

An assessment of the regional surface water quality in the South West Irrigation Area – implications for regional environmental sustainability.

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Introduction

This study was initiated by Harvey Water in partnership with the Department of Agriculture, Western Australia (the Department) in an attempt to obtain accurate, factual data regarding the quality of irrigation water from the headwaters of the South West Irrigation Area (SWIA) through to outfall into the broader regional drainage systems.

The need for an objective study examining this issue was identified as the quality of the water used for and following agricultural irrigation purposes in the area had not been well quantified. However, the popular view in the broader community, and to some extent within the Western Australian natural resource management community, appeared to be that irrigation farming in the region was a major contributor to surface water pollution lower in the catchment.

In 1999, the Department was contracted by Harvey Water to undertake a water quality survey as part of an ongoing partnership between the two organisations. The collection of this data in the irrigation district was important to the Department in terms of better defining sustainability issues and developing sustainable farming systems in what is presently a relatively poorly understood region. The SWIA has been identified as a region with significant potential in terms of agricultural intensification, diversification and development but it is also located in a catchment with a long history of eutrophication and subsequent algal blooms. A good understanding of the processes governing water quality issues in the region is important in order to continue to develop the region in a sustainable manner and to continue to access commodity markets in an ever more demanding marketplace.

Water quality monitoring commenced in early September 1999 and concluded monitoring in July 2002.

Methods

A suite of 21 monitoring sites was selected which included SCADA points, to reflect the quality and quantity of water incident upon the irrigation area from the regional irrigation headworks, and non-SCADA, drain points to reflect the quality of drainage water within the SWIA and below the SWIA in catchment terms. As well as being selected to provide an adequate coverage of channels and drains located higher and lower in the catchment, sites were selected to provide an adequate coverage of the three irrigation districts within the SWIA – Waroona, Harvey and Collie – to determine if any district-specific differences could be observed.

Water samples were collected fortnightly during winter when irrigation water was not being released, and weekly during the summer months following the commencement of the irrigation seasons. Water samples (100 mL) were collected and chilled for transportation to the analytical laboratory, and flow rates were measured to allow calculation of water and nutrient discharge rates. Water samples were analysed in-situ or at the Department office at Waroona for pH, turbidity and electrical conductivity using hand held metering systems, and were transported to the Marine and Freshwater Research Laboratory at Murdoch University for nutrient analysis using Acid-Base persulphate digestion followed by automatic flow-injection analysis.

Raw data was displayed graphically and interpretations were made from these graphs in terms of longitudinal variations in data trends and comparisons between groups. However, to add scientific rigour to the interpretations, data was also analysed statistically utilising SPSS SigmaStat[®]. All data comparisons were initially checked for normality in order to determine the appropriate analyses. Following this, data was analysed either using simple One Way Analysis of Variance (ANOVA) or Kruskal-Wallis One Way Analysis of Variance for non-normal data. Statistical comparisons were completed for all parameters between groups of similar monitoring points. For example, electrical conductivity levels were compared between drains, SCADA points and districts. Additionally, comparisons were made between nutrient levels during irrigation and non-irrigation periods, and between nutrient levels during the three complete years of data availability.

Results and Discussion

The completion of a water quality monitoring programme for the SWIA for three irrigation seasons is a valuable addition to the knowledge base for the area. However, such a short-term programme in a field that demands long-term, high-frequency monitoring to produce meaningful data is limited to some extent.

Several points are, however, clear:

- Overall, pH levels monitored throughout the SCADA and drain points generally fell within the acceptable guidelines while exhibiting fluctuations in pH (and some exceedences of the guidelines) which are commonly measured in water bodies of this type.

- However, the significant and rapid drop in pH levels exhibited in the channels and drains in the Waroona district (and to a lesser extent the Harvey district) does not appear to follow any natural pattern. This suggests that water quality (in terms of pH) in these districts may be in decline due to an external, environmental or anthropogenic factor, and is most likely to be due to extraction of water from near the water / sediment interface during headworks repairs and upgrades.
- All turbidity measurements during the course of this research programme from SCADA points were very low with little seasonal variation. Turbidity levels in drains, while higher than the SCADA points, were not of concern either in absolute value or variability.
- Problems with the high salinity levels of the water sourced from the Wellington Dam and distributed through the Collie irrigation district have been clearly shown. The rapid, negative influence on the water quality of both drain and SCADA points in the Collie District is obvious, as is the lag between the onset of high-salinity irrigation water and the export of high-salinity drain water. The exceedence of the recommended maximum limit for irrigation water for the entire irrigation season shows the limitations that this poor quality water will be inflicting on both regional agricultural productivity and regional, downstream water quality. This would have a marked effect on the real value of this irrigation water in terms of its ability to contribute to profitable and sustainable farming.
- Water quality from the Wellington Dam appears to be deteriorating further.
- The nutrient concentrations in water collected during the irrigation season are similar to or lower than those collected in the same drains during winter. Irrigation nitrogen concentrations are of the order of 70% of those measured during winter. Nutrient levels in excess of the recommended guideline levels do, however, occur but are not the norm. In some cases, when they have done so for extended periods, this has been reported to the State natural resource management agencies as possible point-source pollution events.
- Nutrient load calculations support the conclusions drawn from analyses of nutrient concentration data. That is, while 79% of water travels through the irrigation system during winter, this water carries 88% of the phosphorus and 86% of the nitrogen exported annually. Irrigation water, while accounting for 21% of the water measured during the monitoring programme, carried only 12% of the total phosphorus measured and 14% of the nitrogen.
- However, the total nutrient export rates from the SWIA are significantly (up to 5 times) higher than those from other regional catchments. This is likely to be associated with heavier soils in the irrigation districts, and more intensive farm practices such as increased fertiliser application used in the higher value agricultural practices of this region.

Conclusions

The three year monitoring programme has been adequate and valuable in terms of providing information regarding the water quality incident upon, within and leaving the SWIA. It has highlighted water quality issues in respect of the irrigation supply water in the Collie irrigation district and has shown that both nutrient *concentrations* and *loads* from irrigation-drainage waters are at similar or lower levels than dryland drainage waters. In terms of areal distribution, the monitoring programme has provided an adequate representation of the SWIA.

The initial objective of this monitoring – to gather objective water quality data within the SWIA and to start to develop an understanding of the comparative effects of irrigation farming systems from this – has been met. Additional work to further develop this understanding in terms of catchment and hydrological processes and downstream effects of irrigation farming systems requires a new research programme with different objectives and, consequently, different monitoring parameters. This has now been initiated by the Department and Harvey Water.

References

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