Go with the **Low Flow**

By Susan Gray, Steve Light, and Marshall Cloud

LOW-FLOW purging and sampling methods can mean large cost savings and high-quality data, and can minimize the generation of investigation-derived wastewater. The 100 monitoring wells at the Defense Distribution Region West in Tracy, CA (DDRW-T), should save $100,000+ annually. Consequently, the Environmental Protection Agency (EPA), California Department of Toxic Substances Control, and California Regional Water Quality Control Board have approved full implementation of this sampling method at this location.

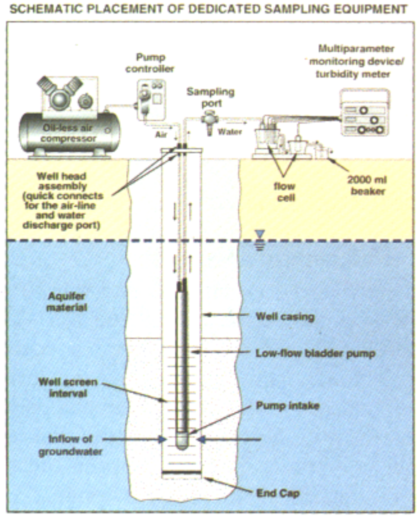
Low-flow Purging

Low-flow purging (also called "micro-purge") involves extracting groundwater at rates comparable to ambient groundwater flow rates to minimize drawdown and limit the mixing of stagnant water in the well casing. The method facilitates equilibration with the surrounding formation (as evidenced by the stabilization of groundwater parameters) and produces samples that are more representative of the formation water. As a result, only the stagnant water in the pump and attached tubing, and the area in the well immediately around the pump, must be purged before sampling. Conventional purging methods require that three to five submerged casing volumes of water be removed before samples can be collected.

The Study

In March and April 1995, DDRW–T conducted a study to investigate the feasibility of using low-flow purging and sampling methods for quarterly groundwater monitoring at the facility. Dedicated bladder pump systems were installed in 30 of 132 monitoring wells; these offered a viable subset of the range of geologic units and contaminant concentrations observed. Bladder pumps were used because there is no impeller to create pressure gradients and off-gassing, and because there is no down-well pump motor to cause heating and additional sample bias. These pumps can also operate efficiently at low-purge rates (110 to 400 milliliters per minute) and can thus minimize artificially generated turbidity and limit mixing fresh water with stagnant water in the casing or with water above the screened interval from other horizons.

SCHEMATIC PLACEMENT OF DEDICATED SAMPLING EQUIPMENT



During sampling, groundwater is discharged to an in-line flow cell that measures pH, specific conductance, redox potential, temperature, dissolved oxygen, and turbidity. Samples were not taken until all parameters had stabilized and turbidity was reduced to 10 nephelometric turbidity units or less. For both methods, turbidity was generally the last parameter to stabilize, followed by dissolved oxygen and redox potential. Turbidity stabilized after about five pump and tubing volumes for the low-flow method.

Using the conventional method, stabilization criteria were usually achieved before three submerged casing volumes had been purged; however, the amount of wastewater generated was controlled by the three- to- five-casing volume requirement. Nonetheless, when using the conventional method, the disturbance on the formation caused by the higher flow rates raised the initial turbidity an order of magnitude higher than when using the low-flow method. Thus, the purge volume required to achieve stability was still significantly greater than that required by the low-flow method.

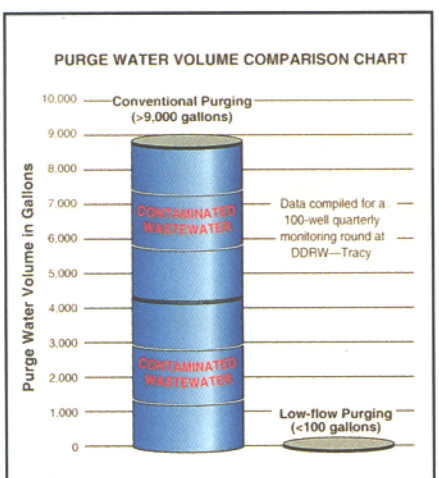
Technical Advantages

A statistical comparison of the analytical results for volatile organic compounds (VOCs) and total metals from each of the 30 wells after two rounds of sampling indicated there was good correlation between low-flow data and historical data from these same wells. Results of volatile organic compound and total metals analyses from samples collected using the low-flow method were also comparable to historic analytical results. The combination of minimizing the agitation of the water column by using dedicated equipment and purging the well at a low-flow rate produced representative data by minimizing the potential for off-gassing of VOCs and limiting artificially generated turbidity.

The use of dedicated equipment means additional advantages as well. It ensures repeatable samples and yields more accurate data because the sample depth, lifting (pumping) method, and sampling system materials are the same from well to well and from sampling round to sampling round. Further, the potential for cross-contamination between wells is eliminated, and accidental contamination of a sample at the ground surface is also reduced.

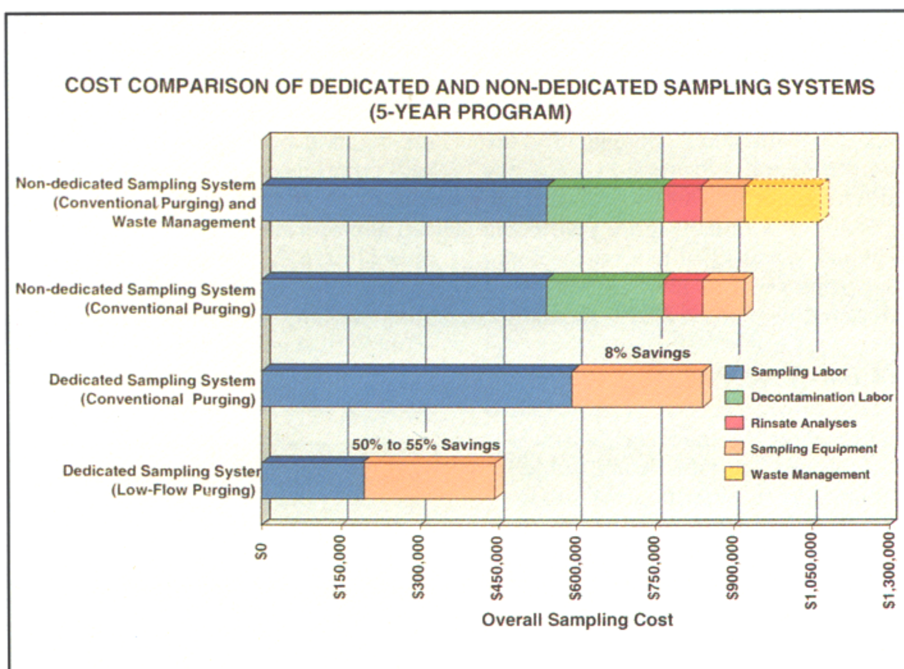
Cost Effectiveness

The most obvious advantage of the low-flow purging method is the reduced volume of purge water and the associated reduction in cost for disposing of the purge water. During typical groundwater sampling at DDRW–T using the conventional method, the sampling of 100 wells would generate over 9,000 gallons of wastewater at an annual cost of some $27,400 for containment and disposal. In contrast, purging and sampling with the low-flow method would generate about 100 gallons of wastewater at an annual cost of about $400.



Low-flow purging also reduces the time spent to purge and dispose of water. Compared to conventional methods using dedicated equipment, two to four hours of time were saved at each well deeper than 50 feet. When compared to the use of portable non-dedicated equipment (which can operate at higher flow rates), only five to 15 minutes were saved at each well. However, this did not reflect the time spent decontaminating equipment between wells and collecting equipment rinsate blanks to monitor the effectiveness of decontamination. These activities can consume up to an hour between wells and generate substantial additional analytical costs.

Using actual costs from this study, the estimated savings for a five-year, 130-well sampling program employing the low-flow method would be about $482,200. This is a 52 percent cost reduction from the non-dedicated conventional sampling method historically practiced at DDRW-T. If the facility had to dispose of the purge water as investigation-derived wastewater, additional savings could be realized. The initial capital cost to install the dedicated bladder pump systems would be recovered in about 1.5 years. Using the low-flow purging and sampling method during a long-term monitoring program (typically 30 years) would further increase cost savings to $3.8 million.



Potential Benefits

The low-flow purging and sampling method should be considered a viable option at sites that involve a costly well-monitoring program (e.g., large submerged casing volumes, an extensive monitoring network, and fine-grained soils). While a dedicated system means a higher initial investment (than does the use of portable equipment), it will minimize labor costs and eliminate some analytical expenses, offering significant savings over the life of a monitoring program. Finally, low-flow sampling can decrease time required to purge and sample each well, minimize generation of wastes, and reduce disposal costs.

While this study and others reveal opportunities for significant cost savings, a site-specific evaluation should be made and regulatory agencies should be contacted before making the final decision about the feasibility of using low-flow methods. TME

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