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## Setting ecologically relevant targets for river pollutant loads to meet marine water quality requirements for the Great Barrier Reef, Australia: A preliminary methodology and analysis

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## ABSTRACT

Loads of suspended sediment, nutrients and pesticides discharged to the Great Barrier Reef (GBR) have increased greatly due to agricultural and urban development of the GBR catchment. As a result, in association with climate change impacts, the ecosystems of the GBR have degraded greatly in recent decades, and the decline in ecosystem health continues. Improved agricultural management practices are now being funded to reverse the decline. However the quantum of reduction in contaminant loads from individual rivers needed to reverse the decline is not known. To estimate load reductions that would reverse the decline we developed what we term Ecologically Relevant Targets (ERTs). These targets are the load reductions of sediment, nutrients and pesticides needed such that GBR lagoonal waters meet the relevant water quality guidelines for the region. The methodology proposed for setting the ERTs is described and examples of ERTs set for the Burdekin Region of the GBR are given.

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### 1. Introduction

Riverine pollutant loads to the Great Barrier Reef (GBR) lagoon have increased substantially since European settlement, with published estimated increases of up to 3–6-fold for suspended sediment, 2–6-fold for nitrogen, and 3–9-fold for phosphorus depending on the individual river (Kroon et al., 2012; Waters et al., 2014). The modeled average annual load of six widely used photosystem II inhibiting herbicides (atrazine, tebuthiuron, simazine, ametryn, diuron and hexazinone) is estimated to be 17,000 kg, however, this is likely to underestimate the total pesticide load, as

at least 34 pesticides have been detected in waterways that discharge to the GBR (Brodie et al., 2013). The main source of excess nutrients, fine sediments and pesticides is agricultural land use (Waterhouse et al., 2012, 2016) (Fig. 1), with increased loads of (i) fine sediment and particulate nutrients primarily derived from erosion in rangeland grazing and cropping lands; (ii) dissolved inorganic nutrients, particularly nitrogen, associated with fertiliser applications in cropping land uses such as sugarcane and horticulture; and (iii) pesticides (particularly herbicides) primarily sourced from sugarcane cultivation and grazing lands (Brodie et al., 2012, 2013).

These increased loads of pollutants are seen as a contributor to the current state of degradation of the GBR (Brodie and Waterhouse, 2012; Brodie and Pearson, 2016; Brodie et al., 2012, 2013; De'ath and Fabricius, 2008, 2010; Hughes et al., 2015; Wooldridge et al., 2015; Thompson et al., 2011, 2014; Lønborg

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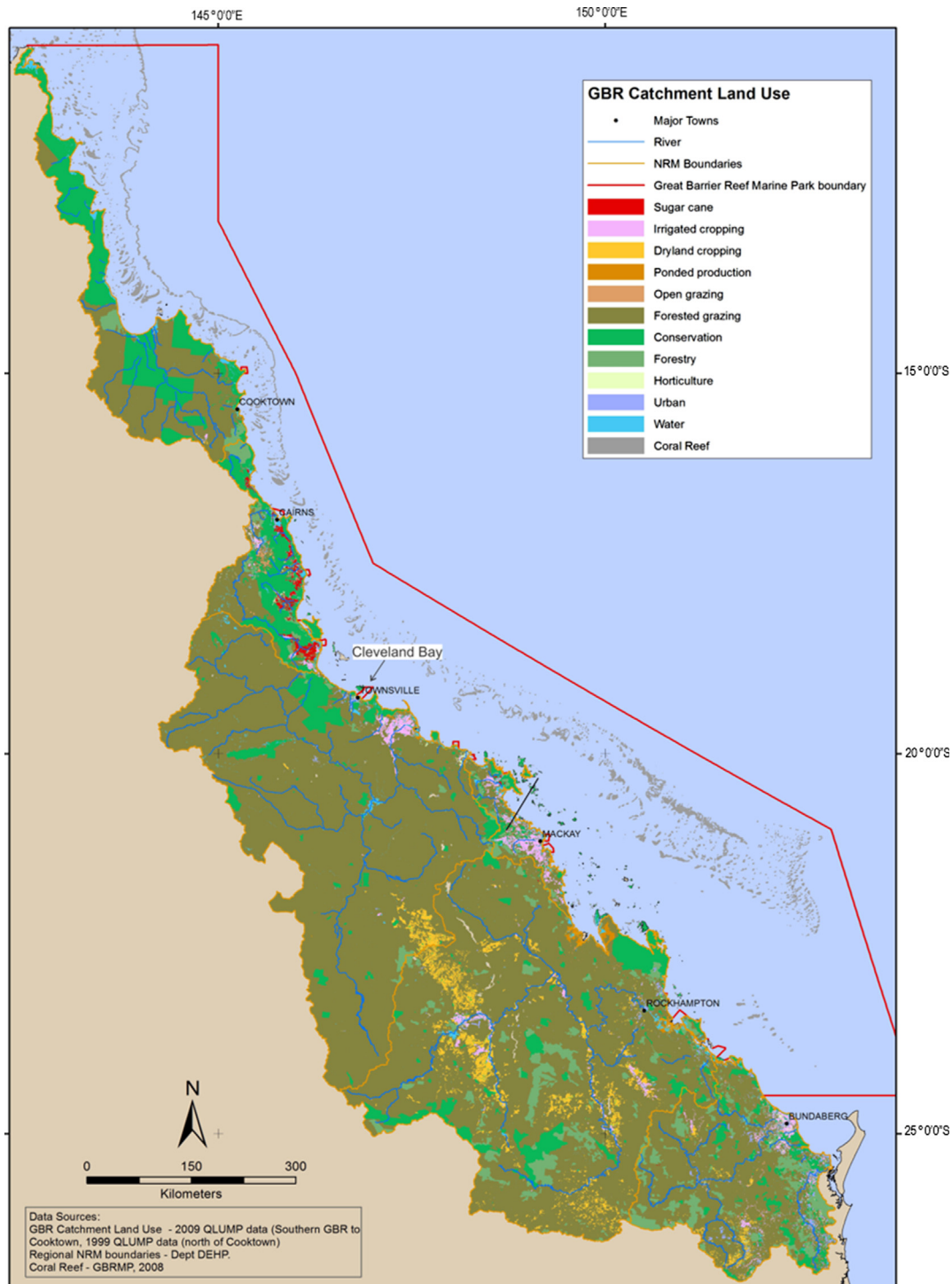


Fig. 1. The Great Barrier Reef and its catchments, showing land uses and the six Natural Resource Management (NRM) regions.

et al., 2014; Voss and Richardson, 2006; Willis et al., 2004) including severe loss of coral cover (De'ath et al., 2012), extensive seagrass loss (Petus et al., 2014; Coles et al., 2015) and consequent reduced populations of megafauna including dugongs (GBRMPA, 2014).

Targets for pollution reduction of sediment and nutrients were first developed in preparation for Reef Plan 2003, the joint Australian and Queensland Government's plan to manage terrestrial runoff for the GBR. These targets (Brodie et al., 2001) were set

as percentage reductions needed in suspended sediment (SS), nitrogen and phosphorus loads for each of the major basins draining to the GBR. They were based largely on the degree of increase in loads due to agricultural development of the basins over the last 200 years, with basins with large increases requiring large reduction targets and those with minor increases small targets. However in the end the targets were not incorporated into Reef Plan 2003 and this version of Reef Plan did not contain pollutant load reduction targets (Queensland Department of the Premier and

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