National Groundwater Committee

Issue Paper 3

Impacts Of Land Use Change On Groundwater Resources

The problem

It has been known for many decades that water in the hydrological cycle is in a continuum between the various parts of the cycle, and development or contamination of one component will impact on the other parts of the cycle.

There is now increasing recognition of the potential for land use and particularly land use change to impact on parts of the water cycle other than just rivers and lakes. The potential impacts on recharge characteristics are of particular concern as the water allocation process assumes a certain level of recharge of suitable quality (on average) each year — if this level of recharge in not achieved this will cause ongoing aquifer depletion in developed aquifers, with all its attendant adverse consequences.

As a resource nears full allocation and/or use, reductions in the recharge become progressively more important.

Background

Surface water hydrologists have long recognised the potential for substantive changes in vegetation in a catchment to influence the potential yield of that catchment – in particular, the response of the ash forests in Melbourne's water supply catchments to logging or fire is well known. For a mature ash forest, the generic hydrologic response is:

- an immediate but relatively small rise in catchment yield, lasting around 5 years;
- a substantial decline in the catchment yield, lasting 25 – 50 years and totally as much as 50% of the pre-logging/fire catchment yield;
- a steady rise in the catchment yield over another 50 - 150 years to return to the pre-logging/fire catchment yield.

This relationship is broadly defined by the "Kuczera curve " (Kuczera 1987). The primary impact has been identified as a change in the base flows to the streams draining the catchments.

Impacts of land use/vegetation change in other environments have not been as well-characterised and may differ significantly in form, although catchment experiments have shown that the response of well mixed species forest to logging is similar, if muted, to that of ash species forest, and the replacement of mixed species forest with pines or with pasture increases the catchment yield.

A more general relationship between projected ground cover and catchment yield has been developed by Holmes and Sinclair (1986) based on a wide range of experimental data across many Australian environments.

There is now a whole body of national and international literature identifying the reduction of recharge to groundwater under forest plantations.

The potential for broad-scale land use change to impact on groundwater accessions in the Green Triangle area of South Australia and Victoria was canvassed by Young and Evans (1998), suggesting that new plantations could be required to acquire a groundwater extraction licence to compensate for the reduction in groundwater accessions resulting from the pines.

More recently, the South Australian Government commissioned a study of the impacts of land use change for water resource managers. Concurrently, the Standing Committee on Agriculture and Resources Management [1] commissioned a review of opportunity and tools for managing the impacts of land use change on water resources. While the scope of both reviews was much wider than impacts on groundwater, the evidence available indicted that the growth of pines (pinus radiata) and bluegums (eucalyptus globulus) could affect the groundwater resource through either or both of two mechanisms:

- Interception of recharge; or
- Direct access to the groundwater resource by tree roots.

Bluegums originating from a higher rainfall environment may actively take groundwater from shallow groundwater domains to maintain their faster growth patterns.

Policy and Management Directions

Conversion of marginal farmland to commercial forest plantations of pines, Bluegums, or less commonly other species, has been supported by governments to reduce land degradation and/or increase regional growth, frequently with collateral positive bio-diversity outcomes**. Paradoxically, this conversion may reduce the quantum of the groundwater resource (and surface water resource) available for in-stream or off-stream use.**

It is unlikely that either set of values can be said to consistently take precedence, although Melbourne's water supply managers have successfully argued for water supply interests ahead of commercial logging in their Yarra catchments. Consequently there are judgments to be made on the balance between competing values where conflicts between land use change and protection of the groundwater resource are perceived to exist.

Large-scale irrigation developments facilitated by investment schemes or industry restructuring have taken up full groundwater allocations in concentrated developments risking long term groundwater quality due to salinity or nutrient degradation. Reduced groundwater recharge due to land use change would exacerbate the difficulties already faced by this group and may inadvertently reduce their water rights.

Policy and management challenges include:

- Lack of acceptance of potential impact by key stakeholders, and a lack of a robust quantification of the potential magnitude and process of impact.
- Administrative separation of land use planning and (ground)water planning/management functions of government
- Lack of robust tools for balancing competing values and informing the choice of dominant values at any specific location/aquifer.

The Way forward

- Establish/foster closer linkages between land use planning and water resource planning and management, supported by the development of generic information packages outlining the current state of scientific knowledge and uncertainties for the information and use by land us planners, and model planning scheme provisions for discretionary use by planners.

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[1] Now the Natural Resource Management Standing Committee.

- Targeted research to quantify the impacts of commercial forest plantation on groundwater recharge, discharge and quality, particularly in relation to those areas where it is likely that tree roots will directly draw on the groundwater resource in competition with conventional groundwater resource development, such as in areas currently or likely to be subject to extensive Bluegum plantations.

References

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