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Optimizing the approach required to accurately predict seasonal water use variation in a *Eucalyptus Globulus* plantation: A Case Study from the Lower Limestone Coast of South Australia

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Increasing demand for water resources makes quantification of agricultural and industrial demand essential for sustainable water management. This study was undertaken in the Lower Limestone Coast of South Australia where plantation forests are known to access groundwater. As the resource is shared between plantation growers, other agricultural users and natural ecosystems, extraction from groundwater resource is licensed by local authorities and water has an associated cost. This study forms part of a broader investigation to accurately quantify plantation water use.

This study investigated the feasibility of instrumenting field sites with fewer sap flow sensors to increase total site monitoring capacity. Research has not yet established the optimal number and arrangement of sap flow sensors required for accurate estimation of sap velocity to estimate evapotranspiration of a forest stand. Field sites of approximately 20 m x 20 m have been used with at least six sap flow sensors in the region to estimate plantation water use characteristics. This study sought to establish whether field sites utilizing three sap flow sensors was feasible to estimate sap flow velocity of a *Eucalyptus globulus* plantation forest over a 10-month period. It also sought to determine whether a wholly random selection of trees was appropriate, or whether the average water use was influenced by tree size.

A monitoring plot of 20 m x 20 m was established. A census of tree diameters at breast height (DBH, measured at 1.3 m above ground level, over bark) was conducted as an indicator of tree size, and the plot was subsequently categorized into three DBH size classes, namely, low (L); Medium (M); and High (H). Within each size class, two sample trees were selected at random and a total of six sap flow sensors were instrumented. A total of 20 tree combinations, involving the sub-selection of 3 sensors out of a possible 6, were analyzed for a selected month during the autumn, winter, and spring seasons.

The average sap velocity was characterised across three seasons with all sap flow combinations. Sap velocity was greatest during spring and lowest during winter, as expected. The average sap velocity increased progressively from LLM (combinations with the smallest DBH trees) to (those with the largest). Larger tree combinations (MMH, HHL, HMM) generally exhibited higher average

monthly sap velocities. When examined to determine total water use, this results in an over-estimation of stand evapotranspiration. In contrast, smaller tree combinations (LLM, LLH, LMM) tended to produce lower sap velocities, potentially leading to underestimation.

Selecting an 'average' combination (LMH) was the most representative approach to measure the average monthly sap velocity using three sensors. This combination produced the same average monthly sap velocity as that based on using six sensors. This suggested that the use of three sap flow sensors can reliably estimate sap velocity on a spatial and temporal basis within a study plot, and also emphasised the need to consider variables like DBH when selecting trees in any monitoring study. Further research will be undertaken to verify the findings at other locations.