1. Introduction

1.1. Project scope

Catchment and Agriculture Services (CAS) within the Department Of Primary Industries supports the West Gippsland Catchment Management Authority (WGCMA) with services relating to land and water management activities under the Regional Catchment Strategy. Following the completion of groundwater flow systems (GFS) mapping for the catchment (SKM, 2005), an action identified under the salinity management strategy was to focus on the priority groundwater flow systems. CAS sought assistance from PIRVic Hydrogeology group to carry out an assessment of the groundwater and salinity conditions at some identified dryland salinity occurrences near the townships of Rosedale, Inverloch and Yarram (**Figure 1**). The main objective was to conceptualise the groundwater/salinity processes and use some robust modelling tools to evaluate various land management options in the three study areas.

Figure 1. Locality map of the West Gippsland Catchment Management area showing the three study areas.

1.2. Project objectives

The project objectives, as set out in the project plan, are as follows:

- The development of conceptual hydrogeological models of each priority salinity groundwater flow system illustrating the dominant recharge and discharge processes occurring in each priority area.
- The development of flowtube models for each priority area to characterise the dominant salinity processes occurring and assess the impacts of various land management options.
- The evaluation of various recharge control focussed management options suitable for key land systems and land-use types on the groundwater flow systems modelled.

- To test model outputs for reliability and provide reasoned recommendations and locations for revegetation, land-use management changes or other salinity management options.
- The documentation of the study findings for the CMA and CAS to help guide salinity management activities in the priority salinity management areas.

The three priority sites were selected for FLOWTUBE modelling on the basis that they:

- Had some groundwater monitoring data available
- Were three relatively different areas from three apparently different parts of the WGCMA region
- Were significant dryland salinity affected GFS's identified in initial site selection discussions with DPI and WGCMA staff.

Some comments as to the broader application of the FLOWTUBE modelling results from the three study sites to other sites and other GFS's in the region are provided in the Conclusions (section 5).

1.3. Overview of FLOWTUBE model

FLOWTUBE (Dawes *et al.* 2000) was developed by CSIRO Land and Water as a simple numerical one-dimensional groundwater flow model. It is a mass-balance model that solves for a change in hydraulic head induced by recharge and discharge fluxes and lateral transfers in the direction of flow. The results of FLOWTUBE are considered to represent a hydraulic head transect along an aquifer. The models constructed for the three study sites are all based on two layer unconfined aquifer systems, in accord with the GFS parameters and conceptual models developed for the sites. In these two layer aquifer cases, the aquifer is assumed to be unconfined and has variable transmissivity, which is dependent on the saturated thickness of the aquifer. **Figure 2** illustrates the basis of the Flowtube modelling approach (from Argent, 2001).

Water sources considered by FLOWTUBE are: (i) point sources of runoff at the upstream end of the aquifer, often manifested as recharge beds collecting surface water from a steeper part of the catchment; and (ii) diffuse recharge or discharge spread in an arbitrary spatial and temporal pattern across the aquifer being modelled. The latter source is the recharge component most altered by the replacement of native species with annual cropping and grazing systems in Australia.

FLOWTUBE allows for a variety of boundary conditions to be established for the aquifer. At the downstream end there are two options:

(i) the flux is controlled by a specified groundwater head at a nominated distance, (useful where a permanent water source occurs nearby that controls head build-up such as a river or irrigation area) or

(ii) the flux is controlled by local aquifer properties and the groundwater surface and drains freely, which can be useful when the groundwater catchment is poorly defined or only the upper part of a catchment is considered.

For diffuse recharge input there are three options;

(i) a user-specified pattern of fixed recharge amounts with an evaporation component controlled by an extinction depth, which is the traditional implementation within groundwater models;

(ii) recharge calculated by FLOWTUBE internally as the difference between the present hydraulic head and a reference elevation multiplied by an impedance factor, applicable where definite connection and transfers exist between a surface storage and transmitting aquifer with little outside influence; and

(iii) a continuous function of recharge/discharge based on GIS analysis of depth to water from a DEM, most useful where there are near surface water levels causing discharge controlled by topographic features.

It should be noted that with the current version of FLOWTUBE, the continuous recharge/discharge functions are mutually exclusive with the head-induced and fixed recharge pattern, as are the two aquifer flux conditions. This means it is not possible to switch between recharge/discharge functions and a sudden flood or drought through a fixed recharge distribution within the one simulation. Spikes of recharge, however, may be superimposed on a head-induced recharge situation.

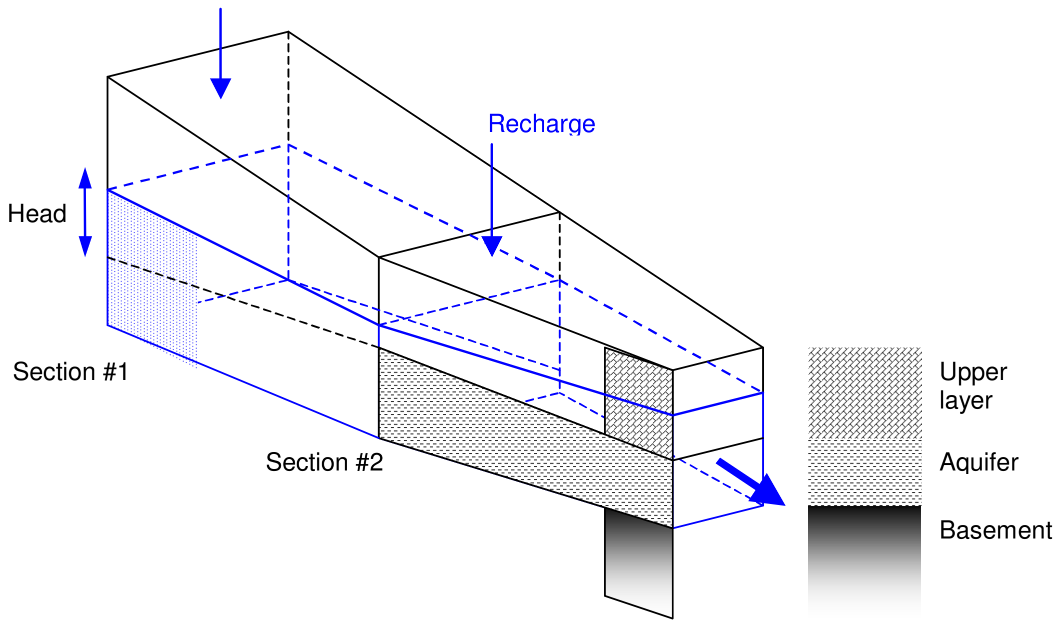

Figure 2. Schematic diagram of FLOWTUBE model (Argent, 2001)