1 Introduction

Groundwater and surface water systems are commonly intimately linked and, therefore, understanding how they respond to climate change and land and water management is fundamental to protecting groundwater dependent ecosystems (GDEs). It is well understood that land use practices and extraction of groundwater resources can affect groundwater levels, flows, and quality. However, there is less understanding about the implications of such effects on the health of above- and below-ground ecosystems that have a dependence on groundwater. Trying to improve this understanding together with knowledge of GDE occurrence, significance, sensitivity and threat has only recently become a National priority.

Possible threats to GDEs include groundwater extraction, climate change, salinity, nutrients, and altered surface water management. An outcome of the 1994 Council of Australian Governments (COAG) Water Reform Framework (Council of Australian Governments 1994) was that water allocation planning is required to protect ecosystems, including GDEs that have an important function or conservation value. The need to improve knowledge of GDEs across Victoria has been made more urgent due to prolonged dry conditions since 1997 and an increased reliance upon groundwater as a resource. The last National Land and Water Audit in Australia estimated that groundwater use had increased by 88% from 1983 to 1997 (Department of the Environment, Water, Heritage and the Arts 2006). Anecdotal evidence, including increased groundwater licensing and exploitations of new or unmanaged aquifers since 1997, suggest that the general increase in groundwater use continues to the present day.

GDEs can include subterranean fauna (stygofauna), wetlands, streams, and lakes, remnant pools of ephemeral streams, and terrestrial vegetation with roots tapping the aquifer (phreatophytes). Groundwater can maintain stream flow during periods of low precipitation, provide nutrients for aquatic biota, and provide thermally stable refuges for fauna. The identification of communities that use groundwater will be used as an *indication of potential dependence* in this review. Determining dependence may require field experimentation and verification.

In addition to the intrinsic importance of maintaining the biodiversity of GDEs, they provide important resources for rural lifestyle. GDEs support fishing, waterfowl hunting, bird watching, and other recreation. The locations of GDEs provide valuable insight to the hydrologic system within catchments and understanding GDEs is important to water resource, environmental, and agricultural management.

This report is the major milestone and culmination of DPI CMI project No 102552, “Groundwater dependent ecosystems”. It began in 2007 and was funded initially from the National Action Plan (NAP) State Reserve and later by the State Water Fund. Project governance has been shared between the Victorian NAP Office and DSE Water Allocation and Licensing Branch. The project addresses for Victoria the first step in developing informed management action plans for protection or enhancement of GDEs, namely the prediction of GDE occurrence across the State. The issue addressed by this project is rated very highly by the National Water Initiative (Raising National Water Standards), the Victorian White Paper for Water (Securing Our Water Future), the Murray-Darling Basin Authority, the Co-operative Research Centre for eWater and the NAP. The persistence of dry conditions over a number of years further reinforces the high priority attention to GDEs.

The report includes a detailed literature review on GDEs and describes a new integrated method that has been developed by the authors and applied to produce the first ever series of regional potential GDE maps for Victoria. To the knowledge of the authors, this is the first time that mapping of GDEs has been attempted at a large scale in Australia and represents one of very few attempts internationally. The strengths and limitations of the currently produced maps are explained in Section 8 together with recommendations for further validation and refinement of the maps.

1.1 Project Objectives

The initially recorded project objectives were to: (i) identify threatened high-value GDEs in Victorian NAP regions (i.e. Goulburn-Broken CMA, North Central CMA, Wimmera CMA, Mallee CMA, Glenelg Hopkins CMA and Corangamite CMA), (ii) assess their groundwater dependency (nature and degree), and (iii) identify the threats to these GDEs, their susceptibility to these threats and likely consequences.

Because this project was venturing into a new research field, it was allowed considerable flexibility to begin with. In the early stages of the project, it was recognised, with agreement from the project funders, that the initial project objectives (above) were too ambitious in the project timeframe and needed to be revised to three equally important pre-requisite objectives, as follows:

1) complete a detailed literature review to improve knowledge of GDE types, function and identification, and to help inform development of a broad scale mapping method;

2) develop a method to predict the occurrence and distribution of GDEs at a regional scale; and

3) produce a series of potential GDE maps for all Victorian NAP regions (Note: with supplementary funding, this was later expanded to the whole State to also include maps for Port Phillip and Western Port CMA, West Gippsland CMA, East Gippsland CMA and North East CMA regions)

The main outcomes sought from the project are:-

1) Valued new knowledge to assist development and refinement of State and regional policies on GDE management and water management in areas of resource competition (including regional Sustainable Water Strategies);

2) Valued new knowledge to assist targeting and management of high-value wetlands/streams and groundwater management areas;

3) Provision of a sound basis for targeting detailed investigations of GDEs; .

4) Reduction in the impact of farming systems on GDEs at risk of disturbance through land use practices, including groundwater pumping and drainage diversion.