AquaCalc Pro Plus

Stream Flow Computer

Instruction Manual

Important Notice

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For questions concerning the operation of the AquaCalc or accessories, call your authorized dealer.

For technical questions concerning hardware, firmware, upgrades, or custom applications, contact JBS Instruments at the above phone numbers.

AquaCalc Pro Plus

Manual Price $25.00

AquaCalc Pro Plus Menu Structure

```
Main Menu
├─ 1) Measure
│   ├─ Measure Options
│   ├─ Setup
│   │   ├─ Section Setup (2 screens)
│   │   └─ Vertical Setup
│   └─ Review Totals
│       └─ Section Totals
├─ 2) Sections
│   ├─ 1-10
│   ├─ 11-20
│   └─ 21-30
├─ 3) Connections
│   └─ Bluetooth Setup
├─ 4) Meters
│   ├─ Meter Settings (2 Screens)
│   └─ Save
└─ 5) Preferences
    ├─ Owner ID
    ├─ RESET Pro
    └─ About
```
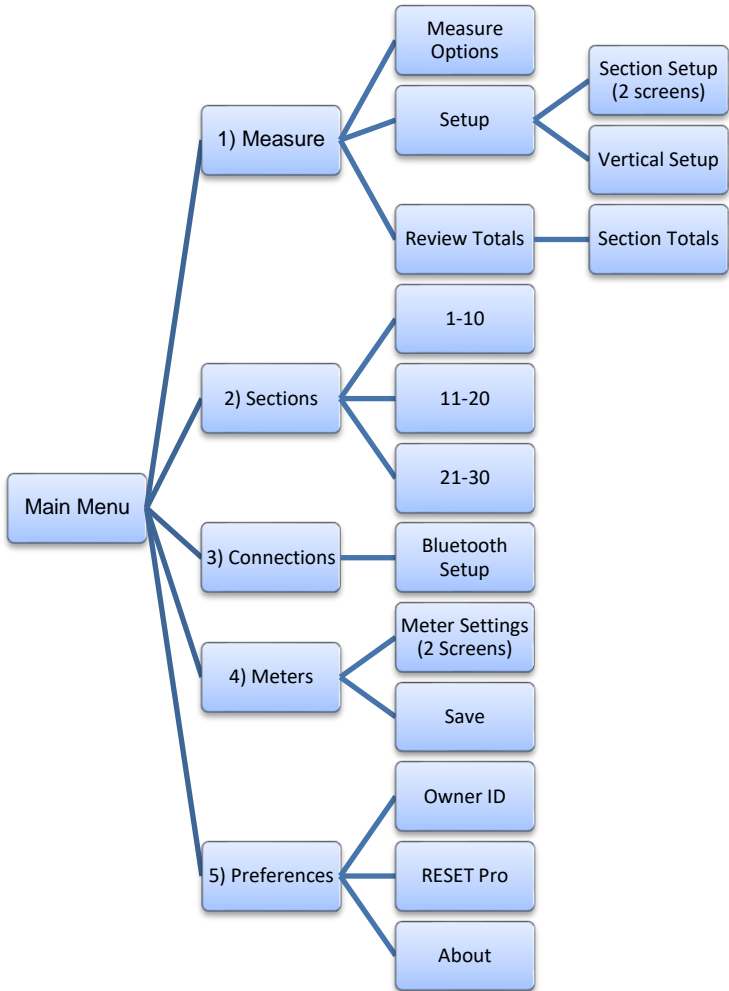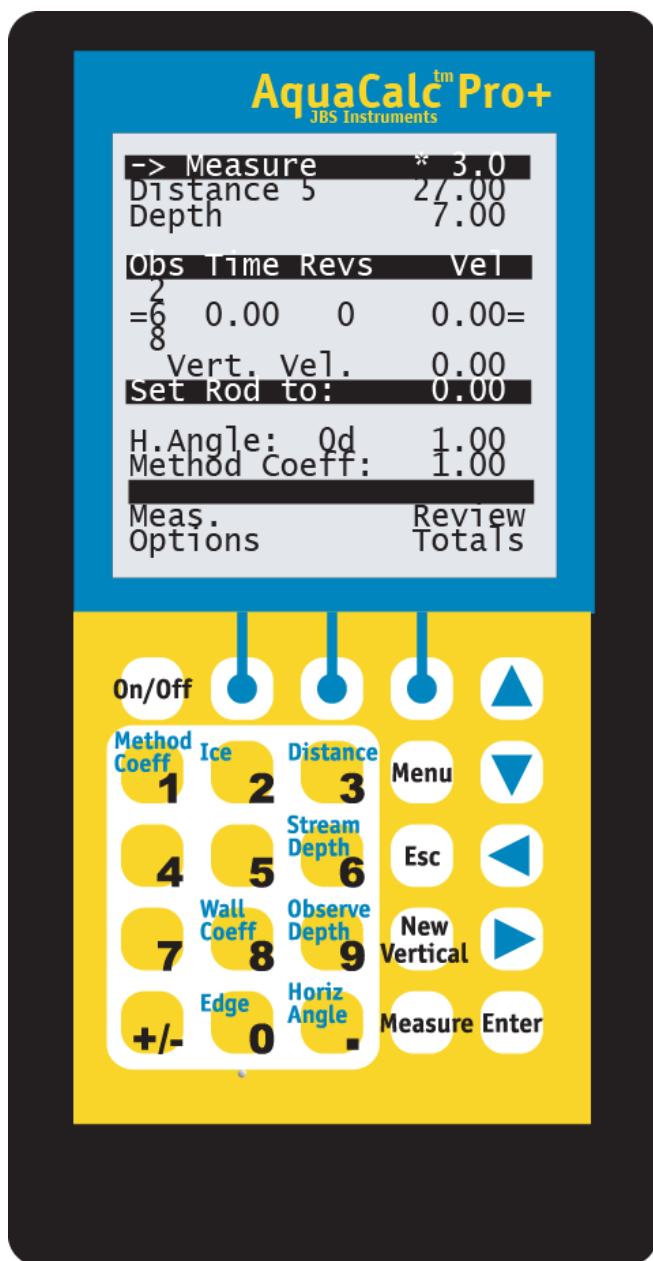
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Getting Started – The Basics

Collecting stream data used to require juggling an arm load of gadgets while counting clicks, writing notes, and performing calculations. The AquaCalc changed all that, and has become the standard for impulse current meter measurements.

You enter the depth and distance at each station. The AquaCalc measures velocity and elapsed time. Then, the AquaCalc calculates the total stream discharge and mean velocity. After stream measurement is complete, you can transfer the data to a laptop or personal computer. It's the fastest, easiest, and most accurate stream measurement instrument for use with current meters available today.

The AquaCalc can automatically recommend appropriate distance locations (verticals), and depth locations whether used with a wading rod or in a suspended measurement so that your completed discharge measurement meets USGS standards with fewer observations.

The AquaCalc will help you work faster and more efficiently, whether you are a seasoned hydrographer measuring many streams, a novice just learning the trade, or a scientist collecting research data. The AquaCalc improves accuracy in the field and saves time in the office. It eliminates transcription errors by transferring the data directly to a personal computer, using a standard ASCII format. Your AquaCalc is designed for years of trouble-free operation. It is sturdy, water resistant and will become an indispensable tool for any hydrographer.

The AquaCalc Pro series follows the policies and procedures of the USGS' methodology for making discharge measurements. The Mid Section Method is used exclusively in this version.

Improving Accuracy / Reducing Errors

We recommend that you follow these simple rules to reduce errors and loss of data:

- We highly recommend the use of the **Calculate Percent Flow Mode** which calculates the next vertical's location such that the current sub-section discharge will not exceed the specified maximum percent of total discharge (typically 5% of total discharge). This feature will reduce errors and shorten your time to a high quality measurement.

- Monitor the battery condition and change or charge the batteries when the first warning appears. Always carry spare NiMh AA batteries when in the stream.

- Pay attention to the frequency of the "clicks" and the displayed velocity for indications of a fouled meter or other problems.

- Always review your data before leaving the measurement site to insure good data entry.

- At a minimum, always write down the following information in your field notes: total Q, mean velocity, area and width.

- Upload your data as soon as possible to your laptop or PDA after completing your measurement.

- The AquaCalc has three standard measurement modes; single point (0.6 depth), two-point (0.2, 0.8), and three-point mode (0.2, 0.6, 0.8). Understand each, and learn when to use each method.

Glossary of Important Terms

There are a few basic terms that are important to working with your AquaCalc.

Section – Measurement section from beginning edge to ending edge.

Vertical - A location in the section identified by a tag-line distance where depth and velocity measurements are performed.

Observation (often abbreviated as Observe or Obs.) – An individual velocity measurement performed in a Vertical.

Observation Depth - A location in the vertical as measured from the surface, .2, .6, or .8.

Sub-Section - Also known as a "panel". The area of a stream related to a vertical, extending halfway to each of the adjacent verticals and from surface to bottom as shown in the following figure.
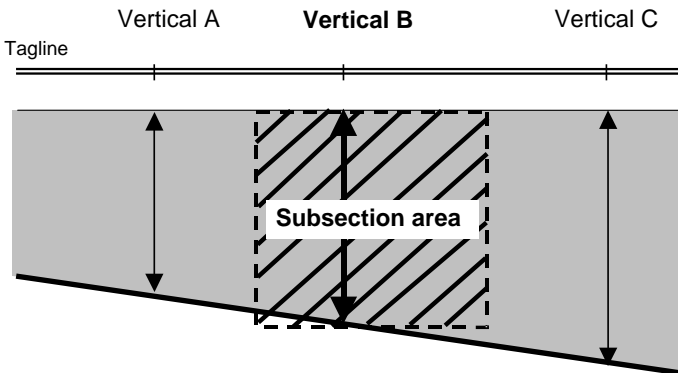
SID – Section ID / Station or Section Identifier

UID – User ID / Users name or identifier

Soft-Key – The three keys that are located directly below the display. The functions of these keys are redefined by the AquaCalc firmware as needed.

Firmware – The program that is loaded into the flash

memory of the AquaCalc.

Basics: Getting Around the AquaCalc.

There are three keys that are used to move between screens in the AquaCalc: Menu, Esc, and Enter.

Menu Key – Will return you to the Main Menu in most screens.

Enter Key – Completes most entries. In some screens press this key to return to the previous screen.

Esc Key – Used to cancel data entry. This key works whenever text is "reversed "with light text on a dark background.

Data Entry Tips and Shortcuts

There are three ways the user can enter information when requested by the AquaCalc:

- **Toggle between predetermined values: -** Pressing the appropriate key toggles (or cycles) through predefined values. For example: Pressing the **3) Baud Rate** key in the Connections Menu cycles through the available communication baud rates.

- **Selection of Menu Items -** When presented with a list of choices, such as a list of available meters, an item may be selected by pressing the indicated key on the numeric keypad.

- **Value Entry:** When using the alphanumeric entry screen text and numeric values are entered by the user, such as Gage ID and Distance, they are displayed at the bottom of the screen during the entry process. Pressing

Enter accepts the entry, while pressing Esc discards the value entered. The Left Arrow (<) key deletes the last key entered and the Right Arrow (>) key adds a space to a text entry.

Special Features of the AquaCalc

The AquaCalc has several modes that can speed measurements while improving accuracy.

- Automated Set Distance Mode

- Automated Percent Flow Mode

- Auto Carry Mode

- Ice Mode

Sounds: Hearing "Clicks" and Beeps

The AquaCalc has a built-in speaker that allows you to hear current meter "clicks", keypad presses, and data entry confirmation tones. The keypad beeps and meter beeps (those made each time a signal is received from the current meter) can be turned on or off in the System Preferences Menu, which is available from the Main Menu. The "uh-oh" sound signals you that the AquaCalc has not received the input it was expecting or that you cannot perform the function you selected.

Important Notes

To achieve continued trouble free use of the AquaCalc pay particular attention to the current meter's "cat whisker" contacts located in the Price AA or Pygmy current meter contact chamber. The proper setting and a good maintenance program will insure trouble free counting of

the current meter revolutions. The use of a magnetic head in place of the contact chamber will provide even better results.

If you are not familiar with the USGS established procedures for measuring discharge of surface waters, it is imperative that you obtain assistance prior to the collection of surface water records. Other methods of stream flow data collection, while acceptable for hand calculation methods, will generate errors in the volume calculations when used with the AquaCalc.

Using the Keypad

The keypad on the AquaCalc has 25 keys. Some of the keys have multiple uses, particularly the numeric keys which are used in the Measure screen.

Keypad Descriptions

Soft-Keys

Navigation Keys

Numeric keypad
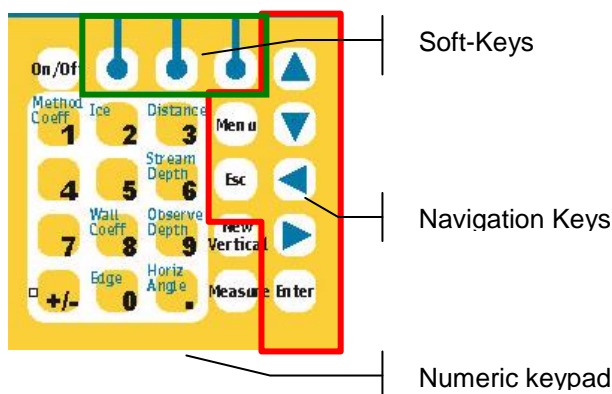
On/ Off – Automatic Power Off

Press the On/Off key to turn on the AquaCalc. Press and hold the On/Off key until the beep changes tones to turn the unit off. The power down screen will then appear and count down ten seconds. Pressing any key during this countdown will return the AquaCalc to the Main Menu screen.

To save batteries, the AquaCalc will power down at the default setting of 10 minutes. This setting can be changed in the System Preferences.

When first powered on, the AquaCalc will show the last active section used in the Active Section area.

Soft-Keys

The functions of the three keys centered directly under the display are changed depending upon the active menu or screen. The function of each key is displayed on the bottom rows of the display when they are active.

Navigation Keys

Up and Down Arrow Keys – While in the Measure screen, these keys are used to change the Observation Depth. When in the Main Menu they are used to adjust the display contrast. Also used to edit alphanumeric entries.

Left and Right Arrow keys – While in the Measure screen, the Left and Right Arrow keys are used to move between verticals. When in the Main Menu or Connections Screen these keys navigate between sections as shown in the Active Section area of the screen.

Enter – The Enter key completes an entry, and exits out of a menu. This key is primarily used to finish entering required input, such as depth and distance.

Shortcut: Data entries with the AquaCalc can be streamlined by using the ENTER key to complete the task.

As an example, a depth of 5 feet would be entered as 5.00; performing four keystrokes. By using the ENTER key to complete the task, the operator would key in 5, then Press ENTER which would complete the entry; for a total of two keystrokes. Using the automated approach, all decimals and zeros are entered automatically.

Menu – This allows the user to access the Main Menu.

Esc – Used to cancel data entry in Reversed Text Escape key allows the user to cancel or back out of a data entry screen without making changes.

Number Keys

Most of the number keys have two functions; the first is to enter a number, and the second is defined by the text in the upper left portion of the key. The following description identifies these special functions.

1/Method Coeff

Allows the user to edit the Method Coefficient. The Method Coefficient provides the user with an alternative Coefficient called the Method Coefficient or M-COEF. The M-COEF allows the user to apply a second coefficient to the sub-section velocity to modify the subsection vertical discharge.

2/Ice

Allows the user to enter an Ice Draft; the ice draft function must be turned on in the section setup menu before this function is active. The Ice Draft is used when measuring stream where ice is present and holes have been punched or drilled to reach the water. Please see Using the Ice Draft Mode.

3/Distance

Enter or edit the tag line Distance. This key is used to enter the distance as read directly from the tag line. The distances entered can be any positive or negative number and can be entered sequentially in either ascending or descending order.

The distance numbers allowed are 0.00 to 9,999.00 feet.

4/

User enters a numeric value of four (4).

5/

User enters a numeric value of five (5).

6/Stream Depth

Enter the Depth. This is a direct entry of depth when performing a wading measurement. When the AquaCalc is set up for a sounding measurement then the depth is based on zeroing the reel when the cups are at the surface of the water (USGS preferred method). The depth that is read from the reel is directly entered into the AquaCalc and according to the weight and hanger bar selected the correct depth will be displayed. Using the AquaCalc in this manner sets the 2, 6, and 8 tenths observations at the correct location in the vertical.

> Note: Valid depths in the AquaCalc are from 0.00 to 99.99 feet.

7/

User enters a numeric value of seven (7).

8/Wall Coeff

Enter or edit the Wall Coefficient. The Wall Coefficient is used to apply a coefficient to a designated wall vertical that will apply a percentage of the adjacent vertical average velocity.

Distance from wall as a ratio of the depth	Mean vertical velocity, as related to Vp
0.00	0.65*Vp
0.25	0.90*Vp
0.50	0.95*Vp
1.00	1.00*Vp

Vp is defined as the mean velocity in the vertical at a distance from the wall that is equal to the depth. Please read the section "*Performing Wall Measurements*" for more information.

9/Observe Depth

User can only enter a numeric value of nine (9).

(Note: The Observe Depth entry is not yet implemented. Use the Up and Down Arrow Keys to change the Observation Depth. In case you enter the wrong observation depth and wish to swap measurements use the Measurement Options Softkey and select the Swap Obs option)

0/Edge

Marks a vertical as an edge of water. The first vertical is automatically marked as an edge of water but the user must mark the ending edge. The AquaCalc algorithm requires a starting point and an ending point to correctly calculate the total discharge of the channel. These starting and ending points are Starting Edge Of Water, and Ending Edge Of Water, or Left Bank Edge Of Water and Right Bank Edge Of Water.

It is best to close a section with an Edge or Wall, and while not essential, we recommend that a measurement have an even number of edges.

+/-

Used to enter a negative sign such as when entering a reversed velocity.

./Horizontal Angle

The horizontal angle entry is used to correct for flow conditions that are not perpendicular to the tag line, such as a bridge that angles across a stream. It is entered as a coefficient that corresponds to the angle from perpendicular; The decimal point must be entered.

Angle in degrees	Coefficient
0	1.00
15	0.97
30	0.87
45	0.71
60	0.50
75	0.26
90	0.00

To enter a Horizontal Angle coefficient, press the period / Horiz Angle key while in the Measure screen and enter a coefficient. When completed press the Enter key.

> An Angle Coefficient Protractor that can be used in the stream is available from JBS, and is reprinted in the back of this manual.

Special Keys

Menu

Used to go to the Main Menu in many screens

Esc

Cancels editing of numbers in any **Reversed Text** entries, and restores the previous value.

New Vertical

While in the Measure screen, pressing this key will create a new vertical and request the user to enter the Tag Line Distance of the new vertical.

Measure

When in the Measure screen, pressing the Measure key starts the internal stopwatch and begins counting the meter revolutions or clicks. Pressing Measure from the Main Menu screen will take you directly into the Measure screen.

When the Measure key is pressed, the AquaCalc will start the timer, count the revolutions, and display the instantaneous velocity, until the measurement is completed.

Enter

Used to complete entries and exit screens. Pressing Enter will move you back to the previous screen.

Turning Your AquaCalc On and Off

Turn on the AquaCalc by pressing the On/Off key. (You may turn off the AquaCalc by returning to the main menu and then pressing and *holding* the On/Off key.) As the AquaCalc starts, it will briefly display an opening screen and then will display the Main Menu.

Batteries - Recharging

The AquaCalc Pro Plus is designed to be used with rechargeable AA Nickel Metal Hydrid (NiMh) batteries. The battery compartment is located behind the display and hold 4 - AA (HR 6) size batteries. The batteries will charge when the AquaCalc Pro Plus is plugged into a powered USB port.

- *Turn off the AquaCalc while charging the batteries.* This will significantly speed up charging times.
- The AquaCalc Pro Plus requires approximately 8 hours for a full charge from completely discharged batteries when the AquaCalc is turned off. *Charging will take significantly longer if the unit is turned on.*
- The battery charging status indicator is located on the front of the AquaCalc under the Edge/0 key. *The indicator will glow orange while charging and green when the batteries are charged.*
- Four new fully charged AA / HR6 1900 mAhr batteries will operate the AquaCalc for approximately 8 hours at 68 °F / 20 °C. Colder temperatures will shorten the battery life.
- We recommend that you carry a spare set of batteries.

Do not try to charge alkaline batteries.
Charging alkaline batteries may cause them to leak or explode and damage your AquaCalc.
Damage caused by improper charging of batteries is not covered under warranty!

Disable USB charging to permanently use Alkaline Batteries.
There is a jumper under the label inside the battery compartment. Remove this jumper to stop the charging of the batteries when the USB is connected.

Menus and Screens – Navigating the AquaCalc Pro Plus

The Main Menu

The AquaCalc Pro Plus Main Menu is the primary screen for navigation within the AquaCalc. Below the menu items is the Section Identifier (SID) for the current active section along with the Number of Verticals and the observed discharge (Q).

> **Important Note:** At the Main Menu, you can create a new Section with the New Section softkey, which automatically names the new section with the date and time, and opens the Measure screen. This auto generated name remains the name of the section until changed by the user.

```
- Menu  +[ ====] 65%

1) Measure
2) Sections 7/30
3) Connections
4) Meters
5) Preferences

  Active Section
SID: BLUE RIVER
Date:  11/25/11
Vert. 25  Q: 17

< Prev   2   Next>
 11/26/11    New
 15:49:06    Section
```

The Main Menu contains several items that can be selected by pressing the appropriate number on the keypad corresponding to the number at the left of the menu item. (Please see the previous section for more information on the keypad)

For example, to go to the Measure screen, press the 1 key while in the Main Menu (You may also press the Measure key to go to the Measure screen).

Additional Main Menu Features

Other not so obvious features are available in the Main Menu as well.

- The Right and Left Arrow Keys can be used to navigate between sections. You can navigate to an existing Section, and then open it for review by pressing the Measure key.

- The contrast of the display can be adjusted using the Up and Down Arrow keys.

- The first "Soft-Key" which is located under the current date and time, when pressed, will take the user directly to system preferences display where the date and time can be changed as well as the other system preferences.

- The right hand Soft-Key **New Section** creates a new section and opens the Measure screen.

- The number of sections that have already been used is listed next to the Sections menu item (In the example above: "7/30").

The Main Menu Items are as follows:

1) **Measure** – This takes you to the measure screen where a majority of the measurement tasks are performed. You may also access the measure screen by pressing the **Measure** key.

2) **Sections –** This is where a section can be Opened, Deleted or a New one created. The Sections Setup is made up of three groups of ten sections. These different groups are

accessed using the Soft-Keys "1-10", "11-20", "21-30" located at the bottom of the screen.

3) **Connections –** Selecting this option will open the Connections Screen where you can download your AquaCalc measurements.

4) **Meter s** – The Meters screen is available by selecting this option. The Meters screen is used to manage your current meters, including naming, assigning serial numbers, and entering calibrations for non-standard meters.

5) **Preferences** – This menu item opens the Preferences and System Settings sub menu where you can set time and date, change auto power off settings, Baud rate, turn on and off beep tones for the keypad and meter, adjust the contrast of the display, and adjust the units (SAE/English or Metric). The **Date** and **Time** Soft-Keys will also take you to System Preferences.

Important Note: If you turn off the AquaCalc, or if the AquaCalc turns itself off automatically, you will need to use the "ReOpen Last" Soft-Key on the Main Menu to load and return to your last section.

AquaCalc Pro Plus Menu Structure

```
Main Menu
│
├─ 1) Measure
│     ├─ Measure Options
│     ├─ Setup
│     │     ├─ Section Setup (2 screens)
│     │     └─ Vertical Setup
│     └─ Review Totals
│           └─ Section Totals
│
├─ 2) Sections
│     ├─ 1-10
│     ├─ 11-20
│     └─ 21-30
│
├─ 3) Connections
│     └─ Bluetooth Setup
│
├─ 4) Meters
│     ├─ Meter Settings (2 Screens)
│     └─ Save
│
└─ 5) Preferences
      ├─ Owner ID
      ├─ RESET Pro
      └─ About
```
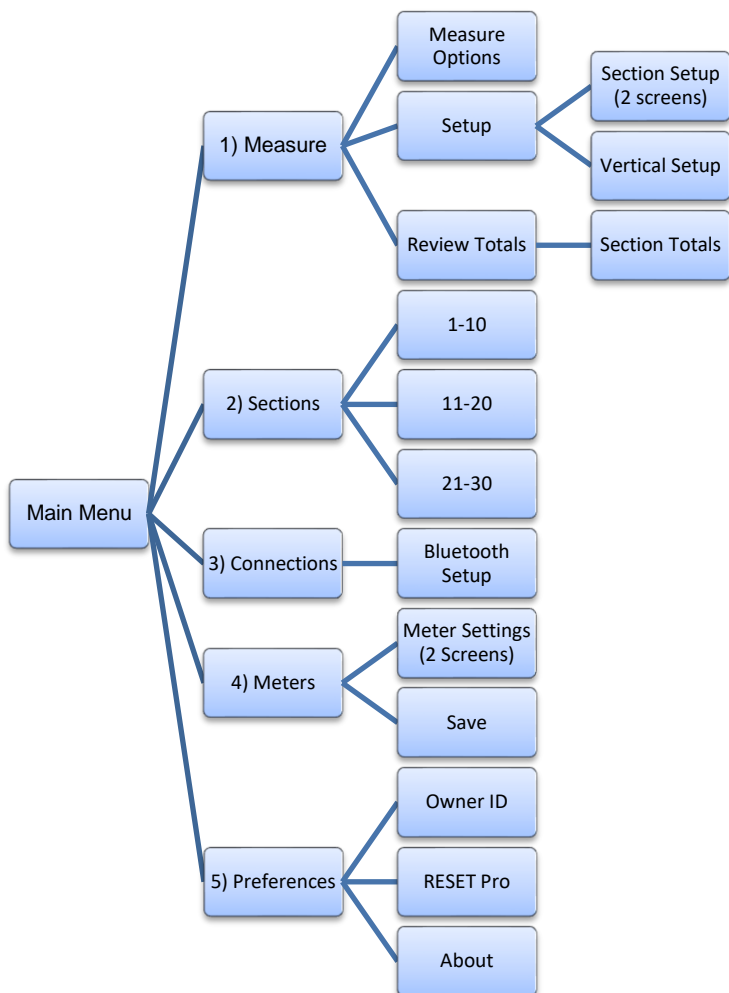
Measure Screen

The Measure Screen Features

```
- Measure      * 3.3
Distance 5     27.00
Depth           7.00

Obs Time Revs    Vel
 2
=6  0.00   0    0.00=
 8
   Vert. Vel.   0.00
Set TSet Rod to:7.00

H.Angle:  0d    1.00
Method Coeff:   1.00


  Meas.        Review
Options Setup  Totals
```

Signal Indicator and Instantaneous Velocity

Vertical Information Area includes vertical number

Observation Information Area

Comments, Coefficients, and Menus Area

Soft-Key Labels Area

The most common screen or display the user will see when using the AquaCalc is the Measure screen. This screen can be accessed by pressing the **Measure** key or the **1** key in the Main menu.

Instantaneous Velocity Indicator

When connected to a spinning current meter, the top line will show an instantaneous velocity along with a flashing asterisk (*) that corresponds to the current meter "clicks".

Tag Line Distance and Stream Depth

The second line displays the number of the vertical, and the tag line distance as well.

The third line displays the depth of the stream, water surface to bottom, at the vertical being measured.

Individual Observation Information

In the center of the screen three lines identify the 2, 6, and 8 observation locations, along with the elapsed time of the measurement and revolution counter.

> **Changing Observation Depth:** You may move between the .2 .6 and .8 observation depth lines by pressing the Up and Down navigation keys.

The Vertical Velocity (Vert. Vel.) line shows the calculated mean velocity for the vertical.

Suggested Wading Rod or Suspension Settings

The AquaCalc can recommend where to set your wading rod or suspended cable reel for .2, .6, and .8 measurements. There are three types of "suspensions" that you can select: Top-set Wading Rod, Suspended Cable, or Sectional Rod (see the "Section Setup" heading for more information).

The line below the Vertical Velocity shows the recommended setting for:

- The Wading Rod ("Set Rod to"),

- The Cable Reel setting ("Set Reel to") or

- Sectional Rod setting ("Set Sect to")

This recommended meter depth will change depending on the observation depth setting of .2, .6, or .8.

Ice Measurements

When performing ice measurements, the suggested depth is calculated from the bottom up, and not the top down. See "Using the Ice Draft Mode" topic in the "Making a Discharge Measurement with the AquaCalc" Chapter for more information on performing Ice Measurements.

Horizontal Angle and Method Coefficient

The Horizontal Angel (H. Angle) is display on line 12 in both degrees and as a coefficient.

The Method Coefficient is entered using the Method Coeff / 1 key. The Method coefficient is used to adjust a measured velocity at the hydrographer's discretion. Please see the description of this key in the Keypad section.

The last two lines identify the current function for each of the three Soft-Keys.

Navigating in the Measure Screen

The navigation keys on the keypad, which include the arrow keys are designed to provide special functions.

Changing Verticals

Use the Left and Right Arrow keys to move between verticals in a section. The right arrow moves you to the next vertical and the left arrow to the previous. A warning message will appear when you try to move past the last vertical.

Changing the Observation Depth

Use the **Up and Down Arrows** to move between the Observation Depths.

Returning to the Main Menu

Use the Menu key to return to the Main Menu from within the Measure screen.

Measure Screen Soft-Keys

Measure Options (Soft-Key in Measure Screen)

While in the Measure Screen, pressing the **Measure Options** Soft-Key opens up a menu that allows access to functions that apply to the current Vertical, and the Observations in that Vertical.

These include:

1) **Velocity: Meas./Est.** – Defines how the velocity at the observation will be obtained, either measured or estimated.

2) **V. Depth: Meas./Est.** – Defines how the stream depth at the vertical will be obtained, either measured or estimated.

3) **Flow Dir.: Normal/Reverse** – Identifies the direction of flow in the vertical.

4) Reserved for future use.

5) **Swap Obs. Data**: - Allows the user to move observations around in the event a measurement was taken at the wrong observation location.

   a. With the Up and Down navigation keys, select the observation to move,
   b. Press the **Meas.Options** Soft-Key,
   c. Press **5** for **Swap Obs Data**,
   d. Select the Observation by number 2, 6 or 8 to where the Observation is to be moved to.

In the case where a value exists in the location you have selected, they will be swapped.

1) **Erase Obs Data** – Allows the user to erase the selected observation.

2) **Delete Vertical** - Allows the user to delete the current vertical.

Setup (Soft-Key in Measure screen)

From the measure screen, pressing the **Setup** Soft-Key opens up a menu that allows access to Section Setup, and Vertical Setup. The Soft-Keys also allow the adjustment of the display contrast. See the "Section Setup Screen" topic later in this chapter for more information on section settings.

Adjust Contrast / Darken and Lighten (Soft-keys in Setup)

When in the field and standing in the sun, your display may begin to darken due to heat and become hard to see. When this occurs, you can adjust the contrast of the display from the Measure Screen by selecting the **Setup** Soft-Key then the **Darken / Lighten** Soft-Keys. Note that contrast can also be adjusted in the Main Menu using the Up and Down Arrows.

Sections Screen

The Sections Screen

The AquaCalc can store up to 30 different and complete discharge measurements at the same or at different cross-sections. These are called "Sections" in the AquaCalc.

> The Sections Menu is used to open, add, and delete sections. To "setup" a section, (i.e. enter information about the section) open the Section and go to the Measure screen. While there press the **Setup** Soft-Key and select **1) Section Setup**

From the Main Menu, Select "2) Sections" from the Main Menu. The Sections Menu will be displayed.

```
- Sections 1 – 10

SID: 09/30/11 14:02:00
1)10/16/11 10:31
2)08/26/11 15:30
3)SAMPLE SECTION ID
4)
5)
6)
7)
8)
9)
0)
   Select Section

 1-10  11-20  21-30
```

The Sections area is divided into three screens with each screen displaying 10 measurements. You may switch between screens by using the Soft-Keys at the bottom of the section screen **"1-10", "11-20", "21-30".** In this screen, Sections may be created, opened or deleted. Select a section by pressing the appropriate number key.

> **Important Note:** The AquaCalc can store a maximum of 30 sections. If all of the sections are filled you will not be able to create a new section in the Sections Menu. You will also not be able enter the Measure screen from the Main Menu. You must first delete a section in the Section Menu.

Pressing a number key in the Section menu will cause that section to flash. If the section has data in it, the Soft-Key menu will change to show the **Open** and **Delete Section** and **Delete Obs.** options.

```
- Sections 1 – 10

SID: 09/30/11 14:02:00
1)10/16/11 10:31
2)08/26/11 15:30
3)SAMPLE SECTION ID
4)
5)
6)
7)
8)
9)
0)
   Select a Section
Delete        Delete
 Obs.  Open   Sect.
```

Creating a New Section

To create a new section in the Sections screen:

1. Select an empty section location by pressing a number key with a blank Section ID, then press the **New** Soft-Key. This will place you directly into the Section Setup menu.

2. Enter the Section information in pages 1 and 2 of the Section Setup screen.

When completed, the Measure screen will appear with the first vertical defined as Water Edge.

Opening an existing Section

To open a section, select its corresponding number on the keypad and then select the Soft-Key **Open.** After opening a section, the AquaCalc will return to the Main Menu.

Deleting a Section

To delete a section, select its corresponding number and then select the Soft-Key **Delete** . A warning is given and the user is requested to select a second Soft-Key, select **Yes Continue** and the section will be deleted and you will be returned to the Sections Menu.

Deleting Only the Observations in a Section

To delete the observations within a Section without deleting the Section information or the vertical and tag line distance information, select the sections corresponding number in the Sections Menu and then select the Soft-Key **Delete Obs.** Notice that a warning is given, then select **Yes Continue** and the section observations will be deleted but the section and vertical information will remain.

Section Setup Screen

The Section Setup Screen is accessed by pressing the **Setup** Soft-Key in the Measure Screen followed by the **1) Section Setup** option.

```
        Section Setup

1)SID: 01/01/2008 12:01
2)UID: BOB

3)Meter:   PAA11 std2

5)Equip  Susp. Cable
6)Sound Wt:   C30 0.50
7)Ice Draft:   No
8) Meas: - .6 -
9)Meas.Time(S):  40
0)Pct.Q Limit: 5



------    ------    More
```

Section Setup Menu – (Page 1)

1) **SID: - Section Identifier (Gage ID)** The Section ID identifies the individual discharge measurement and can be edited here using alphanumeric characters. The AquaCalc automatically creates a Section Identifier based on the time that the new section was created.

2) **UID:** - The User ID identifies the person making the measurement. It can be entered by selecting this option. The User ID can include alphanumeric characters.

3) **Meter:** - Allows selection of a current meter from the current meter table. (Defaults to the first meter in the first location in the table).

4) **Flood Coef:** *This line is only visible and usable if the "8) Meas: .2 FLOOD" measurement option is selected.* Used to enter a flood coefficient which is applied to each velocity measurement in the section. During a flood, velocity measurements can be taken at the 0.2 depth location across the section and then corrected to the mean velocity using a velocity profile coefficient. Please see the section titled "Performing Flood Measurements" in the "Making Discharge Measurements" chapter

for more information. The default flood coefficient value is 1.00.

5) **Equip:** - Selection of TopSet Rod, Sect. Rod or Susp. Cable.

6) **Sounding Wt:** - Select a value of a Columbus weight **C15** through **C300** including hanger bar position or **User 0.00** which will not calculate an offset for zero, and requires the user to enter their own offset on the reel.

7) **Ice Draft: No/Yes** – Turns ice measurement on or off. The Measure Screen will display a line below the Depth that allows the entry of the Ice Draft. Please see the heading "Using the Ice Draft Mode" in the chapter for more information.

8) **Meas.:** Selection of measurement type. This is allows the user to specify the type of measurement to be performed. This will setup the measure screen for any combination of a 2, 6 or 8 tenths measurement so that the measurement screen observation locations are predetermined.

    For example: If you were going to do a wading measurement and all of the verticals were going to be 6 tenths observations, then you would set the value to 6. Every new vertical will default to an observation depth of 6 tenths. Of course, you can always use the Up and Down Arrow keys to select the 6 tenths or 8 tenths location.

    In addition, the ".2 FLOOD" option allows for measurements during flood conditions. During a flood, velocity measurements can be taken at the 0.2 depth location across the section and then corrected to the mean velocity using a velocity profile coefficient. Please see the section titled "Performing Flood Measurements" in the "Making Discharge Measurements" chapter for more information.

9) **Measure Time(S):** Set how long the AquaCalc counts clicks for each observation. Can be set to count for 0 to 250 seconds. The default is 40 seconds.

Warning

Do not set the measurement time to zero, the AquaCalc will not be able to measure.

---

0) **Pct. Q Limit**: - Percent of Total Discharge per Sub-section/Panel Limit. In its Percent Q Automated Mode, the AquaCalc can recommend the next tag-line distance based upon the velocity in the previous vertical, so that each sub-section does not exceed the limit set here.

Enter the maximum percent of estimated discharge per sub-section/panel. The default setting, and the standard used by the USGS in most circumstances, is five percent (5%).

You must also enter the Estimated Discharge in the second screen of the Section Setup Menu, and turn on the Percent Q Mode in the Vertical Menu.

Section Setup Menu - Page 2

```
        Section Setup
        -- Beginning --
1)Water Edge: Right
2)Slope%:      0.0000
3)Gage Ht.:    0.00
4)StaffHt:     0.00
5)Estimated Q:
               0.00
        --- Ending ---
6)Gage Ht:       0.00
7)Staff Ht:      0.00
8) Adj.Est.Q:
               0.00
9)Quality: na


  Back    -----      ------
```

– Beginning –

1) **(Beginning) Water Edge:** - This identifies the starting edge of water for the first vertical and helps identify whether you were moving right-to-left or left-to -right during the discharge measurement. Enter Right or Left *facing down-stream*.

2) **Slope:** - Enter the slope of the stream as a decimal percent (0.90 = 90%). Slope is a required entry to calculate the Manning and Chezy values.

3) **(Beginning) Gage Ht:** - Beginning recording gage height. Often a stream height taken from a data-logger.

4) **(Beginning) Staff Ht:** - Beginning staff gage height. The staff gage height at the beginning of the measurement.

5) **Estimated Q:** - Estimated total discharge as taken from the rating table or a previous measurement. When the Percent Q Automated Mode (see Vertical Setup), is turned on the AquaCalc will recommend the next tag line distance based upon the Percent Q Limit set in the previous Section Setup Menu screen and the value entered here.

– Ending –

6) **(Ending) Gage Ht:** - Ending recording gage height. Often taken from sites data logger. Corresponds to Beginning Gage Ht.

7) **(Ending) Staff Ht:** - Ending staff gage height.

8) **(Ending) Adj. Est. Q:** - An estimated value of Q that changed after the start of the measurement.

9) **Quality:** The users assessment as to the quality of the measurement Excellent, Good, Fair, or Poor.

*Select **Enter** to return to the Measure screen.*

Vertical Setup Menu Page

The first 3 selections are either/or selections. The second three are selectable as desired.

1) **(   ) 5 Pct.Q Method.** – Selects the next vertical based on the estimated Q and the percent value in this case 5%.

We strongly recommend the use of Automated Percent Flow Mode to improve the accuracy of your measurement. Please see the chapter Increasing Accuracy using the Automated Modes *at* page 53 for more information on using the Automated Percent Flow mode.

(*) Use Previous Width – Select the next vertical based on the last two verticals. Do not confuse distance between verticals with a panel / sub-section width.

Please see the chapter Increasing Accuracy using the Automated Modes at page 53 for more information on using this automated feature.

2) **(   ) Manual Entry** – Standard manual entry of tag line distance.

3) **(   ) Copy Depth** – Copies the previous depth.

4) **(   ) Copy Method Coefficient** – Copies the previous Method Coefficient.

5) **(   ) Copy Horizontal Angle** – Copies the previous Horizontal angle.

Select **Esc** to return to the Measure screen.

Review Totals (Soft-Key in Measure Screen)

Selecting the **Review Totals** soft-key in the Measure Screen opens up the **Vertical Totals** Screen. While in this screen you can scroll left or right using the arrow keys to review the sub-section totals. **The Section Total**s screen can be accessed by pressing the **Section Totals** Soft-Key.

Section Totals (Soft-Key in Measure Screen > Review Totals)

This Soft-Key found in the Vertical Totals screen allows the user to review the Section Totals. To properly display the Percent of Discharge difference from the Estimated Q (Q Diff %), you must have entered an Estimated Q in the Section Setup menu. Likewise, the Manning and Chezy Factor need a slope entered in the Section Setup to produce valid numbers.

Select Esc twice to return to the Measure screen.

Select Menu to return to the Main Menu screen.

The Connections Screen

The Connections Screen is used to transfer completed section measurements to other devices. The Connections screen is accessed by pressing **3) Connections** in the Main Menu.

```
- Connections
 SID: BLUE RIVER
 Date:  02/25/11
 Vert. 25  Q:   694
< Prev     2    Next >
1) Manual Download
2) Baud Rate:  19200
3) Connection: USB


  Connection Status
```

Active Section Information Area includes the number of verticals and total discharge.

Connection Settings

Displays information on the status of the connection

Soft-Key Labels Area
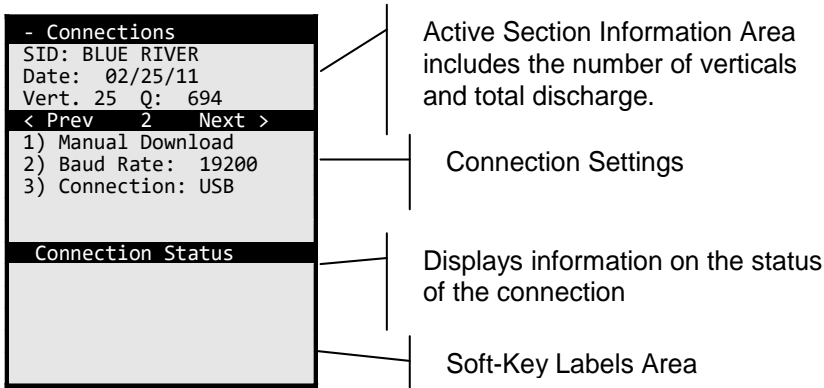
The Connections Screen allows you navigate between sections, set connections type and speed, and then either manually or automatically download measurements when

using the JBS Instruments DataLink program on your personal computer.

You may use the AquaCalc DataLink program (available from our website www.aquacalc.com), or use any other program that can retrieve data from a USB using a serial port profile; such as HyperTerminal to transfer sections to your computer.

The top three lines identify the active Section ID, plus the number of verticals and Total Q for the section.

As your connection is being made and updated, the **Connection Status** area shows messages from the AquaCalc.

Other settings include the type of connection (USB, RS232 serial, or Bluetooth if the optional adapter is installed)

Please see the chapter Transferring and Viewing Measurements on a Computer on page 79 for more detailed instructions on using the Connection Screen and transferring measurements..

Meter Setup

Select Meter Setup from the Main Menu. There are the two screens for the meter setup:

The Meter setup allows the user to configure the AquaCalc for any type of meter that provides a digital or analog signal. The AquaCalc can store ten meters.

Default Meter

The meter in the number one or first location is the default meter for use with all of the 30 sections. If you use a different meter more often, then it is more efficient to configure a meter in the first position that will meet these daily needs and to avoid using the wrong meter.

Changing Meters in a Discharge Measurement

Only one meter can be used in a given section. If you select and use the wrong meter during a discharge measurement, simply select the correct meter from the meter table in the Measurement Section Setup menu and all of the discharge and summary information will be recalculated.

Important Note: The AquaCalc copies the meter rating / coefficients from the Meter into the Section and uses these coefficients until the meter is changed within the Section. When a different meter is selected, the AquaCalc copies the new meter's coefficients and recalculates the discharge.

When changing meters mid-stream:

If meter coefficients are changed in the Meter Screen for an existing current meter, these changes will not be reflected in the active Section unless the meter selection is reloaded. If you change the current meter ratings / coefficients of an existing meter, you must re-select the current meter in the Section for the changes to the ratings to be reflected in the discharge. Only one set of meter coefficients are used per complete section.

The following are the descriptions for the two meter screens:

Meter Settings (Screen 1)

```
         METER SETTINGS
   EDIT METER     1 of 10
 1) Name: PAA11 std2
 2) ID #: 8350
 3) Type: PAA11

 4) Units:          SAE
 5) Revs/Pulses     1/1
 6) Min. Depth      1.50
 7) Max. Depth      0.00
 8) Min. Velocity   0.25
 9) Max. Velocity   8.00

 Select Meter      <- ->

 _____      SAVE      More
```

1) **Name -** Alphanumeric name entered by the user ("PAA11 std2" or enter a custom name like "Joe AA".

2) **ID #** - Usually the serial number of the meter (8350).

3) **Type: PAA11, Pygmy, PAA51, PAAo14, PAAg12, PYGg12, NonStd.**

   The user can select from the list of available meter types or select NonStd. When selecting from the available list of meters all parameters for that meter will automatically setup. When selecting NonStd the user will be required to enter the meter parameters.

4) **Units: SAE or Metric**

5) **Revs/Pulses –** Revolutions versus pulses

6) **Min: Depth** – Enter minimum depth in which this current meter may be used.

7) **Max: Depth** – Enter maximum depth for which this current meter can be used.

8) **Min: Velocity** – Enter minimum velocity for which this current meter can be used.

9) **Max: Velocity** – Enter maximum velocity for which this current meter can be used.

Meter Settings (Screen 2)

The second page of the Meter Settings section is used to enter and review meter coefficients. Each meter can have custom meter coefficients that define the relationship between meter revolutions and the velocity. These coefficients are typically obtained from the current meter manufacturer and can represent from one to three "segments".

Please see the following section "Using Non-Standard Current Meters" for a better explanation meter rating curves and these settings.

```
         METER SETTINGS
   EDIT METER      1 of 10
 1) Name: PAA11 std2
 2) ID #: 8350
 --VELOCITY PROFILE--
 3) Slope  1:    2.2048
 4) Offset 1:    0.0178
 5) Intercept:
 6) Offset 2:
 7) Slope  2:
 8) Intercept:
 9) Slope  3:
 0) Offset 3:


 Back      SAVE    _____
```

1) **Name:** - Alphanumeric name entered by the user (Joe's AA).

2) **ID # :** - Usually the serial number of the meter (8304).

3) **Slope 1:** - Coefficient representing the slope of lowest velocity curve segment

4) **Offset 1:** - Coefficient representing the offset of lowest velocity curve segment

5) **Intercept:** - Crossover point from segment 1 to segment 2

6) **Slope 2:** - Coefficient representing the slope of middle velocity curve segment

7) **Offset 2:** - Coefficient representing the offset of middle velocity curve segment

8) **Intercept:** - Crossover point from segment 2 to segment 3

9) **Slope 3:** - Coefficient representing the slope of highest velocity curve segment

10) **Offset 3:** - Coefficient representing the offset of highest velocity curve segment

Existing Built-in Current Meters:

Meter Descriptions:

- **PAA11 –** The standard USGS type Price AA vertical axis current meter with the USGS standard # 2 rating connected to the 1 to 1 binding post

- **Pygmy -** The standard USGS type Pygmy vertical axis current meter with the USGS standard # 2 rating

- **PAA51 –** The standard USGS type Price AA vertical axis current meter with the USGS standard # 2 rating connected to the 5 to 1 binding post

- **PAAo14 -** The standard USGS type Price AA vertical axis current meter with the USGS standard # 2 rating equipped with a 4 to 1 optical head

- **PAAg12 -** The standard Gurley, USGS type Price AA vertical axis current meter with the USGS standard # 2 rating equipped with a 1 to 2 optical head

- **PYGg12 -** The standard Gurley, USGS type Pygmy vertical axis current meter with the USGS standard # 2 rating equipped with a 1 to 2 optical head

- **NonStd –** User setup required

Using Non-Standard Current Meters including OTT type

The AquaCalc has the current meter rating equations for many standard United States Geological Survey (USGS) meters built in when shipped to the user. The AquaCalc can also accept custom current meter equations for non-standard USGS and European type horizontal axis meters. Most contact type current meters can be used with the AquaCalc if the rating equation is known from calibration tests.

In addition to the built-in current meter rating curves for the Price AA and Pygmy meters, the AquaCalc can store

rating curves for user defined "non-standard" current meters including OTT type meters.

As used by the USGS, meter rating curves are either a single or pair of equations that define the relationship between the number of revolutions per second (counts divided by time) of the current meter cups and the measured velocity. These equations are use to create the meter rating tables used in manual measurements.

STANDARD RATING TABLE NO. FOR AA CURRENT METERS (09)
EQUATION: V = 2.20R + 0.178 (R=revolutions per second)

Seconds	VELOCITY IN FEET PER SECOND Revolutions									Seconds
	3	5	7	10	15	20	25	30	40	
40	0.183	0.293	0.404	0.569	0.845	1.12	1.40	1.67	2.22	40
41	0.179	0.287	0.394	0.556	0.824	1.09	1.36	1.63	2.17	41
42	0.175	0.280	0.385	0.543	0.805	1.07	1.33	1.59	2.12	42
43	0.172	0.274	0.377	0.531	0.787	1.04	1.30	1.56	2.07	43
44	0.168	0.268	0.369	0.519	0.769	1.02	1.27	1.52	2.02	44
45	0.165	0.263	0.361	0.508	0.753	0.998	1.24	1.49	1.98	45
46	0.162	0.257	0.353	0.497	0.737	0.976	1.22	1.46	1.94	46
47	0.159	0.252	0.346	0.487	0.721	0.956	1.19	1.43	1.89	47
48	0.156	0.247	0.339	0.477	0.707	0.936	1.17	1.40	1.86	48

Non-standard current meter ratings can be defined in several segments, one of which is used for lower velocities, the other segments for progressively higher velocities. Each segment is represented by an equation. A crossover or "breakpoint" velocity value is also specified that indicates the velocity at which the next equation is used.

Each equation takes the form:

*y = m * R + b*

where R is the Revolutions per second

or

Velocity = *m* * (revolutions/second) + *b*

Where *m* is the slope of the line and *b* is the value where the line intercepts the *velocity* axis (which in the AquaCalc is identified as the "Offset").

Velocity = *Slope* * (revolutions/second) + *Offset*

The AquaCalc can handle non-standard meter rating curves with up to three line segments representing three velocity ranges. The "Intercept" value in the AquaCalc represents the crossover or breakpoint velocity value at which second (or third) segment is used.

Figure 1: Current Meter Definition in the AquaCalc

revolutions per second
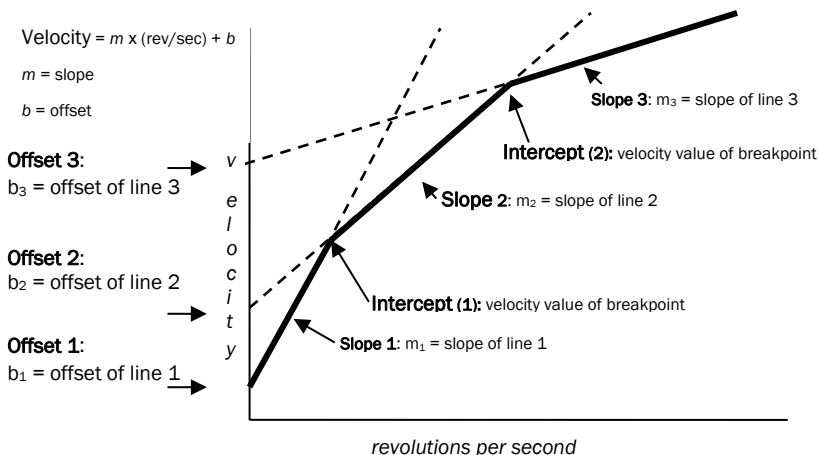
So for a sample Price Type AA Standard No. 1 two segment equation example (This rating is no longer used and has been replaced with new Price Type AA Standard No. 2 below and is included as an example only):

EQUATIONS: V=2.18R + .020(2.200) 2.17R + .030

Note that the value in parenthesis (2.200) represents the velocity above which the second segment is used. The above equation would be entered into the second AquaCalc Meter Settings screen as follows:

```
      METER SETTINGS
   EDIT METER     1 of 10
 1) Name: PAA 2 CUST
 2) ID #: CUSTOM2
 --VELOCITY PROFILE--
 3) Slope  1:    2.1800
 4) Offset 1:    0.0200
 5) Intercept:   2.2000
 6) Offset 2:    0.3000
 7) Slope  2:    2.1700
 8) Intercept:
 9) Slope  3:
 0) Offset 3:


 Back  SAVE      _____
```

A single segment rating curve equation (such as the new Price Type AA Standard No. 2) would be entered in the second Meter Setup screen as:

EQUATION: V = 2.2048R + 0.0178

```
      METER SETTINGS
   EDIT METER     1 of 10
 1) Name: PAA 1 CUST
 2) ID #: CUSTOM1
 --VELOCITY PROFILE--
 3) Slope  1:    2.2048
 4) Offset 1:    0.0178
 5) Intercept:
 6) Offset 2:
 7) Slope  2:
 8) Intercept:
 9) Slope  3:
 0) Offset 3:


 Back  SAVE      _____
```

Step-by-step procedure to add a non-standard current meter

1) From the main menu, select number 4 "Meter Setup"

2) Use the right arrow navigation key to select a new meter to specify.

3) Press number 1 to name this meter

4) Press number 2 to name the meter ID number

5) Press number 3 to select the type of meter "NonStd"

6) Press number 4 to change to metric if required.

7) Press number 5 to change revolutions/pulses

8) Using the '2 of 2' Soft-Key, go to page 2

9) Utilizing keypad number 3 through 0, enter meter constants

10) Press Save

System Preferences

System Preferences screen allows the user to customize the AquaCalc for his or her needs.

1) **Set Time** – Allows the user to change the time of day

2) **Set Date** – Allows the user to change the date

3) **Auto Pwr-off> Off, 5min, 10min, 30min** - Auto Power Off settings determine how long the AquaCalc will wait after not receiving any input or disable Auto-Power Off.

4) **Keypad beep> Yes, No** – User can turn off and on the key audible key click

5) **Meter beep> Yes, No or Meas** - Allows the user to select when the current meter beeps. The AquaCalc can beep each time it senses a "click"

or current meter contact. A setting of "Yes" produces a beep each time the current meter turns and sends a signal When set to "Meas", the AquaCalc will beep only while performing a measurement. When set to "No", the meter beep is turned off.

6) **Lighten Display** – Allows the user to adjust the display contrast. This setting is saved.

7) **Darken Display** – Allows the user to adjust the display contrast. This setting is saved.

8) **Sect.Units> SAE or METRIC** – Set the units for depth, distance, and discharge. The SAE uses "English" units of feet, feet per second and cubic feet per second. The "Metric" setting uses meters, meters per second, and cubic meters per second

9) **AQPro ID** – Set a name for the AquaCalc. The default value is the AquaCalc serial number.

When displaying the System Preferences screen, three new Soft-Keys appear.

There are also three Soft-Keys on this screen **Owner ID, RESET PRO** and **About**.

Restore Default Softkey (System Preferences Screen)

Restore Default returns the settings in the Preferences to their default values.

Reset Pro Softkey (System Preferences Screen)

The **Reset Pro** Soft-Key resets all of the operating systems in the Pro, erases, checks the memory and performs a complete diagnostic test. When pressing this key it must be held down until the key beep quits to be activated. Two more Soft-Keys appear **Yes Continue** and **No Cancel.**

About SoftKey (System Preferences Screen)

The **About** Soft-Key brings up a screen that displays the Serial number of the unit, Firmware version, Company name, phone numbers, and web site URL address.

Increasing Accuracy using the Automated Modes

The AquaCalc can automatically suggest and enter a tag-line distance when you use the automated modes. The distance that the AquaCalc enters can be determined in two different ways:

- **Percent Flow Mode (Recommended)** - Calculates the next vertical distance such that the current sub-section discharge will not exceed the specified maximum percent of total discharge.

- **Calculate Distance Mode** - Calculates the next distance based on the difference between the previous two distances. Useful if you move across the stream in fairly even increments.

Description of Automated Percent Flow Mode

The Percent Flow Mode is a very powerful tool in increasing the accuracy of discharge measurements and the efficiency of the hydrographer. Using this mode a hydrographer can produce more accurate measurements with fewer measurements and in a shorter time.

USGS standards dictate that under normal flow and measurement conditions, an individual sub-section's discharge may not exceed 5% (this percentage can be changed by the user in the AquaCalc).

Using this automated method, you enter an estimated Q based on the current stage and a previously created rating curve or rating table or based on a very recent measurement under very similar conditions. The AquaCalc then monitors your sub-section discharge and

recommends the location of your next vertical, keeping each sub-section discharge below the limits you set.

If a sub-section exceeds the suggested limits, you will be notified. The following concepts are important:

Vertical – A tag-line distance and all of the observations at that tag-line distance**.**

Sub-Section – The area of a stream associated with a vertical. The sub-section width includes a distance halfway to the verticals adjacent to it. The height of the sub-section is the stream depth at the vertical.

Percent Flow in a Sub-Section – The discharge in an individual sub-section, divided by the total stream discharge, expressed as a percentage of the total stream discharge. USGS recommends that under normal conditions no single sub-section contain more than five percent (5%) of the total stream's discharge.

Estimated Total Q – Estimated total stream discharge as determined by the stream's stage and rating curve or observations. (Access: **Section Setup Menu >2 of 2>Estimated Q**)

Adjusted Estimated Q – The total stream discharge used to calculate the percent flow in a subsection. This value is initially set to be equal to the Estimated Total Q entered above and can be changed by the user during a section measurement. (Access**: Section Setup Menu >2 of 2>Adj. Est Q)**

Suggested Tagline Distance – The AquaCalc will suggest the next vertical / tagline distance based on the velocity measured and the depth in the previous vertical / tag-line distance. It will recommend a distance that produces a sub-section area for the previous vertical when multiplied by the velocity will not exceed the specified percent flow (typically 5%). This is all based on an accurate stage/discharge rating or an accurate previous section discharge.

Turning on the Percent Flow Automated Mode

To turn on the Automated Percent Flow Mode you need to perform the following steps:

1) **Select the Percent Q Mode** - In the Vertical Setup Screen **(Measure > Setup > Vertical Setup),** press the 1 key to turn on the Percent Q Mode. The percentage shown will vary based on the Percent Q Limit set below.

2) **Enter a Percent Q Limit** - Enter the discharge-per-subsection upper limit (typically 5% under normal conditions) in the Section Setup screen **Measure > Setup softkey > Section Setup > Pct. Q Limit**

3) Enter an Estimated Q - Enter the estimated discharge based on a rating curve or a previous measurement in the Section Setup screen. **Measure > Setup softkey > Section Setup > 2 of 2 > 5) Estimated Q.**

Using the Percent Flow Mode

After you have completed observations in the first vertical, the AquaCalc will suggest the next tag-line distance by placing a value in the Distance location after you press the **New Vertical** key.

```
   - Measure          * 0.0
 Distance    3        4.00
 Depth                1.00

 Obs Revs    Time     Vel
  2
 =6     91   40.28   2.20=
  8
      Vert.Vel.:    2.20
 Set TSet Rod:      0.00

  H.Angle:  0d      1.00
  Method Coeff:     1.00
 Prev.Vert.   %Q: 5.0
  Meas.            Review
 Options  Setup  Totals
```

Set your current meter at this suggested tag-line location to perform the next measurement and keep the previous

---

vertical/sub-section Q below the percentage you have selected.

Prev. Vert %Q

The third line from the bottom will display the percent of total discharge for the previous vertical/sub-section. If you change the Distance, this percentage will also change. *Remember, the Distance for the next vertical affects the calculated discharge for the previous sub-section panel by changing the width of the previous panel.*

Splitting Sub-section with High Percent Q.

Rapid changes in depth or velocity may cause the AquaCalc to suggest a next vertical distance that is very small or may cause the sub-section Q to exceed the percentage limit. If the distance recommended is unreasonably small, that suggests that the previous panel was too wide, and that you need to insert a vertical before the previous vertical. Simply move back along the tag-line and create a new vertical before the problem vertical problem. The AquaCalc will prompt you to Insert a vertical. Press the **Insert** soft-key to create a vertical back along the tag-line.

Entering an Adjusted Estimated Q (Optional)

The hydrographer may find that a change in stage, an inaccurate rating curve, or a poorly estimated flow results in too many warning flags during the cross-section measurements. Changing the Adjusted Estimated Q value allows the hydrographer work with a different Q while retaining the initial estimated value for the record. This can be set using the following key sequence: **Measure > Setup soft-key > Section Setup > 2 of 2 > 5) Estimated Q.**

Setting the Adjusted Q to zero will turn off the Percent Flow Mode, including all warnings, while preserving the Estimated Q entered at the beginning of the measurement.

Making a Discharge Measurement

This section discusses the steps necessary to perform a discharge measurement with the AquaCalc. These steps include:

- Creating a new section in the AquaCalc

- Setting up the Section for the measuring conditions

- Making Observations

- Reviewing measurements in the AquaCalc

Subsequent sections discuss transferring the completed sections from the AquaCalc to your computer. But first, a little theory.

A Little Theory – The USGS Midsection Method

It is important to understand how a section discharge is calculated in the AquaCalc. The AquaCalc uses the Midsection method that is used by the United States Geological Survey and is well documented in the now out of print Geological Survey Water-Supply Paper 2175 by S. E. Rantz and others titled "Measurement and Computation of Streamflow: Volume 1. Measurement of Stage and Discharge". This document is published on the Internet and can be reviewed at: http://water.usgs.gov/pubs/wsp/wsp2175/

Using this method, a cross-section at the stream is selected at which to measure. A tag-line (basically a tape measure) is stretched perpendicularly across the water from one edge of water to the opposite side. The stream is broken into "sub-sections" by taking velocity

measurements at selected "verticals" in the stream. Several velocity measurements may be taken at different depths in each vertical. Based on USGS standards, no more than five percent (5%) of the total discharge should occur in any sub-section. This is designed to increase the accuracy of the total discharge. Please see the following diagram.

Greater Accuracy in less Time

The AquaCalc has an automated mode which will suggest the proper placement of the current meter to optimize the quality of the discharge measurement with the fewest possible individual observations. See the Chapter titled "Increasing Accuracy Using the Automated Modes".

Figure 2: Sketch of Mid-Section Method (Rantz 1982)
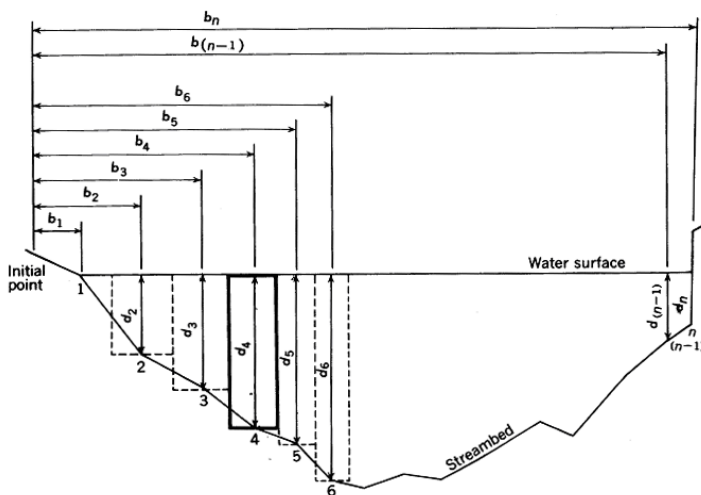
Calculating Discharge

A section discharge is the sum of the discharge in each of the individual subsections associated with each vertical. The sub-section discharge is calculated by multiplying the mean velocity for the vertical times the area of the subsection. The area is determined as the depth of the subsection times its width. The width for a subsection is

determined for a given vertical by taking the distance half-way from the previous vertical to the distance halfway to the next vertical as shown by the below by the bold rectangle indicating the subsection area for vertical number 4.

The following is the sub-section discharge equation for vertical number four:

$$q_4 = v_4 \left[\frac{b_5 - b_3}{2} \right] d_4$$

where

q = subsection discharge

v = mean velocity of vertical

b = distance from initial bank point

d = depth at the vertical.

It is important to note that each subsection assumes an equal depth across the sub-section. Good in-stream practices will place the locations of verticals at locations that minimize either the loss or gain of area: at breaks in the slope of a stream-bed. Also note that there is a "lost triangle" of area at the left of the drawing, just to the right of vertical number 1. It is important when selecting bank side verticals that the discharge in these "lost triangles" be insignificant.

The total discharge for the stream is the sum of the sub-section discharge values.

Calculating the Mean Velocity of a Vertical

The AquaCalc defaults to taking measurements at the six-tenths, two-tenths, and eight-tenths of stream depth locations in a vertical. A measurement taken at the 6-tenths (.6) depth is considered to approximate the mean velocity in the vertical. When a two point measurement is taken at the 2-tenths (.2) and 8-tenths (.8) position, the

average of the measured velocities is used as the mean velocity of the vertical:

$$v = \frac{v_{.2} + v_{.8}}{2}$$

When velocity measurements are taken at the .2 and .6 and .8 positions, the .2 and .8 velocities are averaged, and that velocity is then averaged with the .6 velocity:

$$v = \frac{\dfrac{v_{.2} + v_{.8}}{2} + v_{.6}}{2}$$

Adjusting Observed Velocity with Method and Horizontal Angle Coefficients

The Horizontal Angle and Method Coefficients can be used to adjust the velocity in each observation. They are simple multipliers to the measured observation velocity.

The horizontal angle entry is used to correct for flow conditions that are not perpendicular to the tag line, such as at bridge that angles across a stream. It is entered as a coefficient that corresponds to the angle from perpendicular; The decimal point must be entered.

Angle in degrees	Coefficient
0	1.00
15	0.97
30	0.87
45	0.71
60	0.50
75	0.26
90	0.00

An Angle Coefficient Protractor that can be used in the stream is available from JBS, and is reprinted in the back of this manual.

For example: the Horizontal Angle Coefficient for a flow 30 degrees from perpendicular is equal to 0.87. A measured velocity of 3 fps becomes 2.61 fps when the coefficient is applied:

3 fps x 0.87 = 2.61 fps

To enter a Horizontal Angle coefficient, press the **Period / Horiz Angle** key while in the Measure screen and enter a coefficient. When completed press the Enter key.

The Method Coefficient is used at the discretion of the hydrographer to adjust the velocity of an observation. An example of its use might be at a vertical where it is not possible to place the current meter at the 6 tenths depth due to weed growth. A coefficient might be used to adjust the velocity measured at a point closer to the surface.

To enter a Method coefficient, press the 1 / Method Coeff key while in the Measure screen and enter a coefficient. When completed press the Enter key.

Turning On and Setting up

Turn the AquaCalc On.

Press the **On/Off** key to turn on the AquaCalc (Press and hold the **On/Off** key to turn off the AquaCalc.) The main Menu screen appears.

Create a New Section

There are two ways to create a new section:

1. Select **New Section soft key** from the Main Menu and go directly to the Measure screen. This will create a new section and give it a Section identifier (Gage ID or GID) consisting of the

current date and time. You will be placed in the Measure screen where you can start to measure or you can choose to setup the new section by choosing the "Setup" Soft-Key and then selecting **1) Section Setup** by pressing the **"1"** key. Refer to the *Sections Screen* sub-heading in the *Menus and Screens* chapter for more information on section setup.

or you can create a new section by;

2. Select **2) Sections** from the Main Menu to enter the Sections Menu and create a new section by pressing a number key corresponding to an on screen number with a blank line next to it (the number will blink when selected) and then pressing the **New** Soft-Key. You will be placed in the Section Setup screen Setup the section. Refer to the *Sections Screen* sub-heading in the *Menus and Screens* chapter for more information on section setup.

```
     Sections 1 – 10

SID: 09/30/10 14:02:00
1) SAMPLE NEW SECTION
2)
3)
4)
4)
6)
7)
8)
9)
0
   Select Section

 1-10  11-20  21-30
```

After setting up the section, you will be placed in the Measure screen with the first vertical defined as Water Edge.

Vertical Setup

1. Choice of subsection panel width calculated by five percent (5%) Q method, Based on the previous width or Manual entry.

2. The Pro can also be setup to copy the depth, Method Coefficient, and Horizontal angle.

In the Measure Screen

After setting up a section, press the **Esc** key to return to the Measure screen.

```
- Measure     * 3.3
Distance 1       0.00
Depth            0.00

Obs Time Revs    Vel

Water Edge




 Meas.           Review
Options  Setup   Totals
```

The Display will now show Water Edge in the center of the display.

1) Connect your wading rod and current meter up the AquaCalc using the provided cable.

2) Enter a tag line distance for the Water Edge by pressing the **Distance/3** key and entering a number using the numeric keypad and then pressing the **Enter** key. A measurement may not be performed at the Water Edge.

3) In the stream, move to the next tag line distance where you wish to perform a measurement.

4) Press the **New Vertical** key on the AquaCalc to move to the next vertical.

```
-Measure      * 3.3
Distance 2       2.00
Depth            0.50

Obs Time Revs      Vel
 2
=6   0.00   0    0.75
 8
   Vert. Vel.:    0.75
Set TSet Rod:     0.50

H. Angle:   0d   1.00
Method Coeff:    1.00
Prev.Vert. %Q: 4.0
 Meas.           Review
Options  Setup   Totals
```

5) Enter the tag line distance as requested followed by the **Enter** key.

6) Press the **Stream Depth/6** key and enter a depth for the stream, pressing the Enter key to complete the entry.

7) Select Observation Depth (.2 .6 .8) using the **Up** and **Down** arrow keys, noticing that the active line changes (identified by the equal signs in each margin).

8) Notice that the "Set Tset Rod:" line changes as different observation depths are chosen.

9) Press the **Measure** key to begin measuring, press the **Halt** Soft-key to stop a measurement before the time is complete and record a partial measurement. Press the **Esc** key or the **Abort** Soft-Key to cancel the measurement and not record a measurement.

10) Enter Horizontal Angle, Method Coefficient, and any other items that are necessary to define the conditions at the vertical by pressing the appropriate keys on the numeric keypad.

11) Select a new Observation Depth in the existing Vertical if desired by using the scroll keys, and perform another measurement. All observation velocities must be either a single point, two point, or three point. All other combinations are illegal and the vertical velocity will equal zero.

12) When all of the measurements are complete in the Vertical, press the "Next Vertical" key.

13) Notice that if an estimated Q was entered then the bottom reversed line (darkened line) will display the previous verticals percent of total Q "Prev.Vert. %Q: 4.0".

14) Enter a Distance and a Stream Depth for the new vertical.

15) Perform a measurement in the new vertical.

16) Continue across the stream until finished.

17) When the section is complete, Mark the last vertical as the edge of water by pressing the **Edge/0** key.

18) Use the **Display Total** Soft-Key to review the Section summary.

Aborting a Measurement

To abort a measurement prior to the normal elapsed time interval and not record a velocity, press the **Abort** Soft-Key. This will cancel the timer and the counter and display the previous values or zero.

Halting a Measurement

Halting a measurement stops the clock and records the time, count and calculates the velocity up to that point without making a complete measurement. To stop a measurement prior to the normal elapsed time interval, press the **Halt** Soft-Key. This will stop the time and the

count and display the meter revolutions count values when it was halted.

Performing a Measurement from a Bridge or Cableway

Performing a cable or suspended measurement in the AquaCalc is similar to performing one with a wading rod with these exceptions.

1. You must select the appropriate suspension method from the Section Setup 5) "Equip: TopSet Rod/Susp.Cable/Sect. Rod" toggle option in the Section Setup menu found by selecting **Setup > 1) Section Setup > 5) Equip: Susp.Cable** Line **6) Sounding Weight** will appear allowing you to toggle through standard weight and hanger bar combinations. Hit the Enter key when completed.

2. When setting the Stream depth you will be prompted to: "Zero the reel with the centerline of the meter cups at the water surface and lower the sounding weight to the bottom" and then " Enter the reading into the AquaCalc as read directly from the reel, Do not add the remainder as the AquaCalc will do it for you". The AquaCalc will suggest a setting for the reel for the selected observation. Enter these values and measure.

Proceed with the section as above, setting the reel as recommended at each vertical.

Use Halt During Floods
Suspended measurements from a bridge or cableway are often used during flood and high flow situations. In fast moving currents with debris in the stream, use the "Halt" Softkey in the Measure Screen to stop an observation and record the velocity measured up to that point.

The use of flood coefficients to perform measurements at the .2 depth only, can speed your measurement in critical

flows. Please see the "Performing Flood Measurements" section in this chapter for more information on using an AquaCalc during flood measurements.

Erratic Flow Reset

The AquaCalc will restart the count and the measurement time if the time between "clicks" becomes erratic, either too fast or too slow. This condition in most cases is generally caused by a bad connection or an improperly adjusted current meter. If it is found that the Instantaneous velocity indicator in the upper right area of the display indicates that the AquaCalc is counting but yet no counts appear in the display after a few revolutions, two problems could exist:

You could be measuring in an illegal vertical (the first water's edge vertical will not let you measure),

Or, the AquaCalc could have come out of sync, just Abort the measurement using the **Abort** Soft Key and start over.

Remember the cups must spin prior to pressing the Measure key.

Using the Ice Draft Mode

The AquaCalc has an Ice Draft Mode that helps when performing measurements in streams having a layer of ice on the water. This mode allows you to enter the ice draft in feet or tenths of a foot, and the total depth of the water.
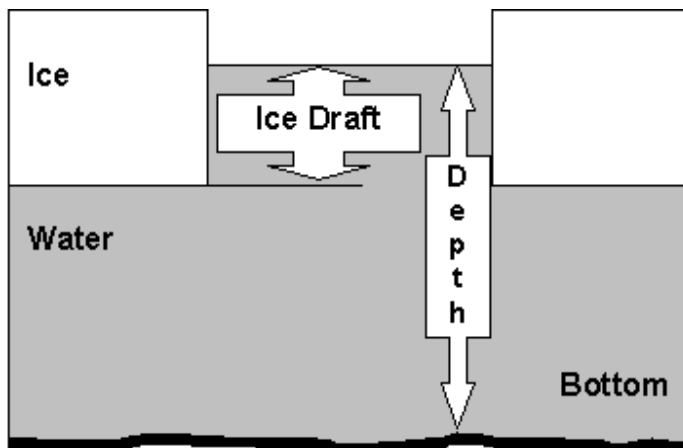
The ice draft is the distance from the bottom of the ice to the surface of the water. The AquaCalc will subtract the ice draft from the total water depth when calculating the discharge.

The Ice Draft Mode is turned on in the Section Menu which is accessible from either the Main Menu or in the Measure Screen using the Setup soft-key followed by the 1) Section Setup Key.

Toggle the Ice Draft Mode on using the **7) Ice Draft** key and return to the Measure screen by pressing the Measure key. A third line is now visible at the top of the screen identifying the Ice Draft entry location. While in the Measure screen, press the **2/Ice** key to enter the Ice Draft.

When using a topset rod, the AquaCalc will suggest the proper rod setting meter placement.

Recommended Depth Setting for Ice Measurements and Sectional Rods

When using a sectional rod, *the suggested depth is the distance up from the bottom*. If you are using a sectional rod, and measuring from the top down, you must

calculate the depth placement of the current meter manually.

Adjusting Ice Measurements with Coefficients

Because of the roughness of the underside of ice cover, ice measurements have a different velocity profile than those in open water.

Ice measurements are discussed in the Geological Survey Water-Supply Paper 2175 by S. E. Rantz and others titled <u>"Measurement and Computation of Streamflow: Volume 1. Measurement of Stage and Discharge".</u> The Water Supply Papers on page 155 recommend that:

> *"...two vertical velocity curves be defined when ice measurements are made to determine whether any coefficients are necessary to convert the velocity obtained by the 0.2 and 0.8 depth method, or by the 0.6-depth method, to the mean velocity. Normally the average of the velocities obtained by the 0.2- and -.8-depth method gives the mean velocity, but a coefficient of about 0.92 usually is applicable to the velocity obtained by the 0.6-depth method."*

Figure 3: Typical Vertical Velocity Curve Under Ice Cover (Rantz 1982)
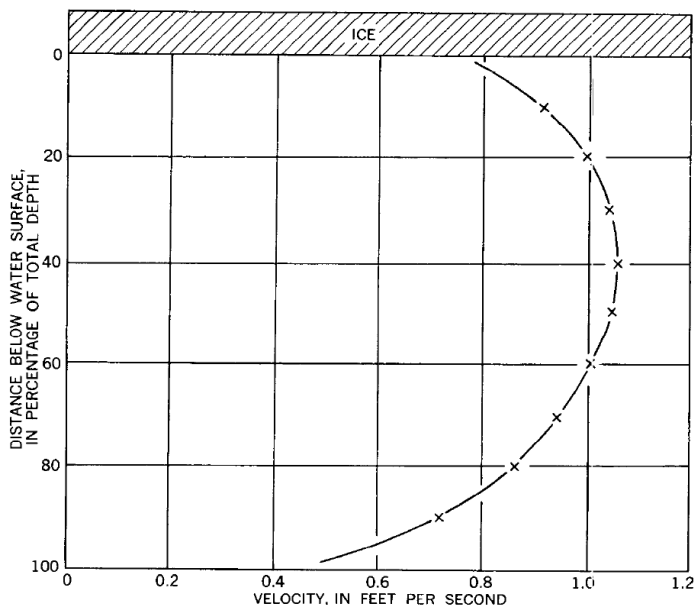
FIGURE 95.—Typical vertical-velocity curve under ice cover.

While recommending that velocity curves be defined before being applied, the factor of 0.92 is suggested as a applicable for 0.6-depth measurements where a velocity profile is not performed. No coefficient is recommended for 0.2 -0.8 averaged velocity measurements.

Using the Method Coefficient to enter the 0.92 Ice Coefficient Automatically.

This typical 0.92 coefficient can be entered as a Method Coefficient and the Copy Method Coefficient option (Measure Screen > Setup softkey > 2) Vertical Setup > 5) Copy Meth. Coef) will copy the same coefficient to each new vertical. Just be sure to only apply the coefficient to 0.6 depth measurements. Set the coefficient to 1.00 for 0.2-0.8 velocity averaged verticals.

A method coefficient is used for just such circumstances as these; the measured velocity in a vertical needs to be adjusted for some reason. Adjusting for velocity profile changes due to weed growth might be another use of the Method Coefficient.

Performing Wall Measurements

When measuring near a vertical surface or wall, a **Wall Coefficient** must be used to compensate for the inability to measure the velocity at the wall. The velocity at the wall will be less than the velocity in the adjacent vertical sub-section.

The following is an excerpt from the Water Supply Papers, please refer to Figure 2: Sketch of Mid-Section Method (Rantz 1982)[1]:

> "When the cross-section boundary is a vertical line at the edge of the water as at vertical n, the depth is not zero and velocity at the end vertical may or may not be zero. The formula for q, or q,t is used whenever there is water only on one side of an observation vertical such as at piers, abutments, and islands. It is necessary to estimate the velocity at an end vertical, usually as some percentage of the adjacent vertical, because it is impossible to measure the velocity accurately with the current meter close to a boundary. There is also the possibility of damage to the equipment if the flow is turbulent. Laboratory data suggest that the mean vertical velocity in the vicinity of a smooth sidewall of a rectangular channel can be related to the mean vertical velocity at a distance from the wall equal to the depth. The tabulation below gives values that define the relation."

[1] This is an excerpt from: Rantz, Measurement and Computation of Stream Flow , Chapter 5.

Distance from wall, as a ratio of the depth	Mean vertical velocity, as related to V_D
0.00	0.65V
.25	.90V
.50	.95V
1.00	1.00V

NOTE-V IS the mean vertical velocity at a distance from the vertical wall equal to the depth.

How To: Making a Wall Measurement

When making a Wall measurement, you do not measure with the current meter directly at the wall. Measure *near the wall* and use the Wall Coefficient to estimate the velocity *at the wall* based on the nearest velocity measurements.

For a wall in your first vertical:

1. Press "**New Section**" soft key at the **Main Menu** to create a new section and open the **Measure Screen**
2. Enter a **Distance** and a **Stream Depth** at the wall
3. Press the **Wall Coeff (8)** key and enter a wall coefficient value
4. Press **New Vertical** key and enter a tag line **Distance** and **Stream Depth** where you will perform your first velocity measurement with the current meter.

For a wall in your last vertical:

1. Perform a velocity measurement at a vertical near the wall
2. Press **New Vertical** to create a new vertical at the wall
3. Enter a **Distance** and a **Stream Depth** at the wall
4. Press the **Wall Coeff (8)** key and enter a wall coefficient value.

Performing Flood Measurements

The Two-Tenths method is often used during flood measurements due to the speed needed during flood events and the difficulty and danger in placing measurement equipment at greater depths.
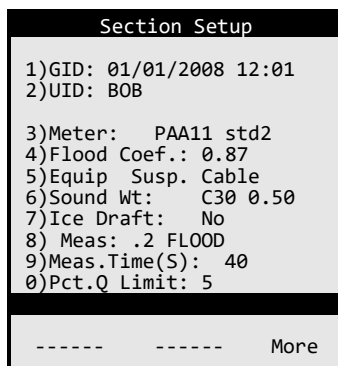
In the AquaCalc, a section can be set up to take observations only at the .2 location, and the velocities adjusted using a Flood Coefficient.

Using the 0.2 Flood Measurement Method

During flood conditions, observations are often made at only the 0.2 observation depth and a coefficient is applied to each velocity observation in the section that convert the 0.2-depth observations to a mean flow.

The AquaCalc has a special setup that can be used in flood conditions where only a 0.2 measurement is desired. A global Flood Coefficient is applied to each measured velocity prior to the calculation of discharge. Please see the next section for discussion of the proper selection and use of Flood Coefficients.

1. In the Measure Screen select the **Setup** Soft-Key and then select **1) Section Setup**. This will open the Section Setup screen.

```
        Section Setup

1)GID: 01/01/2008 12:01
2)UID: BOB

3)Meter:   PAA11 std2
4)Flood Coef.: 0.87
5)Equip  Susp. Cable
6)Sound Wt:    C30 0.50
7)Ice Draft:   No
8) Meas: .2 FLOOD
9)Meas.Time(S):   40
0)Pct.Q Limit: 5


  ------    ------    More
```

2. Press the **8** key until "8) Meas.: .2 FLOOD" shows.
3. Press the **4** key "4) Flood Coef:" and enter the Flood Coefficient.
4. Make all of your observations in the Measure screen in the .2 depth position.

The resulting calculated vertical velocities will all be adjusted by the Flood Coefficient.

Adjusting a single vertical using a coefficient

Proper use of Flood Coefficients[2]

The following excerpt from: Measurement and Computation of Stream Flow , by S.E. Rantz, et. al. ,Chapter 5. *discusses the proper application of flood coefficients.*

"In the 0.2-depth method the velocity is observed at 0.2 of the depth below the surface and a coefficient is applied to the observed velocity to obtain the mean in the vertical. The method is principally used for measuring flows of such high velocity that it is not possible to obtain depth soundings or to position the meter at the 0.8- or 0.6-depth.

A standard cross section or a general knowledge of the cross section at a site is used to compute the 0.2-depth when it is impossible to obtain soundings. A sizable error in an assumed 0.2-depth is not critical in the determination of velocity because the slope of the vertical-velocity curve at this point is usually nearly vertical. (See fig. 5.4.) The 0.2-depth is also used in conjunction with the sonic sounder for flood measurements.

The measurement made by the 0.2-depth method is normally computed by using the 0.2-depth velocity observations without coefficients, as though each observation were a mean in the vertical. The approximate discharge thus obtained divided by the area of the measuring section gives the weighted mean value of the 0.2-depth velocity. Studies of many measurements made by

---

[2] This sub-section is an excerpt from: Rantz, Measurement and Computation of Stream Flow , Chapter 5.

the two-point method show that for a given measuring section the relation between the mean 0.2-depth velocity and the true mean velocity either remains constant or varies uniformly with stage. In either circumstance, this relation may be determined for a particular 0.2-depth measurement by recomputing measurements made at the site by the two-point method using only the 0.2-depth velocity observation as the mean in the vertical. The plotting of the true mean velocity versus the mean 0.2-depth velocity for each measurement will give a velocity-relation curve for use in adjusting the mean velocity for measurements made by the 0.2-depth method.

If at a site too few measurements have been made by the two-point method to establish a velocity-relation curve, vertical-velocity curves are needed to establish a relation between the mean velocity and the 0.2-depth velocity. The usual coefficient to adjust the 0.2-depth velocity to the mean velocity is about 0.87. (See table 2.)

The 0.2-depth method is not as reliable as either the two-point method or the 0.6-depth method when conditions are equally favorable for a current-meter measurement by any of the three methods"

Typical Vertical Velocity Curve
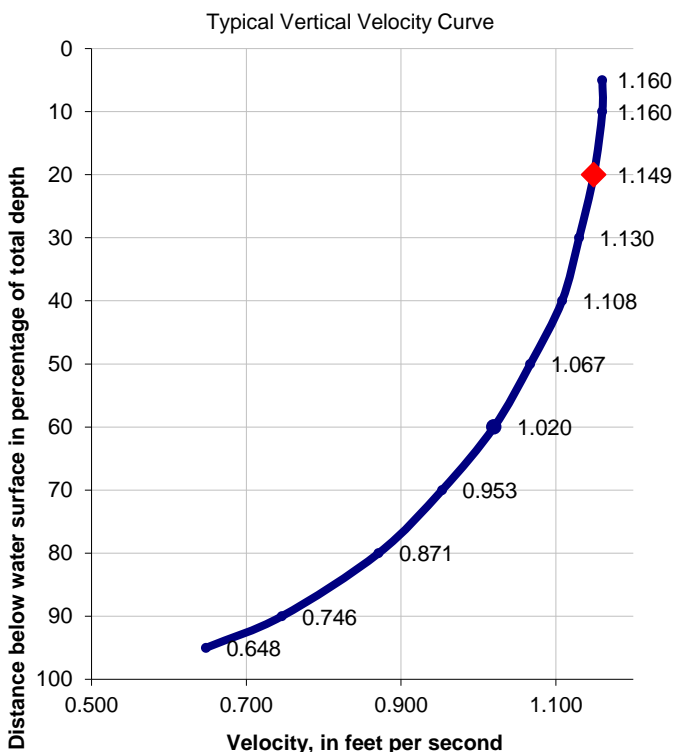
For the profile presented in the above figure, the 0.2 Flood coefficient would be

0.2 Flood Coefficient = 1 / 1.149 = **0.87**.

Reviewing a Measurement in the AquaCalc

The AquaCalc's larger screen and improved on-screen reports and output format make it easier to review data in the field, either viewing the measurement in the AquaCalc or by viewing the output file using a laptop computer.

The Pro has several methods for reviewing measurements. To use these features it is best to have entered an estimated discharge based on the stage and station rating curve. As with the previous versions,

reviewing the total discharge and the final mean velocity serves as a good first check: Are they reasonable? If not, check for entry errors by reviewing each vertical. This is easy with the Pro, as all measurements in a vertical are displayed at once, along with the velocity for each observation.

There are three levels of summary detail that can be used for review:

1. Measurement screen

2. Vertical Totals screen

3. Section Totals screen

Measurement Screen

At the bottom of the measurement screen, the AquaCalc displays the percent of total discharge (%Q) for the previous vertical's sub-section. Scroll through the verticals using the left and right arrow keys, and note the reasonableness and consistency of these values.

Vertical Totals

Pressing the **Review Totals** soft-key while in the measure screen, will display a Vertical Totals screen showing Area and the vertical's discharge. You may also use the left and right arrows in this screen to scroll between verticals.

Section Totals

Pressing the **Section Totals** key in The Vertical Totals Screen will display summary statistics for the entire section including the percent difference in the discharge as estimated from the rating curve and the measured discharge, plus the mean velocity and area.

Transferring and Viewing Measurements on a Computer

The AquaCalc can transfer completed sections to a computer for review, storage, and printing. To transfer data to a computer you will need to use the supplied DataLink software and the AquaCalc download cable. The resulting file is formatted in a readable comma-separated-value (CSV) format that can be opened in most word-processing and spreadsheet programs.

The AquaCalc data can also be uploaded to a PC by using any commercially available communications package such as the HyperTerminal program that comes with Windows.

Three types of connections between the computer and the AquaCalc are possible: USB (the cable is included) an optional RS232 Cable, and through the optional Bluetooth module.

Transfer using a USB Connection

To transfer data using the USB connection, you must first install the AquaCalc USB drivers supplied with your AquaCalc then connect the AquaCalc using the USB cable.

Installing the USB Drivers

Run the "AquaCalc Pro Plus USB Driver Setup.exe" program and follow the on-screen instructions. . The AquaCalc Pro Plus USB drivers are also available from our website at www.aquacalc.com. Use the site search function to search for "USB drivers"

Connect the USB cable

Using the supplied USB to mini-USB cable, remove the blue cover on the AquaCalc to expose the mini USB connection. Connect the small end of the USB cable to the AquaCalc and the large end into a USB slot on your computer. Connecting

USB
Connection

Meter and
Serial
Connection
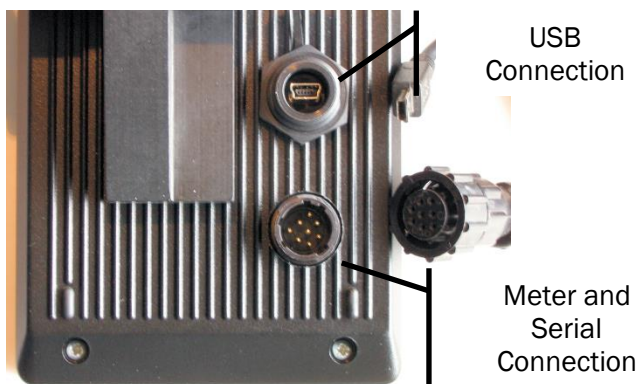
Use DataLink to download measurements.

Using DataLink to Download Measurements

The following describes the AquaCalc DataLink software. For more complete information, please see the help file in DataLink.

To use DataLink to download data from the AquaCalc:

1) Install the AquaCalc Pro Plus USB Drivers as discussed above.

2) Install the AquaCalc DataLink software provided. The DataLink program can be obtained from the AquaCalc website at www.aquacalc.com.

Note: Other serial communications packages such as HyperTerminal (which comes with Microsoft Windows™) can also be used to download a section from the AquaCalc to your computer.

3) Connect the AquaCalc Pro Plus to the USB port of your computer using the provided data cable.

4) Turn on the AquaCalc and press "3) Connections" at the Main Menu to go to the Connections Screen:

```
- Connections
SID: BLUE RIVER
Date:  02/25/11
Vert. 25  Q:   694
< Prev    2    Next >
1) Manual Download
2) Baud Rate:  19200
3) Connection: USB


  Connection Status


```

Active Section Information Area includes the number of verticals and total discharge.

Connection Settings

Displays information on the status of the connection

Soft-Key Labels Area

The AquaCalc Pro Plus must be in the Connections screen to communicate with DataLink.

5) Start the DataLink program.
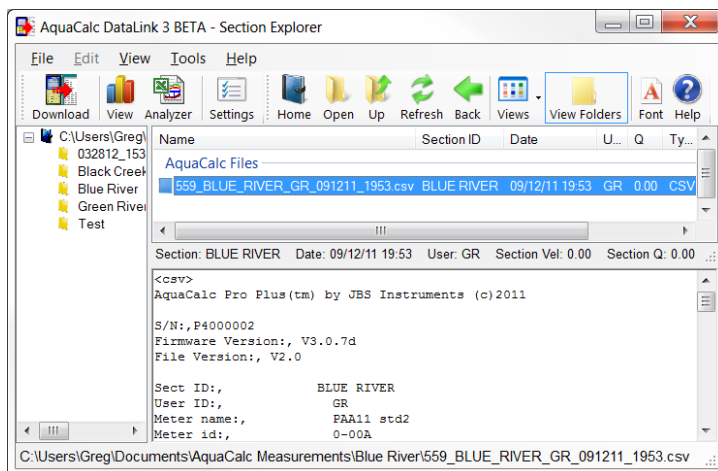
6) Click the Settings button to bring up the Settings dialog box.
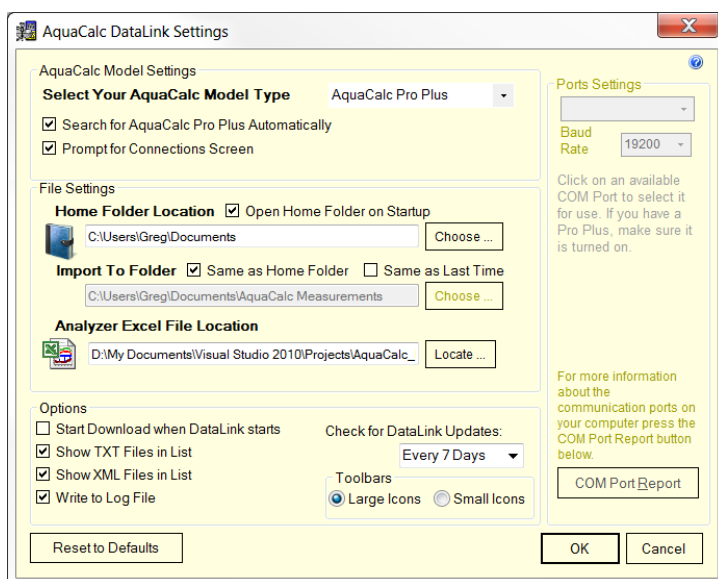
7) Select the "AquaCalc Pro Plus" from the AquaCalc Model drop-down list. Click the OK button to close the Settings window.

8) Select the Download button from the tool bar in DataLink main window. The Download Section Measurements dialog window will appear and DataLink will begin to look for your AquaCalc. Once found, DataLink will get a list of sections from the AquaCalc Pro Plus and display it:
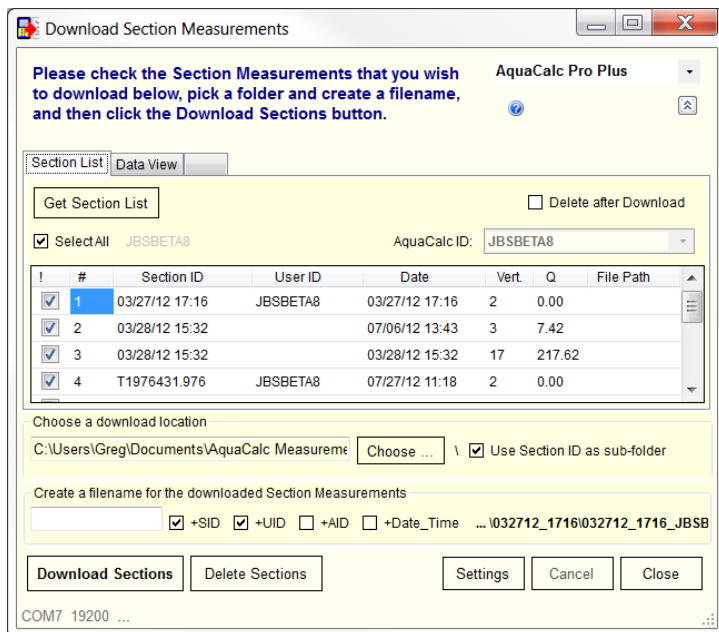
9) Check the Sections that you wish to download and click the "Download" button.

If you do not see information appear in the DataLink screen check your connections and the setting for the communications port and the baud rate in both the AquaCalc and DataLink. The default baud rate for the AquaCalc Pro Plus is 19200. For use with DataLink and automated downloading, set the AquaCalc to:
"**2) Baud Rate: 19200**" and
"**3) Connection: USB**"

Using Other Programs to Download the AquaCalc

The AquaCalc can be downloaded using a terminal emulator type program designed to work with serial data. Windows XP includes a terminal program called Hyperterminal that can be used to download measurements when you do not have the DataLink program. On other platforms and operating systems (Windows Mobile, Android, etc.) other terminal emulator software programs can be used in the same way. The most critical step is to insure that both the AquaCalc and the terminal software are using the same communication settings. The following example uses Hyperterminal on a Windows PC.

HyperTerminal Settings

1. Select Run from the Windows Start Menu. Type in "hypertrm" and press the Enter key. This will start Hyperterminal.

2. Select a name and icon for the upload settings, such as "AquaCalc"

3. Press ENTER

4. Select O.K.

5. At the Phone Number menu, go to Connect Using and select one of the following: Direct to Com 1, Direct to Com 2, Direct to Com 3 or Direct to Com 4.

6. Select O.K.

Transferring Data

1. At the Port Settings screen specify the following:
   Bits per sec (Baud Rate) = 9600
   Data bits = 8
   Parity = None
   Stop bits = 1
   Flow control = None
2. Select O.K.

Transfer Information

On The PC

1. Select Transfer from the pull down windows area,

2. Specify Capture Text

3. In the Capture Text window specify the file and folder location to store the uploaded data. For example C:\Files\Sacramento River\I Street Bridge\T1 06-06-96.txt.

4. Press Start.

On The AquaCalc

1. Connect the USB cable to the AquaCalc and to your computer.

2. Turn the AquaCalc on by pressing the On/Off key.

3. At the Main menu, press **3) Connections**

4. Press the **3) Baud Rate** key until the 9600 setting appears. See the previous headings for the proper settings for the AquaCalc.

5. Press the **1) Manual Download** key from the Connection menu to download the current section.

Viewing and Printing Sections in DataLink

After downloading, section measurements can be viewed and printed using DataLink and the AquaCalc Pro Analyzer Excel file. Please review the help files in DataLink for more information.

Viewing Section Measurements in DataLink

After downloading, a section, you can select the measurement in the main DataLink Window and select the View toolbar icon (or simply double-click on a measurement) to view the file.
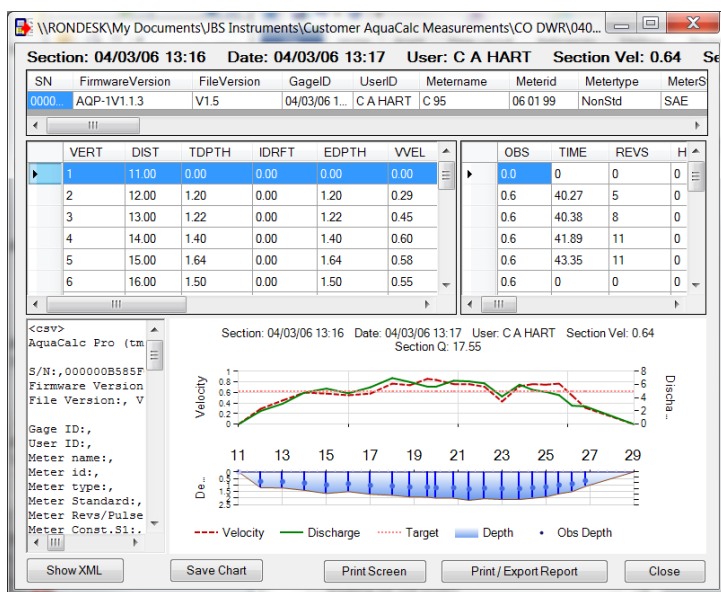
Printing a Report

Right click on a section measurement in the main explorer window and select "Print / Export Report" to view and print a report.
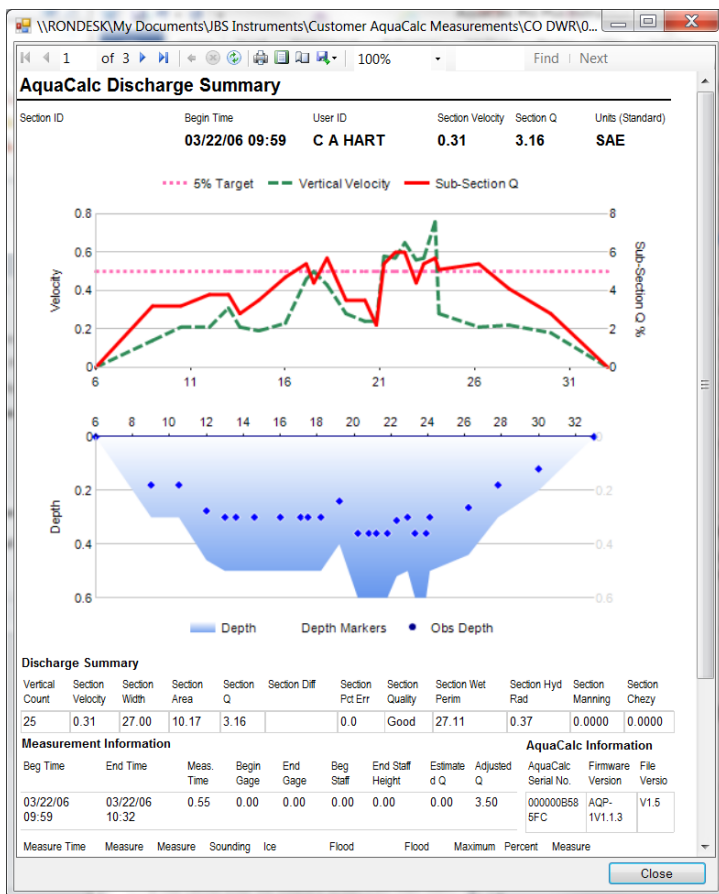
Please see the Help files in DataLink for more information on using DataLink.

Troubleshooting

If you have problems with your AquaCalc, we encourage you to contact us at AquaCalc LLC. The following section may help with more common problems.

Special Problems with the AquaCalc Pro

Uneven number of Edge of Water measurements - It is possible to enter an uneven number of Edges in the AquaCalc Pro Plus. An uneven number of edges results in the improper application of wall coefficients. When working with bridge piers and braided streams check for this problem.

Wrong Meter Constants - Be careful when editing meters and changing meter ratings. It is possible to have a meter that has a name of "PAA11 std2" (the default Price AA 1:1 name) and have specified a meter type of "PYGMY". This will cause the wrong meter constants to be used.

If You Cannot Enter the Measure screen from Main Menu:

The AquaCalc can store a maximum of 30 sections. Each time you turn on the AquaCalc, and immediately press the Measure key, the AquaCalc creates a new measurement with the current date and time as the Section Identifier (or GID for "Gage Identifier). This can rapidly fill up the 30 available section spaces with empty sections. Use the "Reopen Last" Soft-Key in the Main Menu to open the last section that was viewed, and use the Delete Soft-Key in the Section menu to delete old sections.

Turbulent Flow Resetting

The AquaCalc and its operating system firmware were designed not miss a click or double count a click. This makes the AquaCalc robust in its ability to count signals generated by various current meters. These signals are commonly called "clicks" when heard through headphones.

During counting, the AquaCalc looks for patterns in the clicks and determines a "window" of time in which it expects the next click to appear. When the AquaCalc senses a click that it believes is not a valid signal (most often a click that has occurred outside the "window": too soon before or too long after the previous click), it warns the user and then "resets" the measurement time and counter to zero and begins counting again.

The "reset" function of the AquaCalc was originally designed to sense turbulent flow conditions in surging streams (which the USGS qualifies as a poor measurement) and inform the user. The AquaCalc recognizes a bad, missing or rejected signal and then to allow the user to take corrective actions to insure a quality measurement.

There are varying conditions that can cause an AquaCalc to reset during a measurement:

- highly turbulent flow (a valid reset condition),

- broken, loose or corroded connections,

- worn bushings, pivot pins, or cup-bearings,

- a dirty or oily cam lobe and whisker, or

- a poorly adjusted cat whisker.

Any one of the above conditions will cause the AquaCalc to reset during a measurement.

> Note: There is a small probability that the above problems can produce multiple clicks per revolution. If these false clicks are spaced at regular intervals in time, the AquaCalc could very well count them for the full 40 seconds and yield an erroneous velocity measurement.

Identifying the Problem

During the investigation into the customer complaints, it was often found that poorly adjusted or maintained measurement equipment was the problem. (In fact, often technicians using the same equipment with head-sets were also getting false counts, but not realizing it.)

Given the greater difficulty in properly adjusting the Pygmy meter, these points are more particular to the Pygmy meter than the Price AA but can affect both.

Bad or Poorly Adjusted Cat Whisker contacts

The cam and cat whisker contacts must be cleaned daily before or after usage. Oil and carbon build-up on the whisker and cam lobe increases the resistance in the electrical circuit, causing a week signal that the AquaCalc will reject. This rejection of signal was built into the AquaCalc to filter out false signals generated by the wading rod and terminal connectors on the sounding cable when submerged in highly conductive water. The wading rod and current meter acts as a capacitor and, depending upon the conductivity of the water, the signal strength can vary greatly.

The USGS has published standards for maintenance for current meters in OFFICE OF SURFACE WATER TECHNICAL MEMORANDUM NO. 99.06 available from the USGS website.

Pygmy Meter Spin Test

An incorrectly adjusted Pygmy meter whisker can lead to the rapid buildup of carbon deposits in the contact chamber, degrading the electrical signal. We have found

---

that a spin test of 60 seconds +/- 5 seconds will provide the correct amount of tension between the whisker and the cam lobe to generate a strong enough signal for the AquaCalc.

Spin test times less than those recommended above will work, but over time they increase carbon deposits on the whisker and cam lobe, thereby increasing the electrical resistance in decreasing the signal strength.

The increased tension on the cat whisker keeps the contact cleaner for longer periods of time by burnishing the cam lobe and whisker hair against each other. Slow velocities (2 to 3 counts in 40 seconds) with a large dwell angle of contact between the cat whisker and the cam, cause arching for longer periods, and tend to cause the buildup of carbon faster than during normal velocities.

Poor Electrical Contacts

All electrical contacts should be inspected and cleaned on a routine basis. Areas that have been known to fail are:

- spade connectors loose or not soldered,

- corrosion build up where the wire attaches to the bottom of the wading rod,

- loose connections where the rod attaches to the bottom of the wading rod,

- loose bayonet connections,

- corroded bayonet connections,

- corroded AquaCalc connectors and

- broken wires.

- worn and out of tolerance bushings and bearing surfaces:

A badly worn upper bushing will allow the bucket wheel assembly to wobble. If the cam lobe wobbles when in

contact with the cat whisker, the AquaCalc could detect multiple clicks and reset.

A bad pivot pin can allow the bucket wheel to move vertically up and down producing false counts, which will cause the AquaCalc to reject the signal and reset the measurement.

Wading Rod Problems

If you have problems with the AquaCalc restarting / resetting a measurement, and you do not feel that you are in a turbulent flow condition, chances are that there is a problem in getting a good signal from the current meter to the AquaCalc. Please check the following connections:

- Loose or poorly installed AquaCalc Rod bracket
- Loose phone jack
- Loose Pigtail screw and connectors
- Internal shorting or corrosion

Problems with Suspension Equipment

It is more frequent to have problems with connections in suspended measurements due to the condition of most bridge cranes and sounding reels. Check the following for

- Corroded slip rings and dirty brushes
- Loose connectors
- Isolated B reel connector
- Loose terminal connector

Diagnostics Screen

The AquaCalc has a diagnostics screen that allows the user a fast and easy method to insure that the AquaCalc's main hardware components are functioning properly.

You may access the Diagnostics screen by first turning off the AquaCalc and then holding down the **Enter** key, and at the same time pressing the **On/Off** key. When the display flashes, release the **Enter** key. The Diagnostics screen will appear.

```
AOPRO Plus Diagnostics
SN: XXXXXXXXXXXX
RTC 17:50:34 01/14/11
CPU    00:32:55
   INTERNAL H/W TESTS
 SRAM P_FL D_FL UART
 Pass Pass Pass USB
I/O 00 00 00 00 00 01
   FIRMWARE VERSION
  CPU: 11/07/10 09:53
F/W:   V2.0.0
BOOT: 11/07/10 08:03
VERS: 1.8.6
        LOAD PROGRAM
REBOOT  Start
        Update
```

Serial Number

Real Time Clock Date and Time
CPU Clock Time since turned on

Ram memory, Program Flash memory, Data Flash memory, Pass or Fail status. Type of connection.

Firmware date and time stamps for both the CPU and Boot firmware.

Soft-Key Labels for rebooting and loading flash

Upgrading the AquaCalc firmware

When you received your AquaCalc it contained the latest firmware version. As JBS continues to improve the AquaCalc, we will make firmware updates available to our customers. To obtain updates please contact JBS Instruments. Updates can also be obtained from our website at www.aquacalc.com. Look for the AquaCalc Pro Plus Downloads location.

Please refer to the instructions on the website or those that come with the Updater. The basic steps are as follows:

1. Copy all data from the AquaCalc to your computer using the DataLink program.

    WARNING: All Sections and observations in the AquaCalc may be lost when updating the firmware!

2. Install the DataLink software by contacting JBS or downloading it from the JBS website at www.jbsenergy.com.

3. Select "Update AquaCalc Firmware" in Tools menu on DataLink.

4. Connect the AquaCalc to your computer using the USB cable provided with your AquaCalc.

5. Follow the on-screen directions in the Updater wizard.

Appendix

Good site selection, techniques and equipment maintenance makes for good discharge measurements. This Appendix contains extracts and notes to help you perform better discharge measurements using the AquaCalc.

Factors Affecting the Accuracy of Discharge Measurements

1. Equipment must be properly assembled and maintained. Spin tests before and after each measurement provides a good indication of the condition of the equipment.

2. Selection of an appropriate discharge measurement cross-section.

3. Selection and number of observation verticals in a measurement can affect the accuracy of a measurement. A rule of thumb is to have from 25 to 30 verticals in a cross-section and spaced so that each subsection will have an approximate equal discharge usually less than five percent (5%) of the total flow.

4. Rapidly changing stage loses the significance of the value when compared to the calculated discharge, requiring a weighted mean stage to be calculated. Other methods of minimizing stage error include:

    a. shorten the time it takes to make the measurement, change the count time to 20 seconds,

    b. do a flood measurement and make all observation 2 tenths or some distance from

the surface and apply an appropriate coefficient to adjust the velocity to the 6 tenths mean value.

5. Inaccuracies of depth and velocity most often occur when sounding deep streams and rivers. The weight should be of sufficient size that the weight and meter hang straight down and are not carried downstream by the force of the velocity. A weight of insufficient size will artificially increase the depth therefore increasing the area overstating the total discharge. Velocities not perpendicular to the measurement section tag line can also cause an erroneous total discharge. The cosine of the horizontal angle the meter makes with the perpendicular must be measured and applied to the velocity in that vertical. When sounding deep rivers with limited visibility the surface horizontal angle must be used for all observation in the vertical. This is an assumption that the angle at the surface is the same thru ought the entire depth and therefore could be erroneous.

6. Measuring in icy conditions and freezing temperatures. Slush ice will cause erroneous results by affecting the bearings, contact chamber and bucket wheel assembly. Avoid measuring in slush ice conditions if at all possible. Freezing temperatures can also cause ice buildup on the current meter affecting its performance characteristics. When measuring in freezing conditions once the current meter is submerged it should not be taken out of the water until the measurement is complete. This will require the hydrographer to tag his sounding cable a known distance from the bottom of the weight so that the depth can be measured without removing the current meter from the water.

7. Wind can affect a measurement in a number of ways. Wind can obscure the angle of the current making the observer believe there is a horizontal angle component. Wind can also have an adverse effect on

the 2 tenths measurement in shallow streams therefore affecting the velocity distribution in the vertical.

Selecting a Good Measurement Location

Selection of the cross-section is extremely important to a high quality discharge measurement. The following criteria make the best cross-section locations:

1. The cross section should be in a straight reach of the stream with the flow lines parallel to each other.

2. The cross section should be far enough downstream from bridge piers and other obstructions such as boulders to present a laminar flow condition.

3. Velocities and depths should be within the measurement criteria for the meter selected.

    Pygmy current meter depths > 0.3 ft and < 1.5 ft with velocities > 0.25 ft/sec and < 3.0 ft/sec,

    Price AA current meter depths > 1.5 ft with velocities > 0.25 ft/sec and < 8.0 ft/sec.

4. The banks and streambed should be relatively uniform and free of boulders and aquatic growth.

5. Flow should be relatively uniform and free of eddies, slack water, and excessive turbulence.

6. The measurement cross-section should be relatively close to the gaging station control to avoid the effect of tributary inflow between measurement section and the control section and to avoid the effect of storage between measurement section and the control section during periods of rapidly changing stage.

Adjustment of Current Meters

Spin Test

The following are acceptable spin test times for current meters:

- **Pygmy** > 1.5 minutes with 0.5 minutes minimum acceptable value for field use.

- **Pygmy outfitted with a digital magnetic head** > 3.0 minutes with 1.0 minutes minimum acceptable value for field use.

- **Price AA** > 4.0 minutes with 1.5 minutes minimum acceptable value for field use.

Special problems with the Price AA current meter

- Loose connections or broken wires

- Damaged pivot pins

- Oily and/or dirty contacts

- Improperly adjusted current meters

It is recommended that the contact chamber on the Price AA meter be replaced with a magnetic head. This eliminates the constant adjustment of the contacts.

Special problems with the pygmy meter

- Improperly adjusted current meters

- Damaged pivot pin

- Upper bushing out of tolerance

- Oily and/or dirty contacts

- Not removing the shipping pin

It is recommended that the pygmy meter have a retrofitted magnetic head, designed by JBS.

Sample AquaCalc Output

```
<csv>
AquaCalc Pro Plus(tm) by AquaCalc LLC (c)2017

S/N:,00000000
Firmware Version:, V2.0.0
File Version:, V2.0

Sect ID:,            01/01/10 13:03
User ID:,            RON FAUBION
Meter name:,         PAA11 std2
Meter id:,           0-00A
Meter type:,         PAA11
Meter Standard:,     SAE
Meter Revs/Pulses:,  1/1
Meter Const.S1:,     2.2048
Meter Const.O1:,     0.0178
Meter Const.C1:,     0.0000
Meter Const.S2:,     0.0000
Meter Const.O2:,     0.0000
Meter Const.C2:,     0.0000
Meter Const.S3:,     0.0000
Meter Const.O3:,     0.0000
Beg Time:,           01/01/04 13:11
End Time:,           01/01/04 15:01
Meas Time:,          1.83
Line Not Used:,      0.0
Beg Gage height:,    132.05
End Gage height:,    132.10
Beg Staff height:,   0.00
End Staff height:,   0.00
Estimated Q:,        0.00
Adjusted  Q:,        0.00
Measure time:,       40
Measure standard:,   SAE
Measure equipment:,  Susp.Cable
Sounding Weight:,    C15  0.50
Measure ice:,        No
Flood Measurement:,  No
Flood Coef:,         0.00
Max Vertical Q:,     5%
Percent Slope:,      0.0000
Measure Start at:,   REW
Vertical Count:,     27
Section Velocity:,   3.97
Section Width:,      56.20
Section Area:,       174.87
Section Q:,          694.60
Section Diff:,       694.60
Section Pct Err:,    0.0%
Section Quality:,    na
Section WetPerim:,   58.72
Section Hyd Rad:,    2.98
Section Manning:,    0.0000
Section Chezy:,      0.0000
```

```
VERT,   DIST,TDPTH,IDRFT,EDPTH,OBS, TIME,REVS,HA,HC:VF,METH,CLOCK, MVEL, OVEL, VVEL,   SSAREA,     SSQ,SSPCT,
FLAGS
 1,      5.00, 0.00, 0.00, 0.00,  E,      ,     , ,     ,    ,13:11,     ,     , 0.00,    0.00,    0.00,  0.0%,
 2,      9.10, 2.50, 0.00, 2.50, o6,40.69,   5, 0, 1.00,1.00,13:15, 0.29, 0.29, 0.29,    7.50,    2.17,  0.3%,
 3,     11.00, 3.35, 0.00, 3.35, o2,41.29,  24, 0, 1.00,1.00,13:20, 1.30, 1.30
 3,     11.00, 3.35, 0.00, 3.35, o8,41.14,  16, 0, 1.00,1.00,13:19, 0.88, 0.88, 1.09,    6.53,    7.10,  1.0%,
 4,     13.00, 3.15, 0.00, 3.15, o2,40.46,  71, 0, 1.00,1.00,13:29, 3.89, 3.89
 4,     13.00, 3.15, 0.00, 3.15, o8,40.13,  50, 0, 1.00,1.00,13:31, 2.76, 2.76, 3.33,    6.30,   20.95,  3.0%,
 5,     15.00, 3.40, 0.00, 3.40, o2,40.07,  79, 0, 1.00,1.00,13:34, 4.36, 4.36
 5,     15.00, 3.40, 0.00, 3.40, o8,40.73,  52, 0, 1.00,1.00,13:33, 2.83, 2.83, 3.60,    6.80,   24.47,  3.5%,
 6,     17.00, 4.40, 0.00, 4.40, o2,40.16,  92, 0, 1.00,1.00,13:38, 5.07, 5.07
 6,     17.00, 4.40, 0.00, 4.40, o8,40.21,  47, 0, 1.00,1.00,13:37, 2.59, 2.59, 3.83,    8.80,   33.72,  4.9%,
 7,     19.00, 3.20, 0.00, 3.20, o2,40.03,  95, 0, 1.00,1.00,13:42, 5.25, 5.25
 7,     19.00, 3.20, 0.00, 3.20, o8,40.24,  64, 0, 1.00,1.00,13:41, 3.52, 3.52, 4.39,    6.40,   28.08,  4.0%,
 8,     21.00, 3.15, 0.00, 3.15, o2,40.27,  99, 0, 1.00,1.00,13:46, 5.44, 5.44
 8,     21.00, 3.15, 0.00, 3.15, o8,40.31,  62, 0, 1.00,1.00,13:45, 3.41, 3.41, 4.42,    6.30,   27.87,  4.0%,
 9,     23.00, 3.15, 0.00, 3.15, o2,40.13, 102, 0, 1.00,1.00,13:49, 5.62, 5.62
 9,     23.00, 3.15, 0.00, 3.15, o8,40.16,  52, 0, 1.00,1.00,13:48, 2.87, 2.87, 4.25,    6.30,   26.76,  3.9%,
10,     25.00, 3.30, 0.00, 3.30, o2,40.10, 105, 0, 1.00,1.00,13:53, 5.79, 5.79
10,     25.00, 3.30, 0.00, 3.30, o8,40.18,  58, 0, 1.00,1.00,13:52, 3.20, 3.20, 4.50,    6.60,   29.67,  4.3%,
11,     27.00, 3.30, 0.00, 3.30, o2,40.11, 106, 0, 1.00,1.00,14:04, 5.84, 5.84
11,     27.00, 3.30, 0.00, 3.30, o8,40.40,  52, 0, 1.00,1.00,13:56, 2.86, 2.86, 4.35,    6.60,   28.71,  4.1%,
12,     29.00, 3.39, 0.00, 3.39, o2,40.10, 111, 0, 1.00,1.00,14:10, 6.12, 6.12
12,     29.00, 3.39, 0.00, 3.39, o8,40.11,  59, 0, 1.00,1.00,14:09, 3.26, 3.26, 4.69,    6.78,   31.80,  4.6%,
13,     31.00, 3.30, 0.00, 3.30, o2,40.33, 108, 0, 1.00,1.00,14:13, 5.92, 5.92
13,     31.00, 3.30, 0.00, 3.30, o8,40.18,  54, 0, 1.00,1.00,14:12, 2.98, 2.98, 4.45,    6.60,   29.38,  4.2%,
14,     33.00, 3.45, 0.00, 3.45, o2,40.20, 102, 0, 1.00,1.00,14:15, 5.61, 5.61
14,     33.00, 3.45, 0.00, 3.45, o8,40.46,  69, 0, 1.00,1.00,14:15, 3.78, 3.78, 4.69,    6.90,   32.40,  4.7%,
15,     35.00, 3.37, 0.00, 3.37, o2,40.13, 107, 0, 1.00,1.00,14:18, 5.90, 5.90
15,     35.00, 3.37, 0.00, 3.37, o8,40.12,  82, 0, 1.00,1.00,14:17, 4.52, 4.52, 5.21,    6.74,   35.12,  5.1%,
16,     37.00, 3.49, 0.00, 3.49, o2,40.03, 109, 0, 1.00,1.00,14:23, 6.02, 6.02
16,     37.00, 3.49, 0.00, 3.49, o8,40.17,  79, 0, 1.00,1.00,14:20, 4.35, 4.35, 5.19,    6.98,   36.21,  5.2%,
17,     39.00, 3.60, 0.00, 3.60, o2,40.13, 105, 0, 1.00,1.00,14:26, 5.79, 5.79
```

```
17,    39.00, 3.60, 0.00, 3.60, o8,40.33,  71, 0, 1.00,1.00,14:25, 3.90, 3.90, 4.84,    7.20,    34.87, 5.0%,
18,    41.00, 3.40, 0.00, 3.40, o2,40.24, 102, 0, 1.00,1.00,14:29, 5.61, 5.61
18,    41.00, 3.40, 0.00, 3.40, o8,40.15,  85, 0, 1.00,1.00,14:28, 4.69, 4.69, 5.15,    6.80,    34.99, 5.0%,
19,    43.00, 3.80, 0.00, 3.80, o2,40.08, 106, 0, 1.00,1.00,14:32, 5.85, 5.85
19,    43.00, 3.80, 0.00, 3.80, o8,40.14,  78, 0, 1.00,1.00,14:31, 4.30, 4.30, 5.08,    7.60,    38.57, 5.6%,
20,    45.00, 3.90, 0.00, 3.90, o2,40.31, 105, 0, 1.00,1.00,14:38, 5.76, 5.76
20,    45.00, 3.90, 0.00, 3.90, o8,40.22,  83, 0, 1.00,1.00,14:38, 4.57, 4.57, 5.16,    7.80,    40.28, 5.8%,
21,    47.00, 3.90, 0.00, 3.90, o2,40.14,  98, 0, 1.00,1.00,14:42, 5.40, 5.40
21,    47.00, 3.90, 0.00, 3.90, o8,40.24,  72, 0, 1.00,1.00,14:41, 3.96, 3.96, 4.68,    7.80,    36.52, 5.3%,
22,    49.00, 3.70, 0.00, 3.70, o2,40.32, 101, 0, 1.00,1.00,14:45, 5.54, 5.54
22,    49.00, 3.70, 0.00, 3.70, o8,40.46,  55, 0, 1.00,1.00,14:44, 3.01, 3.01, 4.28,    7.40,    31.66, 4.6%,
23,    51.00, 3.32, 0.00, 3.32, o2,40.20,  91, 0, 1.00,1.00,14:48, 5.01, 5.01
23,    51.00, 3.32, 0.00, 3.32, o8,40.14,  54, 0, 1.00,1.00,14:47, 2.98, 2.98, 4.00,    6.64,    26.54, 3.8%,
24,    53.00, 3.58, 0.00, 3.58, o2,40.09,  74, 0, 1.00,1.00,14:51, 4.09, 4.09
24,    53.00, 3.58, 0.00, 3.58, o8,40.32,  42, 0, 1.00,1.00,14:50, 2.31, 2.31, 3.20,    7.16,    22.92, 3.3%,
25,    55.00, 3.45, 0.00, 3.45, o2,40.74,  59, 0, 1.00,1.00,14:54, 3.21, 3.21
25,    55.00, 3.45, 0.00, 3.45, o8,40.11,  31, 0, 1.00,1.00,14:53, 1.72, 1.72, 2.47,    6.90,    17.02, 2.5%,
26,    57.00, 2.40, 0.00, 2.40, o6,40.30,  41, 0, 1.00,1.00,14:59, 2.26, 2.26, 2.26,    7.44,    16.82, 2.4%,
27,    61.20, 0.00, 0.00, 0.00, E,       ,    , ,     ,    ,15:00,     ,     , 0.00,    0.00,     0.00, 0.0%,

<\csv>
```

AquaCalc Pro Plus Output - Header Description

`<csv>`		Computer File Type identifying Comma Separated Value		
`AquaCalc Pro Plus(tm) by AquaCalc LLC (c)2017`		Header beginning		
		(blank line)		
`S/N:`	`0000006F2B19`	Current Meter Identification Number	Default	
`Firmware Version:`	`V2.0.0`	Firmware Version Identification	Default	
`File Version:`	`V2.0`	File Version	Default	
		(blank line)		
`Gage ID:`	`1534000.709`	Gaging Station Identification Number	User	15,a,n
`User ID:`	`MARK JONES`	Hydrogapher Identification	User	15, a,n
`Meter name:`	`A94156`	Meter Name	User	10, a,n
`Meter id:`	`A94156`	Meter Identification Number	User	
`Meter type:`	`PAA11`	Meter Type	User	n/a
`Meter Standard:`	`SAE`	Measurment Type SAE=English/SI=Metric	User	n/a
`Meter Revs/Pulses:`	`1/1`	Ratio of Meter Revolutions per pulse	User	n/a
`Meter Const.S1:`	`2.2048`	Meter Constant 1: m1 – slope (m) of line	User /	1.4, n

		segment 1 where Velocity = (m * rev/sec) +b	Default standard meters	
Meter Const.O1:	0.0178	Meter Constant 1: O1 – Offset (b) of line segment 1 where Velocity = (m * rev/sec) +b		1.4, n
Meter Const.C1:	0	Velocity changeover point of line segment 1 to line segment 2		2.2, n
Meter Const.S2:	0	Meter Constant 2: O2 – Offset (b) of line segment 2 where Velocity = (m * rev/sec) +b		1.4, n
Meter Const.O2:	0	Meter Constant 2: m2 – slope (m) of line segment 2 where Velocity = (m * rev/sec) +b		1.4, n
Meter Const.C2:	0	Velocity changeover point of line segment 2 to line segment 3		2.2, n
Meter Const.S3:	0	Meter Constant 3: m3 – slope (m) of line segment 3 where Velocity = (m * rev/sec) +b		1.4, n
Meter Const.O3:	0	Meter Constant 3: O3 – Offset (b) of line segment 3 where Velocity = (m * rev/sec) +b		1.4, n
Beg Time:	02/23/10 09:41	Date and Time at the Beginning of the Measurement	Calculated	
End Time:	02/23/10 10:16	Date and Time at the end of the Measurement	Calculated	
Meas Time:	0.58	Time for Duration of the entire Measurement	Calculated	
Line Not Used:	0.00	This line is not used.		
Beg Gage height:	0	Inside Gage Height Reading from Inside Gage	User	4.2, n

		at Beginning of Measurement		
`End Gage height:`	0	Inside Gage Height Reading from Inside Gage at End of Measurement	User	4.2, n
`Beg Staff height:`	0	Stage Height Reading from Staff Gage at Beginning of Measurement	User	4.2, n
`End Staff height:`	0	Stage Height Reading from Staff Gage at End of Measurement	User	4.2, n
`Estimated Q:`	230	Estimated Discharge - based on Stage Height and Rating Curve / Table	Calculated	6.2, n
`Adjusted  Q:`	230	Adjusted Estimated Discharge based on Stage Height and Rating Curve / Table. (This value is entered during measurement and changes warning messages.)	User	6.2, n
`Measure time:`	40	User recommended Measurement Time in Seconds (1-99)	User	2, n
`Measure standard:`	SAE	Measurement Units – SAE=English / SI=Metric	User	
`Measure equipment:`	TopSet Rod		User	
`Sounding Weight:`	NA			
`Measure ice:`	No	Identifies whether Ice Draft Mode used		
`Flood Measurement:`	No	Identifies whether .2 Flood Mode used	User	
`Flood Coef:`	0			
`Max Vertical Q:`	5%			2n

Percent Slope:	0		1.4, n
Measure Start at:	REW	Beginning Edge of Water / Bank: REW:Right Edge of Water / LEW: Left Edge of Water	User
Vertical Count:	22	Number of Verticals in the Measurement	Calculated
Section Velocity:	0.74	Mean Velocity	Calculated
Section Width:	144	Width in Feet of the Stream not including Width of Piers, Islands, etc.	Calculated
Section Area:	261.65	Cross-section Area	Calculated
Section Q:	192.68	Total Discharge of Water	Calculated
Section Diff:	-37.32		Calculated
Section Pct Err:	-16.20%	Percent difference from Estimated Q	Calculated
Section Quality:	na		User
Section WetPerim:	145.46		Calculated
Section Hyd Rad:	1.8		Calculated
Section Manning:	0		Calculated
Section Chezy:	0		Calculated

AquaCalc Pro Plus Output – Measurement Section Column Descriptions

Column Heading	Description	Created by	Width, Type
VERT	Vertical Number	Calculated	2, number
DIST	Tag Line Distance	User	5, number
TDPTH	Total Depth	User	4, number
IDRFT	Ice Draft	User	4, number
EDPTH	Effective Depth	Calculated	4, number
OBS	Observation Depth	User	2, alpha-num
TIME	Observation Time in seconds	Calculated	5, number
REVS	Revolutions	Calculated	3, number
HA	Horizontal Angle	Calculated	2, number
HC:VF	Horizontal Coefficient : Vertical Factor	User	4, number
METH	Method Coefficient	User	4, number
CLOCK	Clock time of observation	Calculated	5, alpha-num
MVEL	Measured Velocity	Calculated	4, number
OVEL	Observed Velocity	Calculated or User	4, number
VVEL	Vertical Velocity	Calculated	4, number
SSAREA	Subsection Area	Calculated	4, number
SSQ	Sub-Section Discharge	Calculated	4, number
SSPCT	Sub-Section Percent of Total Discharge	Calculated	4, alpha-num
FLAGS	Not used		

Angle Coefficient Protractor

The protractor on the following page can be used to enter the horizontal angle coefficient. It is also available printed onto clear heavyweight plastic. Please visit our website at www.aquacalc.com for contact information.

Angle Coefficient Protractor

Acceptable Spin Test Limits, in Minutes

Meters	Normal	Min for Field Operation
Pygmy	1.5	0.5
Ice, Vane	3	1.5
Type A, Type AA	4	1.5

Current-Meter & Velocity-Measurement Method for Var. Depths

Water Depth in Feet	Use This Meter	Use This Velocity Method
0.0 to 0.3	Surface float, Volumetric, Weir, Flume, Dye	
0.3 to 1.5	Pygmy	0.6
1.5 to 2.5	Type-A, AA	0.6
2.5 and deeper	Type-A, AA	0.2 & 0.8

Minimum Depths for Weights & Velocity Measurement Methods

Suspension	Min. Depth (ft) 0.6 Method	Min Depth (ft.) 0.2 & 0.8 Method
15 C .5, 30 C .5	1.2	2.5
50 C .55	1.4	2.8
50 C .9	2.2	4.5
75 C 1.0, 100 C 1.0, 150 C 1.0	2.5	5.0
200 C 1.5, 300 C 1.5	3.8	7.5

Note – Use 0.2 method for depths 2.5-3.7 ft. with coefficient (estimated 0.88)

AquaCalc

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