

WinRiver II User's Guide

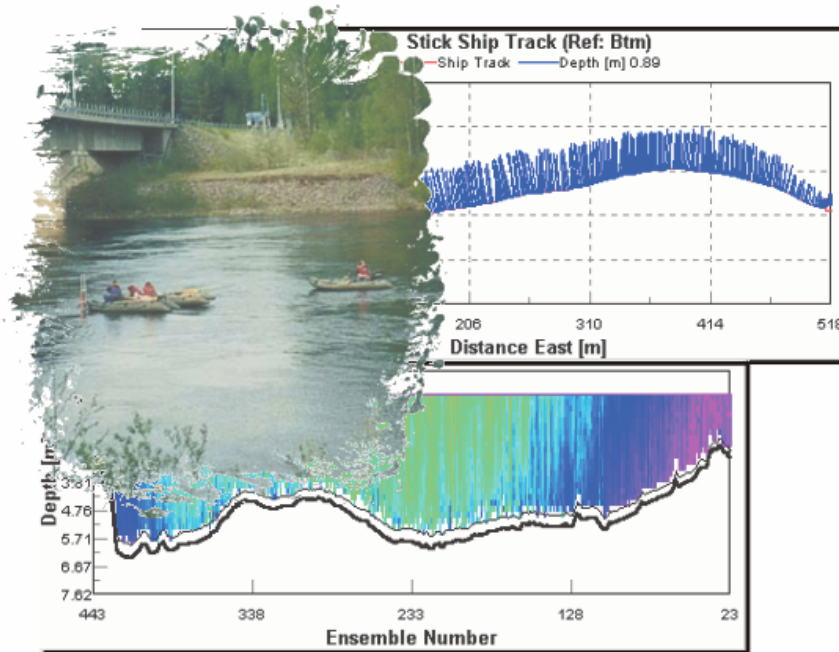


Table of Contents

| | | |
|----------|---|-----------|
| 1 | Introduction | 1 |
| 1.1 | How to Contact Teledyne RD Instruments | 1 |
| 1.2 | Conventions Used in this Guide | 2 |
| 1.3 | Software Requirements | 2 |
| 1.4 | Software Installation | 3 |
| 2 | Overview of WinRiver II | 3 |
| 2.1 | Inputs | 4 |
| 2.2 | Displays | 4 |
| 2.3 | Outputs | 4 |
| 2.4 | File Naming Convention | 6 |
| 2.4.1 | Data Files | 6 |
| 2.4.2 | Navigation Data Files | 7 |
| 2.4.3 | Depth Sounder Data Files | 7 |
| 2.4.4 | External Heading Data Files | 8 |
| 3 | Communications Setup | 9 |
| 3.1 | Advanced ADCP Communications Configuration | 10 |
| 4 | Customizing WinRiver II | 13 |
| 4.1 | Workspace | 13 |
| 4.2 | User Options | 13 |
| 4.2.1 | Acquire Mode Properties | 13 |
| 4.2.2 | General Configuration | 14 |
| 4.3 | Display Options | 15 |
| 4.3.1 | Changing Units | 15 |
| 4.3.2 | Changing the Reference | 15 |
| 4.3.3 | Coordinate System | 16 |
| 4.3.4 | Global Parameters | 16 |
| 4.3.5 | Zoom Functions | 17 |
| 5 | Using the Measurement Control Window | 18 |
| 5.1 | Measurement File Name | 18 |
| 5.1.1 | New Measurement | 18 |
| 5.1.2 | Create Measurement from Data Files | 19 |
| 5.1.3 | Save Measurement | 19 |
| 5.1.4 | Open Measurement | 19 |
| 5.1.5 | Close Measurement | 19 |
| 5.1.6 | Lock Measurement | 19 |
| 5.2 | Site Information | 20 |
| 5.3 | Site Discharge | 20 |
| 5.3.1 | Reprocess Checked Transects | 20 |
| 5.3.2 | Averaging Data | 21 |
| 5.3.3 | Export as HYDROML | 21 |
| 5.3.4 | Add Transect | 21 |
| 5.4 | Transect | 22 |
| 5.4.1 | Reprocess Transect | 22 |
| 5.4.2 | Transect Subsection | 22 |
| 5.4.3 | Add Note | 23 |
| 5.4.4 | Data File | 23 |
| 5.5 | Field and Playback Configuration Nodes | 24 |
| 5.5.1 | Configuration Node Menu Options | 24 |
| 5.5.2 | Set as Active Configuration | 24 |
| 5.5.3 | Configuration Wizard | 24 |
| 5.5.4 | Properties | 24 |
| 5.5.5 | Reset Properties | 25 |
| 5.5.6 | Duplicate | 25 |
| 5.5.7 | Delete | 25 |
| 5.5.8 | Rename | 25 |
| 5.6 | Show Summary | 25 |

| | | |
|-----------|---|-----------|
| 6 | Available Displays | 26 |
| 6.1 | Contour Graph | 26 |
| 6.2 | Profile Graphs | 28 |
| 6.3 | Ship Track Graph | 29 |
| 6.4 | Time series Graphs..... | 30 |
| 6.5 | Tabular Displays | 31 |
| 6.6 | Discharge Summary | 32 |
| 6.7 | Acquire Control Window..... | 32 |
| 6.8 | Adding Customized Graphs to the Menu | 33 |
| 7 | Using the Measurement Wizard | 34 |
| 7.1 | Site Information..... | 34 |
| 7.2 | Rating Information..... | 35 |
| 7.3 | Configuration Dialog | 36 |
| 7.3.1 | Devices | 36 |
| 7.3.2 | Offsets | 37 |
| 7.3.3 | ADCP Wizard Configuration..... | 37 |
| 7.3.4 | Discharge..... | 39 |
| 7.4 | Output Filename Options | 40 |
| 7.5 | Commands Preview..... | 42 |
| 7.6 | Summary Page | 43 |
| 8 | Configuration Node Properties | 45 |
| 8.1 | Commands Page | 46 |
| 8.2 | Depth Sounder / External Heading Page | 48 |
| 8.3 | Discharge Page | 50 |
| 8.4 | Edge Estimates Page | 51 |
| 8.5 | Offsets Page | 52 |
| 8.6 | Processing Page..... | 54 |
| 8.7 | Recording Page | 57 |
| 9 | QA/QC | 59 |
| 9.1 | Set the ADCP Clock..... | 59 |
| 9.2 | Test the Pressure Sensor | 59 |
| 9.3 | Test the ADCP | 60 |
| 9.4 | Compass Alignment..... | 61 |
| 9.5 | Moving Bed Test..... | 61 |
| 10 | Acquiring Discharge Data..... | 63 |
| 10.1 | Establish Transect Start and End Points..... | 64 |
| 10.2 | Holding Position at the Starting Channel Edge | 65 |
| 10.3 | Crossing the Channel | 66 |
| 10.4 | Holding Position at the Ending Channel Edge | 66 |
| 10.5 | Acquiring Discharge Data for Multiple Transects | 66 |
| 10.6 | Data Collections Tips | 67 |
| 11 | Post-Processing of Discharge Data..... | 68 |
| 11.1 | Playback a Data File | 68 |
| 11.2 | Playback Older Data Files..... | 68 |
| 11.3 | Playback Data Display Options..... | 69 |
| 11.4 | Editing an Item During Playback | 70 |
| 11.5 | Creating an ASCII-Out Data File..... | 72 |
| 11.5.1 | Classic ASCII Output | 72 |
| 11.5.2 | Classic ASCII Output Format..... | 73 |
| 11.5.3 | Generic ASCII Output | 75 |
| 11.6 | Print a Graph or Display..... | 78 |
| 11.7 | Capture Setup..... | 78 |
| 11.8 | Using the Q Measurement Summary..... | 79 |
| 12 | Integrating Depth Sounder, External Heading, and GPS Data..... | 80 |
| 12.1 | How to Use Depth Sounders..... | 81 |
| 12.1.1 | System Interconnections with the Depth Sounder | 81 |
| 12.1.2 | Enabling the Depth Sounder Port | 81 |
| 12.1.3 | Using Depth Sounder Data | 82 |

| | | |
|-------------------|--|------------|
| 12.2 | How to Use the External Heading | 84 |
| 12.2.1 | System Interconnections with External Heading | 84 |
| 12.2.2 | Enabling the External Heading Port | 84 |
| 12.2.3 | Using External Heading Data | 84 |
| 12.3 | How to Use GPS | 85 |
| 12.3.1 | Using GPS Versus Bottom Track | 86 |
| 12.3.2 | System Interconnections with GPS | 87 |
| 12.3.3 | Enabling the GPS Port | 87 |
| 12.4 | Compass Correction | 88 |
| 12.4.1 | Magnetic Variation Correction | 88 |
| 12.4.2 | One-Cycle Compass Correction | 91 |
| | Method 1 | 92 |
| | Method 2 | 94 |
| | Method 3 | 97 |
| | Compass Calibration Verification | 99 |
| 13 | ADCP Commands | 100 |
| 13.1 | Send Commands to the ADCP | 100 |
| 13.2 | ADCP Command Overview | 101 |
| 13.3 | <i>WinRiver II</i> Processing Settings | 104 |
| 14 | Water Profiling Modes | 107 |
| 14.1 | General Purpose Profiling Mode 1 | 108 |
| 14.2 | High Resolution Profiling Mode 12 | 109 |
| 14.2.1 | Water Mode 12 Basic Operation | 110 |
| 14.2.2 | Water Mode 12 Environmental Limits | 111 |
| 14.2.3 | Water Mode 12 Minimum Ping and Sub-Ping Times | 111 |
| 14.2.4 | Water Mode 12 Examples | 112 |
| 14.3 | High Resolution Profiling Mode 11 | 113 |
| 14.3.1 | Water Mode 11 Environmental Limits | 115 |
| 14.3.2 | Water Mode 11 Technical Description | 116 |
| 14.4 | High Resolution Profiling Mode 5 | 117 |
| 14.5 | High Resolution Profiling Mode 8 | 117 |
| 14.5.1 | Mode 5, 8 and 11 Specifics | 117 |
| 15 | Bottom Tracking Modes | 118 |
| 15.1 | Using Bottom Mode 7 | 118 |
| 15.1.1 | Environmental Limits | 120 |
| 16 | Troubleshooting | 121 |
| 16.1 | Problems to look for in the Data | 121 |
| 16.2 | Why can't I see my data? | 123 |
| 16.3 | Lost Ensembles | 123 |
| 16.4 | Missing Depth Cell Data | 124 |
| 16.5 | Missing Velocity Data | 124 |
| 16.6 | Unable to Bottom Track | 125 |
| 16.7 | Biased Bottom Track Velocities | 126 |
| 16.8 | Inconsistent Discharge Values | 126 |
| 16.9 | Trouble Profiling in High Turbidity Conditions | 127 |
| 16.10 | Trouble Profiling with Modes 5 and 8 | 127 |
| 16.11 | Trouble Decoding the NMEA Message | 128 |
| Appendix A | - ADCP Measurement Basics | 130 |
| A.1 | Velocity Profiles | 130 |
| A.2 | Bottom Track | 131 |
| A.3 | Other Data | 131 |
| Appendix B | - Discharge Measurement Basics | 133 |
| B.1 | Path Independence | 133 |
| B.2 | Directly Measured Flow and Estimated Regions | 134 |
| B.2.1 | Near Surface Region | 135 |
| B.2.2 | Bottom Region | 136 |
| B.2.3 | Channel Edges | 137 |
| B.3 | Calculating Discharge | 137 |

| | | |
|--|--|------------|
| B.3.1 | Discharge Calculations | 137 |
| B.3.2 | Discharge Calculation Terms | 138 |
| B.3.3 | Determining Moving-Vessel Discharge and the Cross-Product | 139 |
| B.3.4 | Estimating Discharge in the Unmeasured Top/Bottom Parts of the Velocity Profile..... | 140 |
| B.3.5 | Determining Near-Shore Discharge | 143 |
| B.3.6 | Determining the Size of the Top, Bottom, and Middle Water Layers..... | 144 |
| B.3.7 | Calculating Middle Layer Discharge (MidQ)..... | 145 |
| B.3.8 | Estimating Top Layer Discharge | 146 |
| B.3.9 | Estimating Bottom Layer Discharge | 146 |
| B.3.10 | Distance Calculations | 147 |
| B.3.11 | References..... | 148 |
| Appendix C – WinRiver II Data Formats | | 149 |
| C.1 | Navigation Data Output Data Format | 149 |
| C.2 | General NMEA Data Format | 150 |
| C.3 | General NMEA WinRiver II Structure | 152 |
| C.4 | NMEA Input..... | 154 |
| C.4.1 | DBT – Depth Below Transducer | 154 |
| C.4.2 | GGA – Global Positioning System Fix Data | 155 |
| C.4.3 | VTG – Track Made Good and Ground Speed | 156 |
| C.4.4 | HDT – Heading – True..... | 156 |
| C.5 | Further Information About NMEA Strings..... | 156 |
| Appendix D – Shortcut Keys..... | | 157 |
| Appendix – E Software History..... | | 158 |
| E.1 | Version 1.01..... | 158 |
| E.2 | Version 1.02..... | 158 |
| E.3 | Version 1.03..... | 158 |
| E.4 | Version 2.00..... | 159 |
| E.5 | Version 2.01..... | 159 |

List of Figures

| | | |
|------------|--|----|
| Figure 1. | Overview of WinRiver II..... | 3 |
| Figure 2. | Peripheral Configuration Dialog | 9 |
| Figure 3. | Advanced ADCP Configuration Dialog | 11 |
| Figure 4. | One Step Setup..... | 12 |
| Figure 5. | User Options – Acquire Mode | 13 |
| Figure 6. | User Options – General Configuration | 14 |
| Figure 7. | Changing the Units..... | 15 |
| Figure 8. | Global Parameters for Graphs | 16 |
| Figure 9. | Measurement Control Window | 18 |
| Figure 10. | Measurement Control - Measurement Menu | 18 |
| Figure 11. | Measurement Control - Site Information Menu..... | 20 |
| Figure 12. | Measurement Control - Site Discharge | 20 |
| Figure 13. | Averaging Data | 21 |
| Figure 14. | Measurement Control – Transect | 22 |
| Figure 15. | Transect Subsection..... | 23 |
| Figure 16. | Measurement Control - Raw Data File Properties | 23 |
| Figure 17. | Managing Configuration Nodes..... | 24 |
| Figure 18. | Measurement Control - Discharge Summary | 25 |
| Figure 19. | Velocity Contour Graph | 26 |
| Figure 20. | Intensity Profile Graph..... | 28 |
| Figure 21. | Stick Ship Track Graph..... | 29 |
| Figure 22. | Time Series Graph | 30 |
| Figure 23. | Discharge Summary Screen..... | 32 |
| Figure 24. | Acquire Control Window..... | 32 |
| Figure 25. | Data Selection Dialog..... | 33 |
| Figure 26. | Adding a Graph to the Menu | 33 |

| | | |
|------------|--|-----|
| Figure 27. | Warning Message | 37 |
| Figure 28. | Water Mode 12 Options | 38 |
| Figure 29. | Commands Page | 46 |
| Figure 30. | DS/External Heading Page | 48 |
| Figure 31. | Discharge Page..... | 50 |
| Figure 32. | Edge Estimates Page..... | 51 |
| Figure 33. | Offsets Page | 52 |
| Figure 34. | Processing Page | 54 |
| Figure 35. | Near Zone Distance | 55 |
| Figure 36. | Recording Page | 57 |
| Figure 37. | Set the ADCP Clock | 59 |
| Figure 38. | Test the Pressure Sensor | 60 |
| Figure 39. | Test the ADCP | 60 |
| Figure 40. | Moving Bed Test..... | 61 |
| Figure 41. | Ship Track Indicating NO Moving Bed..... | 62 |
| Figure 42. | Velocity Tabular Display Showing Two Good Bins..... | 64 |
| Figure 43. | Enter Beginning Distance From Shore | 65 |
| Figure 44. | Enter Ending Distance from Shore | 66 |
| Figure 45. | Overview of Data Collection | 67 |
| Figure 46. | Editing an Item During Playback | 70 |
| Figure 47. | Applying Corrections to All Transect Files | 71 |
| Figure 48. | Classic ASCII Output..... | 72 |
| Figure 49. | ASCII Item Selection | 76 |
| Figure 50. | ASCII Output Format Selection | 76 |
| Figure 51. | ASCII Data Output Selection..... | 77 |
| Figure 52. | ASCII Output Template..... | 77 |
| Figure 53. | Capture Setup..... | 78 |
| Figure 54. | Q Measurement Summary | 79 |
| Figure 55. | Depth Sounder Offsets..... | 83 |
| Figure 56. | Viewing Depth Sounder Data | 83 |
| Figure 57. | Viewing External Heading Data..... | 85 |
| Figure 58. | Reciprocal Constant Heading Tracks for Determining Magnetic Variation..... | 89 |
| Figure 59. | Determining Local Magnetic Variation | 89 |
| Figure 60. | Entering Local Magnetic Variation | 90 |
| Figure 61. | Data Corrected for Local Magnetic Variation | 90 |
| Figure 62. | Method 1 Compass Correction Procedure | 92 |
| Figure 63. | Entering the Compass Corrections..... | 93 |
| Figure 64. | Method 1 Compass Correction Procedure with Correction Applied | 94 |
| Figure 65. | GPS Versus Bottom Track..... | 94 |
| Figure 66. | Method 2 Compass Correction Procedure | 96 |
| Figure 67. | Entering the Corrections for Method 2 Compass Correction Procedure | 96 |
| Figure 68. | Method 2 Compass Correction with Correction Applied | 97 |
| Figure 69. | Compass Calibration Screen..... | 98 |
| Figure 70. | Command Log..... | 100 |
| Figure 71. | Problems to look for in the Data | 122 |
| Figure 72. | Decorrelation Example | 124 |
| Figure 73. | NMEA Message Header..... | 129 |
| Figure 74. | Velocity as a Function of Depth..... | 130 |
| Figure 75. | Boat versus Water Velocity..... | 131 |
| Figure 76. | Transect Path..... | 133 |
| Figure 77. | Discharge Calculation is Independent of the Boat's Path | 134 |
| Figure 78. | Unmeasured Regions in the Water Column | 135 |
| Figure 79. | Side Lobes | 136 |
| Figure 80. | Discharge Extrapolation Method | 142 |

List of Tables

| | | |
|-----------|---|-----|
| Table 1: | Available Tabular Displays | 31 |
| Table 2: | Fixed Commands | 47 |
| Table 3: | Wizard Commands..... | 47 |
| Table 4: | ASCII-Out File Format..... | 73 |
| Table 5: | WorkHorse River Water Profiling Modes | 107 |
| Table 6: | Commands Relevant to Water Mode 12 Use | 110 |
| Table 7: | Minimum Ping Times (open water with no boundaries) | 111 |
| Table 8: | Minimum Ping Times (Open Water)..... | 112 |
| Table 9: | Minimum Ping and Sub-Ping Times | 112 |
| Table 10: | Commands Relevant to Water Mode 11 Use..... | 114 |
| Table 11: | Commands Relevant to Shallow Water Bottom Tracking | 119 |
| Table 12: | Navigation Data Structure | 149 |
| Table 13: | Fixed Leader Navigation ID Word | 149 |
| Table 14: | NMEA Data Format | 150 |
| Table 15: | Data Fields | 151 |
| Table 16: | General NMEA WinRiver II Structure (prior to ver. 2.00) | 152 |
| Table 17: | General NMEA WinRiver II Structure (ver. 2.00 and later)..... | 153 |
| Table 17: | DBT NMEA Format..... | 154 |
| Table 18: | GGA NMEA Format..... | 155 |
| Table 19: | VTG NMEA Format | 156 |
| Table 20: | HDT NMEA Format | 156 |
| Table 21: | <i>WinRiver II</i> Shortcut Keys | 157 |



WinRiver II User's Guide

1 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.

Making accurate discharge measurements is less difficult than you probably believe now. You will soon see that you need to use only a few keystrokes on the computer to collect data in the field.

Please take the time to read this entire manual. It will be useful to have the ADCP and a computer available to follow along. You may also want to keep the other ADCP Technical manuals handy for reference when you want more detail.



NOTE. This guide covers *WinRiver II* version 2.01.

1.1 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

14020 Stowe Drive
Poway, California 92064

Phone +1 (858) 842-2600

FAX +1 (858) 842-2822

Sales – rdisales@teledyne.com

Field Service – rdifs@teledyne.com

Teledyne RD Instruments Europe

2A Les Nertieres
5 Avenue Hector Pintus
06610 La Gaude, France

Phone +33(0) 492-110-930

FAX +33(0) 492-110-931

Sales – rdie@teledyne.com

Field Service – rdiefs@teledyne.com

Customer Service Administration – rdicsadmin@teledyne.com

Web: <http://www.rdinstruments.com>

24/7 Technical Support +1 (858) 842-2700

1.2 Conventions Used in this Guide


Conventions used in the *WinRiver II* User's Guide have been established to help you learn how to use these programs quickly and easily.


Windows menu items are printed in bold: **File** menu, **Save Measurement**. 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 (*BBTalk*) and file names (*Test_000_000.PD0*).


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

```
WorkHorse Broadband ADCP Version X.XX  
RD INSTRUMENTS (c) 1996-2006  
ALL RIGHTS RESERVED  
>
```

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

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

| | |
|---|---|
|  | CAUTION. 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. |
|---|--|

1.3 Software Requirements

WinRiver II requires the following:

- Windows XP Pro® or Windows 2000®
- Pentium III 600 MHz class PC (higher recommended)
- 64 megabytes of RAM (128 MB RAM recommended)
- 50 MB Free Disk Space plus space for data files (A large, fast hard disk is recommended)
- One Serial Port (two or more High Speed UART Serial Ports recommended)
- Minimum display resolution of 1024 x 768
- CD-ROM Drive
- Mouse or other pointing device

1.4 Software Installation

To install *WinRiver II*, do the following.

- Insert the compact disc into your CD-ROM drive and then follow the browser instructions on your screen. If the browser does not appear, complete Steps “b” through “d.”
- Click the **Start** button, and then click **Run**.
- Type **<drive>:launch**. For example, if your CD-ROM drive is drive D, type **d:launch**.
- Follow the browser instructions on your screen.

2 Overview of WinRiver II

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

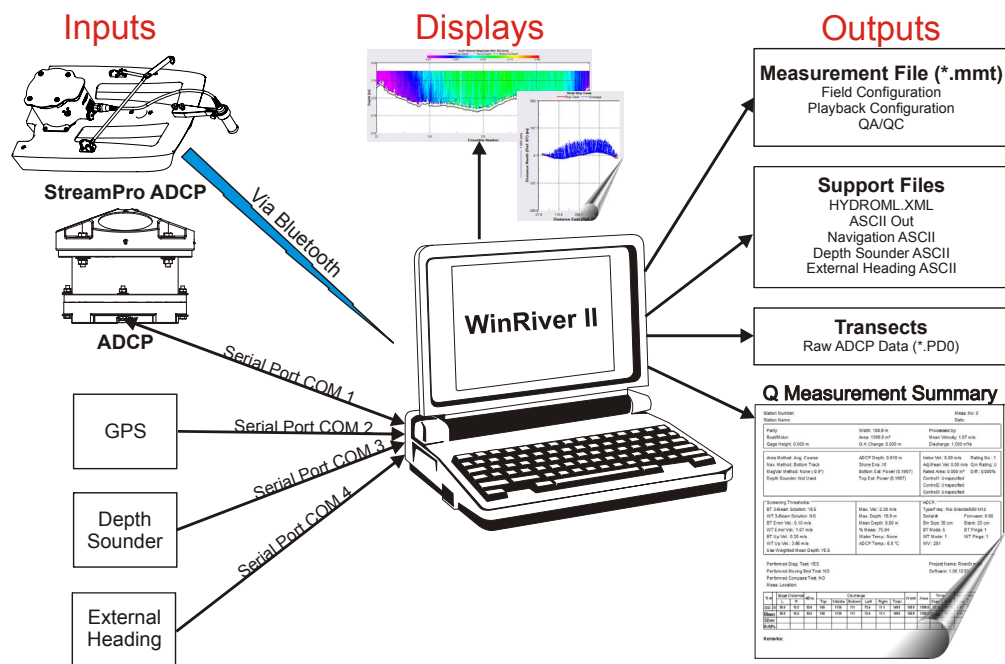


Figure 1. Overview of WinRiver II

2.1 Inputs

In order to use *WinRiver II*, your Workhorse ADCP must meet the following criteria.

- WorkHorse Rio Grande ADCP or the WorkHorse ADCP **must** have the Bottom Track upgrade installed



NOTE. The Bottom Track and High Resolution Water Modes upgrades are available for 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 StreamPro ADCP if your computer has a Bluetooth connection.
- *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)

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



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

2.2 Displays

All of the *WinRiver II* displays may be saved to files or printed. For more information, see [“Available Displays,” page 26](#) and [“Print a Graph or Display,” page 78](#).

2.3 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,” page 34](#)). 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 in-

formation about the measurement control window, see [“Using the Measurement Control Window,”](#) page 18.

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,”](#) page 68).
- QA/QC information (ADCP tests, Moving Bed Test, etc.)
- The **Measurement Control** window shows a list of all the transects and support files.

Transects

- Raw ADCP data files (*.PDO) – 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 deployment, 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 *.PDO raw data file. The transect number is incremented for each transect. For more information on how to collect data, see [“Acquiring Discharge Data,”](#) page 63.

The raw ADCP data files are saved to the same folder as the measurement file. Other TRDI software like *RDI Tools* may be used with the data files as needed. For more information about the format of the of raw ADCP data, see [“Appendix C – WinRiver II Data Formats,”](#) page 149 and the WorkHorse commands and Output Data Format guide.



CAUTION. 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 – 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 external heading data from a user-specified serial port. These files are not used in post-processing.

Q Measurement Summary

- The **Q Measurement Summary** is a printed report of the discharge. See [“Using the Q Measurement Summary,” page 79](#) for more information.

2.4 File Naming Convention

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

2.4.1 Data Files

File Name Format: prefix_meas_MMM_NNN_Date_Time.PD0

| | |
|-----------|--|
| prefix | Filename prefix (see “Output Filename Options,” page 40) |
| meas | Measurement number. This is entered on the Site Information page (see “Site Information,” page 20) 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 . |
| PD0 | PD0 formatted raw ADCP data file |

2.4.2 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.

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.

- a. 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
```

- b. *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](#),” page 149). *WinRiver II* only uses the data in the *.PD0 file.
- c. *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,sssss,PC<CR/LF>
```

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

2.4.3 Depth Sounder Data Files

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

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

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

- b. *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](#),” page 149). *WinRiver II* only uses the data from the *.PD0 file.

- c. *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,sssss,PC<CR/LF>
```

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

2.4.4 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.

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

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

- b. *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](#),” page 149). *WinRiver II* only uses the data from the *.PD0 file.

- c. *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 *sssss* = computer time in hundredths of seconds

3 Communications Setup

When *WinRiver II* is first started, you can set up the communications with the ADCP, GPS (if used), External Heading (if used), and Depth Sounder (if used). Once setup, *WinRiver II* will remember the settings and use them each time the program is started.



NOTE. Using the **Measurement Wizard** (see “Using the Measurement Wizard,” page 34) will also prompt you to set up communications if they are not already configured.

- a. Connect and power up the ADCP as shown in the appropriate ADCP User’s Guide.
- b. Start *WinRiver II*. To open the **Peripheral Configuration Dialog** box, on the **Configure** menu, select **Peripherals**.

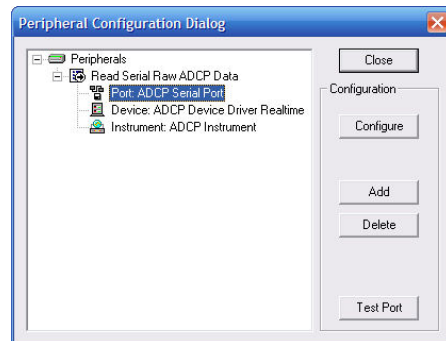
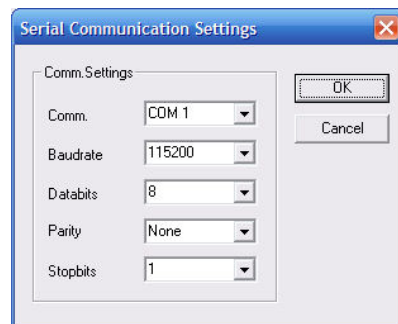


Figure 2. Peripheral Configuration Dialog

- c. 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.



- d. 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. Click **Test Port** to have *WinRiver II* connect to the device and confirm the communication setting.
- e. Press the **Add** button.



- f. Select the device you want to setup and press **OK**.
- g. Select the COM port that the device is connected to. Press **OK** to continue.



NOTE. Only the communication ports installed and available on your system will be displayed.

- h. Once all devices have been set up, select **Close** to exit the **Peripheral Configuration Dialog** box.

3.1 Advanced ADCP Communications Configuration

Use the following steps to communicate with the ADCP or verify command settings.

- a. On the **Configure** menu, select **Peripherals**.
- b. Click the + box next to **Read Serial Raw ADCP Data** to expand the list and then select **Instrument: ADCP Instrument**.
- c. Press the **Configure** button.

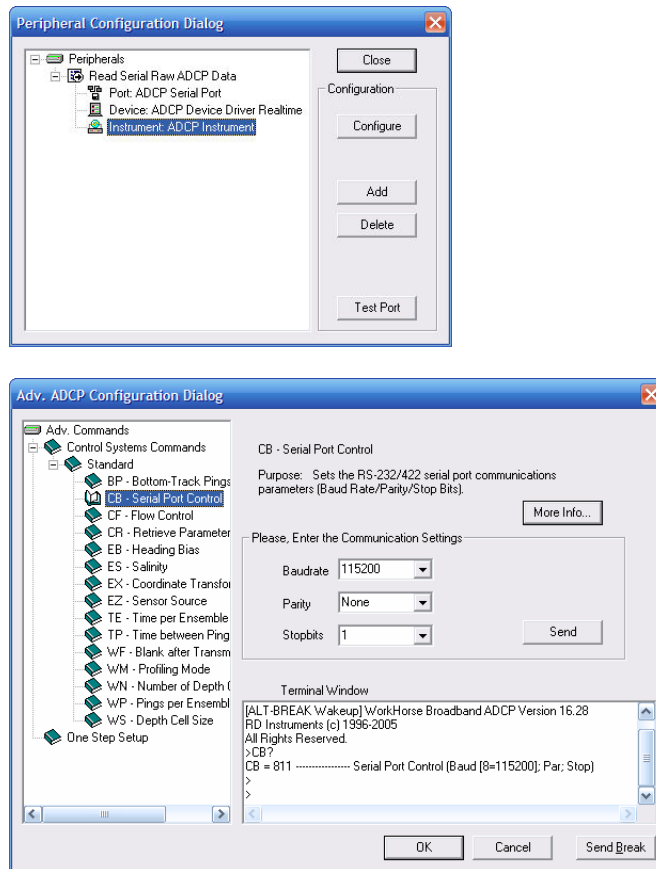


Figure 3. Advanced ADCP Configuration Dialog

- d. 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**.
- e. Use the **Send Break** button to wake up the ADCP.
- f. 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.



CAUTION. 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.



NOTE. WorkHorse Monitor/Sentinel ADCPs will go to sleep if a command is not sent within five minutes; Use the **Send Break** button to wake the ADCP before sending a command.

WorkHorse Rio Grande ADCPs do not sleep. For more information, see the CL command in the WorkHorse Commands and Output Data Format guide.

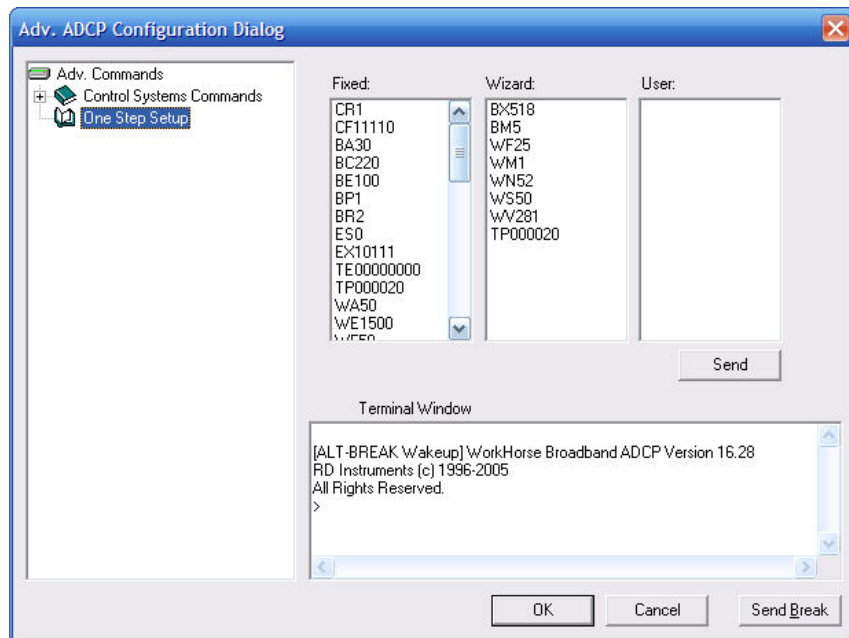


Figure 4. One Step Setup

One Step Setup

Use the **One Step Setup** to check the deployment commands sent to the ADCP after the **Measurement Wizard** has been completed.

- Run the Measurement Wizard (see [“Using the Measurement Wizard,”](#) page 34).
- Click **One Step Setup**. Click the **Send** button.
- If any command generates an error message, stop and correct the problem before deploying.



CAUTION. 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.



NOTE. 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.

4 Customizing WinRiver II

WinRiver II can be customized to look and act, as you prefer.

4.1 Workspace

A Workspace is a collection of windows arranged and sized, as you prefer. 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,” page 14).

4.2 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.

4.2.1 Acquire Mode Properties

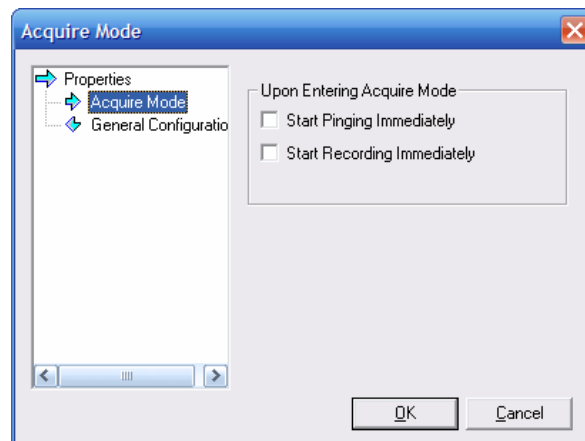


Figure 5. User Options – Acquire Mode

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.

4.2.2 General Configuration

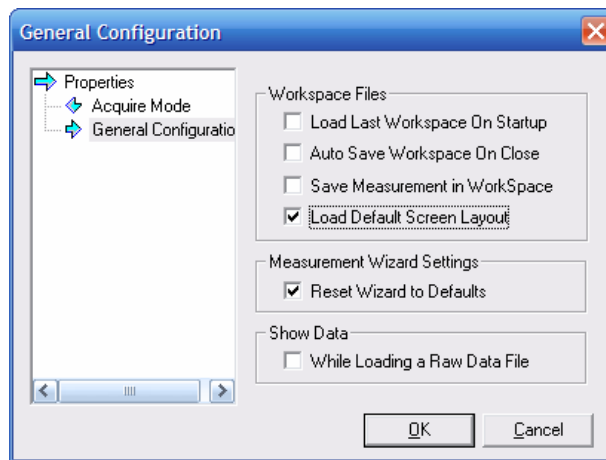


Figure 6. User Options – General Configuration

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.
- **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.

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.

4.3 Display Options

The following options are available for all graphs.



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

4.3.1 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**.



NOTE. 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.

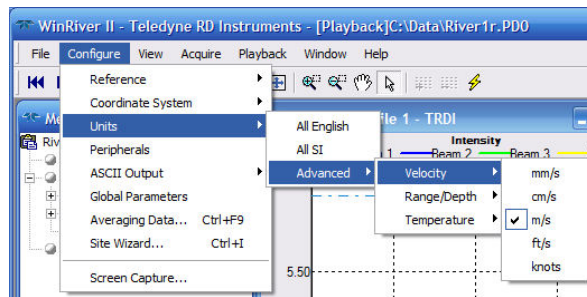


Figure 7. Changing the Units

4.3.2 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.



NOTE. 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.

4.3.3 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 **Ship** coordinate system.



NOTE. The equivalent coordinate system “as received from the ADCP” is to select **Ship** coordinates. **Earth** is always the default.

4.3.4 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**. Click **OK** to exit the screen.

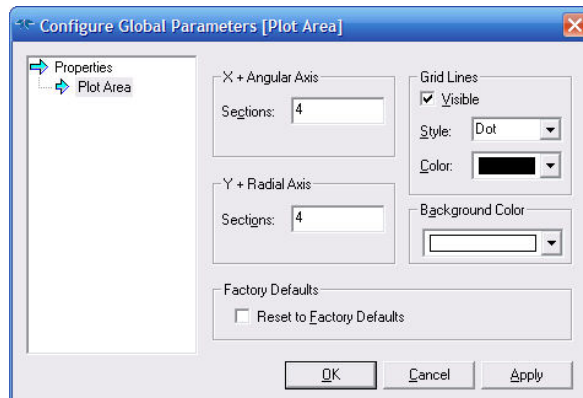






Figure 8. Global Parameters for Graphs

4.3.5 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.

5 Using the Measurement Control Window

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.

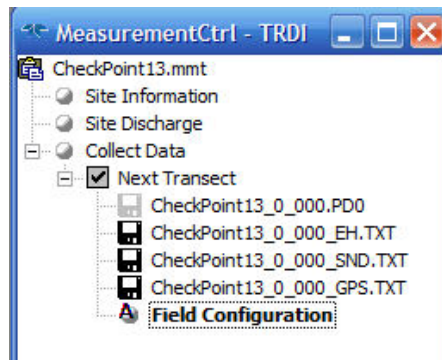


Figure 9. Measurement Control Window

5.1 Measurement File Name

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

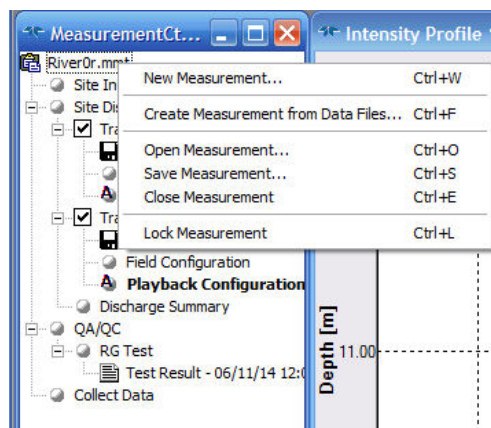


Figure 10. Measurement Control - Measurement Menu

5.1.1 New Measurement

Select **New Measurement** to start the Measurement Wizard (see [“Using the Measurement Wizard,” page 34](#)). If a measurement is already open, you will be prompted to save the current measurement.

5.1.2 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 earlier versions of *WinRiver* (see “[Playback Older Data Files](#),” page 68). *WinRiver II* will extract information from the *.000 files.

5.1.3 Save Measurement

Use the Measurement Wizard to setup *WinRiver II* (see “[Using the Measurement Wizard](#),” page 34). 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.



NOTE. *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.

5.1.4 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**.

5.1.5 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.

5.1.6 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.

5.2 Site Information

Right-click on **Site Information**; this opens the wizard and allows changes to the **Site Information** (see “[Site Information](#),” page 20) and **Rating Information** (see “[Rating Information](#),” page 35) pages of the wizard. If changes are made, save the measurement file (see “[Save Measurement](#),” page 19).

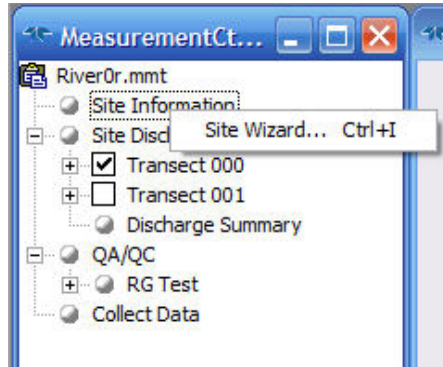


Figure 11. Measurement Control - Site Information Menu

5.3 Site Discharge

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

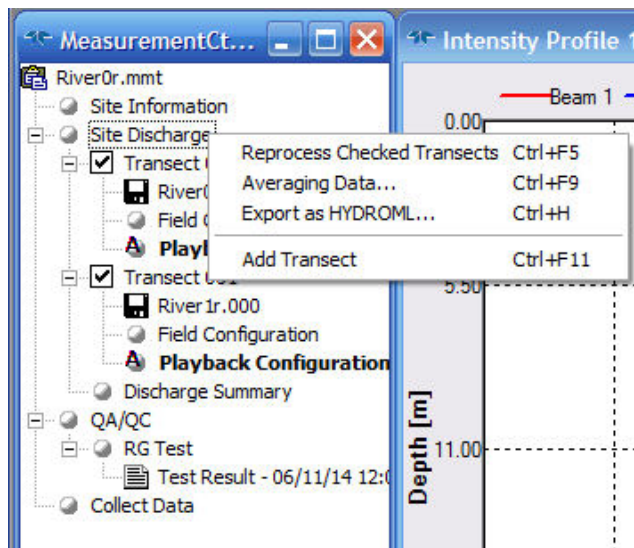


Figure 12. Measurement Control - Site Discharge

5.3.1 Reprocess Checked Transects

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

5.3.2 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**.

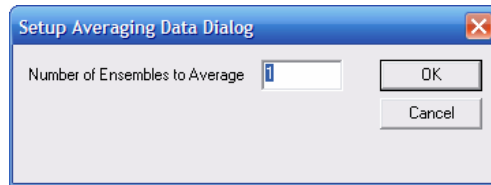


Figure 13. Averaging Data

5.3.3 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.

5.3.4 Add Transect

Use this function to add transects to the measurement file.

5.4 Transect

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

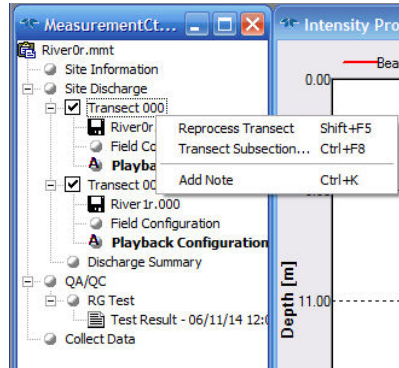


Figure 14. Measurement Control – Transect

5.4.1 Reprocess Transect

Use this function to reprocess only the selected transect file.

5.4.2 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.

- a. Start *WinRiver II* and load a measurement file.
- b. Select the transect file to be subsectioned.
- c. Right-click on **Transect** and click **Transect Subsection**.
- d. 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.
- e. To return to the entire data file, right-click on **Transect** and click **Transect Subsection**. Check the **Select All Ensembles** box. Click **OK**.

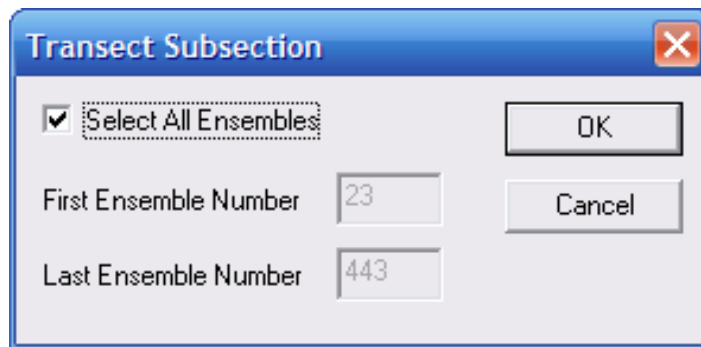


Figure 15. Transect Subsection

5.4.3 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.

5.4.4 Data File

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

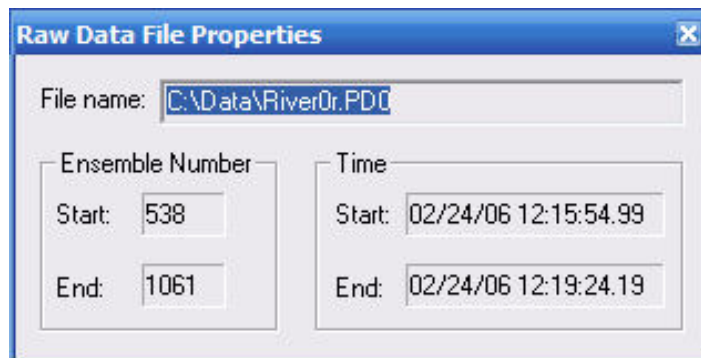


Figure 16. Measurement Control - Raw Data File Properties

5.5 Field and Playback Configuration Nodes

Once you reprocess a transect (see [“Reprocess Transect,”](#) page 22) 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.

5.5.1 Configuration Node Menu Options

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

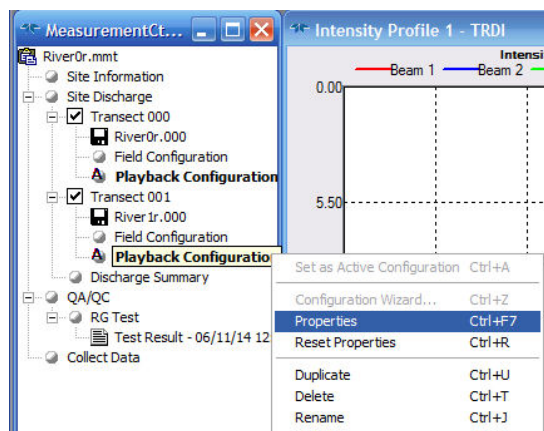


Figure 17. Managing Configuration Nodes

5.5.2 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.

5.5.3 Configuration Wizard

Use this function to start the Measurement Wizard. It will start at the Configuration Dialog page (see [“Configuration Dialog,”](#) page 36).

5.5.4 Properties

Use this function to view the configuration settings (see [“Configuration Node Properties,”](#) page 45). 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**.

5.5.5 Reset Properties

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

5.5.6 Duplicate

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

5.5.7 Delete

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

5.5.8 Rename

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

5.6 Show Summary

Right-click on the **Discharge Summary** field and select **Show Summary** to display the discharge summary (see [“Discharge Summary,”](#) page 32).

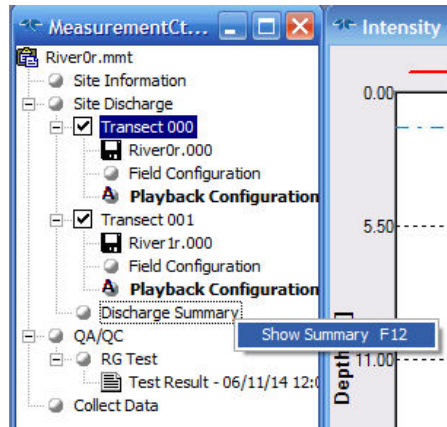


Figure 18. Measurement Control - Discharge Summary

6 Available Displays

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,” page 18)
- Contour Graphs
- Profile Graphs
- Ship Track Graphs
- Time Series Graphs
- Tabular Displays

6.1 Contour Graph

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



NOTE. 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).

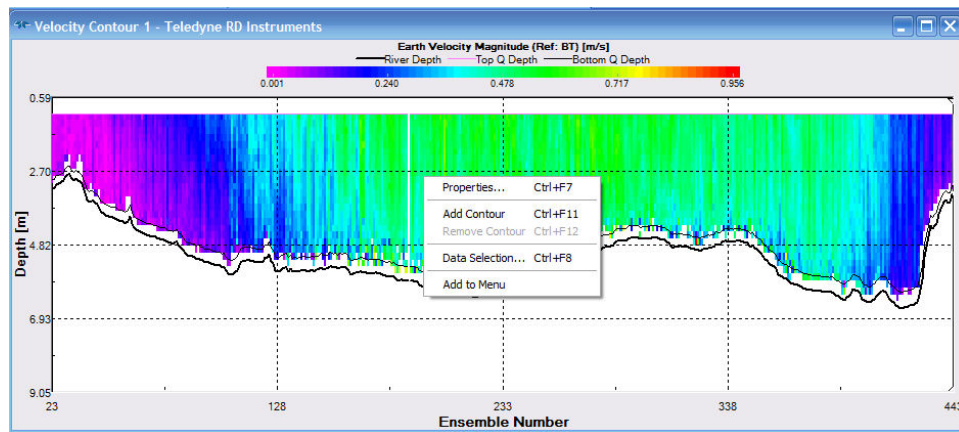


Figure 19. Velocity Contour Graph

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**.

6.2 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.



NOTE. 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**.

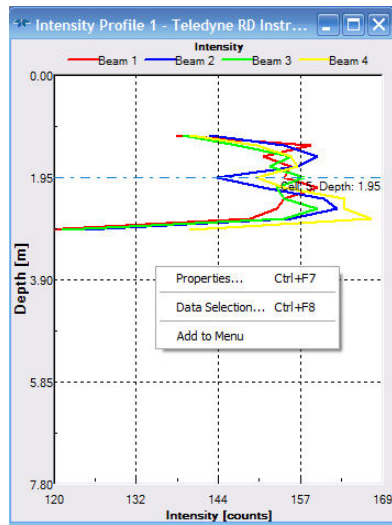


Figure 20. Intensity Profile Graph

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 ab-

sorption 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.

6.3 Ship Track Graph

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 overlays 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.



NOTE. 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.

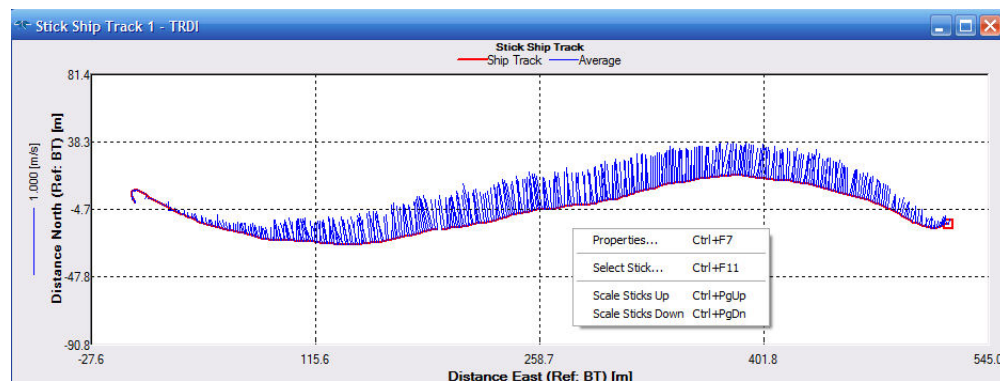


Figure 21. Stick Ship Track Graph

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).

6.4 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 (see “[Offsets Page](#),” page 52). 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
- **Discharge** – Total discharge for each transect. The data from the Discharge History Tabular screen is used.
- **GPS Data** – Number of Satellites in Use and HDOP.
- **Pressure Sensor** – Average pressure sensor reading.

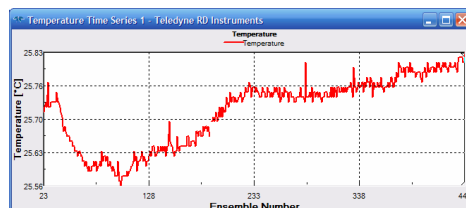


Figure 22. Time Series Graph

6.5 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 Bad Below Bottom** box (see “[Processing Page](#),” page 54).

Table 1: 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. |
| Navigation | The Navigation display lists navigation data about the currently displayed ADCP data ensemble. If the data is invalid, "Bad" is displayed. The GPS Position lines are not visible if the GPS is not present or were not collected during data collection. |
| GPS | The GPS display lists GPS data about the currently displayed ADCP data ensemble. If <i>WinRiver II</i> 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 <i>WinRiver II</i> 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. <i>WinRiver II</i> 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 Bad Below Bottom box (see “ Processing Page ,” page 54). |
| 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. |



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

6.6 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** window. 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.

| Transect | Start Bank | # Ens. | Start Time | Total Q m ³ /s | Delta Q % | Top Q m ³ /s | Meas. Q m ³ /s | Bottom Q m ³ /s | Left Q m ³ /s | Left Dist. m | Right Q m ³ /s | Right Dist. m | Width m | Total Area m ² |
|-------------|------------|--------|------------|------------------------------|--------------|----------------------------|------------------------------|-------------------------------|-----------------------------|-----------------|------------------------------|------------------|------------|------------------------------|
| 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 | 9.55 |
| 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 23. Discharge Summary Screen

6.7 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 24. Acquire Control Window

6.8 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 **Earth Velocity Magnitude and Earth Velocity Direction** and then click **OK**.

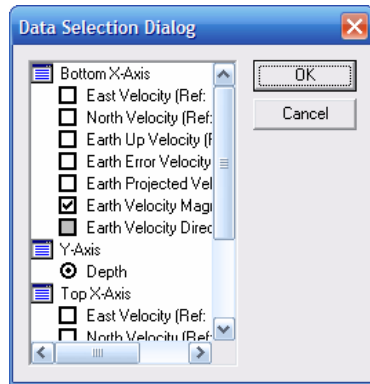


Figure 25. Data Selection Dialog

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**.

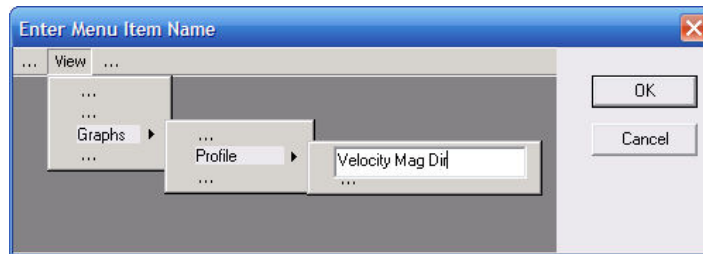


Figure 26. Adding a Graph to the Menu



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


7 Using the Measurement Wizard

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 setup, the measurement file can be saved and then later retrieved.

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

7.1 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,”](#) page 79).



NOTE. If a **Station Name** is entered, it will be used in the **Filename Prefix** box on the **Output Filename Options** page of the wizard (see [“Output Filename Options,”](#) page 40).

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

7.2 Rating Information

Setup Dialog

Measurement Wizard
Rating Information

Rating Information

Inside Gage Height (m): 0 Magn. Variation Method: None
 Outside Gage Height (m): 0 Measurement Rating: Unspecified
 Gage Height Change (m): 0 Control Code 1: Unspecified
 Rating Discharge (m³/s): 0 Control Code 2: Unspecified
 Index Velocity (m/s): 0 Control Code 3: Unspecified
 Rated Area (m²): 0
 Rating Number: 1
 Water Temp (°C):

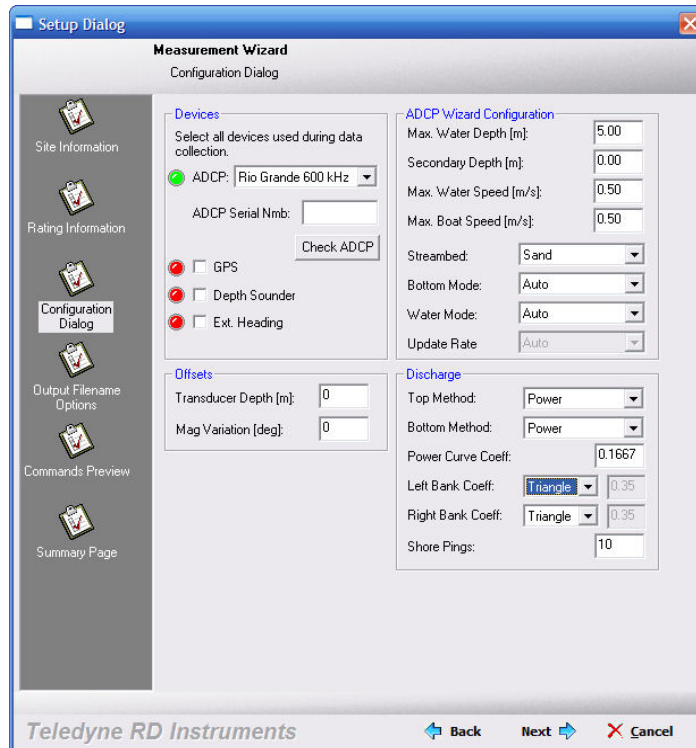
Teledyne RD Instruments Back Next X

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,” page 79).



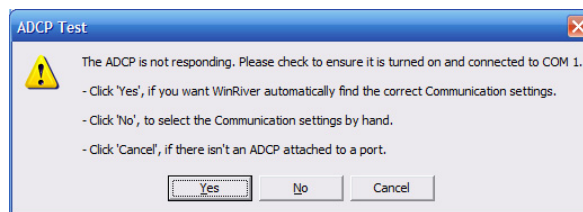
NOTE. You can add/edit this information once the measurement wizard is completed by right-clicking on **Site Information** in the Measurement Control window and selecting **Site Wizard**.

7.3 Configuration Dialog



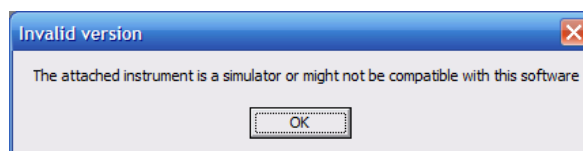
7.3.1 Devices

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 using a Rio Grande 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,” page 79).

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,” page 48.

7.3.2 Offsets

Enter your choices for the **Offsets** section. For more information on these settings, see the “Offsets Page,” page 52.

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

Magnetic Variation (degrees) – Enter the magnetic variation (declination) at the deployment site.

7.3.3 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,” page 46. *WinRiver II* will give warning messages if the settings are not recommended. Click the **Close** button on the message box or continue making choices.

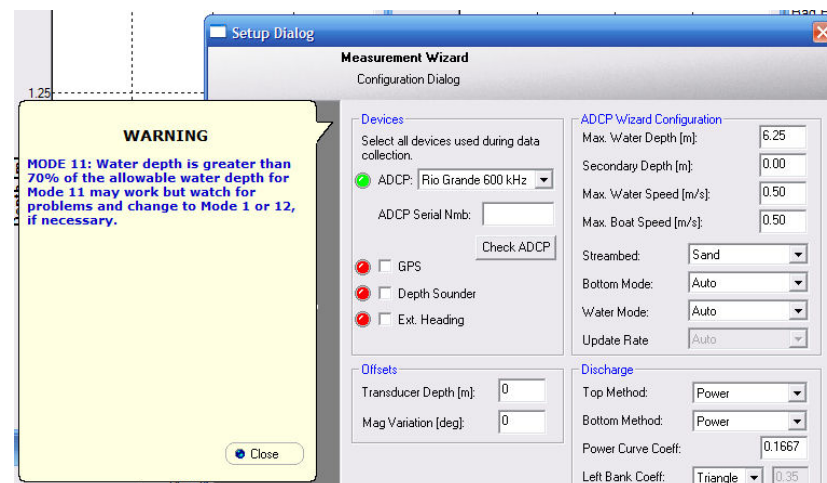


Figure 27. Warning Message

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


Secondary Depth – Enter a secondary depth (optional).

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.

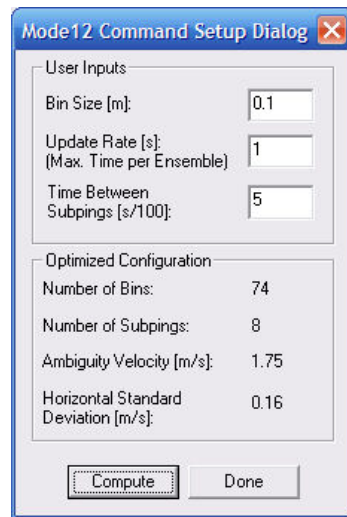



Figure 28. Water Mode 12 Options

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.

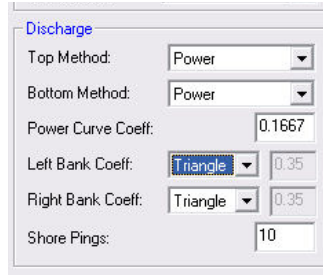
Time Between Subpings (100th seconds) – This set the time between subpings in hundredths of a second and sets the second parameter of the WO command. In the above example, the WO command would be set to WO8,5.

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

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

7.3.4 Discharge

Enter your choices for the **Discharge** section. For more information on these settings, see the “[Discharge Page](#),” page 50.



| | |
|--------------------|---------------|
| Discharge | |
| Top Method: | Power |
| Bottom Method: | Power |
| Power Curve Coeff: | 0.1667 |
| Left Bank Coeff: | Triangle 0.35 |
| Right Bank Coeff: | Triangle 0.35 |
| Shore Pings: | 10 |

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.

7.4 Output Filename Options

Setup Dialog

Measurement Wizard
Output Filename Options

Recording

Filename Prefix: Use Prefix in Filename

Output Directory:

Include Filename Options

Measurement Number

Transect Number:

Sequence Number - Maximum File Size (Mb):

Use Date/Time in Filename

No Date/Time

Short (YY-MM-DD)

Long (YY-MM-DD hhmmss)

Use Delimiter in Filename

No Delimiter

Underscore

Custom

Filename Preview

C:\Measurements\Station\Station_0_000.P00

Teledyne RD Instruments

Enter your choices for the **Recording** section. The **Filename Prefix** and **Output Directory** are part of the **Recording** page (see “[Recording Page](#),” page 57).

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.



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

Output Directory Already Exists

The requested output directory already exists and contains previous measurement data. Please change the Output Directory or Filename Prefix so that a unique directory will be created for the new measurement.

Include Filename Options

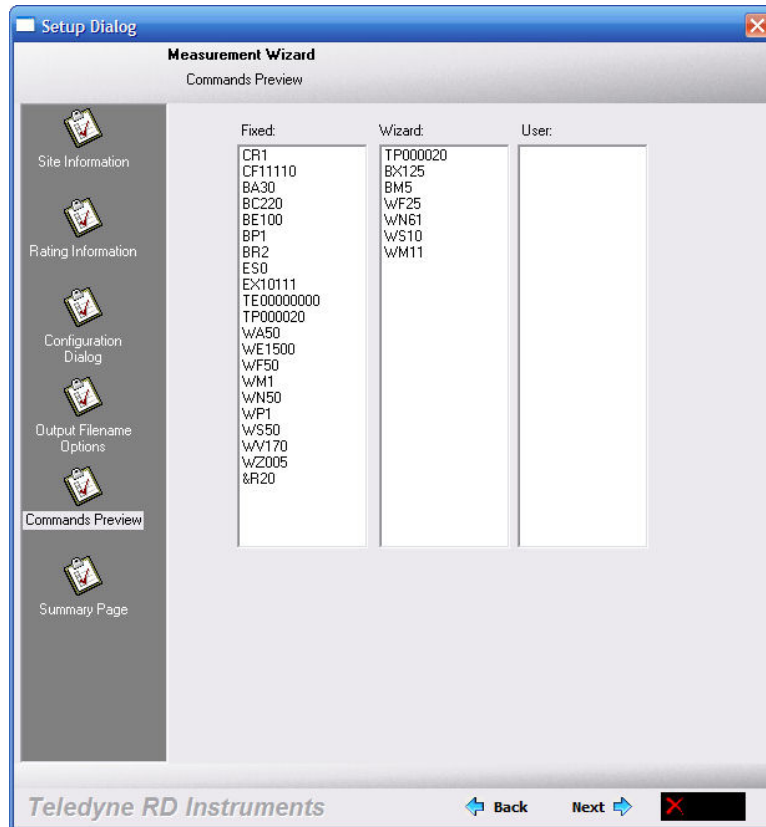
- Check the **Measurement Number** box to add it to the file name.
- Check the **Sequence Number** box and enter a **Max File Size** if you want to limit the size of the data file. Once the file size has been reached, the sequence number will increment.
- To add the Date/Time to the filename, check the **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.

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

In the following example, the filename prefix is CheckPoint, the measurement number is 13, the transect number is 003, the sequence number box, measurement number, and short date/time buttons were selected.

```
C:\Measurements\CheckPoint\CheckPoint_13_003_000_07-04-09.PDO.  
|                                     | | | | |  
|                                     | | | | | Short Data/Time  
|                                     | | | | | Sequence Number  
|                                     | | | | | Transect Number  
|                                     | | | | | Measurement Number  
|                                     | | | | | Filename Prefix  
|                                     | | | | |  
| Output Directory
```

7.5 Commands Preview



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



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



NOTE. 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,” page 46

“ADCP Commands,” page 100

“Water Profiling Modes,” page 107

“Bottom Tracking Modes,” page 118

7.6 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.



NOTE. 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.

Estimated Discharge COV (1 pass) – Not implemented at this time.

Estimated Discharge COV (4 passes) – Not implemented at this time.



NOTE. 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.

8 Configuration Node Properties

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.

To view the field or playback configuration node settings, right-click on the configuration node on the **Measurement Control** window, and then select **Properties** (see “Using the Measurement Control Window,” page 18). The configuration node presently in use will be in bold text.



NOTE. 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.

When creating configuration nodes for data collection, the most important parts in a configuration node are the **Commands** and **Recording** tabs. Set them to the desired parameters. The rest of the parameters can be changed during playback and do not influence data collection.

For correct data display while acquiring data you can enter the following values.

- On the **Offsets** page set the **ADCP Transducer Depth** (part of the Measurement Wizard).
- On the **Discharge** page, specify if you have any preference how to calculate discharge and if you know the shape of your edge bank.
- On the **Depth Sounder/GPS** page, select **Depth Sounder** to be used in processing if you are using a depth sounder and you do not have valid bottom track data.

8.1 Commands Page

You can directly control the profiling parameters sent to the ADCP using the **User Commands** box. The ADCP Technical Manual explains all direct commands in detail. 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,” page 34](#) and [“ADCP Commands,” page 100](#)).



CAUTION. 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**. In the following, we will describe each command and give guidelines for setting these commands for acquiring reliable discharge data. Refer to the WorkHorse Commands and Output Data Format guide for more detailed information about each command.

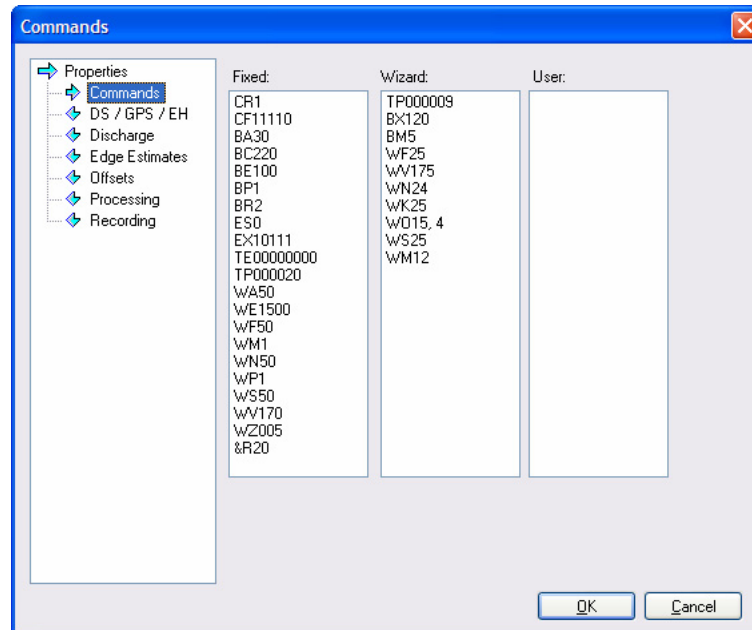


Figure 29. Commands Page

Table 2: 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. |
| 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 3). |
| 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 3). |
| 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 3). |
| 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 3: 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. |



NOTE. The values for the **Wizard Commands** are based on information entered in the **Measurement Wizard** (see "Using the Measurement Wizard," page 34).

8.2 Depth Sounder / 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.

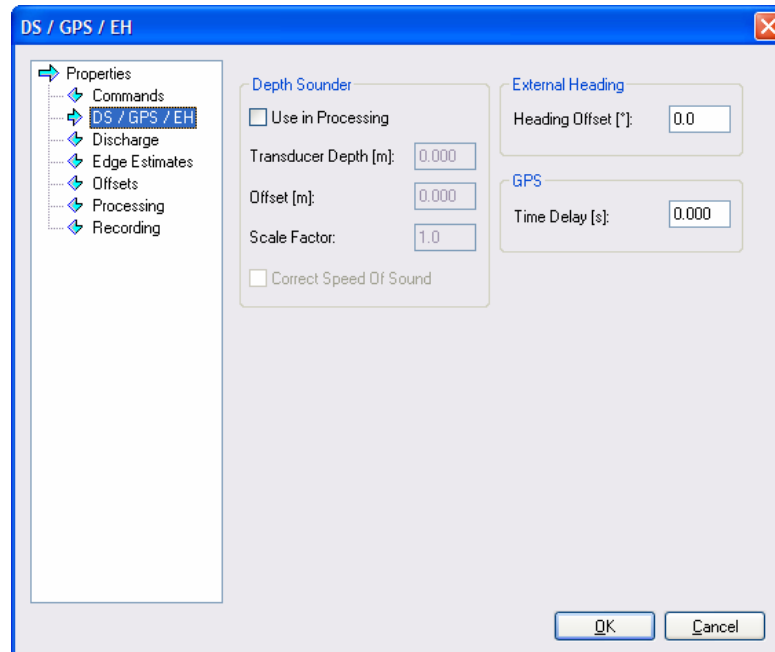


Figure 30. DS/External Heading Page

Depth Sounder

- **Use in Processing** – This will instruct *WinRiver II* to use the depth sounder value in the discharge calculation rather than the ADCP beam depths.
- **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.

External Heading

- **Heading Offset** – Use the **Heading Offset** field to reconcile any differences between the ADCP bottom track heading and those reported by the External Heading NMEA string. Entering a value in the **Offset** box enables this additional offset.

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.

8.3 Discharge Page

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

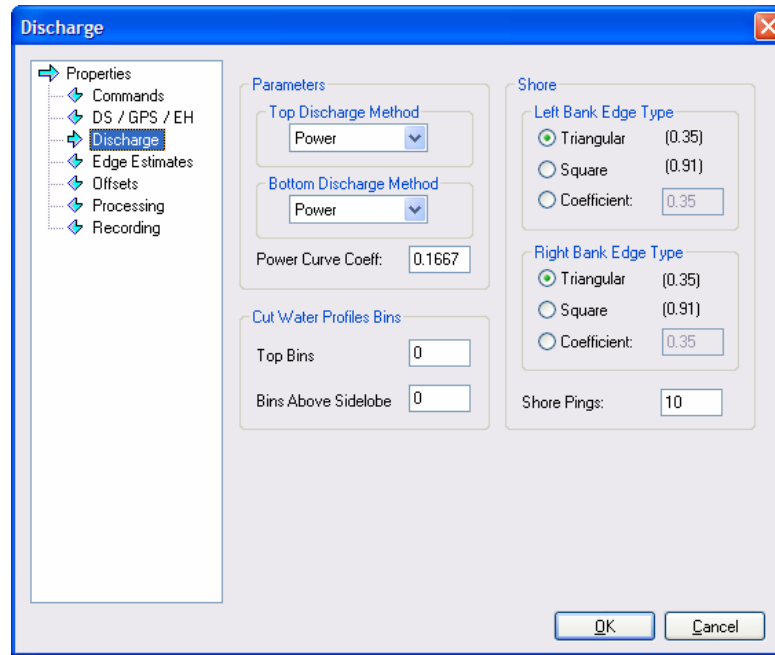


Figure 31. Discharge Page

- 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 en-

tire 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 extra ensembles are recorded to the raw data file during the stationary period at the shore edge help to ensure that you have a good starting ensemble for estimation of the side discharge.

8.4 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.

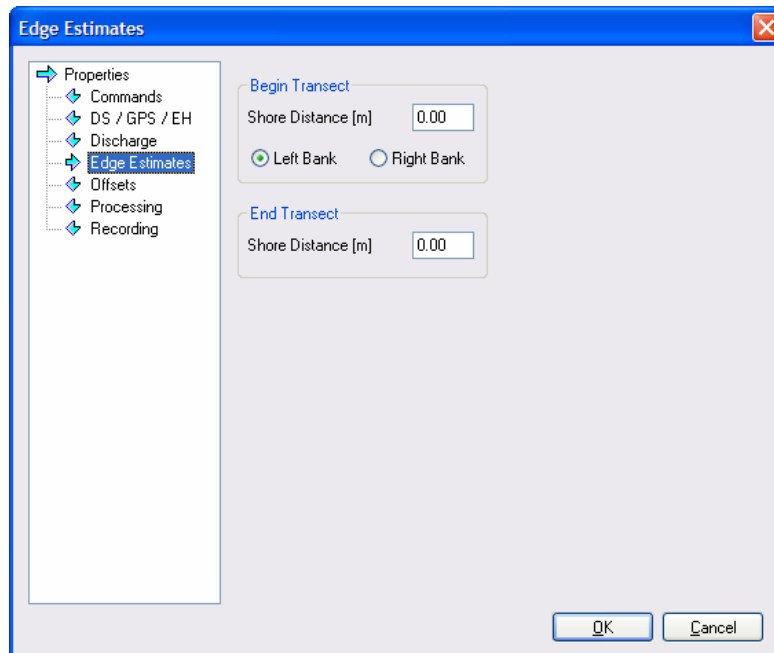


Figure 32. Edge Estimates Page

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.

8.5 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.

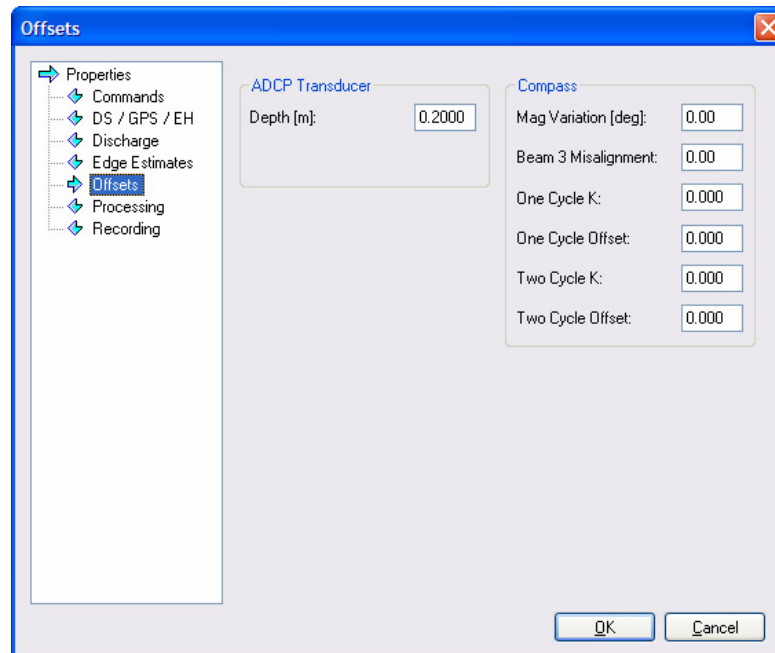


Figure 33. Offsets Page

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 unmeasured 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.



NOTE. 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," page 46).

- **Magnetic Variation** – Use the **Magnetic Variation** field to account for magnetic variation (declination) at the deployment site. East magnetic declination values are positive. West values are negative. *WinRiver II* uses magnetic variation in the data collection and Playback displays to correct ADCP velocities and bottom-track velocities.



NOTE. 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," page 46).

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** – *WinRiver II* uses the **Beam 3 Misalignment** value to align the ADCP's north reference (Beam 3) to the ships bow (see the WorkHorse Technical Manual).
- **Compass Correction** – See "[Compass Correction](#)," page 88, for details on how to do the compass correction.

8.6 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.

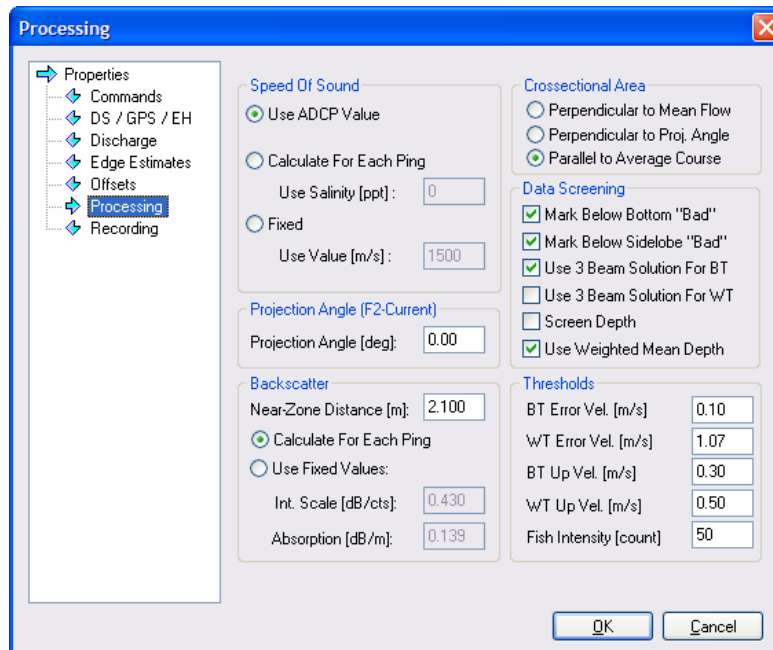


Figure 34. Processing Page

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. Use the **Use ADCP Value** option to select the value being used by the ADCP. The EC and EZ-commands determine 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.

Projection Angle

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

Backscatter

The Backscatter options control the values used to convert between measured Receive Signal Strength (RSSI) to backscatter. 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 35](#)). 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 35](#).

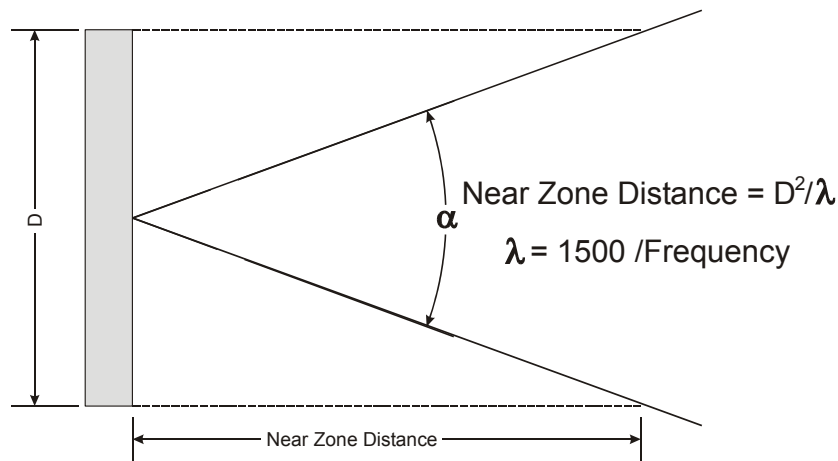


Figure 35. Near Zone Distance

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 |

Cross Sectional Area

Cross Sectional Area can be calculated using three different methods: as perpendicular to the mean flow, perpendicular to the projection angle, or parallel to the average course.

Data Screening

Select **Mark Below Bottom Bad** to mark data below the ADCP-detected bottom or Depth Sounder detected bottom (if selected for processing).
Check the **Use 3 Beam Solution for BT** box to allows 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 allows 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.

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.

8.7 Recording Page

The **Recording** page lists the parameters used to define where the data is recorded during data collection.

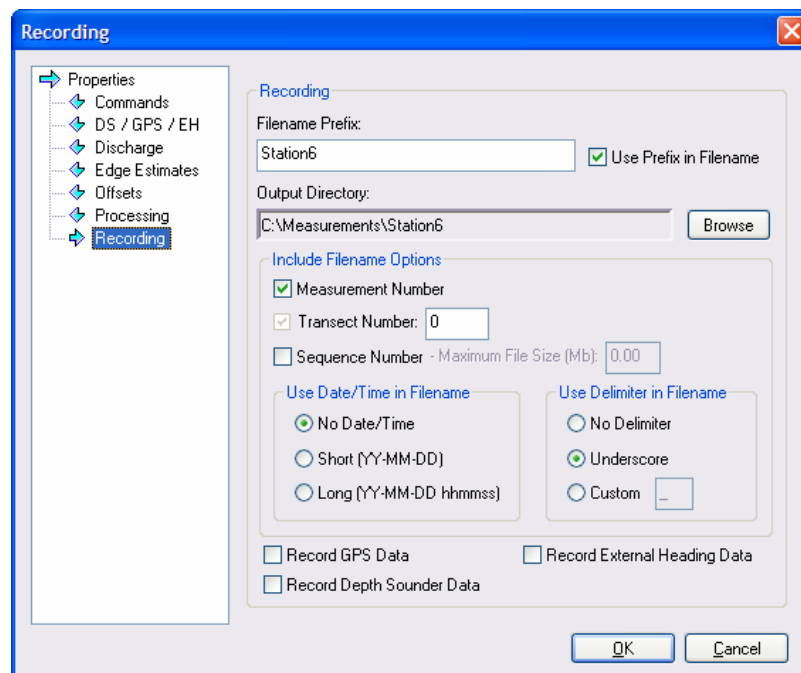


Figure 36. Recording Page

- **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.



NOTE. 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.
- If you want to record ASCII GPS, External Heading, and Depth Sounder data, then select the appropriate box.



NOTE. Collecting ASCII GPS, External Heading, or Depth Sounder files is not required and is not used by *WinRiver II*.



NOTE. If you want to use the depth sounder data in place of the ADCP depth, then you must select **Use in Processing** on the **Depth Sounder / External Heading** page (see “Depth Sounder / External Heading Page,” page 48).

9 QA/QC

Before taking measurements, check the following items.

9.1 Set the 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 **Close** to exit the **Set ADCP Clock** dialog.



NOTE. The first time a transect is started, the **Set ADCP Clock** dialog will open. StreamPro ADCP users will notice that the blue LED will blink until the **Close** button is clicked. This is normal.

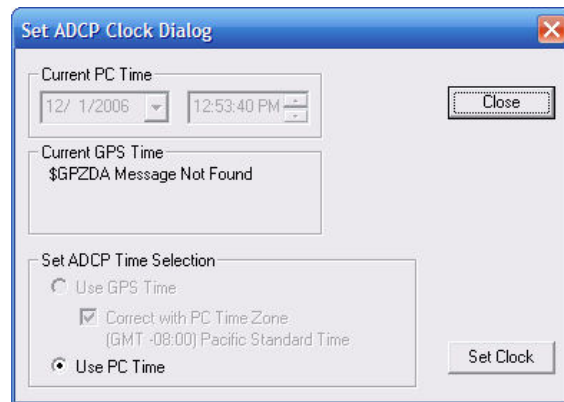


Figure 37. Set the ADCP Clock

9.2 Test the Pressure Sensor

- On the **Acquire** menu, click **Execute Pressure Sensor Test** to verify the ADCP's pressure sensor is functioning properly.
- Click the **Zero Pressure Sensor** button to zero out the sensor.
- Click **Close** to exit the **Pressure Sensor Calibration** dialog.



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

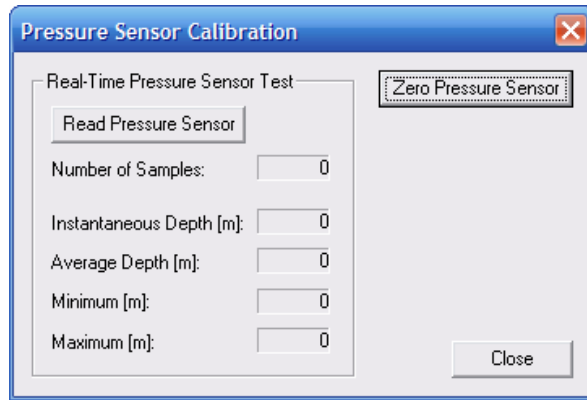



Figure 38. Test the Pressure Sensor

9.3 Test the ADCP

- a. On the **Acquire** menu, click **Execute RGTest** to verify the ADCP is functioning properly.
- b. Click the **Stop PC2** button to end the PC2 test. Click **Close** to exit the **RGTest** dialog.

 **NOTE.** 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.

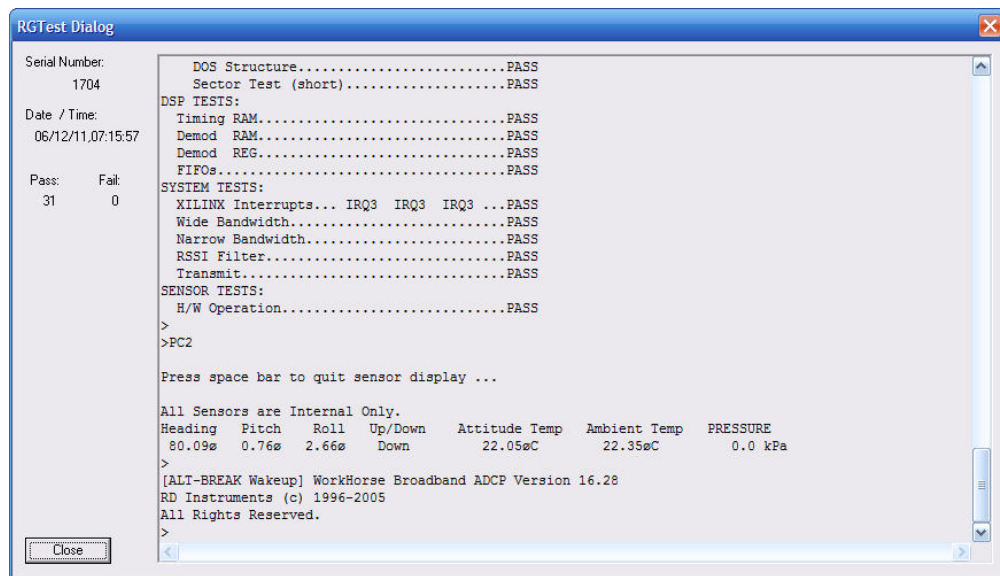


Figure 39. Test the ADCP

9.4 Compass Alignment

The compass alignment is covered in the Integrating Depth Sounder, External Heading, and GPS Data section. Use “[Method 3](#),” [page 97](#) to calibrate a Rio Grande ADCP or a WorkHorse Monitor/Sentinel ADCP with firmware version 16.30 or greater.

9.5 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 (see “[Integrating Depth Sounder, External Heading, and GPS Data](#),” [page 80](#)).

- Using the **Measurement Wizard**, set an estimated depth and velocity.
- On the **Acquire** menu click **Start Pinging** or use the shortcut key **F4**.
- Move the ADCP to the middle of the section, or the point at which the highest velocities can be seen.
- On the **Acquire** menu click **Moving Bed Test**. Select **Stationary** and click the **Start** button.

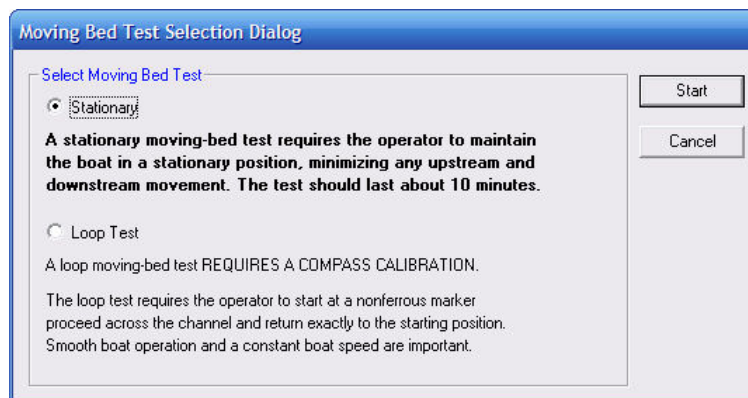


Figure 40. Moving Bed Test



NOTE. The **Loop Test** method was developed by USGS and is not directly supported by TRDI. For more information, refer to the USGS document concerning the loop method at the following link:
<http://pubs.usgs.gov/sir/2006/5079/>

- e. Hold the unit in position for ten minutes and try to minimize any movement.
- f. Keep a close eye on the **Ship Track Graph**. Any movement indicated on here above actual movement would indicate a Moving Bed.
- g. On the **Acquire** menu click **Stop Moving Bed Test**.
- h. Review the data; if this indicates bed movement, move to a more suitable section or use GPS/Depth Sounders as needed.
- i. Use the data to set a better configuration for transects.

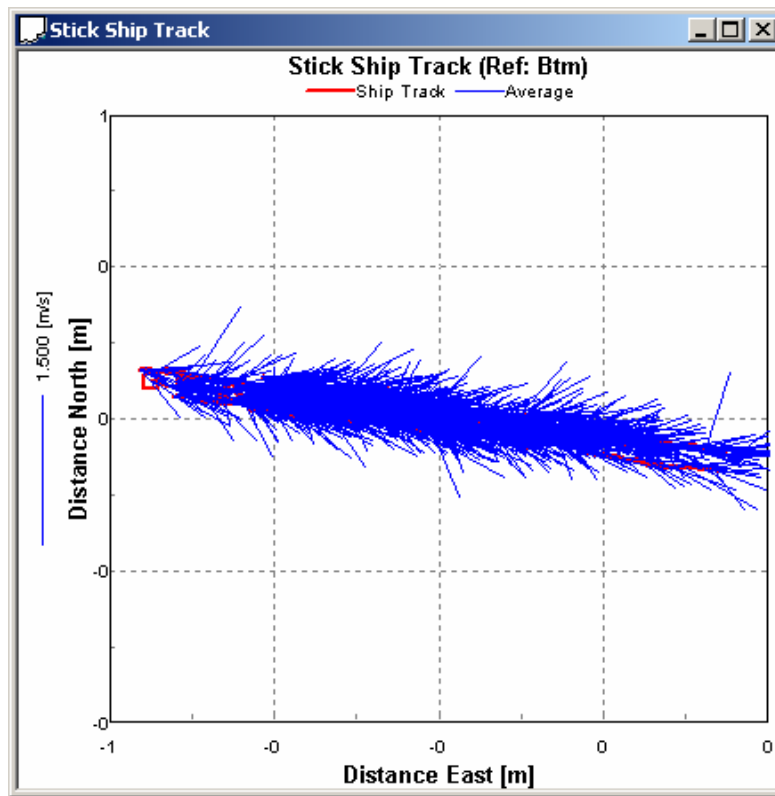


Figure 41. Ship Track Indicating NO Moving Bed

10 Acquiring Discharge Data

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.



CAUTION. If you will be using GPS rather than Bottom Track as the reference, then the Compass and Magnetic Variation must be calibrated.

If you are using Bottom Track as the reference you must set the Magnetic Variation.

See "Compass Correction," page 88 for details on compass calibration procedures.



NOTE. It is a good idea to test the ADCP before collecting data at a particular site to check the ADCP's operation (see "QA/QC," page 59).

- a. Start *WinRiver II* and load or create a measurement file (see "Using the Measurement Wizard," page 34).
- b. 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," page 23).
- c. Press **F4** to start the ADCP ping. The Acquire **Tabular** 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.

In general, after you have started the ADCP ping, 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.



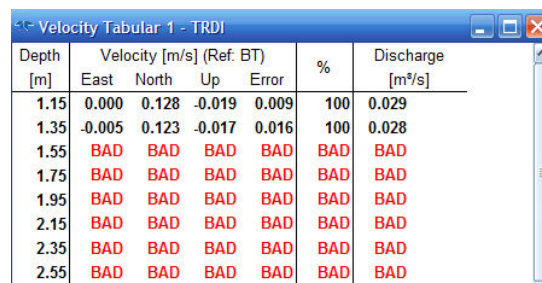
NOTE. You can let the ADCP ping even if it is not in the water. Unlike many other acoustic devices, no damage to the ADCP will occur. It is often useful to operate the ADCP out of the water to test the configuration, practice with *WinRiver II*, or perform other tests.

- d. 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.

10.1 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.

- a. On the **View** menu, select the **Tabular, Velocity** (see [Figure 42](#)) 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). You will 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.



| Depth [m] | Velocity [m/s] (Ref: BT) | | | | % | Discharge [m³/s] |
|-----------|--------------------------|-------|--------|-------|-----|------------------|
| | East | North | Up | Error | | |
| 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 42. Velocity Tabular Display Showing Two Good Bins

- b. 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. 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.

- c. 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 19, page 26](#). Use this display to see how the water depth changes as you make your transect. Note regions where the bottom depth changes quickly.
- d. 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.

10.2 Holding Position at the Starting Channel Edge

- a. Starting at one of your marked edges, use the **Composite Tabular** display to ensure that you have at least two valid discharge measurements.
- b. 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.

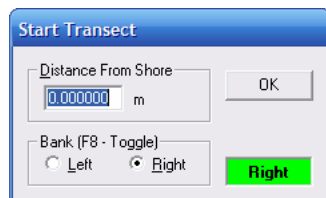


Figure 43. Enter Beginning Distance From Shore



NOTE. Data processing continues while *WinRiver II* is prompting for the edge distance.



NOTE. *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.

- c. 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 starting ensemble for estimation of the side discharge.



NOTE. Shore Ensembles are set in the **Discharge** page (see [“Discharge Page,” page 50](#)).

10.3 Crossing the Channel

- a. Once the shore 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.
- b. 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 select **Properties**.
- c. You can see the discharge for the top, middle and bottom layers on the **Composite Tabular** screen.

10.4 Holding Position at the Ending Channel Edge

- a. 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 the top two depth cells.
- b. Stop at this position and wait for 10 shore pings to be recorded.
- c. 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.

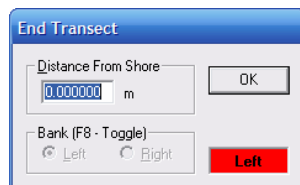


Figure 44. Enter Ending Distance from Shore



NOTE. *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.

10.5 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 dis-

charge 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.

10.6 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.

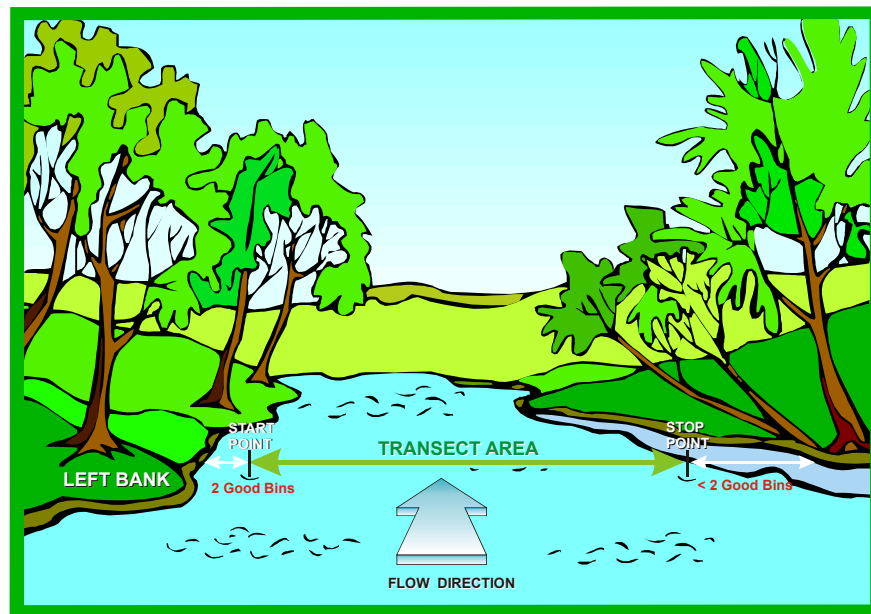


Figure 45. Overview of Data Collection

11 Post-Processing of Discharge Data

WinRiver II is used for post-processing data to get a total discharge value for the channel (see [“Using the Q Measurement Summary,” page 79](#)). Common post-processing tasks include sub-sectioning data to remove bad ensembles (see [“Transect Subsection,” page 22](#)) and creating ASCII files (see [“Creating an ASCII-Out Data File,” page 72](#)). For screen captures, you can change your averaging interval (see [“Averaging Data,” page 21](#)).

11.1 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 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 file 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**.

11.2 Playback Older Data Files

Use the following procedure to playback a data file created using an older version of *WinRiver*. 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.

- a. 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 *.w.000 and *.w.00x configuration file and combines them into the **Field Configuration** node.
- b. To open a workspace file, click **File, Load Workspace**.
- c. 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.
- d. Use the **Measurement Control** window to see what files are in use (see [“Using the Measurement Control Window,” page 18](#)).

- e. 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.
- f. 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.



NOTE. To add or remove a transect from the discharge summary, check or uncheck the box next to the transect.

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

11.3 Playback Data Display Options

The Playback data display options are the same as those for data collection.

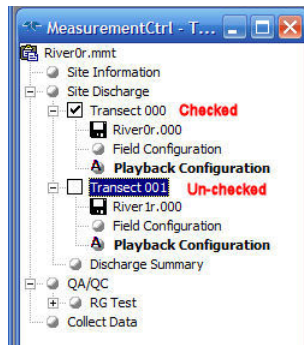
- a. On the **Playback** menu, click **First Ensemble** to go to the beginning of the data file. Click **Play** to review the data. To quickly play through the data, on the **Playback** menu, select **Slider** or drag the ensemble marker on the contour graph.
- b. Right-click the display and select **Properties** to change the scaling fields of the different data displays.
- c. Use the toolbar to zoom in on the **Ship Track** and **Stick Ship Track** graphs (see [“Zoom Functions,” page 17](#)).

11.4 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.

- a. Open the measurement file.
- b. On the **Measurement Control** window, check the Transect file to be corrected and uncheck all of the other Transect files.



- c. On the **Measurement Control** window, right-click on **Playback Configuration** and select **Properties**. Select the **Edge Estimates** page.
- d. Enter the correct shore distance. Right-click on the corrected entry and click **Apply to Checked Active Configurations**. Click **OK** to exit the properties dialog.
- e. The data file will play automatically.

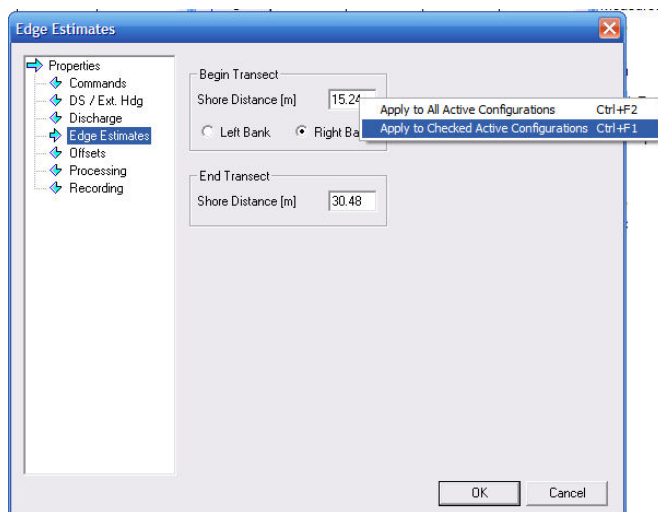


Figure 46. Editing an Item During Playback

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.

- Open the measurement file.
- Make sure all the Transect files are checked.
- On the **Measurement Control** window, right-click on **Playback Configuration** and select **Properties**. Select the **Offsets** page.
- 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.
- The data file will play automatically.

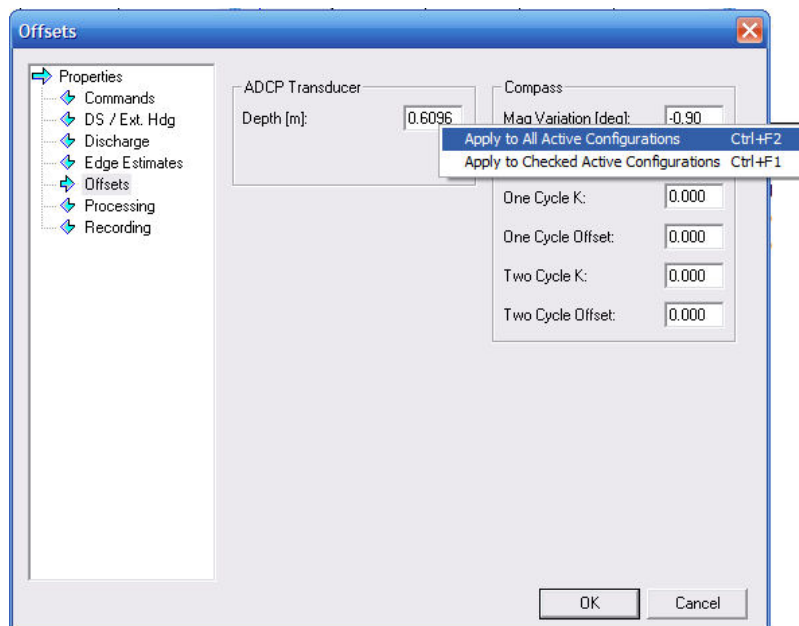


Figure 47. Applying Corrections to All Transect Files



NOTE. To return the all values to the parameters as collected, on the **Measurement Control** window, right-click on **Playback Configuration** and select **Reset Properties**.

11.5 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 sub-section, 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).

The same control over data scaling, averaging, sub-sectioning, and processing available during playback influences the ASCII-out file. *WinRiver II* always writes velocity data (in earth coordinates) to the ASCII-out file. For example, you may select only depth cells (bins) 4 through 9 for display on the screen, metric units (m, m/s), and use speed of sound corrections for a portion of data to be sent as ASCII-out. *WinRiver II* will scale, display, and write the velocity data to the ASCII-out file based on your processing specifications.

11.5.1 Classic ASCII Output

- 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 or reprocess the desired transect (see [“Post-Processing of Discharge Data,”](#) page 68).

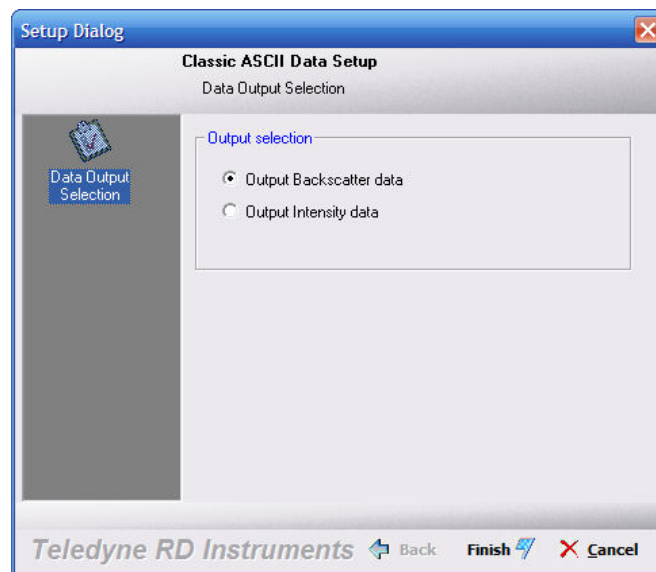


Figure 48. Classic ASCII Output

11.5.2 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," page 23). |
| B | 1 | NOTE 2 - You can enter these lines by right-clicking Transect and selecting Add Note (see "Add Note," page 23). |
| C | 1 | DEPTH CELL LENGTH (cm) |
| | 2 | BLANK AFTER TRANSMIT (cm) |
| | 3 | ADCP DEPTH FROM CONFIGURATION NODE (cm) |
| | 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 4: 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 |

| Row | Field | Description |
|------|--------------------------|---|
| 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 Δ altitude (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 Depth | - Beam 2 |
| 11 | Sounder = NO) | - Beam 3 |
| 12 | | - Beam 4 |
| 9 | DEPTH READING | - Depth Sounder depth |
| 10 | (Use Depth | - Depth Sounder depth |
| 11 | Sounder = Yes) | - Depth Sounder depth |
| 12 | | - Depth Sounder 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 | - invalid |
| | 5 | - Fixed value not used. |
| 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 |
| | 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 |



NOTE. 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.



NOTE. 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
```

11.5.3 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.

- Start *WinRiver II* and load a measurement file. Playback/Reprocess the desired transects (see “[Post-Processing of Discharge Data](#),” page 68).
- On the **Configure** menu, click **ASCII Output**, **Generic ASCII Output**.
- 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.
- Click **Next** to continue.

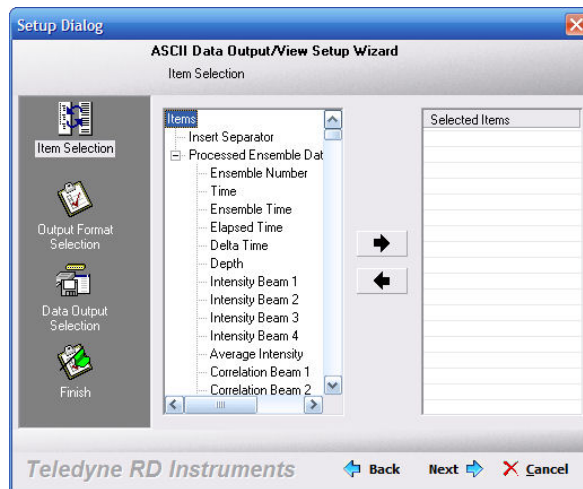


Figure 49. ASCII Item Selection

- e. On the **Output Format Selection** dialog select if you want to include a **Message Header**, what type **Parameter Delimiter**, **Message Delimiter**, and if you want the **Checksum** included.
- f. Click **Next** to continue.

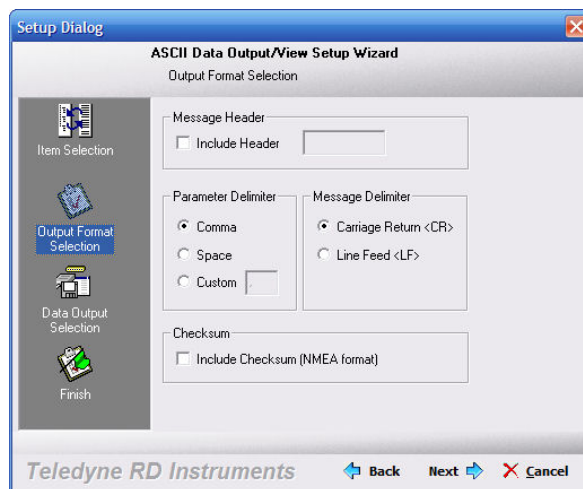


Figure 50. ASCII Output Format Selection

- g. 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.
- h. Click **Next** to continue.

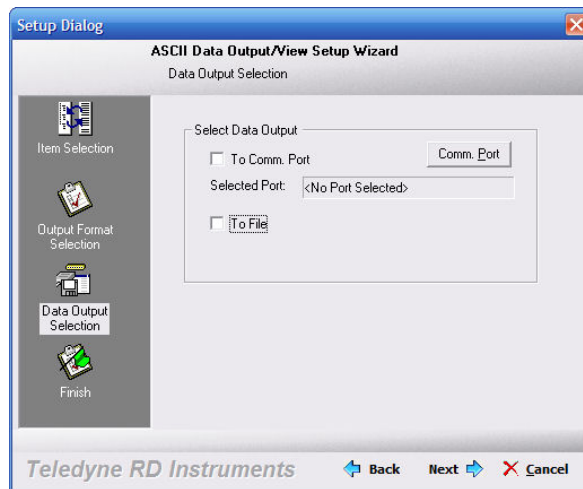


Figure 51. ASCII Data Output Selection

- i. To save the ASCII Output Template, use the **Browse** button and name the file. ASCII template files are saved as *.ttf files.
- j. Click **Finish**.
- k. Playback or reprocess the desired transect (see [“Post-Processing of Discharge Data,”](#) page 68).

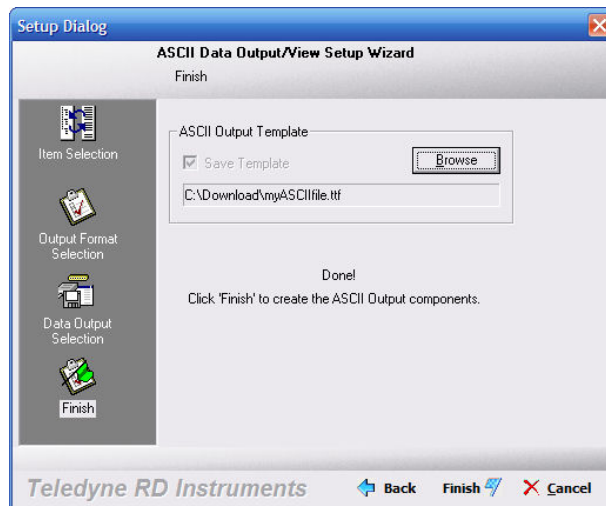


Figure 52. ASCII Output Template

11.6 Print a Graph or Display

- Start *WinRiver II* and open a measurement file.
- Click on the graph/display to be printed. The title bar will be highlighted.
- On the **File** menu, click **Print Setup**. Select the desired setting and printer.



NOTE. Choose **Landscape** for contour graphs.

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

11.7 Capture Setup

If you would like to save a graph/display for use in other documents, do the following.

- Click on the graph/display to be saved. The title bar will be highlighted.
- On the **Configure** menu, select **Capture Setup**. This will bring up a following dialog box.

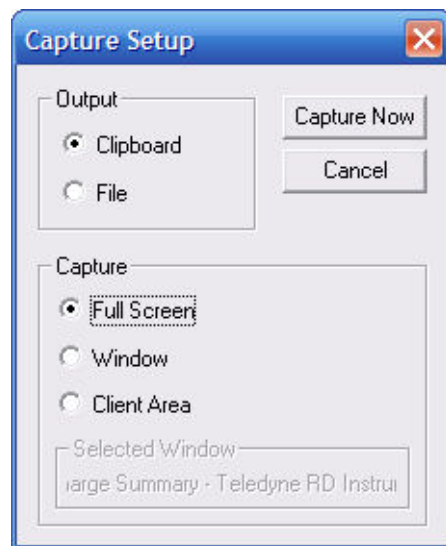


Figure 53. Capture Setup

- 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**.

11.8 Using the Q Measurement Summary

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

- Start *WinRiver II* and open a measurement file.
- 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; un-checking the box will remove the transect from the summary.
- On the **Playback** menu, select **Reprocess Checked Transects**.
- 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.

| Station Number: | | Meas. No.: 0 | | | | | | | | | | | | | | | | |
|-------------------------------|-----------------------------|---|---------------|-----------|--------|--------|------|-------|-------|-------|-------|--------|-------|-------|-----------|------|-------|---|
| Station Name: | | Date: | | | | | | | | | | | | | | | | |
| Party: | Width: 158.9 m | Processed by: | | | | | | | | | | | | | | | | |
| Boat/Motor: | Area: 1398.0 m ² | Mean Velocity: 1.07 m/s | | | | | | | | | | | | | | | | |
| Gage Height: 0.000 m | G.H. Change: 0.000 m | Discharge: 1,500 m ³ /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 m ² | Diff.: 0.000% | | | | | | | | | | | | | | | |
| Depth Sounder: Not Used | Top Est: Power (0.1667) | Control1: Unspecified | | | | | | | | | | | | | | | | |
| | | Control2: Unspecified | | | | | | | | | | | | | | | | |
| | | Control3: Unspecified | | | | | | | | | | | | | | | | |
| Screening Thresholds: | | ADCP: | | | | | | | | | | | | | | | | |
| BT 3-Beam Solution: YES | | Type/Freq.: Rio Grande/600 kHz | | | | | | | | | | | | | | | | |
| WT 3-Beam Solution: NO | | Serial #: Firmware: 0.00 | | | | | | | | | | | | | | | | |
| BT Error Vel.: 0.10 m/s | | Bin Size: 50 cm Blank: 25 cm | | | | | | | | | | | | | | | | |
| WT Error Vel.: 1.07 m/s | | BT Mode: 5 BT Pings: 1 | | | | | | | | | | | | | | | | |
| BT Up Vel.: 0.30 m/s | | WT Mode: 1 WT Pings: 1 | | | | | | | | | | | | | | | | |
| WT Up Vel.: 3.66 m/s | | WV: 281 | | | | | | | | | | | | | | | | |
| Use Weighted Mean Depth: YES | | | | | | | | | | | | | | | | | | |
| Performed Diag. Test: YES | | Project Name: River0r.mnt | | | | | | | | | | | | | | | | |
| Performed Moving Bed Test: NO | | Software: 1.00.12.03 | | | | | | | | | | | | | | | | |
| Performed Compass Test: NO | | | | | | | | | | | | | | | | | | |
| Meas. Location: | | | | | | | | | | | | | | | | | | |
| 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 |
| SD ev | | | | | | | | | | | | | | | | | | |
| R/M/% | | | | | | | | | | | | | | | | | | |

Remarks:

Figure 54. Q Measurement Summary

12 Integrating Depth Sounder, External Heading, and GPS Data

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. See [“Unable to Bottom Track,” page 125](#) in the Trouble Shooting section of this guide for more details on these conditions. 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.

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 high quality, accurate GPS system.
- The GPS must be capable of outputting GGA data strings via the NMEA0183 format. The GGA string contains GPS positions.
- Two serial ports are required on your computer to accept both ADCP and GPS data.



NOTE. GGA is not required if VTG is used.

12.1 How to Use Depth Sounders

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. *WinRiver II* will display the corrected depth (depth of water from the surface) in the **Navigation** tabular screen (See [Figure 56, page 83](#)).



NOTE. In conditions where a depth sounder is required to measure water depth, a GPS is also required to measure the boat speed.

12.1.1 System Interconnections with the Depth Sounder

- a. 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 0813 output with DBT format in feet.
- b. Configure the depth sounder to output the DBT data string via the NMEA0183 format.
- c. 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).
- d. **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 may be used to provide the second and third ports.

12.1.2 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*, do the following steps.

- a. Stop pinging.



NOTE. You are not allowed to change communications parameters while pinging.

- b. Select the **Configure** menu, **Peripherals**. Click the **Add** button.
- c. Choose **Depth Sounder**, and then click **Next**. Choose the COM port that the depth sounder is connected to.



NOTE. Three serial ports are required on your computer to accept ADCP, GPS data, and depth sounder data.

- d. Enter the Depth Sounder communication Baud Rate, Parity, and Stop Bit settings.

- e. Verify the port and communication settings.
- f. Click **OK**.
- g. Start pinging. On the **Configure** menu, click **Peripherals**. Highlight the port the depth sounder is attached to and press **Test Port**. This will open a window in which all the characters coming from the port assigned for the depth sounder are shown. If the communication parameters are set properly you should see "\$ DBT" strings on the display. You need to close this window if you need to perform any other operation.

12.1.3 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, do the following.

- a. Stop pinging.
- b. Right-click on the configuration node in the **Measurement Control** window, and then select **Properties**.
- c. On the "[Depth Sounder / External Heading Page](#)," [page 48](#), select the **Use in Processing** box. The ADCP beam depths will be replaced by the Depth Sounder data.

Under the "[Recording Page](#)," [page 57](#) you can select to collect depth sounder data to an ASCII file.



NOTE. 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*.

- a. On the "[Depth Sounder / External Heading Page](#)," [page 48](#), enter the depth from the surface of the water to the depth sounder's transducer face in the **Transducer Depth** box.
- b. 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.
- c. 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 to the range reported from the depth sounder to the bottom.
- d. 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.

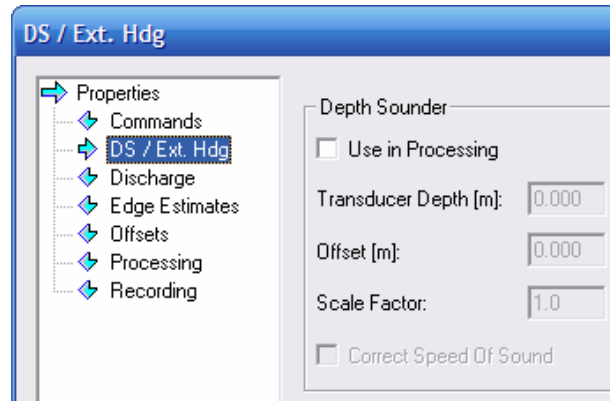


Figure 55. Depth Sounder Offsets

- e. Save the measurement file with a unique name by selecting the **Recording** page and entering a new **Filename Prefix** or **Output Directory**. In naming the measurement file, use a name that will indicate that the depth sounder is being used in place of bottom track depths in the discharge calculation, i.e. *FilenamePrefix_GPS_DS.mnt* for GPS and depth sounder.



NOTE. The decoded data will be displayed in the **Composite Tabular** view if the **Use in Processing** box is selected.

| Navigation (Btm) | | |
|------------------|---------------|-------|
| Boat Speed | 1.625 | [m/s] |
| Boat Course | 148.43 | [°] |
| Water Speed | 1.011 | [m/s] |
| Water Dir. | 259.61 | [°] |
| DS Depth | 13.93 | [m] |
| Length | 50.88 | [m] |
| Distance MG | 43.89 | [m] |
| Course MG | 125.64 | [°] |
| Time | 49.41 | [s] |
| GPS Position | | |
| Latitude | 31° 00.5698' | |
| Longitude | -91° 37.5535' | |

Figure 56. Viewing Depth Sounder Data

12.2 How to Use the External Heading

The external heading is another external sensor that can be used to track the heading. Boats with steel hulls may cause the ADCP's compass to be biased. *WinRiver* will display the corrected heading in the **Composite 1** tabular screen (See “[Using External Heading Data](#),” page 84).



NOTE. Steel hulls may cause the ADCP's compass to be biased - aluminum hulls do not affect the compass.

12.2.1 System Interconnections with External Heading

- a. 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.
- b. Configure the external heading to output the data string via the NMEA0183 format.
- c. Connect the ADCP system to your computer as described in the ADCP User's Guide. Apply power to the system.
- d. **Two** serial ports are required on your computer to accept the external heading in addition to ADCP data.

12.2.2 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*, do the following steps.

- a. Select the **Configure** menu, **Peripherals**. Click the **Add** button.
- b. Choose **Heading, NMEA HDT** and then click **OK**.
- c. Choose the COM port that the external heading is connected to.



NOTE. Two serial ports are required on your computer to accept ADCP data and the external heading data.

- d. Enter the external heading communication Baud Rate, Parity, and Stop Bit settings.
- e. Click **OK**.

12.2.3 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.

- a. Using the Measurement Wizard or through the **Recording** page (see [“Recording Page,”](#) page 57) you can select to collect external heading data to an ASCII file (_EH.TXT).



NOTE. 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*.

- b. You can add an offset to reconcile any differences between the ADCP heading and those reported by the external heading NMEA string. Enter a value in the **Heading Offset** box (see [“Offsets Page,”](#) page 52).



NOTE. The decoded data will be displayed in the **Composite Tabular 1** screen.

| | | | |
|------------------|------------|--------------------|-------------|
| Ens. # | 8 | # Ens. | 8 |
| Lost Ens. | 0 | Bad Ens. | 8 |
| %Good Bins | 0% | Delta Time | 1.30 |
| 23-Jan-01 | | 14:20:29.43 | |
| Pitch | Roll | Ext. Heading | Temp |
| -20° | -1° | 246° | 70°F |

Figure 57. Viewing External Heading Data

12.3 How to Use GPS

In high flow (flood) or high sediment concentration conditions, the ADCP may make biased bottom track 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



NOTE. The ADCP is not malfunctioning – but measuring the environment as designed.

12.3.1 Using GPS Versus Bottom Track

When the ADCP cannot make unbiased bottom track measurements, an external GPS system should be used as the velocity 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.

To use GPS as a vessel speed reference, three conditions must be met:

1. The GPS must be a high quality, accurate GPS system.
2. The compass used to rotate ADCP velocities 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. The Compass Correction section describes the procedures to correct the internal ADCP compass heading data for local magnetic variation and to calibrate the compass for one-cycle deviation errors. These corrections will help to reconcile the magnetic coordinate system of the ADCP with the GPS true earth coordinate system. You must be able to acquire valid bottom-track data to perform these corrections. If you anticipate moving bottom conditions during flood season, you should determine the compass corrections before flood season.
3. Transects must be made slowly to obtain the best quality discharge data when using GPS as the velocity reference. Slow boat speeds will reduce the error contribution to the discharge calculation caused by incorrectly rotating the ADCP velocities into the GPS earth coordinate system. This rotation is necessary to put both the ADCP velocities and the boat velocities determined by the GPS into the same coordinate system.



NOTE. Bottom-track must be enabled in order to use the GPS data even though it is not used as the velocity reference.



NOTE. If you can obtain valid bottom track data, and you use bottom track as your reference system, there is no need to perform the compass correction procedures. Both the water and boat velocities are in the same coordinate system, and no rotation from one coordinate system to another is required.

12.3.2 System Interconnections with GPS

- a. Connect the GPS system to your computer using a serial (RS- 232 or RS- 422) interface (see the GPS Manual for details).
- b. Mount the GPS antenna as close to the ADCP as possible – less than one meter horizontally is the optimum distance. Apply power to the GPS.
- c. Configure the GPS to output GGA and VTG (optional) data strings via the NMEA0183 format. The GGA string contains GPS positions. The VTG string provides velocity information calculated by the GPS.
- d. Connect the ADCP system to your computer using a serial (RS- 232 or RS- 422) interface. Apply power to the system (see the ADCP Technical Manual for details).
- e. Two serial ports are required on your computer to accept both ADCP and GPS data.

12.3.3 Enabling the GPS Port

To enable GPS communications with *WinRiver II*, do the following steps.

- a. Select the **Configure** menu, **Peripherals**. Click the **Add** button.
- b. Choose **GPS**, and then click **Next**. Choose the COM port that the GPS is connected to.



NOTE. Two serial ports are required on your computer to accept both ADCP and GPS data.

- c. Click **Next**. Enter the GPS communication Baud Rate, Parity, and Stop Bit settings.
- d. Click **Next**. Verify the port and communication settings. Click **Next**.
- e. Click **Finish**. The GPS data will be recorded to the raw data file.

Optional Settings

- GPS Latitude and Longitude data can be saved to a separate ASCII file by choosing **Record GPS Data** on the “[Recording Page](#),” page 57.
- For best results, make sure the ADCP is using ship coordinates (EX10nnn command (default value), where the nnn values are set to 0 or 1 as desired) in the “[Commands Page](#),” page 46.

12.4 Compass Correction

The following section describes the procedure to correct the ADCP's compass for use with the GPS data. The first correction to the compass is for local magnetic variation and the second correction is for one-cycle magnetic deviation errors.



CAUTION. *Both of these corrections are important 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.*

If you plan on using GPS, it is strongly recommended that you perform the compass correction procedures outlined in this section. A new compass correction should be determined if you are working more than 10 to 40 miles from the site where the last correction was performed, if you will be working in significantly different temperatures from the last compass calibration, or if your ADCP mounting has changed.



NOTE. We recommend installing the ADCP with beam 3 forward for making discharge measurements (refer to the installation guide) and for the compass correction procedures. If beam 3 is not forward, you will need to carefully measure the rotation angle of beam 3.



NOTE. If you have a Rio Grande ADCP with firmware 10.05 or greater, perform the Method 3 calibration before you do the Magnetic Variation Correction (see "Method 3," page 97).

12.4.1 Magnetic Variation Correction

Local magnetic variation correction can be estimated by referring to a chart of the local area, but many times this information is not adequately precise. Use the following steps to determine the local magnetic variation.

- a. Find a calm low current area where there is no moving bottom affects to do the compass correction. You must be collecting and using GPS data and be able to bottom track in the chosen location.
- b. Create or open a workspace file (see ["Workspace,"](#) page 13) that has the **Composite Tabular** and **Compass Calibration** tabular displays, and a **Ship Track** display.
- c. On the **Settings** menu, **Reference**, set the reference to **GPS (GGA)**.
- d. On the ["Offsets Page,"](#) page 52, set the **Magnetic Variation** value and compass correction (**One Cycle K** and **One Cycle Offset**) values to zero. Ensure that the **Beam 3 Misalignment** angle is set to the Beam 3 misalignment.

- e. Mark a starting point. This should be a point that you can easily refer-
ence to (an end of a pier, or a stationary marker).
- f. Start *WinRiver II* and load a measurement file. Press **F4** to start pinging.
Press **F5** to start recording.
- g. 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 58](#). Monitor the heading display in
the **Standard Tabular** view, and adjust your course to stay on a constant
heading (not a constant course).

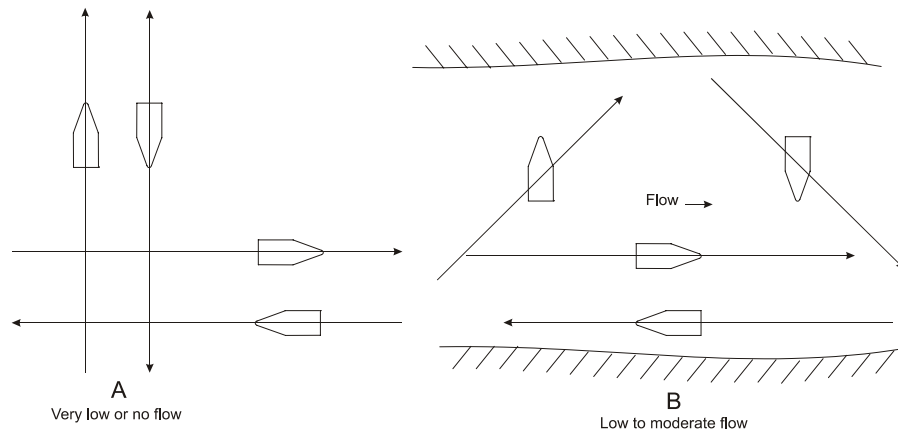


Figure 58. Reciprocal Constant Heading Tracks for Determining Magnetic Variation

- h. Record the value of **GC-BC** from the **Compass Calibration Tabular**
screen as shown in [Figure 59](#). 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 59. Determining Local Magnetic Variation

- i. Drive a track along the opposite heading direction as shown in
[Figure 58](#). Press **F5** to start recording.
- j. Record the value of **GC-BC**. Use the average of the two values to esti-
mate 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 direc-
tions, is recommended). Average the values of **GC-BC** for all of the
tracks. This averaged value is the local magnetic variation.

- k. Modify the “Offsets Page,” page 52 and enter the **Magnetic Variation** value. In the example below, we have entered a magnetic variation of 12.2 degrees.

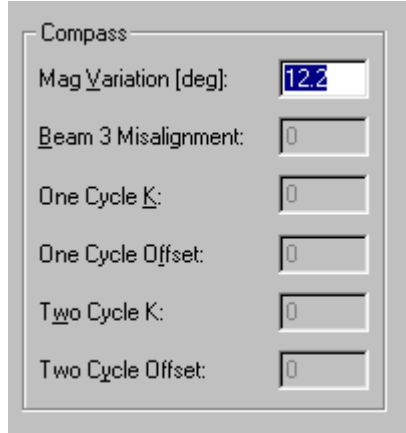


Figure 60. Entering Local Magnetic Variation



NOTE. It is a good idea to duplicate or rename the playback configuration to reflect that it has been corrected for magnetic variation (see “Duplicate ,” page 25 and “Rename,” page 25). For example, if you original file was RDGPS1, then the modified file could be named RDGPS1_MagCorrected to show that it has the Magnetic Variation value correction added.

- l. Make sure the modified playback configuration is set as the **Active Configuration** (see “Configuration Node Menu Options,” page 24). 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 61).

| | | |
|-------------|-------|-----|
| BMG-GMG mag | 2.4 | [m] |
| BMG-GMG dir | 231.7 | [°] |
| GC-BC | 0.1 | [°] |
| BC/GC | 0.992 | |

Figure 61. Data Corrected for Local Magnetic Variation

12.4.2 One-Cycle Compass Correction

Ferrous objects in the vicinity of the ADCP can affect the internal flux-gate compass. These affects will show up as one and two cycle errors in the compass heading. The one-cycle error can be corrected by using one of two methods described later in this section. The two-cycle error is typically negligible, but can be checked by using the AX-command as outlined in the Maintenance manual. Perform the AX-command with the ADCP mounted in the boat, and drive the boat in a small circle. If the two-cycle error is more than 0.5 degrees, check to see if there are any large ferrous objects close to the ADCP mounting that can be removed.

There are three methods of compass corrections. The first two 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.

There are three ways to determine and correct this non-closure error. The first procedure 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 the second method, 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 procedure 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.

The third method provides the easiest way to calibrate the compass for one-cycle errors but it can only be used with the WorkHorse Rio Grande ADCPs with firmware version 10.05 and higher or Monitor/Sentinel ADCPs with firmware version 16.30 and higher. If you have an ADCP with an earlier version of firmware, contact TRDI to upgrade the firmware. You do not need to be able to collect valid bottom track data for this third method to work. This procedure can be performed at sites with a “moving bottom”.

Method 1

To reduce the error, do the following steps.

- a. 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!).
- b. 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**.
- c. 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.
- d. Create or open a workspace file (see “[Workspace](#),” page 13) that has the **Composite Tabular** and **Compass Calibration** tabular displays, and a **Ship Track** display.
- e. Start *WinRiver II* and load a measurement file. Press **F4** to start pinging. Press **F5** to start recording.
- f. 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 62](#), 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 62. Method 1 Compass Correction Procedure

- g. Come back as close as you can to the starting point (within 30 cm or less). Press **F5** to stop recording.
- h. Record the **Course MG**, **Distance MG**, and **Length** values from the **Tabular** display. For example, in [Figure 62, page 92](#), the **Course MG** is 234.33° , the **Distance MG** is 22.79 meters, and the **Length** is 1754.50 meters.
- i. 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 63](#), 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**).
- j. On the **Settings, Configuration Settings, Offset** tab, enter the values for the **One Cycle K** and **One Cycle Offset**.

| Compass | |
|----------------------|--------|
| Mag Variation [deg]: | 13 |
| Beam 3 Misalignment: | 0 |
| One Cycle K: | 0.0129 |
| One Cycle Offset: | 234.33 |
| Two Cycle K: | 0 |
| Two Cycle Offset: | 0 |

Figure 63. Entering the Compass Corrections

- k. If the ADCP is mounted with beam 3 pointed in a direction other than forward along the ship's centerline, determine the clockwise rotation of beam 3 relative to the ship's centerline and insert the value in the **Beam 3 Misalignment** box.
- l. Apply the One Cycle K and One Cycle offset corrections to the configuration that contains the magnetic variation corrections.
- m. Replay the data using the corrected configuration. The circle non-closure error as indicated by **Distance MG** should now be minimized ([Figure 64, page 94](#)). If the compass has been adequately corrected, the ratio of **Distance MG** to **Length** should be 0.01 or less ($2.83/1754.50 = 0.0016$).
- n. 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 64. 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. The ratio between distance made good and the length of the track (**BMG-GMG** and **Length**, respectively on the *WinRiver II* display in [Figure 66, page 96](#)) is the magnitude of the one-cycle compass error and the one-cycle offset is the **BMG-GMG** angle.

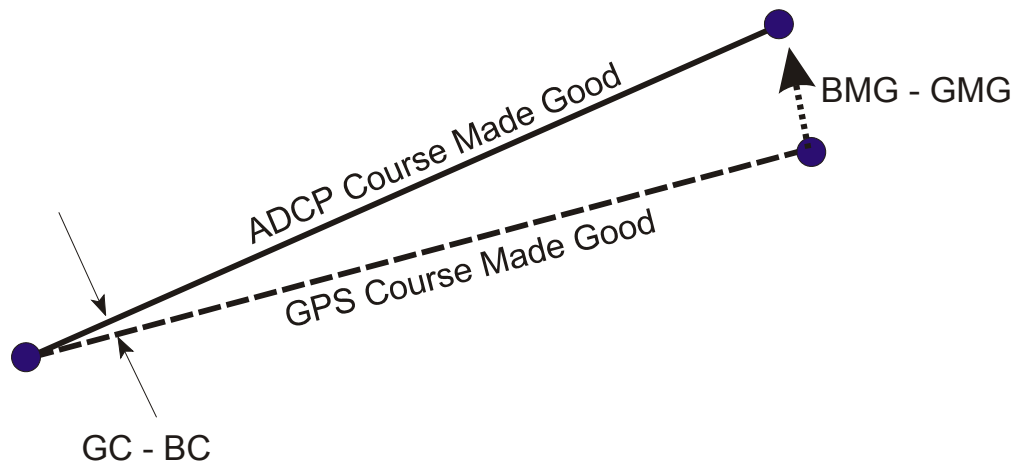


Figure 65. GPS Versus Bottom Track

To reduce the error, do the following steps.

- a. 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).

- b. 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)**.
- c. 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 GPS is being used and that the magnetic variation correction has been applied.



NOTE. GPS is used for the velocity reference in Method 2, while Bottom-Track is the reference in Method 1.

- d. Create or open a workspace file (see “[Customizing WinRiver II](#),” page 13) that has the **Composite** and **Compass Calibration** tabular displays, and a **Ship Track** display.
- e. Start *WinRiver II* and load a measurement file. Press **F4** to start pinging. Press **F5** to start recording.
- f. 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 66, page 96](#), three circular tracks were made to provide a total track length of 1731.76 m.
- g. 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.
- h. Record the **BMG-GMG** vectors (magnitude and direction) and **Length** values. For example, in [Figure 66, page 96](#), the **BMG-GMG Direction** is 231.6°, the **BMG-GMG Magnitude** is 21.7 m, and the **Length** is 1731.76 m.
- i. 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 66, page 96](#), 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**).

| | | | | | |
|------------------------------------|-----------|-----------|------------|------------------|-------------|
| Ens. # | 1025 | # Ens. | 1009 | Navigation (GGA) | |
| Lost Ens. | 0 | Good Bins | 99% | Boat Speed | 0.123 [m/s] |
| | 27-May-99 | | 9:25:36.30 | Boat Course | 62.81 [°] |
| Pitch | Roll | Heading | Temp | Water Speed | 0.067 [m/s] |
| 0° | 1° | 72° | 21°C | Water Dir. | 357.67 [°] |
| Compass Calibration Tabular | | | | Calc. Depth | 26.03 [m] |
| BMG-GMG mag | 21.7 | [m] | | Length | 1731.76 [m] |
| BMG-GMG dir | 231.6 | [°] | | Distance MG | 1.49 [m] |
| G-C-BC | 44.3 | [°] | | Course MG | 278.65 [°] |
| BC/GC | 15.340 | | | Time | 1308.51 [s] |

Figure 66. Method 2 Compass Correction Procedure

- j. On the “[Offsets Page](#),” [page 52](#), enter the values for the **One Cycle K** and **One Cycle Offset**.

Compass

Mag Variation [deg]:

Beam 3 Misalignment:

One Cycle K:


One Cycle Offset:

Two Cycle K:


Two Cycle Offset:

Figure 67. Entering the Corrections for Method 2 Compass Correction Procedure

- k. If the ADCP is mounted with beam 3 pointed in a direction other than forward along the ship’s centerline, determine the clockwise rotation of beam 3 relative to the ship’s centerline and insert the value in the **Beam 3 Misalignment** box.

 **NOTE.** It is a good idea to rename the configuration to reflect that the compass correction has been applied.

- l. 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 68](#), [page 97](#)).
- m. You can now use the corrected configuration for acquiring discharge measurements.

 **NOTE.** TRDI recommends using a bottom-track referenced configuration (Method 1). If you have a Rio Grande ADCP, TRDI recommends using Method 3.

| Ens. # | 1025 | # Ens. | 1009 |
|-----------|------|------------|------|
| Lost Ens. | 0 | Good Bins | 99% |
| 27-May-99 | | 9:25:36.30 | |
| Pitch | Roll | Heading | Temp |
| 0° | 1° | 72° | 21°C |


| Compass Calibration Tabular | |
|-----------------------------|-----------|
| BMG-GMG mag | 2.4 [m] |
| BMG-GMG dir | 265.5 [°] |
| G-C-BC | 8.1 [°] |
| BC/G-C | 2.531 |

| Navigation (GGA) | |
|------------------|-------------|
| Boat Speed | 0.123 [m/s] |
| Boat Course | 62.81 [°] |
| Water Speed | 0.066 [m/s] |
| Water Dir. | 357.56 [°] |
| Calc. Depth | 26.03 [m] |
| Length | 1731.76 [m] |
| Distance MG | 1.49 [m] |
| Course MG | 278.65 [°] |
| Time | 1308.51 [s] |

Figure 68. Method 2 Compass Correction with Correction Applied

Method 3

This procedure is used to correct the Rio Grande's internal flux-gate compass for one-cycle deviation errors. The compass correction procedure given here can be used in place of the Method 1 or 2 compass correction procedures 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.

 **NOTE.** The Rio Grande firmware has been modified to allow the correction of the one-cycle errors with the AF command. WorkHorse ADCPs with firmware versions lower than 16.30 do not have this capability.

- Mount the Rio Grande ADCP in the boat as it will be used to acquire data.
- On the **Configure** menu, select **Peripherals**.
- Click the + box next to **Read Serial Raw ADCP Data** to expand the list and then select **Instrument: ADCP Instrument**.
- Press the **Configure** button.
- At the ">" prompt, type **AR** and press the **Return** key. Type **Y** to return the Fluxgate Calibration Matrices with the factory original values.

```
>AR
Do you really want to write over the active fluxgate calibration
data [y or n]?Y

Fluxgate Calibration Matrices Updated with Factory Original Values.

>
```

- Click **OK** to exit the **Advanced ADCP Configuration Dialog**, then click **Close** to exit the **Peripherals Configuration Dialog**.

- g. On the **Acquire** menu, click **Execute Compass Calibration**. Click on the **Calibrate** button to begin the compass calibration.

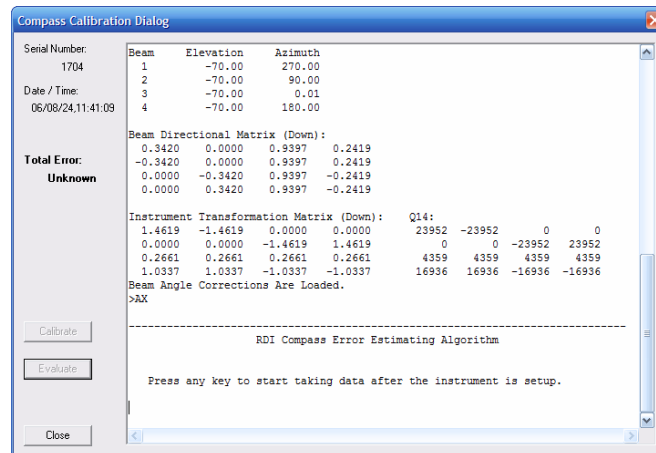


Figure 69. Compass Calibration Screen

- h. 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.
- i. While you continue to drive the boat in circles, press any key to start the compass calibration. Follow the on screen prompts.
- j. Press **D** for details.

```
HEADING ERROR ESTIMATE FOR THE CURRENT COMPASS CALIBRATION:
OVERALL ERROR:
  Peak Double + Single Cycle Error (should be < 5):  n̄ 1.73ø
DETAILED ERROR SUMMARY:
  Single Cycle Error:                               n̄ 1.70ø
  Double Cycle Error:                               n̄ 0.42ø
  Largest Double plus Single Cycle Error:           n̄ 2.12ø
  RMS of 3rd Order and Higher + Random Error:      n̄ 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.
```

>

- k. 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.

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.

- a. On the **Acquire** menu, click **Execute Compass Calibration**. Click on the **Evaluate** button to begin the compass verification.
- b. Rotate the ADCP slowly 360 degrees (approximately 5 degrees per second). Pay particular attention to the Overall Error.
- c. 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(|

13 ADCP Commands

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](#),” [page 46](#).

13.1 Send Commands to the ADCP

- Start *WinRiver II* and use the Measurement Wizard to generate the basic commands (see “[Using the Measurement Wizard](#),” [page 34](#)).
- Right-click on **Field Configuration** and select **Properties** (see “[Configuration Node Menu Options](#),” [page 24](#)). Select the **Commands** page.
- Enter the commands in the **User Commands** box.



CAUTION. Only enter a **User** command if you are fully aware of the command consequence.

- Change the **Filename Prefix** or **Output directory** on the **Recording** page (see “[Recording Page](#),” [page 57](#)) to save the measurement file with a unique name.
- 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.
- 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.

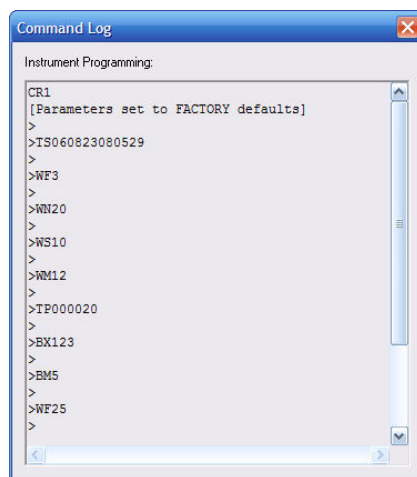


Figure 70. Command Log

13.2 ADCP Command Overview

You can directly control the profiling parameters sent to the ADCP using the “[Commands Page](#),” page 46. 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](#),” page 34).



CAUTION. 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 each command and give guidelines for setting these commands for acquiring reliable discharge data. Refer to the WorkHorse Commands and Output Data Format Guide 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](#),” page 107).

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](#),” page 118).

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.



NOTE. The 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.

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, $WN = \text{Maximum Expected Depth (in centimeters)} / WS + 2$

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.

$$WV = \text{Maximum Relative Water Velocity} \times \sin(\text{Beam Angle}) \times 1.5$$

Where Beam Angle = 20° for the Rio Grande ADCP

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.



NOTE. 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.

13.3 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](#),” page 52. 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 the magnetic variation correction procedure (see “[Magnetic Variation Correction](#),” page 88) to determine the local magnetic variation in your area (see the “[Offsets Page](#),” page 52). 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.

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 “[Offsets Page](#),” page 52). 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 “[Offsets Page](#),” page 52). 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](#),” page 54). 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.



NOTE. 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](#),” page 54).

Extrapolation Method

- **Top and Bottom Discharge Method** – three methods, **Power**, **Constant**, and **3 Point Slope** 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](#),” page 54).

50). 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](#),” page 133. 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 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 ($1/6^{\text{th}}$ 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](#),” page 15). **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.

14 Water Profiling Modes

This section explains all of the water-profiling modes available for the WorkHorse Rio Grande, Mariner ADCPs, and WorkHorse ADCPs with the high-resolution water profiling upgrade installed. 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 5](#) 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 5: WorkHorse River Water Profiling Modes

| | Mode 1 | Mode 12 | Mode 11 | 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 dependant) with low shear and/or turbulence. | 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 | 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).



NOTE. The ranges in [Table 5, page 107](#) are measured from the transducer face. Add the transducer depth to determine the actual minimum and maximum profiling depths.



NOTE. 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.

14.1 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 75, page 131](#)).

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:

$$WV = (\text{max. apparent velocity in cm/s}) * (\sin B) * (1.5)$$

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.

NOTE.

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.

14.2 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,” page 111](#) 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 dependant defaults), and the WO commands to your ex-

isting 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

14.2.1 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 6: Commands Relevant to Water Mode 12 Use

| | |
|----------|--|
| 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. |



NOTE. For detailed explanations of the Water Mode 12 commands, see the WorkHorse Commands and Output Data Format Guide.

14.2.2 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.

14.2.3 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 7: 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 8: 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 dependant 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 9: 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.

14.2.4 Water Mode 12 Examples

Examples of Improved Standard Deviation of velocity measurement:

- 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.
- 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%.



NOTE. The savings are $(.0024 * \#Bins + .14)$ W-Sec per Sub Ping. The % savings are higher in shorter-range profiling.

14.3 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,”](#) page 115)
- 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 10: 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) |

 **NOTE.** For detailed explanations of the Water Mode 11 commands, see the WorkHorse Commands and Output Data Format Guide (April 2002 revision) or Interim Change Notice ICN006.

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. |

14.3.1 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.

14.3.2 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.

14.4 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.

14.5 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.



NOTE. If the shears, turbulence, background noise, or ADCP motion is too great, the ADCP will not collect data.

14.5.1 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 deployments.

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 deployments 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.

15 Bottom Tracking Modes

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.

15.1 Using Bottom Mode 7

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 11: Commands Relevant to Shallow Water Bottom Tracking

| 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. |

15.1.1 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 ± 9 m/sec.
- Long term Accuracy is 0.3% velocity measurement ± 0.1 cm/s

Other Considerations:

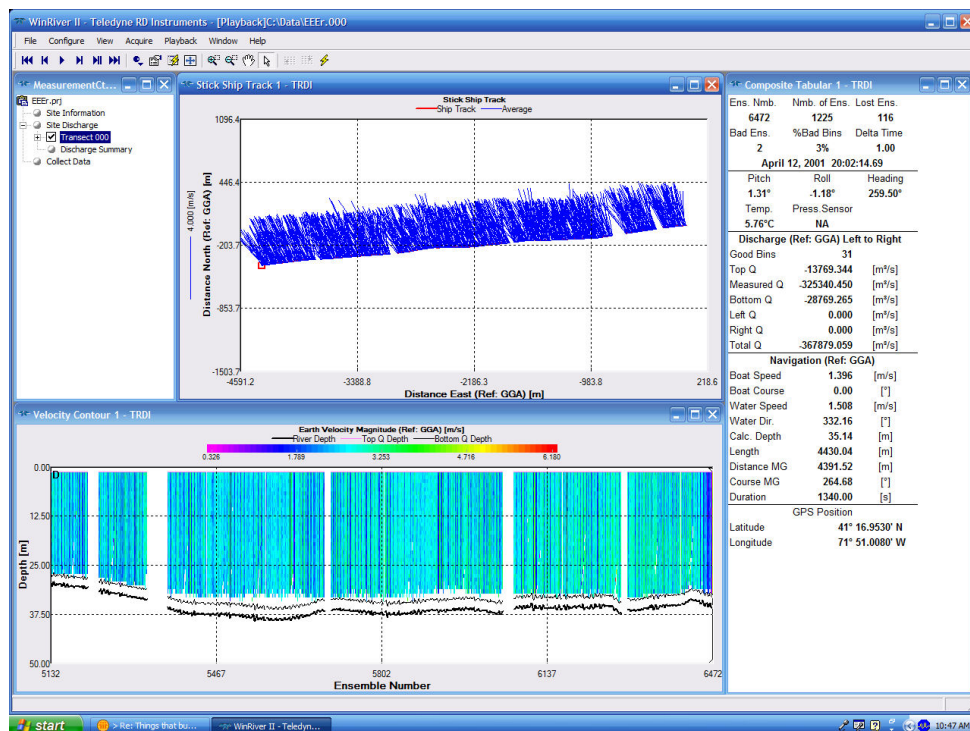
Ping times for Shallow Water Bottom Tracking (Bottom Mode 7) are approximately 3 times longer than standard bottom tracking (Bottom Mode 5) in shallow water and approximately 1.5 times in water > 5m. If it is necessary to collect data as fast as possible, Bottom Mode 5 will give faster ping times but 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.

16 Troubleshooting

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](#),” page 1).

16.1 Problems to look for in the Data



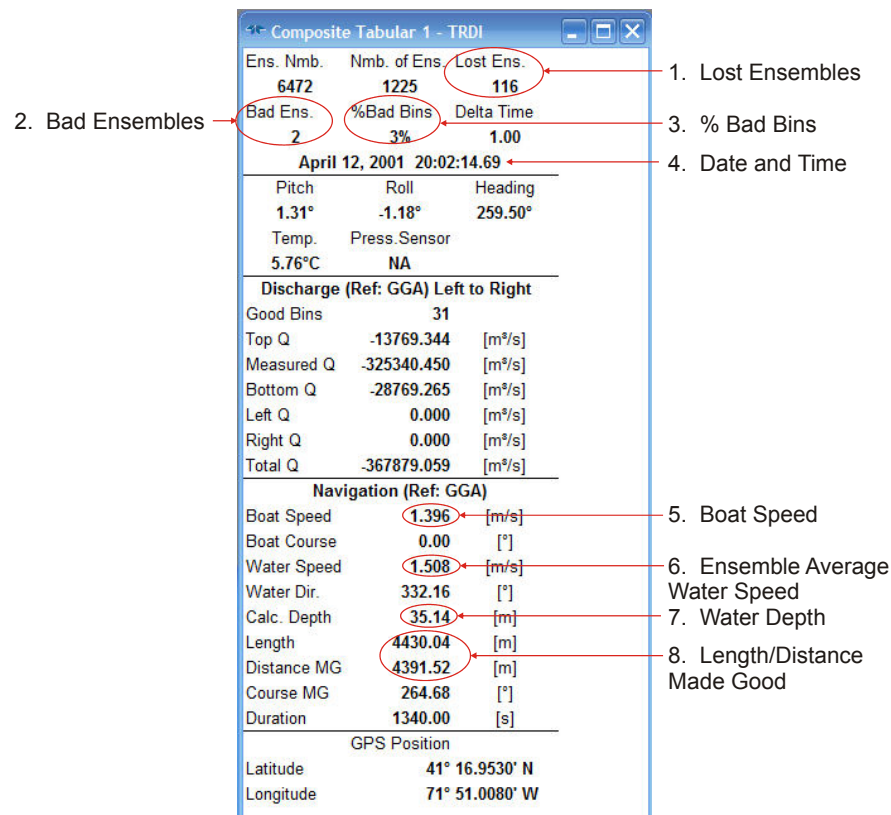


Figure 71. Problems to look for in the Data

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.

16.2 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 110 100 000** will override the default **WD 111 100 000** 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.

16.3 Lost Ensembles

If the Number of lost ensembles on the **Standard** and/or **Composite Tabular** 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 a 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.

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.

16.4 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.

16.5 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.

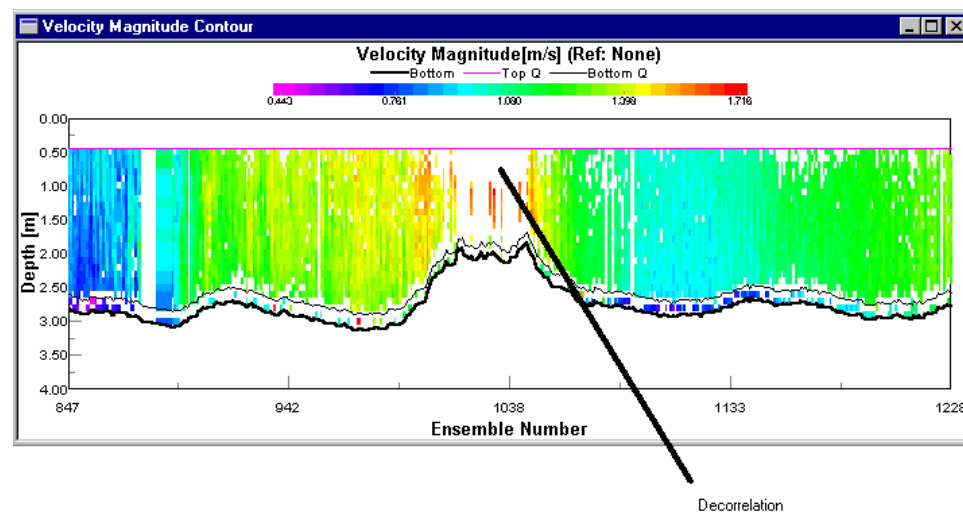


Figure 72. Decorrelation Example

16.6 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.



NOTE. You must use GPS with the echo sounder (see “Integrating Depth Sounder, External Heading, and GPS Data,” page 80).

16.7 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



NOTE. 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,”](#) page 80. *WinRiver II* can calculate discharge in real-time using the GPS data in place of bottom track velocities.

16.8 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.

16.9 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.

16.10 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,” page 107](#). Check that the maximum relative water speed (water plus boat speed) and profiling range do not exceed the limitations given in [Table 5, page 107](#). Both Modes 5 and 8 must have a minimum water depth to profile. These depths are listed in [Table 5, page 107](#).

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.

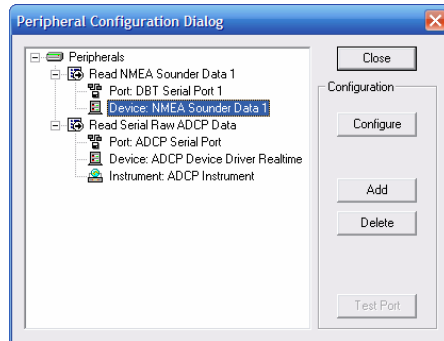
16.11 Trouble Decoding the NMEA Message

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.

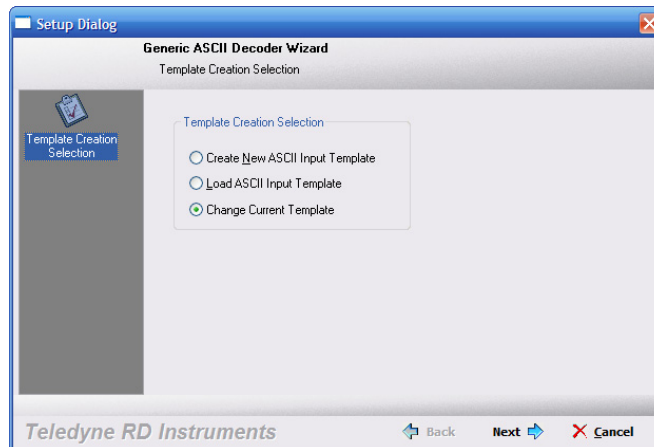


NOTE. In the following example, a depth sounder communications port has been configured. The same procedure can be used for GPS or External Heading devices by selecting the proper peripheral device in step “b” once the device has been added.

- a. On the **Configure** menu, click **Peripherals**.
- b. Click the + box next to **Read NMEA Sounder Data 1** to expand the list and then select **Device: NMEA Sounder Data 1**.
- c. Press the **Configure** button.



- d. On the **Template Creation Selection** page, make sure that **Change Current Template** is selected and then click **Next**.



- e. 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.
- f. Click **Next** until the wizard is done (do not make any further changes) and than click **Finish**.

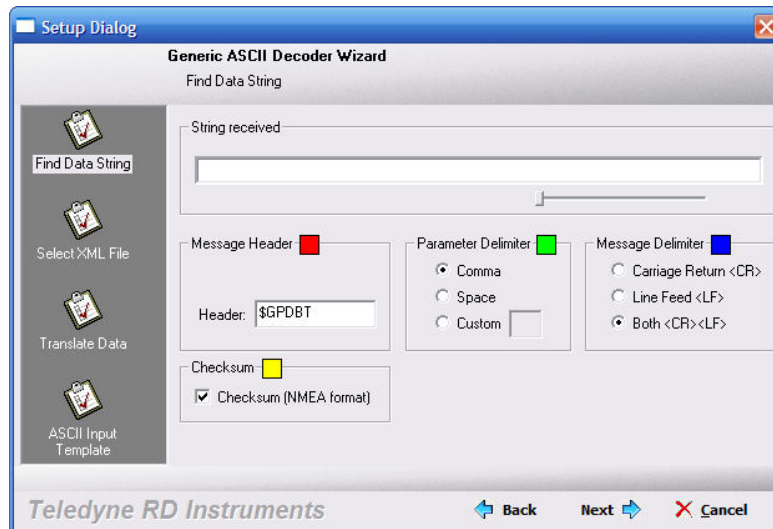


Figure 73. NMEA Message Header

Appendix A - ADCP Measurement Basics

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.

A.1 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.

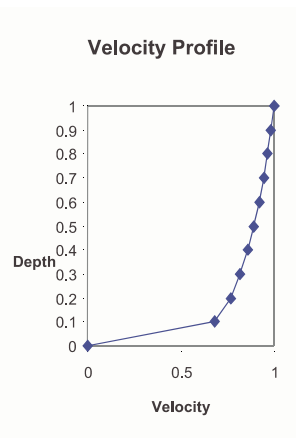


Figure 74. Velocity as a Function of Depth

A.2 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 75](#)). 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.

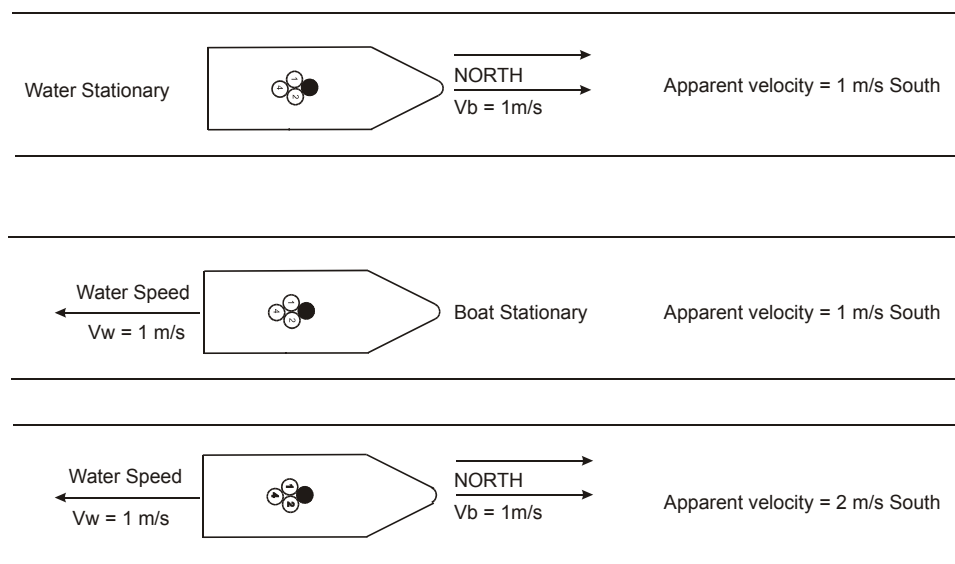


Figure 75. Boat versus Water Velocity

A.3 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 flux-gate 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

A typical discharge measurement is calculated from several transects of data. Referring to [Figure 76](#), a transect goes across the river from point A to point B, and the total discharge (ΣQ_1) is recorded. A second transect is then made starting at point B and ending at point A, and the second total discharge (ΣQ_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.

$$\Sigma Q = \frac{(\Sigma Q_1 + \Sigma Q_2 + \Sigma Q_3 + \Sigma Q_4 + \dots)}{N}$$

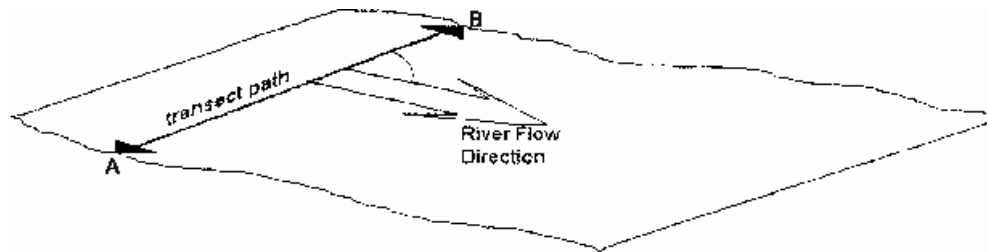


Figure 76. Transect Path

B.1 Path Independence

Discharge is the accumulated flow crossing perpendicular to the boat's path (see [Figure 77, page 134](#)). 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.

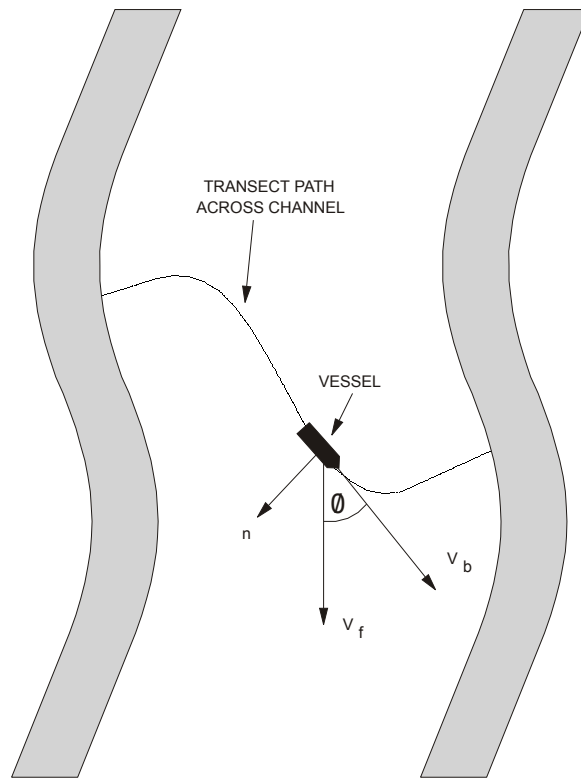


Figure 77. Discharge Calculation is Independent of the Boat's Path

B.2 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 78, page 135](#) for an illustration of the unmeasured areas.

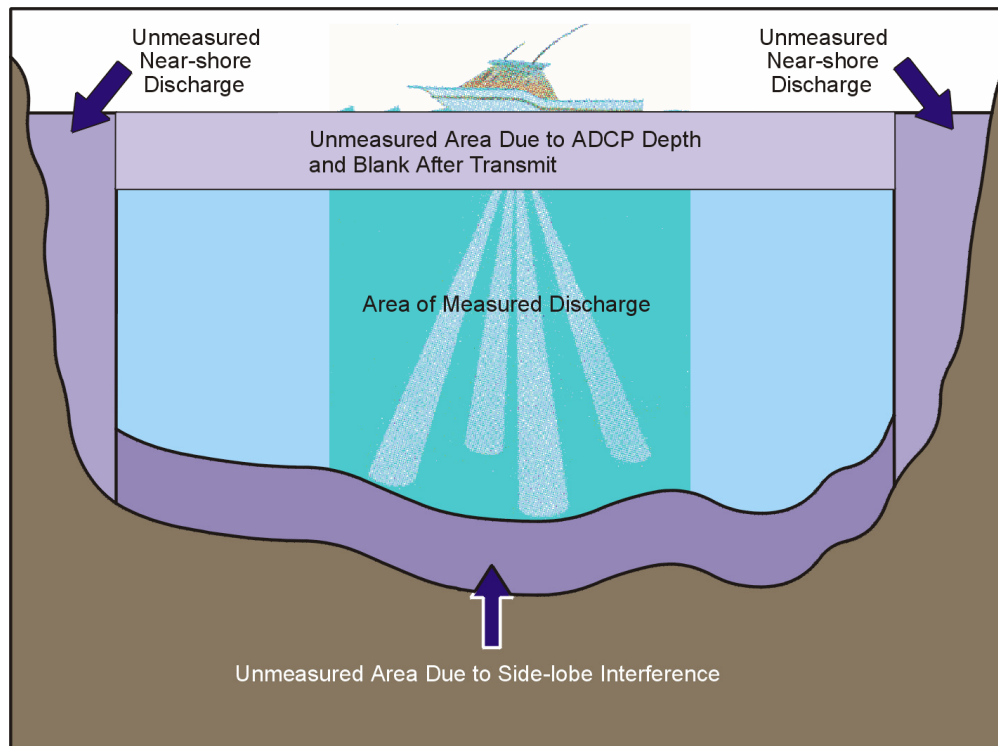


Figure 78. Unmeasured Regions in the Water Column

B.2.1 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 dis-

tance, and $(\text{bin} + \text{transmit length} + \text{lag})/2$. 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).

B.2.2 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 79](#)).

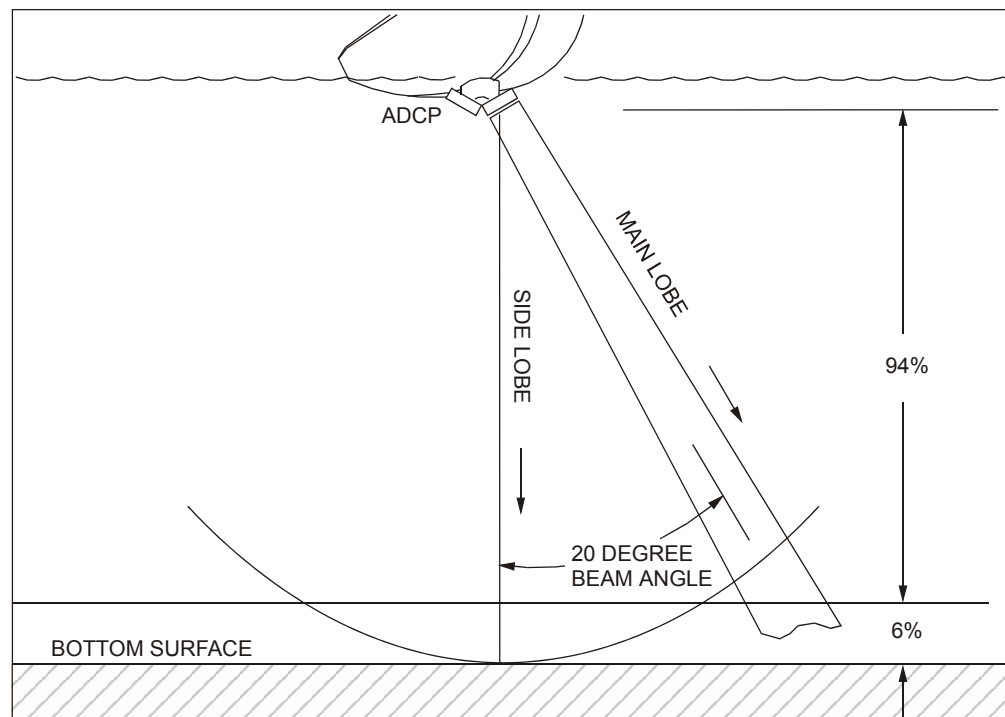


Figure 79. Side Lobes

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.

B.2.3 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.

B.3 Calculating 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 78, page 135). *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.

B.3.1 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 77, page 134) 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,” page 80](#) 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*.

B.3.2 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}). |
| * 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 |



NOTE. *These data are directly output by the ADCP.

B.3.3 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 77, page 134](#)). The general equation for determining total channel discharge (Q_t) through an arbitrary surface (s) is (Simpson and Oltmann, 1990; Gordon, 1989):

$$\iint_s V_f \cdot n \, ds \quad (1)$$

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:

$$ds = |V_b| \, dz \, dt \quad (2)$$

$$V_f \cdot n = |V_f| \sin(\theta) \quad (3)$$

$$\iint_s V_f \cdot n \, ds = \int_0^T \int_0^d |V_f| |V_b| \sin(\theta) \, dz \, dt \quad (4)$$

$$= \int_0^T \int_0^d (V_f \times V_b) \cdot k \, dz \, dt \quad (5)$$

Converting the cross-product $(V_f \times V_b) \cdot k$ into rectangular (vessel) coordinates, we get:

$$(V_f \times V_b) \cdot k = F_x B_y - F_y B_x \quad (6)$$

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.

B.3.4 Estimating Discharge in the Unmeasured Top/Bottom Parts of the Velocity Profile

There are two methods available in *WinRiver II* to estimate discharge in the unmeasured top/bottom parts of the velocity profile based on the Top/Bottom Discharge Estimate settings in the **Configuration Settings, Discharge** tab. The two methods are **Constant** and **Power**.

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) or from the last good bin to the bottom (BtmQ). See [“Estimating Top Layer Discharge,” page 146](#) and [“Estimating Bottom Layer Discharge,” page 146](#) for details on how *WinRiver II* does this.

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 $b = 1/6$).

$$u / u^* = 9.5 (z / z_0)^b \quad (7)$$

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:

$$u = (9.5u^* / z_0^b)z^b \quad (8)$$

If we let $a' = (9.5u^* / z_0^b)$, then:

$$u = a'z^b \quad (9)$$

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](#):

$$X = a''z^b \quad (10)$$

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 80, page 142](#)). 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 .

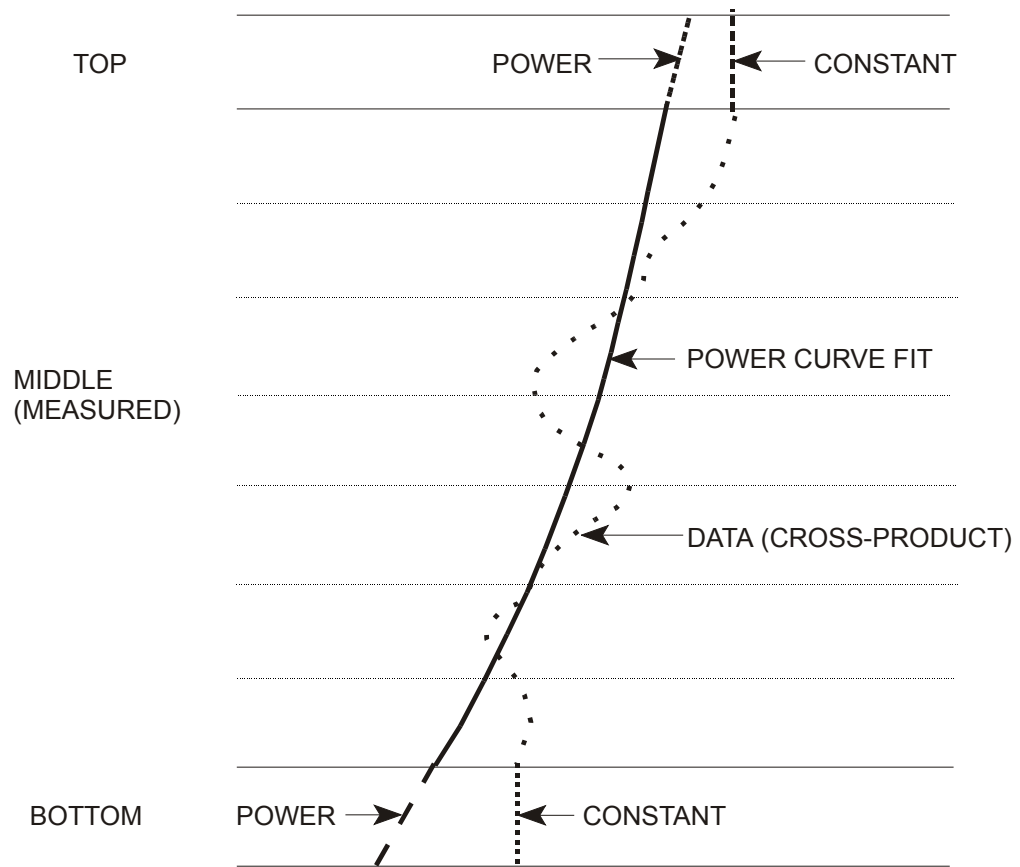


Figure 80. Discharge Extrapolation Method

First, we integrate the ADCP data over the valid depth range.

Let

$$R_1 = \int_{z_1}^{z_2} X(z) dz \quad (11)$$

Where: $dz = \text{depth cell size } (D_a)$.

Therefore:

$$R_1 = D_a \sum_{i=z_1}^{z_2} X_i \quad (12)$$

Second, use the anti-derivative of the power law of [Equation 10](#) to integrate the power law over the middle water layer:

$$f(z) = a''z^b \rightarrow F(z) = a'' \frac{z^{b+1}}{b+1} \quad (13)$$

Let:

$$R_2 = \int_{Z_1}^{Z_2} f(z) dz \quad (14)$$

$$= a'' \frac{z^{b+1}}{b+1} \Big|_{Z_1}^{Z_2} \quad (15)$$

$$= \frac{a''(Z_2^{b+1} - Z_1^{b+1})}{b+1} \quad (16)$$

Equating the integrals we solve for a'' :

$$R_1 = R_2 \quad (17)$$

$$D_a \sum_{i=Z_1}^{Z_2} X_i = a'' \left[\frac{Z_2^{b+1} - Z_1^{b+1}}{b+1} \right] \quad (18)$$

$$a'' = \frac{D_a(b+1) \sum_{i=Z_1}^{Z_2} X_i}{Z_2^{b+1} - Z_1^{b+1}} \quad (19)$$

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 (see [“Estimating Top Layer Discharge,”](#) page 146 and [“Estimating Bottom Layer Discharge,”](#) page 146).

B.3.5 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

$$Q_{shore} = CV_m L d_m \quad (20)$$

Where:

- C = Coefficient (0.35 - 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 re-processing, you can change these values in the **Edge Estimates** page (see “[Editing an Item During Playback](#),” page 70).

B.3.6 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 [Figure 80, page 142](#) 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} .

$$D_{top} = D_{ADCP} + D_b + ((D_p + D_0 + D_a)/2) \quad (21)$$

Mode 5 and 8
$$D_{top} = D_{ADCP} + D_b + ((D_p + D_a)/2) \quad (22)$$

For the total water depth, we use the average of the beam depths.

$$D_{avg} = \text{Average of four beam depths} \quad (23)$$

WinRiver II computes the last good bin depth from D_{avg} 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.

$$D_{LGmax} = (D_{avg} \cos(\theta) + D_{ADCP}) - ((D_p - D_0)/2) \quad (24)$$

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 (MidQ). *WinRiver II* obtains the distance to the bottom (D_{total}) as:

$$D_{total} = D_{avg} + D_{ADCP} \quad (25)$$

From the proceeding we can define the boundaries of the water layer (see [Figure 80, page 142](#)) where each is referenced from the bottom boundary:

$$Z_1 = D_{total} - D_{LG} - D_a / 2 \quad (26)$$

$$Z_2 = D_{total} - D_{top} + D_a / 2 \quad (27)$$

$$Z_3 = D_{total} \quad (28)$$

The water layer thickness follows:

$$Top\ Layer = Z_3 - Z_2 \quad (29)$$

$$Middle\ Layer = Z_2 - Z_1 \quad (30)$$

$$Bottom\ Layer = Z_1 \quad (31)$$

B.3.7 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.

$$Q_i = X_i \Delta t D_a \quad (32)$$

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.

$$MidQ = \sum_{i=1}^N Q_i \quad (33)$$

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.

B.3.8 Estimating Top Layer Discharge

There are two ways to compute the top layer discharge estimate based on the setting of **Top Discharge Estimate** in the configuration. The two options are **Constant** and **Power**. Estimating Discharge in the Unmeasured Top/Bottom Parts of the Velocity Profile outlines these methods.

Constant Method. *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.

$$TopQ = X_{FG} \Delta t (Z_3 - Z_2) \quad (34)$$

Power Method. *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 80, page 142](#)).

$$TopQ = \Delta t a^n \int_{Z_2}^{Z_3} Z^b dz \quad (35)$$

$$= \frac{\Delta t D_a (Z_3^{b+1} - Z_2^{b+1}) \sum_{i=Z_1}^{Z_2} X_i}{Z_2^{b+1} - Z_1^{b+1}} \quad (36)$$

B.3.9 Estimating Bottom Layer Discharge

There are two ways to compute the bottom layer discharge estimate based on the setting of **Bottom Discharge Estimate** in the configuration. The two options are **Constant** and **Power**. Estimating Discharge in the Unmeasured Top/Bottom Parts of the Velocity Profile outlines these methods.

Constant Method. *WinRiver II* estimates the discharge for the bottom water layer by extrapolating the value of the cross-product in the last good bin (X_{LG}) to the bottom. This method extrapolates data in a straight line to the bottom.

$$BtmQ = X_{LG} \Delta t Z_1 \quad (37)$$

Power Method. *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 80, page 142):

$$BtmQ = \Delta t a^n \int_0^{Z_1} z^b dz \quad (38)$$

$$= \frac{\Delta t D_a Z_1^{b+1} \sum_{i=Z_1}^{Z_2} X_i}{Z_2^{b+1} - Z_1^{b+1}} \quad (39)$$

B.3.10 Distance Calculations

WinRiver II uses the following formulas to calculate distance.

Distance Made Good

$$DEast = DEast + 1/2 * (VEast[n-1] + VEast[n]) * (T[n] - T[n-1]) \quad (40)$$

$$DNorth = DNorth + 1/2 * (VNorth[n-1] + VNorth[n]) * (T[n] - T[n-1]) \quad (41)$$

$$Dgood = \sqrt{DEast^2 + DNorth^2} \quad (42)$$

Where:

D = distance
 V = velocity
 n = the ensemble number
 T = time

Total Length of Course Over Ground (called **Length** in *WinRiver II* display).

$$LEast = 1/2 * (VEast[n-1] + VEast[n]) * (T[n] - T[n-1]) \quad (43)$$

$$LNorth = 1/2 * (VNorth[n-1] + VNorth[n]) * (T[n] - T[n-1]) \quad (44)$$

$$Length = Length + \sqrt{LEast^2 + LNorth^2} \quad (45)$$

Where:

L = length
 V = velocity
 n = the ensemble number
 T = time

B.3.11 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.

Gordon, R. L. (1989). "Acoustic Measurement of River Discharge." *Journal of Hydraulic Engineering*, Vol. 115, No. 7, July 1989, 925-936.

Appendix C – WinRiver II Data Formats

C.1 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 12: 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 (<i>WinRiver II</i> Structure) | General NMEA (14 BYTES + msg body) |
| NMEA Strings (for backwards compatibility with <i>WinRiver</i>) | DEPTH SOUNDER (DBT) (38 BYTES) |
| | GPS GGA (97 BYTES) |
| | GPS VTG (45 BYTES) |
| ALWAYS OUTPUT | RESERVED (2 BYTES) |
| | CHECKSUM (2 BYTES) |



NOTE. 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 (see the [WorkHorse Commands and Output Data Format](#) guide) to locate the offset to the specific ID of the data type you wish to decode. The table below shows the navigation IDs.

Table 13: Fixed Leader Navigation ID Word

| ID | Description |
|--------|------------------------|
| 0x2022 | General NMEA structure |
| 0x2100 | \$xxDBT |
| 0x2101 | \$xxGGA |
| 0x2102 | \$xxVTG |
| 0x2104 | \$xxHDT |

Once the ID of the data type is located use the data format section to locate the bytes you wish to decode using the data format for your ADCP.

C.2 General NMEA Data 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 14](#).

Table 14: NMEA Data 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. (<i>WinRiver II</i> 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. <i>WinRiver II</i> also uses the unassigned ADC Mnemonic Code for its own data files). |
| ["<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 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 bits 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 15](#).

Table 15: 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 | A fixed length alpha field. This type of field contains a fixed number of upper-case or |
| aa | lower-case alpha characters. |
| aaa | |
| etc. | In all strings recognized by <i>WinRiver II</i> , all these fields have a length of one character. |
| x | A fixed length numeric field. This type of field contains a fixed number of numeric |
| xx | characters (0 - 9). |
| xxx | |
| etc. | 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. |

NOTES. 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](#)," page 154.

C.3 General NMEA WinRiver II Structure



NOTE. This structure is used by versions prior to *WinRiver II* version 2.00.

Table 16: General NMEA WinRiver II Structure (prior to ver. 2.00)

| General ID | Specific ID | Msg Size | Delta Time | Msg Body |
|------------|-------------|----------|------------|----------|
| 0x2022 | see below | | | |
| 2 bytes | 2 bytes | 2 bytes | 8 bytes | n bytes |

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;
```




NOTE. This structure is used by *WinRiver II* version 2.00 and later.

Table 17: General NMEA WinRiver II Structure (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;
```

C.4 NMEA Input

The NMEA messages *WinRiver II* reads are standard DBT, GGA, VTG, and HDT messages.

C.4.1 DBT – Depth Below Transducer

Water depth referenced to the transducer.

\$__DBT,x.x,f,x.x,M,x.x,F*hh<CR><LF>

Table 18: 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*.

C.4.2 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 19: 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. |
| 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 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*.

C.4.3 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 20: 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 |
| 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*.

C.4.4 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 21: HDT NMEA Format

| Field | Description |
|--------|-----------------------|
| 1* x.x | Heading, degrees True |
| 2 T | HEX 54 |

* This field is used by *WinRiver II*.

C.5 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 – Shortcut Keys

Use the shortcut keys to quickly perform tasks.

Table 22: 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-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 RGTest |
| 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) |

Appendix – E Software History

E.1 Version 1.01

- Initial release.

E.2 Version 1.02

- Fixed problem with generating ASCII out.
- Fixed problem with beam depths in BT Tabular window.
- Fixed problem with not consistently saving configurations settings.
- Fixed problem with edge distances while acquiring data.
- Added resolution to Gage Height values.
- Added warning in the measurement wizard if the ADCP depth is set to zero.
- Fixed problem with some StreamPro data in playback.
- Fixed problem with locking up while using measurement wizard when following specific steps.
- Added reference to measurement file.
- Added warning when measurement is locked and closing a measurement.
- Added warning when measurement is locked and printing measurement summary.
- Fixed problem with Site Discharge and Playback Configuration icons.
- Fixed problem with Duration on the Composite Tabular display that was truncated to seconds.
- Changed code for Minimum Profiling Depth for Cell 1 and 2.

E.3 Version 1.03

- Fixed problem with assigning transect numbers to all “000” when importing old data files.
- Changed generic ASCII Output format for Longitude and Latitude.
- Fixed problem with saving files that contain '.' in directory path.
- Fixed problem with the discharge profile graph when using constant or 3-pt for the top extrapolation method.

- Fixed problem with finding configuration files when creating measurement from StreamPro data files if filename has an extra "."
- Fixed problem with decoding VTG when the "mode indicator" field is missing.
- Fixed problem with "Stop Pinging" menu item being disabled.
- Fixed fatal exception when dragging Generic ASCII Output item.
- Fixed problem with bad data file crashing the application playback.
- Fixed problem with "Number of Ensembles" decoding in Detailed Discharge tabular display.
- Fixed problem with wrong bin size chosen for certain wizard inputs.
- Changed generic ASCII output Latitude and Longitude resolution.
- Fixed problem with PD0 and mmt files stored in incorrect location.
- Increased resolution of decimal places for Latitude and Longitude on Composite and GPS displays.
- Fixed problem with classic ASCII output combining information from different data files.
- Added speed of sound correction for bottom track depth.

E.4 Version 2.00

- Added "Section by Section" subprogram.
- Disabled tests in Acquire menu for the StreamPro.
- Disabled "Update Rate" in the wizard for the StreamPro.
- Forced "Bottom Mode" selection to 10 in the wizard for the StreamPro.
- Optimized internal PD0 NMEA structures.

E.5 Version 2.01

- Added better support for Monitor/Sentinel WorkHorse ADCPs.
- Added support for COM ports bigger than 32.
- Moved the default position of the Acquire Control display to the lower right corner of the display (over Composite Tabular screen).
- Added "GPS Delay" parameter to "DS/GPS/EH" page.
- Fixed broken GPS compatibility with older versions of WinRiver.

- Fixed problem with GPS lagging behind the ensemble data for high GPS output rates.
- Fixed problem when printing in landscape.
- Fixed problem when sub-sectioning file with lost ensembles.
- Fixed sidelobe screening for intensity and correlation that did not account for transducer offset.
- Fixed depths numbers in Stick Ship Track when switching units.
- Fixed problem with updating the units in Stick Ship Track.
- Fixed behavior of the Wizard with StreamPro when running second time.
- Corrected wording in measurement wizard GPS warning.
- Mode 12 warning is now shown only when Rio Grande is selected.
- Fixed problems with incorrect save location after measurement files have been moved.
- Re-arranged items on the “Output Filename Option” page in the wizard.
- Changed the minimum allowed input value for Near Zone Distance to 0.
- Fixed drawing of the line between transects and statistical information when the last transect is not checked.

NOTES

NOTES