

Technical Note

Automating Crest Stage Gages with Continuous Monitoring Instruments

Rugged TROLL® 100 and Rugged TROLL® 200 instruments offer advantages over cork-float method

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Comparison of automated level gages and traditional crest stage gages

Overview

Crest stage gages are typically used to gather data from ephemeral streams or waterways that are subject to infrequent, but severe flooding. Increasingly, crest stage gages are becoming a cost-effective means of gathering peak flow data, which can then be used in a variety of applications, such as emergency planning, engineering design, and stormwater permitting.



Figure 1. Crest stage gage site with staff gage.

Traditional crest stage gages—Advantages and disadvantages

The USGS (2006) describes traditional crest stage gages as having the following advantages:

- Inexpensive
- Sturdy design that withstands flash floods and extreme conditions
- Accurate measurement of peak stage

Disadvantages include:

- Measures only the peak event in-between site visits
- Absence of date, time, or continuous data
- Storm flow cannot exceed the height of the gage
- Subject to internal sedimentation effects during high flows, which may impede peak flow measurements



Figure 2. Cork on the inside of the crest stage gage.

Automated crest stage gages—Advantages and disadvantages

Similarly, the USGS (2006) describes the advantages of automated crest stage gages:

- Records date, time, and continuous data
- Measures multiple peak flow events between site visits
- Field calibration not necessary
- Fewer site visits required
- User-selected recording time interval
- Can be integrated into real-time monitoring networks

The USGS (2006) cites equipment cost as the primary disadvantage of automated systems. However, by factoring in labor and fuel costs and the benefits of high-resolution data, automated systems offer a cost-effective monitoring solution.



Figure 3. In-Situ Inc. Rugged TROLL® 100 and Rugged TROLL® 200 instruments.

Choose an instrument for use as a crest stage gage

When selecting a level-measuring device, first choose an absolute (non-vented) sensor, such as the Rugged TROLL 100 instrument or Rugged TROLL 200 instrument. A gauged (vented) sensor will flood if the peak flow elevation exceeds the height of the vent tube.

The Rugged TROLL 100 is deployed on a suspension wire. Optionally, the Rugged TROLL 200 can be deployed on direct-read cable to access data without removing the instrument or with stripped and tinned cable to access data via telemetry (using RS485 or SDI-12 communications).

You will also need a Rugged BaroTROLL® instrument running concurrently with the Rugged TROLL instrument to compensate for barometric effects on the data, if required. Select a safe location nearby where the Rugged BaroTROLL will not be submerged during peak flow.

Configure the Rugged TROLL instrument as a crest stage gage

1. Install Win-Situ® 5 software to your local hard drive from the In-Situ® software CD or web site.
 2. Attach a Rugged TROLL® Com to the Rugged TROLL 200 and a PC or RuggedReader® handheld PC or place the Rugged TROLL 100 into a docking station.
 3. Plug the Rugged TROLL Com or docking station into a USB or serial port on a desktop/laptop PC, or into the serial port on a RuggedReader® handheld PC.
 4. Open Win-Situ 5 software.
 5. The screen will show the My Data tab. Establish communication with the instrument.
- Hint: On first connection, be sure to select the correct COM port for a USB or serial connection, then connect to the device.
6. Sync the PC and instrument clocks, if necessary.
 7. Set up a site, if necessary.
 8. To set up a data log, follow the steps in the Logging Setup Wizard, accessed under the Logging tab.
 9. Select the Site where this set of data will be logged and supply a name for the log.
 10. Select the parameters to measure. (Make sure to choose Level/Depth option.) Choose the measurement units, and specify the order in which the selected parameters will be logged.

Hint: Selecting Pressure helps correct data if a reference is set incorrectly.



11. Choose a logging method. Choose Event.

Note: In an Event Log, the device polls a single parameter at a “fast” rate to determine if it meets defined event conditions, and logs all selected parameters at that rate during an event. The device logs all selected parameters at a “slow” default rate when no event is occurring.

- a. First, select the sensor and event parameter of interest. (Only one parameter is scanned for an event.)

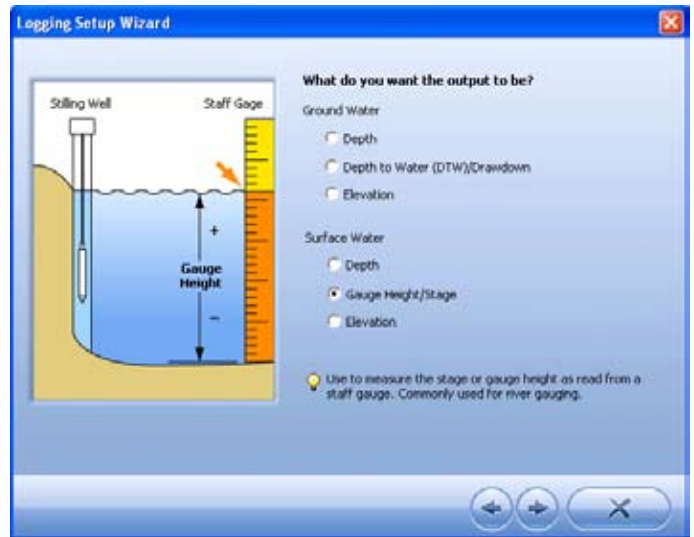
Hint: The parameter units are displayed for your information. If you wish to change the units, go back two screens.

- b. Next, select how frequently you would like to sample or check the event parameter. This rate is also the rate of logging during event conditions. (This value can range from 1 second to 40 days. The default interval is 1 minute.)
- c. Using the check boxes, select the event criteria that must exist for the “fast” logging to occur: greater than, less than, changes by, or any combination. When these conditions are met, an “event” is occurring. During an event, measurements are logged at the rate you specified in step b.



- d. Enter the “slow” default rate to record (log) data during non-event conditions. It is defined by a number of samples taken at the rate specified in step b. For example, if your “check event parameter every” rate is 5 minutes, and your default “record data every” is 12 measurements, then data will be logged every hour (5 minutes x 12 = 60 minutes) when no event is occurring. (The minimum value is 2 and the maximum value is 65535. The default is 60.)

12. Select the start condition. Select a Manual Start if you can connect to the instrument in the field with a communication cable. Use a Scheduled Start to start logging at a specific date and time if you are not using a communication cable and will be unable to connect to the instrument in the field. If desired, select the stop condition and specify how to handle a full device memory.
13. Select **Gage Height or Stage**. Logged readings will track water level as related to markings on a nearby staff gage.



14. Once you have determined the value of your Level Reference, the software gives you three options that control when the Level Reference is applied. Select one of the following options for setting the reference:
 - **Set new reference now:** Choose this option with the **Rugged TROLL 200 instrument, deployed on a cable**, with an active software connection when the device is installed in its final position in the water. The current probe reading is set equal to the Level Reference to create the “offset” that takes effect at the start of the data log. The log header will show the probe reading at the time that the Level Reference is entered.
 - **Set first logged reading to any value (e.g., a staff gage):** Choose this option with **Rugged TROLL 100 or Rugged TROLL 200 instruments that are deployed on a wire hanger** because you cannot communicate with it when it is submerged.
 - **Remind me to set reference later (Rugged TROLL® 200 instrument on a cable only):** Use this option to defer the entry of your Level Reference during log setup and set a reminder to enter it when the test is manually started. (Do not use this option for a scheduled start.)

15. Install the Rugged TROLL® instrument in its monitoring location. You may place the instrument inside a traditional crest stage gage casing. Secure it so that it does not move during the test period.


*Hint: If logged data from a Rugged BaroTROLL® will be used to post-correct Rugged TROLL data logs, start the Rugged BaroTROLL log **before** the Rugged TROLL log in order to capture the barometric pressure when the reference is set on the Rugged TROLL. Be sure that both instruments' clocks are synchronized.*

16. Enter the reference before starting the log if you have not already done this.
17. Enter the specific gravity.
18. Review the Summary and click OK.


Downloading and Post-Correcting Data

Select Rugged BaroTROLL Log File correction method when you have access to a Rugged BaroTROLL log file covering approximately the same time period as the file to be corrected. You will need:

- The name of the Rugged BaroTROLL log file
- The name(s) of the absolute log file(s) you want to correct

1. After the Rugged TROLL log has stopped, click the download button  on the Logging tab. All data will be downloaded, automatically saved, and organized by site.
2. Repeat for the Rugged BaroTROLL data.
3. Launch BaroMerge™. Select Use a BaroTROLL file.



4. Click the  button, select the Rugged BaroTROLL source file, and click OK. All Rugged BaroTROLL log files in your Win-Situ working directory can be displayed, but only one file may be selected.
5. In the BaroMerge main window, click Next.
6. Values from the Rugged BaroTROLL file will be displayed in the next window. You can edit these values if you like. Click Next when ready.
7. In the next window, select the log file(s) to which the correction will be applied and click OK.
8. BaroMerge applies the correction to the selected log file(s). A progress bar shows when processing is complete.
9. Compensated data files may be viewed or exported from the My Data tab in Win-Situ 5.

Application Technologies

- Rugged TROLL 100 instrument with docking station
- Rugged TROLL 200 instrument with direct-read cable or docking station
- Rugged BaroTROLL instrument with direct-read cable or docking station
- RuggedReader® handheld PC
- Rugged TROLL® Com accessory with Rugged TROLL 200 direct-read cable
- Win-Situ® 5 and Win-Situ® Mobile software
- TROLL® Link telemetry system

References

1. USGS. 2006. *Automated crest-stage gage application in ephemeral streams in New Mexico*. Fact Sheet 2005-3136. Washington, D.C.
2. In-Situ Inc. 2008. *Absolute vs. Gauged: Comparing Absolute and Gauged Pressure Sensors*.
3. In-Situ Inc. 2007. *Event Testing with Level TROLL® and Aqua TROLL® Data Loggers*.
4. In-Situ Inc. 2005. *Manual Barometric Correction*.



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