Nationally Standardised Protocol for State of the Environment Groundwater Sampling in New Zealand – Flow Chart

Instructions in **RED** must be done See over for further explanations

Step 1: Pre-sampling ☐ tick box

1.1 Check site details
1.2 Gather equipment
1.3 Calibrate field meters

- pH: Calibrate at the start of each day. Use at least 2 standard solutions (pH 4, 7 or 10)
- Conductivity: Calibrate at the start of each day. Use at least 1 standard (50-750 µS/cm)
- Temperature: Calibrate annually. Use at least 3 standard solutions (5-25°C)

Check temperature compensation for pH & conductivity calibrations using chilled standard solutions

If temperature compensation function is not working, re-calibration is required at each site. Use standard solutions at ambient groundwater temperature

Step 2: On-site Preparation ☐

2.1 Confirm correct site
2.2 Confirm appropriate sampling point
2.3 Check meter calibration
2.4 Clean sampling equipment

Check calibration at each site using at least 1 standard solution for pH and 1 standard solution for conductivity. The meter reading must be within ± 6% of expected value

If the specified criteria cannot be met on-site calibration is required

If re-calibration cannot be achieved the meter must not be used

Step 3: Purging ☐

3.1 Measure depth to water
3.2 Calculate volume to be purged
3.3 Install pump if necessary
3.4 Initiate pumping if necessary
3.5 Monitor field parameters
3.6 Assess adequacy of purging

One Purge Volume (litres)
$= 3.14 \times [D-W][R]^2 \times 1000$

D = well depth in metres
W = depth to water in metres
R = radius in metres

Continue purging until:

1 Container/flow cell and tubing have been rinsed with a quantity of water exceeding 3 times their volume
AND
2 Temperature, pH & conductivity have been measured on least 4 occasions, each measurement one purge volume apart
AND
3 The difference between the last two measurements are within the limits:
- Temperature: ± 0.2°C **AND**
- Conductivity: ± 3% **AND**
- pH: ± 0.1 pH units

Step 4: Sample Collection ☐

4.2 Preparation:
a. Label bottles
b. Reduce pump rate if required
4.3-4.7 Collect samples in any order as required:
- Isolated from atmosphere
- Filtered acid-preserved
- Filtered unpreserved
- Unfiltered unpreserved

4.8 Collect sterile unfiltered unpreserved sample if required:
a. Stop pump and terilize sample point
b. Wear clean, sterile gloves

Step 5: Site Clean-up ☐

Clean and rinse all sampling equipment between sites

Step 6: Sample storage, transport and delivery ☐

Some types of samples require appropriate measures to ensure that adequate chilling during storage and transport.
During the day: Samples should be kept in a chilli bin, with at least 5 frozen pads, or 3 kg of ice.
Overnight Courier: Replace frozen pads/ice used during the day with at least 3 kg of ice for overnight transport.
Minimise airspace in chilli bin.

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1.2 A preservative is required for some types of sample, (e.g. an acid preservative for samples to be analysed for cations). Be prepared to chill samples (e.g. for nutrients) to 1-4°C immediately after collection and for the duration of transport to the laboratory.

2.2 An appropriate sampling point is one that minimises the purging time (see Step 3) and minimises the potential for contamination or alteration of the sample. It is acceptable to collect samples from a short length of clean hose attached to the tap or wellhead.

3.2 For calculation of purge volume:

- Well depth, depth to water, and well radius must be expressed in meters in order to derive the purge volume in litres.
- If the depth to water under ambient (non-pumping) conditions cannot be determined for any reason, assume "depth to water" = 0.
- Well depth can be obtained from the drilling log or through the use of the dip tape.
- Well radius refers to the casing dimension and not to the dimension of the bore.
- If it is not possible to determine depth to water and if the well depth is unknown, then purge volume cannot be calculated. In this case, any samples collected from the well will not comply with this protocol.

3.3 The pump should be installed so that its intake is positioned at least 1 m below the static water level and a minimum distance above the top of the screened/open interval of 10 times the well diameter (for example, 1500mm for a 150mm well diameter). This will ensure that the sample is representative of the entire screened or open interval of the well.

3.4 A suitable pumping rate produces a continuous stream of water from the pump outlet or sample point without turbulence, entrainment of air or pump cavitation. Compliance with this protocol requires determination of the pumping rate during purging.

3.6 For assessment of adequacy of purging, note that:

- The purging operation requires extraction of *at least three times* the calculated purge volume and may require extraction of many more than three times the calculated purge volume.
- The field values of temperature, conductivity and pH must be measured on at least four separate occasions, each measurement at least one purge volume apart.
- The differences between the last two sets of field measurements must be the same within the following limits:
  - Temperature: ±0.2 °C, AND
  - Conductivity: ±3% (±5% if <100 µS/cm at 25 °C), AND
  - pH: ±0.1 pH unit

4.3-4.7 All samples must be collected sequentially from the sample point or from a short length of clean tubing attached to the sample point. The filtered acid-preserved, filtered unpreserved, unfiltered unpreserved samples and the samples collected in isolation from the atmosphere can be collected in any order.

4.8 Sterile samples must be collected after all other samples. This is because the requirements for sterilisation could potentially influence the chemistry of samples collected afterwards. Note that sterilisation of the sample point requires the pump to be turned off briefly.

Refer to Groundwater Sampling Protocol for further detailed explanations when required