onset
HOBO® Data Loggers

Choosing a Water Level Logger:
5 Things You Should Know

Introduction

As the demand for water resources continues to grow in the United States and abroad, the ability to assess the impact of urban development and agriculture on water resources is more important than ever. To meet this growing demand, water resource managers, engineers, and hydrologists have a greater need to monitor groundwater and surface water levels with water level data loggers in order to document baseline and changing water levels over time.

Water level loggers typically incorporate built-in micro-processors, pressure sensors, and battery power in a rugged enclosure designed for long-term underwater deployment. They can be deployed and left unattended for months at a time, collecting water level data at user-defined intervals and storing it digitally into logger memory. By operating in a continuous 24/7 monitoring mode, water level loggers eliminate many of the hassles of manual data collection, and facilitate monitoring of multiple locations at the same time.

Water level loggers also automate the process of archiving and reporting data. Hydrologists can simply offload the logger data to an office or laptop computer and create detailed graphs or tables with the click of a mouse. The charts can be easily printed for documentation purposes while the electronic data are automatically archived.

While water level loggers have become the data collection instrument of choice for an increasing number of hydrologists, the myriad of product choices available today can make it difficult to determine which product is right for your application.

Whether you have previous experience with water level logging, or are just getting started, this report can help you choose the right products for your needs. It points out the five most important considerations to keep in mind, and offers tips on specific features.

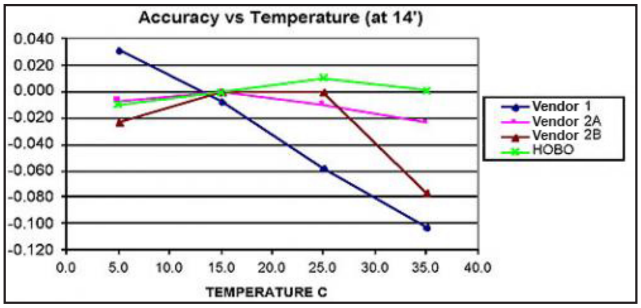
1. Accuracy specs can be misleading

When evaluating water level accuracy, questions you'll want to ask the manufacturer include:

The accuracy a water level logger can achieve at the high or low end of a given range may be far different from the accuracy at the middle of the range.

• Does the accuracy specification apply across the full-calibrated measurement range of the logger? The accuracy a water level logger can achieve at the high or low end of a given range may be far different from the accuracy at the middle of the range. For this reason, it's important to find out if the logger's accuracy specification refers to a single point or the entire measurement range. Knowing the full-range accuracy of a water level logger will give you assurance that the logger will meet your accuracy requirements.

• Do temperature variations cause additional error outside of the accuracy spec? Some water level loggers are not able to effectively compensate for temperature changes, which cause incorrect pressure readings. For this reason, it's important to find out if error that results from temperature changes is included in the accuracy specification, or if there is a separate error term that must be added. Data loggers with reduced overall mass will equilibrate more quickly to changing temperature conditions to increase dynamic response during changing conditions. The response-time specifications will indicate how quickly the logger will equilibrate.



Accuracy for typical loggers over temperature

• Does the accuracy specified relate only to the logger's sensor, or to the entire logger? A water level logger's sensor and analog-to-digital (ADC) converter both contribute to accuracy error. The error from the ADC can be just as significant as sensor error. For this reason, you'll want to confirm with the manufacturer that the specified accuracy refers to the entire instrument rather than just the sensor. To realize a 0.01 foot water level resolution requires at least a 12-bit ADC with a 30 psi water level sensor.

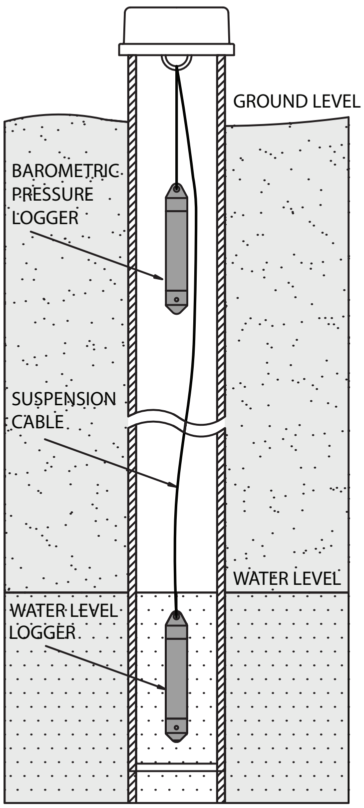
• Is drift important? The pressure sensors in water level loggers will drift over time. Whether or not you need to be concerned about drift depends on your application. Drift is important in cases when absolute pressure values are needed, or if there are no recent reference level or depth measurements available. This may be the case if a water level logger is deployed for more than one year and no reference-level readings are taken during that deployment. Otherwise, drift is not a significant factor since it will be offset by regular (i.e. monthly) manual reference-level readings.

Regardless of whether drift will affect your data, it is a good idea to ask the logger manufacturer for drift specifications.

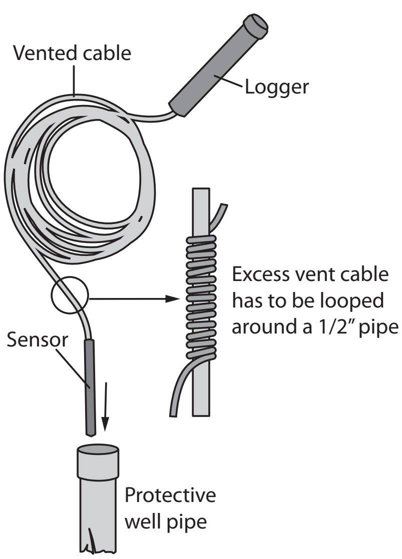
In addition to these questions, be sure to ask the manufacturer if the logger's accuracy has been verified or measured against NIST-traceable standards. Some companies offer NIST-traceable calibration certificates as verification of the accuracy of each logger.

2. Vented vs. non-vented loggers

Non-vented



Vented



There are two primary types of water level loggers – vented and non-vented.

Vented loggers include a built-in vent tube that enables the loggers to automatically compensate for atmospheric pressure changes. By equalizing these changes on both sides of the pressure sensor, a well-designed and maintained vented water level logger can provide high-accuracy water level data.

Non-vented loggers do not use vent tubes. Instead, these loggers can be barometrically compensated using a barometric pressure logger and a simple software function to perform the mathematics. Barometric pressure values can also be obtained from weather stations within a 10-mile radius.

When comparing vented and non-vented loggers, be aware that while vented loggers have the potential to provide the greatest accuracy, they also have a number of limitations that can cause problems and result in bad data and/or data loss:

- Vented loggers are bulkier than non-vented loggers. This makes transporting them out to field sites more difficult – especially when several units need to be deployed. In many cases, the bulkiness of a vent cable can also become a problem when trying to fit the logger down a narrow well opening. The cable must be protected when extended over sharp casing edges, and the end must be stored in a watertight location while the logger is deployed.

- Most vented loggers require the use of desiccants for moisture protection. While desiccants can keep moisture out of the logger effectively, they typically need to be changed on a regular basis. This adds to the amount of logger maintenance required, which, in turn, increases the total cost of ownership of the logger.

- Vent tubes with contaminant-resistant material must be used if contaminants are present in the groundwater or surface water being monitored. This can add to the cost of a water level logger. Additionally, if a logger has been deployed in contaminated water, it must be decontaminated before it can be redeployed. This may take a considerable amount of time since vent tubes are typically 25 feet in length or longer.

- Vented loggers are not flexible when it comes to deploying them at various depths. Their cables cannot be lengthened without sending them back to the supplier, and cables typically cost several dollars per foot. Shortening the cable requires the user to delicately coil the cable, without creating any kinks.

- Condensation can easily build up in vented loggers, which can lead to accuracy problems.

- If the end of the vented logger cable is inundated by rising water, all subsequent data are compromised due to unknown pressure compensation dynamics during the flood event. This is a significant problem when monitoring water levels of streams and rivers during storm events. These limitations highlight the advantages of a non-vented logger. Non-vented loggers are more compact, require minimal maintenance, can be easily deployed in wells of varying depths, and are not affected by flood water.

3. Software features that really matter

Just as water level loggers can vary considerably from model to model, so too can the graphing & analysis software that accompanies them. From a general standpoint, it's a good idea to look for a logger with software that is highly intuitive, so the learning curve is minimal. The software should enable you to quickly and easily perform tasks such as configuring parameters, launching the logger, and offloading data, with point-and-click simplicity.

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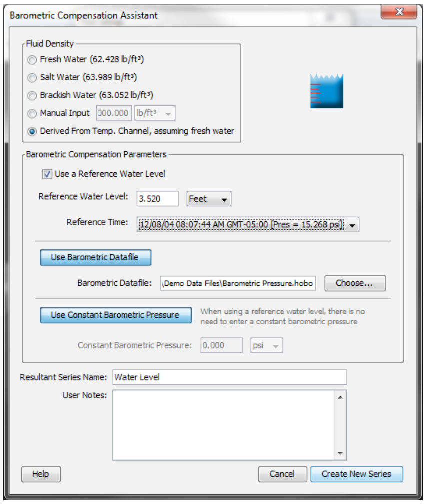
In terms of specific features, you'll want to make sure that the logger software supports the following:

• Barometric compensation – To convert a non-vented logger's pressure readings to barometrically-corrected water level values, make sure the logger software has a barometric compensation utility. These tools typically allow you to enter reference level, water density, and other values into a dialogue box, and then automatically perform the pressure-to-water level conversion.

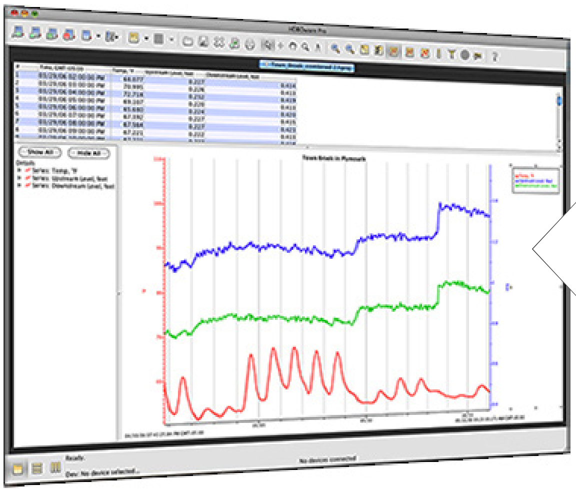


HOBOware's Barametric Compensation Assistant

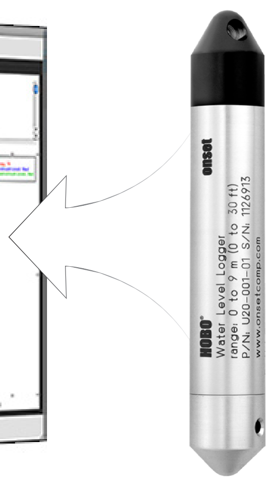
• Multi-logger graphing – When monitoring water levels at multiple sites, it is often advantageous to be able to view and analyze data from each water level logger on a single graph. Be sure to ask the manufacturer about this capability.

• Easy data export – Because water level data often needs to be incorporated into other software programs, such as spreadsheets or modeling programs, make sure the logger software allows you to quickly and easily export data with the click of a mouse. The software should also allow you to copy and paste graph images into other programs for generating reports.

• Project save and recall – While the ability to save and recall projects may seem like a basic feature of any logger software package, the reality is that many do not support this capability. Since a project typically involves a number of steps, including merging multiple data files together, converting pressure readings to water level units, and formatting charts, you'll want to be sure that the logger's software will allow you to save your work so it can be easily recalled and added to in the future.



HOBOware graph showing U20 temperature in red, and water level at 2 points along a stream in blue and green.



HOBO U20-001-01 water level logger

4. Buying vs. renting

In the past, the relatively high price of water level loggers has prevented many hydrologists from purchasing their own supply of loggers. Many have chosen to rent loggers instead. While renting can be a convenient option for short-term deployments, it is important to be aware that the price of water level loggers has decreased to the point where purchasing is more cost-effective for many applications.

If you provide hydrology or groundwater services, owning your own inventory of water level loggers may give you a competitive edge, since you'll be able to waive additional equipment rental fees for your customers.

5. Choose the right computer interface

When choosing a water level logger, you'll want to make sure that the logger can quickly and easily be hooked up to a laptop or office computer. A logger with a direct USB interface enables plug-and-play ease-of-use, which can be particularly helpful when offloading data in the field. Direct USB also enables you to offload data in a matter of seconds, compared to the minutes it takes via serial communications.

Loggers that rely on mechanical plug-in connectors can be damaged by water in the field and cause logger failures. Water level loggers with an optical interface that is completely sealed within the logger's housing eliminate the possibility of water-related damage and/or failures.

Other informational resources available from Onset:

Data Logger Basics

In today's data-driven world of satellite uplinks, wireless networks, and the Internet, it is common to hear the terms "data logging" and "data loggers" and not really have a firm grasp of what they are.

Most people have a vague idea that data logging involves electronically collecting measurements of key environmental parameters, such as temperature, relative humidity, or energy use. They're right, but that's just a small view of what data logging is.

Monitoring Green Roof Performance with Weather Stations

Data logging weather stations are the ideal tools for documenting green roof performance. A weather station can measure weather parameters such as rainfall, stormwater runoff, temperature, relative humidity, wind speed, solar radiation, and a host of non-weather parameters such as soil moisture on a continuous basis (say every five minutes, hourly, or an interval appropriate to the situation). For the purpose of this discussion, "weather station" may refer to a data logger that measures and stores data from weather sensors. The information a weather station collects can help you make wise choices about designing, tuning, and maintaining a green roof.

Deploying Weather Stations: A Best Practices Guide

From the tropics to the poles, climate, agriculture and other researchers rely on unattended research-grade, data logging weather stations. For example, the US Department of Agriculture uses weather stations to study anything from molecular plant pathology to forest management. Non-government groups, such as universities, use weather stations to study a wide array of subjects including how glacial activity affects air temperature. Additionally, commercial companies depend on weather stations to conduct businesses.

Our new best-practices guide, Weather Station Deployment Techniques, shares field-proven tips and techniques for installing research-grade weather stations in the field. A range of topics are discussed, including weather station site location, sensor placement, system configuration, and cable protection.

Monitoring Wetlands with Data Loggers: A Best Practices Guide

Wetlands act as a natural filter for polluted water and thus play an essential role in water quality protection. They serve as floodwater storage to help minimize erosion, and create a habitat for many fish and wildlife.

While a variety of factors have decreased the number of wetlands in the U.S. by half since 1950, many organizations are restoring wetlands back to their original flourishing ecosystems. To ensure success, it is necessary to monitor wetland factors such as water level, temperature, and rainfall.

This guide shares field-proven best practices for configuring, launching and deploying portable data loggers in wetland monitoring applications. A range of data logger types is covered, and tips are provided on logger installation and maintenance.

Underwater Temperature Loggers: Considerations For Selection & Deployment

This paper offers guidance and tips on selecting and deploying water temperature loggers. Three main phases of operation are discussed: configuration & launch, deployment, and data retrieval & analysis.

Access our full resources library at: www.onsetcomp.com/learning