11 Environmental implications of reclaimed water use for irrigated agriculture

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Reclaimed water is generally rich in the nutrients nitrogen (N) and phosphorus (P), contains soluble salts not removed in the treatment process, and often has a high concentration of sodium (Na^+) or potassium (K^+) relative to other cations. It may also contain traces of heavy metals, toxic organic compounds or other substances that are highly soluble in water and are therefore not removed in the treatment process. This chapter discusses the potential onsite and offsite impacts that may result from these constituents if irrigation with reclaimed water is not carefully managed. When irrigation with reclaimed water results in application of more nutrients than can be used by the crop, the excess either accumulates in the soil or is leached from it. Phosphorus is strongly sorbed and, therefore, tends to accumulate near the surface in most soils, posing a risk of being washed into surface waters. Excess nitrogen accumulates in soluble form (nitrate) and may be subject to leaching beyond the crop root zone and, eventually, to groundwater. Other potential impacts include the development of salinity, and the accumulation of sodium, which adversely affects soil structure and permeability (see *Chapter 7*). High concentrations of potassium can have a similar effect to sodium. Heavy metals (see *Chapter 8*) and toxic organic chemicals (see *Chapter 10*) are usually not present in sufficient concentrations to be of immediate concern, but their potentially serious impact needs to be recognised.

Introduction

There has been increasing pressure to avoid the direct discharge of wastes into rivers, oceans and other waterbodies. This pressure stems from recognising the need to protect the environment. In many parts of Australia and the world, discharge of nutrient-rich wastes has exacerbated the eutrophication of river systems and contributed to toxic blue-green algae blooms (Gutteridge Haskins and Davey 1991). When discharged into the ocean, the disturbance of the nutrient balance affects marine life, and if the waste has received minimal treatment, it may cause both aesthetic and human health problems on beaches (Brodie 1995; Zann 1996). In some countries there are also cultural reasons for land application rather than disposal to a waterbody (Cameron *et al* 1997).

The use of reclaimed water for irrigating productive agricultural, horticultural or forest crops has become a widespread alternative to discharge into rivers and oceans. The extra costs of treatment or diversion can be offset by the value of the product. Waste streams contain a significant amount of water (estimated to be 1600 GL/yr in Australia; Dillon 2000) and reclaimed water is potentially a valuable resource for irrigation in the dry Australian environment. Most reclaimed water contains plant nutrients (eg N, P and sometimes K) that need to be added as fertilisers to achieve satisfactory plant yields. Thus, reclaimed water contains the ingredients most limiting to crop production in Australia. However, the nutrients may not be in the correct ratios required for optimum plant growth and therefore require special management to prevent nutrient imbalances in the crop (see *Chapter 5*).

Although irrigation with reclaimed water enables diversion of nutrients from waterbodies, it may have other environmental impacts if not carefully managed (Bond 1998). The National Water Quality Management Strategy (1997) publication 'Australian guidelines for