

Investigations of the impact of groundwater abstraction on surface water / groundwater interactions using carbon-14

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Groundwater resources are increasingly being developed across the globe, particularly in arid to semi-arid regions where, in periods of drought, groundwater is heavily relied upon. Over abstraction of groundwater has the potential to impact surface water flows in these catchments. However, the processes and timescales at which this impact operates are generally poorly understood. Groundwater dating using carbon-14 can aid in the understanding of long-term surface water / groundwater interaction processes. The study area, the Maules Creek catchment is located on the western slopes of the Great Dividing Range in NSW, Australia. The Maules Creek flows westward and eventually into the Namoi River. Within this catchment, groundwater has been extensively abstracted mainly for the irrigation of cotton, since the early to mid 1980s. Correspondingly, an average decline of groundwater levels of about 4 m has been observed over the last 30 years. Consequently, flow in the Namoi River appears to have become more intermittent over the same period. Groundwater samples were collected from 40 monitoring bores and radiocarbon analysis was completed at ANSTO. Fifteen samples were analysed by the primary author in April 2009 and a further 25 samples were analysed by ANSTO as part of a collaboration. The results generally indicate increasing apparent groundwater ages with distance along the groundwater flow paths and with depth beneath the ground surface. However, noticeable differences to this pattern are observed. Near the Namoi River, older groundwater is generally found at much shallower depths than anticipated. This reflects an upward discharge of groundwater into the river. Also near the river, at groundwater abstraction bores which experience large seasonal drawdown, this age pattern is severely disrupted with modern water found at considerable depth in the aquifer. It appears that the origin of this modern groundwater is recently infiltrated river water that flows into the aquifer due to the lowered groundwater levels. This significant change in the surface water / groundwater interaction has an overall impact on the catchment water balance with substantial impacts on the volume of water entering the river from the aquifer.