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Presentation title:

"Effects of intraborehole flow on purging and sampling long-screened or open wells"

David Poulsen[1], Peter Cook[1], James McCallum[1], Craig Simmons[1] and Shawan Dogramaci[2]

[1]National Centre for Groundwater Research and Training (NCGRT), School of the Environment, Flinders University, GPO Box 2100, Adelaide SA 5001, Australia

[2]Rio Tinto Iron Ore, 162-168 St Georges Tce, Perth, WA, Australia

Abstract

Wells with long screens or open intervals are common and in some cases they are all that is available to investigate a groundwater system. However, such wells create a shortcut for vertical flow of water, driven by hydraulic head gradients. In a recharge area, water moves vertically down through the borehole and, over time, a plume of 'contaminating' water develops in zones with lower head. When the well is pumped, yield from zones with lower head will actually be water originating from zones with higher head. This process requires special consideration if groundwater samples are to be accurately interpreted.

This modelling study investigates mixtures of groundwater sampled from a long-screened well and the time needed to purge a plume of intraborehole flow as a function of preceding un-pumped duration. An unconfined regional groundwater system (dimensions of 3000 x 77 x 75 m) was simulated using MODFLOW, with recharge applied across the surface and discharge via a constant head boundary on one side. A long-screened well was represented using the Multi-Node Well Package (MNW2) and water was traced by simulating groundwater age in MT3DMS. Un-pumped and pumped stress periods were applied in uniform, layered and heterogeneous systems.

Results show that the volume of intraborehole flow can exceed the common practice of purging three casing volumes, even under small vertical head gradients and short times. Pumping a well draws water from all permeable zones in the screened interval so, unless packers are used to target specific intraborehole flow receiving zones, total pumped volume must greatly exceed the volume of intraborehole flow if it is to be fully removed. Complete purging may not be feasible, so identifying which depths a sample actually represents avoids misleading interpretations and provides representative data for at least some depths in a wells screened interval.