Lower Richmond Trial Catchment

Location

The Lower Richmond trial catchment is located in the far North Coast region of New South Wales, about 700 km north of Sydney and about 200 km south of Brisbane. The catchment of about 23,000 ha consists of three parts:

(i.) The southern half of the Alstonville Plateau, which is a dissected upland basalt plateau whose streams drain into;

(ii.) the Tuckean Swamp, a large estuarine back swamp connected to;

(iii.) the Tuckean Broadwater, which is an arm of the Richmond River estuary.

Topography

The Alstonville Plateau is made up of low rolling hills, typically at an elevation of 100 to 150m above the coastal plain. The plateau margin is relatively steep and slumping is commonly indicated by landslip debris, some linked with springs. In contrast, the Tuckean Swamp is a level to gently concave swampy depression of about 5,000 ha in area and mostly at or near 1 m AHD (Morand, 1994).

Climate

The Lower Richmond experiences relatively mild temperatures with average annual rainfall varying 1800mm near the coast to 1400mm inland. The long-term monthly rainfall record shows a distinctly wetter season during the summer and autumn, and a relatively dry period in the late winter and spring.

Geology and Soils

The Alstonville Plateau is formed from the sequence of basaltic flows and interbedded sediments of the Tertiary Lismore Basalt (20-23Ma), associated with the Mount Warning volcanic complex. The sequence contains flood and valley-fill lava flows with fossil soil horizons, minor alluvial sands and gravels, and finer-grained lake deposits including diatomite. Krasnozems are the dominant soil type which are prized for agriculture due to their free draining, self-mulching characteristics (Morand, 1994). The sandstones and shales of the Clarence-Moreton Basin form the older basement to the Lismore Basalt. The Tuckean Swamp is a large back barrier lagoon infilled with Quaternary coastal sediments (Drury, 1982). This includes a relatively thick sequence of Pleistocene marine sands and estuarine clays at depth, overlain by a veneer of Holocene estuarine clays and alluvial silts and clays. The nature and distribution of the Holocene estuarine clays is particularly critical as they are pyritic and have the potential to develop into acid sulfate soils.

Land use

Commercial rainforest species such as red cedar and hoop pine initially attracted timber getters in the mid to late 19th century. Agricultural settlement followed extensive clearing of the plateau, originally for dairying and sugar cane. The current dominant horticulture of macadamias and avocados started expanding in the 1970's. A broad range of crops are now grown on the plateau, including low chill stonefruit, tropical fruits, pecan nuts, citrus, coffee, kiwi fruit, cut flowers and blueberries as well as commercial nurseries. Population growth has seen agricultural lands being replaced by rural residential development. Prior to European development, the Tuckean Swamp was a regionally significant habitat for waterbirds and fish, and an important resource for Aboriginal people (Baldwin, 1997). Drainage works has enabled beef cattle grazing as well as sugar cane, dairying and rural residential allotments. There are significant parcels of Crown Land, including the Tuckean Nature Reserve, in the area.

Hydrology

Five main tributaries of Tucki Tucki, Marom, Youngmans, Gum and Yellow Creeks drain the upland plateau into the adjacent Tuckean Swamp. These creeks have persistent baseflows due to groundwater input from the basalt aquifers. The permeable krasnozem soil profile and underlying weathered and fractured basalt form an important shallow, local-scale, dynamic aquifer which discharges into the plateau streams (Brodie and Green, 2002). There are also permeable horizons deeper within the basalt pile consisting of highly fractured or vesicular basalt, fossil soils and alluvial sediments that act as aquifers. Groundwater tends to flow down-dip in these deeper horizons and can discharge lower in the landscape, particularly at the base of the plateau escarpment. The hydrology of the Tuckean Swamp is highly modified due to construction of drains and a tidal barrage. With the barrage limiting estuarine influences, the swamp is dominantly a freshwater wetland regime.

Water Use

The increased intensity and diversity of land use on the plateau, in combination with the regional population growth, has resulted in a corresponding increase in water demand. Generally, the permeable nature of the soils combined with the small property sizes, limits the construction of on-farm dams, and most surface water licenses are for in-stream pumping. Groundwater is extracted from shallow wells, excavations and natural springs for a variety of uses including drinking, general household, irrigation and stock. In the Tuckean Swamp, land holders either access surface water from the drainage network or shallow groundwater from spearpoints or wells to supply their water requirements. In the Tuckean, most water is used for stock and domestic purposes, rather than irrigation or town water supply.

Water Issues

Although seemingly in a high rainfall area, water availability is a key issue on the Alstonville Plateau. There are limited opportunities to develop water storages to manage supply through extended dry periods. The highly permeable soils constrain suitable sites for surface reservoirs; the shallow and free-draining nature of the watertable aquifer means that it can be unreliable during droughts; and the deeper aquifers tend to be low-yielding. Protection of water quality on the plateau is also an issue. In particular, faecal contamination of both surface water and groundwater supplies needs to be addressed as a matter of public health (Budd et al, 2000). In the Tuckean Swamp, the most significant water management issue is the generation of highly acidic runoff from acid sulfate soils. As the drainage network is efficient in reducing the incidence of flooding and waterlogging, it also tends to lower the shallow watertable in the swamp. This encourages the oxidation of pyrite within the previously waterlogged shallow estuarine sediments, a chemical reaction that generates sulphuric acid. Following major rainfall events, the store of acid can migrate into the drains and be exported into the Tuckean Broadwater. The consequences of this acidity are fish kills, poor water quality, land degradation, reduced agricultural productivity, loss of estuarine fisheries habitat, and degraded vegetation and wildlife values (Hagley, 1996).

Water Management

The plateau streams are part of the unregulated surface water management area of the Richmond River. In 1995, an embargo was placed on applications for new licences to extract water from these streams. The groundwater resources of the Alstonville Plateau have been formalised in a groundwater management area (GWMA 804), which has been classified as highly stressed due to the risk of over-extraction or contamination (DLWC, 1998). As a consequence a Water Sharing Plan has recently been developed for the basalt aquifers of the plateau (DLWC, 2003). In 2001, an embargo has been enacted on new

groundwater licence applications. A Land and Water Management Plan has been developed for the Tuckean Swamp, with a primary focus on managing the impacts of acid sulfate soils (Baldwin, 1997). Overall, the management of water resources and acid sulfate soils are key components of the catchment blueprint for the Richmond (NRCMB, 2002).

Conjunctive water management approach

In a dynamic coastal catchment like the Lower Richmond, there is a high degree of connectivity between surface water features such as streams, wetlands and drains and their underlying groundwater systems. These groundwater – surface water interactions can have implications in terms of water availability, with discharge of shallow groundwater having a pivotal role in maintaining stream flows between rainfall events. This can be important for providing water security for ecosystems, as well as for consumptive water users such as irrigators or town water supplies. Connectivity is also critical from a water quality perspective. In acid sulfate soil environments, the role of fluctuating watertables and discharge of shallow groundwater into drains is central to the generation and export of highly acidic waters. This highlights the need to take a conjunctive approach to water management in these catchments, where the management of the surface water and groundwater systems has to be coordinated.

Relevant Links

Water Sharing Plan for the Alstonville Plateau Groundwater Sources
Northern Rivers Catchment Management Board
Acid Sulfate Soils in NSW

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