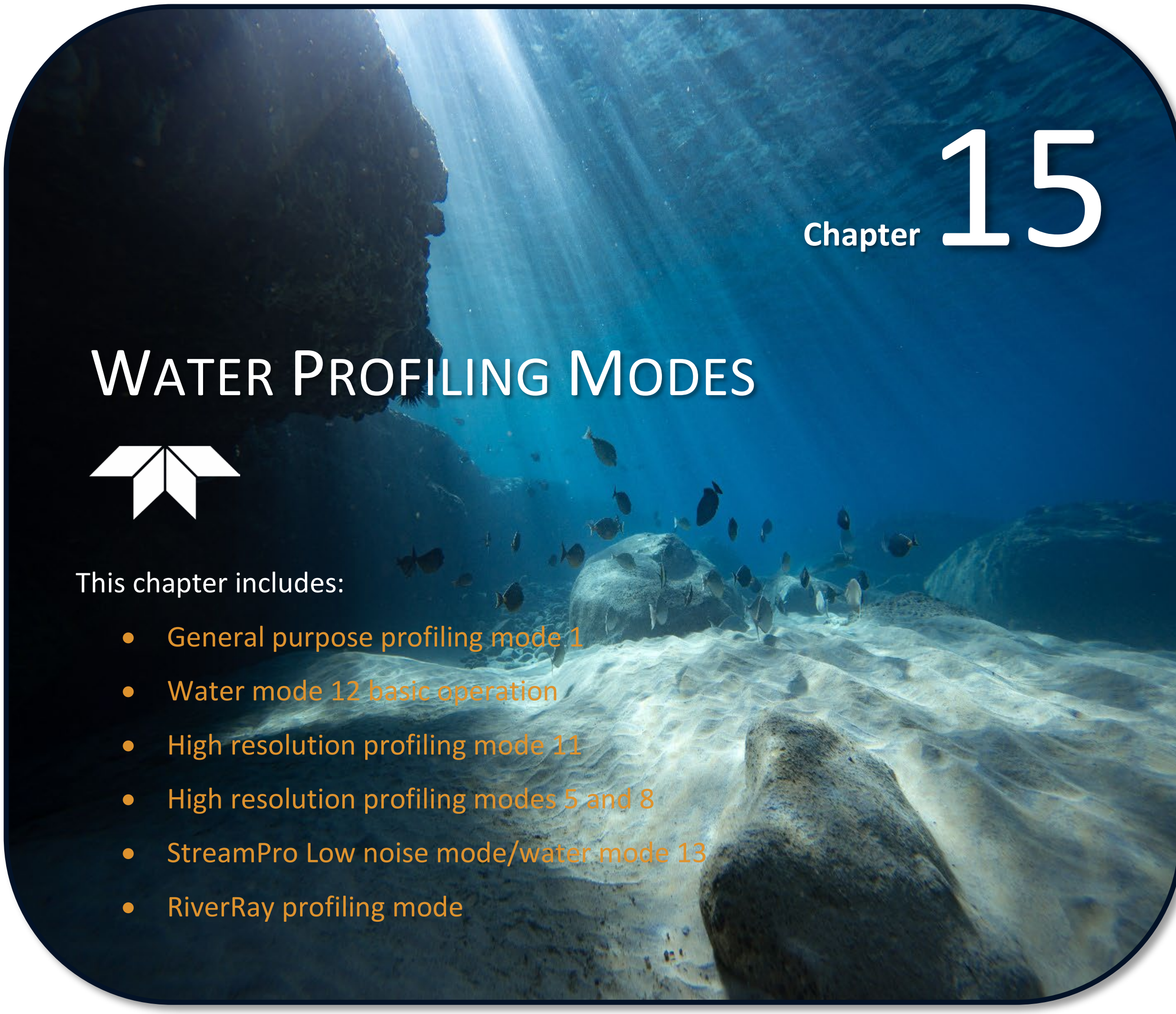
- ***Top and Bottom Discharge Method*** – four methods, **Power**, **Constant**, **3 Point Slope**, and **No Slip** are provided to extrapolate the discharge in the upper and lower layers of the water that are not directly measured by the ADCP (see the Discharge Page). Constant extrapolation uses the velocity at the nearest depth cell for the remainder of the water column. Power extrapolation fits a power curve to the directly measured portion of the water column, and then uses that power law fit to compute the discharge in the unmeasured portions. The **3 Point Slope** method for top extrapolation uses the top three bins to estimate a slope and this slope is then applied from the top bin to the water surface. A constant value or slope of zero is assumed if less than six bins are present in the profile. The details of these computations are documented in Appendix B - Discharge Measurement Basics. A good starting point is to use power for both the top and bottom layers. After you have taken some data on one of your channels, you can see how good the power law fit actually is by looking at the **Profiles, Discharge** display in Playback. You can then try other methods and/or exponents in playback to attempt to improve the fit.

  The **No Slip** method for bottom extrapolation uses the bins present in the lower 20% of the depth to determine a power fit forcing it through zero at the bed. In the absence of any bins in the lower 20% it uses the last single good bin and forces the power fit through it and zero at the bed. By making this selection the user is specifying that they do not believe a power fit of the entire profile is an accurate representation. If the **No Slip** method is selected, missing bins are estimated from the bin immediately above and below using linear interpolation.

- ***Power Curve Coefficient*** – this value is used in the power extrapolation fit. An exponent of 0.1667 (1/6th power law) is a theoretical solution for open channel flow. For more information on the theory of power law for flow resistance see Chen, Cheng-Lun, "Unified Theory on Power Laws for Flow Resistance", Journal of Hydraulic Engineering, Vol. 117, No. 3, March 1991, 371-389.
- ***Left/Right Bank Edge Type*** – Use this field to describe the geometry of your edges. Choose **Triangular**, **Square**, or a user-specified **Coefficient**.

Velocity Reference

Use the **Settings** menu, **Reference** to set the velocity reference (see Changing the Reference). **Bottom Track** should always be used for river measurements from a moving vessel except if there is a moving bottom and GPS is available. With this setting, true water velocities will be presented in the *WinRiver II* displays because the boat velocity has been subtracted from the relative velocities measured by the ADCP. If **None** is chosen as the velocity reference, than relative velocities will be displayed.



Chapter 15

Water Profiling Modes

This chapter includes:

- General purpose profiling mode 1
- Water mode 12 basic operation
- High resolution profiling mode 11
- High resolution profiling modes 5 and 8
- StreamPro Low noise mode/water mode 13
- RiverRay profiling mode

This section explains all of the water-profiling modes available for the WorkHorse Rio Grande, RiverRay, RiverPro/RioPro ADCPs with the high-resolution water profiling upgrade installed. For StreamPro systems, an additional Water Mode 13 is available. For each mode, we provide a general description, an explanation of the best place to use this mode, specifics about the mode, and any setup considerations. Use Table 11 as a guide for choosing the appropriate mode for your water flow conditions.

Typically if the flow is slow and the depth is shallow you would first try Mode 11. If the flow were too fast or turbulent for Mode 11 you would use Mode 12 if fitted. If Mode 11 or Mode 12 is not suitable then Mode 1 will work in all but the most extreme situations. Mode 12 with 1 sub-ping is the same as Mode 1. Mode 5 and Mode 8 are still included for backward compatibility and for users who are familiar and satisfied with their performance.

Table 11: River Water Profiling Modes

	Mode 1	Mode 12	Mode 11	River-Ray/RiverPro/RioPro	Mode 13	Mode 5	Mode 8
Typical application	Fast water of all depths. Rough and dynamic situations. Good in streams too fast or deep for modes 5, 8 & 11 or where Mode 12 has problems.	Fast water of all depths. Good in streams too fast or deep for modes 5, 8 &11. Good for deep, slow water. See Note 1.	Slow, shallow streams with velocities < 1.0 m/sec (depth dependent) with low shear and/or turbulence.	The RiverRay and RiverPro/RioPro selects bin size and profiling mode automatically depending on depth and water conditions. There are no user commands required to set cell size, number of cells, profiling mode, etc. See RiverRay Profiling Operation	Slow, shallow streams where the Maximum Stream Depth is ≤ 1.0 meters and the Maximum Stream Velocity is < 0.25 m/s	Slow, shallow streams with velocities < 0.5 m/sec with low shear and/or turbulence.	Shallow streams with velocities < 1 m/sec and with moderate shear (rough bed) and/or turbulence.
Minimum recommended cell size (meters)	**0.50*** 0.25	**0.25*** 0.10	**0.10** 0.05		StreamPro ADCPs Only See Low Noise Mode/Water Mode 13	**0.10** 0.10	**0.10** 0.10
Recommended Cell Size (meters)	**0.50** 0.25	**0.25** 0.10	**0.25** 0.05			**0.25** 0.10	**0.25** 0.10
Single ping standard deviation (cm/s) (using rec. cell size)	**13.62** 13.64	**6.24** 6.95	**0.74** 1.34			**0.33** 0.44	**3.34** 5.15
First range cell (meters)	**0.97** 0.51	**0.73** 0.26	**0.49** 0.09			**0.49** 0.14	**0.49** 0.14
Minimum profiling range (meters) Bottom Mode 5	**1.7** 1.0	**1.7** 1.0	**1.6** 0.9			**1.6** 0.9	**0.9** 0.6
Minimum profiling range (meters) Bottom Mode 7	**NA** 0.7	**NA** 0.5	**NA** 0.3			**NA** 0.7	**NA** 0.3
Maximum profiling range (meters)	**73.1** 19.55	**68.29** 15.82	**<8.0** <4.0			**<8.0** <4.0	**<8.0** <4.0
Maximum relative velocity (m/s)	10 m/sec	10 m/sec	1 m/sec (Depth Dependant)			0.5 m/sec	1 m/sec

* 600 kHz values are in **bold** font, and 1200 kHz values are in regular font.
Specifications are for 25 cm blank 600, 5cm Blank 1200, 10° C temperature, and 0.0 ppt salinity.
Note 1. Mode 12 table assumes 20 sub-pings (WO 20,4).

The ranges in Table 11 are measured from the transducer face. Add the transducer depth to determine the actual minimum and maximum profiling depths.

Maximum range depends on water temperature and depth cell size. Use *PlanADCP* to compute the maximum range for a particular ADCP set-up and water temperature. The standard deviation of modes 5, 8 and 11 varies with water speed, boat speed, bed-form roughness, channel depth, and turbulence.

General Purpose Profiling Mode 1

General Description - This is our most robust mode of operation. It allows for good data collection in all environments.

Best Use Areas - Mode 1 is good for all areas. It works well in areas of turbulent currents, strong shears, low backscatter concentrations (or where signal returns are apt to be weak), high background noise (such as being used from a ship), and in areas where the water changes from shallow (1 m) to deep (>6 m).

Specifics - The standard deviation determined by the bin size (WS command) and the ambiguity velocity (WV). The ambiguity velocity tells the ADCP what maximum velocity it will see. If you were operating the ADCP from a moving platform, the maximum velocity would be the ADCP's maximum speed (motion through the water) plus the maximum water speed. This is called the maximum "apparent velocity" (see Figure 77).

Setup Considerations - To set the Mode 1 ambiguity velocity correctly, you must have an idea of the maximum apparent velocity to set the WV command. Use the following formula to set the WV-command:

WV = (max. apparent velocity in cm/s) * (sin B) * (1.5)

Where:

- B = Beam angle (20 degrees for the Rio Grande)
- (1.5) = Safety margin. You can reduce this safety margin if you are sure you will not exceed the maximum apparent velocity. We recommend a minimum safety margin of 1.1.

The minimum suggested setting for the WV-command is 100 cm/s (WV100), which corresponds to an apparent horizontal velocity of 3 m/s.

The ADCP default setting for the WV-command is 175 cm/s (WV175), which corresponds to an apparent horizontal velocity of 5 m/s. *WinRiver II* sets the WV command to WV170.

The maximum recommended setting for the WV-command is 480 cm/s (WV480), which corresponds to an apparent horizontal velocity of 15 m/s. Higher settings (maximum is WV700) will produce bad velocity data.

The values shown here do not include a safety factor.

High Resolution Profiling Mode 12

Water Mode 12 is the result of the continued evolution of the signal processing within our WorkHorse products. It is effectively an improved version of Water Mode 1 (our most robust Water Mode) offering higher sampling rates (up to 20Hz) and more precise velocity measurement. Water mode 12 was designed primarily for use in short-range, small-depth cell applications; however under the right conditions it can be used anywhere Water Mode 1 is used and results in either reduced variance for a set time period or reduced power consumption.

Recommended Applications

- High Resolution, Shallow water profiling in rivers, streams and estuaries.
- Boundary layer measurements.

Conditions where you would use Mode 12

- You require a Small Depth Cell Size (Min 1 cm)
- You require Low Standard Deviation of velocity measurement and velocities are too fast for Water Mode 11.

Mode 12 is not suitable for:

- Dynamic situations. (See Water Mode 12 Environmental Limits for more detail).

What is Required

- Update the WorkHorse ADCP firmware version to the latest version.
- Install the High Ping Rate feature upgrade in your WorkHorse ADCP.
- Add the WM12, WK (for depth cells sizes less than WS frequency dependent defaults), and the WO commands to your existing configuration command files to take advantage of this new mode.

Why is Water Mode 12 an Improvement?

- Water Mode 12 is an evolution of our existing Water Mode1.

The key Improvements are:

- Depth Cell Size can be set to 1 cm minimum (previously 5 cm for a 1200)
- Maximum number of depth cells has been increased to 255 (previously 128).
- Sampling rates up to 20Hz over a wide range of velocities

Water Mode 12 Basic Operation

Typically a WorkHorse transmits pulses, collects information on the returned signal, and processes this information into a velocity measurement. The process is called a ping. With Water Mode 12 we shorten the procedure and transmit and receive a series of sub-pings that are not fully processed until the desired number have been accumulated (the number is determined by the WO command). The system then averages this data and completes the final processing to produce ping velocity values but the sub-ping raw data is not stored. Sensor data is read only once at the start of the ping and is applied to averaged sub-pings. The result is faster processing so more data can be collected for a given time and hence better measurement precision.

Table 12: Commands Relevant to Water Mode 12 Use

Command	Description
WM12	Selects Water Mode 12.
WV170	Used to adjust the characteristics of the transmission pulse. A higher WV allows measurement of higher velocity currents. (100 Minimum, 700 Maximum) Default=WV170
WK1	Sets Depth Cell (Bin) size in cm, 1cm minimum (WK1). Overrides the WS command for small depth cells. If you never use depth cells less than 5cm for a 1200 or 10cm for a 600 then you can still use the WS command. Default =WK0 (uses WS)
WO pp,hh	Where pp = number of Sub pings per ping and hh = minimum number of 0.01 seconds between Sub pings. A typical setting for a 1200KHz system for use in shallow water would be WO20,4, which transmits 20 sub-pings 40msec apart and then averages them to create the ping which is recorded.

For detailed explanations of the Water Mode 12 commands, see the WorkHorse Commands and Output Data Format Guide.

Water Mode 12 Environmental Limits

The maximum horizontal and vertical velocity is determined by the WV command. The default WV170 command gives a maximum horizontal velocity measurement of +/- 5m/sec.

If Water Mode 12 is used on a platform or mooring that experiences large accelerations during the ping sampling period then some bias may occur.

Other Considerations:

- To achieve high sampling rates (e.g. 20Hz) the number of depth cells should be less than 60 (WN command should be 60 or less).
- Maximum Sub Ping rates must be considered to avoid ping-to-ping interference.
- The sensor information is read only once at the start of the Water Mode 12 ping. Maximum duration of the Sub Pings must be considered if operating in a dynamic environment.
- Maximum duration of the Sub Pings must be considered in light of Bottom Tracking. If too much time separates the Water and Bottom pings "stripy data" may result. It is recommended to use BP2 in these situations.

Water Mode 12 Minimum Ping and Sub-Ping Times

Pinging too fast may result in ping-to-ping interference. We have always recommended that the ping rate be no faster than 1.5 times the Bottom Tracking range for a particular frequency in salt water. The result is the following ping times for open water with no boundaries:

Table 13: Minimum Ping Times (open water with no boundaries)

Frequency	Minimum Ping Times Salt Water	Minimum Ping Times Fresh Water
300kHz	450ms	660ms
600kHz	180ms	330ms
1200kHz	67ms	85ms

These are very conservative numbers and, to our knowledge, have always worked. If we allow absorption and range spreading enough time to attenuate the previous ping by 25dB relative to the current ping and we are confident that there are no significant boundaries (e.g. life layer) within the frequency dependant range (Note: not the user set profiling range) of the acoustic signal then we can reduce these times. This gives the following values for open water:

Table 14: Minimum Ping Times (Open Water)

Frequency	Minimum Ping Times Salt Water	Minimum Ping Times Fresh Water
300kHz	200ms	330ms
600kHz	90ms	160ms
1200kHz	30ms	40ms

When the bottom is within range, the situation is improved once the time is set so that multiple bounces off the bottom occur between pings. A bounce is described as when the previous ping has traveled to the bottom, bounced to the surface, returned to the bottom, and then back to the instrument. Each bounce dissipates energy. How much is dependent on the bottom roughness (rough is better). This loss adds to the absorption loss. We recommend the following minimum ping and sub-ping times when the bottom is within range however these are conservative and can be reduced if the user is confident there is no interference.

Table 15: Minimum Ping and Sub-Ping Times

Maximum Bottom Depth	Minimum Ping Times (WO or TP) 1200KHz	Minimum Ping Times (WO or TP) 600KHz	Minimum Ping Times (WO or TP) 300KHz
5m	40msecs	60	80
10m	60	60	80
20m	80	80	100
50m	80	200	300
100m	NA	250	350

NOTE. TRDI Field Service can provide detailed advice on how to calculate the minimum ping times for particular environments.

Water Mode 12 Examples

Examples of Improved Standard Deviation of velocity measurement:

1. 1200 kHz, 10cm Bin, in 5-meter bottom depth of water:
   - WM1 takes 175ms and results in a Standard Deviation of about 30 cm/s. Thus, it takes 1.6 seconds to get to 10cm/s.
   - WM12 with 9 Sub Pings gets the same performance in 0.65 seconds.
2. 600 kHz, 25cm Bin, in 10 meters bottom depth of water:
   - WM1 takes 160ms and results in a Standard Deviation of about 26 cm/s. In 0.5 sec (3 Mode 1 Pings) the Standard Deviation would be ~ 16cm/s.
   - WM12 with 6 Sub Pings, Standard Deviation would be ~ 11cm/s in 0.5secs.

Examples of Improved Energy Usage:

300 kHz, 4m Bin, 100 meters profile with 10 burst pings/ensemble:
- WM1 uses 13.1 W-Sec per ensemble.
- WM12 uses 11.9 W-Sec for 10 Sub Pings per Ensemble – a saving of 9%.

600 kHz, 2m Bin, 40 meters profile with 10 burst pings/ensemble:
- WM1 uses 5.9 W-Sec per ensemble.
- WM12 uses 3.7 W-Sec for 10 Sub Pings per Ensemble – a savings of 37%.

The savings are (.0024*#Bins + .14) W-Sec per Sub Ping. The % savings are higher in shorter-range profiling.

High Resolution Profiling Mode 11

Water Mode 11 is the result of the continued evolution of the signal processing within our WorkHorse products. It is part of our High Resolution, "Pulse to Pulse coherent" options for WorkHorse products that include Modes 5, 8, and 11. These options have 10 to 100 times higher precision than our standard Broadband operation. If used within their limits, you will be able to collect significantly better data with your WorkHorse ADCP than ever before.

Recommended Applications

- High Resolution, Shallow water profiling in slow moving rivers, streams and estuaries.
- Boundary layer measurements.

Conditions where you would use Mode 11

- Shallow Water (4m max. 1200KHz, 8m max. 600KHz)
- Low Flow Velocity (<1m/s) (See Water Mode 11 Environmental Limits)
- You require a Small Depth Cell Size (Min 1 cm using the WK command)
- You require Low Standard Deviation of velocity measurement.

Mode 11 is not suitable for:

- Deep water profiling (improvements to the range of Water Mode 11 are currently under development)
- Relative Water velocities greater than 1m/s
- Profiling in high turbulence or shear

What is Required

- Update the WorkHorse ADCP firmware version to 16.19 (Monitor/Sentinel) and 10.12 (Rio Grande), or higher.
- Install the High Resolution Water Profiling feature upgrade in your WorkHorse ADCP (standard in a Rio Grande).
- Add the WM11 and WK (for depth cells sizes less than 5cm for a 1200 and 10cm for a 600) commands to your existing configuration command files to take advantage of this new mode.

Why is Water Mode 11 an Improvement?

- Water Mode 11 is an evolution of our existing Water Modes.

The Key Improvements are:

- Depth Cell Size can be set to 1 cm minimum (previously 5 cm for a 1200 and 10cm for a 600) using the WK command.
- Improved signal processing so Water Mode 11 has a wider performance envelope than our previous High Resolution Water Mode 5.

For Moving Platform users with Bottom Tracking

Table 16: Commands Relevant to Water Mode 11 Use

Command	Description
WM11	Selects Water Mode 11 Default =WM1
BP1	Enables Bottom Tracking. With bottom tracking enabled the transmission pulse is automatically adjusted for the depth. The system effectively "tunes" WZ for the best performance down to the default minimum of WZ5. Max. Depth is 4 m for a 1200.
WZ	If Bottom Tracking is enabled it sets the Minimum Ambiguity velocity which is used. It is not necessary to change this command from the default WZ5 if bottom track is enabled. Default = WZ5
WK	Sets Depth Cell (Bin) size in cm, 1cm minimum (WK1). Overrides the WS command for small depth cells. If you never use depth cells less than 5cm for a 1200 or 10cm for a 600 then you can still use the WS command. Default =WK0 (uses WS)

For detailed explanations of the Water Mode 11 commands, see the WorkHorse Commands and Output Data Format Guide.

For Fixed Platform users

Command	Description
WM11	Selects Water Mode 11
WZ5	Used to adjust the characteristics of the transmission pulse for improved maximum velocity at shallower depths. With a 1200KHz ZedHed™ you would use WZ15 for depths less than 1m, WZ10 for depths up to 2m, WZ5 for depths up to 4m. Default = WZ5. Note: If WZ is changed to greater than the default WZ5 and bottom track is enabled then the range will be restricted according to the value of WZ.
BP1	Enables Bottom Tracking. With bottom tracking enabled the transmission pulse is automatically adjusted for the depth. The system effectively "tunes" WZ for the best performance down to the default Minimum of WZ5. Note: Bottom Tracking Feature is an option with some instruments.
WK	Sets Depth Cell (Bin) size in cm, 1cm minimum (WK1). Overrides the WS command for small depth cells. If you never use depth cells less than 5cm for a 1200 or 10cm for a 600 then you can still use the WS command to set the depth cell size.

Water Mode 11 Environmental Limits

For 1200 KHz systems, a useful "rule of thumb" for determining whether the water conditions are within the envelope of Mode 11 is the Depth times Velocity product. Water Mode 11 may not work if the Depth (m) times the Velocity (m/sec) product is greater than one.

Other Environmental Limits

- Maximum relative Horizontal velocity depth <1m (1200KHz) or <2m (600KHz), 100cm/sec
- The maximum relative horizontal velocity gradually reduces with depth to approx. 25 cm/sec at 4m (1200KHz) or 8m (600KHz)
- It is important to keep in mind that with water mode 11, in depths less than 1 meter, the maximum beam velocity that can be reliably measured under all circumstances is 50cm/sec (this equates to 150cm/sec relative horizontal velocity as long as no vertical components are present). What this means is that the vector combination of horizontal and vertical velocities along a beam should not exceed 50cm/sec or errors may occur. As your relative horizontal velocities approach 100cm/sec in shallow water it is important to move slowly and smoothly to minimize any additional platform motion that might contribute to the relative velocity in the vertical or horizontal plane.

Other recommendations:

- Currently not recommended for 300 KHz systems.
- Maximum Depth Cell size: 0.25m (600 kHz), 0.125m (1200 kHz)
- WT can be used with the 1200 KHz ZedHed™ in shallow water (<1m) to reduce transmit pulse length. This is normally left at default WT = 0 (Transmit Pulse Length = Depth Cell Size) however if you are using small depth cells e.g. 5cm you could use WT2 to reduce the transmit pulse length to 2 cm and possibly get an extra depth cell in the profile.

Examples of Performance

- 1200 kHz in 2 meters of water, 5cm depth cell size: Standard Deviation of water velocity measurement (SD) < 1.0cm/s.
- 600 kHz in 4 meters of water, 10cm depth cell size: Standard Deviation < 0.9cm/s.
- 1200 kHz in 1 meter of water, 1cm depth cell: Standard Deviation < 5cm/s.

- 600 kHz in 2 meters of water, 10cm depth cell: Standard Deviation < 1.6 cm/s.

Water Mode 11 Technical Description

In order to understand the advantages of Water Mode 11 we must briefly revisit the basis of Broadband processing, Water Mode 1, and the pulse coherent Water Mode 5. It is advisable that you are familiar with the primer and application note explanations of Water Mode 1 and Water Mode 5.

Pulse to pulse coherent processing used in Water Mode 11 applies a combination of the techniques used in Water Mode 1 and Water Mode 5 processing. It effectively improves the maximum relative velocity over where Water Mode 5 can operate while retaining the measurement precision. We first transmit a coded pulse and the processor listens and collects the return signal data. At a predetermined time (automatic if Bottom Tracking is enabled) the second coded pulse is transmitted and the processor continues to collect return signal data. The processor then applies autocorrelation functions to measure the approximate time separation between returned pulses and determines the approximate water speed. Phase measurement techniques are then applied to determine a more precise water speed.

Because of the large pulse separations used in Water Mode 11 as with Water Mode 5, we rely on the fact that the pulses are being affected by similar water conditions. If the conditions change between pulses beyond a certain point because of turbulence or high velocity, measurement becomes difficult (it is referred to as decorrelation) and data will be missing from the profile. If a large number of depth cells contain no velocity data then the user should switch to Water Mode 1 or 12.

High Resolution Profiling Mode 5

General Description - Mode 5 is our high-precision, shallow-water mode. Mode 5 allows for very low standard deviation (less than 3 cm/s) in shallow water. Mode 5 should be used with bottom tracking enabled.

Best Use Areas - Mode 5 is ideal for shallow water with water currents less than 50 cm/s.

Mode 5 is not good for areas where there is shear, turbulence, background noise, or fast ADCP motion (above 0.5 to 1 m/s). If high shears, turbulence, background noise, or fast ADCP motion occurs, the ADCP will not collect data.

High Resolution Profiling Mode 8

General Description - Mode 8 is our medium-precision shallow-water mode. The standard deviation of Mode 8 is about 10 times greater than Mode 5 for the same size depth cell and water speed. Mode 8 should be used with bottom tracking enabled.

Best Use Areas - Mode 8 is ideal for shallow water (8 m and less), where there is any shear, turbulence, background noise, or fast ADCP motion (maximum 1-2 m/s). Mode 8 can be used in fixed measurements or slow-moving platform measurements where the water velocity flows are very low. However, Mode 5 is better suited for those areas.

> If the shears, turbulence, background noise, or ADCP motion is too great, the ADCP will not collect data.

Mode 5, 8 and 11 Specifics

Mode 5, 8, and 11 use short encoded pulses that travel to the bottom, where it is reflected and then goes back up to the ADCP. When the signal is received at the transducer face, the ADCP transmits another pulse. The ADCP knows how long to wait before sending the second transmission because Bottom-Track measures the water depth. For this reason, it is important to use bottom tracking for downward-looking measurements.

For Modes 5, 8 and 11 two pulses are processed to create the velocity estimate. The standard deviation for Mode 5, 8 and 11 is very low because there is a relatively long lag between the two pulses. Mode 5 estimates the velocity based on the Doppler shift, and its algorithm is sensitive to ambiguities. Therefore, this mode is highly sensitive to conditions with high shear, turbulence, and fast ADCP motion. Mode 8 makes the estimation based on a proprietary scheme. Mode 8 has no ambiguity problems, and therefore it can operate in areas that Mode 5 cannot. However the method of estimating velocity used by Mode 8 has a higher standard deviation as compared to Mode 5 operation. Mode 11 is an evolution of Mode 5 and has the standard deviation of velocity measurement of Mode 5 with better performance in shallow water and ability to measure higher velocities. Use an ambiguity velocity value of 5 cm/s WZ005 (lag setting) for most measurements to allow for the deepest possible profiling range. The ADCP automatically adjusts this setting higher based on the depth of the water measured by bottom tracking.

There are some applications where you may wish to obtain only valid data near the ADCP when the bottom is out of range of the system. In these cases, the setting of WZ005 will still work. It allows the system to collect data as deep as it can.

The profiling range of the high-resolution modes is limited by two factors: (1) the very short encoded pulses used, and (2) the maximum velocity water velocity. These pulses do not put much energy in the water, so the signal return is weak. The deeper the profile, the slower the water must move or an ambiguity error will occur.

Low Noise Mode/Water Mode 13

> The Low Noise Mode is only available for StreamPro ADCPs.

If the stream you are about to measure is shallow and slow, then you may wish to try the Low Noise Mode. <u>Shallow means 1 meter or less and slow means less than 0.25 meters per second.</u> If you get "very good data" then you have made the right choice and you may continue to use it in this environment. However, keep a very close watch on the results as you continue to make transects so that should conditions change you are aware of the fact.

> Should the environment change, the data will become less than satisfactory, in which case you would be better to return to mode 12.

Also, it is very important that the boat be pulled across the stream in a smooth/slow manner. The rule of thumb says to keep the boat speed to less than the current speed; it is difficult to keep that slow when the current speed approaches zero!

Attaching a small bag of pebbles on the rear of the float that dip into the water will cause drag and can improve boat movement performance. Experiment as necessary.

RiverRay/RiverPro/RioPro Profiling

RiverRay and RiverPro/RioPro pinging is automatic: the ADCP selects bin size and profiling mode automatically depending on depth and water conditions. There are no user commands required to set cell size, number of cells, profiling mode, etc.

The RiverRay and RiverPro/RioPro each have several distinct regions of operation based on range to bottom. For example he RiverRay profile will have two different bin sizes if the range to the bottom is more than 5 meters. The first five bins will be 10cm bins, called surface bins. These bins reduce the thickness of the top layer for which velocity data must be extrapolated to compute discharge. The deeper part of the profile will have 80 cm bins if the range to the bottom is greater than 10 meters or 40cm bins if the range to bottom is between 5 meters and 10 meters. If the range to bottom is between 2 meters and 5 meters, then the profile will use 20 cm bins. If the range to bottom is less than 2 meters, the bin size will be 10cm. In these shallow regions, the instrument will automatically determine whether to use a coherent profiling mode or use the same profiling mode that is done in deep water. When coherent profiling is possible, it provides velocity measurement with very low uncertainty when the water velocity or turbulence is low enough for a coherent mode to operate reliably. If the range to bottom is less than 45cm, no velocity profile data is output. Table 17 and Table 18 summarize the RiverRay and RiverPro/RioPro operation respectively:

Table 17: RiverRay Operation

Range to Bottom	Data Cell Size	Surface Data Cell Size	Number of Surface Cells
R > 10m	80 cm	10cm	5
10m > R > 5m	40cm	10cm	5
5m > R > 2m	20cm	10cm	3
2m > R	10cm	N/A	0

Table 18: RiverPro/RioPro Operation

Range to Bottom	Data Cell Size	Surface Data Cell Size	Number of Surface Cells
40m > R > 15m	96cm	12cm	5
15m > R > 6m	48cm	12cm	5
6m > R > 3m	24cm	12cm	3
3m > R > 1.5m	12cm	12cm	2
1.5m > R > 0.5m	6cm	6cm	2
0.5m > R	2cm	N/A	0

Figure 71 illustrates some of this behavior with an example RiverRay profile. No bottom track reference is applied to make the operation a bit easier to visualize. Starting from the right we see that there are 5 small surface bins at the top of the profile with 40 cm bins below. About 1/8th of the way across where the depth is 5 meters, there are 3 surface bins with 20 cm bins below that. The red square in Figure 71 shows where the switch from 5 surface bins to 3 surface bins occurs. Figure 72 is zoomed in on the area shown by the square. The blue line in Figure 72 indicates the switch.

Continuing toward the left, at just past 3/4ths of the way across the figure, the boat speed became slow enough for the RiverRay to automatically switch to using coherent mode; the noise in the data is dramatically reduced.

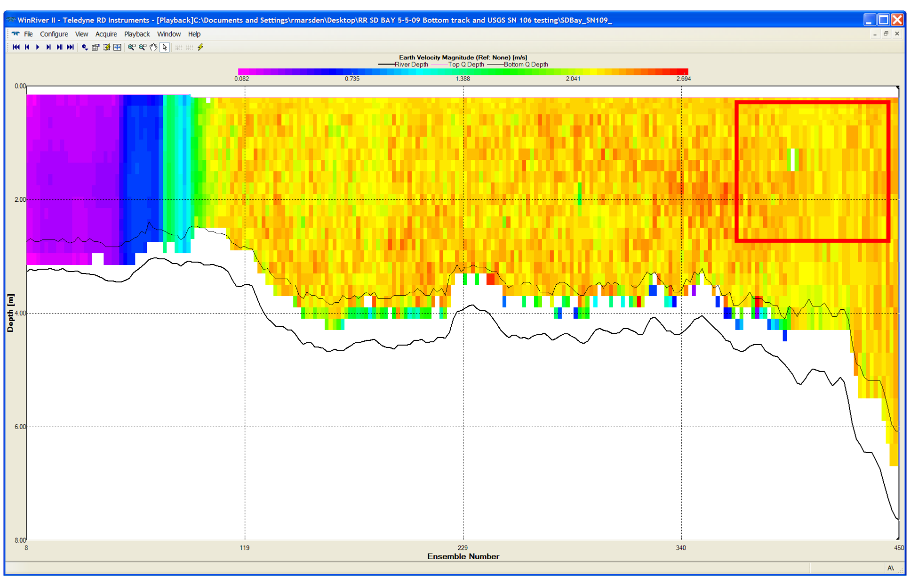


Figure 71. RiverRay Operation

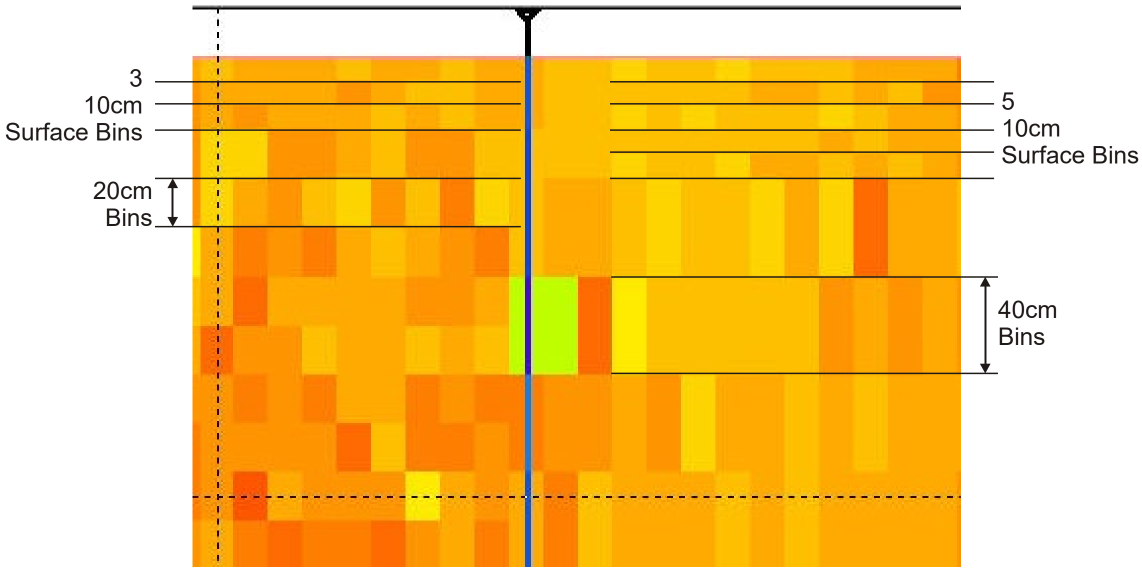
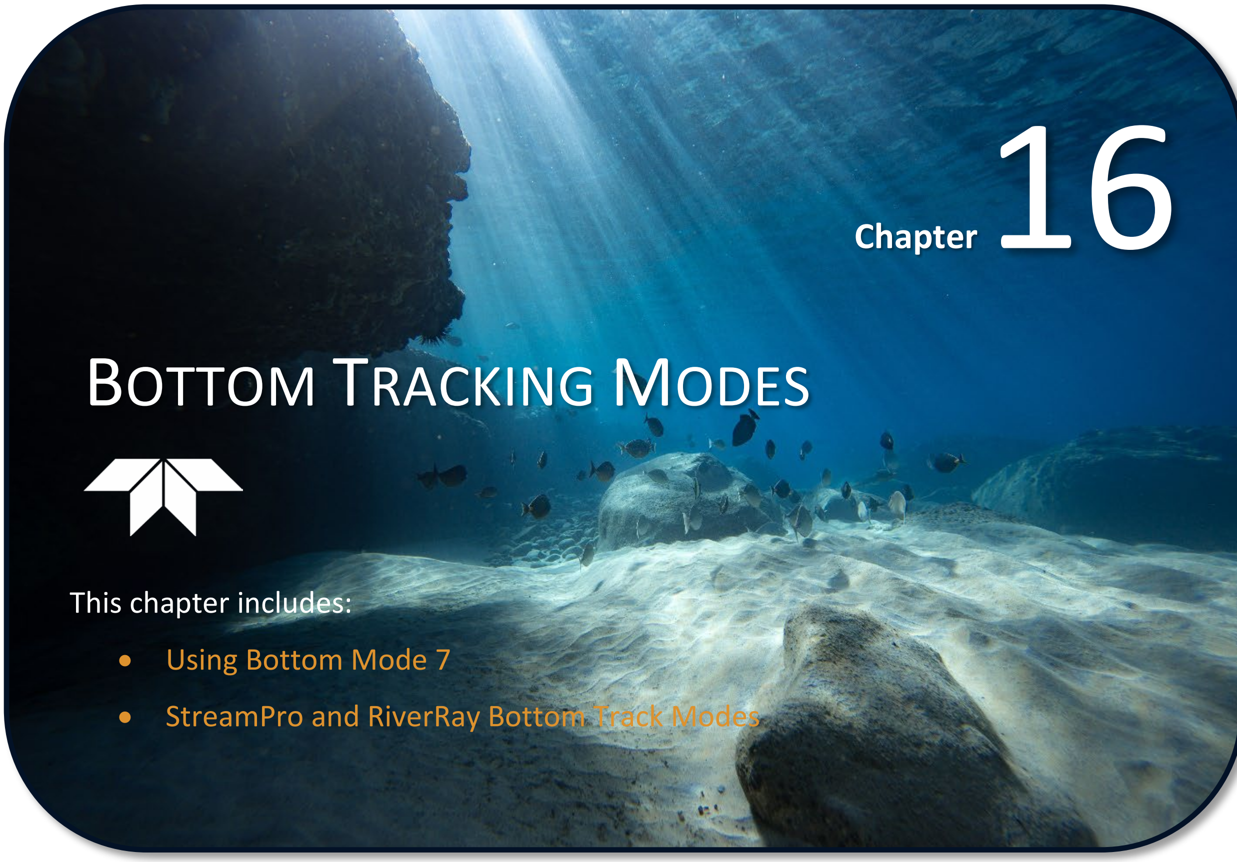


Figure 72. RiverRay Switching From Three Surface Bins to Five Surface Bins



Chapter 16

BOTTOM TRACKING MODES

This chapter includes:

Using Bottom Mode 7

All Rio Grande ADCPs include the standard Bottom Tracking modes. Bottom Track is an option with Monitor and Sentinel systems. Bottom Mode 5 gives good performance in systems of all frequencies. It is the default Bottom Mode in *WinRiver II* and in the Rio Grande firmware.

With the development of the ZedHed (1200 KHz low ringing transducer) and Water Profiling Mode 11, it became possible to measure water profiles much closer to the transducer face and therefore shallower water. Bottom Mode 7 was developed to fully utilize the capability of the ZedHed and allows bottom tracking in water as shallow as 30 cm. If Shallow water Bottom Tracking (Bottom Mode 7) is fitted to your system (ZedHed 1200KHz systems only) then you can add BM7 and &R30 to your command file to use Bottom Mode 7 instead of Bottom Mode 5.

Shallow Water Bottom Tracking Mode 7 improves the performance envelope of our standard bottom tracking. A 1200 KHz ZedHed™ system will work in water as shallow as 30 cm. Bottom Mode 7 has an improved bottom location algorithm that improves performance in all locations and specifically in high backscatter environments. While its main improvement has been in shallow water performance, it can be used to the full range of the instrument.

Recommended Applications

- Current profiling and discharge measurements in shallow rivers and streams.

Basic Operation

When Bottom Tracking is enabled (BP1 or more) the WorkHorse transmits pulses that are dedicated to determining the velocity of the WorkHorse relative to the bottom. The bottom pings are interleaved with the water pings with a separation determined by the TP command (Time Between Pings). As with Bottom Mode 5 a Bottom Track Ping actually consists of several pings with computations to determine the best velocity measurement for the depth and speed. The highest precision is obtained in depths less than 5 meters and velocities less than 90 cm/sec. When operating in shallow water the slower the velocity of the boat or float the more precise the velocity measurement.

The Bottom Track mode is set by default to Bottom Mode 5 (BM5). By enabling Bottom Mode 7 (BM7), you are able to improve your Bottom Track data in high backscatter environments such as rivers and improve shallow water performance.

What is Required

- Update the WorkHorse ADCP firmware version to 16.19 (Monitor/Sentinel) and 10.12 (Rio Grande), or higher.
- Install the Shallow Water Bottom Tracking Mode 7 feature upgrade in your WorkHorse ADCP.
- Add the BM7 and &R30 command to your existing configuration command files to take advantage of this new mode.

Table 19: Commands Relevant to Shallow Water Bottom Tracking

Command	Description
BP1	Enables Bottom Tracking
BM7	Selects Bottom Mode 7
BX80	Selects the maximum range for bottom detection. This can be adjusted to improve the time taken for bottom relocation in poor conditions in shallow water. The default for a 1200KHz ZedHed™ system is BX300 (30 meters). When debris or other factors are causing bottom tracking to be lost, the BX value can be reduced e.g. BX80 (8 meters). This will reduce the time for bottom relocation.
BV aaaaa,bbb,cc	This command adjusts the characteristics of Bottom Mode 7 and should be left at frequency dependant defaults. It should only be changed on the recommendation of Teledyne RD Instruments Customer Service. Please refer to the WorkHorse Commands and Output Data Format guide for more details.
&R30	Adjusts the transmit pulse length to 30% of depth. This command MUST be used in conjunction with BM7.

Environmental Limits

- Minimum Tracking depth for 1200KHz – 30cm
- Bottom Mode 7 is currently not recommended for 600 KHz ADCP systems.
- Maximum horizontal velocity measurement is ±9m/sec.
- Long term Accuracy is 0.3% velocity measurement ±0.1cm/s

Other Considerations:

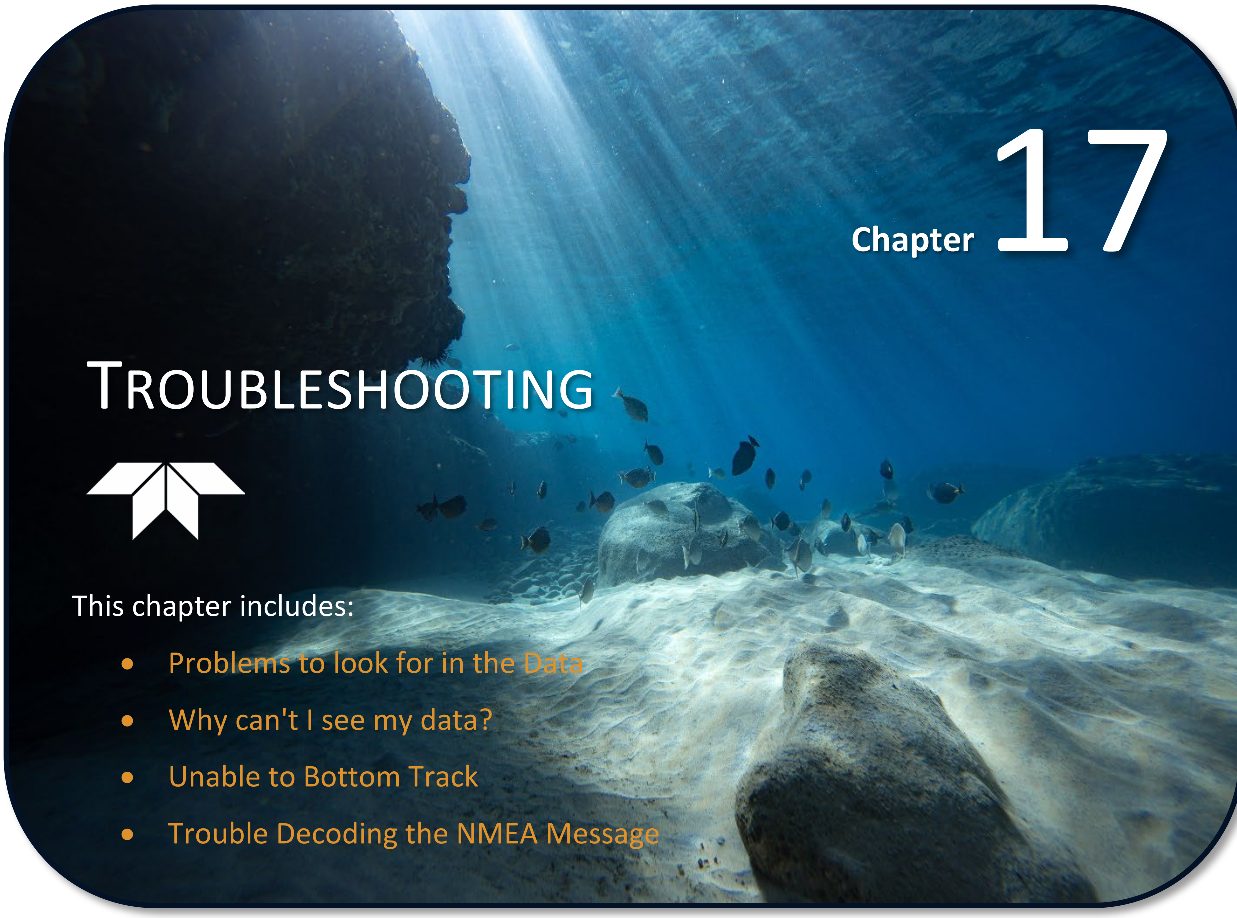
Ping times for Shallow Water Bottom Tracking (Bottom Mode 7) are approximately 3 times longer than standard bottom tracking (Bottom Mode 5) in shallow water and approximately 1.5 times in water > 5m. If it is necessary to collect data as fast as possible, Bottom Mode 5 will give faster ping times but at the expense of shallow water performance.

The &R30 command is automatically added to the wizard commands section after the BM7 command to override the &R20 command which is coded into *WinRiver II* and is also the Rio Grande firmware default. This adjusts the length of the bottom track transmit pulse as a percentage of depth. The &R20 command is used with Bottom Mode 5 for slightly improved performance in shallow water.

StreamPro/RiverRay/RiverPro/RioPro Bottom Track Modes

TBD. Contact TRDI for information if required.

NOTES



Chapter 17

TROUBLESHOOTING

This chapter includes:

Use the following suggestions to guide you if you are having trouble obtaining reliable discharge data. If you cannot arrive at a solution after trying the suggested solutions below, send a description of the problem, some example data files along with their associated measurement files, and a *BBTalk* log file to your local representative or to Teledyne RD Instruments via email. We will assist in analyzing the problem (see How to Contact Teledyne RD Instruments).

Problems to look for in the Data

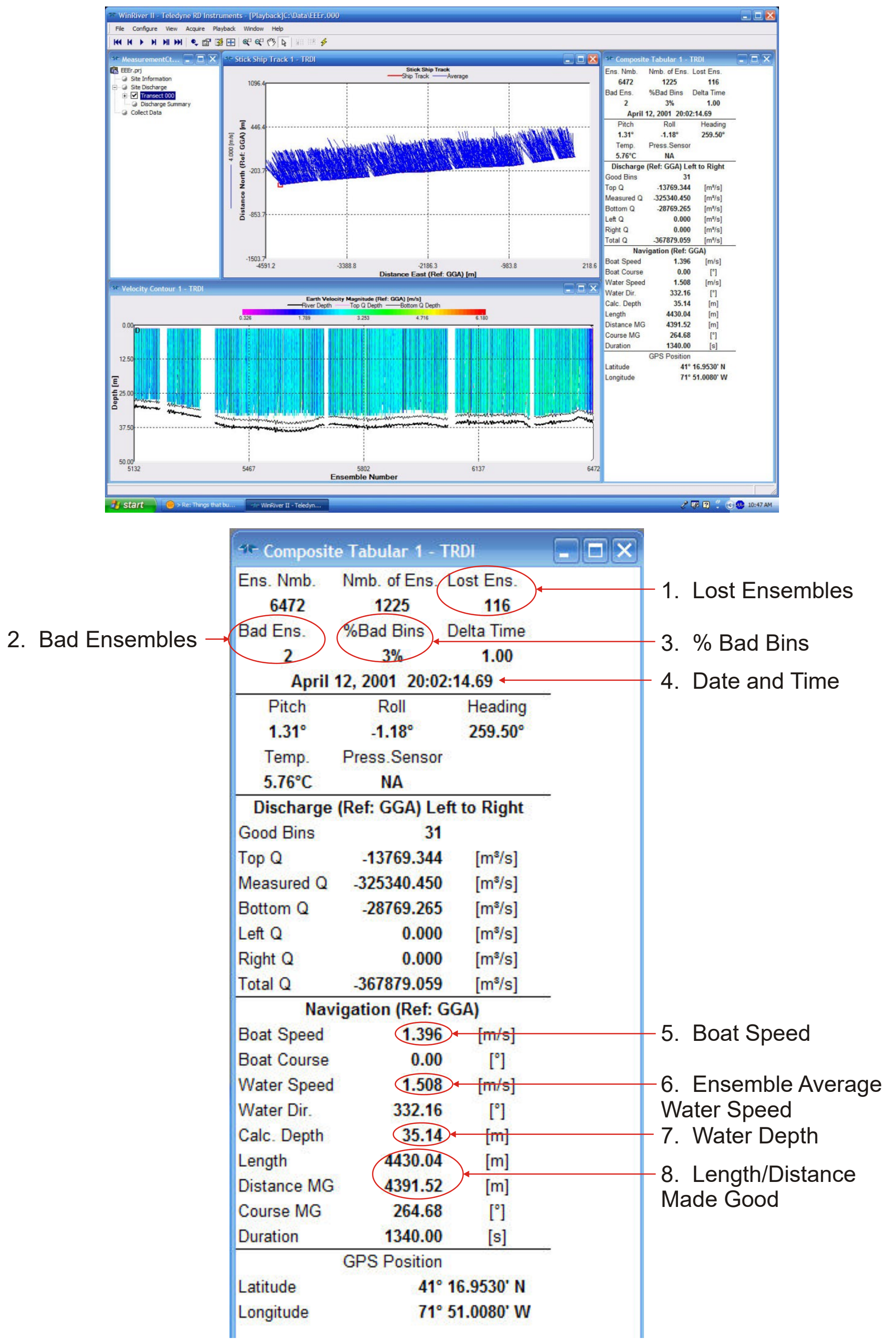
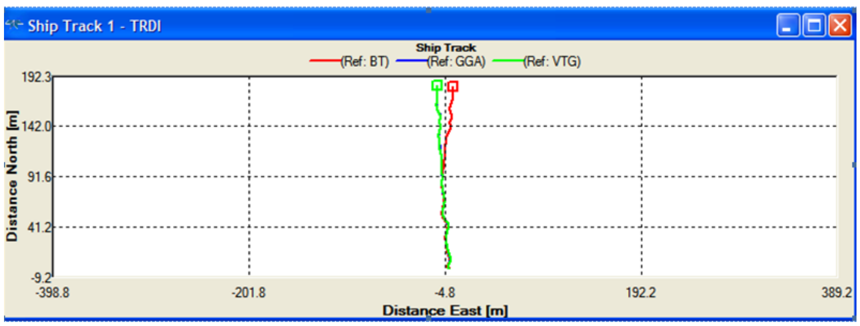


Figure 73. Problems to look for in the Data

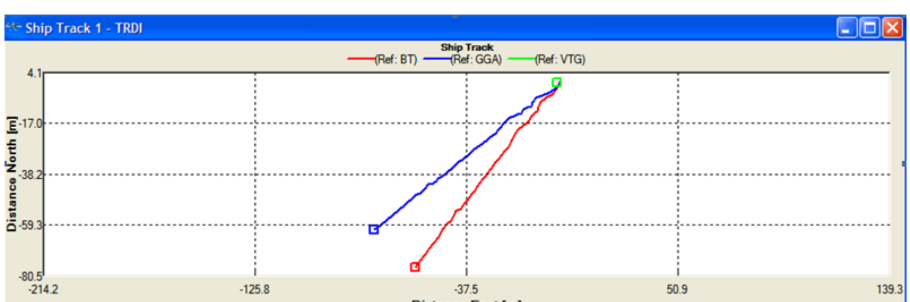
Data problems to look for:

1. Check for ensembles lost due to communication problems. This number is usually very small.
2. Check for ensembles that did not meet quality guidelines and did not return a discharge. If this number is large by comparison to the total number of ensembles then a setup change is possibly required.
3. Check for percentage of bad bins that have returned a discharge measurement over number of bins.
4. Verify the ADCP Date and Time.
5. Check if ancillary data is reasonable.
6. Ensure that the boat/float speed is lower than the water speed. Observe the maximum water speed during the transect. This will be used to determine the best configuration.
7. Observe the maximum water depth during the transect. This will be used to determine the best configuration.
8. Verify that the **Distance Made Good** corresponds to the reality. **Distance Made Good** much greater than reality indicates a compass problem or a river with a moving bed. Check if the boat path is going upstream on some parts of the transect to detect moving bed.



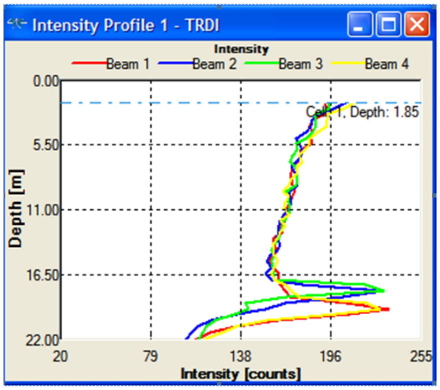
Because the tracks line up well in the beginning and diverge later on (away from the bank) this would indicate a moving bed. The Bottom Track will appear to move up stream because the bed is actually moving downstream. When you transect past the moving bed portion of the river the tracks will parallel each other.

The USGS consider a moving bed velocity that is greater than 1% of the mean water velocity to be a moving bed condition. See their web site for more details: http://hydroacoustics.usgs.gov/.

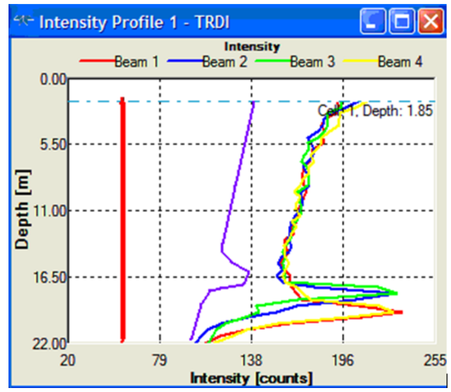


Don't assume plots like this are caused by a moving bed until you have completed the compass alignment and magnetic variation setting**.** Beam 3 is the "key" beam, the one that is aligned with the compass. For example, if beam 3 is pointing north the compass will read north.

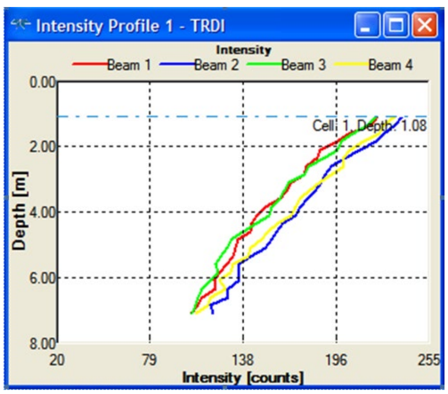
Intensities



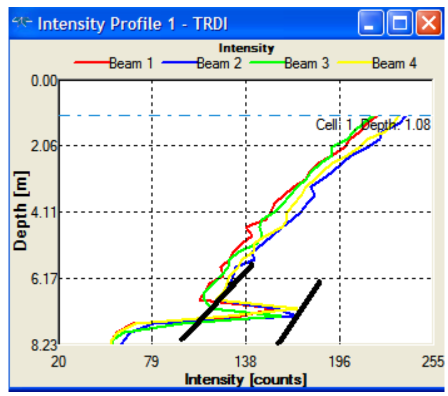
Intensities on all four beams



One beam with low intensity and noise floor



High Sediment

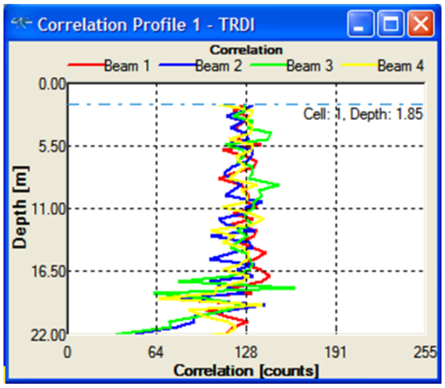


Bottom Bump

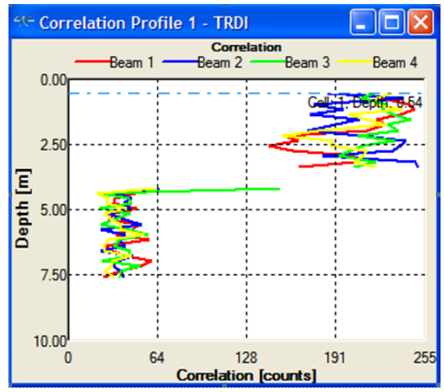
Check intensity plots for:

- Check that you have intensities on all four beams. Check that they decrease with depth. If you un-check the **Mark Below Bottom** and **Below Sidelobe**, you will be able to see the bottom bump (increase in counts).
- The picture on the top right shows that beam 2 is low. It may be caused from picking up cross talk from the other beams.
- The red line on the top right shows the noise floor. No matter how deep the beams go their counts will never be below the noise floor (solid red line) which is the result of noise in the water an (mainly) in the electronics.
- Note that two of the beams have a count increase slightly below the other two beams in the top displays. This is caused by the depths being deeper for those two beams or the pitch and roll is not close to zero.
- In high sediment conditions, note that the counts start off more to the right at the start (top) and then drop off quickly with depth. This will restrict your range for any particular frequency. The best solution is to use a lower frequency ADCP.
- If you are able to bottom track but your Water Profile is limited, then increasing the bin size will put more power into the water and hence help.
- If you are having difficulty bottom tracking in high sediment conditions, you could consider reducing the BA command value at your own risk. Some have done this cautiously with beneficial results.

Correlation



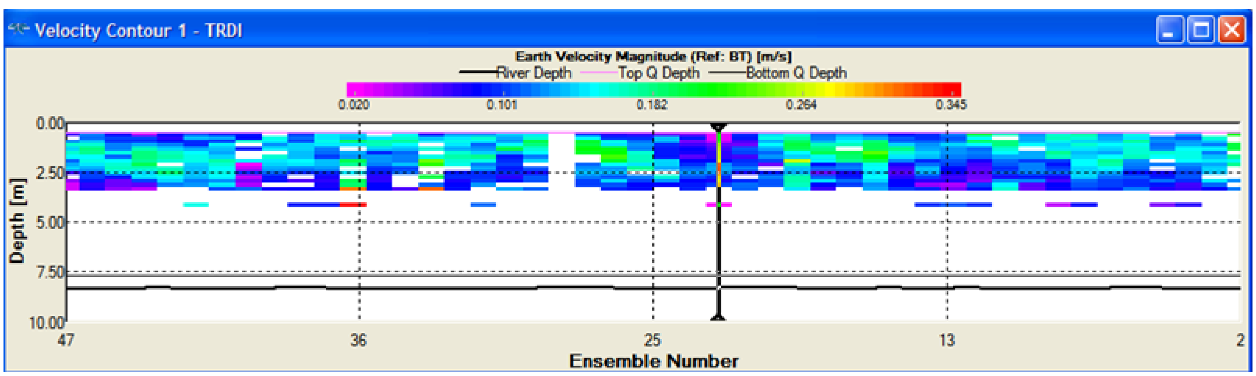
Water Mode 1 Correlation



Water Mode 11 Correlation (WH600Khz)

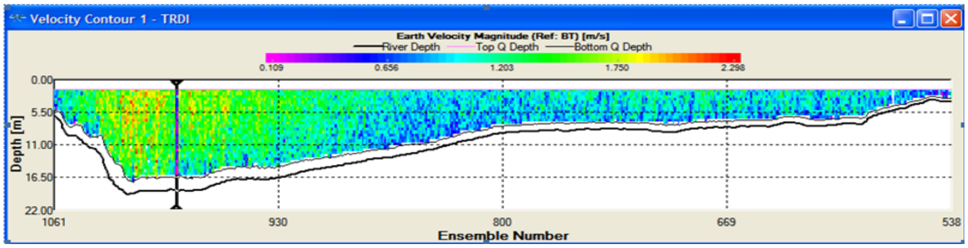
Check correlation plots for:

- Normal Water Mode 1 correlation "wiggles" around 128 counts. This is good data.
- For Water Mode 11, the correlations are good at the top of the picture, down to the 4-meter level, and then they are bad. This is because the long lag (widely separated coherent pulses) gets interfered with by the previous pulse pair.
- If Water Mode 11 does not work for you, then select Mode 12 or Mode 1 in that order.
- As a rule of thumb for using Water Mode 11: the velocity * depth should be <1 for a 1200 kHz ADCP and < 2 for a 600 kHz ADCP.

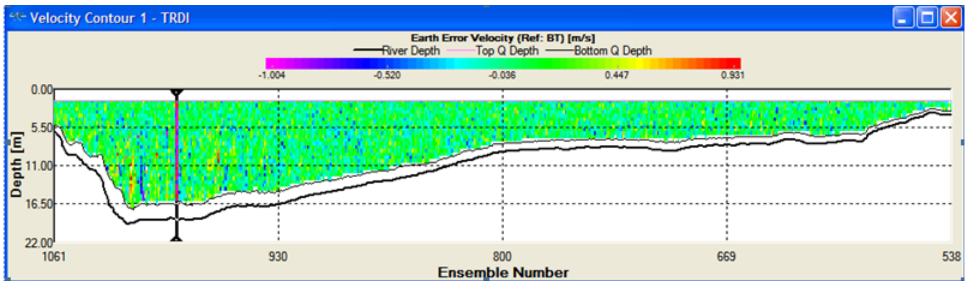


This is what the Water Mode 11 velocity profile looks like when the depth is too great for the WM11 profiling capability. If you were to use it in even deeper water, you will see that the data will "continue" after about 8 meters on down to 132 meters, leaving a gap in the 4 to 8-meter range (as shown above). The solution is to switch to Water Mode 12 or Water Mode 1.

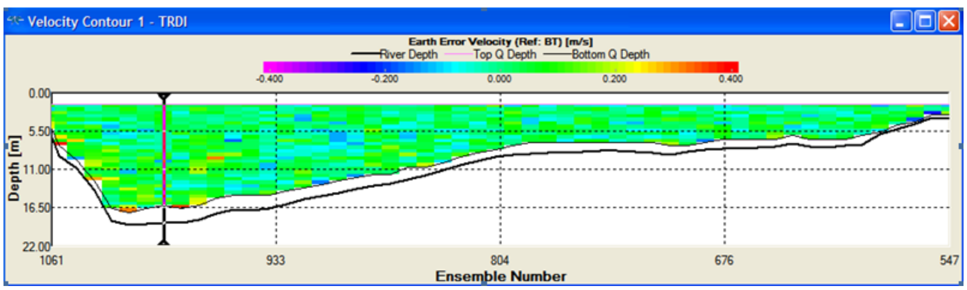
Error Velocity



Earth Velocity



Error Velocity

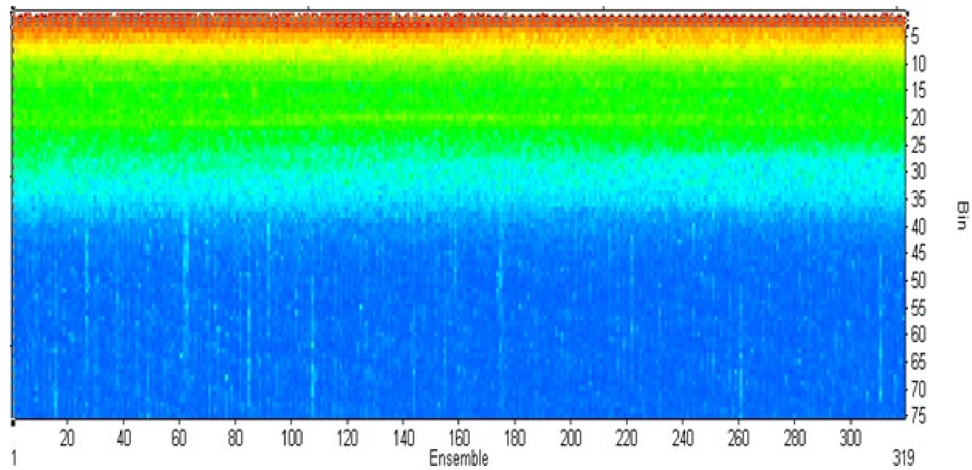


Averaged Data

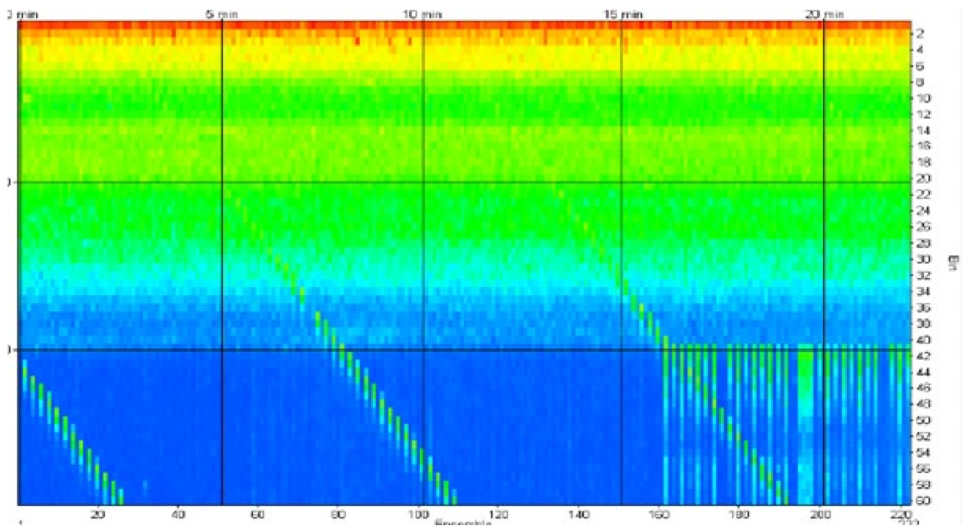
Check Earth Velocity Magnitude and Error Velocity plots for:

- Error Velocities should be “sprinkled” with plus and minus values. They should be less than 3x Standard Deviation. You can obtain the Standard Deviation from *PlanADCP*.
- Average the data. Set the color scale range as needed.

Interference



Narrowband interference

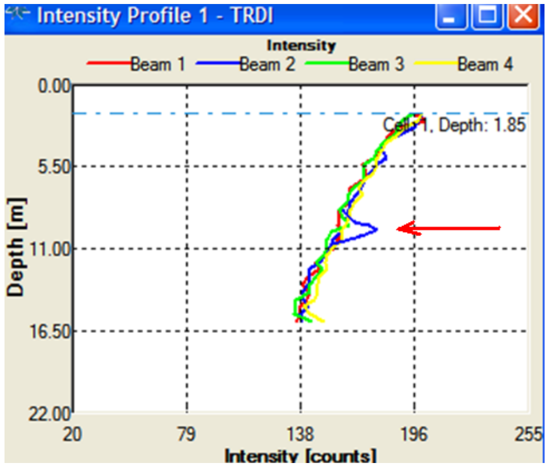


Echo Sounder, Multi Beam - possible types of interference

Check for echo sounder or other types of interference:

- Note the regularity of the stair step patterns. This makes it easy in this example to detect that interference exists. Sometimes interference can be a bit more subtle.
- The solution is to turn off devices until the source of the interference is found.

Fish



Check for intensity that increases because of fish:

- Look at a contour of intensity or slide though a profile if you suspect fish. The WA command allows you to set the screening level for fish. Essentially, it allows you to set how large the intensity of one beam can be versus the intensities of the other beams before marking that cell bad.
- Note the fish may appear in one or more beams.

Why can't I see my data?

If you do not see any data on contour graphs or other displays during Playback mode, check the following items:

- **Mark Below Bottom "Bad"** is selected in the **Configuration Settings**, **Processing** tab and you do not have valid bottom depth data.
- Your reference data is not valid. If your reference is GPS on the **Settings**, **Reference** menu and you did not have GPS active during data collection; your data will always be invalid.
- Check the contour or profile graphs minimum and maximum depth axis is setup properly. On the **Velocity Tabular** view, look at the left column where the depth of the water profile depth cells are displayed and set the minimum and maximum depth accordingly.
- On the **Velocity Tabular** view, if you see negative depths, your system is up-looking and you need to adjust the **ADCP Transducer Depth** on the **Configuration Settings**, **Offsets** tab.
- The data is not present. Check the commands sent to the ADCP on the **Configuration Settings**, **Commands** tab. For example, sending WD 11**0** 100 000 will override the default WD 11**1** 100 000 command and tell the ADCP to **not** collect echo intensity data. This will result in displaying "Bad" on Tabular views and not displaying at all on contour or profile graphs.

Lost Ensembles

If the Number of lost ensembles on the **Standard** and/or **Composite Tabular 1** views starts to increase, it may indicate a problem with the communications setup between the ADCP and *WinRiver II*. You may have the serial communications speed set too high for your computer or you are inadvertently holding a key down too long. Since the computer's keyboard has a higher priority than its serial port, serial data can get lost if the keyboard is used too long at the same time that serial data is being received.

One solution is to minimize the amount that you use the keyboard while the computer is receiving data from the ADCP. Another solution is to lower the serial communications speed of the ADCP and the computer; this reduces the computer's load with respect to serial port processing. A third option is to use a computer equipped with a 16550 UART, which buffers the serial port, allowing the computer to keep up with the flow of data.

> If the ensemble numbers have gaps but continue to increase in value, then check for communications issues. If the ensemble number gets reset to one, then check for a power failure issue with the ADCP.

To change the ADCP and computer baud rate, use *BBTalk* to communicate with the ADCP. Send a CB-command with the desired baud rate value (see the WorkHorse Commands and Output Data Format Guide). Press **F5** to change the serial port baud rate to match the ADCP. Enter **CK** to save the new baud rate for the ADCP. This must be done before pressing **END** to send a Break signal or the ADCP will reset back to the default 9600-baud rate. Press **END** to check the communications using the new baud rate.

Another source of the problem is interference in the transmission of data. Try not to place the ADCP's underwater cable near a generator, the engine, or other large electrical equipment. Do not coil the ADCP's underwater cable around large metal objects.

Missing Depth Cell Data

Missing depth cell data will be marked as bad in the data displays. The data within these cells has not met echo intensity, correlation, or percent-good thresholds. Bad cells do not generally effect a discharge measurement because discharge is extrapolated for missing bins.

Missing Velocity Data

Because of the large pulse separations used in Water Mode 11 as with Water Mode 5, we rely on the fact that the pulses are being affected by similar water conditions. If the conditions change between pulses beyond a certain point because of turbulence or high velocity, measurement becomes difficult (this is referred to as decorrelation) and data will be missing from the profile. If a large number of depth cells contain no velocity data, then switch to Water Mode 1 or 12.

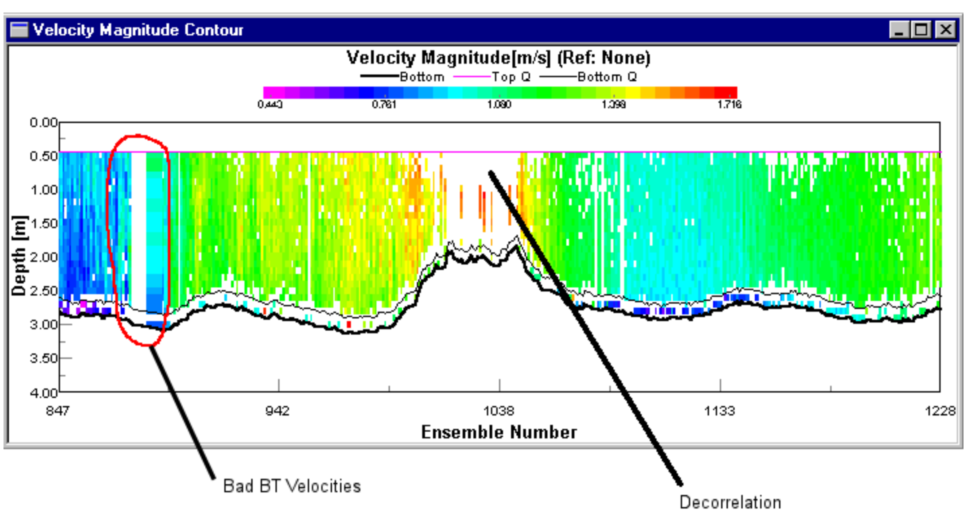


Figure 74. Decorrelation Example

Unable to Bottom Track

If you are losing bottom track, indicated by "bad" bottom track velocities or no depth indicated, then one or more of the following is possible:

- The depth set in the BX-command is not deeper than the maximum depth of the channel: increase BX and try again.
- If there are abrupt depth changes in your river channel, bottom track may have trouble locking on to the rapidly changing depths as you transect. If you know where the abrupt changes are located in your channel try to move slowly over these regions.
- There is something blocking one or more of the beams. It may be air being pulled below the transducer: try putting the ADCP deeper in the water. Some kind of debris has become caught on near the ADCP and is interfering with the beams: check the ADCP and its mount to see if debris has become entangled on the ADCP.
  - The bottom has grass, weeds, brush, or other submerged materials that are disrupting the beams near the bottom: try moving to a different nearby location to see if the problem changes.
  - There is a high sediment concentration near the bottom, and there is not enough contrast between the suspended sediment layer and the actual bottom to determine the true bottom range. Some users have found success detecting the bottom in these conditions by substituting a lower frequency ADCP, i.e. a 300 kHz in place of a 600 kHz, but at some point the sediment concentration will be so high the ADCP won't work.

If you cannot get valid bottom track depths using the suggestions above, an echo sounder can be used in place of bottom tracking.

> You must use GPS with the echo sounder (see Integrating Depth Sounder, External Heading, and GPS Data).

Biased Bottom Track Velocities

If one or more of the following occurs, it is an indication of bias in the bottom tracking data:

- The *course made good* is longer than expected.
- The Ship Track graph shows an upstream offset compared to the actual track taken by the boat.
- If you hold station at a position in the channel, the Ship Track indicates that you are moving upstream.

The bias can be caused by two different environmental sources:

- High sediment concentration in the water column (Water Bias)
- Fluid layer of sediment flowing along the bed of the stream (Moving Bottom)

These two environmental sources produce biased values for ADCP bottom track, which in turn will bias the discharge calculation. The consequences of these environmental sources and the biased ADCP bottom track are:

- Discharge computed with the ADCP is biased low
- The vessel track (Ship Track) is biased upstream
- The measured velocities (corrected for boat speed) are also low

The ADCP is not malfunctioning – but measuring the environment as designed.

If you obtain biased bottom track data at your river site, you can use GPS as the velocity reference in place of bottom tracking as described in the section on Integrating Depth Sounder, External Heading, and GPS Data. *WinRiver II* can calculate discharge in real-time using the GPS data in place of bottom track velocities.

Inconsistent Discharge Values

If the measured discharge is lower than expected and not reproducible to better than 5%, you may be experiencing one or more of the following conditions:

- Biased Bottom Track (see the previous section)
- There are tidal or other time dependent factors affecting the discharge.

A small repeatable difference in discharge values can be expected between transects made going different directions across the channel. This difference can be caused by several factors:

- Wind can cause the boat to heel causing the ADCP depth to be slightly deeper when traveling in one direction versus another.
- The ADCP may be mounted so that it is shadowed from the flow when a transect is made with the ADCP on the downstream side of the boat. Mounting the ADCP from the front of the boat may reduce the difference in discharge values between reciprocal transects.

Selecting the wrong bank will make the water velocities appear to go upstream (negative Qs) – set banks correctly.

Discharge Summary - TRDI

Transect	Start Bank	# Ens.	Start Time	Total Q m³/s	Delta Q %
Riv000	Right	524	12:15:54	1469.504	-29672.89
Riv001	Right	385	12:12:36	-1479.442	29672.89

Trouble Profiling in High Turbidity Conditions

In flows with very high sediment concentrations, the acoustic energy transmitted by the ADCP into the water undergoes high levels of absorption. The ADCP will not receive enough returned energy to make valid velocity measurements. In this case, the echo intensity profile will show the received signal level reaching the noise floor before the bottom is encountered. Some ADCP users have been able to successfully profile in these conditions by using a lower frequency system, i.e. a 600 kHz rather than a 1200 kHz, or a 300 kHz rather than a 600 kHz.

Trouble Profiling with Modes 5 and 8

Modes 5 and 8 are designed for use in shallow and slow moving water, and though they provide reduced standard deviation over Mode 1, they are highly sensitive to shear and turbulence. We strongly recommend Mode 1 for most profiling conditions. If you are having trouble profiling using Modes 5 or 8, review the section on Water Profiling Modes. Check that the maximum relative water speed (water plus boat speed) and profiling range do not exceed the limitations given in Table 11. Both Modes 5 and 8 must have a minimum water depth to profile. These depths are listed in Table 11.

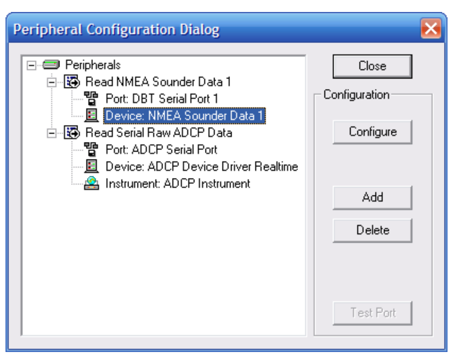
If the relative velocity and minimum and maximum depth requirements for modes 5 and 8 are met, and you still cannot get reliable performance, there may be turbulence and shear conditions in your river channel which are causing these modes to fail. You will need to profile using general purpose profiling Mode 1.

Trouble Decoding the NMEA Message

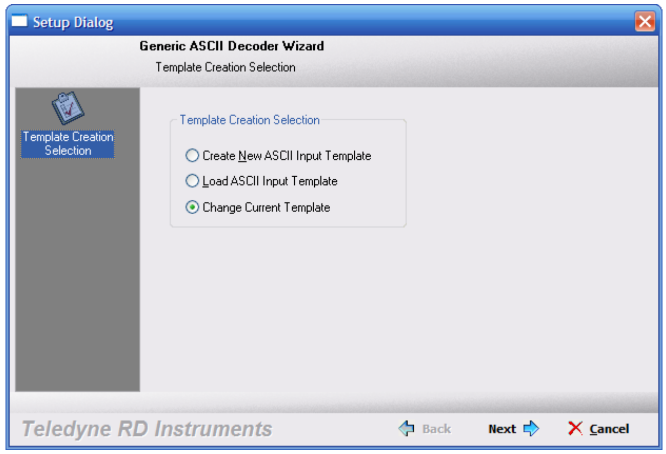
The NMEA Message Header consists of five characters defined by the NMEA 0183 standard. The first two characters are the talker identifier and the next three characters identify the message. For example, the Depth Sounder Message Header is $GPDBT. If your depth sounder device outputs the DBT NMEA message but uses a different talker identifier, you will need to configure *WinRiver II* so it can read the device.

In the following example, a depth sounder communications port has been configured. The same procedure can be used for GPS or External Heading devices by selecting the proper peripheral device in step "b" once the device has been added.

1. On the **Configure** menu, click **Peripherals**.
2. Click the + box next to **Read NMEA Sounder Data 1** to expand the list and then select **Device: NMEA Sounder Data 1**.
3. Press the **Configure** button.



4. On the **Template Creation Selection** page, make sure that **Change Current Template** is selected and then click **Next**.



5. On the **Find Data String** page, change the **Header** to match your device. If your device does not output a Checksum, than un-check the **Checksum** box.
6. Click **Next** until the wizard is done (do not make any further changes) and then click **Finish**.

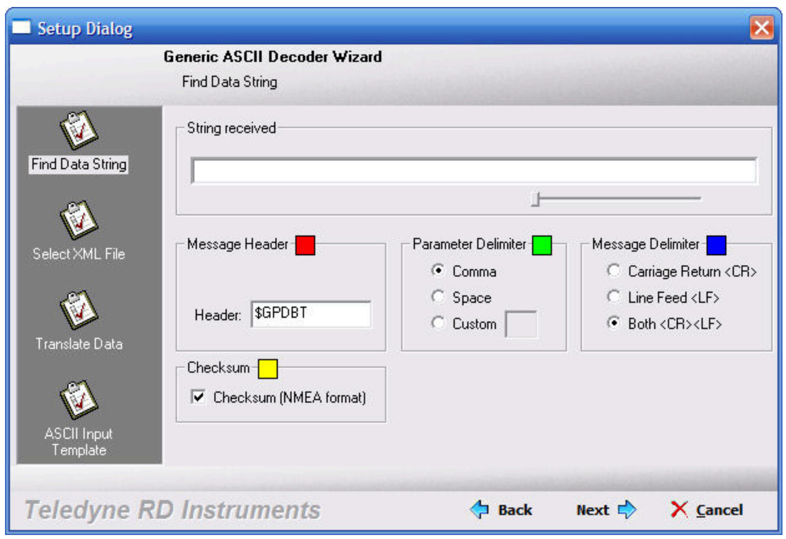
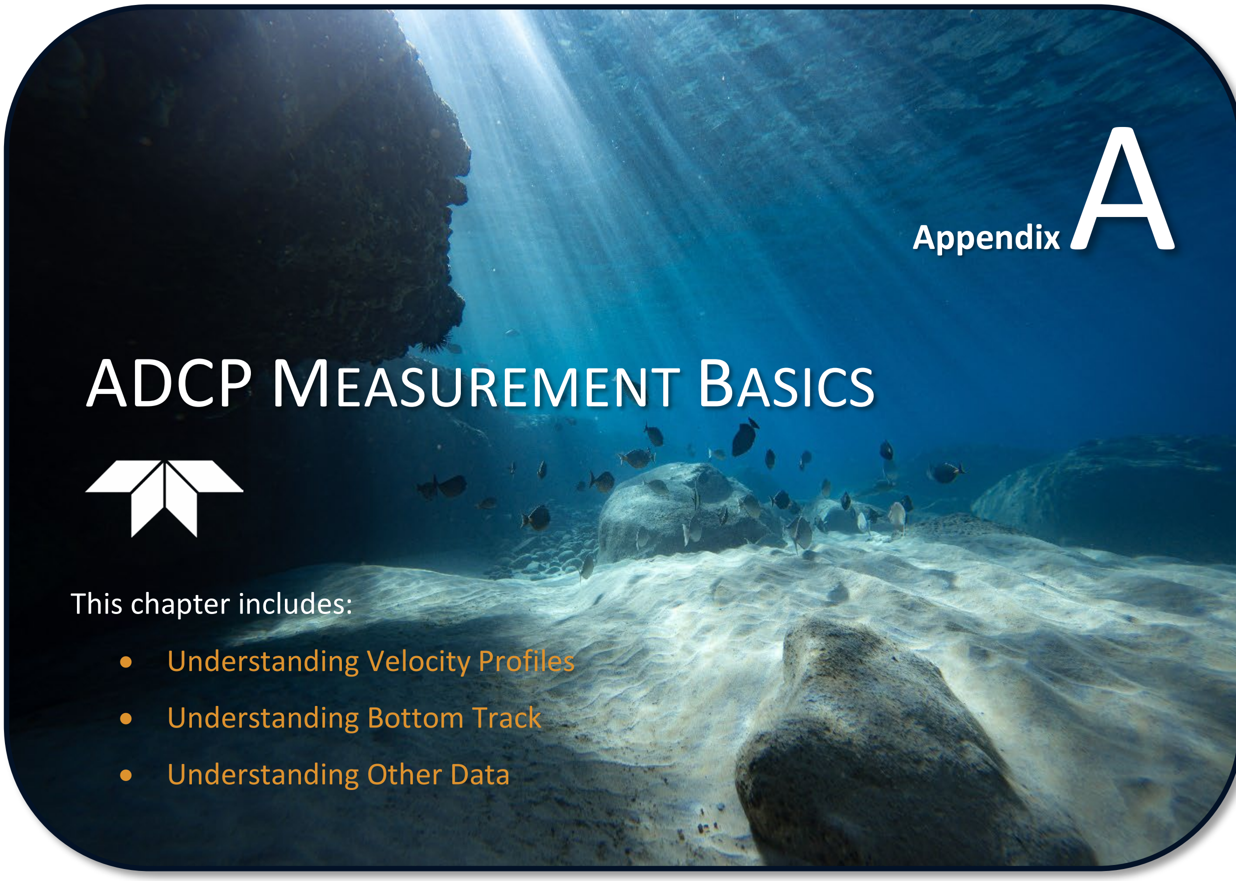


Figure 75. NMEA Message Header

NOTES



Appendix A

ADCP MEASUREMENT BASICS

This chapter includes:

- Understanding Velocity Profiles
- Understanding Bottom Track
- Understanding Other Data

The ADCP is an Acoustic Doppler Current Profiler. It measures vertical profiles of the water's velocity using acoustic energy. A pulse of energy (known as a *ping*) is transmitted into the water much like a submarine's SONAR but at much higher frequencies. This energy is reflected off particles suspended in (and moving with) the water and some of it returns to the ADCP. The ADCP measures the Doppler shift (change in frequency) of the reflected energy and from this, computes the velocity of the water relative to the ADCP. We won't go into the details in this manual. If you would like to learn more about how the ADCP measures velocity, please read the BroadBand ADCP Primer.

The ADCP also measures its own speed and direction across the bottom of the channel using the same technique used to measure the velocity of the water. The details of the measurement are different since the bottom is solid (or nearly so) compared to the water. The BroadBand ADCP Primer also has additional details concerning how bottom tracking operates.

Understanding Velocity Profiles

As the ADCP processes the signal reflected off the particles in the water, it divides the water column into a number of discrete segments stacked in the vertical. These segments are called *depth cells*. The ADCP determines the velocity and direction of each depth cell. If we graph the velocity as a function of depth, we get a velocity profile from near the surface to near the bottom. The thickness of the depth cells is something that you get to select (within certain constraints set by the instrument's design and the laws of physics). With a 1200 kHz ADCP these depths cells can be as small as 5 cm, or 10 cm for a 600 kHz system. So in water a few meters deep, you can make many simultaneous velocity measurements in the vertical dimension.

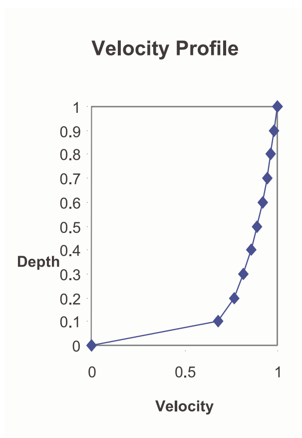


Figure 76. Velocity as a Function of Depth

Understanding Bottom Track

When water profiling, the ADCP measures the speed and direction of the water relative to the ADCP. So, an ADCP moving north at 1 m/s in calm water or water flowing south at 1 m/s past a stationary ADCP will both produce the same output from the ADCP for water velocity (see Figure 77). An ADCP moving north at 1 m/s through water flowing south at 1 m/s would produce an apparent water velocity of 2 m/s toward the south. The ADCP *bottom track* measures the speed and direction of the bottom motion relative to the

ADCP. By subtracting the ADCP velocity from the apparent (relative) water velocity, the true velocity of the water (with respect to the bottom) is determined.

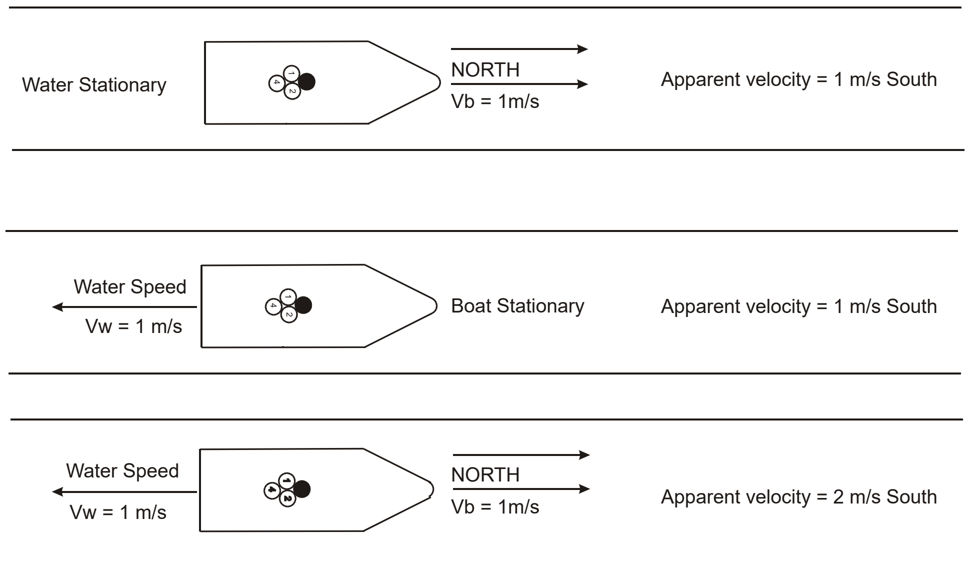


Figure 77. Boat versus Water Velocity

Understanding Other Data

The ADCP also records several other pieces of information that are related to the measurement of the velocity of the water. These are briefly described below.

Temperature. The ADCP has a sensor in the transducer head to measure the temperature of the water at the ADCP. Measurement of the velocity of the water (and the bottom) depends on the speed of sound in the water at the ADCP. The ADCP uses the measured water temperature along with a user-input value of salinity to calculate the sound speed.

Compass. The ADCP has a magnetic compass that measures the orientation of the ADCP relative to the earth's magnetic field. If you have requested earth coordinates for data collection (EX-command) the compass data will be used by the ADCP to output velocities in earth coordinates. *WinRiver II* will use the heading information to transform the raw data to earth coordinates before display if it has been collected in beam, instrument or ship coordinates.

Pitch and Roll. The ADCP also has pitch and roll sensors. These allow either the ADCP or the *WinRiver II* software to correct the velocity measurements for rocking or tilting of the ADCP.

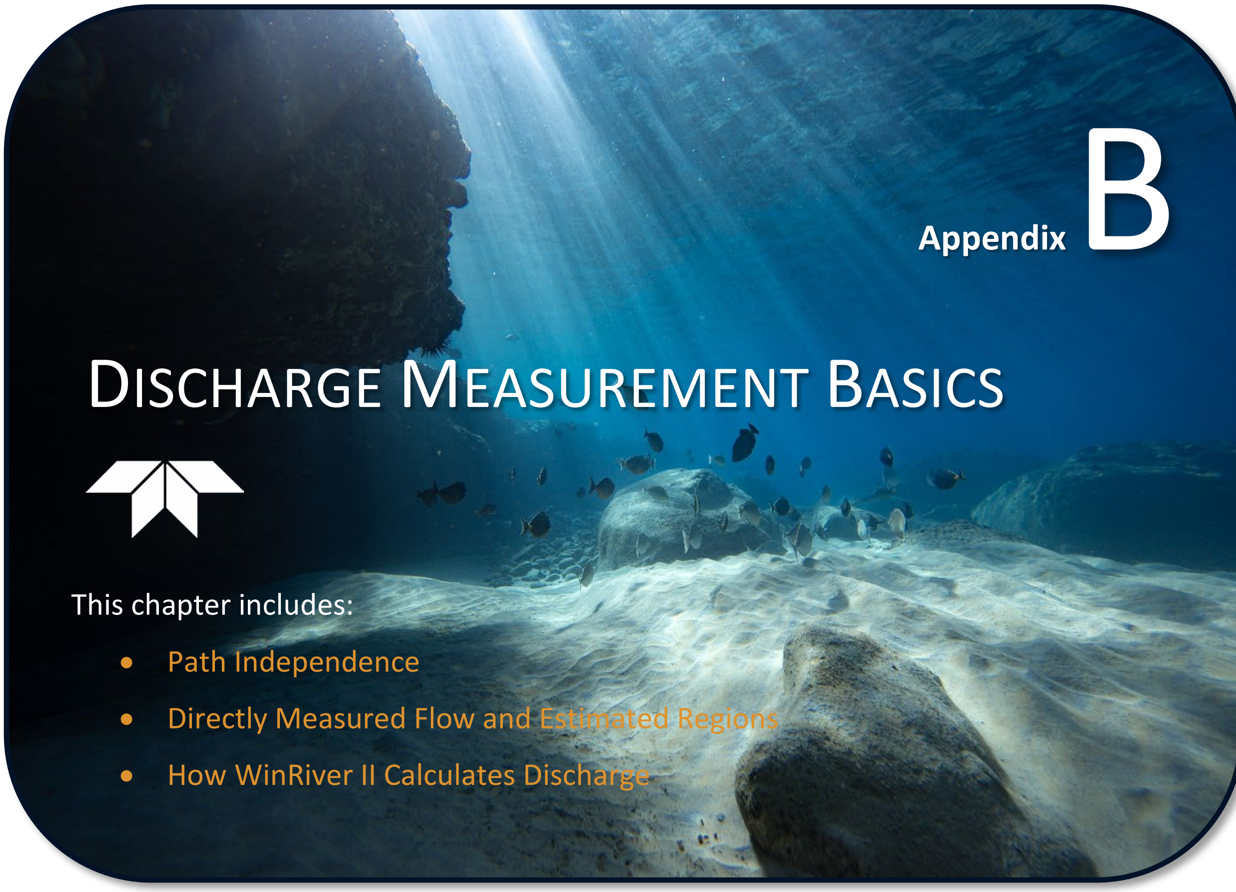
Intensity. The ADCP also records the intensity of the acoustic echoes received back from the energy scattered off the particles suspended in the water. This information is useful for verifying ADCP operation. It also provides a visual display of how sediment backscatter is distributed.

Correlation. The amplitude of the correlation function, in each depth cell, output by the ADCP is quality assurance for your data.

ADCP Percent Good. The ADCP can average data from individual pings internally to create ensemble data before sending it out. If for some reason, one ping of the ensemble has bad data, that information is not used in the average. Single ping ensembles are recommended, and in this case, the percent-good will be 100% (good data) or 0% (bad data).

Transect Percent Good. *WinRiver II* presents a percent good value that is different from that in the raw ADCP data. Within *WinRiver II*, this value represents the percentage of discharge calculations that are valid in a particular depth cell.

Real-time Clock. The ADCP has a real-time clock that measures time to 0.01-second precision and is accurate to within a few seconds per month for operating temperatures between 5 and 40 degrees Celsius. The date and time of a ping or ensemble is output as part of the data. The time between ensembles multiplied by the boat velocity is the displacement of the boat between ensembles. This is used to compute the discharge as well as to plot the boat trajectory.



Appendix B

Discharge Measurement Basics

This chapter includes:

- Path Independence
- Directly Measured Flow and Estimated Regions
- How WinRiver II Calculates Discharge

A typical discharge measurement is calculated from several transects of data. Referring to Figure 78, a transect goes across the river from point A to point B, and the total discharge ($\sum Q_1$) is recorded. A second transect is then made starting at point B and ending at point A, and the second total discharge ($\sum Q_2$) is determined. Continue this process until you have the desired number of transects. An even number of at least four transects is recommended to calculate the discharge at a site. The actual river discharge estimate will then be the average of the *N* individual transect discharge values.

$$\Sigma Q = \frac{(\Sigma Q_1 + \Sigma Q_2 + \Sigma Q_3 + \Sigma Q_4 + \ldots)}{N}$$

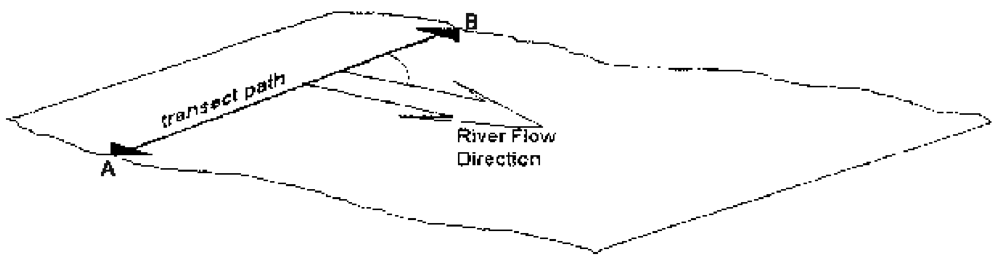


Figure 78. Transect Path

Path Independence

Discharge is the accumulated flow crossing perpendicular to the boat's path (see Figure 79). Any arbitrary line can define the cross-section across the river. It does not need to be straight across the river. The ADCP measures the actual path of the boat from the change in the boat's position. As well, it measures the flow across the path throughout the water depth. You do not need tag lines or even try to steer a straight course. This makes it much easier and safer to obtain a discharge measurement, particularly at high flood stages or at sites with high traffic or wide channels.

The *WinRiver II* software calculates the discharge using this information. *WinRiver II* can replace bottom tracking by using GPS data to measure the boat velocity and an external depth sounder to measure water depth.

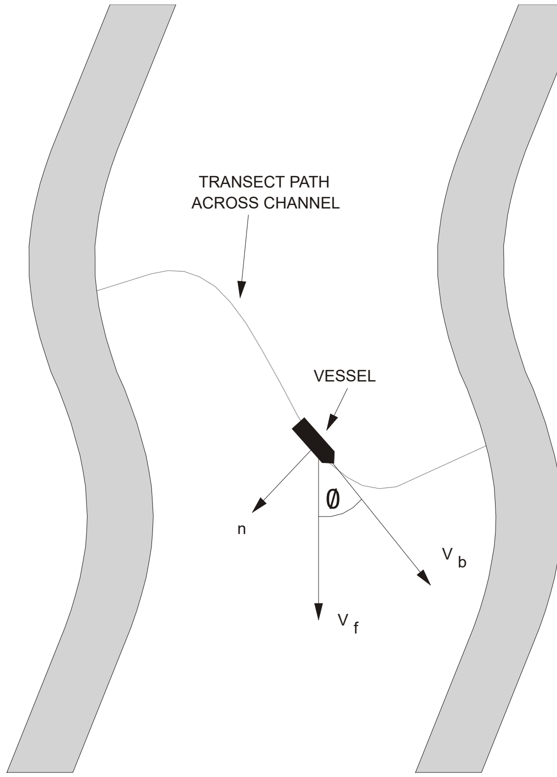


Figure 79. Discharge Calculation is Independent of the Boat's Path

Directly Measured Flow and Estimated Regions

The ADCP measures most of the water velocity from just in front of the ADCP to 6% above the bottom. At the channel edges, where the water is very shallow, the water depth is too shallow for the ADCP to profile. The *WinRiver II* software will estimate the discharge in these regions using several input values from the user. Each of these unmeasured regions will be discussed below. Refer to Figure 80 for an illustration of the unmeasured areas.

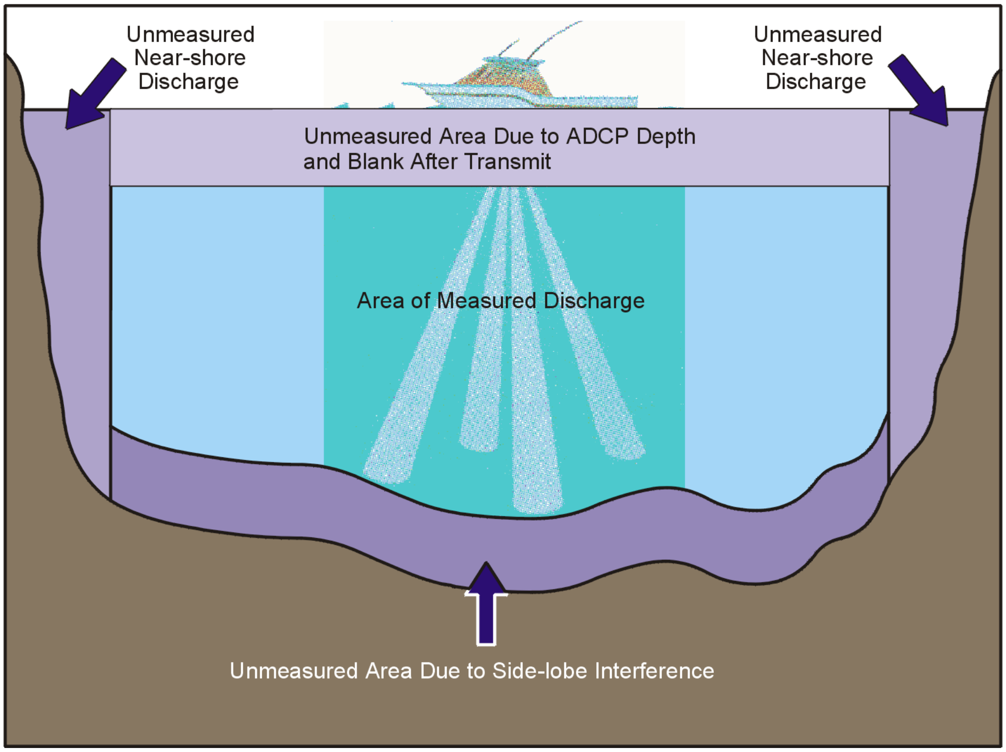


Figure 80. Unmeasured Regions in the Water Column

Near Surface Region

ADCP Depth. The acoustic transducers of the ADCP need to be completely covered with water. A typical transducer depth is around 20 cm, which will totally immerse the ADCP. This allows reasonable boat speeds before air is pulled beneath the transducer (which blocks the acoustic energy from getting into the water) and allows for some rocking of the boat. In calm water, you may be able to put the ADCP less deep and you may need to put it deeper if the water is rough or very fast.

Blank After Transmit. The same transducer is used to receive the acoustic energy after transmitting a pulse. A short time (or a short sound travel distance) must pass before receiving is possible. This delay is called the blanking distance, and it allows the ADCP to ring down and become acoustically quiet before receiving the return signal. For the 600 kHz and 1200 kHz Rio Grande ADCPs, this distance is 25 cm.

Pulse Structure – Lag. For general profiling (mode 1), the acoustic pulse sent out is actually two or more distinct pulses that are closely spaced. The spacing is called the lag. One lag is required beyond the blanking distance to start processing the data in the first bin.

The distance below the surface to the middle of the first cell for Mode 1 general purpose profiling is the sum of the ADCP depth, the blanking distance, and (bin +transmit length + lag)/2. For a 600 kHz ADCP in mode 1 with 50-cm depth cells, the distance to the top of the first depth cell is about 90 cm. The ADCP and the software will automatically calculate this distance for you (you have to tell the software the depth of the transducer).

Bottom Region

Side Lobes. There is also a shallow layer of water near the bottom for which the data is not used to compute discharge. When the ADCP sends out an acoustic pulse, a small amount of energy is transmitted in *side lobes* rather than in the direction of the ADCP beam. Side lobe reflection from the bottom can interfere with the water echoes. This gives erroneous velocities for the water near the bottom. *WinRiver II* does not use data in the region that may be affected. The ADCP has beams oriented at 20 degrees from the vertical, and the thickness of the side lobe layer is 6% of the distance from the transducers to the bottom (see Figure 81).

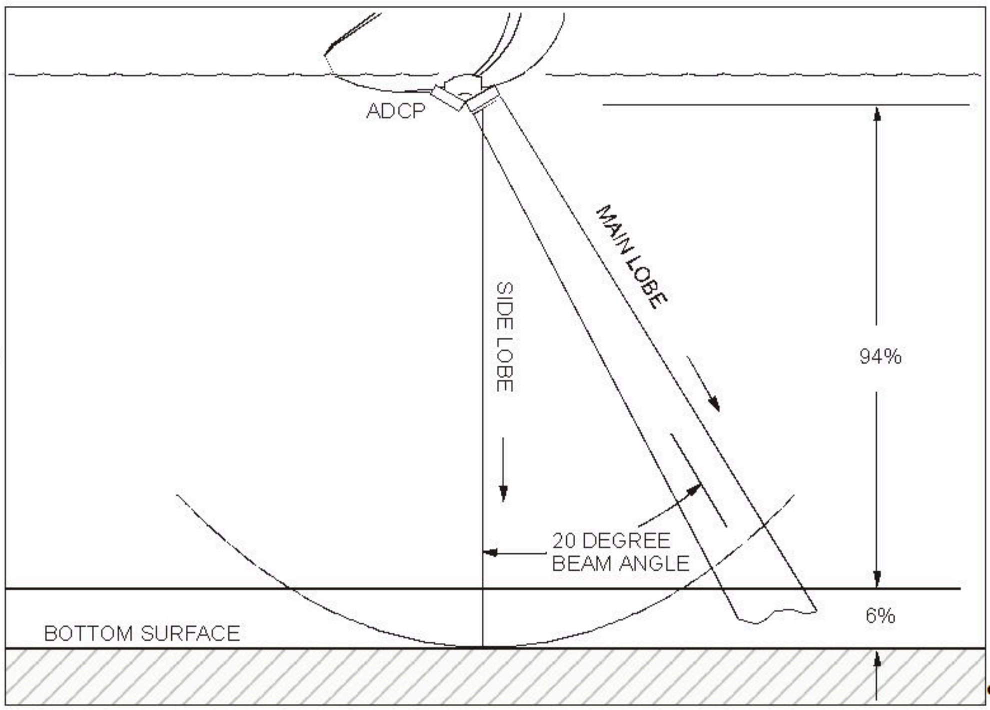


Figure 81. Side Lobes

Pulse length. *WinRiver II* also does not use any data within one depth cell of the bottom or the side lobe layer. The reason is that in the last depth cell, energy at the front of the pulse is reflecting off of the bottom while energy at the rear of the pulse is reflecting off of the water. The energy reflected from the front of the pulse contaminates the reflection from the rear of the pulse. So, no data from within the 6% side lobe layer plus one depth cell from the bottom is used.

Channel Edges

Minimum Depth. From the discussion of the top and bottom layers, you have probably deduced that there is a minimum depth in which you may acquire meaningful data. As you approach the sides of your channel, the water will become too shallow for the ADCP to make a valid measurement. The edges are determined by the last segment to have two valid bins and bottom track.

How WinRiver II Calculates Discharge

This section explains how *WinRiver II* calculates discharge. For the data measured by the ADCP, *WinRiver II* calculates discharge (measured water layer – Measured Q). For the unmeasured parts of the profile (top water layer – Top Q, bottom water layer – Bottom Q, left near-shore discharge - Left Q, right near-shore discharge – Right Q) *WinRiver II* estimates the discharge (Figure 80). *WinRiver II* accumulates these values over the entire transect (or subsection of a transect if selected). The total discharge (Total Q) is the summation of discharge in the top, measured, bottom, left, and right layers.

Discharge Calculations

Discharge is the total volume of water flowing through a cross-section of water per unit of time. *WinRiver II* computes this total volume discharge (ΣQ) for each ADCP ensemble. An ADCP measures profiles of water-current velocity relative to the vessel. The ADCP also measures the velocity of the vessel relative to the bottom and depth to the bottom for each ADCP beam. Computation of discharge depends only on these data. We do not need to know compass heading or vessel location. Furthermore, the transect can be an arbitrary curve (see Figure 79) as long as it starts near one side of a channel and ends near the other.

The uncertainty in the discharge estimate arises from random errors, biases, and missed data (near the surface and bottom, and near the sides of a channel). *WinRiver II* can extrapolate near-shore discharge (near the channel sides). The algorithm for estimating discharge is adopted from Simpson and Oltmann (1990), and Gordon (1989).

There are two methods available in *WinRiver II* for estimating the discharge in the unmeasured parts of the profile. You can use either the **Constant** method (i.e., "straight up and down") or a **Power** law method. If you select a **Power** method for either the top or bottom unmeasured part of the profile, you can select the exponent of the power law based on flow conditions and the roughness of the channel bed. For more information on the theory of power laws for flow resistance see Chen (1991).

Bottom Track velocity data from the ADCP must be valid for the moving-vessel discharge calculation to be correct. In cases where bottom-track is not functioning due to moving bottom effects, a GPS and Depth Sounders can be used. See Integrating Depth Sounder, External Heading, and GPS Data for more information.

We begin with a discussion of the moving-vessel method of determining discharge using an ADCP. We then discuss how *WinRiver II* implements this method and determines the size of the top, bottom, and middle water layers. The Discharge Calculation Terms page lists several terms used throughout our discussion. The explanations presented here assume the ADCP is looking down, so *first* implies *shallowest* and *last* implies *deepest*.

Discharge Calculation Terms

Term	Definition
Δt	Time difference between successive ensembles.
BtmQ	Estimated discharge for the unmeasured data at the bottom of the profile.
$^*D_a$	Depth cell (bin) size, or the length of the range gate. Each range gate corresponds to a depth cell. The ADCP constructs a profile from a series of range gates or depth cells.
D_{ADCP}	Depth of the ADCP transducer face from the water surface.
$^*D_b$	Blank beyond transmit.
D_{LG}	Depth of the last good bin (i.e., the last bin in middle water layer).
D_{LGmax}	Depth of the last possible good bin.
D	Depth to the bottom (i.e., the channel bed).
D_{avg}	Averaged measured depth from the ADCP beams (not including D_{ADCP}).

Term	Definition
*D_o	Lag between transmit pulses or correlation lag.
*D_p	Transmit pulse length. D_p is the length of a single transmit pulse. Broadband systems transmit two or more pulses. If the pulse is coded, this is the total length of one coded pulse, not the length of a single element.
*D_{top}	Depth of the center of the first bin.
MidQ	Discharge computed for the middle of the profile from ADCP or integrated GPS velocity and bottom-track data.
*N_p	Number of transmit pulses.
TopQ	Estimated discharge for the unmeasured data at the top of the profile.
X	Cross-product computed from ADCP data
X′	Synthetic cross-product computed from the power-curve fit

*These data are directly output by the ADCP.

Determining Moving-Vessel Discharge and the Cross-Product

The moving-vessel method for measuring total discharge using an ADCP is computed by transecting a channel from bank to bank and accumulating the discharge for each ensemble (see Figure 79). The general equation for determining total channel discharge (Q_t) through an arbitrary surface (*s*) is (Simpson and Oltmann, 1990; Gordon, 1989):

$$\iint_S V_f \cdot n \, ds \qquad (1)$$

where

- *ds* = Differential area.
- V_f = Mean water velocity vector.
- *n* = Unit vector normal to *WinRiver II* path at a general point.

For a vessel moving across a channel, the area of *s* is determined by the vertical surface beneath the *WinRiver II* path. Because the ADCP measures both vessel motion (ADCP bottom-track velocity) and water velocity, we can re-order the integral above (Equation 1) in the following form.

Let

- *dz* = Differential depth
- *dt* = Differential time
- V_b = Mean vessel velocity vector
- *T* = Total *WinRiver II* time
- *d* = Total depth (D_{total})
- *k* = Unit vector in the vertical direction

Then:

$$ds = \left|V_b\right| dz \, dt \qquad (2)$$

$$V_f \cdot n = \left|V_f\right| \sin(\theta) \qquad (3)$$

$$\iint_S V_f \cdot n\, ds = \int_0^T \int_0^d |V_f|\, |V_b|\, sin(\theta)\, dz\, dt \qquad (4)$$

$$= \int_0^T \int_0^d (V_f \times V_b) \cdot k\, dz\, dt \qquad (5)$$

Converting the cross-product (V_f x V_b) •k into rectangular (vessel) coordinates, we get:

$$(V_f \times V_b) \cdot k = F_x B_y - F_y B_x \qquad (6)$$

where:

F_x	= Cross-component of the mean water velocity vector.
F_y	= Fore/aft component of the mean water velocity vector.
B_x	= Cross-component of the mean vessel velocity vector.
B_y	= Fore/aft component of the mean vessel velocity vector.

The values for F_x, F_y, B_x, B_y are rotated to earth coordinates before computing the cross-product above (which does not affect the value of the cross-product). Note that *WinRiver II* converts these values to earth coordinates before any processing is done. Throughout the remainder of this section, we will assign the symbol X to represent the cross-product.

Estimating Discharge in the Unmeasured Top/Bottom Parts of the Velocity Profile

There are several methods available in *WinRiver II* to estimate discharge in the unmeasured top/bottom parts of the velocity profile based on the Top/Bottom Discharge Method settings. The **Top Discharge**

Methods are **Constant**, **Power**, and **3-pt Slope**. The **Bottom Discharge Methods** are **Power** and **No Slip**.

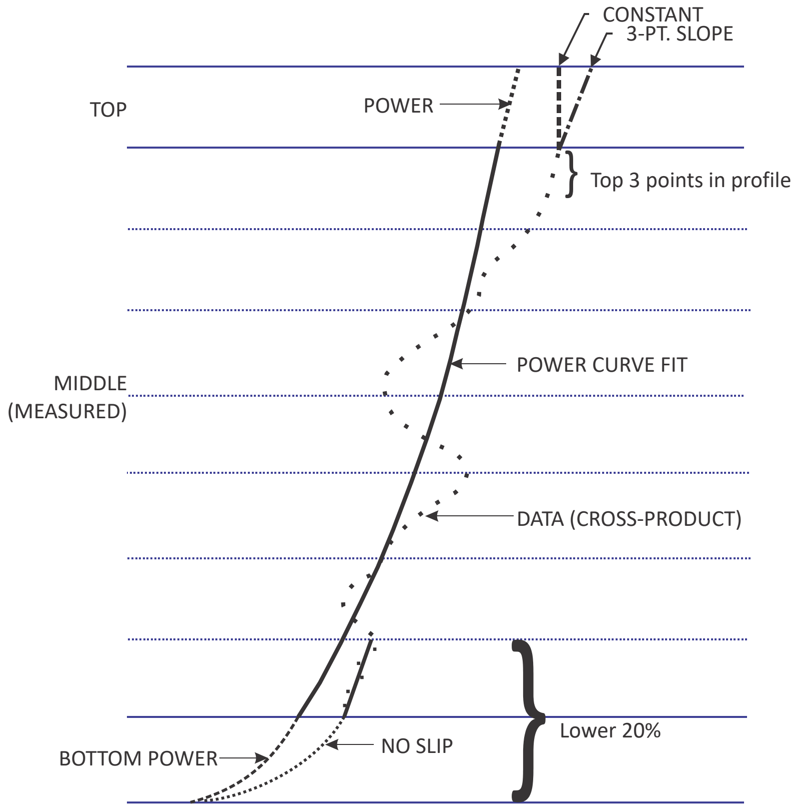


Figure 82. Discharge Extrapolation Method

3 Point Slope. This method for top extrapolation uses the top three bins to estimate a slope and this slope is then applied from the top bin to the water surface. A constant value or slope of zero is assumed if less than six bins are present in the profile.

No Slip. This method for bottom extrapolation uses the bins present in the lower 20% of the depth to determine a power fit forcing it through zero at the bed. In the absence of any bins in the lower 20% it uses the last single good bin and forces the power fit through it and zero at the bed. By making this selection the user is specifying that they do not believe a power fit of the entire profile is an accurate representation. If the **No Slip** method is selected, missing bins are estimated from the bin immediately above and below using linear interpolation.

Constant Method. This is the simplest method of estimating the discharge in the unmeasured parts of the profile. However, this method does not follow accepted hydraulic descriptions of the vertical distribution of horizontal water velocities in open channels, particularly in the bottom water layer near the bottom boundary where the velocity decreases to zero. Simpson and Oltmann (1990), and Gordon (1989), discuss this method. This "straight up and down" method extrapolates the cross-product from the first good bin in the profile to the top (TopQ). It can only be used for top extrapolation.

WinRiver II estimates the discharge for the top water layer by extrapolating the value of the cross-product in the first good bin to the surface. This method extrapolates data in a straight line to the surface.

$$TopQ = X_{FG}\,\Delta t\,(Z_3 - Z_2) \qquad (7)$$

Power Method. Chen (1991) discusses the theory of power laws for flow resistance. Simpson and Oltmann (1990) discuss Chen's power law equivalent of Manning's formula for open channels (with $b = 1/6$).

$$u / u^{*} = 9.5\,(z / z_0)^{b} \qquad (8)$$

where:

z	= Distance to the channel bed.
u	= Velocity at distance z from bed.
u^*	= Shear velocity.
z_0	= Bottom roughness height.
b	= Exponent (1/6).

Combining terms not from the ADCP we get:

$$u = (9.5u^{*} / z_0{}^{b})z^{b} \qquad (9)$$

If we let $a' = (9.5u^{*}/z_0{}^{b})$, then:

$$u = a'z^{b} \qquad (10)$$

For the moving boat discharge calculation, the cross-product (X) is computed from the ADCP velocities (Equation 6), replacing u in the power law of Equation 9:

$$X = a''z^{b} \qquad (11)$$

For each depth cell, *WinRiver II* computes the distance from the channel bed z and the cross-product X. The next step is to solve for the unknown a'' in the power law of Equation 10. *WinRiver II* solves for a'' by setting the anti-derivative of the power law equal to the cross-product values integrated over the valid depth range of the profile.

Let:

Z_1	= Distance from the channel bed to last (deepest) good bin
Z_2	= Distance from the channel bed to first (shallowest) good bin

The values for Z_1 and Z_2 define the region of the profile with valid ADCP data (see Figure 82). This is referred to as the middle layer of the profile. Determining the Size of the Top, Bottom, and Middle Water Layers, discusses how *WinRiver II* determines Z_1 and Z_2.

First, we integrate the ADCP data over the valid depth range.

Let

$$R_1 = \int_{Z_1}^{Z_2} X(z)\,dz \qquad (12)$$

Where: dz = *depth cell size* (D_a).

Therefore:

$$R_1 = D_a \sum_{i=Z_1}^{Z_2} X_i \qquad (13)$$

Second, use the anti-derivative of the power law of Equation 10 to integrate the power law over the middle water layer:

$$f(z) = a'' z^b \rightarrow F(z) = a'' \frac{z^{b+1}}{b+1} \qquad (14)$$

Let:

$$R_2 = \int_{Z_1}^{Z_2} f(z)\, dz \qquad (15)$$

$$= a'' \frac{z^{b+1}}{b+1} \Big|_{Z_1}^{Z_2} \qquad (16)$$

$$= \frac{a''(Z_2^{b+1} - Z_1^{b+2})}{b+1} \qquad (17)$$

Equating the integrals we solve for a'':

$$R_1 = R_2 \qquad (18)$$

$$D_a \sum_{i=Z_1}^{Z_2} X_i = a'' \left[\frac{Z_2^{b+1} - Z_1^{b+1}}{b+1} \right] \qquad (19)$$

$$a'' = \frac{D_a (b+1) \sum_{i=Z_1}^{Z_2} X_i}{Z_2^{b+1} - Z_1^{b+1}} \qquad (20)$$

Using a'', we can apply the anti-derivative of the power law to integrate over the unmeasured regions of the profile at the top and bottom.

WinRiver II estimates the discharge for the top water layer by integrating the power law of Equation 10 over the top water layer and multiplying by Δt (see Figure 82).

$$TopQ = \Delta t\, a'' \int_{Z_2}^{Z_3} Z^b dz \qquad (21)$$

$$= \frac{\Delta t D_a (Z_3^{b+1} - Z_2^{b+1}) \sum_{i=Z_1}^{Z_2} X_i}{Z_2^{b+1} - Z_1^{b+1}} \qquad (22)$$

WinRiver II estimates the discharge for the bottom water layer by integrating the power law of Equation 10 over the bottom water layer and multiplying by Δt (see Figure 82):

$$BtmQ = \Delta t\ a'' \int_0^{Z_1} z^b\ dz \tag{23}$$

$$= \frac{\Delta t\ D_a\ Z_1^{b+1} \sum_{i=Z_1}^{Z_2} X_i}{Z_2^{b+1} - Z_1^{b+1}} \tag{24}$$

Determining Near-Shore Discharge

You can use *WinRiver II* to estimate the discharge near the shore. *WinRiver II* uses a ratio-interpolation method for estimating the velocity between the channel bank and the first or last known mean velocity (V_m) determined by averaging water velocity in several ensembles (called segments). In the **Settings** menu, **Configuration Settings**, **Discharge** tab you can set that number as number of "Shore Pings". You can define the **Left** and **Right Bank Edge Type** by selecting the shape of the area between a channel bank and the first and the last segment or by specifying a coefficient. The formula for determining a near shore discharge is

$$Q_{shore} = C V_m L d_m \tag{25}$$

Where:

C	= Coefficient (0.3535 - for triangular, 0.91- for rectangular shape),
V_m	= Mean water velocity in the first or the last segment,
L	= Distance from the shore to the first or the last segment specified by the user,
d_m	= Depth of the first or the last segment.

It is highly recommended to enter the shore distances when prompted in *WinRiver II* Acquire mode. You will be prompted when you start or stop a transect. The distances will be written to the measurement file. During reprocessing, you can change these values in the **Edge Estimates** page (see Editing an Item During Playback).

Determining the Size of the Top, Bottom, and Middle Water Layers

Before computing discharge, *WinRiver II* must determine the size of the top, bottom, and middle water layers (see Discharge Calculation Terms for term definitions).

WinRiver II uses the center of the first depth cell to find the thickness of the top water layer. To compute the thickness of the top water layer, we start with the depth to the center of the first depth cell, D_{top}.

Standard Modes

$$D_{top} = D_{ADCP} + D_b + ((D_p + D_0 + D_a)/2) \tag{26}$$

Pulse Coherent Modes

$$D_{top} = D_{ADCP} + D_b + ((D_p + D_a)/2) \tag{27}$$

For the total water depth, we use the average of the beam depths.

$$D_{avg} = Average\ of\ \ four\ beam\ depths \qquad (28)$$

WinRiver II computes the last good bin depth from D_{min} (minimum beam depth) by determining the depth of noise interference from the acoustic side lobes, adding the depth of the transducer face from the surface, and subtracting a thickness that depends on the transmit pulse sequence.

Standard Modes

$$D_{LG\max} = (D_{\min} \cos(\theta) + D_{ADCP}) - ((D_p + D_0)/2) \qquad (29a)$$

Pulse Coherent Modes

$$D_{LG\max} = (D_{\min} \cos(\theta) + D_{ADCP}) - (D_p /2) \qquad (30b)$$

D_{LGmax} is the last possible depth of a good bin. D_{LG} is the depth of the lowest bin that is above D_{LGmax}. The position of the last good depth cell (D_{LG}) gives us the starting depth of the bottom water layer. The valid ADCP velocity data in depth cells starting at D_{top} and ending at D_{LG} are used to calculate the middle layer discharge (Mid*Q*). *WinRiver II* obtains the distance to the bottom (D_{total}) as:

$$D_{total} = D_{avg} + D_{ADCP} \qquad (31)$$

From the proceeding we can define the boundaries of the water layer (see Figure 82) where each is referenced from the bottom boundary:

$$Z_1 = D_{total} - D_{LG} - D_a/2 \qquad (32)$$

$$Z_2 = D_{total} - D_{top} + D_a/2 \qquad (33)$$

$$Z_3 = D_{total} \qquad (34)$$

The water layer thickness follows:

$$Top\ Layer = Z_3 - Z_2 \qquad (35)$$

$$Middle\ Layer = Z_2 - Z_1 \qquad (36)$$

$$Bottom\ Layer = Z_1 \qquad (37)$$

Calculating Middle Layer Discharge (MidQ)

WinRiver II calculates the middle layer discharge over the range determined by the middle water layer thickness (Equation 29). For each bin, WinRiver II computes the discharge in that bin using the cross-product (Equation 6) and the time difference between successive ensembles.

$$Q_i = X_i\ \Delta t\ D_a \qquad (38)$$

where:

i = Bin number.

Q_i = Discharge in the i^{th} bin.
Δt = Time between last good and next good ensemble

NOTE. If there are for example two bad ensembles, Δt accounts for time between the bad ensembles. A small number of missing/bad ensembles will not greatly affect the discharge.

WinRiver II determines the discharge for the middle layer by summing all the discharges from the individual bins.

$$MidQ = \sum_{i=1}^{N} Q_i \qquad (39)$$

Where:

FG = The first good bin. If the first bin has bad data, *WinRiver II* increments *i* until it finds good data. If *WinRiver II* does not find good data, it does not calculate discharge for that ensemble.

LG = The number of the last good bin just above the bin that D_{LG} intersects.

Distance Calculations

WinRiver II uses the following formulas to calculate distance:

Distance Made Good

$$DEast = DEast + 1/2 * (VEast[n-1] + VEast[n]) * (T[n] - T[n-1]) \qquad (40)$$

$$DNorth = DNorth + 1/2 * (VNorth[n-1] + VNorth[n]) * (T[n] - T[n-1]) \qquad (41)$$

$$Dgood = \sqrt{DEast^2 + DNorth^2} \qquad (42)$$

Where:
D = distance
V = velocity
n = the ensemble number
T = time

Total Length of Course Over Ground (called **Length** in *WinRiver II* display).

$$LEast = 1/2 * (VEast[n-1] + VEast[n]) * (T[n] - T[n-1]) \qquad (43)$$

$$LNorth = 1/2 * (VNorth[n-1] + VNorth[n]) * (T[n] - T[n-1]) \qquad (44)$$

$$Length = Length + \sqrt{LEast^2 + LNorth^2} \qquad (45)$$

Where:
L = length
n = the ensemble number

V = velocity T = time

Water Speed Calculations

WinRiver II uses the following formula to calculate water speed:

$$Water\ Speed = \frac{\text{TopQ} + \text{MiddleQ} + \text{BottomQ}}{\text{Ensemble area}}$$

Flow speed Calculation

WinRiver II uses the following formula to calculate flow speed:

$$Flow\ Speed = \sqrt{\left(\frac{SumEast}{Total}\right)^2 + \left(\frac{SumNorth}{Total}\right)^2}$$

References

The following references were used in preparing this section.

Chen, Cheng-Lung (1991). "Unified Theory on Power Laws for Flow Resistance." Journal of Hydraulic Engineering, Vol. 117, No. 3, March 1991, 371-389.

Simpson, M. R. and Oltmann, R. N. (1990). "An Acoustic Doppler Discharge Measurement System." Proceedings of the 1990 National Conference on Hydraulic Engineering, Vol. 2, 903-908.

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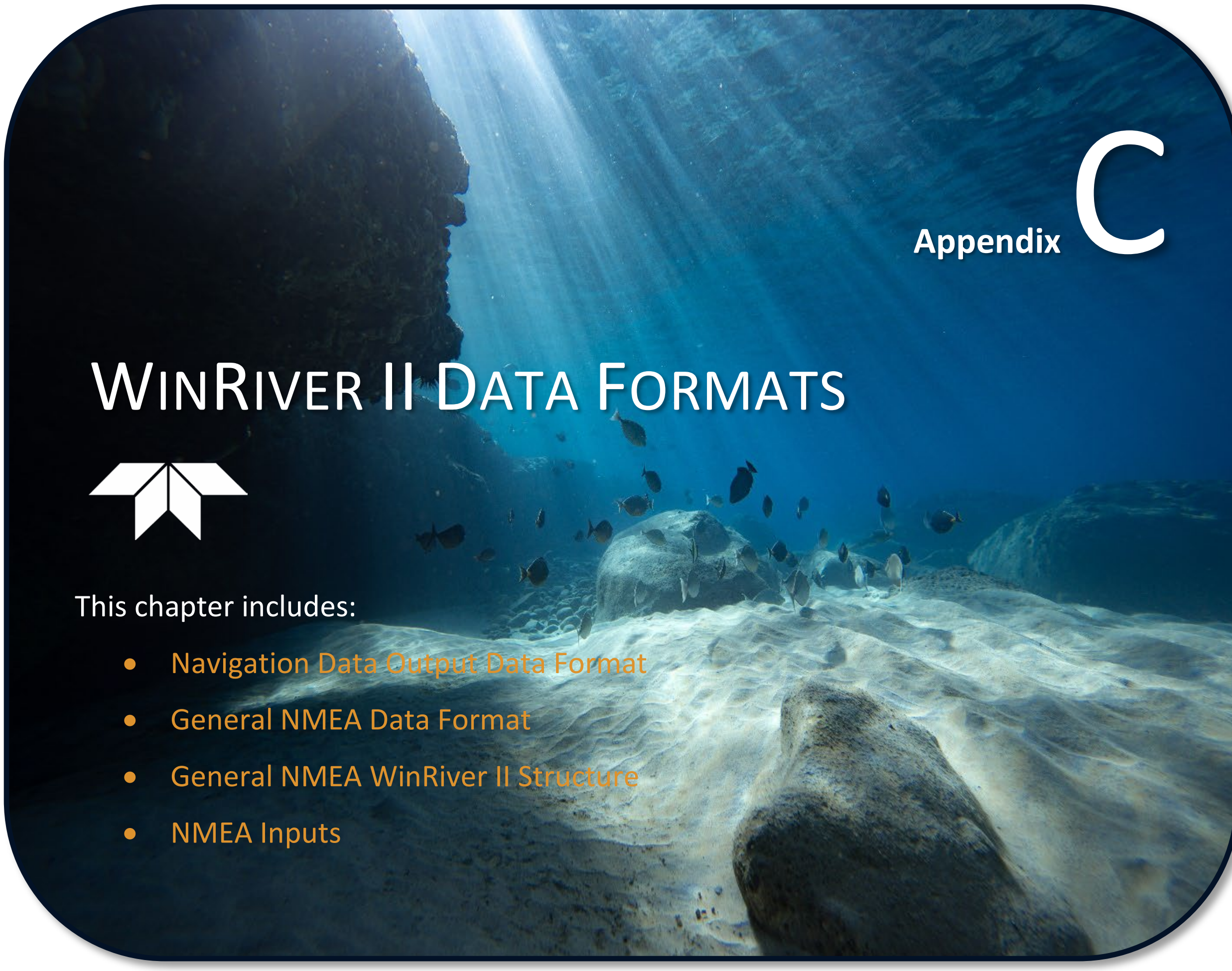
NOTES



Appendix C

WinRiver II Data Formats

This chapter includes:

- Navigation Data Output Data Format
- General NMEA Data Format
- General NMEA WinRiver II Structure
- NMEA Inputs

Navigation Data Output Data Format

WinRiver II can read in, decode, and record ensembles from an ADCP and NMEA data from some specific (i.e. GPS and attitude sensors) external devices. *WinRiver II* stores this data in the *.PD0 raw data file (leaving all original data input from the ADCP in its original format).

Table 20: Navigation Data Structure

ALWAYS OUTPUT	**HEADER** (6 BYTES + [2 x No. OF DATA TYPES])
	FIXED LEADER DATA (59 BYTES)
	VARIABLE LEADER DATA (65 BYTES)
WD-command WP-command	**VELOCITY** (2 BYTES + 8 BYTES PER DEPTH CELL)
	CORRELATION MAGNITUDE (2 BYTES + 4 BYTES PER DEPTH CELL)
	ECHO INTENSITY (2 BYTES + 4 BYTES PER DEPTH CELL)
	PERCENT GOOD (2 BYTES + 4 BYTES PER DEPTH CELL)
BP-command	**BOTTOM TRACK DATA** (85 BYTES)
General NMEA (*WinRiver II* Structure)	**General NMEA** (14 BYTES + msg body)
NMEA Strings (for backwards compatibility with *WinRiver*)	**DEPTH SOUNDER (DBT)** (38 BYTES)
	GPS GGA (97 BYTES)
	GPS VTG (45 BYTES)
ALWAYS OUTPUT	**RESERVED** (2 BYTES)
	CHECKSUM (2 BYTES)

The other formats (Header, Fixed Leader Data, etc.) are explained in the WorkHorse Commands and Output Data Format guide.

Use the Binary Header Data Format to locate the offset to the specific ID of the data type you wish to decode. The table below shows the navigation IDs.

Table 21: Fixed Leader Navigation ID Word

ID	Description
0x2022	General NMEA structure
0x2100	$xxDBT
0x2101	$xxGGA
0x2102	$xxVTG
0x2104	$xxHDT

PDDecoder Library in C language

The Teledyne Marine PDDecoder library is an open-source library written in C language to decode the PD0 data formats that are commonly output by Teledyne Marine/Teledyne RD Instruments ADCPs. The definition and details of the PD0 format can be found in the Workhorse Commands and Output Data Format guide. Available for download from the Teledyne software portal:

https://tm-portal.force.com/TMsoftwareportal

NMEA Message Format

Much of the following information was abstracted from the NMEA 0183 standard. Discussion is limited to NMEA strings that *WinRiver II* understands. All NMEA messages are ASCII strings with the general format as shown in Table 22.

Table 22: NMEA Message Format

String	Description
$	HEX 24 – start of sentence
<Address field>	Approved address fields consist of five characters defined by the NMEA 0183 standard. The first two characters are the TALKER identifier. The next three characters identify the message. The proprietary address field consists of the proprietary character "P" followed by a three-character Manufacturer's Mnemonic Code, used to identify the TALKER issuing a proprietary sentence, and any additional characters as required. NOTE: This is not supported by WinRiver II. (*WinRiver II* accepts any <u>two</u> valid characters as the TALKER identifier in approved address fields.) (Teledyne RD Instruments uses the TRDI Mnemonic Code for proprietary address fields, even though it is assigned to Radar Devices. *WinRiver II* also uses the unassigned ADC Mnemonic Code for its own data files).
[","<data field>] . . . [","<data field>]	Zero or more data fields, each preceded by a "," (comma, HEX 2C) delimiter. The number of data fields and their content are determined by the address field. Data fields may be null (contain no characters). The comma delimiter is required even when a data field is null.
["*"checksum field]	Checksum The checksum is the 8-bit exclusive OR (no start or stop bits) of all characters in the sentence, including "," delimiters, between but not including the "$" and the "*" delimiters. The hexadecimal value of the most significant and least significant 4 its of the result are converted to two ASCII characters (0-9, A-F) for transmission, The most significant character is transmitted first.
<CR><LF>	HEX 0D 0A – End of sentence

Data Fields

Detailed descriptions of each message *WinRiver II* uses are provided below. These descriptions use format specifiers for data fields. The meanings of some of the format specifiers are listed in Table 23.

Table 23: Data Fields

Field	Description
hhmmss.ss	A mixed fixed/variable length time field. 2 fixed digits of hours, 2 fixed digits of minutes, 2 fixed digits of seconds, and a variable number of digits for decimal-fraction of seconds. Leading zeros are always included for hours, minutes, and seconds to maintain fixed length. The decimal point and associated decimal-fraction are optional if full resolution is not required.
x.x	A variable length integer or floating numeric field with optional leading and trailing zeros. The decimal point and associated decimal-fraction are optional if full resolution is not required. (example: 73.10 = 73.1 = 073.1 = 73). A negative sign "-" (HEX 2D) is the first character if the value is negative. The sign is omitted if value is positive.
hh	A fixed length HEX number. The most significant digit is on the left.
a aa aaa etc.	A fixed length alpha field. This type of field contains a fixed number of upper-case or lower-case alpha characters. In all strings recognized by *WinRiver II*, all these fields have a length of one character.

Field	Description
x xx xxx etc.	A fixed length numeric field. This type of field contains a fixed number of numeric characters (0 - 9). Some fields allow negative values. If needed, a negative sign "-" (HEX 2D) is the first character, increasing the length of the field by one. The sign is omitted if value is positive.
A	A single character status field. A = Yes, Data Valid, or Warning Flag Clear. V = No, Data Invalid, or Warning Flag Set.
Other single letter	A single character field with fixed content. The letter is the content of the data field. When used below, the HEX value of the letter is also given.

Spaces should not be used anywhere in these NMEA strings. Spaces may only be used in variable text fields. No NMEA string recognized by *WinRiver II* uses a variable text field.

If data is not available or unreliable, a null field is used. A null field is a field with no characters in it. When a null field is present, two delimiters (comma, *, or <CR>) are found side by side. A null field does NOT contain the zero character (HEX 30), the ASCII NUL character (HEX 00), a space (HEX 20), or other character.

WinRiver II ignores some fields when it decodes messages. The fields it reads are explained in NMEA Input.

General NMEA WinRiver II Structure

The general NMEA structure used by WinRiver II has evolved over time as dictated by changing requirements, including but not limited to the addition of geo-referencing GPS hardware in select ADCPs. This structure contains variable content, differentiated by specific subtype IDs. A single PD0 ensemble will likely contain multiple instances of the General NMEA structure. Those instances may consist of multiple IDs and multiple instances of each ID. The process of integrating NMEA data into the PD0 data stream can also impact the specific subtype ID present in the data. In addition, NMEA data integrated into the PD0 data stream by the WinRiver II software may also generate the original WinRiver NMEA structures (0x2100, 0x2101, 0x2102, and 0x2104).

The *BBConv* utility and decoders cannot be used with General NMEA Structure data since multiple instances and formats exist and many of them are incompatible with the decoder structure.

Table 24: General NMEA WinRiver II Structure

General ID	Specific ID	Msg Size	Delta Time	Msg Body
0x2022	see below			
2 bytes	2 bytes	2 bytes	8 bytes	n bytes

Table 25. Summary of NMEA source and Subtype IDs

NMEA data source	GGA	VTG	DBT	HDT	Other
ADCP's Internal geo-referencing GPS	004	005			
WinRiver II versions Prior to 2.00	100	101	102	103	
WinRiver II versions 2.00 and greater	104	105	106	107	
ADCP integrated NMEA data	204	205	206	207	200

The message body for specific subtypes 004, 005, 104, 205, 206, 207, and 200 consists of the actual unmodified ASCII NMEA message. Formats for the NMEA GGA, VTG, DBT, and HDT messages are provided below.

IDs 100, 101, 102, and 103 are used by versions prior to *WinRiver II* version 2.00.

Table 26. General NMEA message body Structures (prior to ver. 2.00)

Structure	ID
S_NMEA_GGA	100
S_NMEA_VTG	101
S_NMEA_DBT	102
S_NMEA_HDT	103

Specific ID=100 (GGA)

```
typedef struct S_NMEA_GGA
{
    TCHAR   szHeader[10];
    TCHAR   szUTC[10];
    DOUBLE  dLatitude;
    TCHAR   tcNS;
    DOUBLE  dLongitude;
```

```
    TCHAR   tcEW;
    BYTE    ucQuality;
    BYTE    ucNmbSat;
    FLOAT   fHDOP;
    FLOAT   fAltitude;
    TCHAR   tcAltUnit;
    FLOAT   fGeoid;
    TCHAR   tcGeoidUnit;
    FLOAT   fAgeDGPS;
    SHORT   sRefStationId;
}S_NMEA_GGA;
```

Specific ID=101 (VTG)

```
typedef struct S_NMEA_VTG
{
    TCHAR   szHeader[10];
    FLOAT   fCOGTrue;
    TCHAR   tcTrueIndicator;
    FLOAT   fCOGMagn;
    TCHAR   tcMagnIndicator;
    FLOAT   fSpdOverGroundKts;
    TCHAR   tcKtsIndicator;
    FLOAT   fSpdOverGroundKmh;
    TCHAR   tcKmhIndicator;
    TCHAR   tcModeIndicator;
}S_NMEA_VTG;
```

Specific ID=102 (DBT)

```
typedef struct S_NMEA_DBT
{
    TCHAR   szHeader[10];
    FLOAT   fWaterDepth_ft;
    TCHAR   tcFeetIndicator;
    FLOAT   fWaterDepth_m;
    TCHAR   tcMeterIndicator;
    FLOAT   fWaterDepth_F;
    TCHAR   tcFathomIndicator;
}S_NMEA_DBT;
```

Specific ID=103 (HDT)

```
typedef struct S_NMEA_HDT
{
    TCHAR   szHeader[10];
    double  dHeading;
    TCHAR   tcTrueIndicator;
}S_NMEA_HDT;
```

IDs 104, 105, 106, and 107 are used by *WinRiver II* version 2.00 and later.

Table 27: General NMEA message body Structures (ver. 2.00 and later)

Structure	ID
S_NMEA_GGA_V2	104
S_NMEA_VTG_V2	105
S_NMEA_HDT_V2	107
S_NMEA_DBT_V2	106

```
typedef struct S_NMEA_GGA_V2
{
    CHAR     szHeader[7];
    CHAR     szUTC[10];
    DOUBLE   dLatitude;
    CHAR     tcNS;
    DOUBLE   dLongitude;
    CHAR     tcEW;
    BYTE     ucQuality;
    BYTE     ucNmbSat;
```

```
    FLOAT   fHDOP;
    FLOAT   fAltitude;
    CHAR    tcAltUnit;
    FLOAT   fGeoid;
    CHAR    tcGeoidUnit;
    FLOAT   fAgeDGPS;
    SHORT   sRefStationId;
} S_NMEA_GGA_V2;

typedef struct S_NMEA_VTG_V2
{
    CHAR    szHeader[7];
    FLOAT   fCOGTrue;
    CHAR    tcTrueIndicator;
    FLOAT   fCOGMagn;
    CHAR    tcMagnIndicator;
    FLOAT   fSpdOverGroundKts;
    CHAR    tcKtsIndicator;
    FLOAT   fSpdOverGroundKmh;
    CHAR    tcKmhIndicator;
    CHAR    tcModeIndicator;
} S_NMEA_VTG_V2;

typedef struct S_NMEA_HDT_V2
{
    CHAR    szHeader[7];
    double  dHeading;
    CHAR    tcTrueIndicator;
} S_NMEA_HDT_V2;

typedef struct S_NMEA_DBT_V2
{
    CHAR    szHeader[7];
    FLOAT   fWaterDepth_ft;
    CHAR    tcFeetIndicator;
    FLOAT   fWaterDepth_m;
    CHAR    tcMeterIndicator;
    FLOAT   fWaterDepth_F;
    CHAR    tcFathomIndicator;
} S_NMEA_DBT_V2;
```

NMEA Inputs

The NMEA messages *WinRiver II* reads are standard DBT, GGA, VTG, and HDT messages.

DBT – Depth Below Transducer

Water depth referenced to the transducer.

$__DBT,x.x,f,x.x,M,x.x,F*hh<CR><LF>

Table 28: DBT NMEA Format

Field		Description
1*	x.x	Water depth, feet
2	f	HEX 66
3	x.x	Water depth, Meters
4	M	HEX 4D
5	x.x	Water depth, Fathoms
6	F	HEX 46

* This field is used by *WinRiver II*.

The first two characters must match your device and are set in the Peripheral Configuration Dialog (see System Interconnections with the Depth Sounder).

GGA – Global Positioning System Fix Data

Time, position, and fix related data for a GPS receiver.

$__GGA,hhmmss.ss,llll.ll,a,yyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>

Table 29: GGA NMEA Format

Field		Description
1*	hhmmss.ss	UTC of position - 2 fixed digits of hours, 2 fixed digits of minutes, 2 fixed digits of seconds, and a variable number of digits for decimal-fraction of seconds. Leading zeros are always included for hours, minutes, and seconds to maintain fixed length. The decimal point and associated decimal-fraction are optional if full resolution is not required.
2*	llll.ll	Latitude - Two fixed digits of degrees, 2 fixed digits of minutes, and a variable number of digits for decimal-fraction of minutes. Leading zeros are always included for degrees and minutes to maintain fixed length of the first 4 chars. The decimal point and associated decimal-fraction are optional if full resolution is not required.
3*	a	Latitude hemisphere. N or S.
4*	yyyy.yy	Longitude - 3 fixed digits of degrees, 2 fixed digits of minutes, and a variable number of digits for decimal-fraction of minutes. Leading zeros are always included for degrees and minutes to maintain fixed length of the first 5 chars. The decimal point and associated decimal-fraction are optional if full resolution is not required.
5*	a	Longitude hemisphere. E or W.

Field		Description
6*	x	GPS Quality indicator: 0 = fix not available or invalid 1 = GPS fix 2 = Differential GPS fix 3 = GPS PPS Mode, fix valid 4 = Real Time Kinematic. System used in RTK mode with fixed integers 5 = Float RTK. Satellite system used in RTK mode, floating integers 6 = Estimated (dead reckoning) mode 7 = Manual Input Mode 8 = Simulator mode 9 = Position computed using almanac This shall not be a null field.
7*	xx	Number of satellites in use, 00 – 12, may be different from the number in view
8	x.x	Horizontal dilution of precision
9*	x.x	Antenna altitude above/below mean-sea-level (geoid)
10	M	HEX 4D. Units of antenna altitude, meters
11	x.x	Geoidal separation. The difference between the WGS-84 earth ellipsoid and mean-sea-level (geoid), "-" = mean-sea-level below ellipsoid.
12	M	HEX 4D. Units of geoidal separation, meters
13	x.x	Age of Differential GPS data. Time in seconds since last SC104 Type 1 or 9 update, null field when DGPS is not used.
14	xxxx	Differential reference station ID, 0000-1023

* This field is used by *WinRiver II*.

The first two characters must match your device and are set in the Peripheral Configuration Dialog (see System Interconnections with the Depth Sounder for an example).

VTG – Track Made Good and Ground Speed

The actual track made good and speed relative to the ground.

$__VTG,x.x,T,x.x,M,x.x,N,x.x,K,a*hh<CR><LF>

Table 30: VTG NMEA Format

Field		Description
1*	x.x	Track, degrees true
2	T	HEX 54
3*	x.x	Track, degrees magnetic
4	M	HEX 4D
5	x.x	Speed, knots
6	N	HEX 4E
7*	x.x	Speed, km/hr
8	K	HEX 4B

Field		Description
9	a	Mode indicator A=Autonomous mode D=Differential mode E=Estimated (dead reckoning) mode M=Manual input mode S=Simulator mode N=Data not valid This shall not be a null field.

* This field is used by *WinRiver II*.

The first two characters must match your device and are set in the Peripheral Configuration Dialog (see System Interconnections with the Depth Sounder for an example).

HDT – Heading – True

Actual vessel heading in degrees True produced by any device or system producing true heading.

$__HDT,x.x,T *hh<CR><LF>

Table 31: HDT NMEA Format

Field		Description
1*	x.x	Heading, degrees True
2	T	HEX 54

* This field is used by *WinRiver II*.

The first two characters must match your device and are set in the Peripheral Configuration Dialog (see System Interconnections with the Depth Sounder for an example).

Further Information About NMEA Strings

Users who need full details about NMEA data strings can find more information in the NMEA 0183 standard, available from the National Marine Electronics Association at.

P O Box 3435 New Bern, NC 28564-3435	252-638-2626 (voice) 252-638-4885 (fax)	nmea@coastalnet.com (e-mail) http://www.nmea.org/ (web site)

Appendix D

Manual Compass Calibration

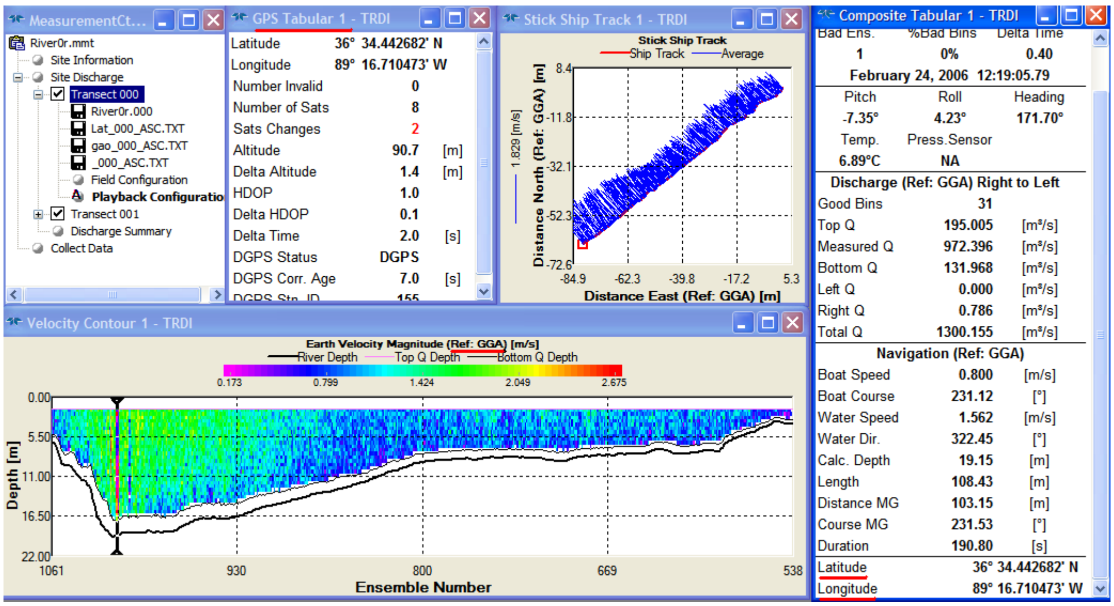
This chapter includes:

- Manually Calculating Magnetic Variation
- Manual One-Cycle Compass Correction

Manually Calculating Magnetic Variation

To determine the local magnetic variation manually:

1. Find a calm low current area where there are no moving bed effects to carry out this procedure. You must be collecting and using GPS data and be able to bottom track in the chosen location, and you must first complete the compass calibration procedures described above.
2. Create or open a workspace file (see Creating a Workspace) that has the **Composite Tabular 1** and **GPS Tabular 1** displays, and a **Ship Track** display.



3. On the **Settings** menu, **Reference**, set the reference to **GPS (GGA)**.
4. On the Offsets Page, set the **Magnetic Variation** value and compass correction (**One Cycle K** and **One Cycle Offset**) values to zero. Ensure that the **Beam 3 Misalignment** and Heading Offset angles are correctly set if you are using an external heading.
5. Mark a starting point. This should be a point that you can easily reference to (an end of a pier, or a stationary marker).
6. Start *WinRiver II* and load a measurement file. Press **F4** to start pinging. Press **F5** to start recording.
7. Drive a straight track with constant heading (accelerate slowly and maintain a slow steady speed) for at least 200 meters (the longer the course the better) as shown in Figure 83. Monitor the heading display in the **Standard Tabular** view, and adjust your course to stay on a constant heading (not a constant course).
8. Drive a track along the opposite heading direction as shown in Figure 83.

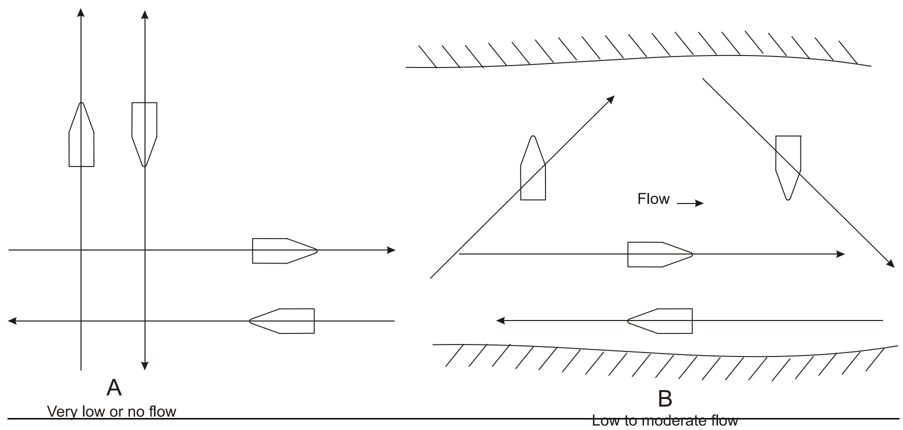


Figure 83. Reciprocal Constant Heading Tracks for Determining Magnetic Variation

9. Record the value of **GC-BC** from the **Compass Calibration Tabular** screen as shown in Figure 84. This is the compass error on this course (variation + deviation). Press **F5** to stop recording.

BMG-GMG mag	60.4	[m]
BMG-GMG dir	302.5	[°]
GC-BC	12.3	[°]
BC/GC	0.992	

Figure 84. Determining Local Magnetic Variation

10. Drive a track along the opposite heading direction as shown in Figure 83. Press **F5** to start recording.
11. Record the value of **GC-BC**. Use the average of the two values to estimate the magnetic variation. Use as many pairs of reciprocal tracks along other heading directions as desired to get a better value (a total four vectors, which is two track pairs in approximately orthogonal directions, is recommended). Average the values of **GC-BC** for all of the tracks. This averaged value is the local magnetic variation.
12. Modify the Offsets Page and enter the **Magnetic Variation** value (east magnetic declination values are positive; west values are negative).
13. Make sure the modified playback configuration is set as the **Active Configuration** (see Configuration Node Menu Options). When the data is played back, average the **GC-BC** value for two reciprocal headings. This value should be close to zero if the correction was made correctly (Figure 85).

BMG-GMG mag	2.4	[m]
BMG-GMG dir	231.7	[°]
GC-BC	0.1	[°]
BC/GC	0.992	

Figure 85. Data Corrected for Local Magnetic Variation

Manual One-Cycle Compass Correction

In rare circumstances the integrated compass calibration procedures may not work reliably. Ferrous objects in the vicinity of the ADCP can affect the internal magnetic compass. These effects will show up as one and two cycle errors in the compass heading. The one-cycle errors can be corrected by using one of two methods described later in this section.

There are two manual methods for developing one-cycle error corrections. They require you to drive in a circle, starting and stopping at exactly the same point. Bottom-track may show that you have not returned to the same location. This non-closure error is caused by the one-cycle compass deviation, and it can be estimated from the magnitude and direction of the non-closure.

After you have driven in a circle, the magnitude of the non-closure error is indicated by the **Distance MG** (Made Good) value. The ratio between distance made good and the length of the track (**Distance MG** and **Length**, respectively) is the one-cycle magnitude of the compass error and the one-cycle offset is the **Course MG** angle.

Method 1 is the preferred method for BroadBand and WorkHorse ADCPs such as the Sentinel and Monitor. It provides a more accurate estimation of the one cycle compass error than Method 2, but it requires that you have a stable dock or marker that you can drive away from in your boat and then return to within 30 cm (1 ft.). If you do not have a marker that will allow this kind of accuracy, use the second method to determine the one-cycle error. For both of these procedures, you must be in a location where you can obtain valid bottom track data. Neither method will provide accurate results when moving bed conditions are present. Compass corrections developed using these methods are only applicable for the location, mounting configuration, and specific boat/ADCP combination used to develop the corrections.

TRDI recommends using a bottom-track referenced configuration (Method 1).

Method 1

To reduce the compass error:

1. Find a calm low current area where you can obtain valid bottom tracking data to perform the compass calibration procedure. Mark a starting point that you can easily return to and maintain position (an end of a pier, or a stationary buoy). You will need to be able to return to this location to within about 30 cm (1 ft.) (even closer is better!).
2. Make sure that *bottom track is the velocity reference* for the Method 1 compass calibration procedure. On the **Configure** menu, **Reference**, set the reference to **Bottom Track**.
3. On the **File** menu, select **Save Measurement** and create a new configuration from the file that was modified for the magnetic variation. We suggest naming the configuration to reflect that Bottom Tracking is being used and that the magnetic variation correction has been applied.
4. Create or open a workspace file (see Creating a Workspace) that has the **Composite Tabular** and **Compass Calibration** tabular displays, and a **Ship Track** display.
5. Start *WinRiver II* and load a measurement file. Press **F4** to start pinging. Press **F5** to start recording.
6. Drive in a circular course with a circumference of about 1000 meters or larger (as large as possible). It is important to make a large circular track to make a good estimate of the one-cycle compass correction factors, and it is also important to make the path as close to a true circle as possible. Use the **Ship Track** screen to help make the circular course at a slow steady speed. If your location does not allow you to run a large circular course, you can run several continuous circles (say 3 to 5) being sure to pass your original starting point as you complete each circle. You would then use the combined course length from all of the circles in determining the one-cycle errors as

described in the following steps. In Figure 86, three circular tracks were made to provide a total track length of 1754.50 meters.

Navigation (Btm)		
Boat Speed	0.078	[m/s]
Boat Course	81.55	[°]
Water Speed	0.041	[m/s]
Water Dir.	302.93	[°]
Calc. Depth	26.03	[m]
Length	1754.50	[m]
Distance MG	22.79	[m]
Course MG	234.33	[°]
Time	1308.51	[s]

Figure 86. Method 1 Compass Correction Procedure

7. Come back as close as you can to the starting point (within 30 cm or less). Press **F5** to stop recording.
8. Record the **Course MG**, **Distance MG**, and **Length** values from the **Tabular** display. For example, in Figure 86, the **Course MG** is 234.33°, the **Distance MG** is 22.79 meters, and the **Length** is 1754.50 meters.
9. Take the ratio between **Distance MG** and **Length**; this is the magnitude of the one-cycle error (**One Cycle K**). In our example as shown in Figure 87, you would determine the ratio as 22.79/1754.50 = 0.0129. The **Course MG** 234.33° is the one-cycle error offset (**One Cycle Offset**).
10. On the **Settings**, **Configuration Settings**, **Offset** tab, enter the values for the **One Cycle K** and **One Cycle Offset**.

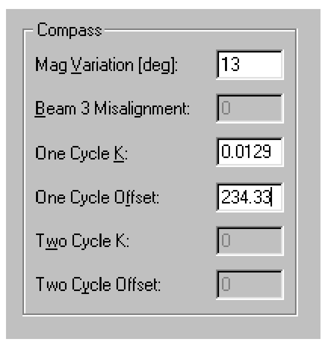


Figure 87. Entering the Compass Corrections

11. ADCP heading data from an internal compass module is normally indexed to beam 3 of the ADCP. If External Heading data is used, or if a different heading reference orientation is desired, you must enter properly coordinated values for **Heading Offset** and **Beam 3 Misalignment** (see Using External Heading Data, GPS/EH/DS Page, and Offsets Page).
12. Apply the One Cycle K and One Cycle offset corrections to the configuration that contains the magnetic variation corrections.
13. Replay the data using the corrected configuration. The circle non-closure error as indicated by **Distance MG** should now be minimized (Figure 88). If the compass has been adequately corrected, the ratio of **Distance MG** to **Length** should be 0.01 or less (2.83/1754.50 = 0.0016).
14. You can now use the corrected configuration for acquiring discharge measurements.

Navigation (Btm)		
Boat Speed	0.078	[m/s]
Boat Course	81.10	[°]
Water Speed	0.041	[m/s]
Water Dir.	302.48	[°]
Calc. Depth	26.03	[m]
Length	1754.50	[m]
Distance MG	2.83	[m]
Course MG	258.45	[°]
Time	1308.51	[s]

Figure 88. Method 1 Compass Correction Procedure with Correction Applied

Method 2

If you don't have a marker available that allows you to return to the same location (within 30 cm), you can still determine the one-cycle correction factors. For this procedure, *GPS is used as the reference* rather than the dock or stationary marker used in Method 1. The magnitude of the non-closure error is estimated by the magnitude of the **BMG-GMG** vector, and the **BMG-GMG** angle is the course made good direction. The ratio between distance made good and the length of the track (**BMG-GMG** and **Length**, respectively on the *WinRiver II* display in Figure 90) is the magnitude of the one-cycle compass error and the one-cycle offset is the **BMG-GMG** angle.

GPS is used for the velocity reference in Method 2, while Bottom-Track is the reference in Method 1.

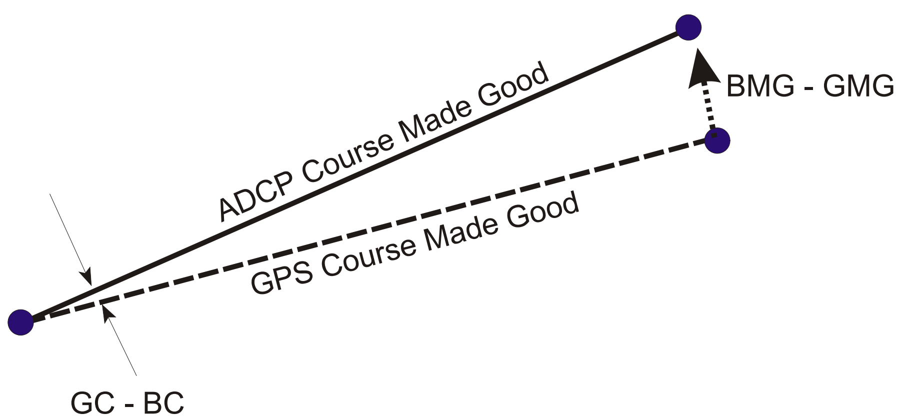


Figure 89. GPS Versus Bottom Track

To reduce the compass error:

1. Find a calm low current area where you can obtain valid bottom tracking data to perform the compass calibration procedure. Mark a starting point. You will need to be able to return to this general location to within about 3 meters (10 feet).
2. Make sure that *GPS (GGA) is the velocity reference* for the method 2 compass calibration procedure. On the **Settings** menu, **Reference**, set the reference to **GPS (GGA)**.
3. On the **File** menu, select **Save Measurement** and create a new configuration from the file that was modified for the magnetic variation correction.
4. Create or open a workspace file (see Customizing WinRiver II) that has the **Composite** and **Compass Calibration** tabular displays, and a **Ship Track** display.

5. Start *WinRiver II* and load a measurement file. Press **F4** to start pinging. Press **F5** to start recording.
6. Drive in a circular course with a circumference of about 1000 meters or larger (as large as possible). It is important to make a large circular track to make a good estimate of the one-cycle compass correction factors, and it is also important to make the path as close to a true circle as possible. Use the **Ship Track** screen to help make the circular course at a slow steady speed. If your location does not allow you to run a large circular course, you can run several continuous circles (say 3 to 10) being sure to pass as close as possible to your original starting point as you complete each circle. You would then use the combined course length from all of the circles in determining the one-cycle errors as described in the following steps. In Figure 90, three circular tracks were made to provide a total track length of 1731.76 m.
7. Monitor the **BMG-GMG** vector display in the Compass Calibration Tabular display as you come back to your starting location. Press **F5** to stop recording.
8. Record the **BMG-GMG** vectors (magnitude and direction) and **Length** values. For example, in Figure 90, the **BMG-GMG Direction** is 231.6°, the **BMG-GMG Magnitude** is 21.7 m, and the **Length** is 1731.76 m.
9. Take the ratio between **BMG-GMG Magnitude** and **Length**; this is the magnitude of the One-Cycle Error (**One Cycle K**). In our example as shown in Figure 90, you would determine the ratio as 21.7/1731.76 = 0.0125. The **BMG-GMG Direction** 231.6° is the One-Cycle Error Offset (**One Cycle Offset**).

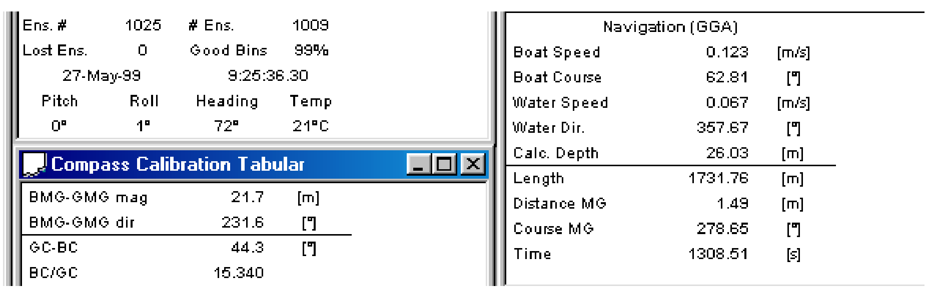


Figure 90. Method 2 Compass Correction Procedure

10. On the Offsets Page, enter the values for the **One Cycle K** and **One Cycle Offset**.

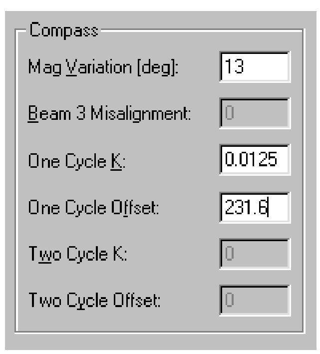


Figure 91. Entering the Corrections for Method 2 Compass Correction Procedure

11. ADCP heading data from an internal compass module is normally indexed to beam 3 of the ADCP. If External Heading data is used, or if a different heading reference orientation is desired, you must enter properly coordinated values for **Heading Offset** and **Beam 3 Misalignment** (see Using External Heading Data, GPS/EH/DS Page, and Offsets Page).
12. Start *WinRiver II* and replay the data using the corrected, GPS-referenced configuration. The circle non-closure error indicated by the **BMG-GMG Magnitude** will be minimized. If the compass

has been adequately corrected, the ratio of **BMG-GMG Magnitude** to **Length** should be 0.01 or less (2.4/1731.50 = 0.0013 in Figure 92).

13. You can now use the corrected configuration for acquiring discharge measurements.

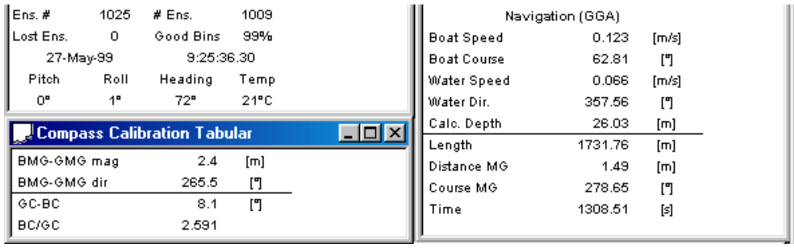


Figure 92. Method 2 Compass Correction with Correction Applied

Appendix E

Shortcut Keys

This chapter includes:

- Shortcut keys

The following shortcut keys are available in *WinRiver II*:

Table 32: WinRiver II Shortcut Keys

Key	Description
F1	Help
F2	Reprocess transect
F3	Configuration Setting
F4	Start/Stop Pinging
F5	Start/Stop Transect
F6	Moving Bed Test
F7	Properties
F8	Toggle Bank
F9	Toggle Ensemble Header Tabular view
F11	Toggle Detailed Discharge/Composite Tabular view
F12	Toggle Discharge Summary Tabular view
Ctrl-A	Output ASCII data file
Ctrl-A	Set as Active Configuration (when Measurement Control window selected)
Ctrl-B	Reference - Bottom Track
Ctrl-C	Copy
Ctrl-D	Toggle Acquire Control window
Ctrl-E	Close Measurement File
Ctrl-F	Create Measurement from Data Files
Ctrl-F1	Apply to Checked Active Configurations
Ctrl-F2	Apply to All Active Configurations
Ctrl-F11	Select Stick (when Ship Track graph selected)
Ctrl-F11	Add Transect (Playback) (when Measurement Control window selected)
Ctrl-F11	Add Contour Pane (when Contour graph selected)
Ctrl-F12	Remove Contour Pane (when Contour graph selected)
Ctrl-F3	Toggle Measurement Management window
Ctrl-F5	Reprocess Checked Transects
Ctrl-F7	Properties (when window or file selected)
Ctrl-F8	Data Selection (when Profile or Contour graph selected)
Ctrl-F8	Transect Subsection (Playback) (when Measurement Control window selected)
Ctrl-F9	Averaging Data
Ctrl-G	Reference - GPS (GGA)
Ctrl-H	Export as HYDROL
Ctrl-U	Duplicate Configuration node (when Measurement Control window selected)
Ctrl-T	Delete Configuration node (when Measurement Control window selected)
Ctrl-J	Rename Configuration node (when Measurement Control window selected)
Ctrl-R	Reset Configuration node Properties (when Measurement Control window selected)
Ctrl-I	Site Wizard
Ctrl-K	Add Note (when Measurement Control window selected)
Ctrl-L	Lock/Unlock Measurement File
Ctrl-M	View Command Log
Ctrl-N	Reference - None
Ctrl-O	Open measurement file
Ctrl-P	Print
Ctrl-Q	Quick Measurement
Ctrl-PgDn	Scale Sticks Down (when Ship Track graph selected)
Ctrl-PgUp	Scale Sticks Up (when Ship Track graph selected)
Ctrl-S	Save Measurement File
Ctrl-V	Reference – GPS (VTG)
Ctrl-W	New Measurement
Ctrl-Z	Configuration Wizard
Shift-F4	Set PC and ADCP Clock
Shift-F5	Reprocess Selected Transect
Shift-F6	Reprocess Next Transect
Shift-F8	Execute ADCP Test
Shift-F9	Execute Pressure Sensor Test
Shift-F10	Execute Compass Calibration
Minus	Previous Ensemble (Playback)
Space	Next Ensemble (Playback)
Ctrl-Space	Several Ensembles (Playback)
Ctrl-Home	Slider / Go to Ensemble (Playback)
Home	First Ensemble (Playback)
End	Last Ensemble (Playback)