Montana Department of
ENVIRONMENTAL QUALITY MEMO

To: DEQ SRS

From: Amy Sivers

Date: 4/18/2005

Re: **SRS Low-Flow Purging and Sampling Guidelines**

The following guidelines provide the basis for low-flow sampling protocol at Montana Department of Environmental Quality (DEQ) Site Response Section (SRS) facilities, unless site-specific and contaminant-specific conditions require alternate protocols be followed. If alternate protocols are proposed, the sampler must provide a detailed written justification for the deviation from these guidelines. If the sampler is other than DEQ, the sampler must obtain DEQ approval prior to commencing a low-flow sampling event or program. If the sampler implements a deviation from these guidelines, such deviation must be documented in writing where the resulting data are discussed, for example in the site investigation (SI) report or monitoring report, and also in the field log book or groundwater sampling log.

Low-flow sampling purges stagnant water out of the well to allow sampling of formation water; however it is intended to purge and sample only a limited interval of the well/formation column.

Applicability of Guidelines:
"Low-flow" purging and sampling is also called "minimum drawdown" and "low-stress" purging and sampling. This SRS guidance does not cover minimum-purge or no-purge sampling.

Guidelines:

1) Low-flow sampling is generally not appropriate for wells that contain light or dense non-aqueous phase liquids (LNAPL or DNAPL), and is not appropriate for collecting samples of LNAPL or DNAPL.
2) A positive displacement pump that allows for an adjustable pumping rate should be used for low-flow groundwater sampling under most conditions
    a. Suction pumps, such as peristaltic pumps, are inappropriate for collecting volatile organic compounds (VOCs), semi-volatile organic compounds

(SVOCs), volatile petroleum compounds and some (pH-dependent) metals, particularly in wells deeper than 10-15 feet, because of the potential for degassing and associated potential pH changes.

b. Inertial pumps (such as Waterra) or bailers should never be used for low-flow sampling because they generate turbulence in the well.
c. Dedicated pumps are preferable to portable pumps. Portable pumps may create disturbance in the water column during installation, and also require decontamination between wells.
d. If a portable pump is used, new or dedicated tubing must be used at each sampling location, and the pump must be lowered gently into the well to minimize disturbance to the water column.

3) If a petroleum-powered generator is used to run the sampling pump, the power source must be located at least 10 feet downwind of the wellhead and sampling apparatus, and should be located at least 30 feet downwind if possible.
4) Pump intake must be in an appropriate location with respect to well screen.
   a. For most sites, and at wells with screens 10 feet long or shorter, the pump intake should be located at approximately the midsection of the saturated screened interval.
   b. For wells with screens longer than 10 feet, the primary flow zones and contaminant concentration intervals must be identified and pump intake location must be determined in consultation with SRS.
   c. For sites with intervals of different contaminant concentrations within the well screen, the pump intake should be located in the most contaminated interval.
      i. For example, at sites with LNAPLs, such as gasoline-type petroleum contamination, it may be appropriate to collect groundwater samples from the upper portion of the saturated screened interval. However, the pump intake and pumping rate must not allow drawdown of the water level to the level of the pump intake.
      ii. At sites with DNAPLs as sources of groundwater contamination, it may be appropriate to locate the pump intake in the lower portion of the well; however, the pump should not be placed in the lower two feet of the well if possible, so as to avoid disturbing sediment.
   d. For fractured bedrock sites and other sites with preferential contaminant flow pathways, the pump intake should be placed to sample the most hydraulically conductive interval, unless the sampling objective is to sample a different flow path.
5) Low-flow sampling is designed to achieve laminar groundwater flow through the well screen and into the pump intake. This sampling technique therefore requires knowledge of well construction and lithology surrounding the well, and it requires that the well be in good condition. Therefore if well construction information is unavailable, or screen silting/biofouling or other well construction

issues have been observed, the well in question should not be used for low-flow sampling. Re-development of site wells is advisable prior to introducing low-flow sampling, particularly if wells are more than five years old.

6) Pump tubing must be appropriate for the analytes to be sampled. Certain types of plastic tubing can either sorb contaminants from sample water or contribute contaminants to sample water as it flows through the tubing.
    a. Teflon, Teflon-lined and steel tubing is preferred for sampling for organic compounds including VOCs, SVOCs, petroleum, pesticides and PCBs. If other tubing is used for these analytes, an equipment blank should be used to check that contaminants are not being added to the water, and SRS may require that a 'spiked' solution be run through the tubing to check for sorbtion.
    b. In addition to Teflon and Teflon-lined tubing, PVC, polypropylene or polyethylene tubing is also appropriate for metals sampling. Stainless steel tubing is not appropriate for collecting metals samples, although equipment blanks may demonstrate whether or not there is an effect.
    c. The smaller the diameter of tubing used, the easier it will be to maintain low flows without getting air bubbles in the tubing.
    d. Maximize tubing wall thickness and minimize tubing length to minimize diffusion between water and the atmosphere.
    e. If a peristaltic pump is used for low-flow sampling (see #2 above), pharmaceutical grade ("pharmed") tubing should be used around the rotor head of the pump to avoid diffusion to/from the atmosphere.
7) Pump rates for low-flow sampling should generally not exceed 0.3 liters/minute. Aquifers with particularly high conductivity may be able to sustain higher flow rates with laminar flow into the well and without excessive drawdown.
8) Initial depth to water must be measured prior to starting the water pump. Depth-to-water measurements must be collected frequently during purging and sampling and recorded in the sampling log; depth to water is typically measured at the same frequency as stabilization parameters are measured. Depth to water may be measured using an air-water interface probe, or a transducer located above the pump. If a transducer is used it must be 'truthed' at the start and end of sampling using an interface probe. Depth to water measurements should have minimum 0.01-foot accuracy. Care should be taken when inserting measurement devices into the well to avoid disturbance to the water column.
9) Total well depth should never be measured at the start of the low-flow sampling event, because this causes disturbance of the water column in the well. Instead, total well depth should be measured in advance of the sampling event, and may be re-measured after completion of a low-flow sampling event.
10) Initial drawdown should ideally not exceed 0.3 feet; however, initial drawdown in excess of 0.3 feet may be allowed if the water level stabilizes after that initial drawdown. If the water table is initially above the top of the well screen, then the water level should not be allowed to drop below the top of the well screen during

purging and sampling. Also, total dewatering is never acceptable in low-flow sampling – if low-flow purging causes total dewatering, passive samplers may be an appropriate alternate sampling methodology.

11) Pumped water should flow through an in-line water quality meter such as a flow-through cell. Stabilization parameters should be decided on a site-specific basis, dependent on site geochemistry and other factors, with the following understanding:
    a. Field indicator parameters for stabilization include turbidity, dissolved oxygen, specific conductance, and redox potential. Temperature may also be recorded during well purging. Stabilization criteria should be those established in the EPA document ORD/OSWER EPA/540/S-95/504 as referenced at the end of this document.
    b. The key stabilization parameter for VOC sampling is dissolved oxygen, which should stabilize to three consecutive readings within 10% of each other (this is a 10% difference between the magnitudes of the readings, and not 10% DO in the samples), OR within 10% of 0.2 mg/L, whichever is greater. SRS may require that additional stabilization parameters be monitored.
    c. The key stabilization parameter for other contaminant sampling is turbidity, which should stabilize to three consecutive readings within 10% of each other, OR three consecutive readings below 10 Nephelometric Turbidity Units NTU, whichever is greater. SRS may require that additional stabilization parameters be monitored.
12) Stabilization parameters should be measured on a three- to five-minute frequency; where a flow-through cell is used, complete exchange of water through the flow-through cell is necessary between measurements. The proposed work plan/SAP/SOP for low-flow sampling must state the frequency of stabilization parameter measurements.
13) Samples should be collected after indicator parameters have stabilized. When more than one sample type is to be collected from the well, samples should be collected in order from most volatile to least volatile analytes.
    a. The pump should not be moved or turned off between purging and sampling.
    b. The pump rate may be decreased for sample collection in order to allow filling of sampling containers (this is often necessary to fill VOC sampling vials).
    c. Note – as in all groundwater sampling, make sure the flow-through cell is bypassed during sample collection.
14) If parameters do not stabilize, either:
    a. the well should be purged for a minimum of four hours prior to sampling, or
    b. a minimum of three well volumes should be evacuated from the well prior to sampling, or

c. the sampler should discontinue purging and not collect a sample.

If a sample is collected, lack of stabilization of parameter values should be documented in the field logbook. Whether to allow sampling when parameter stabilization is unattainable is a site-specific and contaminant-specific decision.

Site-specific decisions:

Many decisions about protocol for low-flow sampling must be made on a site-specific basis. These include any proposed exceptions to the guidelines above, and the following additional requirements:

- QA/QC requirements
- Decontamination requirements – for portable pumps, dedicated pumps, dedicated tubing
- Condition of existing on-site wells and need for re-developing or replacing old wells
- Stabilization parameters and stabilization criteria
- Sample collection at wells where parameters do not stabilized after purging
- Field filtering requirements for any samples
- How to compare low-flow data to existing non-low-flow site data (VOCs may increase because of lower mixing, agitation, etc; metals, PAHs and other particulate-associated COCs may decrease due to less suspended sediment in the sample) – whether to require contemporaneous side-by-side sampling using low-flow and traditional methods to compare data, or whether to compare low-flow data to historical site data.

References:

Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures – Puls, R.W. and Barcelona, M.J. (April 1996) – EPA ORD/OSWER EPA/540/S-95/504

Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples From Monitoring Wells – EPA Region 1 (July 30, 1996) EPA R1 SOP# GW 0001.

Standard Operating Procedure for Low-Stress (Low Flow) / Minimal Drawdown Groundwater Sample Collection – EPA Region 9 (undated) EPA R9

Groundwater Sampling Procedure Low Stress (Low Flow) Purging and Sampling – EPA Region 2 (March 16, 1998) GW Sampling SOP Final.

Technical Guidance on Low-Flow Purging and Sampling and Minimum-Purge Sampling (2nd ed.) – Nielsen, D.M. and Nielsen, G.L. (April 2002) – Nielsen Environmental Field School, NEFS-TG001-02.