An isotopic approach to hydrological mass balance in the Nattai River catchment (SE, NSW), 2. rain, groundwater, and stream sulphate ^{35}S, $\delta^{34}S$, $\delta^{18}O$, $\Delta^{17}O$

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Accurate prediction of catchment performance using mass-balance hydrological models requires detailed understanding of dynamic input parameters. These include rainfall – runoff, evapo-transpiration – groundwater recharge, and baseflow contributions.

The Nattai (Fig. 1) is typical of many rivers in the Sydney water catchment areas where small (<20mm) low intensity rain events cause minor rise in river levels, returning to pre-event levels within a couple of days. Between rain events groundwater with variable residence time supports streamflow. The age of groundwater supporting this flow may be dated by tritium (~10-50 years) and ^{14}C (~1,000-40,000 years) techniques. However, these techniques have poor age resolution to characterise surface water or groundwater discharge less than 50yrs.

This research describes the application of a rarely used radio-isotope dating technique (^{35}S $t_{1/2}$ = 87.1 days). ^{35}S is a cosmogenic isotope produced in the upper atmosphere by cosmic rays. ^{35}S is suitable for determining the residence time of sulphate in surface drainage and rapid flow groundwater discharge in steep coastal catchments with timescales from months to 2 years (Michel and Turk 1996). An estimate of water residence time can be derived by application of sulphate retardation factors for stream and groundwater systems. Retardation factors are refined with the aid of other isotopic markers such as sulfate-$\delta^{34}S$, $\delta^{18}O$ and $\Delta^{17}O$.

Rainfall sulphate ^{35}S was sampled from 2 sites, Mittagong in the upper Nattai catchment and a near coastal site Mt Keira over 20 individual rain events from May 2005 to February 2006.

Sample type	**Range**	**Average**	**Apparent SO_4 Age**
10*Mittagong Rain	2.5 – 18.1 Bq/g	av 8.1 Bq/g	0 mths
49*Nattai R & tributaries	0.08 - 1.8 Bq/g	av 0.47 Bq/g	12 mths
5*Groundwater	0.06 - 0.13 Bq/g	av 0.09 Bq/g	20 mths

The wide range of ^{35}S in rain reflects the variable sulphate source. Measured trace elements and stable SO_4 isotopes in rain from the Illawarra region identify sea spray and highly variable anthropogenic sources as typically dominant over atmospheric fallout of sulphate aerosols from DMS oxidation. However, to determine the assumed near constant ^{35}S flux, the minor proportional contribution of sulphate from atmospheric fallout (DMS oxidation) must be separated from the major sea-spray and anthropogenic sources, which contain no ^{35}S but dilute significantly sulphate in rain.

Nattai River samples downstream from Mittagong's effluent discharge (~0.25 Bq/g) and samples from a 91mm high flow rain event (~0.1 Bq/g) are included in the averages. This has the effect of increasing the apparent average age for the stream samples. Individual tributaries each show a characteristic mix between short term interflow storage (<6 mths) and groundwater discharge contributions (20 mths). The short groundwater residence time implies a relatively rapid flow system for shallow groundwater. No discharge sites for deeper groundwater could be identified below the Hawkesbury Sandstone.

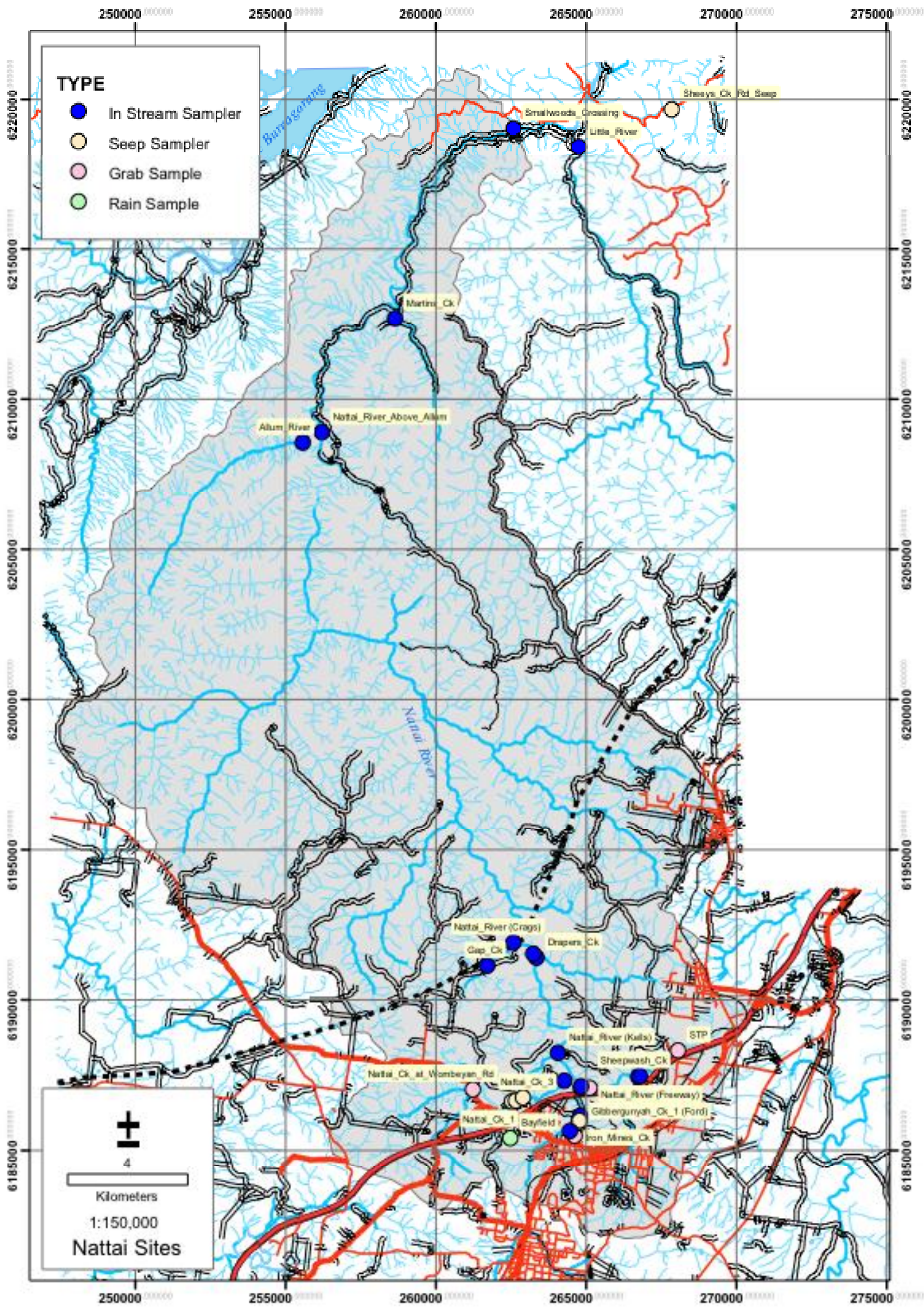

Figure 1 Location of sample sites in the Nattai catchment.

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