A COMPARISON OF PASSIVE SAMPLING AND LOW-FLOW OR BAILED SAMPLING RESULTS ACROSS A RANGE OF AUSTRALIAN HYDROGEOLOGICAL SETTINGS

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INTRODUCTION

The availability of no-purge groundwater sampling technologies offers the opportunity to undertake more cost-effective and sustainable approaches to groundwater monitoring in the management of contaminated sites. A number of studies indicate that groundwater samples collected without prior purging (no-purge sampling) can produce results under specific conditions that are comparable to samples collected through conventional purging methods (Byrnes et al., 1996; Bealer et al., 1998; API, 2000; Savoie & LeBlanc, 2012). ERM working with Viva Energy Australia (Viva Energy) developed a programme of trialling and evaluating no-purge groundwater sampling on a range of sites within Viva Energy's portfolio.

METHODS

Technology Selection

The initial project step was the evaluation and selection of a range of no-purge technologies to trial. Based on review of available no-purge sampling technologies the HydraSleeve™ was selected as it was considered to suit a broader range of analytes and to be more cost effective than alternative methods.

Site Evaluation

Consistent with ITRC (2006) guidance, the study evaluated 145 sites within a portfolio of petroleum hydrocarbon sites for appropriate conditions for no-purge sampling. The portfolio includes sites across Australia and represents a range of hydrogeological conditions. Trial sites for no-purge sampling were selected where water quality within a monitoring well screen was considered most likely to be representative of groundwater in the aquifer. The conditions considered to lead to this scenario were:

a) Unconfined aquifers with monitoring wells screened across the groundwater table;
b) Unconsolidated aquifers;
c) Aquifers with moderate to high groundwater flow velocities;
d) Monitoring wells that have been well developed and are free from biofouling;
e) Sampling for petroleum hydrocarbons only; and
f) No measureable non-aqueous phase liquids (NAPL) in the monitoring well.

In addition to the site conditions outlined above, no-purge sampling trials were conducted at sites where high-precision sampling was not required and where results from sampling methods that employed purging were available for comparison. Sites near monitoring endpoints with regulators were also excluded. Across the portfolio, 77 of the 145 sites reviewed (53%) were found to be suitable for the no-purge sampling trials.

Groundwater Sampling

For sites and wells selected for no-purge sampling, Hydrasleeve™ grab samplers were deployed within the screened interval at depths based on the well's position relative to the plume source area and on observations made during the drilling and/or historical sampling of the well. This was done to best target the water column interval where hydrocarbon concentrations were expected to be highest.

For the purposes of comparing no-purge to more recognised sampling methods, at three sites sampling was completed within a week of the no-purge trial using the purge and bail or low flow techniques historically used on site. The data analysis and review in this paper focuses on the results for TRH C_6-C_{40} and BTEX from these three sites.

The three sites evaluated are: Site A with an unconsolidated sand aquifer (8 wells), Site B with a weathered shale aquifer (4 wells), and Site C with a fractured basalt aquifer (15 wells).

RESULTS AND DISCUSSION

For Site A and Site B, which were characterised by unconsolidated aquifers, the no-purge results provided reasonable results when compared to both the corresponding low-flow sampling and historical results. The relative percent difference (RPDs) of no-purge BTEX and TRH C_6-C_{10} results compared to the low flow results ranged from 10% to 130% and were consistent with the range of RPDs for site field duplicates. It is noted the higher range of RPDs were from lower concentration (less than 500 µg/L) samples. The RPDs for TRH $>C_{10}$-C_{16} ranged from 0% to 366%. Where the RPDs for TRH $>C_{10}$-C_{16} exceeded the site field duplicates range, the no-purge sample results reported higher than the low flow sample.

By contrast results from Site C, located in a fractured basalt aquifer, indicated that the connectivity of specific wells, presumable through the fracture network, and the aquifer’s response to pumping were controlling factors in how results from the no-purge sampling compared to those from more traditional purging methods. At one well, results from the no-purge sampling were several orders of magnitude below previous results; at another well, results from the no-purge sampling over predicted those from low flow sampling. At this site, differences in results between the two sampling methods did not appear to be related to the analyte or to the concentration range.

CONCLUSIONS

The results show that where the criteria are consistent with those presented in ITRC (2006) guidance, no-purge sampling is likely to be a suitable technique for groundwater monitoring with suitable hydrogeological and well conditions as well as suitable site data quality objectives. In fractured rock environments, variations in fracturing and groundwater pathways may results in no-purge sampling results that are not comparable to those from purging-based sampling methods.

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