Modelling the salinity impacts of catchment strategy implementation in the Shepparton Irrigation Region

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Introduction

Salinity impacts on the River Murray from the implementation of works associated with Salinity Management Plans and more recently Catchment Strategies are accountable under the Murray Darling Basin Commission (MDBC) Basin Salinity Management Strategy (BSMS). To meet its obligations under Schedule C of the Murray Darling Basin Agreement, the Shepparton Irrigation Region Catchment Implementation Strategy (SIRCIS) endorsed a review of the salinity impact its implementation has on the River Murray to 30 June 2004 (SKM, 2007).

The review which was managed by Goulburn-Murray Water included the engagement of consultant Sinclair Knight Merz to develop a model to estimate the SIR drainage flow and salt loads for the Benchmark Period 1975 to 2000 at pre-strategy and current levels of development. The outputs were fed into the MDBC MSM-Bigmod models which assessed the SIRCIS salt disposal impacts.

Objectives

1. To provide adequate estimates of salt load and timing using a transparent method that is agreed upon and endorsed by the Murray-Darling Basin Commission
2. To estimate the salinity impact for:
    - the (benchmark) climatic period (July 1975 to June 2000);
    - the (previous benchmark) climatic period (July 1975 to June 1985)
    - historical and ongoing management
3. To provide adaptability in the model that enables additional data and improvements in our understanding of salinity processes to be progressively incorporated
4. To enable flexibility in the model to address likely changes in landuse and management
5. practices for the region that may influence the salinity impact; and To provide cost effectiveness in the model's development, application and use. (SKM, 2007)

Method

The model developed is a simplified physical process model that is aimed at simulating the seasonal drainage response of a catchment to climatic and operational conditions. The processes represented in the model (Figure 1) include:

- infiltration
- evapotranspiration
- rainfall and irrigation runoff
- irrigation (channel supply, drain diversion and groundwater pumping)
- and base flow into drains from groundwater
- disposal of groundwater to channels and drains

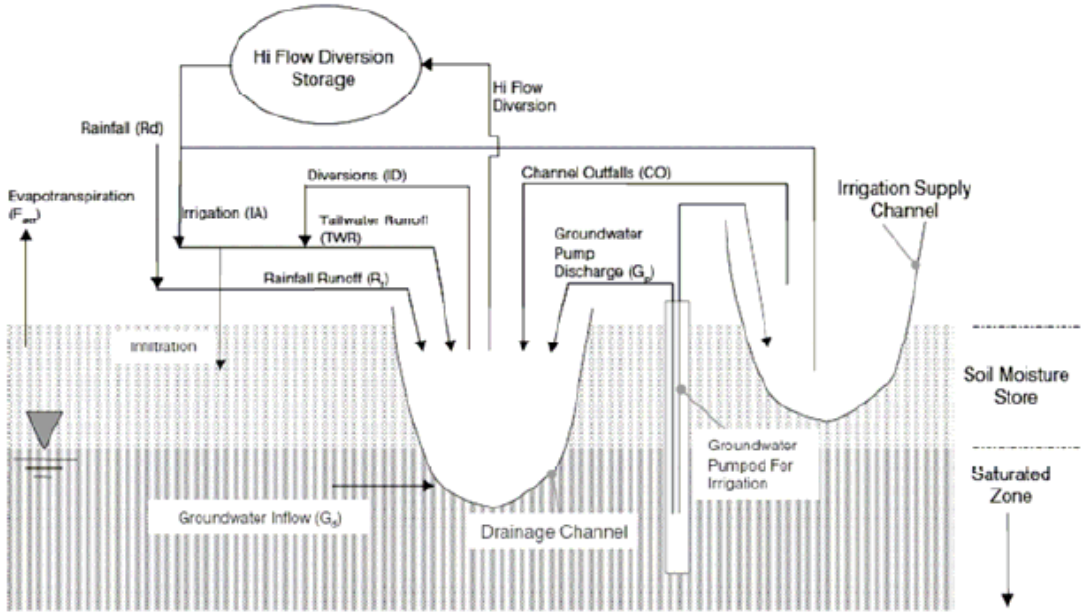

Figure 1 Physical Process Model

The model was applied to 13 sub catchments where detailed monitoring data was available. Most, but not the entire SIR was represented by these models. The model for each sub catchment was calibrated against gauging data with the aim that the calibrated parameters could then be used to define catchment areas covering the entire SIR for benchmark period scenario modelling.

15 catchment models were then developed to represent most of the SIR, using the calibration parameters from the gauged catchment models. These 15 models were used to obtain estimates of drain flow and salinity over the MDBC climate reference period from July 1975 to June 2000 representing "pre plan" (1988) and current (to 30 June 2004) catchment conditions. Time series data from the models were provided to MDBC and fed into the MSM-Bigmod models to calculate salt disposal impacts.

Results and discussion

The salt disposal impact is expressed as the average increase in salinity in the River Murray at Morgan in EC units (microS/cm), which can be converted to give a measure of the economic effects of the increased salinities on water users from the lower Murray. Any works that increase salt loads leaving the catchment that were implemented after 1 January 1988 are classed as an accountable action. The accountable actions implemented in the SIR to 30 June 2004 and the salinity effect (impact) calculated by both the endorsed strategy assumptions commonly used in the SIR and those estimated by MSM-Bigmod are shown in table 1.

Table 1 Overall Salinity Effects of the SIRCIS

Accountable Actions/Works	Salinity Effects based on Rules of Thumb used in SIR	Salinity Effect Modelled (Physical) at Morgan SA
40 public groundwater pumps. 26 dispose to drains, 10 to channels, and 4 have the ability to discharge to either channels or drains. The pumps have an average capacity of 0.8 ML/d and an average salt load of 2.8 tonne/day. The flow weighted salinity of their discharge is therefore 5,850 EC.	1.44 EC	1.45 EC
166 private pumps authorised to outfall an allocated disposal volume during winter-spring. These have an average capacity of 0.85 ML/d and a typical salinity of approximately 2,850 EC.	1.01 EC	1.03 EC
185 km of arterial drains.	0.41 EC	0.07 EC
432 km of community surface drains.	0.10 EC	0.16 EC
26 small capacity private pumps protecting horticulture in the Shepparton East area, plus the equivalent of 6 others installed prior to 1991. These all discharge to the drainage system.	0.14 EC	0.14 EC
15.9 hectares of tile drainage protecting horticulture, discharging to the drainage system.	0.02 EC	0.02 EC
Total	***3.12 EC***	***2.87 EC***
Effect of Reduced Tail Water Fraction (TWF)		1.00 EC

The result from MSM-Bigmod Model is 2.87 EC. This compares with 3.12 EC which was registered for the Strategy as at 30 June 2004 based on the endorsed strategy assumptions. The salinity cost effect for the accountable actions (excluding the TWF discussed below) was determined to be $240,000/yr/EC.

Reduced Tailwater Fraction

The modeling identified a potential additional impact of 1 EC that was attributed to the reduced TWF achieved from on-farm improvements implemented under the SIRCIS. This new learning from the review is to be investigated further to determine the extent of non-SIRCIS factors such as drought, low irrigation allocations, increased salinity of runoff due to groundwater use or irrigation and water trade which may contribute to the reduction in TWF.

Other uses for the model

To meet its obligations under Schedule C of the Murray Darling Basin Agreement, the following uses of the model have been identified;

- A predictive tool to forecast the ultimate salt credit requirements of the Strategy (ie at full
- implementation);
- A predictive tool to evaluate "what if" scenarios; and
- A tool to estimate land use change impacts on salt credit requirements.
- To meet SIRCIS & MDBC BSMS reporting requirements,

Conclusions

The physical impact of the Shepparton Irrigation Region Catchment Strategy was 2.87 EC at Morgan S.A as at 30 June 2004. The physical effect of the reduced tailwater factor is currently shelved at 1.00 EC (adverse). The adoption of a Salinity Cost Effect of $240,000 per year per EC at Morgan results in the salinity debit of the Shepparton Irrigation Region Catchment Implementation Strategy at 30 June 2004 to be $929,000 per year.

Further investigations is required to determine the underlying cause or causes of the reduction in Tailwater Factor, and if necessary, a further change to the Base Case.

Postscript

MSM BIGMOD has been updated since June 2006 when the results reported above were obtained. The SIR data sets have been re-assessed by BIGMOD, resulting in changed impacts for the SIR.

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References

SKM 2007, Shepparton Irrigation Region Salinity Audit: Modeling Outcomes
Department of Sustainability and Environment
Department of Primary Industries