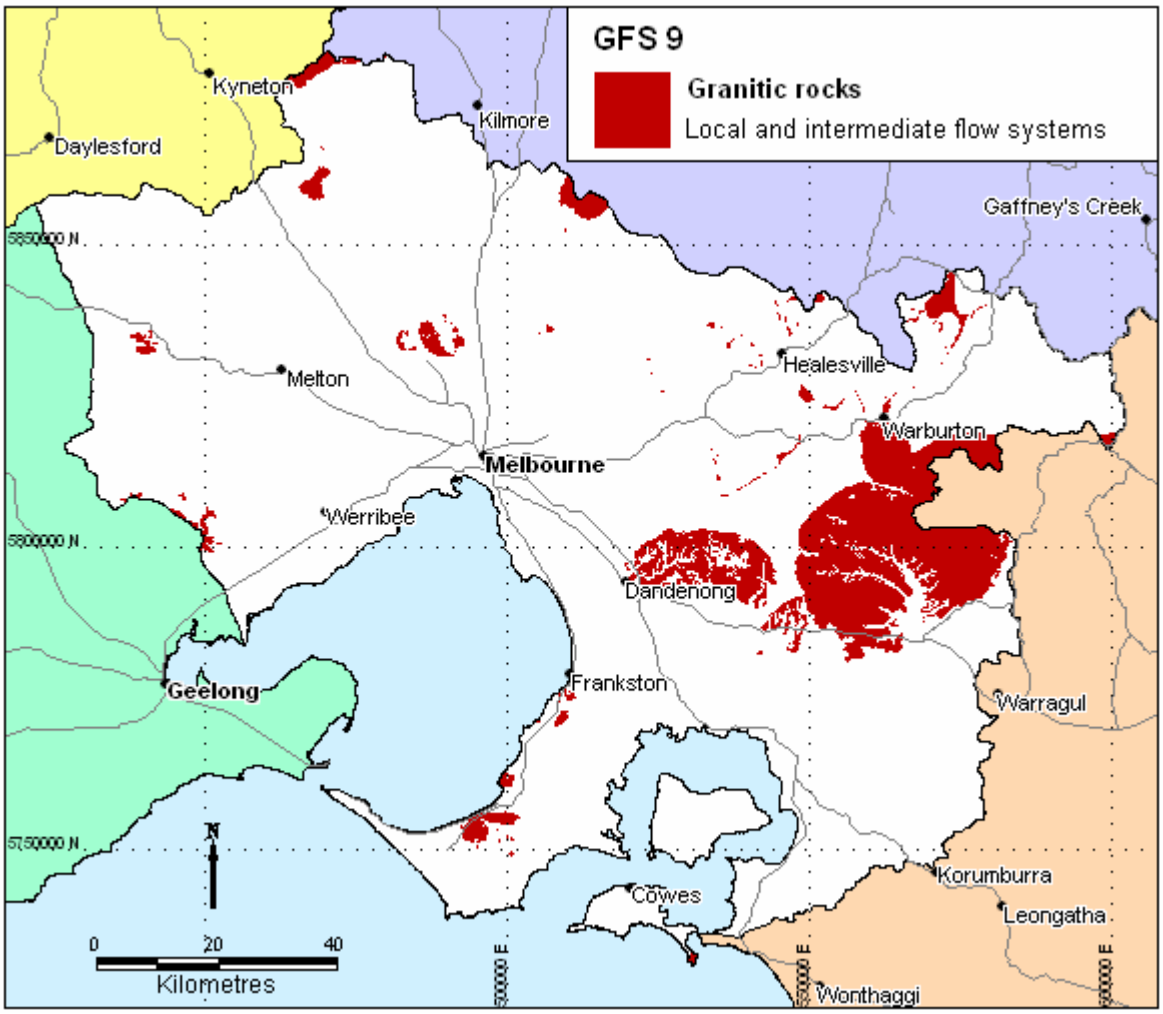
Local and intermediate flow systems in the granitic rocks

Region: All of PPWP CMA, with predominance in the east

Type areas: Powelltown, Dewhurst, Tynong North, The You Yangs.

Brief description: The granitic rocks in the PPWP CMA region were formed around 370 million years ago when granitic magma cooled slowly at depths of two to five kilometres within the sedimentary rocks. The resulting crystalline rocks are now exposed by extensive erosion. Deep weathering has created a variable regolith comprising thick kaolin clay in places, and sandy grus or granite tors elsewhere.

Typically, sub-surface water movement in this GFS occurs through a variety of pathways and processes. Ephemeral fresh-water springs, usually following heavy or prolonged rainfall, are a feature of the landscapes where tors of granite are exposed at the surface. In areas with well-developed A_2 horizons in the soil profile, seasonal lateral flow is significant. In other areas where thick kaolin clays have developed (eg. Bulla), groundwater flow is sluggish through the clayey profile, but may be enhanced by a more permeable 'transitional' aquifer sitting immediately above the fresh fractured rock aquifer system.



Problem statement: Small areas of salinity are mapped in the Bunyip, Garfield and Tynong areas near the junction of the granite with the Westernport plain (GFS 17). South of Balliang, severe salinity occurs along the edge of the granitic rocks of The You Yangs, although may not be greatly influenced by the flows in the granite (see GFS 2).

Landscape attributes

Geology: Devonian granites, granodiorites and ademellites (Dud, Dug)

Topography: Dissected ranges, rolling hills, undulating plateaus, isolated rocky hills.

Land Systems:

Central Victorian Uplands

1.1 East Victorian Dissected Uplands

2.1 West Victorian Dissected Uplands - Midlands

South Victorian Uplands

3.3 Moderate Ridge – Mornington Peninsula

Regolith: Highly variable, from fresh rock exposed at the surface (eg. Tynong North, Mount Disappointment); to sandy loams and sands (Powelltown); to extremely weathered regolith of thick kaolin clays (eg. Bulla).

Annual rainfall: 500 mm to 1750 mm

Dominant mid-1800s vegetation type: Predominantly Forest

Current dominant land uses: National Parks and conservation areas, urban and industrial development, grazing, cropping, water supply catchments, tourism and recreational developments.

Mapping method: Outcrop geology

Hydrogeology

Aquifer type (porosity): Fractured rock, saprock and saprolite (secondary porosity), soil and grus (primary porosity).

Aquifer type (conditions): Unconfined where it is exposed in outcrop and semi confined in sub-crop.

Hydraulic Conductivity (lateral permeability): Highly variable. Estimates for each component are: saprolite varies from approximately 10^{-6} m/d to 10^{-1} m/d, grus varies from 10^{-3} m/d to 10^{-1} m/d, and the rock varies from 10^{-10} m/d to 10^{-2} m/d, although can be considerably higher in fractured zones.

Aquifer Transmissivity: Generally low, but may be up to 10 m^2/d.

Aquifer Storativity: Variable. Estimated to be less than <0.05 for saprolite and grus and <0.01 for the fractured rock.

Hydraulic gradient: Generally low to moderate, but may be locally steep.

Flow length: Generally less than 5 kilometres, but individual pathways can be much longer.

Catchment size: Small (~<500 Ha) to moderate (>1000 Ha).

Recharge estimate: Unknown and variable with location. Possibly up to 25 mm/yr or more in wetter landscapes.

Temporal distribution of recharge: Seasonal (winter and spring), with more recharge in wetter years.

Spatial distribution of recharge: Catchment wide but varies with the depth of regolith, slope and waterlogged areas in the landscape.

Aquifer uses: Minor use, mainly for stock and domestic purposes.

Salinity

Groundwater salinity (TDS): Generally in the range of 500 mg/L to 10000 mg/L.

Salt store: High where regolith is deeply weathered and thick.

Salinity occurrence: Minor occurrences along drainage lines and low-lying areas.

Soil Salinity Rating: S1, S2.

Salt export: Both baseflow to streams and wash-off from surface.

Salt impacts: Both on-site and off-site.

Risk

Soil salinity hazard: Generally low to moderate, but is high where the regolith is deeply weathered kaolin clay.

Water salinity hazard: Low to moderate.

Assets at risk: Agricultural land, urban and engineering infrastructure.

Responsiveness to land management: Largely unknown, but thought to be moderate to high.

Granite landscape north of Lancefield.

Granite landscape at Tynong North

Management Options

The largest salinity issue occurs at Balliang, and the hydrogeological processes leading to its occurrence remain to be confirmed (refer to management options GFS 2). If the salinity processes can be modified by working on the granitic terrain, there would be significant opportunity for its management given rainfall is below 600 mm. However, the hydrological processes at Balliang have probably reached quasi-equilibrium, and the salinity may not expand significantly in the future. Substantial treatment programs are in place at the site and the cost - benefit of recharge control methods to ameliorate the discharge site need to be calculated and based on credible scenario models.

Smaller salinity discharge areas along the edge of the granitic bedrock east of Pakenham are perhaps more problematic given significantly higher rainfall and the potential for salinity issues to expand.

Dryland agriculture options for managing salinity in local and intermediate flow in the **granitic rocks**.

Salinity focus: Balliang, Bunyip, Garfield, Tynong

Options	Treatments	Comments
Biological Management of recharge	Perennial pastures	Moderate impact at Balliang– rainfall below 600mm. Soil fertility is a constraint to plant production, hence water use. Rehabilitate and improve grazing management of native grass pastures. Low impact east of Pakenham– rainfall above 700mm. Some contribution to run-off and waterlogging control
	Crop management	Low impact– generally limited cropping in these landscapes. Little or no benefit above 700 mm
	Trees/woody vegetation	Low to moderate impact– contribution to overall recharge (and runoff) control if trees incorporated into farming system. Impact dependent upon rainfall and scale of plantings.
Engineering intervention	Surface drainage	Low to moderate impact– disposal issues
	Groundwater pumping	Low to moderate impact– disposal issues. Pump sites possible in granitic colluvium.
Productive uses of saline land and water	Salt tolerant pastures	High impact– important to assist stabilising salt affected areas
	Halophytic vegetation	Moderate impact– species suited to temperate, moderately dry climate could provide ground cover on severely scalded areas (e.g. Balliang)
	Saline aquaculture	Low to moderate impact– apart from Balliang, discharge sites only small
	Salt harvesting	Low impact– groundwater is not sufficiently saline
	Others	See OPUS database (NDSP)

Management implications given projected land use

Though the Balliang region is targeted as a zone for possible waste water re-use (irrigation), such developments will tend to occur on the higher quality soils of the adjacent basalt plains. As urban development stretches eastwards of Pakenham there will be issues for urban infrastructure in low lying discharge and waterlogged areas. Peri-urban development may present additional opportunities for controlling run-off and waterlogging, and to a lesser extent recharge.