Groundwater Purging & Sampling
Low-flow
Standard Operating Procedure

1.0 Purpose

The purpose of this procedure is to describe the field methodology for collecting groundwater samples using the low-flow method for the Town of Plymouth water quality monitoring wells. The objective of this procedure is to obtain representative groundwater samples by minimizing turbulence in the well by using low-flow pumps.

REFERENCES:
EPA Low stress purging and sampling procedures for the collection of groundwater samples from monitoring wells. July 30, 1996 Rev 2

2.0 Definitions

Purging: removing stagnant groundwater standing in a monitoring well to allow replacement by fresh formation groundwater.

3.0 Procedure

3.1 Equipment

- submersible pump with hose, portable control unit, electric generator and extension cord
- water level indicator
- water quality meter (YSI)
- flow-thru-cell for YSI
- appropriate Teflon tubing for flow-thru-cell
- gloves for collecting samples
- 5-gallon bucket
- graduated cylinder
- stop watch
- calculator
- table
- map of monitoring wells
- well keys
- bolt cutters
- sampling containers as needed
- sample labels
- waterproof taping
- chain-of-custody forms
- cooler with ice
- field logbook (bound)

- waterproof permanent marker
- first aid kit
- fire extinguisher
- deionized water for decontamination
- Liquinox for decontamination

3.2 Well Purging

The objective of well purging is to obtain a representative water sample with minimum disturbance of the water column. The well shall be purged until a minimum of two screen volumes has been removed and field parameters have stabilized.

Record all applicable information in the logbook as described in section 3.5 Field Logbook.

A reference point (measuring point) will be created on the north side of the PVC pipe with a permanent marker. This is where all measurements will be taken from including water level and total depth. Upon opening the well take a measurement of static water level. An additional measurement shall be taken three minutes after first measurement to verify equilibration.
For total depth measurements, the distance between the water sensor and the end of the water level indicator probe must be measured independently and added to each measurement.

Slowly lower the submersible pump into the well casing to the bottom of the well avoiding unnecessary agitation of silt. Pull the pump back to the position of the well screen interval (ex. 2.5-ft above the bottom of a 5-ft well screen). Allow water level to stabilize (5-10 minutes).

Attach the pump to the portable control unit and generator. Place generator down-wind and as far away from the sampling site as possible. Attach the pump outflow tubing to the flow-thru-cell containing the (YSI) water quality unit.

Start the pump on the lowest setting and adjust flow slowly until the water discharges as to not disturb suspended material in the well. Measure the pumping rate with a graduated cylinder and stopwatch. The ideal pumping rate is between 1000L/min-2000mL/min (0.1 and 2 liters per minute). Drawdown should be kept to a minimum, less than 0.50ft, when possible.

A minimum of two screen interval volumes of water must be purged. The volume of water in the screen interval shall be calculated in gallons based on the length of the screen and screen diameter. **Note**: For wells that were constructed with the natural formation as the filter pack media the well volume will be calculated using the casing unit volume only.

The Well Screen Unit Volume (sv) will be calculated using the following equation:

Well Screen Volume (gal.) = 0.041 $(D_c)^2$ (H_s)

where D_c = well casing diameter in inches and

H_s = length of well screen interval in feet

0.041 = conversion factor

The Saturated Filter Pack Unit Volume will be calculated using the following equation:

Saturated Filter Pack Unit Volume = 0.041 $[(D_B)^2 - (D_C)^2]$ $(H_S)P$

where D_B = well boring diameter in inches

D_C = well casing diameter in inches

H_S = length of well screen interval in feet

P = 0.30 = effective porosity of gravel pack (dimensionless)

0.041 = conversion factor

Example: For an 11-inch diameter borehole, 2.5-inch casing diameter, filter pack porosity= 0.30, screened interval = 10ft

Well Screen Volume = $0.041\ (2.5)^2\ (10) = 2.56$ gal

Saturated Filter Pack Unit Volume = $0.041(11^2 - 2.5^2)\ (10)(0.30) = 14.11$ gal

Total Unit Volume = Saturated Filter Pack Vol + Casing Unit Vol= 16.67gal

Two Unit Volumes = 16.67*2 = 33.34 gallons

Monitor water quality parameters of at least 3 readings and document in logbook in five-minute intervals including water level. Purging is complete when a minimum of two screen interval volumes has been purged and field parameters have stabilized. Stabilization is achieved when three consecutive readings are within the following:

- pH values are within ±0.1 pH unit,
- temperature within 3%,
- specific conductance is within 3%,
- dissolved oxygen is within 10% (or ± 0.2 mg/L for DO < 2.0 mg/L), and
- turbidity is within 10% if >10 NTU; ± 1.0 NTU between 5 and 10 NTU; or < 5 NTU

In some instances, the parameters may not stabilize and a decision must be made on whether to sample or continue purging to a three-well volume. **A three well volume purge** is calculated by multiplying the Total Unit Volume by three.

3.3 Sample Collection

Following the purging of the well, samples will be collected without disturbing the pump. Label the sample bottles with appropriate label and cover with clear waterproof sealing tape. Record applicable information in the logbook and on the chain-of-custody form including sample analysis, number and type of bottles, sampling time, etc…

Samples will be collected from the spigot on the flow-thru-cell, ensuring that sample containers with preservative do not overflow. Following sampling, immediately place the samples in an ice-filled cooler. Turn off the portable control unit and remove pump from the well. The field equipment will be decontaminated with deionized water and a phosphate free detergent such as Liquinox.

3.4 Quality Assurance & Quality Control

Note: For each sampling round each quality control listed below will be collected in the field for all the chemical analyses for the laboratory.

Equipment Blanks

Deionized water will be used to collect equipment blanks prior to operation of the well. The blank will be assigned a unique chain-of-custody control number and stored in the cooler of ice with the other samples.

Field Duplicate

Field duplicate samples will be collected immediately following the original sample collection. The duplicate will be assigned a unique chain-of-custody control number and stored in the cooler of ice with the other samples.

3.5 Field Logbook

All field notes will be kept in a bound field logbook using waterproof ink and contain the following information:

- sampling personnel
- weather conditions
- equipment used
- site conditions and well ID
- condition & type of well
- site map
- water level & total depth measurements
- minimum purge calculation
- purge start/stop time
- pumping rate
- field parameters
- date and time of sampling
- sample collector
- sample analyses and sample container type/number
- QA/QC collected
- relinquishment of samples