Title: **Low Flow Pumping Versus Field Filtering Analysis with Respect to Implementation**

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Background/Need: Many monitoring wells yield turbid samples due to inadequate well development and/or the agitating effects of bailing the well. Wisconsin requires field filtering of inorganic samples from these wells in order to eliminate turbidity resulting from the well environment. However, the EPA is concerned that filtering may remove colloidal material normally present in groundwater. Metals tend to sorb to the surfaces of these colloidal particles. In theory, slow pumping at rates below 200 ml/min eliminates the need for filtering and retains the naturally occurring colloids without obtaining additional material from the well environment. In October 1991, the U.S. EPA banned field filtering in favor of low flow pumping at Subtitle D landfills. This ban became effective in October 1994. Wisconsin and other states were concerned about the change in practice because results from unfiltered samples, especially those with significant turbidity, could trigger false positives that would unnecessarily force a site into assessment monitoring under Subtitle D.

Objectives: To determine if there is a significant difference between levels of metals contamination found in a well using the low flow pumping technique as opposed to using the bailing and field filtering technique. A second objective was to determine how the implementation of the low flow pumping method would affect the ability of groundwater professionals to perform quarterly monitoring activities in a cost effective manner.

Methods: Monitoring wells in unconsolidated material with 5 to 15 foot screen lengths were sampled at depths ranging from 10 to 115 feet. Low flow pumping using a positive displacement pump was initiated with flows never higher than 600 ml/min and in most cases less than 200 ml/min. The pump discharge tubing was connected to a flow through cell where the following measurements were taken: pH, temperature, conductivity, dissolved oxygen and turbidity. A sample was collected for metals analysis after turbidity values stabilized. Following this a bailed and filtered sample was collected for comparison to the low flow sample. Samples were analyzed for metals appropriate to each site, including arsenic, cadmium, chromium, copper, iron, lead and zinc. Thirteen low flow/bailed and field filtered sample pairs were collected from 3 sites resulting in 35 comparable metals analyses.

Results and Discussion: Out of 35 sample pairs, 24 exhibited the expected tendency of the low flow sample to reflect a higher level of metals contamination than the bailed and field filtered sample. Ten of these pairs, however, showed either no difference between metal concentrations in the sample pairs or actually exhibited an effect opposite to what we expected. In eight of these samples the filtered counterpart exhibited higher levels of contamination than did the unfiltered, low flow sample. Over 50 percent of the sample pairs showed less than a 20 µg/L difference in metal concentration. Almost 25 percent of the sample pairs showed lower concentrations in the slow pumped sample. Therefore, this study did not consistently support the theory that field filtered samples underestimate levels of metals contamination. Generally the low flow pumping technique produced less turbid samples that were presumably more representative of aquifer water.

Using the low flow pumping technique to produce more representative samples was evaluated in light of various complications associated with implementing the method. The low flow pumping technique was not effective in wells with low hydraulic conductivities. The technique performed adequately, however, in winter sampling conditions where temperatures were below freezing. The low flow pumping technique took

a minimum of 2 hours to sample a well while it took as little as 20 minutes to sample using a bailer. The cost of the low flow pumping system is approximately $5,000 while the cost of a bailer and line is approximately $200. Additionally, the sampling equipment needed for the low flow pumping technique is cumbersome which can cause problems when access to the well is difficult.

A survey of those who sample monitoring wells at landfills in Wisconsin was included as part of this study. Eighty percent of those surveyed use a bailer to purge wells prior to sampling while 89 percent use a bailer to retrieve the sample. Sixty-one percent of those responding to the survey indicated that over 50 percent of their wells produce turbid samples.

Recommendations:

1. When using the low flow pumping technique, use turbidity to determine when a representative sample is being obtained.
2. When using the low flow pumping technique, measure water levels in the well while pumping to ensure that drawdown is not occurring while purging and sampling.
3. Do not ban field filtering. Bailing and field filtering can continue to be an appropriate method at some wells under some circumstances.
4. Consider using the low flow pumping technique where costs can be justified and when there is a question whether or not a groundwater standard has been exceeded.
5. If using the low flow pumping technique, use a dedicated low flow pumping system and a pump which can start at a low rate where possible.
6. Consider using a technique other than low flow pumping if financial resources are limited, if exceedence status is not in question, if the well can be purged dry, if metals are not of concern or if access to the well is difficult.
7. Further studies should: a) Compare the sampling results for inorganics other than metals and VOCs when sampling using the low flow pumping technique to results when bailing; b) Investigate new more effective methods for sampling wells which can be purged dry; and c) Investigate further the cases where higher metals values were found in the bailed and field filtered samples that were found in their low flow counterparts.

Related Publications: Connelly, J. 1994. Monitoring Well Sampling - You Can't Always Get What You Want But Can You Get What You Need? EPA/600/R-94/205, pp. 43-53.

Key Words: low flow pumping, slow pumping, bailing, field filtering, metals, groundwater sampling, groundwater monitoring

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Final Report: A final report containing more detailed information on this project is available for loan from Wisconsin's Water Library, University of Wisconsin - Madison, 1975 Willow Drive, Madison, Wisconsin 53706 (608) 262-3069.