

Commercial plantations for salinity management and water quality benefits

A unique partnership is developing in the Corangamite Catchment Management Authority region in south western Victoria.

A plantation grower is working with regional scientists and salinity managers to establish a commercial plantation to protect a valuable water quality asset from a salinity risk in a target area in the Moorabool River catchment.

This looks like a win – win situation!

The region:

The Corangamite CMA region comprises an area of over 1.3 million hectares with a population exceeding 400,000; the majority centred in the two cities of Ballarat and Geelong.

The regional landscapes are varied with highlands in the north and south, and a large volcanic plain in between. Rainfall ranges from 600 to 2000 mm.

Over 21,000 hectares of land salinity has been mapped, with the majority on the volcanic plains

Although salinity has been a feature of the landscapes for at least 20,000 years, its area has increased considerably since the commencement of European settlement 200 years ago.

The forecast is dire. It has been predicted that by 2050 many of the regions major assets, particularly the internationally important wetlands, the urban water supplies and the productive agricultural land will deteriorate further.

For this reason the Corangamite region was declared one of the 21 priority regions in the National Action Plan for Salinity and Water Quality. Since the plan commenced in 2001, the region has received approximately \$15 million to invest in salinity management

The partnership opportunity:

An area of 22,368 hectares was identified as a target area in the regional Salinity Action Plan 2004. In the target area a potential salinity benefit – the protection of an urban drinking water supply – is considered achievable by establishing a consolidated block of trees.

The partnership opportunity is for regional salinity managers to develop partnerships with land managers to target investment of National Action Plan for Salinity and Water Quality funds in managing the salinity threat.

The scientist:

Peter Dahlhaus, environmental geologist, likens the target area to “a sponge sitting on a table”. Peter was part of the team that developed the salinity action plan for the region during 2002 and 2003¹. The plan used the concept of overlaying salinity hazard (Considering area of land salinised, line of watercourse salinised, groundwater salinity rating, depth to watertable rating, flow weighted stream salinity weighting, groundwater flow system rating) with regional assets (agricultural land, environment, infrastructure & utilities, water resources, cultural heritage) to identify target areas for prioritised salinity investment.

His scientific analysis of the target area is detailed in Appendix 1.

Simply, saline groundwater discharging from the gravel caps (the red area) in Figure 3, which were cleared of native vegetation by agriculture and gold mining activities over the past 165 years, is causing an increasing trend in salinity in the Moorabool River. Consequently this is a threat to urban water quality assets that supply Geelong.

Peter, and the salinity action plan team, are confident that establishing tree plantations to control the recharge should provide significant benefits. Approximately 6,419 hectares are suited to the establishment of timber plantations, in order to control the recharge.

The salinity manager:

Paul Carroll, a team leader in the Department of Primary Industries regional sustainable agriculture team, gave his team the task of seeking out land managers within the target area who could be willing plantation growers. His team are negotiating with other land managers for a variety of tree planting options, however have 'sealed a deal' with regional forest growers and timber processing company Associated Kiln Driers (AKD) Softwoods Pty Ltd, who will establish around 120 hectares of Pinus radiata on their own land in the target area in 2005. Paul considers the investment partnership with AKD Softwoods Pty Ltd as providing the opportunity for getting more trees in the catchment for 'recharge reduction' sooner for the strategic reason of improving water quality for the city of Geelong.

¹ Corangamite CMA (2004) Draft Regional Salinity Action Plan

The plantation grower:

Neil Harris, Forest and Resources manager with AKD Softwoods, is busy planning for this years planting program on their property within the target area. The company are now able to plant a greater area on their land as the salinity priority investment is available. As Neil develops the property management plan he will prioritise planting those areas that fall within the salinity target area. Planning this plantation project within the Moorabool local government area has been simplified by the inclusion of 'as of right' for plantation establishment in the Moorabool Shire planning scheme.

As part of the whole property management Neil is also working with the Moorabool Gorge Recovery project, run by local Landcare coordinator Ralph Cotter, which seeks to protect, enhance and restore native vegetation in targeted areas along the Moorabool River.

The investor:

Peter Codd, Community and Partnerships Program Manager with the Corangamite Catchment Management Authority, has been managing investment for salinity management in the region since 1990, and the NAPSWQ program since its inception in 2001. He sees targeted government salinity investment operating in partnership with regional industries as an excellent pathway for future salinity management. In the order of \$500,000 will be invested in both 2004/05 and 2005/06 for on-ground targeted salinity management activity in the Corangamite CMA region.

APPENDIX 1 — The 'science' of the salinity target area:

'Approximately 22,368 hectares in the Morrisons – Sheoaks region was selected as a salinity management target area on the basis of increasing salinity trends in the Moorabool River and the consequent threat to urban water quality assets. This main offtake pipeline for urban water, at the Southern end of the catchment, supplies approximately 50 megalitres/day or approx 30% of the total water for the City of Geelong (population 185,000). The current water quality at the Sheoaks off-take pipeline averages 970 °S/cm EC². This creates a major increased salinity burden on the whole urban water supply region, since the water has to be blended with fresher water from other sources to reduce the salinity levels to the urban supply target of 500 °S/cm EC.

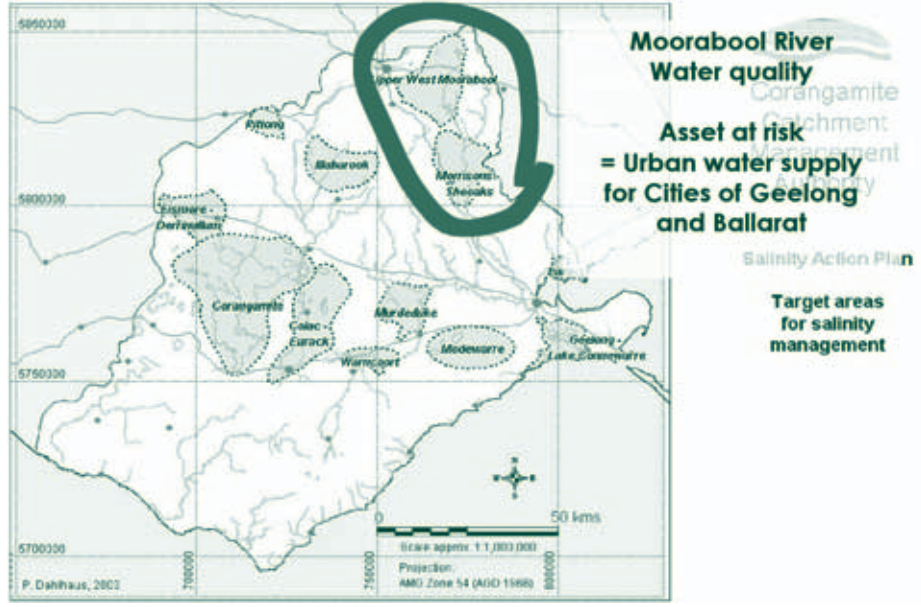
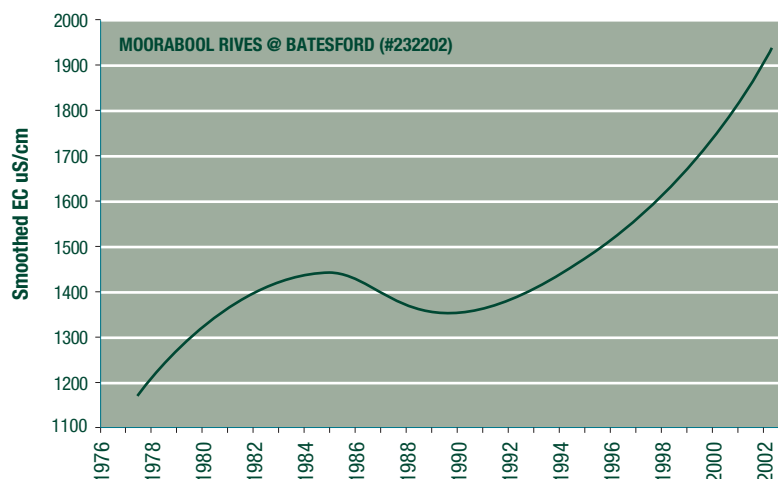


Figure 1: Location of salinity target area in Corangamite CMA region.

In addition to the impact for the city of Geelong, the increasing salinity in the Moorabool River also impacts on the urban water supplied to smaller towns where the water comes directly from river itself. Over recent years, the salinity of the water supplied to these towns has ranged from 600-1600 °S/cm EC. It has been consistently above 1000 °S/cm EC, the maximum value recommended in the Australian Drinking Water Guidelines (ADWG, 1996).

² Salinity is measured as Electrical Conductivity (°S/cm). 1°S/cm ≈0.6 mg/L Total Dissolved Solids (TDS)

Figure 2: Salinity trend 1976 to 2002



The trends in salinity measured in the Moorabool River from November 1976 to June 2001 were modelled using a semi-parametric method developed by Morton (1997). The method results in a smoothed salinity trend which removes the influence of flow (discharge) and annual seasonal variation. At the upstream end of the target area, the river carries a mean salt load of 28.8 tonnes/day, with no significant change in the salinity over the past 26 years of monitoring (measured at Morrisons, gauging station # 232204). Below the downstream end of the target area (Sheoaks), the salinity trends in the Moorabool River have been significantly increasing over the past 26 years. The linear trend measured at the Batesford gauging station (# 232202) from November 1976 to October 2001 is 18.7 ± 7.0 °S/cm/yr EC. The non-linear trend (Figure 2) shows the rise from 1170 °S/cm to 1940 °S/cm over that period. The 9average salt load was calculated as 37 tonnes/day.

Based on the modelled salinity trends, and data supplied by the urban water authority, it appears that the salinity increase is partly caused by salt additions from the tributaries which enter the river as it flows through the target area (Table 1). Approximately 11 kilometres of salinity has been mapped along the stream banks of these tributaries, and approximately 63 hectares of secondary salinity on the agricultural land in their sub-catchments.

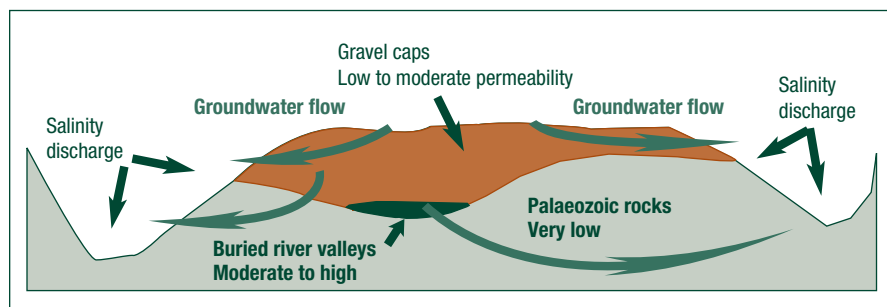
Table 1: Salinity values sampled progressively downstream in the target area.

Location (in downstream order)	Maximum	Minimum	Average
Moorabool River at Morrisons	1500 °S/cm EC	350 °S/cm EC	704 °S/cm EC
Tea Tree Creek (tributary)	5200 °S/cm EC	700 °S/cm EC	2595 °S/cm EC
Eclipse Creek (tributary)	4800 °S/cm EC	220 °S/cm EC	2630 °S/cm EC
Sheoaks off-take (Moorabool River)	1600 °S/cm EC	480 °S/cm EC	968 °S/cm EC

Four groundwater flow systems occur in this area:

1. Intermediate and local flow systems through fractured Palaeozoic sedimentary rocks comprising deeply weathered shales and sandstones with sporadic quartz veins
2. Local flow systems in Tertiary gravel deposits, comprising ferruginised and silicretised sands which cap the older rocks
3. Intermediate flow systems in the fractured basaltic rocks of Neogene to Quaternary age
4. Regional and intermediate flows in the "Deep Lead" aquifers, comprising gravel, sand, silt and clay in the beds of buried ancient river valleys.

Figure 3: Conceptual model of salinity processes



The conceptual model is based on the observation that saline groundwater discharge occurs at the base of the gravel caps (Figure 3). The clearing of the native vegetation from the landscape for agriculture and gold mining activities over the past 165 years has potentially increased infiltration and recharge.

Establishing tree plantations to control the recharge should provide significant benefits, since the gravel caps are spatially limited and have a low groundwater storage capacity. Scenarios (50-year management) were calculated using Flowtube, a one-dimensional finite difference model (Dawes et al., 1997). The results showed that eucalypt plantations over the entire slopes in conjunction with revegetating discharge zones would provide the most effective control of saline groundwater discharge from the base of the gravel caps. Approximately 6,419 hectares are suited to the establishment of timber plantations, in order to control the recharge.

It is conservatively estimated that the groundwater discharge from the gravel caps and the associated salt wash-off from saline discharge areas has contributed 30% to 50% of the increase in salinity to the Moorabool River in the target area in recent years. That is, 10 °S/cm/yr to 15 °S/cm/yr rise in EC.

Based on the conceptual model, and the scenarios modelled using estimated hydrogeological parameters for the flow system in the gravel caps (Dahlhaus et al., 2002), it is calculated that for every 500 hectares of trees planted on the gravel cap GFS there would be one °S/cm/yr drop in EC at the Sheoaks urban water off-take pipeline over a 20 to 50 year time frame. Depending on the salt wash-off contribution, treating the 63 hectares of saline discharge may reduce the salinity by a further 0.5 °S/cm/yr.

Until further investigations and research are completed, the causes of rising salinity in the Moorabool River remain speculative. Although this initial study suggests that salinity management using trees will reduce the saline discharge over a 20 to 50 year time-frame, in the short-term more immediate actions are needed.'

(Extracted From 'CHARACTERISING GROUNDWATER FLOW SYSTEMS FOR SALINITY MANAGEMENT IN THE CORANGAMITE REGION, AUSTRALIA.' Peter G.Dahlhaus, CSIRO Land and Water & Flinders University of South Australia (2004), a paper presented at Groundwater Flow Understanding from Local to Regional Scales. XXXIII Congress IAHR & 7th ALHSUD, Zacatecas, Mexico, 11-15 October, 2004)

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