LOW FLOW SAMPLING THE COMPLETE GUIDE

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water monitoring instruments

What is Low Flow sampling?

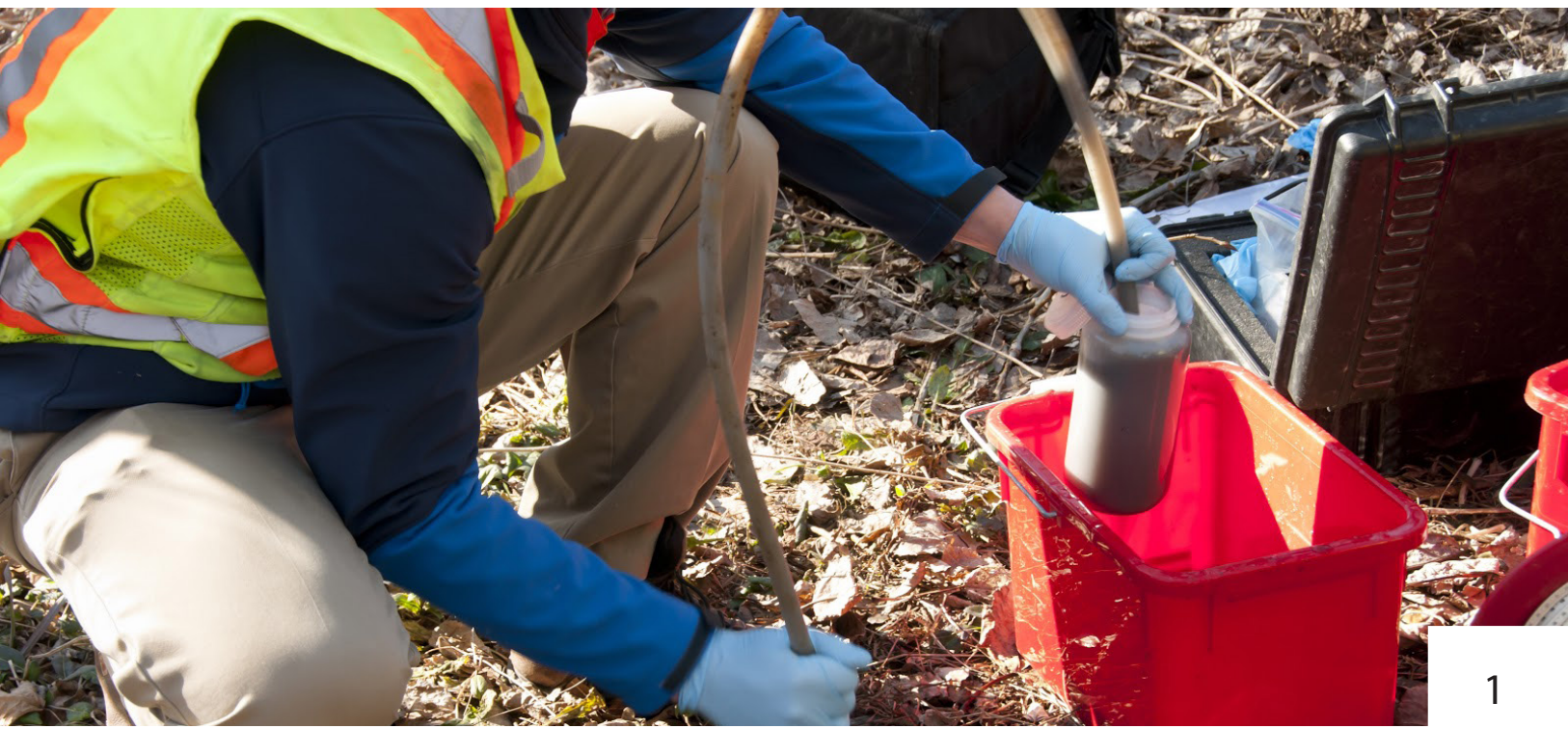
Collecting and testing water samples is all well and good when the water is on the surface, but what happens when you want to collect samples that are located underground?

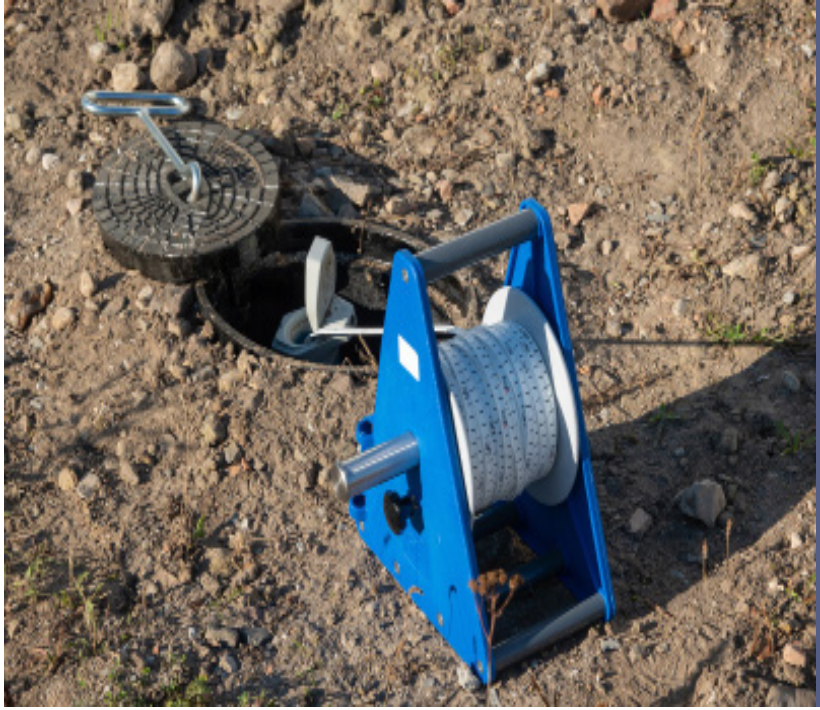
With low flow groundwater sampling, you can accurately and effectively monitor water located in aquifers underground. The aim is to collect water samples underground accurately while ensuring no outside factors end up impacting the water, and in turn, the collected data.

These samples are then used by scientists, environmentalist agencies and similar outfits that can use data surrounding the quality of the water to inform others or make decisions. The practice for this method of sampling groundwater is meticulously implemented as not to disturb the sample and to give an accurate picture of the water's overall quality.

Low flow sampling will monitor different aspects of the water in order to determine its overall quality. Most often it will look for changes in pH levels, dissolved oxygen, electrical conductivity and temperature.

However, some groundwater samples may look into other characteristics of water quality. This is all done with a set of specialised water quality measuring equipment, of which there are a number of variations available.





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The Difference Between High Flow and Low Flow Sampling

The difference between high flow and low flow sampling can be seen in the equipment used and the rate at which water is extracted from the ground. These differences are related as different equipment is needed to get water out of the ground quickly.

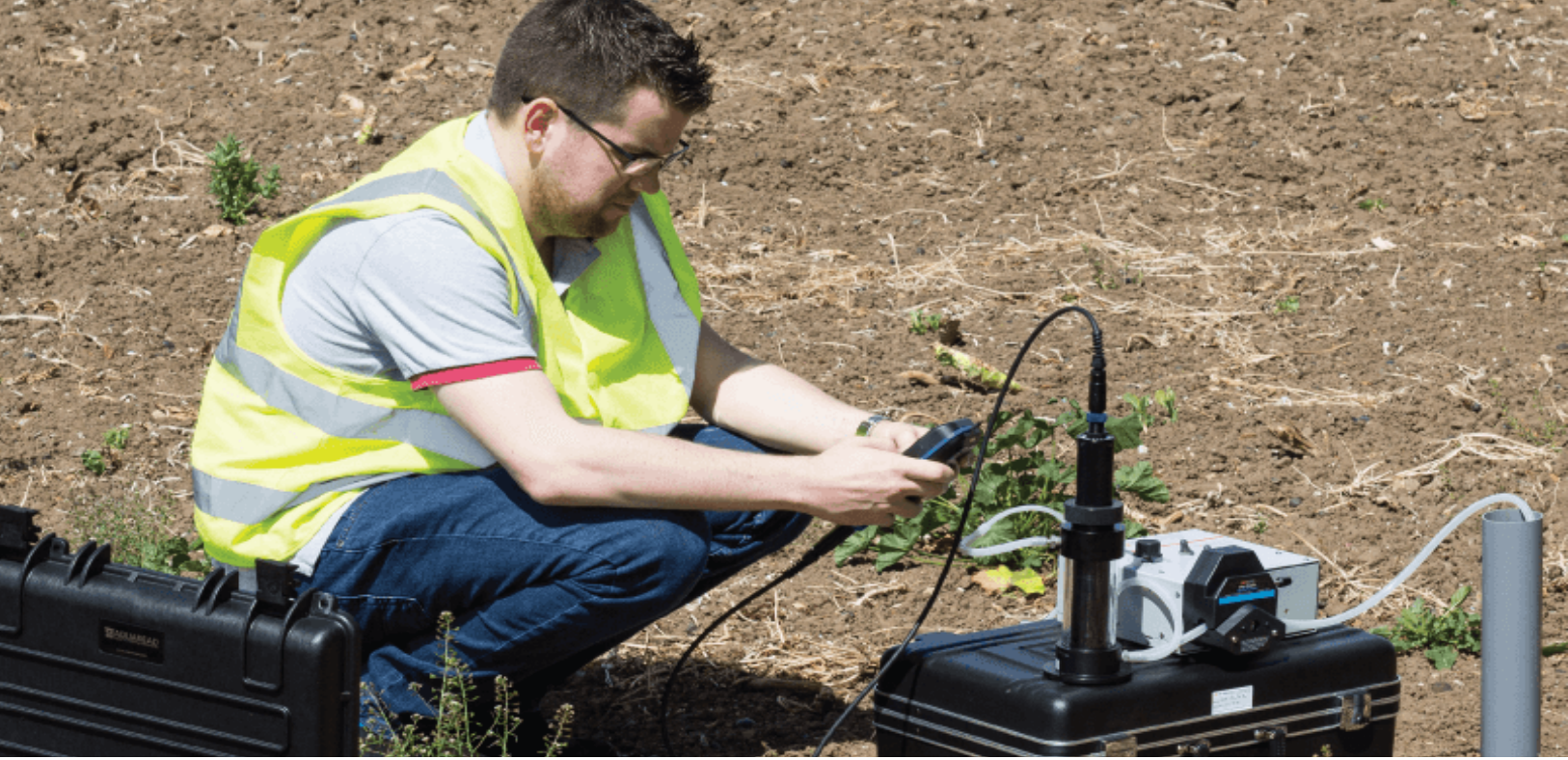
High flow sampling will use bailers to extract water from the ground at a faster rate. This method purges significant amounts of water compared to low flow sampling. Low flow sampling will analyse the water quality by obtaining smaller amounts of water at a rate below 500 milliliters per minute. It does this using a probe that captures the water and uses sensors to take readings.

The criticism of high flow sampling revolves mostly around its ability to contaminate the samples and reduce the accuracy of the sample readings. The higher pumping rates cause a mixing of the water with other chemicals and materials, making the likelihood that the sample is not an accurate representation of the groundwater.

The wellhead of the bailer used in high flow sampling may also cause contamination and even aeration of the sample may occur. Other criticisms surround the amount of water wasted when extracting samples and the potential for this to cause issues for wildlife and nearby residents.

As a result, low flow sampling has overtaken the uses of high flow sampling. In contrast to high flow sampling, it boasts many advantages, including:

- Purging of less water so less is wasted
- No wastewater is left behind
- Does not empty wells and cause soil to mobilise
- Requires less time to complete.



Equipment Necessary for Low Flow Sampling

Whatever you're measuring or testing, your low flow sampling project will involve purging the water underground at a steady rate. This is done to ensure there is less disturbance to the site during the purging procedure, as conducting the process too quickly could negatively impact sample results.

To purge the water, you will need a low flow sampling pump. There are many different types of pumps on the market, so you will need to make sure you select the one that best fits your needs.

For reference, the size of your borehole will have a large impact on the type of pump you will need. For example, Inertial pumps are suitable for boreholes that are 10mm in diameter or above.

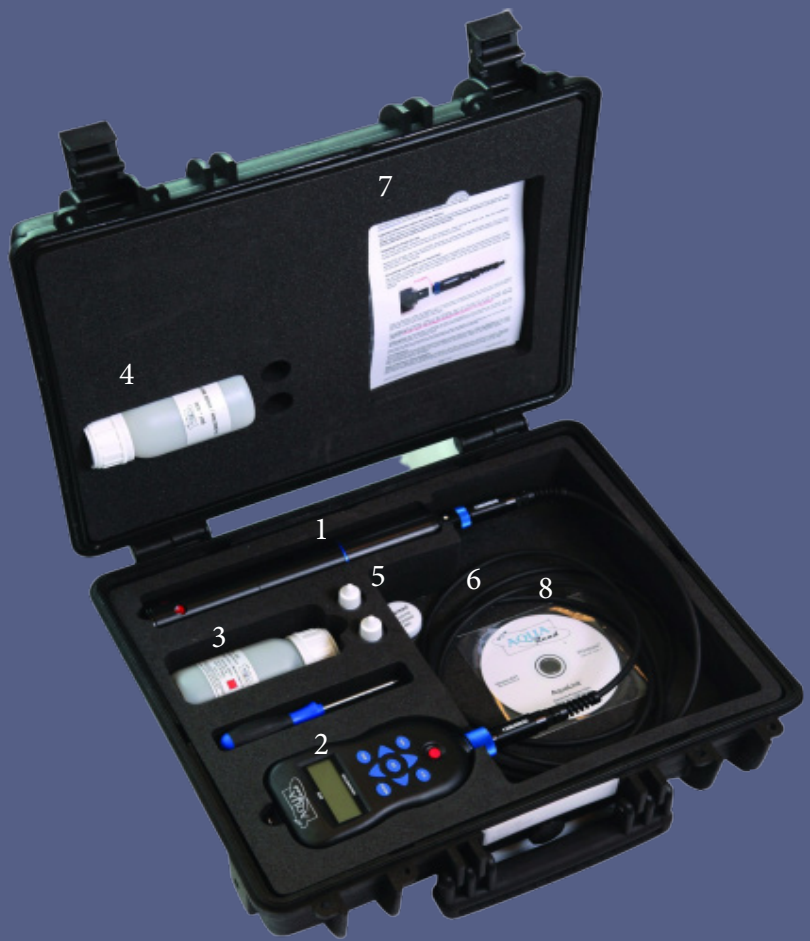
While the size of the borehole will be your main consideration, there are other factors that may influence your decision. Some pumps are fully automatic, while others require manual pumping throughout the purging process. The costs of various pumps will also likely be an important consideration, so be sure to explore all your options before settling on your chosen low flow sampling pump.

Purged water is not much help unless you have the equipment necessary to conduct your required tests on the samples, which is why a water quality measurement device is so important.

What you intend to measure will play a large role in which water quality measurement device you select, although many devices are able to measure multiple parameters at once to help streamline the process.

Our very own AP range of devices, including the AP-2000, are able to monitor all of the most common testing parameters, with the option to attach additional sensors as needed.

At a glance - the AP-2000 package



1 The AP-2000 is an advanced portable multiparameter water monitoring probe. It comes with a range of standard sensors included and also offers some customisation options that allow you to add additional sensors to the probe.

2 The GPS Aquameter is used for taking spot measurements, logging data manually and for calibrating the probe's sensors. Its built in GPS receiver allows it to capture the location of data set you record.

3 A bottle of calibration solution is provided with every package to help calibrate the AP-2000 probe.

4 A calibration rinse bottle is also included to aid with calibration.

5 Storage solution is included to help keep the sensor moist between uses.

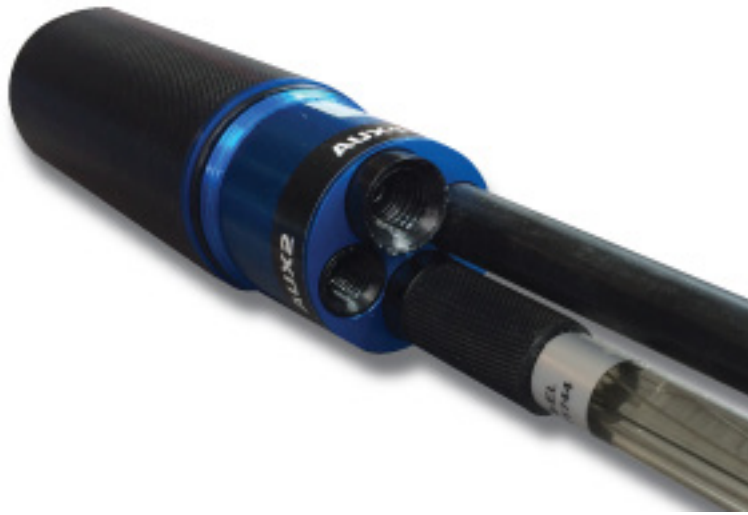
6 All packages come with a tough 3m cable that feature our AquaConn Connectors. The cables have Kevlar running their lengths to provide extra tensile strength. A USB cable is also included for connecting the Aquameter to your PC for data download.

7 Starter cards are included with every package to guide you through the setup process and to help troubleshoot any common problems.

8 A CD to help install the AquaCal software on your PC or laptop to upload and view your collected data.

AP-2000 Parameters and Specifications

- ☑ Optical DO
- ☑ Specific EC
- ☑ Absolute EC
- ☑ pH
- ☑ ORP
- ☑ TDS
- ☑ Resistivity
- ☑ Salinity
- ☑ SSG
- ☑ Temperature



AP-2000/2000-D Mechanical Specification

Protection Class	IP68 (permanent immersion)
Immersion Depth	Min 75mm. Max 100m**
Operating Temperature	-5˚C - +70˚C
Dimensions (L x Dia)	290mm x 42mm
Weight	700g

*Additional parameters Salinity, TDS, SSG and Res are calculated from the EC and Temperature readings.

**100m submersion for period of 1 week, 30m submersion suitable for permanent deployment, depth measurement up to 60m.

Careful monitoring of the water being purged and collected is vital for effective low flow sampling. To help measure the drawdown and levels of the water underground, you will need a form of water level measurement device.

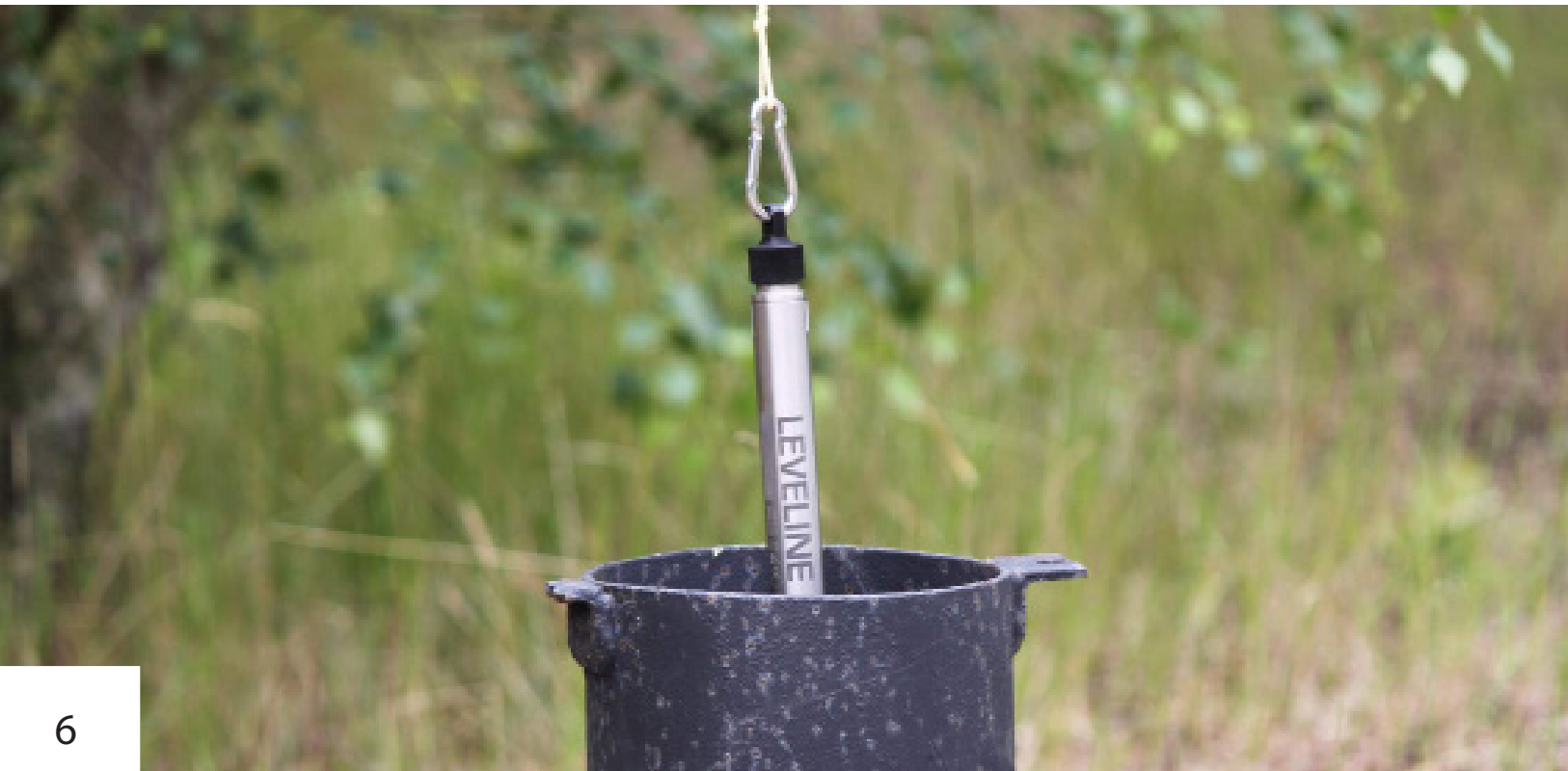
The most simple to use of these devices is a Heron water level meter. They can be used to easily and quickly measure water levels and is available in both static mode, which is used for measuring the depth of water, as well as drawdown mode, which is more suited for low flow sampling.

Alternatively, Leveline loggers allow users to collect water level data automatically and store the data in its internal memory. Made from titanium and with a 500,000 data point memory and 10 year battery life, the Leveline range of water level loggers are more suited for longer term monitoring but are still suitable for shorter term projects as well.

Finally, you will need tubing to help connect all the necessary parts together. The length of tubing required will depend on how far down the water underground is located, but the type of tubing will also be an important consideration.

Tubing for low flow sampling can be found in various materials, all with their advantages and disadvantages. Polyethene tubing is often chosen due to its strength and durability, while Teflon tubing is sometimes chosen as it provides excellent resistance to most solvents and acids.

To ensure you only get accurate results that are representable of the water as a whole, you will need to follow a specific procedure and use the best water sampling equipment. Equipping yourself with training or the knowledge of how to execute sampling correctly, and the tools to do it, will go a long way to getting accurate results.



How to Conduct Low Flow Sampling

Each test site is different, which is why it is recommended to do a full survey of the site before conducting any low flow sampling. Depending on the site, specific rules will need to be followed to ensure a safe and efficient test.

The first and perhaps most simple is to know the background to the area itself. If it is on a piece of protected land or is a historical site, you want to make absolutely sure you have permission from the relevant body that you are allowed to conduct tests on the site.

Once equipped with your AP-2000 package, the first thing you will need to do before commencing low flow sampling will be to to purge the water located in the aquifer underground.

This will need to be done at a rate that mimics that of ambient water flow. For reference, a typical flow rate from a pump during low-flow purging is approximately 0.1 to 0.5L/min.

There is continued debate as to whether manual or automatic pumping is more effective, while the truth is both have their advantages and disadvantages.

Automatic pumping can make the process easier but requires close monitoring to ensure the groundwater being pumped is not expelled too quickly. On the other hand, manual pumping gives you greater control but requires constant monitoring.

Whether you opt for automatic or manual pumping, ensuring it is done at the correct speed is vital. If done too fast you run the risk of contamination, while doing it too slowly increases the likelihood of the well water and water from the aquifer mixing together.

Stabilisation Reading Limits

Turbidity (10% for values greater than 5 NTUs; if three turbidity values are less than 5 NTUs, consider the values as stabilised.

Dissolved Oxygen (10% for values greater than 0.5mg/L, if three dissolved oxygen values are less than 0.5mg/L, consider the values as stabilised.

Specific Conductance (3%)

Temperature (3%), pH (+0.1 unit)

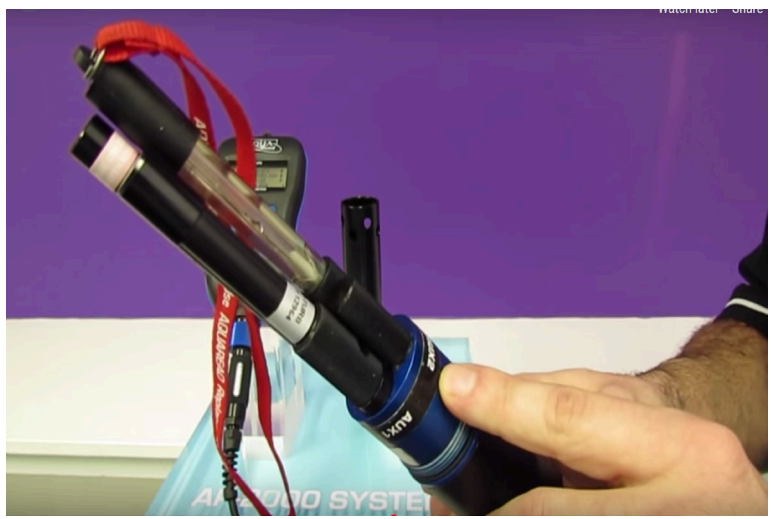
Oxidation/Reduction Potential (+10 millivolts)

Once pumped, it's important to then conduct stabilisation tests on the water before a complete sample is taken. The most common parameters to check when performing low flow sampling are pH, D.O, conductivity and temperature.

To ensure stabilisation is reached, we recommend taking readings every 3-5 minutes.
Once three readings have been taken that return the same results within limits, samples can be safely collected. These limits are outlined above, as recommended by the Environment Protection Agency.

The reliability of the sample is greatly dependent on the steps involved to be carried out properly without contaminating the sample with soil and oxygen. Having state-of-the-art equipment, such as the AP-2000 is important but using it correctly is just as important.

Once the sampling has been completed, it is important to clean your equipment before taking another sample or this can cause data errors in the following samples.



Important Considerations for Low Flow sampling

Low flow sampling is by no means a simple process. If proper care and consideration are not taken, there is the risk of inaccurate groundwater samples, damage to the test site and in some cases, a risk to the individuals working on the site themselves.

To minimise these risks and ensure your low flow sampling process is efficient throughout, there are a number of important factors to take on board.

When conducting low flow sampling, there is the possibility that the groundwater you are testing contains trace contaminants. Regardless of whether there is or not, it is recommended to always wear a clean pair of non-powdered disposable gloves each time a different location is sampled.

If dealing with samples believed to contain high concentrations of contaminants, it is important that they are stored separately from those samples containing low levels or no traces of contaminants.

Furthermore, if working in multiple areas, it is recommended to begin tests in the area least suspected to be contaminated in order to minimise the risk of cross-contamination.

It is also important to have a solid understanding of what you are testing for. For example, When testing for volatile organic compounds (VOCs) there is a risk of losing them in the collection process if proper pumping procedures are not adhered to. To minimise the likelihood of loss, it is recommended to

"If working in multiple areas, it is recommended to begin tests in the area least suspected to be contaminated in order to minimise the risk of cross contamination."

avoid using vacuum pumps and to not tamper with the tubing, as this may result in a pressure change.

Hot temperatures and direct sunlight can also negatively impact results for low flow sampling. Heating of the groundwater can affect the accuracy of the results, as well as the possible risk of damaging equipment. To avoid this, ensure your tests are conducted during cooler times of the day, or make use of an umbrella or tent to limit the impact of the sun.

Finally, there are a few general handling and preservation tips to bear in mind when working with your collected samples.

All samples should be put into appropriate and clearly labelled containers, although any collected for volatile organic compounds, acidity or alkalinity need to ensure they do not have any headspace in the containers they are kept in. Any other containers should be filled with some space still remaining to allow for any ullage that may occur.

For more information on low flow sampling, get in contact with us today.

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