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Enhancing the hydrogeological landscape (HGL) characterisation of the Greater Launceston area (GLA) through better understanding of dolerite weathering, stream water properties and a revised landscape evolution model

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In the Greater Launceston Area (GLA) in northern Tasmania, Australia, there is a widespread urban salinity problem with severe impacts on urban/peri-urban infrastructure in localised areas. Salinity patterns in the landscape (elevated flux to waterways; salt efflorescence at the land surface) could be related to: the underlying rock type, the thickness of regolith materials and hence the volume of the salt store, the landforms present and the amount of water passing over and through the landscape.

In northern Tasmania secondary mineralogy on dolerite typically includes formation of Fe/Ca smectite phases (e.g. nontronite, saponite) and Fe-Ti oxides/sesquioxides (e.g. hematite, goethite) with some primary phases (e.g. Ca-plagioclase feldspar, augite) weathering through to a suite dominated by kaolinite clay and Fe-Ti oxides/sesquioxides. Deeply weathered profiles in the GLA have weathered to the kaolintite-clay dominant mineralogy and in places there are gibbsite/beidellite/hematite/goethite bauxites developed. Most existing salinity mapping emphasises salt manifestation over paleo-estuarine sediments of the Paleogene Tamar-Esk River system, so incorporation of deeply weathered Jurassic dolerite materials into the salt budget considerably augments the estimated potential hazard.

Rapid stream surveys provide a snapshot of stream electrical conductivity (EC) over the study area at regular intervals allowing a broad evaluation of salt flux patterns in surfaces waters. Higher EC readings were obtained from selected streams draining: deeply weathered dolerite profiles (0.37 1.86 dS/m) and deeply weathered Paleogene paleo-estuarine sediments (0.49 to 1.16 dS/m). Lower values were measured on up-faulted dolerite blocks (<0.10 dS/m); moderately weathered, high relief dolerite (<0.03 dS/m), and in incised streams flowing over a rocky dolerite substrate (<0.03 dS/m). The patterns of stream EC reflect the nature of the regolith materials the streams drain, and match mapped patterns for distribution of deeply weathered Jurassic dolerite and moderately to deeply weathered bedded paleo-estuarine sediments of the Paleogene Tamar-Esk river system, some Quaternary terrace deposits along the Tamar and Esk Rivers; and some Holocene estuarine sediments.

Recent geomorphic mapping has enabled development of a more comprehensive and consistent landscape evolution model that builds on existing knowledge. This model describes the influence of a progressively incising Tamar-Esk river system in response to episodic lowering of the local base level, with multiple episodes of valley widening as the river system stabilised after incision. Successive lowering events dissected earlier landforms, but locally remnant surfaces are preserved that represent former fluvial plain and terrace features. These processes were partially controlled by the structural configuration and contrasting resistance of the underlying lithologies, influencing the planform geometries of the rivers, and consequently the potential to preserve paleo-fluvial features. Because the Tamar River is an estuarine system, some of the lowermost preserved surfaces are likely to reflect marine processes (e.g. 5-7m; 10-12m ASL). The geomorphic mapping was conducted independently of the hydrogeological landscape (HGL) characterisation in the GLA, but there is strong correlation between the areas identified as having elevated salinity hazard (HGL) and newly mapped remnant surfaces in this landscape.

This work complements HGL research and supports development of an increasingly rigorous evidence-based framework for GLA salinity hazard management.