TECHNICAL NOTE

Yarra and Ninghan Drainage Basins -- Background

(Location, climate, geology, physiology, soils, native vegetation, landuse.)

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The Yarra Yarra and Ninghan Drainage Basins (618 and 619 in the national scheme) are adjoining catchments located about 200-400 km nor-northeast of Perth. Along their southern boundary, they both abut the Mortlock Catchment of the Avon Drainage Basin and extend northeast into the pastoral zone. Only the segments inside the 'clearing line' is of interest here (1,006,252 and 255,666 ha respectively; Shepherd *et al.* 2002); together they form a substantial proportion of the northern wheatbelt.

The bedrock underlying most of the Yarra Yarra and all of the Ninghan is Archaean granite and gneiss of the Yilgarn Craton (Lipple *et al.* 1983; Blight *et al.* 1984; Baxter & Lipple 1985). Outcrops are generally uncommon and subdued. Graites/gneisses tend to be concentrated along (or near) subcatchment divides, where they form low, rounded hills or rocky pavements. Greenstone belts comprise Archaean sedimentary and volcanic rocks, with characteristically prominent ferruginous units, known as banded iron formations (bifs). Full-blown greenstone belts are rare in the wheatbelt – they are more common (or at least more conspicuous) in the pastoral section of the Yarra Yarra/Ninghan, or in the goldfields further east. Inside the clearing line, greenstones are

known only in the Koolanooka Hills / Perenjori Hills and extensions to the nor-northwest. However, isolated outcrops of sedimentary rock, chert and/or basalt have been identified throughout the region.

A small part of the Yarra Yarra Basin (the section west of Three Springs) lies outside the Yilgarn Craton, in the Perth Basin -- a 1,000 km-long half-graben extending along the southwestern margin of Australia and across the entire coastal plain and continental shelf. The boundary between the Yilgarn and the Perth Basin is the Darling Fault, a major structure with a complex history, but an eventual westerly downthrow of at least 15 km. Movements along the Darling Fault at various times through the Mesozoic, and possibly into the Cainozoic (Playford *et al.* 1976), are probably responsible for the palaeodrainage changes discussed in the following paragraphs.

Drainage in both basins is internal. Lake Moore (120,000 ha) is the terminus for the Ninghan Basin. In the Yarra Yarra Basin, a chain of about 4,500 saltlakes marks a low-lying, 300 km belt (which superficially resembles a river). The larger lakes in the chain are Hillman (near Kalannie), DeCourcy, Goorly, Mongers, Weelhamby, Nullewah, and the terminal Yarra Yarra Lakes (near Three Springs and Carnamah). The resemblance to a river is misleading, however. Although floodwaters regularly meander through long sections of the chain, there are no historical records of continuous flow from one end of the chain to the other. In fact, given the exceedingly low relief (the total fall from Lake Hillman to the terminal Yarra Yarra Lake is only about 50 m, which equates to an average gradient of 0.00167, or 1 m per 6 km), and the slight gradient reversals in some sections, it is doubtful that the lake chain has performed as a river at all during modern geological times.

Like other saltlake systems on the Yilgarn, the Yarra Yarra chain follows a pre-existing palaeodrainage system (Van de Graaff *et al.* 1977; Clarke 1994; Salama 1997). These palaeodrainage systems are usually assumed to date from Tertiary times, as they sometimes contain fossil-bearing, Tertiary sediments (Clarke 1994). However, the original river pattern may have developed under Permian icesheets as melt-water drainage systems. Moreover, the palaeodrainage system is not static through time. There have been stream-captures, diversions, rejuvenation, valley-infill, and even flow-reversals as a result of differential tilting (Salama 1997; Beard 1999; Commander 2005). The Ninghan and Yarra Yarra basins were probably connected until the early Tertiary by at least two westward-flowing rivers, which continued across the Swan Coastal Plain to the sea (through areas that are now parts of the Moore River Basin).

Based largely on topographic evidence, Beard (2000) considered that the present Yarra Yarra catchment is not actually a single river basin, but consists rather of several independent palaeorivers. These palaeorivers have become amalgamated by tectonic activity (probably Eocene), which coincidentally blocked off westward access to the sea. Prolonged aridity (probably since Miocene times, with the exception of a pluvial interlude in the Pliocene; Anand & Paine 2001) led to reduced flows. Erosion and peneplanation of the catchment area made those flows sluggish, and eventually produced the silt-clogged, broad, flat valley-floors that characterise the drainage system today.

The Yarra Yarra/Ninghan Basins occupy an area of profound ecological significance. Both basins straddle the biological boundary between the Southwest and Eremaean Provinces (Orchard 1999). The 'clearing line' (the inland limit of intensive land use) is

generally recognised as the boundary itself. The Southwest Province includes the well-watered coastal and subcoastal heathlands (kwongan), forests, mallees and woodlands, with their distinctive, highly diverse suite of endemic plants and animals. The Eremaean Province, by contrast, is typified by sand-dunes, spinifex grasslands and mulga shrublands. It extends across arid and semi-arid parts of the continent, almost as far as the northern and eastern coasts. Its flora and fauna are characteristically species-poor.

As is frequently reported in Western Australia, the patterning of pre-European vegetation closely follows soil distribution (Clarke 2001). On the upland sandplains, there is a clear distinction between north and south. Yellow deep sands ('wodgil') and yellow/brown sandy earths predominate in the south, while red loamy earths predominate in the north and northwest (Schoknecht 2002). The vegetation communities most commonly associated with these soil groups are acacia shrublands/thickets and casuarina thickets respectively. Halophytic vegetation, York gum woodlands with saltbush understorey, and melaleuca/hopbush thickets occupy the broad valley floors and lake-fringe country in both areas. Eucalypt woodlands (salmon gum/ gimlet/ York gum) are characteristic of red 'morrel' soils on gentle slopes.

Most of the native vegetation has now been cleared to make space for broadacre wheat-sheep farming. The proportion of remnant vegetation in the Yarra Yarra and Ninghan Basins is estimated at 11.6% and 13.7% (Shepherd *et al.* 2002). The major 'Beard vegetation associations' represented are succulent steppe (samphire/ bluebush/ saltbush), medium woodland (York gum/ salmon gum), acacia shrubland, and thicket (melaleuca/ casuarina/ mallee) (Beard 1979, 1980).

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