REGIONAL STATE OF THE ENVIRONMENT 2016

FOR THE NORTH COAST REGION OF NEW SOUTH WALES

Acknowledgements

Regional State of the Environment 2016

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The information contained in this publication is based on the technical knowledge and understanding of the authors and reviewers and is current at the time of preparation (November 2016). However, users are reminded of the need to ensure that the information upon which they rely is up-to-date, and to check the currency of the information with appropriate government agencies or an independent advisor.

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Abbreviations and Units of Measurement

ASS	acid sulfate soils
BFT	biodiversity forecasting tool
CAP	catchment action plan
CMA	Catchment Management Authority (now Local Land Services)
CZMP	coastal zone management plan
DPI	Department of Primary Industries
DPI Water	NSW Water
EHA	effective habitat area
EPA	Environment Protection Agency
GDE	groundwater dependent ecosystem
ICOLL	intermittently closed or open lakes or lagoons
IP&R	integrated planning and reporting
LEP	local environment plan
LGA	local government area
LLS	Local Land Services
MER	monitoring, evaluation and reporting
MPA	marine protected area
NRC	Natural Resources Commission
NRM	natural resource management
OEH	Office of Environment and Heritage
OSMS	onsite sewage management system
RSoE	Regional State of the Environment Report 2016
SEQ	south-east Queensland Catchments
SLATS	state-wide land cover and trees study
SoE	State of the Environment report
SMU	soil management unit
WSP	water sharing plan
WSUD	water sensitive urban design
WWTP	waste water treatment plant

Units of Measurement

CO_2-e	carbon dioxide equivalent	kL	kilolitre
ha	hectare	kWh	kilowatt hour
GJ	gigajoule	ML	megalitre
MWh	megawatt hour	Mt	megatonne
kg	kilogram	ppm	parts per million

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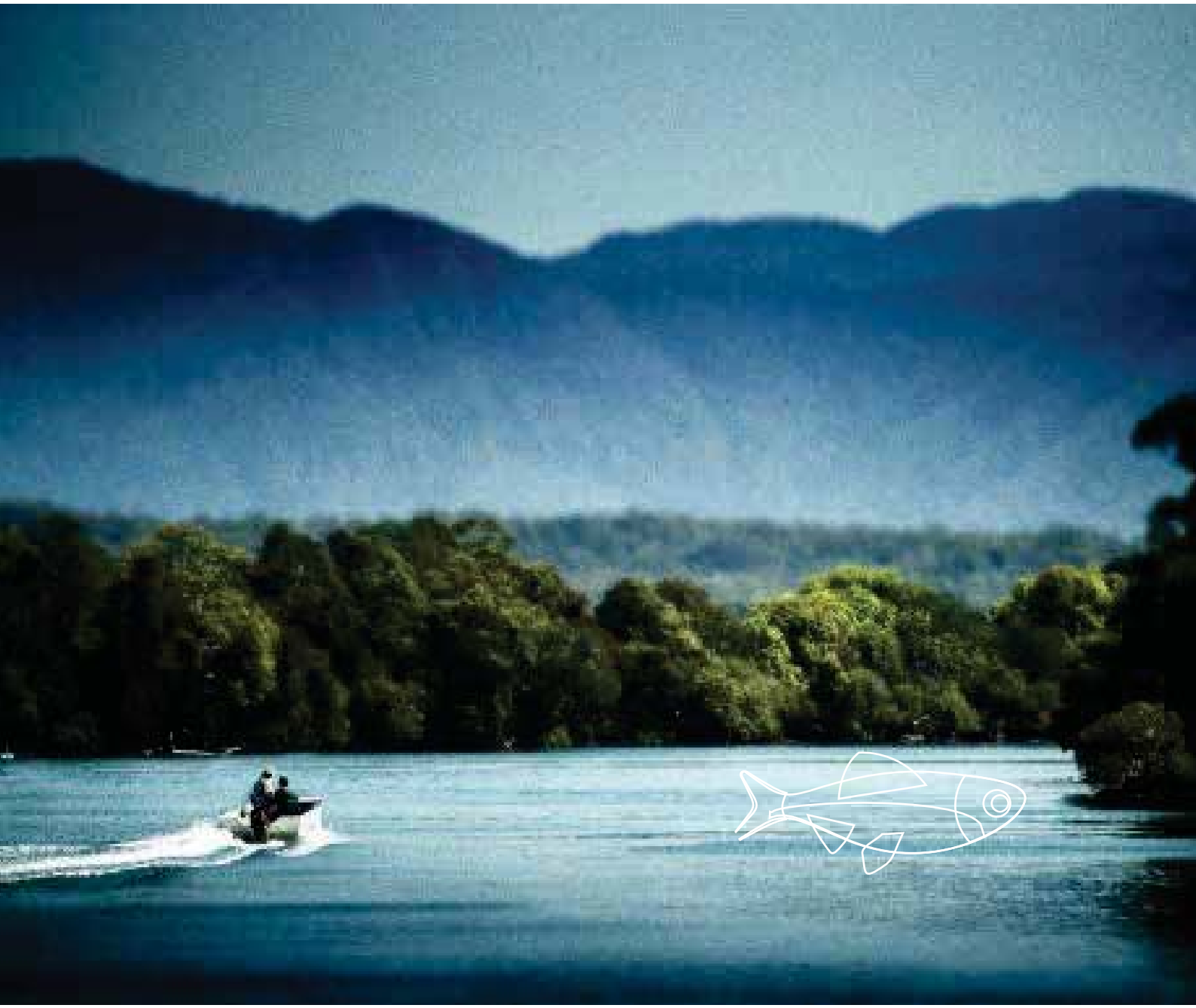


INTRO

Introduction

This Regional State of the Environment 2016 (RSoE) is the second prepared for the North Coast region of New South Wales (NSW). It involved collaboration between the 12 general purpose councils (councils) along the region's coast, (from Port Macquarie-Hastings Council in the south to Tweed Shire Council in the north and including Lismore and Kyogle councils), three county councils (now Rous County Council), and the North Coast Local Land Services (formerly the Northern Rivers Catchment Management Authority). It aims to report on environmental condition at both a regional and local level primarily for the 2012 to 2016 reporting period, but including information from the 2012 RSoE where relevant.

The RSoE utilises national, state and local data which is broken down by local government area where possible to provide local trends but is also used to provide regional trends. The reporting region for the 2016 report has changed since the 2012 report due to the transition of the Northern Rivers Catchment Management Authority (CMA) to the North Coast Local Land Services (LLS) in 2014. This change resulted in the reporting region changing to match the boundaries of the twelve participating Local Government Areas (LGA). Figure 1 shows the location of the region and participating LGAs for 2016.

Initiated by the Department of Premier and Cabinet and brokered by the former Northern Rivers CMA (now North Coast Local Land Services – NCLLS), the RSoE Report Project commenced in 2009, with a project working group developing a set of indicators specifically for the reporting region. The first report was produced in 2012. The report is funded by the 15 participating councils and North Coast Local Land Services. By working together, the councils in partnership with LLS hope this report will provide a regional perspective on the current environmental state while also providing locally-relevant information.

State of the environment reporting

A State of the Environment (SoE) report serves to inform the community and local and state governments on the condition of the environment in the reporting area, key pressures acting on the environment, and responses to those key pressures.

This **condition–pressure–response** information can be used to increase community awareness of environmental issues, and to guide natural resource managers in prioritising and addressing management actions.

SoE reporting is a requirement for local government under the *Local Government Act 1993*. Amendments to the Act in 2009 altered the reporting schedule and structure, requiring a comprehensive SoE report every 4 years (in the year of an ordinary election). The SoE reports are part of the NSW Government's Integrated Planning and Reporting (IP&R) framework. This framework guides each council's strategic planning and reporting, and requires the creation of a community strategic plan which incorporates environmental objectives among other things. The RSoE provides environmental benchmarks which councils and natural resource managers can use for better decision-making.

Photo: Belingen Shire Council

Objectives of the Regional SoE

The objectives of the Regional SoE include:

- To provide a common set of themes and indicators that report on meaningful trends in environmental health at a regional scale over time, with a shift in the emphasis towards indicators of natural resource condition rather than pressure and response
- To enhance data gathering, sharing, assessment and publication processes across all stakeholders and reporting frameworks
- To integrate, align and standardise local, regional and state reporting processes such as NSW SoE, State of the Catch ments and regional natural resource management (NRM) prioritisation and investment processes
- To develop a broader, more inclusive framework that captures more NRM programs and stakeholders
- To provide a more accessible and meaningful report for community and decision-makers on the condition of the local environment and where resources are best placed to respond to community expectations
- To reduce duplication of resources in SoE and NRM reporting
- To link regional priorities and targets via the various regional plans and the environmental component of local government community strategic plans.

Relationship to other state-wide and regional reporting

The RSoE for the North Coast region of NSW attempts to integrate aspects of the following reporting that is undertaken in the region:

- 'NSW Natural Resources Monitoring, Evaluation and Reporting Strategy' (NSW MER Strategy) which reports across a range of environmental themes across the state
- State of the Catchments which reports against catchment management authority (CMA) regions and are yet to be repeated for the new LLS regions
- North Coast LLS which reports annually on the region's investment, but does not currently consider the achievements of other NRM stakeholders (e.g. local governments)
- NSW SoE reports which are prepared without any tangible links to local government SoE or LLS reporting.

These frameworks report independently of each other and are not delivered in an integrated or strategic manner. As such, they do little to inform state-wide SoE reporting, the NSW 2021 state plan targets, or regional NRM prioritisation and investment processes. It is a goal of the NSW MER strategy to better integrate and streamline regional NRM reporting to enable local government reporting to inform State of Catchment reporting and vice versa (DECCW 2010a).

Regional partnership

The *Local Government Act 1993* encourages regional reporting as it provides not just an isolated assessment of an area with an arbitrary administrative boundary (a council area) but a catchment and regional picture incorporating a range of environmental features. It also encourages collaborations, which allow broadscale projects to be implemented with better regional outcomes, and assists with management of shared resources, particularly rivers and areas of special ecological significance.

The RSoE Report Project partnership is between the participating general councils and county councils in the North Coast Region (Figure 1), supported by LLS. NSW Government agencies are also involved in the project providing expertise and data. Involved agencies include Department of Premier and Cabinet, Division of Local Government, Office of Environment and Heritage (OEH), Department of Primary Industries (DPI), Department of Lands, DPI Water, and the NSW Food Authority.

Participating councils are:

- Ballina Shire Council
- Bellingen Shire Council
- Byron Shire Council
- Clarence Valley Council
- Coffs Harbour City Council
- Kempsey Shire Council
- Kyogle Shire Council
- Lismore City Council
- Nambucca Shire Council
- Port Macquarie – Hastings Council
- Richmond Valley Council
- Tweed Shire Council
- Far North Coast Weeds*
- Richmond River County Council*
- Rous Water*

* now merged into Rous County Council

In this report, the 'region' refers to the area covered by the 12 participating councils.

Photo: Coffs Harbour City Council

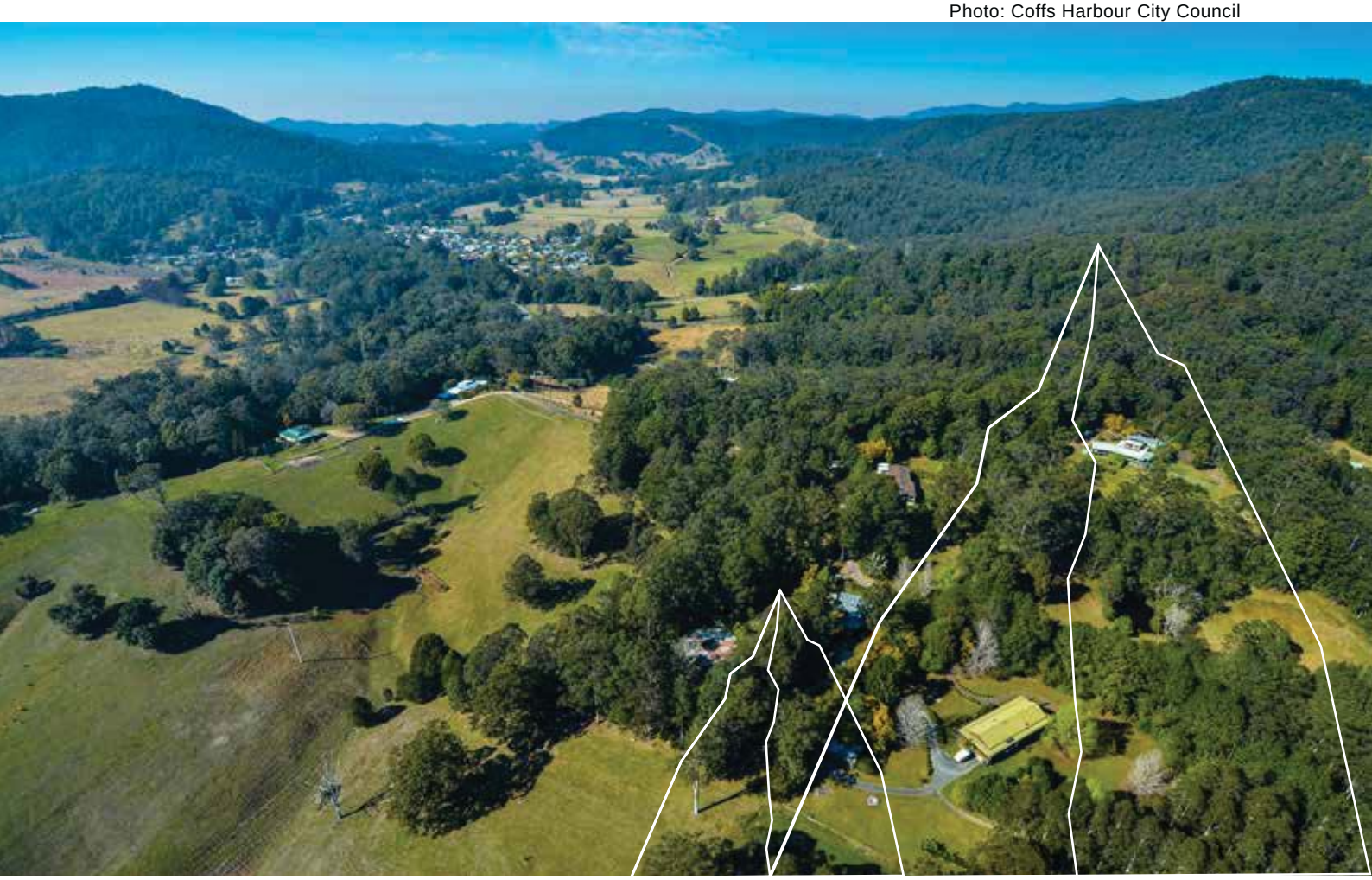


Figure 1: Councils participating in the Regional SoE Report 2016

Report structure, indicators & data

The report is made up of a suite of documents – an overall Summary, the main technical report (this document) and individual Summaries for each Local Government Area (LGA) within the reporting region. All documents are available on each participating Councils' websites.

The four environmental themes are:

1. People and the Environment
2. Biodiversity and Vegetation
3. Land and Soils
4. Water.

These themes were selected as they are compatible with the state-wide standard and targets established by the Natural Resources Commission (NRC 2005), the body that guides NRM and monitoring, evaluation and reporting in NSW. Each theme contains a number of resource categories which each have indicators and measures. There are 20 resource categories in total. Indicators relate to condition, pressure or response. Themes, resource categories and indicators are shown in Table 1.

The indicators focus on environmental condition as a better reflection of environmental state rather than pressure and response. The 2012 RSoE Report was considered as a baseline of environmental condition for the reporting region to then use as a guide when reporting again in 2016. The 2016 report also has a condition focus identifying trends where possible.

Data has been provided by all participating councils, OEH, Department of Primary Industries (DPI), North Coast Local Land Services (LLS), DPI Water, and Landcare. Not all councils and agencies could supply all the requested data, so in some instances there are data gaps. Where there are data gaps that cannot be filled, they are noted in the respective data table, figure or text. Major data gaps exist for wetlands, riparian vegetation, rocky reef biota and soils/land management. These are detailed in the text and are also recognised widely at regional, state and national levels (see DECCW 2010b; State of the Environment 2011 Committee).

Data quality is highly variable, and a rating of data quality is provided for each indicator. Quality ratings were either provided by the data custodian or were based on discussion with the data custodian. High quality data indicates the data provider has confidence the data is accurate and reliable. Medium data quality is mostly accurate and reliable but has a small degree of error or uncertainty. Low quality data has inaccuracies and a large degree of uncertainty, which may be due to an incomplete dataset or the methods used to collect the data.

Photo: A Harrison

Table 1: Themes, resource categories, indicators and measures used in the Regional SoE 2016 (C=Condition , P=Pressure, R=Response)

Section	Resource category	Indicator	Measure/s	C/P/R
Theme 1: People and the environment				
1.1	**Regional climate characteristics**	Climatic conditions that prevailed from 2012 to 2016	General description including rainfall, temperature and flooding	**C**
1.2	**Population characteristics and change**	Population growth and distribution	Population statistics from the Australian Bureau of Statistics for 2001, 2006 and 2011	**C**
		Population densities		**P**
1.3	**Climate change: reducing emissions and preparing for change**	Atmospheric carbon dioxide (CO_2) concentrations	CO_2 concentration in parts per million for 2012	**C**
		Annual greenhouse gas emissions — tonnes CO_2 equivalent (CO_2-e) per capita by LGA	Total energy consumption and emissions by LGA	**P**
			Council operational energy consumption (streetlights, service and infrastructure provision), total fuel consumption, and emissions by LGA	**P**
		Greenhouse gas abatement — tonnes of CO_2-e abated	Total renewable energy exported to the grid and tonnes CO_2-e abated by LGA	**R**
			Report on council abatement works and estimated tonnes CO_2-e abated	**R**
1.4	**Surface water demand**	Extraction	Kilolitres consumed in total by LGA and percentage residential, non-residential	**P**
			Total kilolitres consumed per connection by LGA 2010–16	**P**
1.5	**Waste**	Total waste generated	Total waste to waste management facilities by LGA and per capita for 2010–16. Domestic waste comparison across LGAs	**C**
		Total waste diverted from landfill	Total waste recycled or diverted from landfill per capita for 2010–16	**R**
1.6	**Environmental Levy**	Environmental Levy by LGA	Levy funding by LGA and its distribution	**R**
Theme 2: Biodiversity and vegetation				
2.1	**Ecologically functional landscapes**	Habitat connectivity	Connectivity index based on Biodiversity Forecasting Tool (BFT) modelling	**C**
		Effective habitat area	Area based on BFT modelling	**C**
		Net vegetation change — clearing	Area cleared based on Statewide Landcover and Trees Study (SLATS) methodology; Private Native Forestry approvals by LGA	**P**
		Management of key habitats and priority areas	Number of national, state, regional and local plans and strategies in place to protect biodiversity	**R**
			Number of strategies, plans and programs guiding biodiversity management by LGA	**R**
		Vegetation mapping	Type of mapping and status	**R**
2.2	**Native vegetation restoration**	Habitat areas restored	Area in hectares	**R**
		Environmental volunteers working on private and public land	Number of volunteer hours spent on habitat restoration	**R**
2.3	**Conservation reserves and agreements**	Actions to protect native vegetation	Area of land protected within the national park estate by LGA	**R**
		Council land-use zoning	Comparison of previous and current local environment plans (LEP) for area under environmental protection	**R**
		Land protected under conservation agreements	Number and area of agreements by type and agency	**R**
2.4	**Native flora and fauna**	Threatened species, populations and communities	Number by LGA	**C**
		Key threatening processes	Number by LGA	**P**
2.5	**Invasive species**	Extent of invasive weed species	Extent of area protected (hectares)	**C/P**
			High risk sites, pathways and priority sites identified (area, length and number)	**R**
		Extent of invasive weed control	Area and length of high risk sites and pathways treated	**R**
			Evidence of reduced weed impacts (area)	**R**
		Extent of pest fauna species	Current pest distributions	**C/P**
		Number of pest control programs	Current pest control programs by LGA	**R**

Table 1: Continued

Section	Resource category	Indicator	Measure/s	C/P/R
		Theme 3: Soils and land use		
3.1	**Soils**	Soil condition	Soil management unit condition by NSW MER Strategy indicator	**C**
3.2	**Land use**	Land managed within its capability	Land management by soil monitoring unit and NSW MER Strategy indicator	**P**
3.3	**Funded land and soils management activities**	State and federally funded soil and land management activities	Area of land under soil rehabilitation works	**R**
3.4	**Acid sulphate soils**	Extent of acid sulfate soils (ASS): hotspots and drainage density	Area of ASS hotspots, high and low risk ASS soils, and length of ASS drains	**P**
		Area of remediated acid sulfate soils, drains and associated wetlands	Area of ASS and associated wetlands remediated	**R**
3.5	**Mining activity**	Mining and exploration licences by LGA	Number and area of current licences and applications	**P**
		Theme 4: Water		
4.1	**Estuarine & freshwater rivers**	Water quality, macro invertebrates and fish assemblages	Ecohealth assessment results, NSW MER Strategy program results for water quality, macroinvertebrates, and fish assemblages	**C**
		Presence of riparian vegetation	Length or area of known riparian vegetation and condition of mapped riparian vegetation by LGA	**C**
		Waste water treatment plant (WWTP) performance	Volume and percentage of wastewater discharged to waterways and reused by LGA	**P/R**
		On-site sewage management system (OSMS) performance	Total number OSMS, number inspected per annum, number of failures and estimate of unknown or unregistered OSMS by LGA	**P/R**
		River restoration works and riparian vegetation restoration	Area or kilometres and activity or project type	**R**
		Stormwater improvement works and water sensitive urban design (WSUD) plans	Stormwater management and WSUD plans by LGA	**R**
			Stormwater improvement works by LGA	**R**
4.2	**Wetlands**	Wetland condition	Water quality, soil quality, biota and presence of pests from NSW MER Strategy program	**C**
		Wetland pressure	Catchment, hydrological and habitat disturbance and alteration from NSW MER Strategy program	**P**
		Wetland remediation	Area remediated by LGA	**R**
4.3	**Groundwater**	Groundwater quality	If data available	**C**
		Groundwater extraction	Percent of long-term annual extraction limit allocated and risk category by groundwater source	**P**
		Number of groundwater dependent ecosystems (GDE) under water sharing plans	Water sharing plans status for 2016 and number of GDEs covered by them	**R**
4.4	**Near-shore marine**	Marine water quality	Beachwatch results for 2016 and marine Chlorophyll-a levels	**C**
		Rocky reef biota	Current status of seabed mapping, reef fish assemblages, mollusc and fish species richness and marine debris	**C**
		Area of marine protected areas	Area of marine protected areas in the North Coast Region and zoning for activities	**R**
		Coastline management	Status by LGA for coastal hazards mapping and coastal zone management plan preparation	**R**

The reporting region

The reporting region falls within the North Coast Region, which extends from the Camden Haven River south of Port Macquarie to the Queensland border in the north, and west to the tablelands (Figure 2). This region is characterised by some of the NSW coast's largest river systems, and by the Great Dividing Range and its presence so close to the coast. The coast itself is dotted with coastal lakes and estuaries, headlands and coastal wetlands. Just inland from the coastal lowlands is the escarpment of the Great Dividing Range, with hills and valleys and remnant forest. Further west the land rises to the plateau, with World Heritage–listed rainforest at Dorrigo, and surrounding agricultural land as the plateau extends west to the northern tablelands. The region is renowned for its biodiversity, with the Macleay–McPherson Overlap which results in both temperate and tropical species and ecosystems occurring in the same region, many at the extent of their range. A similar overlap occurs in the adjacent marine waters, where temperate, subtropical and tropical waters meet, creating an outstanding diversity of marine life (DECCW 2010d).

The region's biodiversity is recognised through World Heritage areas, marine parks, an aquatic reserve, indigenous protected areas, and national parks and nature reserves which occupy 23% of the reporting region.

The area sustains increasing population levels, with associated industry, development and agriculture. Significant changes have occurred since European settlement, with major timber industries clearing large parts of the North Coast region in the late 1800s, clearing for agricultural use, and alterations of rivers and estuaries for water supply, cropping and other purposes. Current industries in the region include grazing, timber, horticulture, cropping, commercial fishing, dairying, aquaculture and tourism.

The region faces a range of pressures including an increasing population centred on the coast, associated increasing natural resource use and expanding urban areas. Monitoring of these pressures and their impacts is critical to allow timely management to prevent further degradation of an already impacted environment.

Photo: Lismore City Council

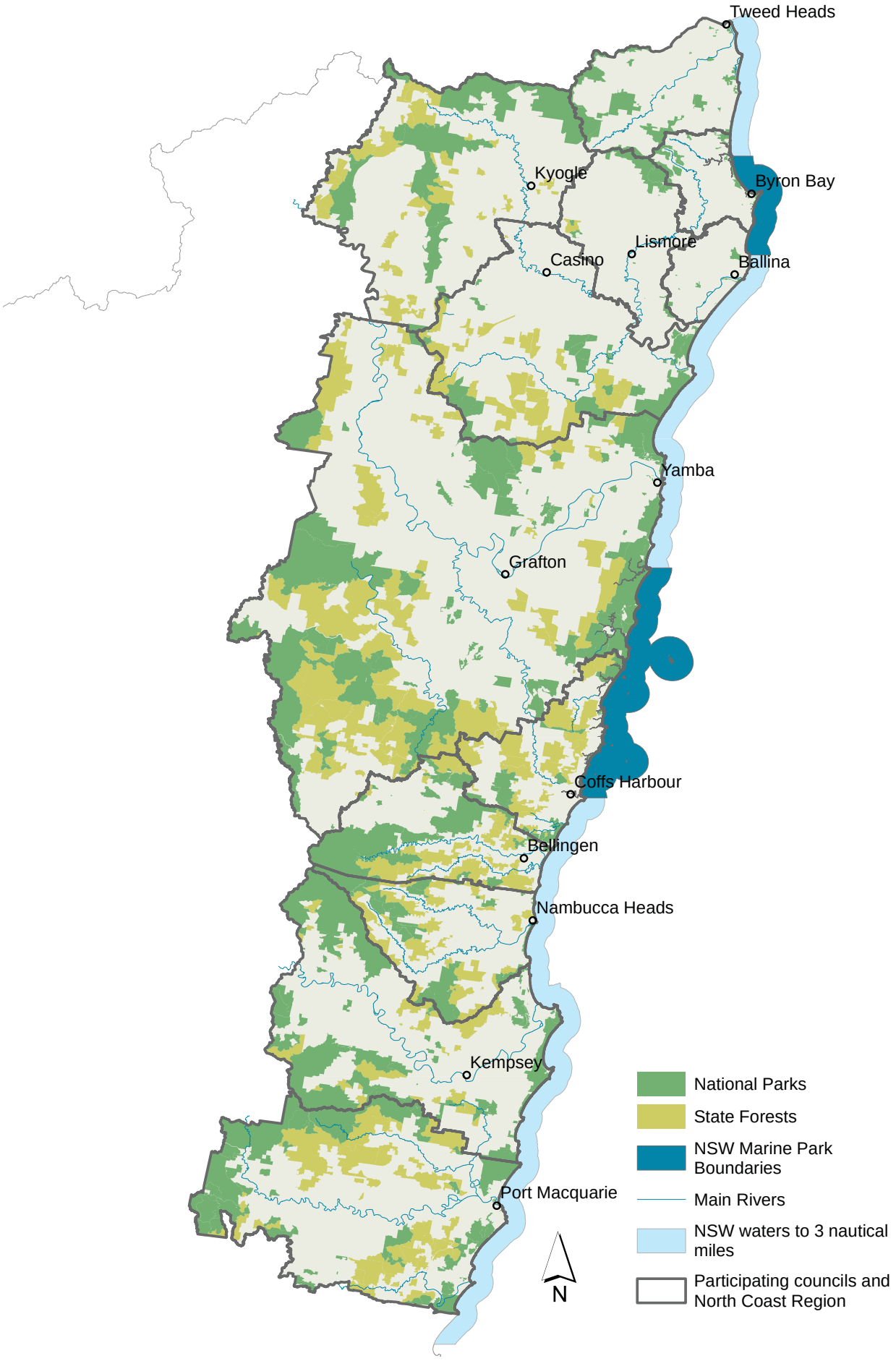


Figure 2: Reporting region with National Parks, State Forest and Marine Parks

ONE

Photo: Bellingen Shire Council

People and the Environment

Since the first RSoE report for the North Coast region of NSW in 2012, there has been significant population growth in some areas, little change in others, and a very different weather pattern to the La Niña –dominated weather of the last report. Pressures are increasing for a number of indicators, but reducing for others as is detailed in this Theme.

This section discusses the current condition of the region's population and climate, the pressures of population density, greenhouse gas emissions, water extraction and waste generation, and identifies trends since the 2012 RSOE report.

1.1 Regional climate characteristics

INDICATOR: Climatic conditions that prevailed throughout 2012–16 (CONDITION)
DATA SOURCE: Bureau of Meteorology
DATA QUALITY: High

2012 saw the end of the four-year La Niña cycle and resultant above average rainfall. The North Coast was deluged twice in January 2013 with the tail-end of ex-Tropical cyclone Oswald followed by an east coast low which resulted in two separate major flood events across the entire region.

Rainfall in 2014 was below average with no flooding recorded in the region, and 2015 rainfall records show average rainfall across the region despite the El Niño which resulted in below average rainfall in other regions. In 2016, the June east coast low brought record-breaking daily rainfall totals on June 5th to all areas within the region, resulting in flooding, extensive coastal erosion and infrastructure damage (BOM 2016a).

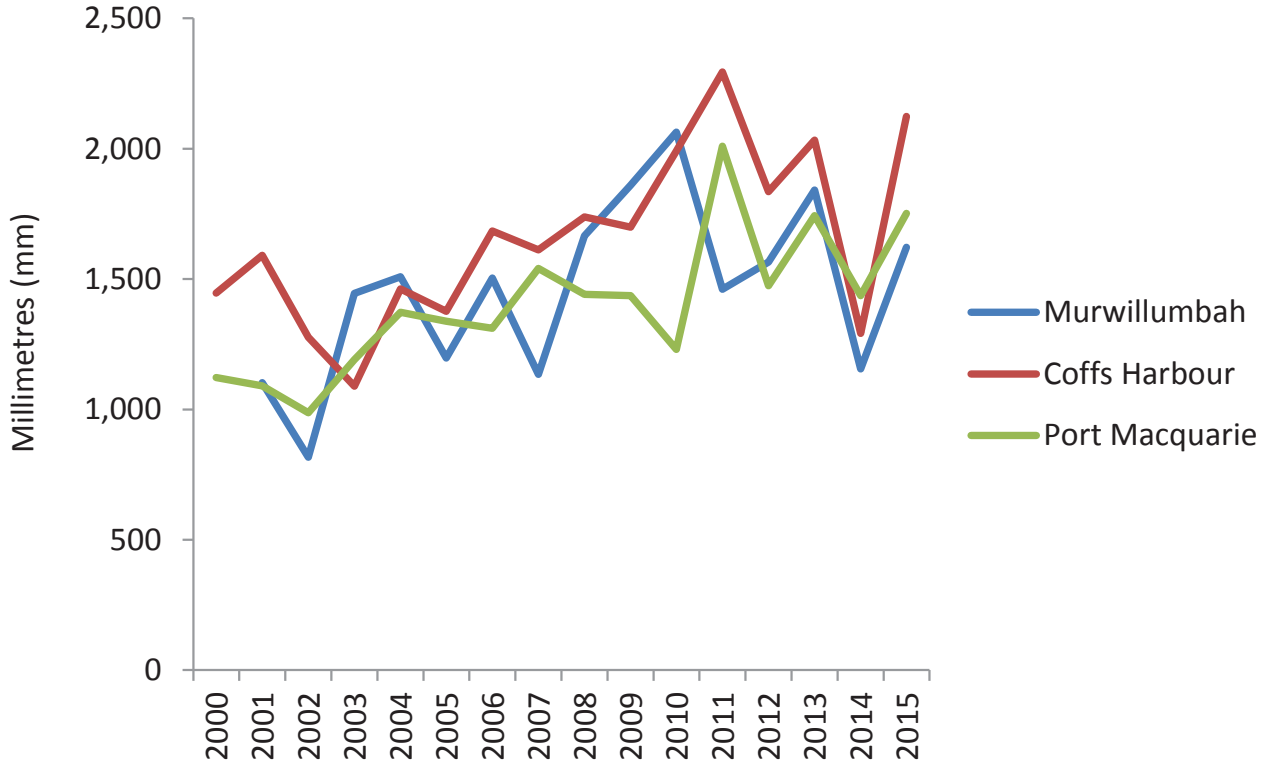


Figure 3: Annual rainfall for three major centres in the region
(Source: Bureau of Meteorology)

2013 was Australia's warmest year on record. Persistent and widespread warmth throughout the year led to record-breaking temperatures and several severe bushfires. 2014 was Australia's third-warmest year on record, and 2015 fifth warmest but also dry due to the El Niño conditions. In October 2015 the region experienced heatwaves and temperatures well above the mean, recording record-breaking temperatures in many locations (BOM 2013, 2014, 2015).

The variable nature of our regional climate with at least annual flooding in some areas and the vagaries of rainfall due to the southern oscillation index status (el Niño/la Niña) provides the region's councils with challenges to manage the consequences of these climate events. The extreme rainfall and widespread flooding cause water quality and river/estuary health issues due to the high nutrient and sediment loads that enter river systems during floods. Some studies indicate that nutrient and sediment loads carried by flood-water are underestimated (Wallace et al. 2009). River systems do recover from floods, but reducing sediment and nutrient loads during flood events is vital and possible with good land management practices and adequate riparian vegetation. Additionally, the drier times with less reliable rainfall place increased stress on water resources, which are mostly unregulated in the reporting region. These are discussed under Theme 4: Water.

1.2 Population characteristics and change

INDICATORS:	Population growth and distribution (CONDITION) Population densities (PRESSURE)
DATA SOURCE:	Australian Bureau of Statistics
DATA QUALITY:	High
TREND:	Increasing pressure

The North Coast region of NSW continues to experience significant population growth in the Tweed, Port Macquarie-Hastings and Coffs Harbour LGAs. Byron Shire recorded the highest population growth in the region since 2009, growing by 7.14%, just below the NSW average of 7.99%. Over the same period, the population of Tweed LGA grew by 6.84%, Port Macquarie-Hastings increased by 6.56% and Coffs Harbour by 5.2%. Other LGAs have a very stable population, with Kyogle Shire only experiencing a 0.24% increase – 23 people – and Clarence Valley increasing by 1.2%. (see Figures 4 and 5). No LGAs decreased in population over this period (ABS 2016).

The regional profile is one of high coastal population pressure which reduces with increasing distance from the coast. Growth is centred on the largest towns, indicating employment, industry and economic growth continue to influence population change. The large increase in Byron Shire's population may be due to the lifting of the sewer moratorium in 2008 and the waiving of development application contributions for secondary dwellings (Byron Shire pers. comm. 2016). The North Coast population profile is typical of NSW and the east coast of Australia, and places increasing pressure on state and local governments to manage the disproportionate growth along the coastal fringe.

Population density is highest in the Ballina, Tweed and Coffs Harbour LGAs, with densities of 85, 70 and 62 people per square kilometre respectively. Byron was next at 58 people per square kilometre. Kyogle had the lowest population density at 3 people per square kilometre, with Clarence Valley next lowest at 5 (ABS 2016).

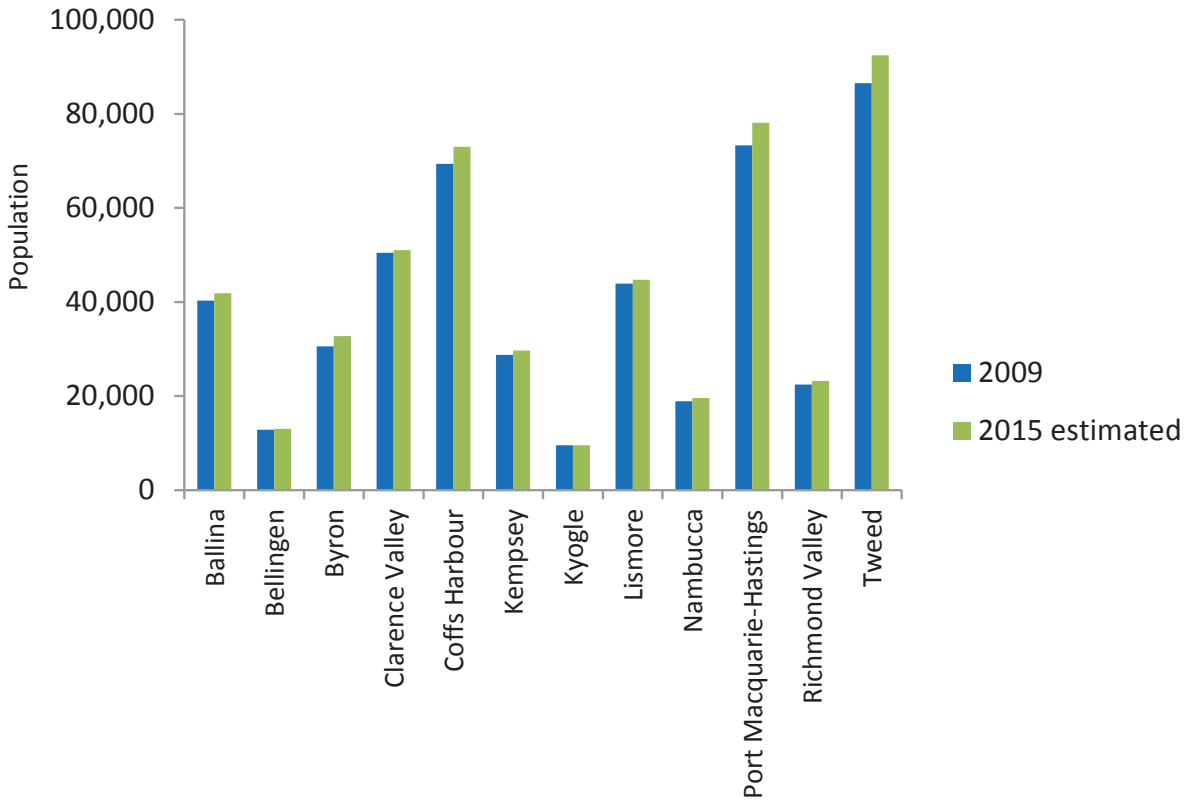


Figure 4: Population change by LGA from 2009 to 2015 (source: ABS)

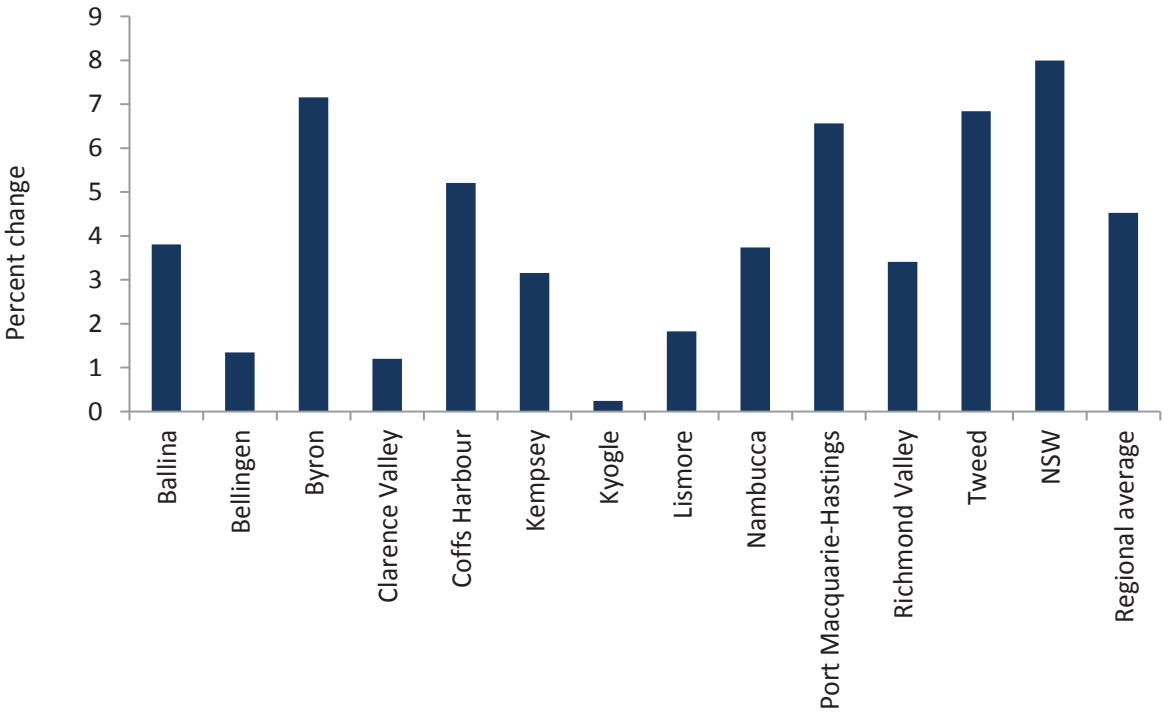


Figure 5: Percentage change in population by LGA since 2009
(Source: ABS)

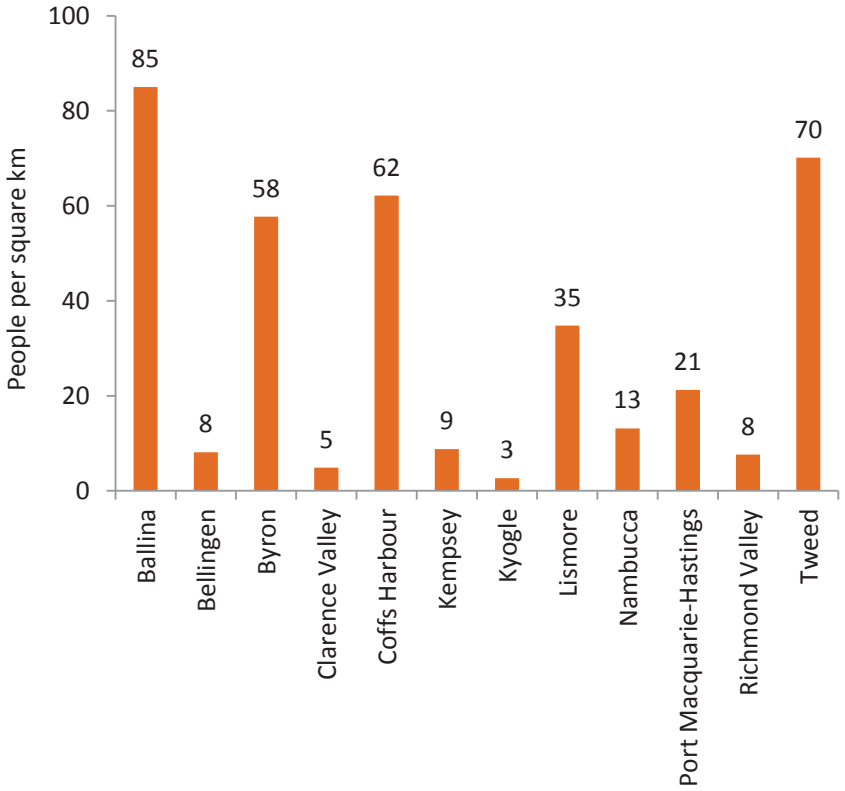


Figure 6: Population density by LGA in 2015
(Source: ABS)

1.3 Climate change: reducing emissions and preparing for change

INDICATOR:	Atmospheric carbon dioxide concentrations (CONDITION)
DATA SOURCE:	CSIRO
DATA QUALITY:	High
TREND:	Increasing Pressure
INDICATORS:	Emissions per capita and annual council emissions (PRESSURE) Greenhouse gas abatement — tonnes of carbon dioxide equivalent (RESPONSE)
DATA SOURCE:	Commonwealth of Australia, councils, county councils, Essential Energy
DATA QUALITY:	Medium to high
TREND:	Reducing pressure regionally for electricity emissions, increasing pressure for fuel emissions

Since the 2012 RSoE report, the region has experienced the hottest year on record, the hottest autumn on record, record-breaking rainfall, and extreme east coast lows. The sea surface temperatures in eastern Australia have continued to show an increasing trend, reflecting the global trend of increasing air and water temperatures (BOM 2016b). Atmospheric concentrations of greenhouse gases are measured globally, and carbon dioxide is the greenhouse gas of greatest importance as it has been the largest contributor to global warming (IPCC 2007). Greenhouse gas emissions are calculated by converting them to carbon dioxide equivalent (CO_2-e), which allows comparison across all emissions relative to carbon dioxide concentration.

1.3.1 Atmospheric carbon dioxide concentrations

There are no local or regional data on carbon dioxide concentrations, so this section discusses national trends. Cape Grim in Tasmania has been monitoring the atmospheric concentration of carbon dioxide since 1976, and is one of three premier baseline air pollution stations in the World Meteorological Organization's Global Atmosphere Watch network. The Cape Grim Baseline Air Pollution Station monitors southern hemispheric air, while in the northern hemisphere the Mauna Loa Observatory in Hawaii has been continuously monitoring and collecting data related to atmospheric change since the 1950s. The third monitoring station is in Greenland (CSIRO 2016).

In April 2012 the concentration of carbon dioxide at Cape Grim was 388.8 parts per million (ppm). By August 2016, it had reached 401.42 ppm, indicative of the rising trend since 1976 (see Figure 7 – CSIRO 2016).

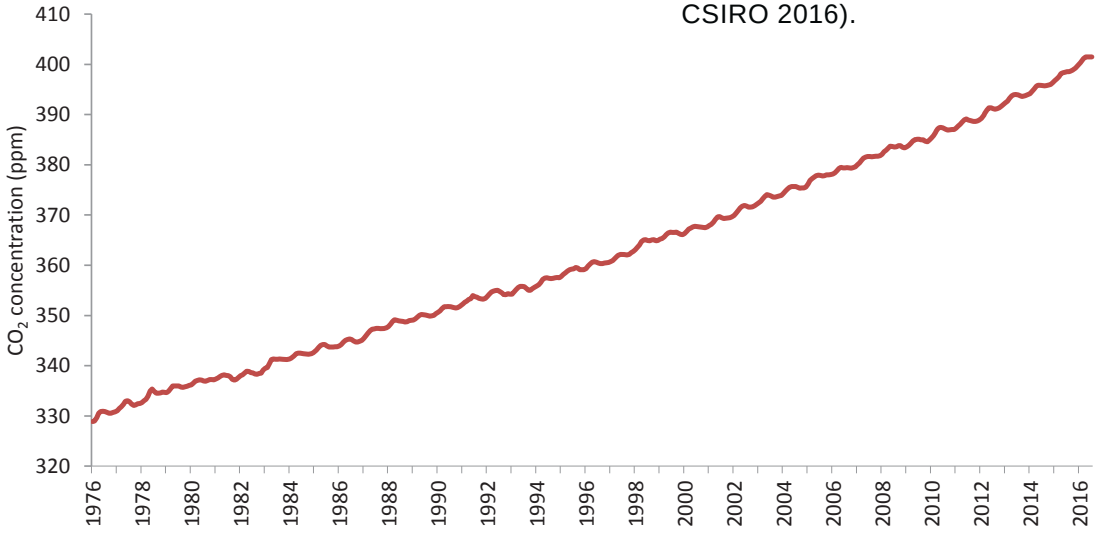


Figure 7: Atmospheric carbon dioxide concentrations measured at Cape Grim, Tasmania (Source: CSIRO)

1.3.2 National greenhouse gas emissions

There are no local data so this section discusses national trends. Australia's annual total emissions for the year to December 2015 are estimated to be 535.7 Mt CO_2-e, which is a very slight decrease of 2% since the March 2012 level of 546.8 megatonnes (Mt) CO_2-e (see Figure 8 – Department of the Environment and Energy 2016).

Emissions per capita and the emissions intensity of the economy, including the Land Use, Land Use Change and Forestry sector, were both at their lowest levels in 26 years in the year to December 2015 (Department of the Environment and Energy 2016). However, emissions from electricity generation and use, as well as transport are still increasing, but are offset by reductions in emissions from agriculture and forestry/land use changes since 1990. In the past 12 months, emissions from Land use, Land use change and Forestry (LULUCF) have increased by 50% but contribute only 1% of Australia's overall emissions (see Figure 9 - Department of the Environment and Energy 2016). Per capita, Australians currently emit 22.5 tonnes CO_2-e per annum, compared to 25.4 tonnes CO_2-e per annum in 2012 (Department of the Environment and Energy 2016).

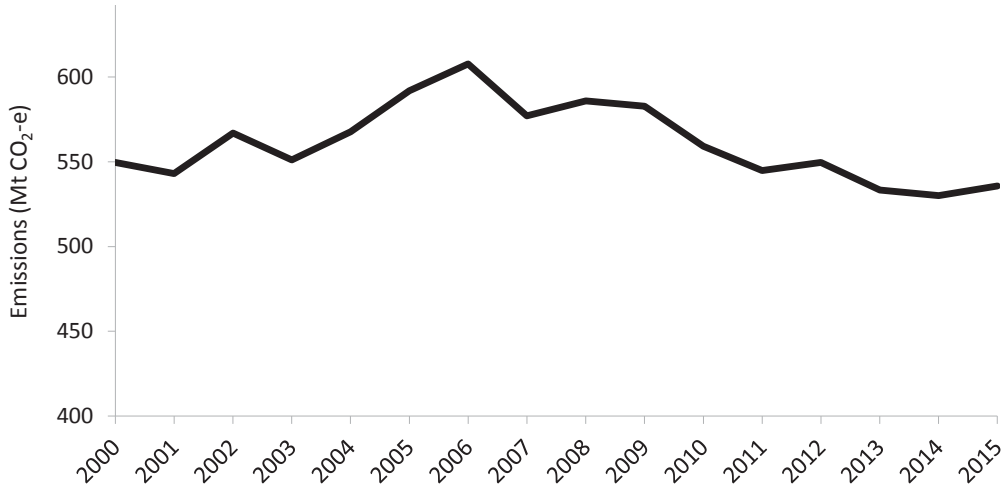


Figure 8: National greenhouse gas emissions by year (Source: DEE 2016)

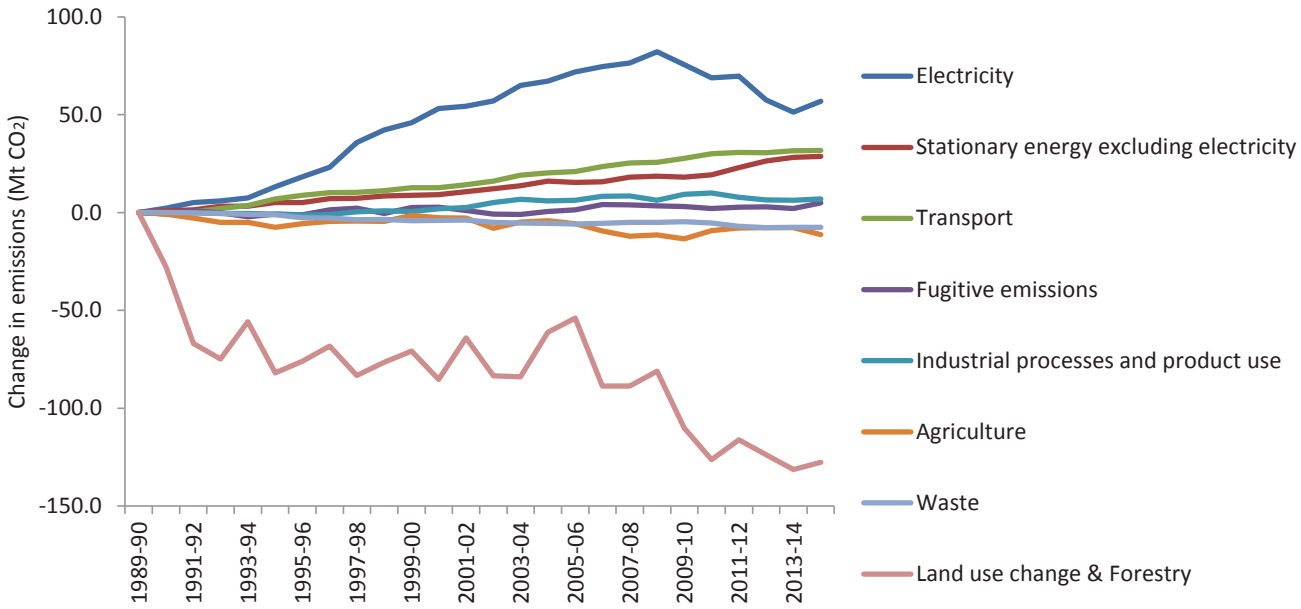


Figure 9: Emissions by sector since 1990 (Source: DEE 2016)

1.3.3 Local greenhouse gas emissions

With electricity being the highest sector contributing to greenhouse gas emissions in Australia, reducing energy consumption while increasing the contribution of renewable energy production is essential to reducing emissions. Many councils within the region have committed to emissions reduction plans or similar which set targets for emissions reduction and increases in renewable energy infrastructure.

Regional greenhouse gas emissions

Essential Energy, the primary energy provider in the reporting region, provided total energy consumption data by postcode for the period 2011–2016 for residential and non-residential consumers, as well as the level of renewable electricity fed back to the grid from roof top solar installations. The postcodes were apportioned to the relevant LGA using the ABS Census methodology. This information was used to generate per capita energy consumption for each LGA and for the reporting region (see figures 10 and 11). The data shows that across the reporting region, residential and non-residential energy consumption is equal at exactly 50% each. Bellingen had the highest residential proportion at 57%, and Lismore the lowest at 42%.

Total electricity consumption from the grid across the region is very stable for both residential and non-residential connections from 2011 to 2016. This demonstrates the contribution of roof-top solar installations and energy-efficiency measures, as the population has grown but total electricity use has not. Most roof-top solar installations are on net meters, meaning the electricity they produce is not measured, only the demand from the grid is measured along with any excess electricity generated and fed back to the grid. With roof top solar installations now at nearly 30% of all households in some LGAs, they are making a significant contribution to electricity demand, but this is unmeasured.

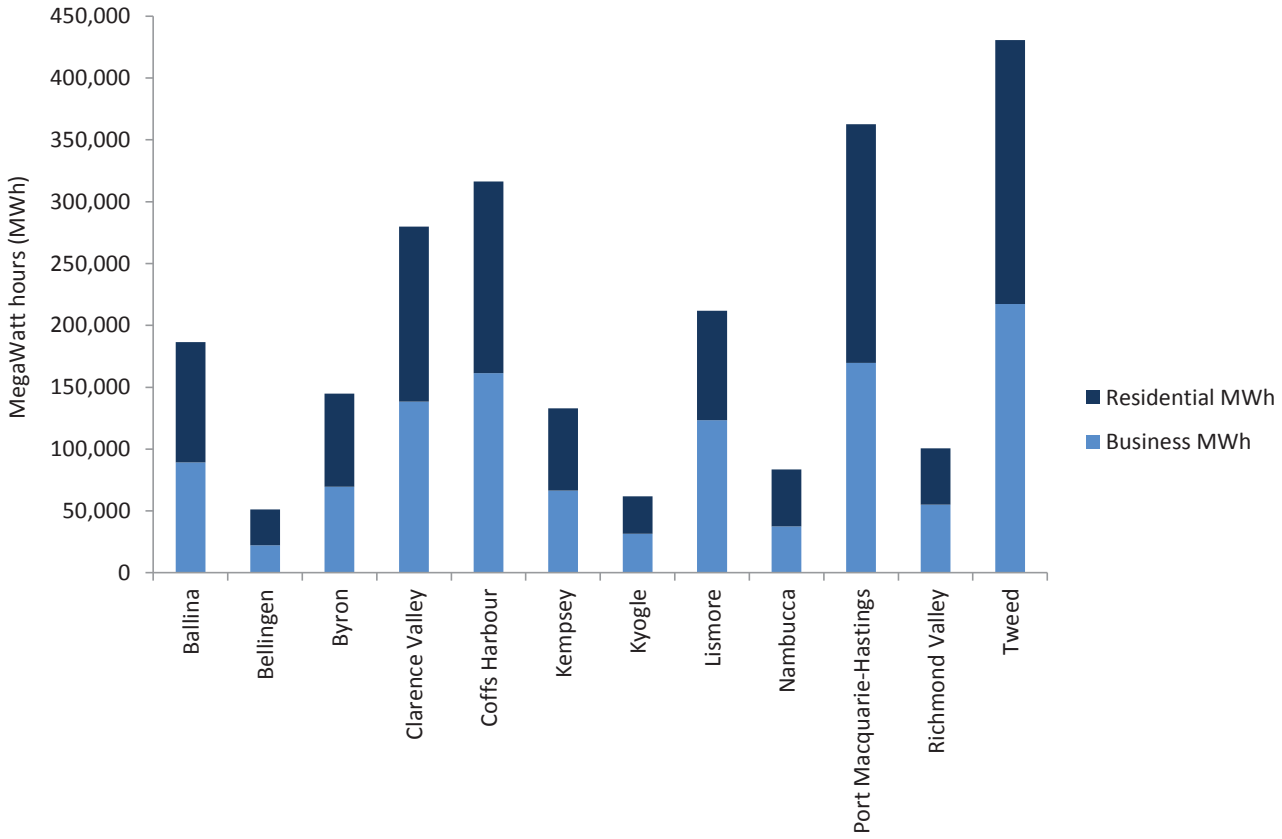


Figure 10: Electricity consumption by LGA for 2015/16 residential and non-residential
(source: Essential Energy)

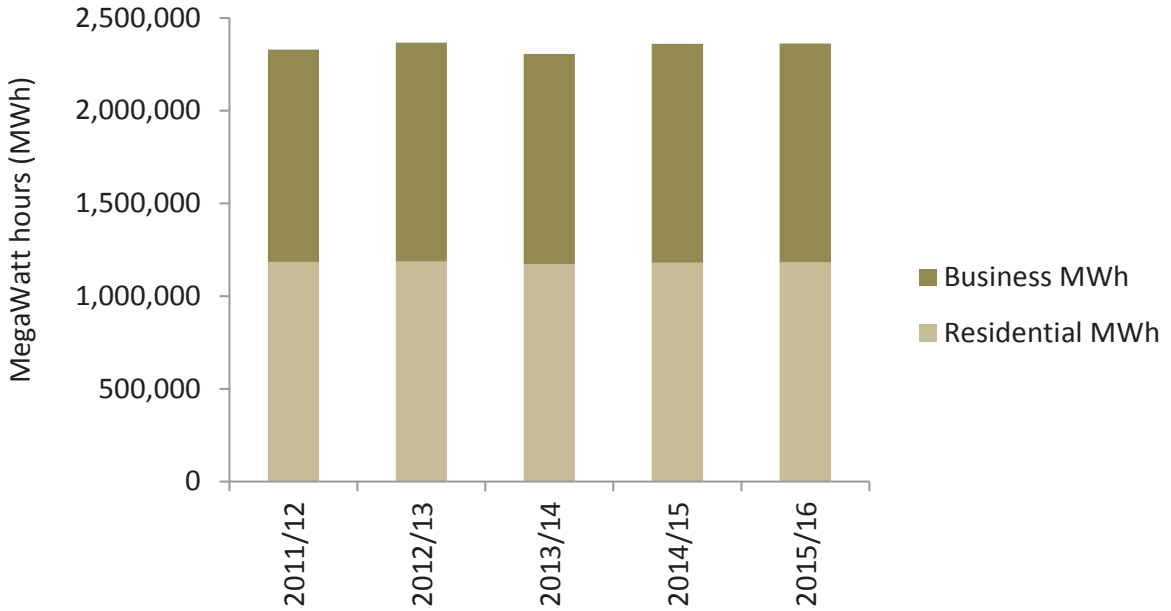


Figure 11: Total regional electricity consumption 2011-2016
(source: Essential Energy)

For residential electricity use, per capita consumption has been stable within each LGA over the five years of data collection. There are variations between LGAs, with Kyogle having the highest per capita consumption at 3,155 kiloWatt hours annually, and Richmond Valley the lowest at 1,960 kiloWatt hours per person annually (figure 12).

Residential per capita electricity consumption and associated emissions are consistent across the reporting region, with an average of 2 tonnes CO_2-e emitted per person in 2016.

For the reporting region, a total of 2,362.36 gigawatt hours of electricity was consumed in 2016, emitting 1.98 million tonnes of CO_2-e. Note: figures quoted in the 2012 RSoE report cannot be compared as the methodology used and data obtained are different.

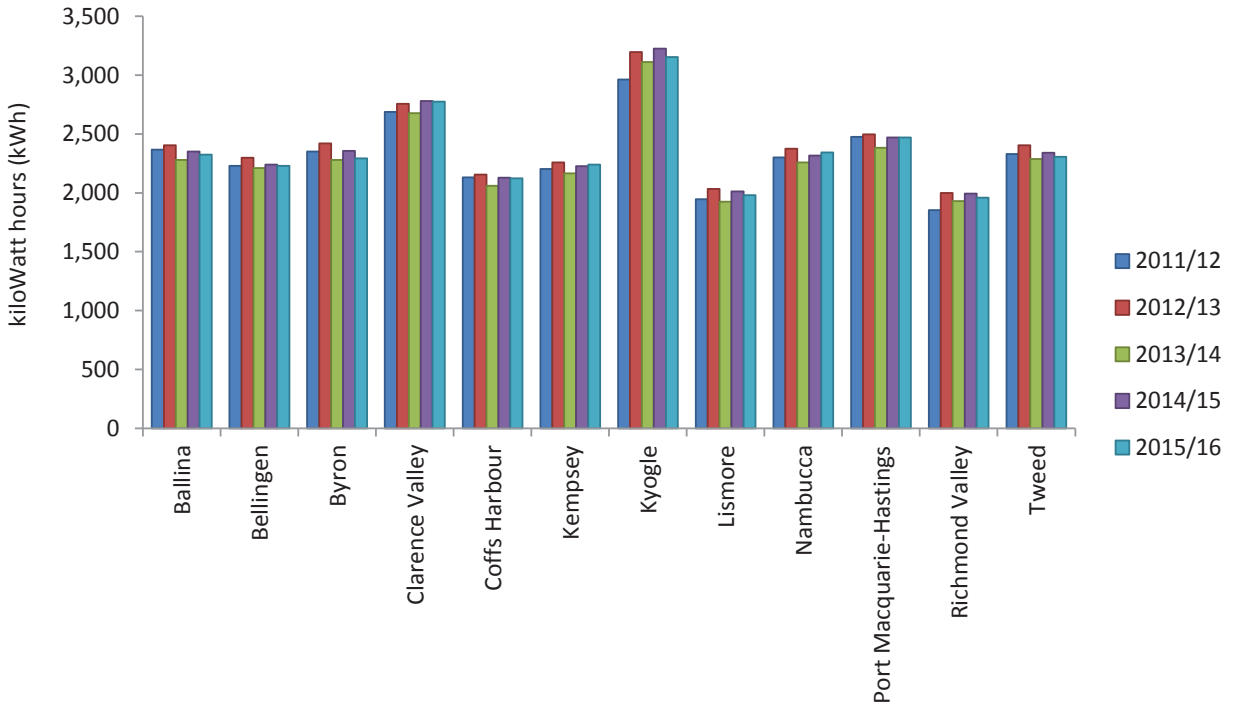


Figure 12: Per capita residential electricity consumption by LGA from 2011 to 2016 (source: Essential Energy)

Council greenhouse gas emissions

Council electricity and fuel consumption was collected from 2010 to 2016 for most Councils. Council energy consumption includes all council assets and buildings such as office and library buildings, depots, sewerage treatment plants, water treatment facilities, swimming pools and streetlighting. Fuel consumption includes use by all council vehicles and plant equipment.

For all councils, emissions from general electricity consumption are the largest contributor to the total greenhouse gases, and consumption is highly variable. Port Macquarie-Hastings Council has the highest per capita emissions from electricity use in the region, almost three times the regional average. However, the installation of a number of roof-top solar systems has reduced the emissions by almost 25% in 2016, down from 611 kg CO_2-e in 2014/15. Coffs Harbour, Ballina and Tweed councils have the next highest per capita electricity consumption at 182, 179.2 and 179 kg CO_2-e per person respectively. Kyogle, Bellingen and Nambucca councils have the lowest per capita emissiosn at 100, 122, and 123 kg CO_2-e in 2015/16. The general trend across the region is a slight decrease in emissions of 2.5% since 2012.

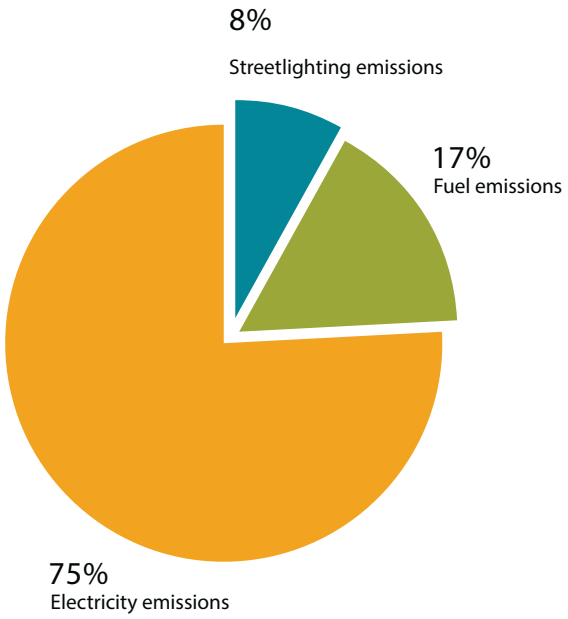


Figure 13: Greenhouse gas emissions by LGA and per capita for electricity, streetlighting and fuel consumption by councils for 2015 (Source: Councils)

Greenhouse gas emissions from streetlighting are generally stable across all councils, as the majority have installed energy-efficient streetlighting as part of the former Cities for Climate program.

Fuel consumption is also variable across the reporting councils, with Kyogle, Richmond Valley and Lismore having the highest per capita fuel consumption at 47.2, 44.8 and 31.8 kg CO_2-e respectively for 2014/15, and Coffs Harbour, Tweed, Port Macquarie-Hastings, and Byron councils the lowest at 12, 14.0, 14.1, and 14.4 kg CO2-e in 2014/15 respectively (see figure 15). Fuel use may vary due to events such as severe storms, fires or increased building works. The general trend across the region is that fuel use is increasing by at least 10% for every council except Tweed, which has dropped by 10%.

However, emissions should not be directly compared between LGAs as the services provided by the three county councils (now amalgamated into Rous County Council) span multiple northern LGAs and need to be taken into consideration when interpreting the emissions of individual councils. Richmond River County Council services Ballina, Lismore and Richmond Valley LGAs; Far North Coast Weeds services Tweed, Byron, Ballina, Kyogle, Lismore, and Richmond Valley LGAs and Rous Water supplies water to Ballina, Byron, Lismore and Richmond Valley LGAs. In the southern LGAs, these services are all provided by individual LGAs. Rous Water emitted almost 5,000 tonnes CO_2-e in 2014/15 for its water treatment and supply operations, adding around 1,000 tonnes CO_2-e to each of the councils it supplies, indicating the energy-intensive nature of water treatment.

In 2014/15, a total of 153,000 tonnes CO_2-e were emitted by councils across the region, equivalent to 300 kg per person.

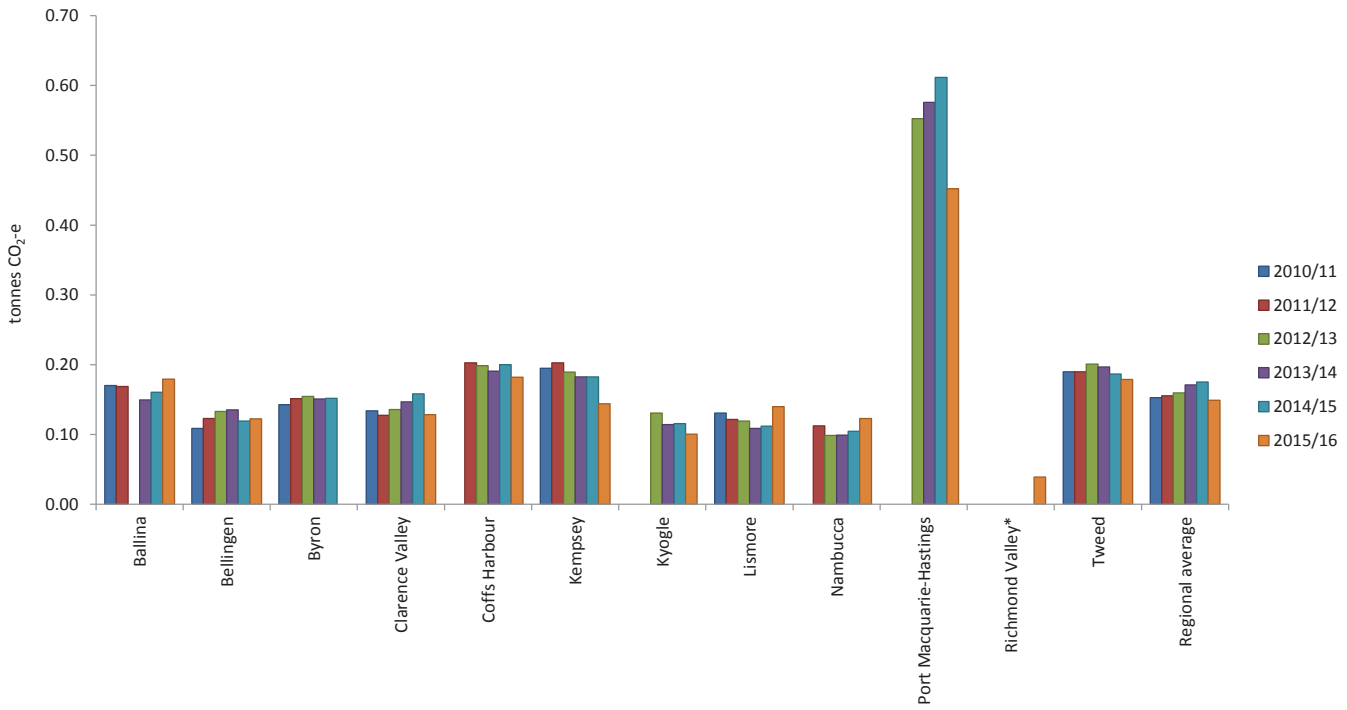


Figure 14:Council per capita electricity emissions 2011 to 2016
* incomplete dataset (Source: Councils)

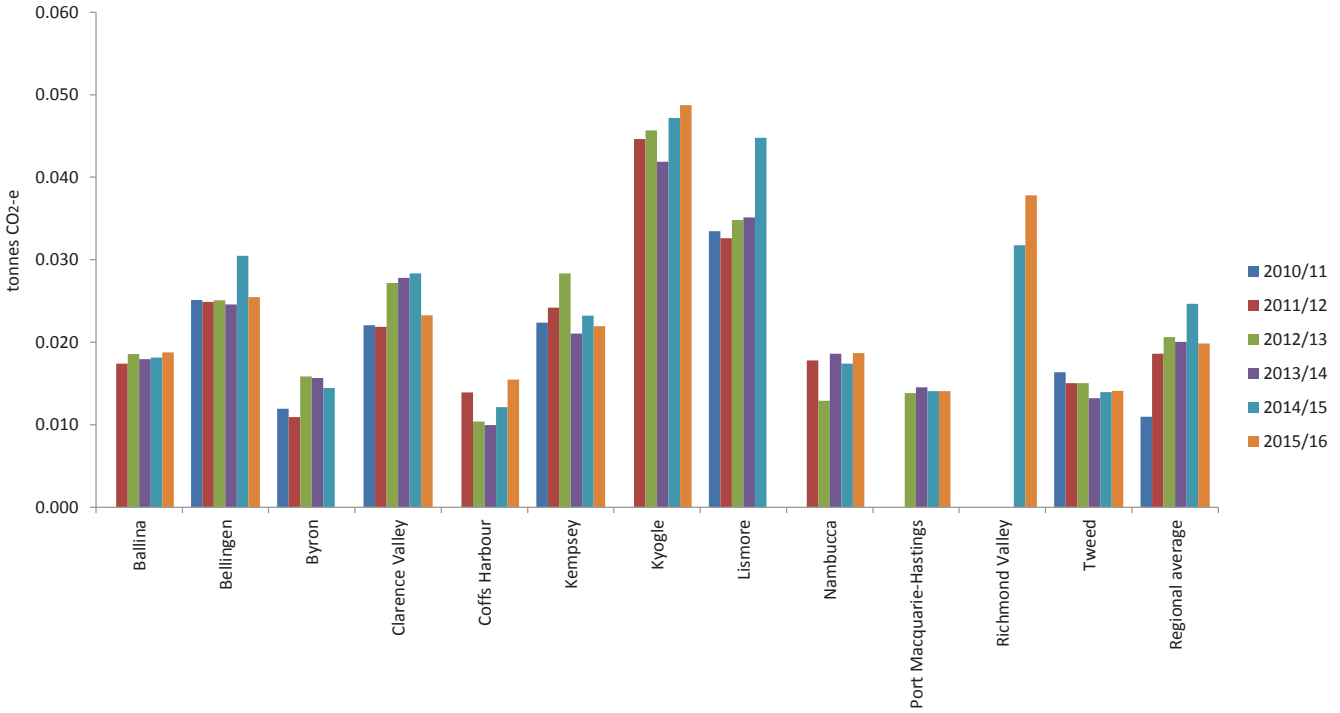


Figure 15: Council per capita fuel emissions for 2010 - 2016
Measure in tonnes CO2-e (Source: Councils)

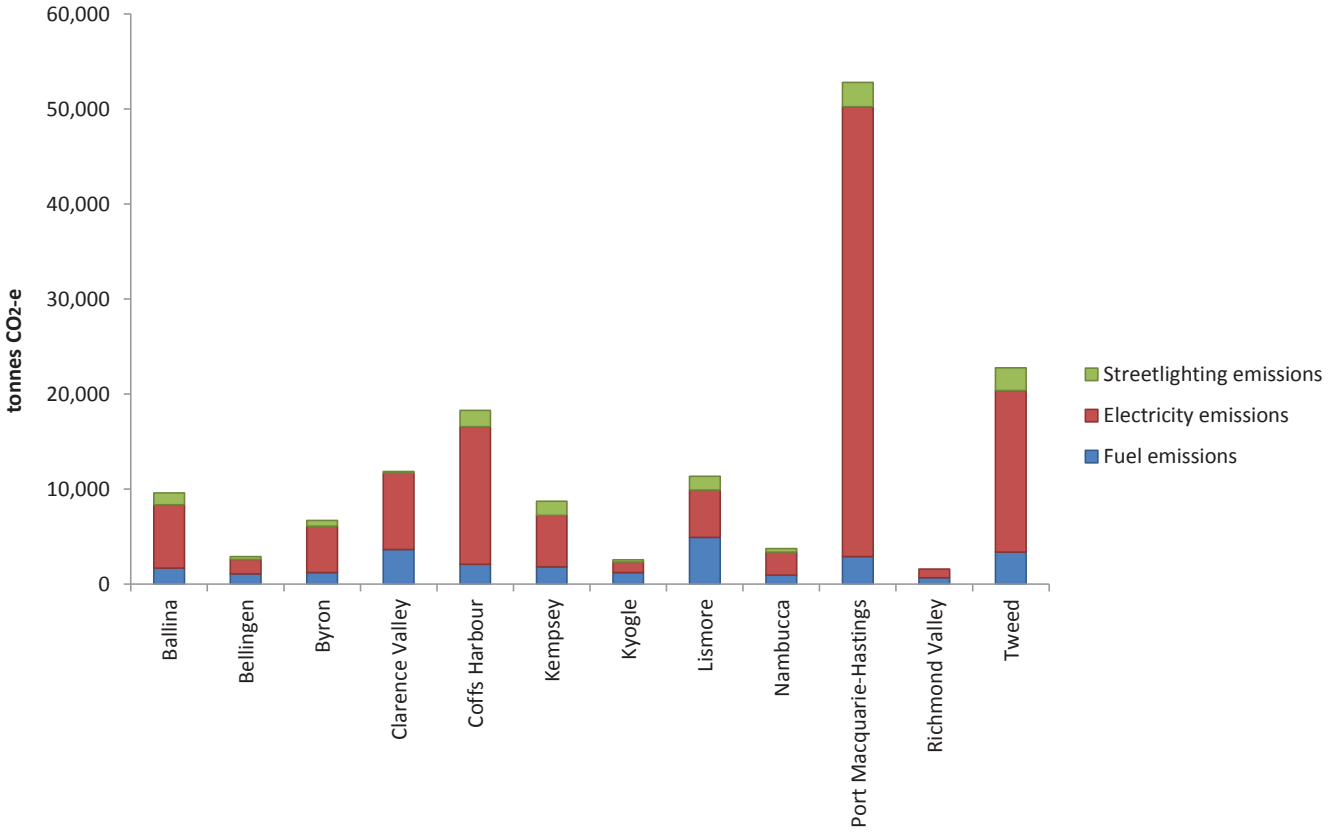


Figure 16: Total council emission for 2016 by LGA
Measure in tonnes CO2-e (Source: Councils)

1.3.4 Greenhouse gas abatement

In response to increasing greenhouse gas emissions, councils are looking at a variety of mechanisms to reduce emissions from their operations. Some of the region's councils have committed to renewable energy targets and have reduced their vehicle fleets. Many have retrofitted buildings, are creating energy from waste, and are installing large capacity roof-top solar.

Table 2 summarises the various measures each council in the reporting region has implemented to reduce their operational emissions and the estimated abatement.

Table 2: Tonnes CO_2-e abated through council initiatives (Source: Councils)

Local Government Area	Abatement description	Estimated tonnes CO_2-e abated 2015/16
Ballina	Large capacity solar installation in 2014 plus smaller systems (1 x 300kW 1 x 40kW, 4 x 10kW), Comprehensive fleet management system, use of biodiesel	500
Bellingen	Multiple roof-top solar installations, lighting upgrades for many council assets, two solar hot water systems at council pools	300
Byron	Multiple reroof-top soar installations, commercial volume hot water system at holiday park, ongoing education programs	300
Clarence Valley	Five roof-top solar installations, one 51 kW capacity, vehicle fleet improvements, landfill gas flaring	10,300
Coffs Harbour	Rigby House large solar power installation from 2010 still performing well, multiple smaller roof-top solar installations, commercial capacity solar hot water at holiday parks and community facilities, bicycle fleet implemented in 2011 for short trips, streetlighting upgrade in 2002 still performing well, and the Englands Rd landfill gas flare	9,000
Kempsey	One large scale solar installation, numerous smaller ones, and ongoing vehicle efficiency monitoring. Streetlghting upgrade in 2009 still performing.	200
Kyogle	Seven roof-top solar installations, six installed in 2015/16	77
Lismore	A variety of roof-top solar installations, vehicle fleet improvements, waste water treatment plant upgrades	1,428
Nambucca	Purchase of energy-efficient vehicles with engine cut-off feature	50
Port Macquarie - Hastings	Four large capacity solar installations	300
Richmond Valley	Some roof-top solar installations and streetlighting upgrade	61
Tweed	Two large capacity and multiple smaller capacity roof-top solar installations, vehicle fleet efficiencies, change to on-line and electronic processing, solar streetlighting in 1 location,	250
	TOTAL	**22,766**

Not all actions have had emissions estimates calculated, but the various initiatives have resulted in at least 22,766 tonnes CO_2-e being abated in the reporting region, equating to approximately 15% of total council emissions across the region.

Since the 2012 RSoE, there has been a substantial increase in the installation of roof-top solar on dwellings throughout the reporting region. In 2012, the highest level of roof-top solar was 21% of dwellings in some suburbs of the Ballina Shire. Ballina Shire now has 29.7% of all dwellings with roof-top solar, and the level of renewable energy fed back to the grid has increased by 65%. Data from the Australian Photovoltaic Institute (www.pv-map.apvi.org.au) indicates the level of roof-top solar installation on dwellings ranges from 18.1% in Kempsey Shire to 29.7% in Ballina Shire, with a regional average of 24.2% (see figure 17). AS previously discussed, as all roof-top solar will be on net meters by the end of 2016, the contribution of solar to electricity production will not be actively measured.

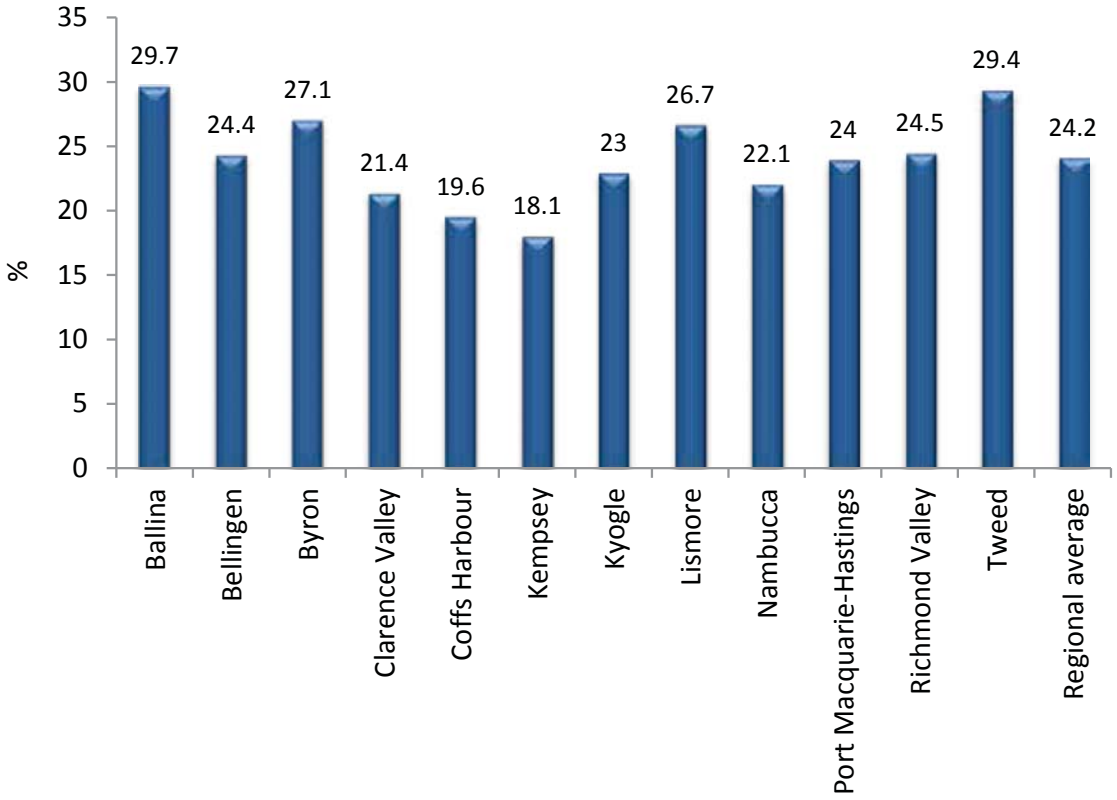


Figure 17: Percentage of dwellings with roof-top solar
(Source: APVI 2016)

Analysis of data provided by Essential Energy indicated in 2012 approximately 128 kilowatt hours (kWh) of renewable electricity was fed back to the grid per person, whereas in 2016 it had risen to 230 kWh (figure 17). However, this energy generation only contributes 5% of the total electricity consumption in the region (up from 1.5% in 2012).

The amount of electricity generated from domestic solar installations and used within those dwellings is not measured so it is difficult to determine the full contribution of roof-top solar to total domestic electricity demand.

Some of the electricity consumption figures may indicate that those with roof-top solar may not be making the most of their asset. For example, Kyogle Shire has the highest per capita electricity consumption from the grid but also the highest per capita renewable energy fed back to the grid. This is a common scenario across the region which may be due to the generous feed-in tariff which ceases at the end of 2016, or it may indicate household-ers would benefit from better education by solar providers on how to maximise the benefits of solar. The current innovations in battery storage for solar will ensure that in a few years many households will be generating a much higher proportion of their electricity consumption from their roof-top solar.

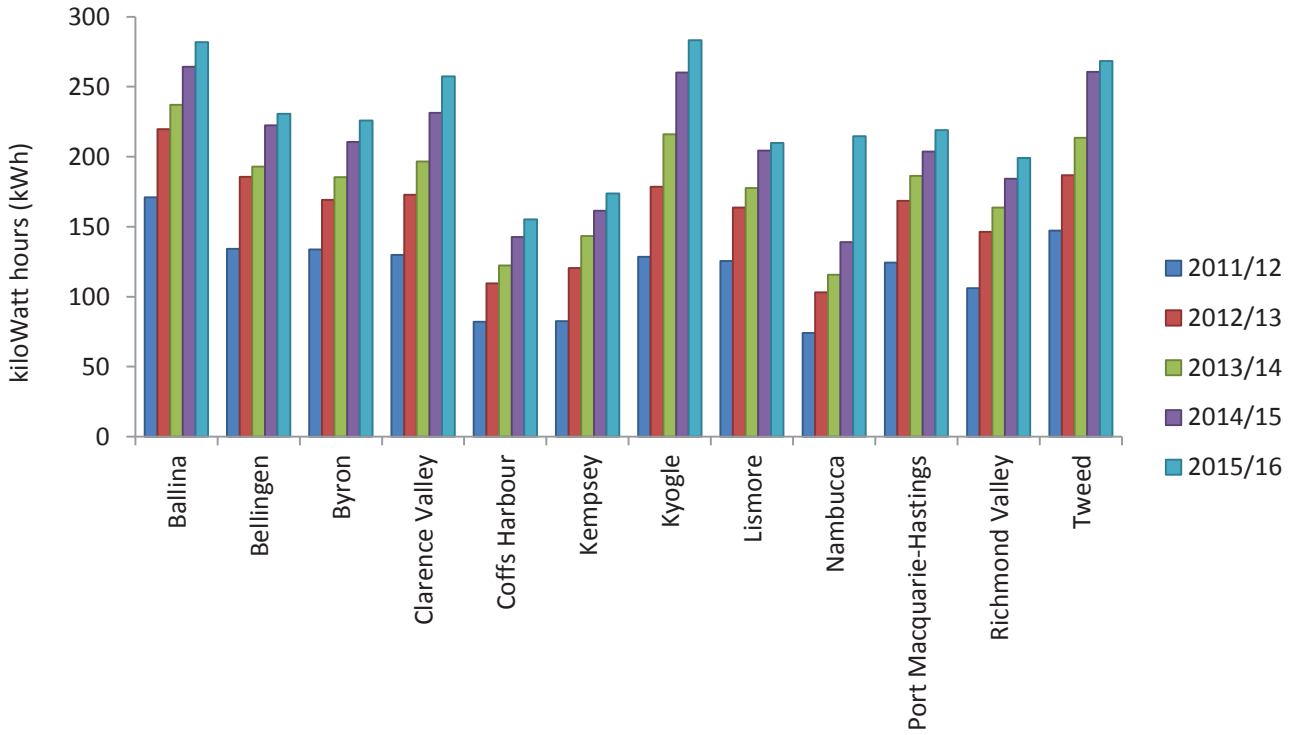


Figure 18: Per capita renewable energy fed back to the grid (roof-top solar) 2011-2016
(Source: Essential Energy)

Kyogle, Ballina and Tweed LGAs have the highest level of renewable energy generation, with Kempsey and Coffs Harbour the lowest generators as shown in Figure 18. Although there is an increase in the uptake of renewable energy generation by businesses and the community, the quantity of energy produced is very low (at 5%) compared with the overall level of electricity consumption, although the contribution of domestic solar to total consumption is not known (see figure 19).

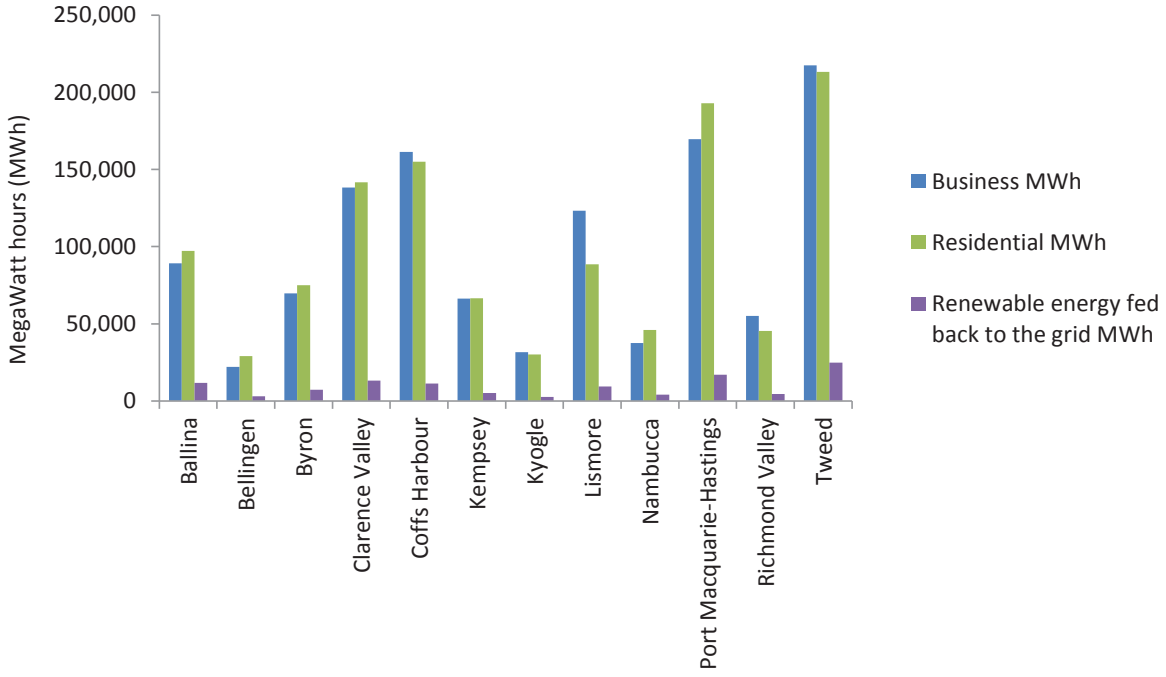


Figure 19: Total electricity use by LGA including renewable energy fed back to the grid
(Source: Essential Energy)

1.4 Surface water demand

INDICATOR: Surface water extraction (PRESSURE)
DATA SOURCE: Councils and county councils
DATA QUALITY: High
TREND: Increasing pressure

Water extraction places pressure on our rivers and on groundwater, particularly during low rainfall times when river flows are low and aquatic life can be impacted. Water-saving initiatives have been in place for some time in the region, and thanks to the high rainfall the region receives, strict water restrictions have not had to be implemented. The water consumption figures in figure 20 show that consumption of mains water per connection has increased by 30% over the reporting period in most areas.

The average domestic or residential water consumption per connection across the region is 167 kilolitres annually in 2014/15, which is slightly below the regional NSW domestic average of 172 kilolitres in 2013/14 (EPA 2015). Kyogle had the lowest per connection domestic consumption of 144 kL in 2015, followed by Clarence Valley at 147 kL and Port Macquarie-Hastings at 151 kL. The highest per connection water use was by Ballina at 181 kL in 2015, and Byron at 180 kL.

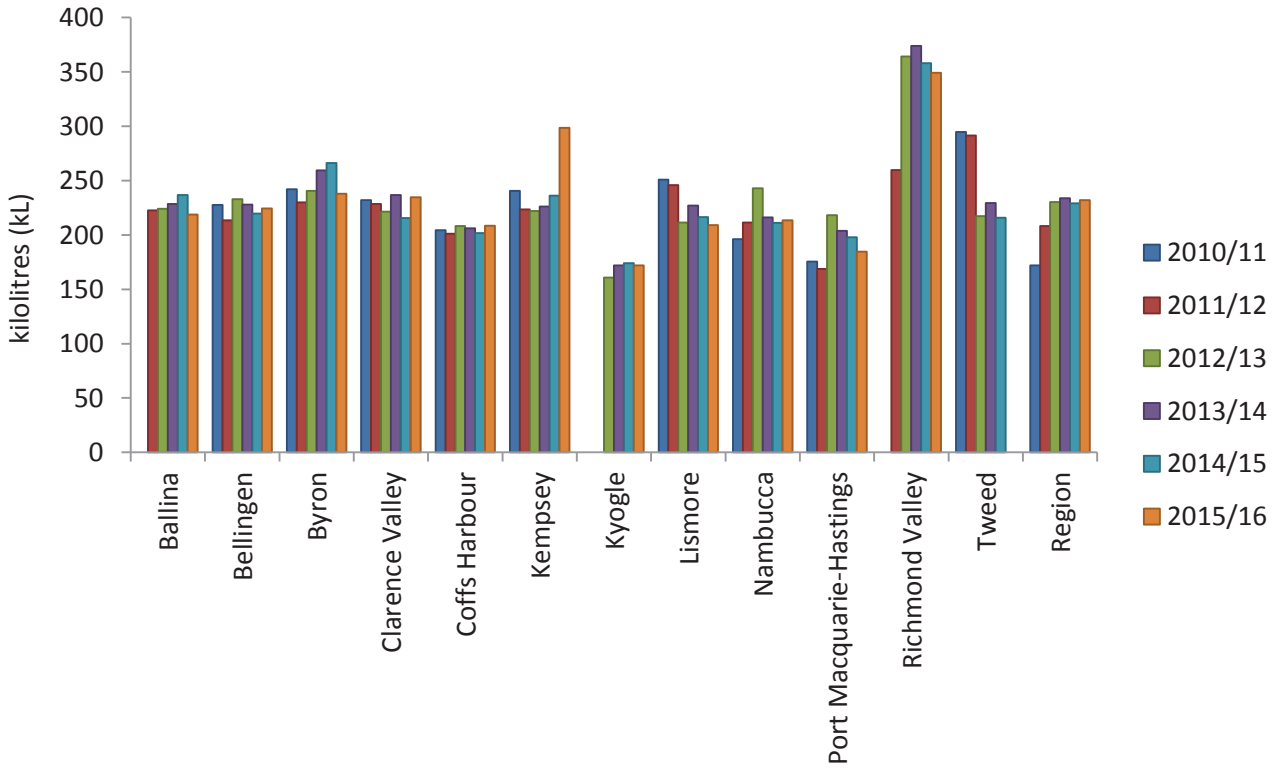


Figure 20 : Water use per connection by LGA for urban water (kL)

The breakdown of residential versus non-residential water use is shown in Figure 21. Richmond Valley has the most non-residential water connections in the region, and Ballina the fewest.

Some areas rely on groundwater for general water supply, such as Kempsey and Nambucca LGAs, which source the majority of their potable water from groundwater. Rous Water also have four bores which supply groundwater when required.

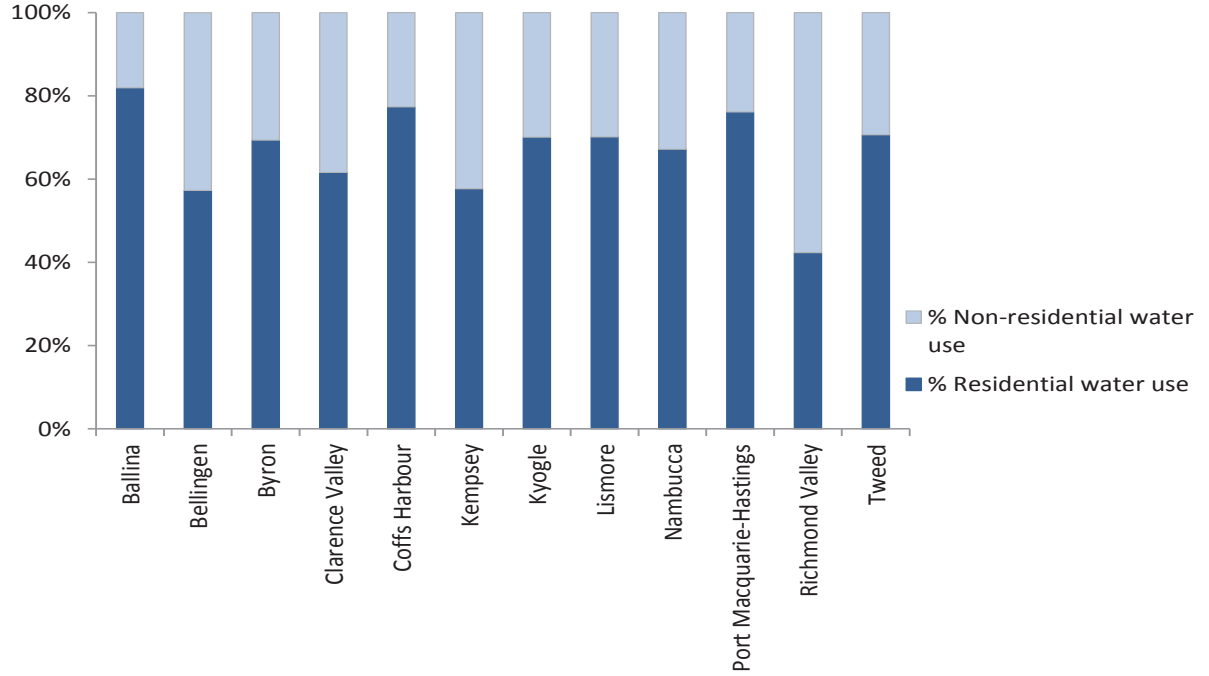


Figure 21 : Residential versus non-residential water use

Pressure on water resources comes from all sectors of our society. Agriculture, particularly intensive livestock and plant agriculture, utilises large volumes of water. The North Coast region has a significant intensive agriculture sector, but as water is generally unmetered in our unregulated catchments, true water extraction for agriculture is unknown. DPI Water has recently finalised all but one of the Water Sharing Plans for the region, which should better track water use and the potential for overallocation while also providing for environmental flows. However, some councils report that a number of fully-allocated subcatchments appear to be under considerable stress from the expansion of intensive plant agriculture which is not recognised at a regional level at this stage, or by DPI Water. It is hoped the Water Sharing Plans may better manage the trading of water and construction of large on-stream storages within fully allocated subcatchments. Figure 22 shows water consumption by sector for the whole of NSW, which may not truly reflect the North Coast Region but indicates the proportion of water use for each sector (ABS 2015).

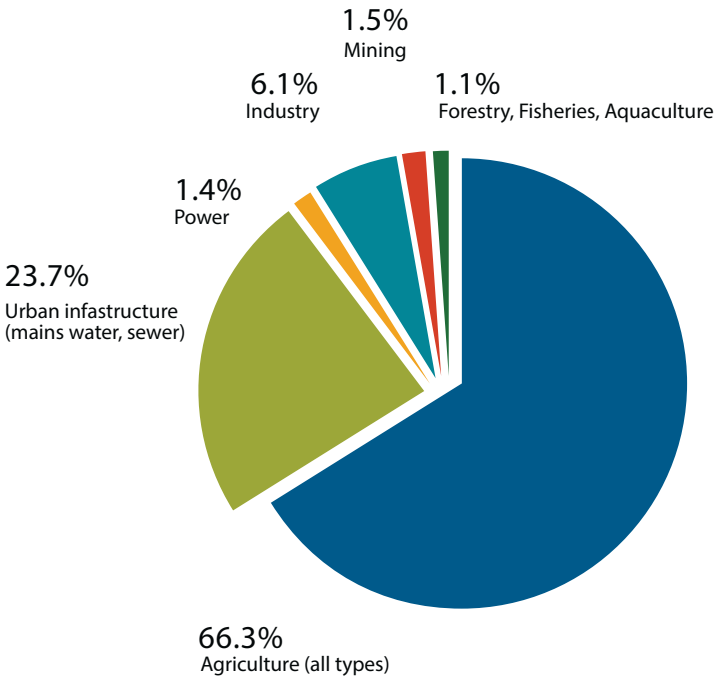


Figure 22: Water consumption by sector for NSW 2013/14 (Source: ABS 2015)

1.5 Waste

INDICATORS:	Total waste generated (PRESSURE) Total waste diverted from landfill (RESPONSE)
DATA SOURCE:	Councils and county councils
DATA QUALITY:	High
TREND:	Increasing pressure

With increasing populations and the increased costs and issues associated with waste disposal, councils are working to reduce the total amount of waste generated and the amount of waste sent to landfill, and increase reuse and recycling. The reporting region is facing waste disposal challenges, as landfills are nearing capacity in many LGAs, and costs are increasing. As such, councils are endeavouring to reduce waste from all sectors.

General trends indicate total waste generated per capita is increasing, but more is being recycled. So we are throwing away more but feeling good about it as it is being recycled. This however does not reduce the pressure on waste facilities. Many councils within the reporting region still have a less than 50% recycling or diversion from landfill figure, while others are as high as 80%. Some councils are reporting that there is poor use of greenwaste bins and an increase in contamination of recycling, resulting in increased waste to landfill. The data shows that waste generation is variable across the region with few councils showing clear trends.

Councils across the region have improved waste management infrastructure since 2012. Clarence Valley Council introduced the three-bin system in late 2012, which halved the amount of waste going to landfill. Ten out of the twelve regional councils compost all green and biomass waste including biosolids. Byron Shire Council has just commenced an arrangement with Lismore City Council to use their composting facilities for greenwaste which previously went to landfill. In many LGAs, all waste is sorted ensuring maximum recovery of waste that can be recycled or composted, and minimising what goes to landfill.

Despite these improvements, waste in half the region's LGAs is increasing, and rates of diversion from landfill have dropped in the past 12 months for the same LGAs.

Figures 23 and 24 show total waste generated by LGA from 2011 to 2016 and per capita domestic waste generated over the same period. This data must be interpreted cautiously as there continues to be issues with consistency of waste data collection across the region, and with the majority of LGAs collaborating with neighbouring LGAs to better manage waste, it is difficult to properly account for the origin of the waste.

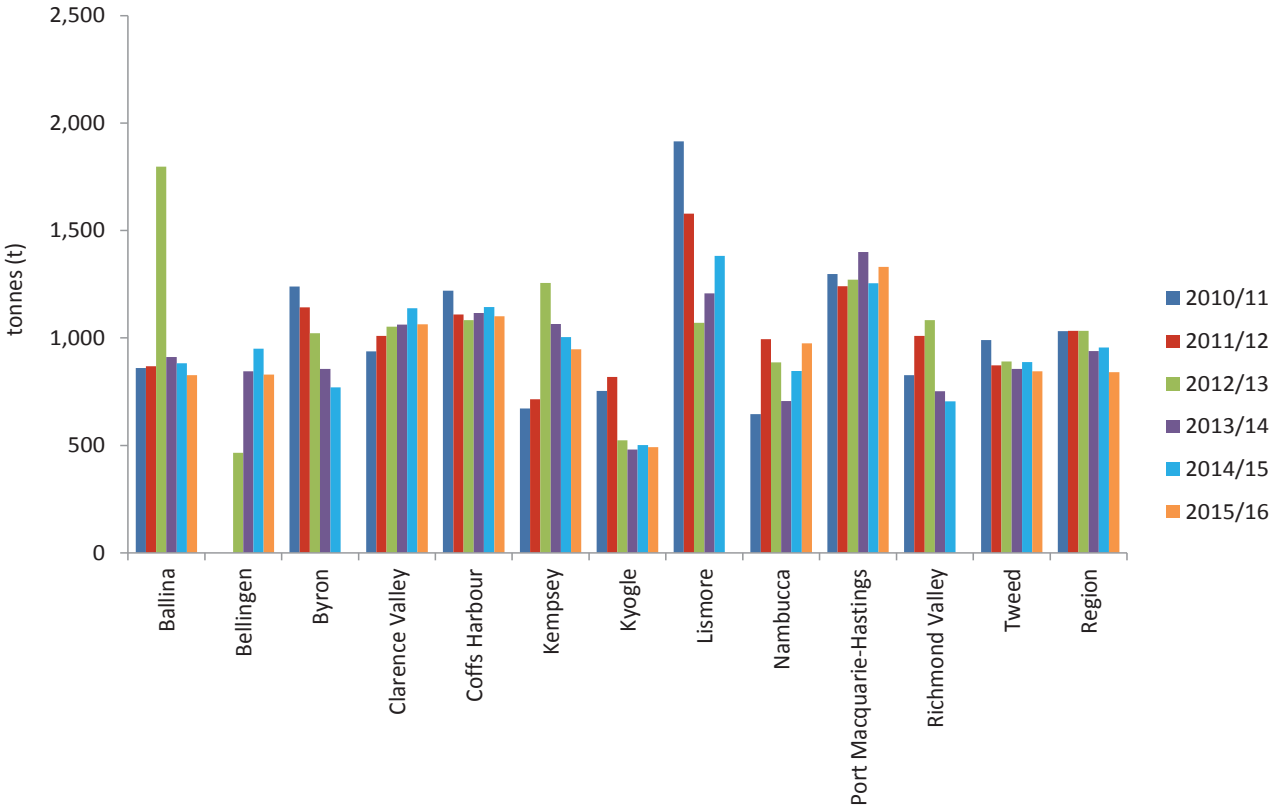


Figure 23: Total waste generated per capita (kilograms) by LGA
(Source: Council)

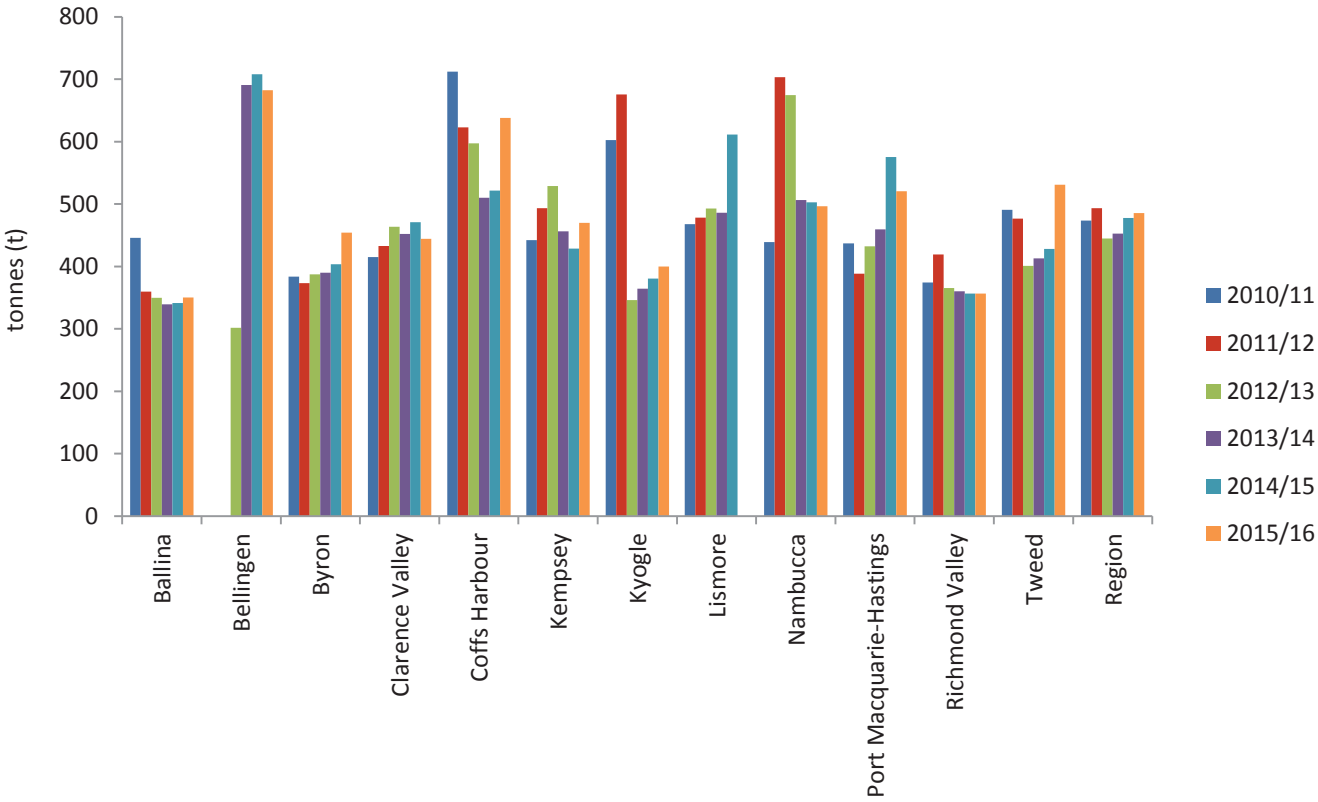


Figure 24: Domestic waste generated per capita (kilograms) by LGA
(Source: Council)

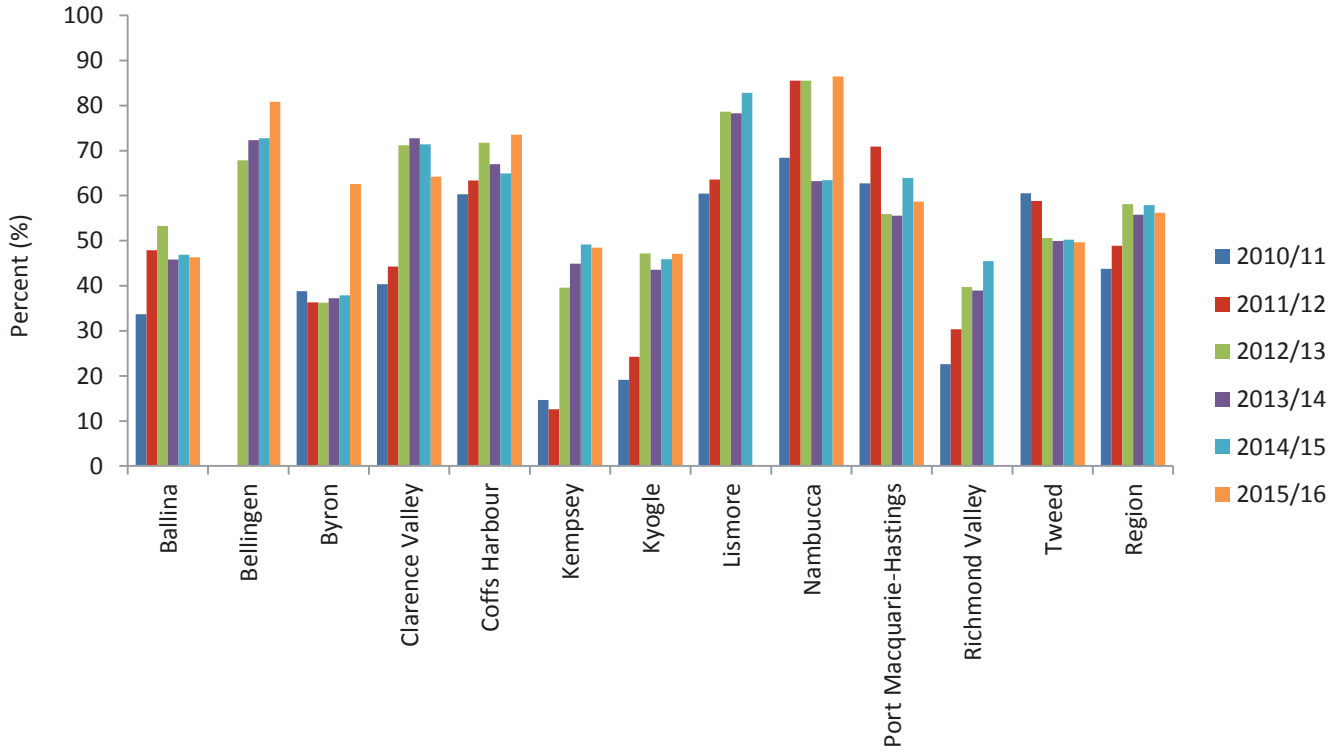


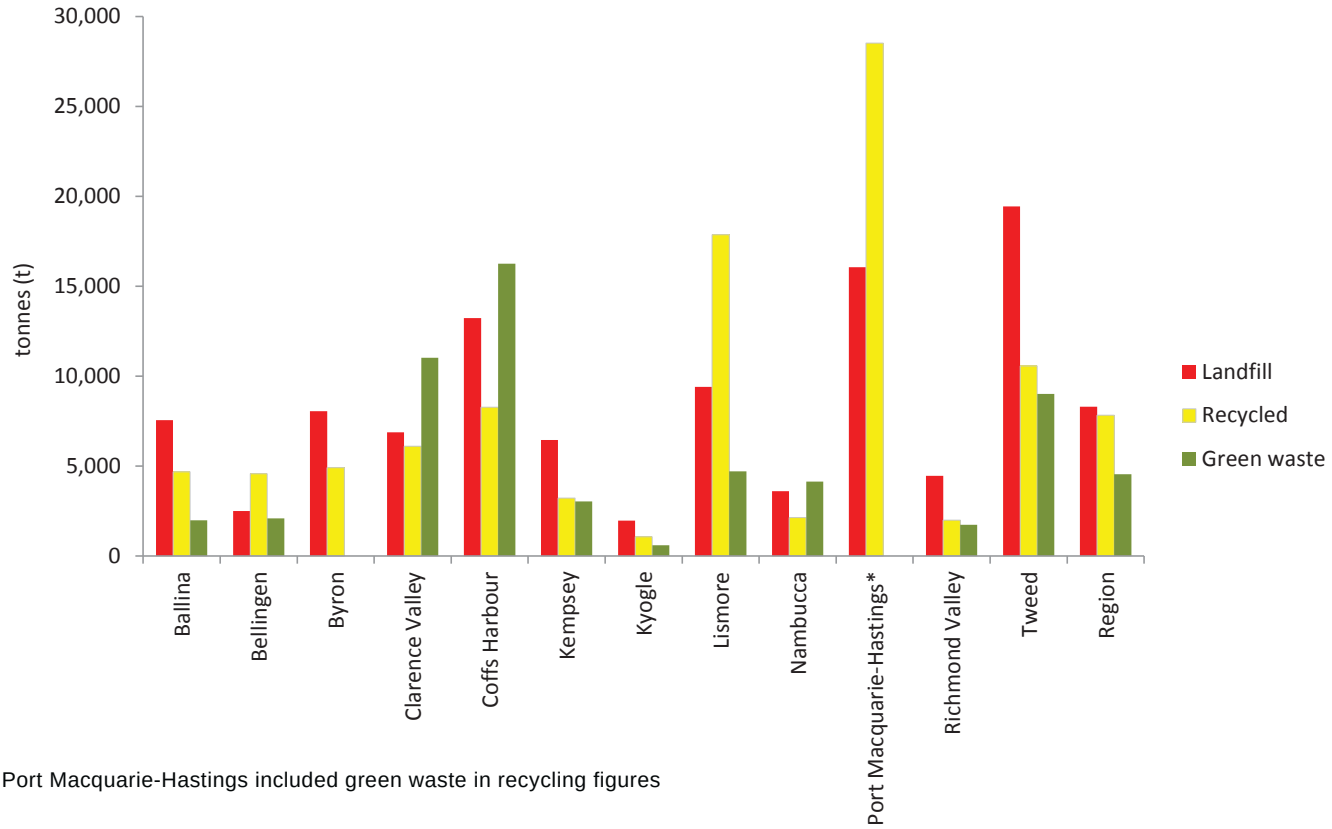
Figure 25: Percentage of domestic waste diverted from landfill by LGA
(Source: Council)

Across the region, total waste generation per capita has decreased by 9.5% since 2011, from 1,032 kg per person waste generated down to 935 kg per person in 2016. Six of the twelve regional councils have reduced total waste generated, three are steady, and three have increased. Byron LGA had the greatest reduction in total waste generation of 38 percent, Kyogle LGA next with a 35% reduction, Lismore LGA with a 28% reduction, Tweed and Richmond Valley LGAs with a 14.5% reduction, and Coffs Harbour LGA with 9.8% reduction. Nambucca and Kempsey LGAs had increases of 51% and 41% respectively, and Clarence Valley a 13.5% increase.

In the region for 2014/15, the annual total waste generated per capita ranged from 1,382 kg per person in Lismore to 501 kg per person in Kyogle. The regional average for that year was 955.7 kg per capita.

Waste generation rates are influenced by extreme events. For example in 2013, the debris left by ex-Cyclone Oswald and the East Coast Low that followed resulted in Ballina Shire having to deal with almost three times the usual amount of green-waste, much of it contaminated. This means that waste figures can vary greatly from year to year.

For domestic waste only in 2015/16, the annual total household waste generated ranged from 682 kg per person in Bellingen and 638 kg per capita in Coffs Harbour down to 350 kg per person in Ballina, and 400 kg in Kyogle, with a regional average of 485 kg. Again performance is variable within the region with three LGAs reducing domestic waste significantly (Kyogle, Ballina and Coffs Harbour), two steady (Bellingen and Richmond Valley), and seven increasing by more than seven percent. Overall there has been a 2.6% increase in total domestic waste generation across the reporting region since 2011.



* Port Macquarie-Hastings included green waste in recycling figures

Figure 26: Domestic waste by type for all LGAs in 2014/15 (tonnes)
(Source: Council)

Domestic recycling performance and diversion of waste from landfill has improved by 41% across the reporting region (figure 25). Diversion rates from landfill range from a minimum of 45.5% of all domestic waste up to 86.5%, with a regional average of 62%. This means that in 2014/15, 99,500 tonnes of domestic waste went to landfill across the region, while 148,500 tonnes was diverted – either recycled or composted.

Figure 26 shows the quantity of domestic waste by waste stream for 2014/15 for each LGA.

1.6 Environmental Levy

INDICATORS:	Levy to fund environmental works (RESPONSE)
DATA SOURCE:	Councils and county councils
DATA QUALITY:	HIGH
TREND:	new indicator, no past data

Funding environmental work is always a challenge for councils. The rehabilitation works described in the next theme demonstrate the dependence councils have on both external grants and volunteers to implement environmental works. To ensure some type of on-going funding, many councils in the region have introduced a levy on rates to fund necessary environmental works and programs either conducted by council themselves or used to fund community and other projects to carry out necessary on-ground works.

Table 3 shows which councils have a levy and how it is distributed. In 2015/16, nearly $3.5 millon worth of funding for environmental programs was raised through levies.

Table 3: Levy funding raised in 2015/16 (Source: Councils)

LGA	Levy type	Amount raised in 2015/16	People & the Environment	Biodiversity & Vegetation	Land & Soils	Water
Ballina	None	-	-	-	-	-
Bellingen	Levy on rates	$227,446	40.5	35.5	2	22
Byron	Levy on rates	$407,700	36	37	0	27
Coffs Harbour	Levy on rates	$1,285,738	16	73	3	8
Clarence Valley	None	-	-	-	-	-
Kempsey	Levy on rates	$402,719	8.5	47	0.5	44
Kyogle	None	-	-	-	-	-
Lismore	Levy began 1/7/16	-	-	-	-	-
Nambucca	Levy on rates	$340,250	37	10	0	53
Port Macquarie-Hastings	Levy on rates	$744,327	20	50		30
Richmond Valley	None	-	-	-	-	-
Tweed	None	-	-	-	-	-
	TOTAL	$3,408,180				

The breakdown of funding by theme indicates the majority of councils are relying on this source of funds to carry out essential weed control programs, to run biodiversity and water quality programs, to fund staff related to these roles, and to match-fund grants. Some levy funds are directed to Landcare groups and with their vast volunteer support, represent a good investment for the environment. There is little support for land management and soils programs within the current allocation of funds, with only 1% of the funds directed to this theme (see figure 27).

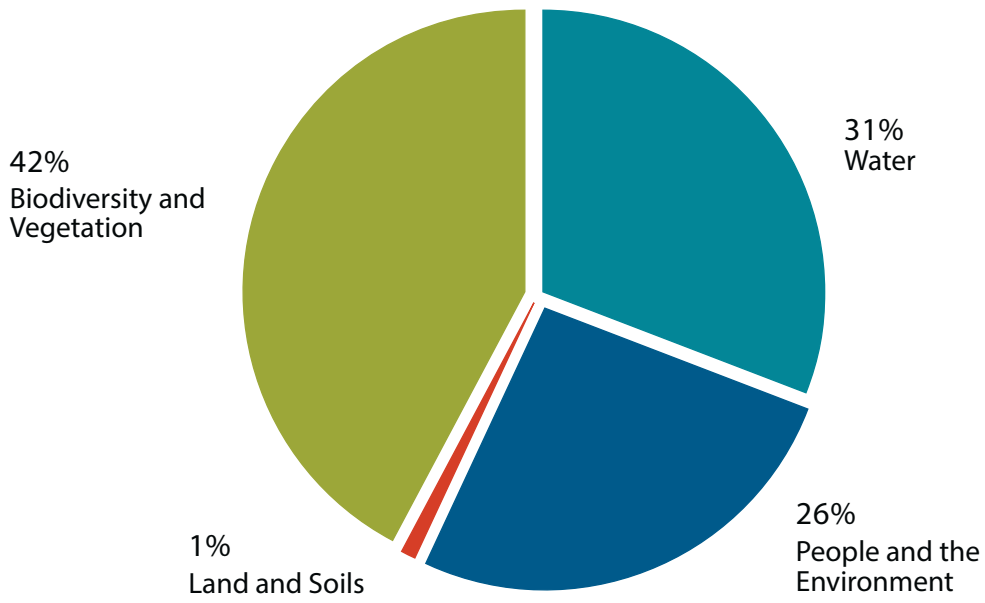


Figure 27: Breakdown of levy funding by RSoE theme for 2015/16 (Source: councils)

Photo: Lismore City Council

TWO

Biodiversity and Vegetation

The North Coast region of NSW is renowned as one of the most biologically diverse areas in Australia. Appropriate management of pressures on biodiversity and vegetation is essential to ensure current condition is maintained or improved as per the targets in NSW 2021: A plan to make NSW number one. These targets include:

NSW 2021:

- Protect and restore priority land, vegetation and water habitats
- Manage weeds and pests; protect and conserve land, biodiversity and native vegetation; protect rivers, wet ands and coastal environments.

The NSW Monitoring, Evaluation and Reporting (MER) Strategy expired in 2015 and is yet to be replaced. Currently the NSW Natural Resources Commission is preparing a core set of state-wide key performance indicators and metrics, a performance evaluation framework, including indicative tools, systems and practices, and a roadmap to implement the framework. Implementation will be the role of Local Land Services.

Each Council within the reporting region has its own set of environmental objectives within their Community Strategic Plans which guides the management of biodiversity and vegetation locally. At state level, the current NSW legislation protecting vegetation, threatened species and national parks is under review. The NSW Government released a draft package of land management and biodiversity conservation reforms in response to the Independent Biodiversity Legislation Review Panel's recommendations in May 2016. The draft packages included the draft Biodiversity Conservation Bill and the draft Bill to amend the *Local Land Services Act 2013*, as well as other supporting products (OEH 2016a). The packages were placed on public exhibition and have been met with concern by landholders as well as environmental experts and conservationists as the package is interpreted as relaxing the current protection for native vegetation and threatened species, potentially increasing the risk of environmental degradation.

This section discusses the current condition of the region's biodiversity and vegetation; the pressures of habitat loss, clearing and invasive species; and the responses by state and local government to species and vegetation protection, management of key habitats and restoration programs.

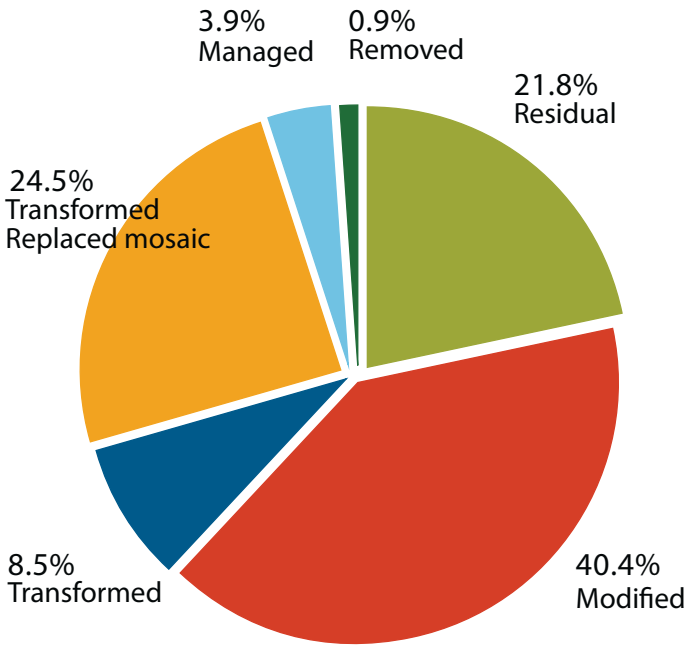
Photo: Project officer Jane Eales capturing a Bellinger River snapping turtle for assessment (Nic Denshire)

2.1 Ecologically functional landscapes

INDICATORS:	Habitat connectivity and effective habitat area (CONDITION) Net vegetation change – clearing (PRESSURE)
DATA SOURCE:	OEH
TREND:	INCREASING PRESSURE
INDICATOR:	Management of key habitats and priority areas (RESPONSE)
DATA SOURCE:	Government agencies (various), councils and county coucils

The reporting region covers a diverse area of habitats and vegetation types, and assessing the current condition of these vegetation types and habitats is an ongoing task. In 2012, vegetation condition in the reporting region was determined using a variety of existing datasets from OEH and detailed in the 2012 RSoE report. There has been no new information since then, so the information is repeated here.

The information refers to the reporting region for 2012, the former Northern Rivers Catchment Management Authority (CMA) region, which includes the 12 LGAs as well as parts of the Northern Tablelands.



2.1.1 Habitat connectivity and effective habitat area

Vegetation condition for the former Northern Rivers CMA region (the current North Coast region plus part of the New England tablelands) was assessed in State of the Catchments 2010 (DECCW 2010b).

Results are summarised in Figure 13 which shows percent of the former CMA region by vegetation condition based on the national vegetation condition classification. Condition states used in this system are as follows.

- RESIDUAL: native vegetation community structure, composition and regenerative capacity is intact with no significant perturbation from land-use or land management practices
- MODIFIED: native vegetation community structure, composition and regenerative capacity is intact but perturbed by land-use or land management practices
- TRANSFORMED: native vegetation community structure, composition and regenerative capacity is significantly altered by land-use or land management practices
- TRANSFORMED/REPLACED-Adventive mosaic: vegetation that cannot be readily classified as either transformed (native) or replaced-adventive (non-native) on the basis of available state-wide datasets
- REPLACED: managed: native vegetation is replaced with cultivated vegetation
- REMOVED: vegetation removed to leave non-vegetated land cover.

Figure 28: Vegetation condition in the North Coast Region including part of the tablelands region (source OEH SOC vegetation data)

In the region 21.8% of vegetation is classified as residual vegetation (i.e. relatively natural and undisturbed), and another 40.4% is modified (i.e. relatively intact but with some disturbance). The remaining 37.9% is significantly altered, replaced or removed. This gives the region a 'fair' rating for vegetation condition, which is the same rating given to NSW as a whole. To gain a better understanding of vegetation extent and condition at a regional and local level, other OEH datasets were analysed. Figure 29 shows the percentage of existing (or extant) vegetation in each LGA in the reporting region. Clarence Valley has the highest coverage of native vegetation at 75%, with Kempsey next at 73.8%, and Port Macquarie-Hastings at 73.1%. The LGAs with the least existing vegetation cover were Ballina (20.5%), Lismore (24.6%) and Byron (37%). The reasons for the low vegetation cover will be discussed later in this section.

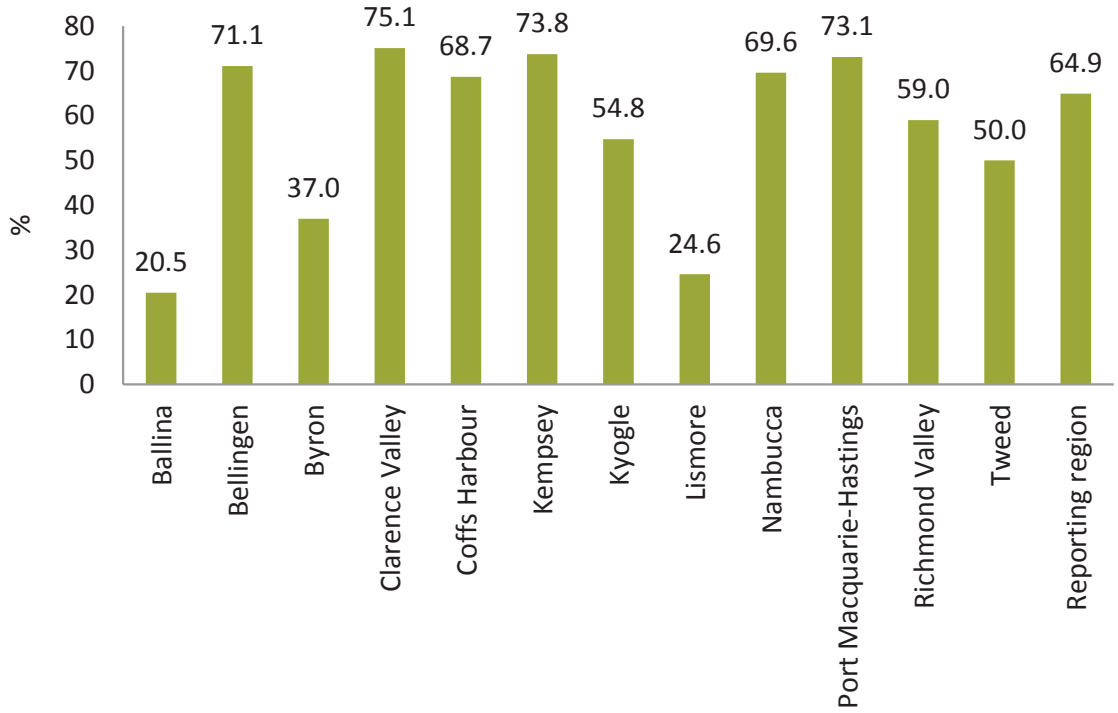


Figure 29: Percent extant vegetation in the reporting region
(Source: OEH)

Current vegetation extent does not give an indication of the quality of the vegetation as species habitat or the connectivity of the vegetation. To determine the area of effective species habitat, 'effective habitat area' was calculated using the OEH Biodiversity Forecasting Tool (BFT). Outputs from the BFT are numerous, and only two have been used for this condition assessment. The BFT uses a map of existing vegetation communities, an estimate of the pre-1750 extent of these communities, a map of current vegetation condition, and a map of threats across the region, and uses these map values to estimate effective habitat area, habitat connectivity, and many other outputs and measures. The BFT takes into account urban and cleared areas and is considered a 'true' value of effective habitat (DECCW 2010d).

Effective habitat area (EHA) is shown in Figure 30, with LGAs ranked from 'poor' (red) to 'very good' (dark blue). The heavily cleared northern LGAs of Lismore, Ballina and Byron have the poorest effective habitat area of the region, with the adjacent LGAs of Tweed, Richmond Valley and Kyogle only having a slightly higher EHA. The southern LGAs all had 'good' EHA, however, the LGAs with the best EHA (Greater Taree and Glen Innes Severn) are outside the reporting region. The effective habitat areas are summarised in Figure 31.

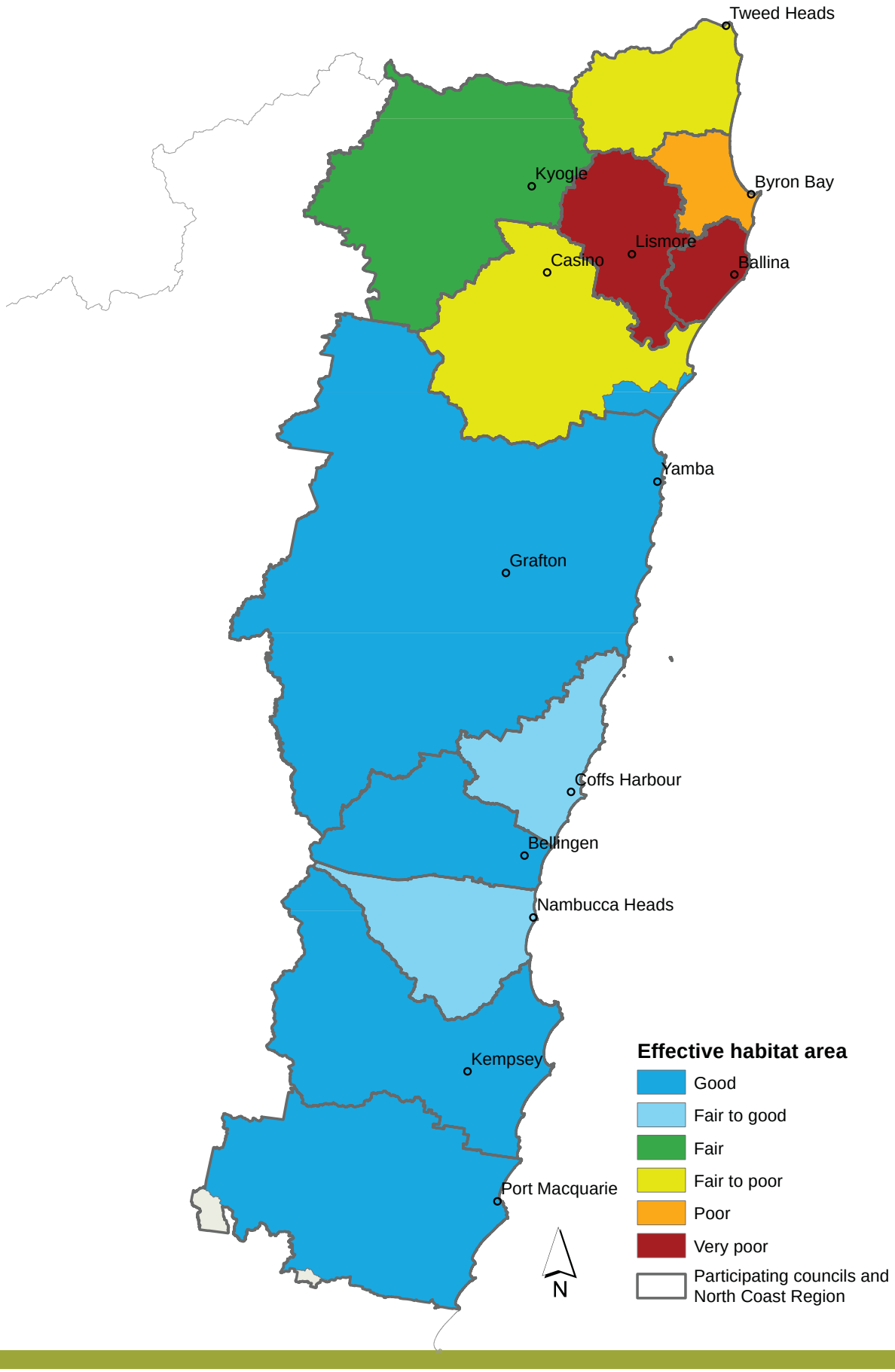


Figure 30: Mean effective habitat area in the region by LGA (source: OEH)

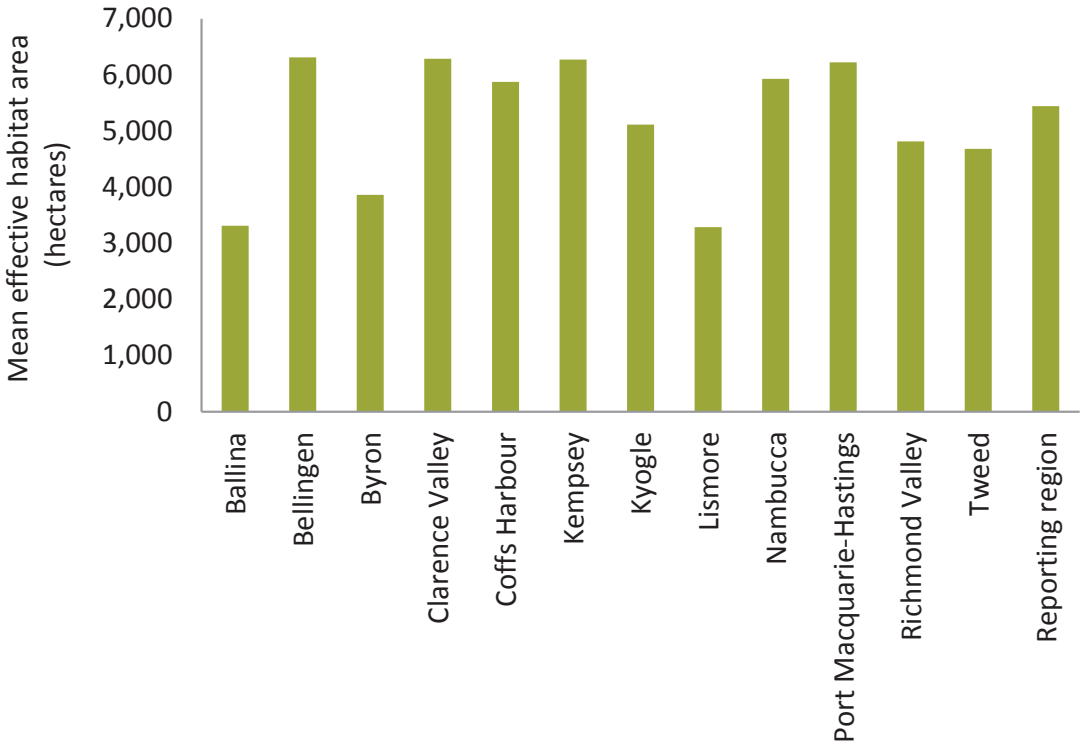


Figure 31: Mean effective habitat area in the region (source: OEH)

Habitat connectivity is another measure of vegetation condition, and can assist with determining status of species. Poor habitat connectivity impacts species by limiting their dispersal and restricting population structure and genetic flow between populations. For successful species population expansion and diversity, habitat connectivity must be on a scale that is sufficient to permit gene exchange and range expansion, support trophic (food-web) relationships, accommodate disturbance processes such as climate change, and support river flows that maintain the ecology (hydro-ecological flows) (Whitten et al. 2011).

Again using the BFT, habitat connectivity was determined by assessing the cohesiveness (togetherness) of the vegetation. Figure 32 shows habitat connectivity for the former Northern Rivers CMA region and the LGAs within it. The northern LGAs of Lismore, Ballina, Byron and Tweed have the lowest habitat connectivity, indicated by the pale areas on the map. The dark red areas indicate good to excellent habitat connectivity, and are generally within national parks and state forest. Clarence Valley LGA has the best coastal connected habitat, with Yuraygir and Bundjalung national parks covering the majority of the coastline.

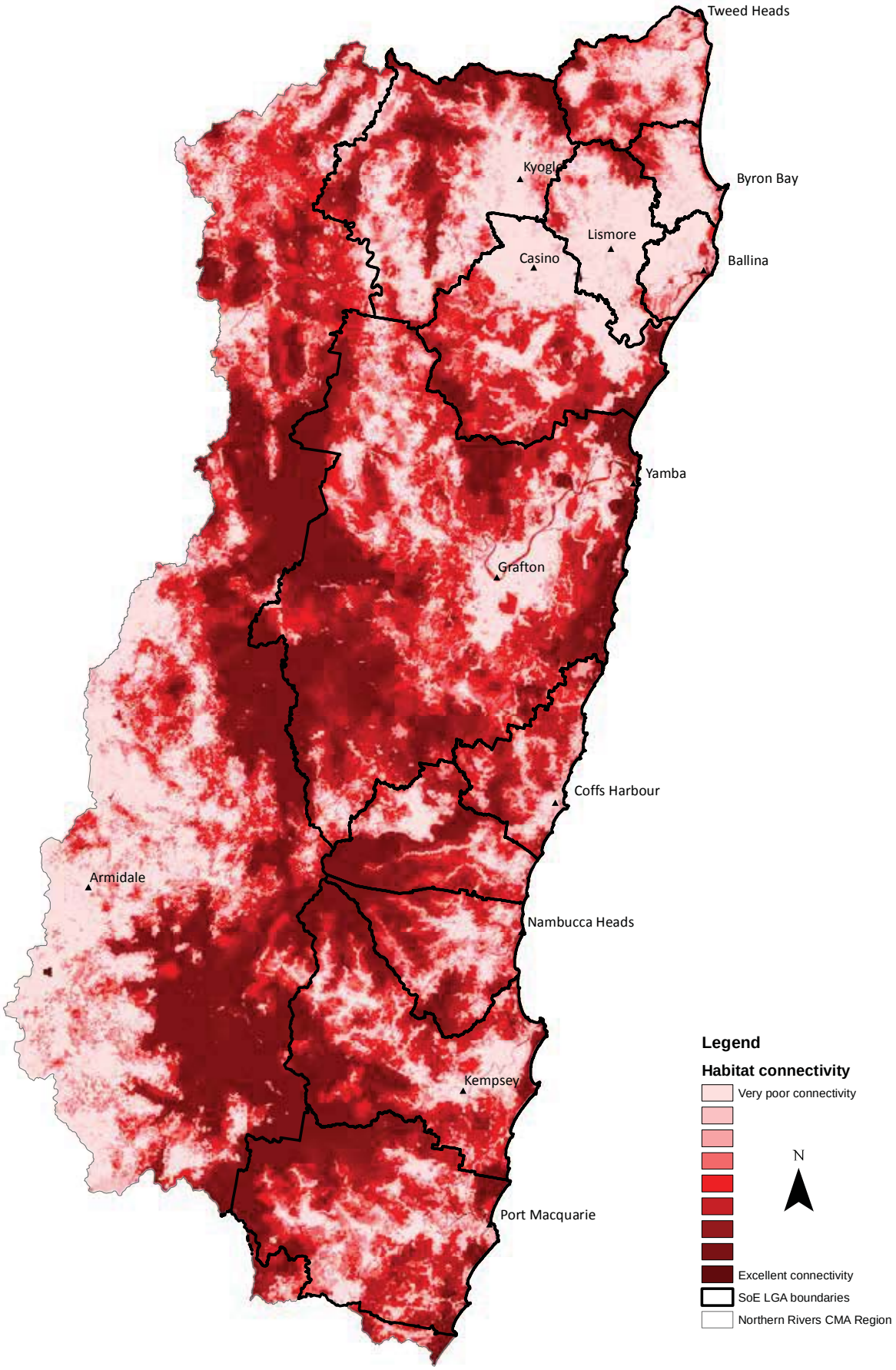


Figure 32: Habitat connectivity in the former Northern Rivers CMA Region

2.1.2 Net vegetation change – reduction in woody vegetation

The greatest pressure on vegetation in the North Coast region of NSW is land clearing and the fragmentation of remaining vegetation (DECCW 2009b). As shown in the 2012 habitat connectivity and effective habitat area maps previously, the LGAs of Ballina, Byron, Lismore and Tweed have been subject to more historical clearing than other LGAs in the reporting region. This area used to be covered by what is known as the Big Scrub, which was once the largest continuous tract of subtropical rainforest in Australia, covering 75,000 hectares of the rich basalt soils to the east and north of Lismore. From the 1860s onwards arable land including parts of the Big Scrub was heavily cleared for agriculture and timber, and by 1900 was essentially gone. The Big Scrub remnants are now protected within nature reserves, however, their small size, fragmentation and isolation makes them vulnerable to further degradation from invasive species, visitor impacts and fire (NPWS 1997). Ideally, protection of adjacent vegetation on private land would ensure these remnants remain in some connected state. Native vegetation clearing is listed as a key threatening process at state and national levels, and is considered to be the single greatest threat to biodiversity in NSW (DECCW 2009b).

For the 2012 Regional SoE Report, SLATS data was available from the Office of Environment and Heritage (OEH). This data is no longer available at a regional or local level, so the 2012 SLATS information is repeated here, again referring to the former Northern Rivers CMA region as the reporting region.

Prior to 2013, annual change in woody vegetation was assessed using Landsat remote sensing data analysed with SLATS methodology (Statewide Landcover and Trees Study) developed in Queensland (DERM 2012). This methodology detects woody vegetation, such as forest, that is over 2 metres high with more than 20% canopy cover. Records of woody vegetation change (i.e. alteration/removal) in NSW began in 1988 and are kept by OEH who reports annually on vegetation change in NSW (OEH 2012a). Figure 33 shows data for vegetation loss by type in the former Northern Rivers CMA region (larger than the current North Coast region), and then by individual LGA in Figure 34.

Photo: C Stehn

Categories of change in woody vegetation are:

- CROP, PASTURE, THINNING: generally on private agricultural land and for agricultural purposes
- FORESTRY: includes Forest NSW operations, plantation forests and private native forestry.
  Note that clearing for forestry relates to timber harvesting, and is subject to regulatory controls both on public and private land to ensure sustain able operations and appropriate ongoing management for natural resource outcomes and future timber production
- INFRASTRUCTURE: includes roadworks, power lines, fire breaks, fencing and mining
- FIRE: includes recent fires only where fire scar is visible and veg etation loss is temporary.

At a regional level, approximately 100,000 hectares of woody vegetation (2.2% of the former CMA region) has been removed or fire-affected from 1988 to 2010. Forest harvesting in state forests and approved private plantations and private forestry agreements account for 50% of the area; vegetation removal for agriculture accounts for 27% of the area; fire accounts for 17% of the area, with the 2009 fires affecting substantial areas; and infrastructure works accounting for only 5% of the area. The SLATS methodology only measures changes in woody vegetation and does not take into account regrowth, replanting, restoration or natural regeneration after fire or forestry operations. It is also unable to distinguish between beneficial clearing, such as removal of non-native vegetation (e.g. weeds species such as Camphor laurel), and other types of clearing. So these clearing figures need to be interpreted along with the figures in Section 2.3.1 which indicate the area of land under protection at state, regional and local levels exceeded 23% of the reporting region in 2012. Woody vegetation removal data by LGA is presented in Figure 34.

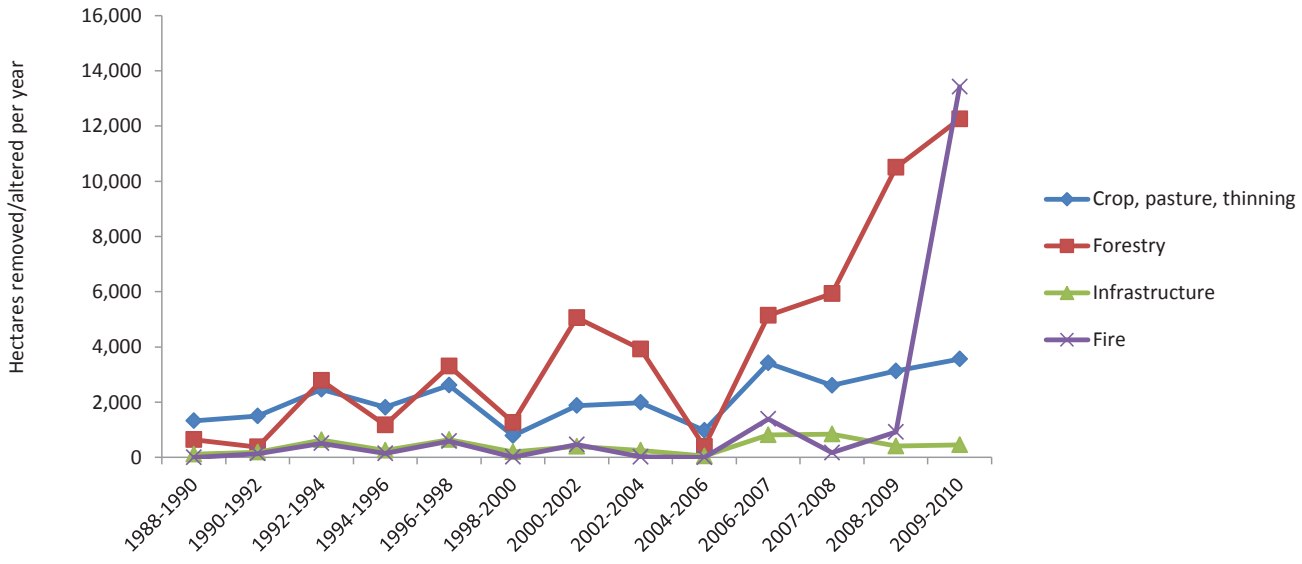


Figure 33: Woody vegetation clearing in the reporting region between 1988 and 2010

Figure 34 shows the percent of each LGA cleared since 1988 using the NSW woody vegetation change data. The LGAs with the highest percentage of area cleared also have the highest area of state forest, so the trend in forestry harvesting correlates with the area of state forest within each LGA. The LGAs with the lowest clearing rates are those with little or no state forest. Clearing within the reporting region from 1988 to 2010 was generally low and mostly confined to state forest harvesting operations.

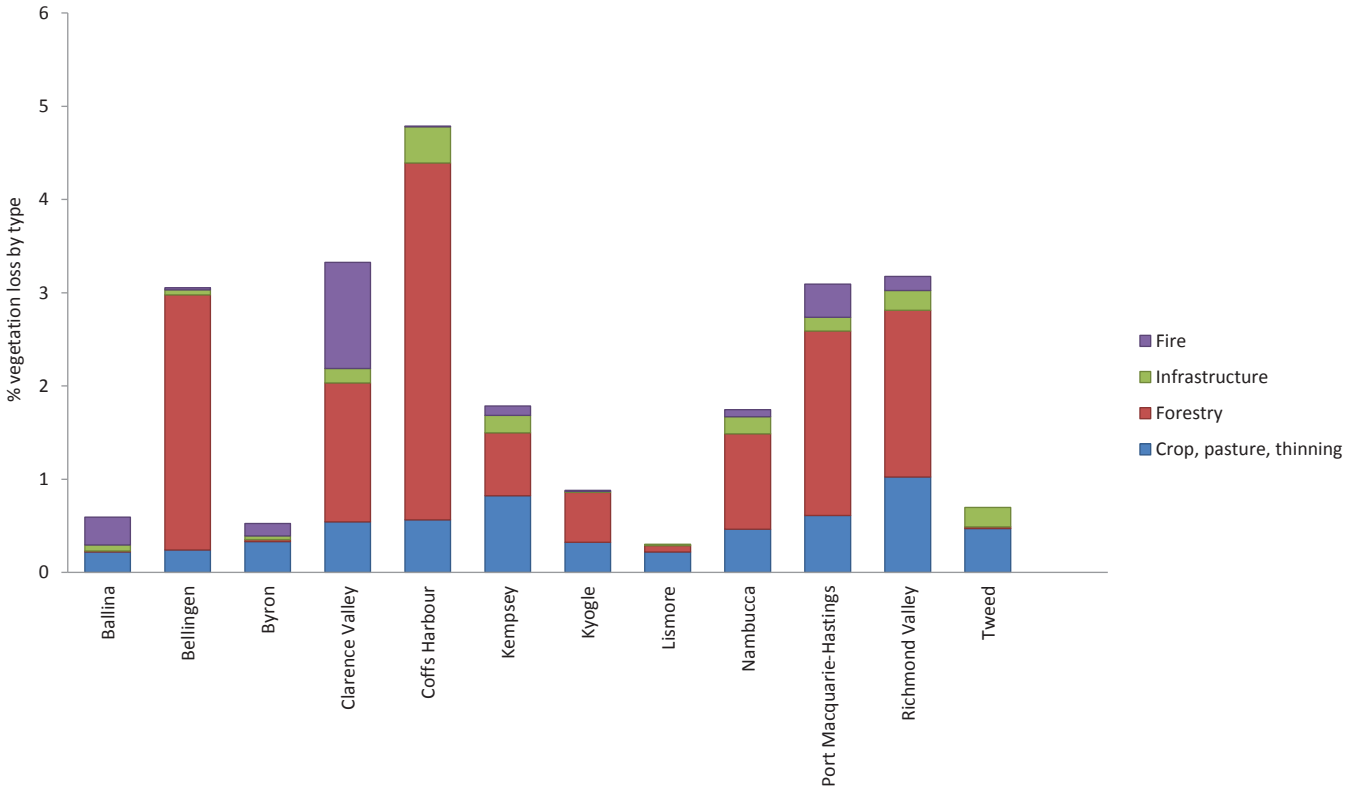


Figure 34: Percent of vegetation cleared since 1988 (Source: OEH)

Native vegetation removal for forestry can occur on private land under private native forestry (PNF) provisions. Private native forestry operations are subject to approval under the Native Vegetation Act 2003, require a property vegetation plan to be prepared, and must adhere to the Private Native Forestry Code of Practice for Northern NSW (EPA 2013). Since 2007, private native forestry in the North Coast region has increased significantly. Of the 2,916 PNF agreements approved in NSW between 2007 and June 2015, 69.4% were in the reporting region, covering 49.7% of the total area under PNF agreements in NSW (EPA Public Register 2016). Table 4 and figure 35 show the area by LGA for approved PNF, which currently totals nearly 267,000 hectares of the North Coast region of NSW, or 13% of private land.

The area under PNF agreements for the North Coast region as at June 2015 was 266,727 hectares. It is not known how many of these approvals were actually harvested. However the SLATS data from 1998 to 2007 for the former Northern Rivers CMA region showed total vegetation loss from any type of forestry and farmland operations to be just under 43,000 hectares (OEH 2012), demonstrating the potential impact of PNF agreements if they are all enacted.

During consultation with councils in the reporting region in 2012, a number reported that they considered private native forestry to be the biggest threat to biodiversity.

In 2016 it is again a very significant issue. Issues relating to PNF raised in 2016 include:

- Approvals being issued on land designated as koala habitat under the under the relevant local environment plan (LEP) or koala management plan
- Approvals being issued on land zoned for environmental protection under LEPs
- Approvals being issued on land designated as steep
- No communication with Councils on PNF approvals
- Failure to adhere to the PNF Code of Practice

Some councils have obtained legal advice and others taken their complaints regarding PNF and inappropriate approvals to the Minister for the Environment, indicating the seriousness of this issue. With the very low existing native vegetation (see section 2.1.1) it could be argued that Ballina, Byron and Lismore should not have any PNF approvals at all. These councils are experiencing PNF approvals over areas of identified koala habitat. Their Koala habitat maps are currently awaiting gazettal by the Department of Planning and the Environment, but as the EPA's own PNF Code of Conduct states, koalas are listed as a threatened species and therefore restrictions apply (EPA 2013). It appears the EPA is breaching its own Code of Conduct when approving PNF agreements over these areas.

Table 4: Area of Private Native Forestry approvals by year and LGA (source: EPA)

LGA	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total Area (Ha)
Ballina	-	-	-	-	25	14	49	-	-	**88**
Bellingen	17	1,398	947	794	1,786	1,381	377	554	280	**7,534**
Byron	-	-	-	-	59	94	85	-	-	**238**
Clarence Valley	4,655	22,859	35,663	17,561	22,793	16,804	9,684	9,921	2,364	**142,304**
Coffs Harbour	32	881	1,100	1,229	610	797	604	570	11	**5,834**
Kempsey	1,950	4,460	2,789	2,190	2,076	2,345	3,182	1,649	91	**20,732**
Kyogle	1,728	3,016	4,022	3,278	3,079	3,628	1,241	2,433	12	**22,437**
Lismore	-	397	150	176	34	259	59	-	-	**1,075**
Nambucca	785	1,091	2,094	1,415	1,765	1,383	714	704	267	**10,218**
Port Macquarie-Hastings	1,428	3,288	1,381	2,986	2,790	2,548	1,336	1,664	1,259	**18,680**
Richmond Valley	6,146	8,026	5,634	2,808	2,650	4,506	2,877	2,571	507	**35,725**
Tweed	-	139	124	215	11	79	274	20	-	**862**
Total Area (Ha)	**16,741**	**45,555**	**53,904**	**32,652**	**37,678**	**33,838**	**20,482**	**20,086**	**4,791**	**265,727**

Photo: N Cotsell

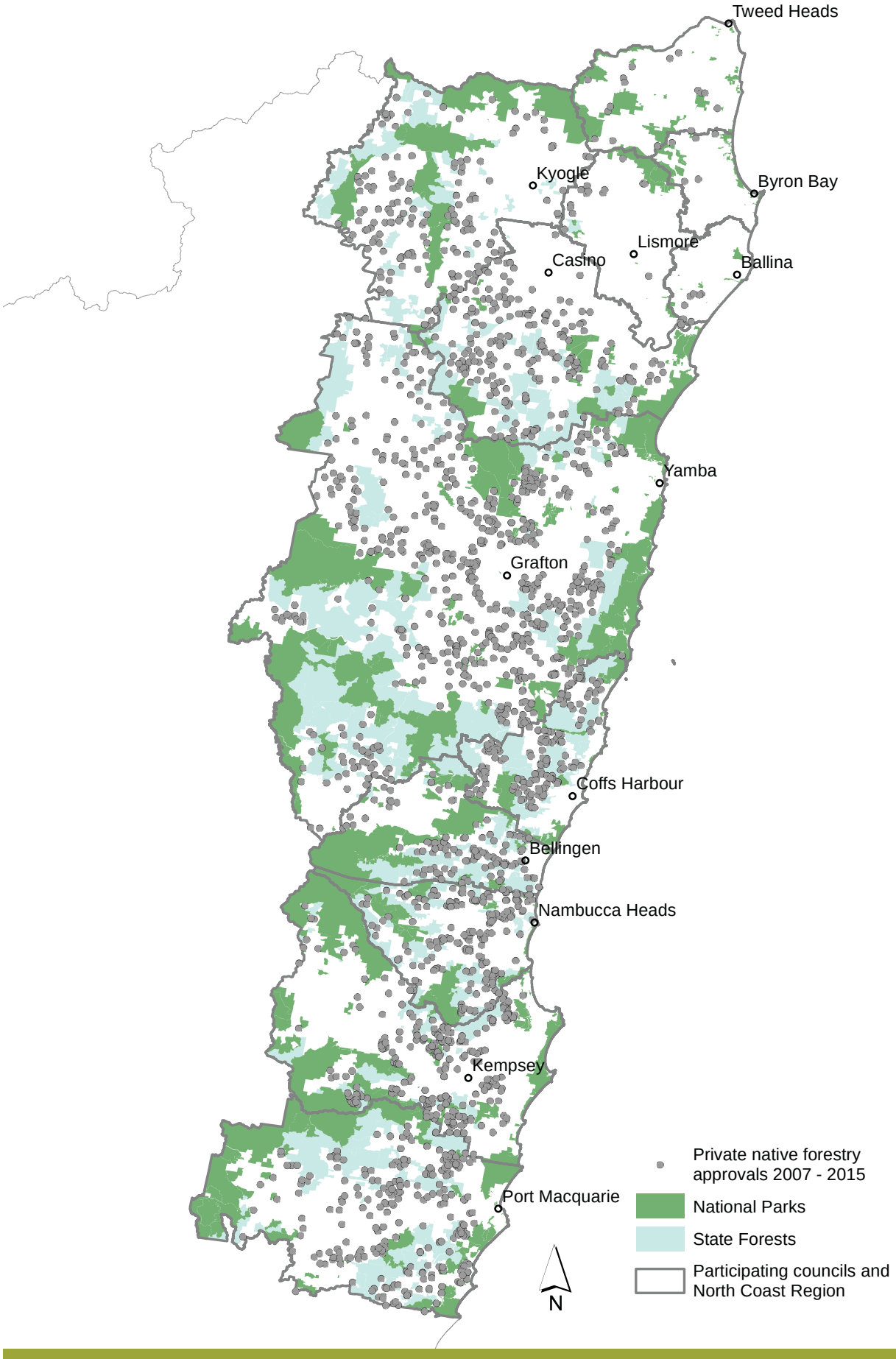


Figure 35: Private Native Forestry approvals 2007-2015 by LGA (source: EPA)

To ensure remaining vegetation, habitats, species and habitat connectivity are maintained or improved, a number of biodiversity plans and strategies are in place at national, state, regional and local levels. These are listed in Table 5. These plans and strategies all relate to each other and guide natural resource management at each government level.

Table 5: Biodiversity plans and strategies

Government level	Plan	Agency
National	*Australia's Biodiversity Conservation Strategy 2010–2030*	DEE
National	*Australia's Native Vegetation Framework*	DEE
National	*National Wildlife Corridors Plan 2012*	DSEWPC
National	*Threatened Species Strategy 2015*	DEE
National	*Australian Weeds Strategy (new one due 2017)*	DAWR
State	*NSW 2021:A Plan to make NSW number 1*	NSW Government
State	*NSW Invasive Species Plan 2008–2015 (Draft 2015-2022 plan due)*	DPI
State	*NSW Biosecurity Strategy 2013 - 2021*	DPI
State	*NSW Weeds Action Program 2015-2020*	DPI
State	Threat abatement plans	OEH/DPI
State	Threatened species recovery plans	OEH/DPI
State	State environmental planning policies (SEPPs)	DOP
Regional	*Far North Coast Regional Conservation Plan*	OEH
Regional	*Draft Mid North Coast Regional Conservation Plan*	OEH
Regional	*Northern Rivers Regional Biodiversity Management Plan*	OEH
Regional	*Border Ranges Rainforest Biodiversity Management Plan*	OEH
Regional	*Lord Howe Island Biodiversity Management Plan*	OEH
Regional	*Local Strategic Plan 2016-2021*	NCLLS
Local	Local environment plans	Local Government
Local	Development control plans	Local Government
Local	Coastal zone management plans	Local Government
Local	Biodiversity plans	Local Government
Local	Koala plans of management	Local Government
Local	Vegetation plans and strategies	Local Government
Local	Weed action plans or programs	Local Government

Table 6: Local government area plan, strategies, projects and vegetation mapping

Local government area	Plans, strategies, projects and vegetation mapping
Ballina	Roadside vegetation management plan
	Koala Plan of Management (awaiting gazettal)
	Bushland management plans (site specific)
	Richmond River Coastal Zone Management Plan
	Koala habitat mapping (koala planning area)
Bellingen	Bellingen Weed Action Program
	Bellingen Shire Koala Plan of Management 2015
	Dangar Falls Reserve Plan of Management 2015
	Plan of Management Bellingen Island Integrated Reserves 2012
	Bellingen Shire Coastal Zone Management Plan 2014
	Bellinger and Kalang Rivers Estuary Management Plan 2008
	Bellinger River Health Plan 2010
	Kalang River Health Plan 2010
	Bellinger River Estuary Action Plan 2011
	Bellinger & Kalang Rivers Estuary Action Plan Stage 2 2014
	Bellinger & Kalang Estuaries Erosion Study 2010
	Bellingen Shire Estuary Inundation Mapping Study 2015
	Bellingen Shire Climate Change Action Plan 2012
	Bellingen Climate Change Adaptation Strategy 2010
	Lower Bellinger and Kalang Flood Study 2015
	Fine-scale vegetation mapping (eastern section LGA) 2014
	Jaliigirr Project Priority Corridor Connections 2015
	Gleniffer Reserves Master Plan 2015
	Regional Wildlife Corridors
	Koala Habitat Mapping 2015
	Coastal vegetation of the Bellingen LGA 2006
Byron	Byron Biodiversity Conservation Strategy
	Council bush regeneration works program
	Bush Futures Project
	Koala Plan of Management
	Mullumbimby Flying Fox Camp Management Actions
	Byron Shire Coastal Zone Management Plan
	Brunswick Estuary Coastal Zone Management Plan
	Byron Coast Vegetation Mapping
	Byron Hinterland Vegetation Mapping
Clarence Valley	Biodiversity Management Strategy
	Clarence Estuary Management Plan
	Clarence Riparian Strategy
	Koala Management Plan (in development)
	Wooloweyah Lagoon Coastal Zone Management Plan
	Wooli Estuary Management Plan
Coffs Harbour	Coffs Harbour Biodiversity Action Strategy
	Biodiversity Monitoring Plan
	Jaliigirr project
	Class 5 Comprehensive LGA-wide Vegetation Mapping
	Revised Koala Plan of Management (Northern Precinct)
	Vegetation Management Plan (Waste Facility Conservation Area Restoration)
	Vertebrate Pest Management Strategy
	Orara River Rehabilitation Strategy
	Various Coastal Zone Management Plans
	Habitat Connectivity Mapping (draft)
	Koala Habitat Mapping
Kempsey	Kempsey Coastal Zone Management Plan
	Macleay Estuary Management Plan
	Korogoro Creek Estuary Management Plan
	Shorebird Management Strategy
	Sherwood Borefields Rehabilitation Plan
	Biodiversity Strategy
	Comprehensive Koala Plan of Management (Eastern Portion Kempsey LGA)
	Vegetation Mapping 2007
	Habitat Connectivity Mapping (draft)

Table 6: Continued

Local government area	Plans, strategies, projects and vegetation mapping
Kyogle	Roadside Vegetation Management Plan
Lismore	Richmond River Coastal Zone Management Plan
	Koala Plan of Management for South-east Lismore
	Biodiversity Management Strategy 2015
	Roadside vegetation management plan
	Site-specific vegetation management plans
	Wilsons River Reach Plan
Nambucca	Nambucca Shire Coastal Zone Management Plan 2012
	Nambucca River Estuary Management Plan 2008
	Nambucca River Foreshore Masterplan 2010
	Deep Creek Entrance Management Policy 2013
	Climates Change Adaptation Strategy
	Nambucca Shire Coastal Koala Habitat Study
	Vegetation Mapping: Coastal lowland vegetation & potentially threatened ecological communities
Port Macquarie-Hastings	Comboyne Plateau NRM plan and Subcatchment plan
	Vegetation and Koala Habitat Mapping
	Riparian (fresh and estuarine) management
	Public bushland management programme / invasive species plan
	Coastal zone management
	Biodiversity Strategy
	Kooloonbung Creek Plan of Management
	Maria River Wilderness Project
	Zonation – biodiversity priority modelling
	GAP-CLoSR habitat connectivity modelling
Richmond Valley	Evans River Estuary Management Study & Plan
	Richmond Valley Koala Habitat Atlas
	Salty Lagoon Channel Project
	Evans Head Coastal Management Plan 2104)
	Richmond River Coastal Zone Management Plan 2012
Tweed	Tweed Vegetation Management Strategy - Biodiversity Grants
	River Health Grants
	Tweed Coast Comprehensive Koala Plan of Management
	Roadside Vegetation Management Plan
	Recovery of Threatened Species in Priority Implementation Areas
	Land for Wildlife
	Backyard Habitat for Wildlife
	Tweed Byron Koala Connections
	Protecting and Linking High Conservation Value Habitat
	Numinbah Nature Links
	Tweed Vegetation management Strategy mapping 2009 – entire LGA
Far North Coast Weeds	Administration of the *Noxious Weeds Act 1993*
	Local weed management plans
	Removal of Noxious Weeds (Trees) policy
Richmond River County Council	McAnelly Riparian Restoration Plan
	Richardsons Riparian Restoration Plan
	Woodburn Riparian Restoration Plan
	Swan Bay Management Plan
	Kilgin Koala Planting & Remnant Restoration Management Plan
	Amphletts Lagoon Management Plan
	Bora Creek Management Plan
	Mynumia Lagoon Management Plan
	Seelim Creek Management Plan
	Gas Works Creek Management Plan
	Tuckean Swamp Land & Water Management Plan
	Richmond River Coastal Zone Management Plan
Rous Water	Wilsons River Catchment Management Plan

The outputs from these plans and projects will be detailed in other sections.

2.2 Native vegetation restoration

INDICATORS:	Habitat areas restored (RESPONSE) Environmental volunteers working on private and public land (RESPONSE)
DATA SOURCE:	Councils, North Coast LLS, Landcare
DATA QUALITY:	Medium
KEY ISSUE:	Volunteer hours underestimated as not always reported

Restoration of native vegetation has been shown to be particularly effective when sites are of a manageable size, objectives are clear, action plans are simple, and follow-up is timely and regular (Sleeman 2010). There is a general lack of comprehensive evaluation of restoration projects, but where evaluation has occurred, results indicate that restoration of degraded areas does improve ecosystem services, however, restored sites remain of a lower habitat and vegetation quality than un-degraded sites or areas (Suding 2011).

As shown previously in Tables 5 and 6, the North Coast region of NSW has a comprehensive suite of strategies, plans and programs at state and local level that involve native vegetation restoration. Some of these programs are run by state agencies such as the new Saving our Species program by OEH, the various incentives programs run by North Coast Local Land Services, the NSW Environmental Trust, and Habitat Rehabilitation Grants run by DPI. Many councils in the region also provide funding for habitat rehabilitation, some through a levy raised through rates, and others as part of their standard operations using internal funds to assist with grant funding applications. Landholders make a large contribution to restoration, actively restoring their properties and often working with involved agencies to monitor the success or progress of their projects. In 2016 alone, 345 landholders were involved in implementing natural resource management knowledge and skills on their properties (Local Land Services data 2016).

Also assisting restoration efforts is the vast reserve of volunteers who provide a free but highly valued contribution to habitat restoration. Groups such as Landcare, Dunecare, Rivercare, EnviTE and Green Army (formerly GreenCorps) have assisted many councils, North Coast Local Land Services, National Parks and Wildlife Service and Fisheries NSW to restore both land and aquatic habitats. There are 483 Landcare groups in the North Coast region of NSW alone, and many undertake regular restoration work without documenting hours or detailing areas restored, so the figures in the tables will vastly underestimate the work volunteers provide. Figures indicate at least 20,000 volunteer hours are provided annually across the region.

Grant funding is also essential for habitat restoration, with much of the work undertaken having been funded by various sources. Table 7 shows the area of habitat restored for council-run projects from 2012-2016, the funding contributions, and the number of volunteer hours contributed where known. Riparian and wetland habitats are not included in the figures below as these are reported in Theme 4: Water. Note that councils vary in the way they capture this data. Many do not routinely report this information, so not all activities have been reported here and this is considered to be an underestimate of restoration work conducted.

Table 7: Habitat restoration and volunteer hours 2012–16 (Source: Councils)

LGA or County Council	Year	Area restored (ha)	Trees planted	Land type	Activity	Funding	Volunteer hours *
Ballina	2012/13	82	1,681	Public land	Weed control & planting	Council, Landcare, Community Groups, Environmental Trust	3,500
	2013/14	8	340			Dunecare	550
	2014/15	8	300			Dunecare	650
	2015/16	30	8,750	Public and private land		20 million trees project	-
Bellingen	2012/13	4	-	Public land	Weed control & planting	Council, Landcare, Community Groups, Environmental Trust	-
	2013/14	4	-		Weed control & planting	Council, Landcare, Community Groups, Environmental Trust	-
	2014/15	8	-		Weed control on saltmarsh; weed control and planting	Wetland Care Aust, Council, Landcare, Environmental Trust	-
	2015/16	5	1,200		Weed control & planting	Council, Landcare, Community Groups, Environmental Trust	-
Byron	2012/13	96	6,400	Mostly public	Weed control & planting	Council, Landcare, Community Groups, Environmental Trust, LLS, Biodiversity Fund	-
	2013/14	103	505	Public land			-
	2014/15	58	46				2,000
Coffs Harbour	2012/13	325	3,000	Public & private land	Weed control & planting	Council, LLS, Landcare	2,500
	2013/14	250	2,500	Public land		Council, Landcare	2,500
	2014/15	251	2,600	Public & private land		Council, LLS, Landcare	2,500
	2015/16	273	2,050	Public & private land		Council, LLS, Landcare	2,500
Kyogle	2012/13	3	300	Public land	Weed control & planting	Council, Environmental Trust	2,300
Lismore	2012/13	41	-	Public land	Regeneration	Council	-
	2013/14	45	-				-
	2014/15	43	-				-
	2015/16	43	-				-
	2012/15	132	15,000	Public & private land	Weed control & planting	Landcare over 4 years	5,440
Nambucca	2015/16	130	-	Public land	Weed control	Council, OEH, Environmental Trust, LLS	-
Port Macquarie-Hastings	2012/13	1,427	9,500	Public land	Weed control and planting	Council, Landcare, LLS, Environmental Trust, National Parks Association	17,000
	2013/14	1,427	7,500				17,000
	2014/15	1,500	11,500				18,500
	2015/16	600	2,000				17,000
Tweed	2012/13	150	800	Public land	Weed control and planting	Council, Landcare, coummunity groups	7,000
	2014/15	1	-		Weed control	LLS	-

2.3 Conservation: reserves and agreements

INDICATOR:	Actions to protect native vegetation (RESPONSE)
DATA SOURCE:	OEH, DPI
DATA QUALITY:	High
INDICATOR:	Council land use zoning (LEPs) (RESPONSE)
DATA SOURCE:	Councils
DATA QUALITY:	High
INDICATOR:	Vegetation protected & rehabilitated under private agreements
DATA SOURCE:	North Coast LLS, OEH
DATA QUALITY:	Medium

Biodiversity protection and conservation is achieved at a regional level through the national parks system, at a local level through council land zoning, and at the landholder level through agreements with individual landholders on private land.

2.3.1 Protection of native vegetation

In the North Coast region in 2016, 20.5% of the region was protected in national parks, nature reserves and state conservation areas. State forests covered 15.4% of the region.

The breakdown of land in the national park estate and state forests by LGA is detailed in Figure 36 and Table 8.

Since 2012, there have been two additions to the National Parks Estate in the reporting region totalling 1,837 hectares– Cobaki Nature Reserve in Tweed Shire, 70 hectares gazetted in 2016, and Everlasting Swamp National Park in Clarence Valley, 1,767 hectares gazetted in 2014. There are no changes to State Forest within the region.

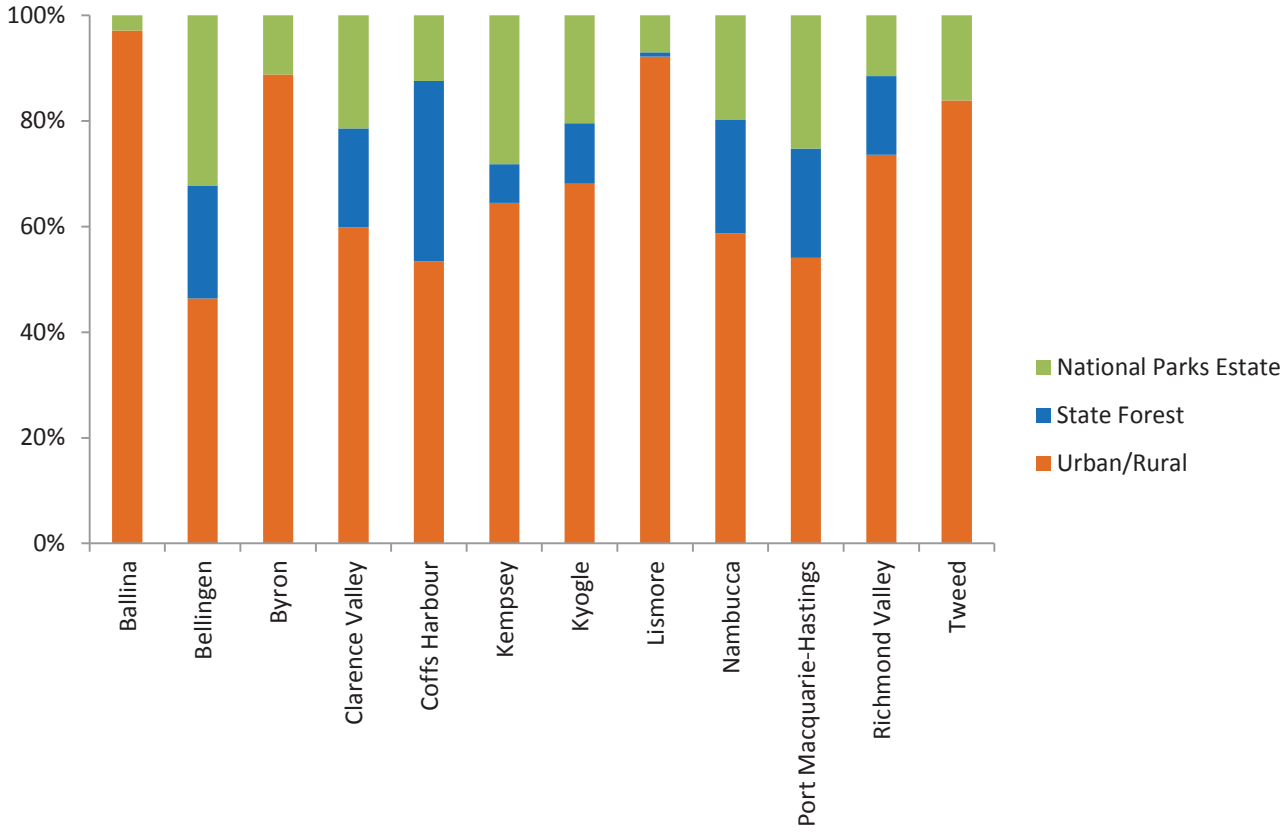


Figure 36: Landuse by LGA (Source: OEH, Forests NSW)

Table 8: Area of national park estate and state forest in 2016 (Source: OEH; DPI)

Local Government Area	Total area (ha)	National Parks Estate (ha)	% National Parks Estate	State Forest (ha)	% State Forest	% change since 2012
Ballina	49,200	1,451	2.9	0	0.0	0
Bellingen	159,980	51,890	32.4	34,231	21.4	0
Byron	56,713	6,486	11.4	0	0.0	0
Clarence Valley	1,042,193	225,271	21.6	196,566	18.9	0.8
Coffs Harbour	117,434	15,067	12.8	40,117	34.2	0
Kempsey	337,515	96,741	28.7	24,751	7.3	0
Kyogle	358,294	73,618	20.5	41,350	11.5	0
Lismore	128,704	9,061	7.0	1,092	0.8	0
Nambucca	149,045	29,664	19.9	31,902	21.4	0
Port Macquarie-Hastings	368,081	91,409	24.8	74,495	20.2	0
Richmond Valley	304,617	35,092	11.5	49,032	16.1	0
Tweed	131,796	21,379	16.2	0	0.0	0.3
Reporting Region	3,203,570	657,130	20.5	493,537	15.4	0.3

Photo: N Cotsell

2.3.2 Council land-use zoning (LEPs)

In council areas, land zoning is governed by the local environment plan (LEP) which includes areas of national park and nature reserve, areas of environmental protection, and areas where certain activities are not permitted due to environmental impacts. In 2012, the majority of LGAs in the reporting region had prepared new LEPs according to the NSW Government's requirement for all councils to prepare a single LEP which conforms to the format and content of the new Standard Instrument LEP..

In late 2012, the northern LGAs of Byron, Ballina, Kyogle, Lismore and Tweed had their environmental zones (E zones) deferred by the Department of Planning and Environment. This has reduced the area of native vegetation under protection within the reporting region since 2012, and has created uncertainty for affected landholders and Councils. Unfortunately the deferred E zones in some instances were designed to protect the remnant Big Scrub vegetation on private land in the Northern LGAs, which have very little intact native vegetation remaining (See section 2.1.1).

NSW Department of Planning finalised its review of E zones in LEPs for the Northern NSW local government areas in October 2015, and has now provided guidance to the affected Councils based on their findings which enables the development of proposals for environmental protection zones, also providing a set of criteria that can be used Statewide when designating zoning (DPE 2015).

Table 9: Details current Environmental zoning within gazetted LEPs

Local Government Area	Area national parks estate (ha)	% LGA	Area environmental protection (ha)	% LGA
Ballina	1,451	2.9	deferred	-
Bellingen	51,890	32.4	20,516	12.8
Byron	6,486	11.4	deferred	-
Clarence Valley	225,271	21.6	58,971	5.7
Coffs Harbour	15,067	12.8	7,855	6.7
Kempsey	96,741	28.7	6,458	1.9
Kyogle	73,618	20.5	deferred	-
Lismore	9,061	7.0	deferred	-
Nambucca	29,664	19.9	1,801	1.2
Port Macquarie-Hastings	91,409	24.8	5,615	1.5
Richmond Valley	35,092	11.5	4,369	1.4
Tweed	21,379	16.2	deferred	-
Reporting region	657,130	20.5	105,584	3.3

2.3.3 Land protected under conservation agreements

At the landholder level, there are a number of different land conservation agreements that protect native vegetation on private land in the North Coast region. As of 30 June 2016, approximately 1,500 hectares of land was conserved under North Coast Local Land Services agreements and 23,600 hectares under agreements managed by OEH, totalling 25,128 hectares or nearly 4% of the region. Of these agreements, 5,860 hectares are protected in perpetuity. These are shown by agreement type in Table 10 below.

Table 10: Area of private land under conservation agreements in 2016

Local Government Area	Number of agreements	Area (ha)	Agreement Type
Ballina	4	24.97	In perpetuity
	1	19	Ongoing
Bellingen	11	595.2	In perpetuity
	8	899.7	Ongoing
Byron	6	130	In perpetuity
	7	150	Ongoing
Clarence Valley	12	1727.83	In perpetuity
	14	13,075	Ongoing
Coffs Harbour	7	314.69	In perpetuity
	8	1252	Ongoing
Kempsey	2	50.5	In perpetuity
	3	332.4	Ongoing
Kyogle	1	105	In perpetuity
	13	1550	Ongoing
Lismore	1	121	In perpetuity
	9	201	Ongoing
Nambucca	1	5	In perpetuity
	4	784.5	Ongoing
Port Macquarie - Hastings	2	144	In perpetuity
Richmond Valley	3	870	In perpetuity
	2	411.8	Ongoing
Tweed	3	209.8	In perpetuity
	8	593	Ongoing
North Coast Local Land Services - whole region	42	1562	In perpetuity
	TOTAL	25,128	
	In perpetuity	5,860	
	Ongoing (no specified date)	19,269	

2.4 Native flora and fauna

INDICATORS:	Number of endangered and vulnerable species, populations, and ecological communities (CONDITION) Key threatening processes (PRESSURE)
DATA SOURCE:	OEH, DPI
DATA QUALITY:	Medium to high
TREND:	Decreasing condition / Increasing pressure

The North Coast region of NSW has very high species diversity. It also contains a number of species found nowhere else in Australia, and others which due to their diminished range are now only found in isolated pockets in our region. For example, Mitchell's rainforest snail is only found in the northern part of the North Coast region between Ballina and Tweed Heads; Coastal Fontainea shrub (Fontainea oraria) is now found only near Lennox Head headland; the Bellinger River snapping turtle is known only from a single river catchment, and the marine brown alga Nereia lophocladia is only known from waters off Coffs Harbour. The region supports over 40% of NSW threatened species and one fifth of NSW-threatened ecological communities, despite the region occupying only 6.3% of the state (DECCW 2010b).

The current status of native flora and fauna in the reporting region is discussed in this section along with key threatening processes impacting these species.

Of the approximately 1,000 species listed as vulnerable, endangered, critically endangered or presumed extinct in NSW, 452 species (or 45%) are found in the North Coast region, and some LGAs within the reporting region support a very high number of these species. There are 45 listed key threatening processes that are relevant to the North Coast region for both land and aquatic species and habitats, with DPI responsible for managing aquatic KTPs through Priorities Action Statements and OEH managing terrestrial KTPs through threat abatements plans, and priorities action statements. New declarations of endangered species, populations and communities since 2012 are summarised in Table 11 and can be accessed from NSW BioNet at www.bionet.nsw.gov.au.

The species listed are all now managed by OEH under the Saving our Species program, which allocates threatened species to different management streams based on their threatened status, ecology, habitat and distribution, threats, and our knowledge base. The NSW Government has dedicated $100 million to this program until 2021 to secure the futures of these species in the wild (OEH 2016b).

Table 11: Changes to the status of threatened species in the region since 2012
(Source: BioNet online database at www.bionet.nsw.gov.au)

Status in NSW	Species added since 2012	Species	Relevant LGA
Critically endangered species	1	Bellinger River snapping turtle	Bellingen
Critically endangered population	1	New England Peppermint (Eucalyptus nova-anglica) Woodland on Basalts and Sediments in the New England Tableland Bioregion	Potentially found in Clarence Valley, Coffs Harbour, Bellingen, Kempsey, Port Macquarie-Hastings
Endangered population	2	Allocasuarina inophloia (F.Muell. & F.M.Bailey) L.A.S.Johnson population in the Clarence Valley Local Government Area	Clarence Valley
		Koala Phascolarctos cinereus (Goldfuss, 1817) between the Tweed and Brunswick Rivers east of the Pacific Highway	Byron Shire and Tweed Shire
Endangered species	6	Black-tailed antechinus	Tweed, Kyogle, Lismore, Byron, Ballina
		Wollumbin Dogwood *Ozothamnus vagans*	Tweed, Byron, Ballina, Lismore, Kyogle, Richmond Valley
		Torrington Mint-bush *Prostanthera staurophylla sensu stricto*	Potentially found in Kyogle, Clarence Valley
		Craven grey box *Eucaltyptus largeana*	Potentially occurs in region
		Solanum sulphureum (a purple flower)	Port Macquarie-Hastings
		Diuris eborensis (an orchid)	Tablelands parts of Clarence Valley, Bellingen, Kempsey, Port Macquarie-Hastings
Endangered ecological community	0	No change since 2012	-
Key Threatening Processes	2	Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Region
		Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners Manorina melanocephala	Region
Aquatic species (marine and freshwater)	0	No change since 2012	-

Illustration: N Aichroy

2.5 Invasive species

INDICATORS:	Extent of invasive weed species (CONDITION/PRESSURE) Extent of invasive weed control (RESPONSE)
DATA SOURCE:	Councils, county councils
DATA QUALITY:	Low to medium
INDICATORS:	Extent of pest fauna species (CONDITION/PRESSURE) Number of pest fauna control programs (RESPONSE)
TREND:	Decreasing condition / Increasing pressure

Whilst having some of the highest biodiversity in the country, the North Coast region also has some of the highest numbers of invasive species, both weeds and vertebrate pests. In recent years, cane toads have progressed further south, the Indian myna has become more prolific, and with high rainfall and warm climate, it is an area where weeds thrive if allowed.

Since the 2012 Regional SoE Report, tropical soda apple, a South American invader, has become the focus of a targeted eradication campaign having caused billions of dollars worth of damage to agricultural land in the USA (LLS 2016). The introduced myrtle rust pathogen has become so widespread that it is predicted to cause the localised extinction of some species of Myrteacae (Carengie et al 2015). Research underway by DPI and NCLLS is demonstrating how far wild dogs will roam, and local volunteers are continuing to curb the increasing populations of Indian mynas in the region. ABC news reported on 7 November 2016 that red fire ants were within 50 km of the NSW border having moved south from Brisbane (ABC 2016).

The current condition of invasive species is described in this section with local responses.

Photo: Cane toad, N Cotsell

2.5.1 Invasive weed species

In the North Coast region, weed control is the responsibility of Local Control Authorities (LCAs). There are seven LCAs in the reporting region who report to the North Coast Weeds Advisory Council who in turn reports to NSW DPI as part of the NSW Weeds Action Plan 2015-2020. Far North Coast Weeds (FNCW) is the largest LCA in the region covering Tweed, Byron, Ballina, Lismore, Kyogle and Richmond Valley LGAs. Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey and Port Macquarie-Hastings are the other regional LCAs operating within their own LGAs.

Currently, the highest priority weeds in the region are:

- Tropical Soda apple
- Miconia
- Paper Mulberry
- Cecropia
- Kidney leaf mud plantain
- Hymenachne
- Aleman grass
- Senegal tea plant
- Alligator weed
- Water lettuce

A five year weeds action program funded by the LCAs, DPI and LLS was completed in 2015 and is the main dataset reported on here. All LCAs worked in a coordinated manner to achieve set targets. As the region changed for weeds reporting in 2013, only the two final years are presented here for consistency. These figures are summarised below in table 12.

Table 12: Weed inspection and control by LGA 2013 – 2015 (source: NCWAC)

2013/14	Far North Coast Weeds	Clarence Valley	Coffs Harbour	Bellingen	Nambucca	Kempsey	Port Macquarie-Hastings	Regional TOTAL
High risk sites (number)	4,361	403	550	92	92	512	149	**6,159**
High risk sites (Ha)	5,000	-	7,875	24	144	3,970	2,832	**19,845**
High risk sites treated (Ha)	365	663	588	12	-	-	-	**1,628**
High risk pathways (km)	16,063	3,792	1,013	730	651	1,222	2,288	**25,759**
High risk pathways treated (km)	7,728	782	141	550	-	1,042	1,987	**12,230**
Other priority sites (number)	1,011	239	86	24	76	350	326	**2,112**
Other priority sites (Ha)	348	-	1,023	60	238	-	-	**1,669**
Other priority sites treated (Ha)	348	815	27	9	600	-	-	**1,799**
2014/15	Far North Coast Weeds	Clarence Valley	Coffs Harbour	Bellingen	Nambucca	Kempsey	Port Macquarie-Hastings	Regional TOTAL
High risk sites (number)	1,879	1,002	764	93	94	328	31	**4,191**
High risk sites (Ha)	1,426	-	2,330	544	144	14,110	3,201	**21,754**
High risk sites treated (Ha)	1,426	320	1,363	19	-	-	-	**3,129**
High risk pathways (km)	4,312	2,865	1,368	600	450	6,710	2,812	**19,117**
High risk pathways treated (km)	2,078	718	587	695	-	850	1,558	**6,486**
Other priority sites (number)	1,645	225	253	30	78	299	1,110	**3,640**
Other priority sites (Ha)	20,186	-	262	868	238	-	-	**21,554**
Other priority sites treated (Ha)	82	296	2	8	-	-	-	**387**

The five year program covered over 2.3 million hectares of land outside of National Parks and State Forests, targeting high priority weeds and inspecting high risk sites and pathways such as waterways (floods are a major weeds vector), roadsides, railways, nurseries, and cattle yards.

The figures reported here (see Table 12) only apply to weed control conducted by councils and county councils under the Weeds Action Plan, and do not include specific habitat restoration projects that involve weed removal, or the work private landholders do to control weeds.

The program was considered to be very successful in its collaborative response to Tropical Soda Apple, involving the North Coast, Mid North Coast and Northern Tablelands regions. Funding was provided by Local Control Authorities, Local Land Services and DPI. This program to date has been highly successful in containing a potentially disastrous infestation. Rapid response strategies have

also been implemented for numerous species in the region including Seeded Banana, Banana Passionfruit, Red Trumpet Vine, Hymenachne and Asparagus virgatus.

Monitoring of past eradication is essential to prevent re-emergence. The region's LCAs have a significant monitoring program focussing on high risk and high priority species and on preventing re-emergence at eradicated sites.

This program has been particularly successful for key weed species including Hymenachne, Tropical Soda Apple, Giant Devils Fig, Water Lettuce. Aleman Grass, Miconia and Kidney Leaf Mud Plantain. Coordination through NCWAC has resulted in numerous effective joint programs between Local Control Authorities and state agencies such as NPWS, Forestry Corp and Crown Lands, as well as cross-tenure projects that incorporate private property (NCWAC 2016).

2.5.2 Invasive fauna species

Vertebrate pests in the North Coast region — including rabbits, foxes, goats, cats, dogs, deer, cane toads, pigs and mosquito fish — are all listed as key threatening processes in NSW, meaning they have a measureable impact on threatened species populations and their habitats.

Information collected by DPI Vertebrate Pest Research Unit on vertebrate pests in the region along with feedback from councils is provided in Table 13.

Each Council within the reporting area has some type of program or service to assist in vertebrate pest control. Most rely in part on the services of volunteers and Landcare to conduct vertebrate pest management. These are listed in Table 14.

Table 13: Vertebrate pest species by LGA for 2016 (Source: DPI)

Pest	Density	Location
Cane toads	Medium to high	Clarence River to Tweed. LGAs report numbers are steady.
	Low	Port Macquarie
Pigs	Low to medium	Coastal areas mainly around Clarence and Kempsey
	Medium to high	Tablelands areas
Horses	Low to medium	Clarence Valley, Coffs Harbour and tablelands areas
Goats	Generally low	Mostly confined to the tablelands region
Foxes	Presence	All of North Coast Region
Dogs	Medium to high	Present in all partsof the region including Tweed, Ballina and Byron. In 2012, was thought to be absent from these areas. Increasing presence reported.
	Low	Along the coastal strip
	Absent	Nowhere
Deer	Low to medium	Southern, central section of Region, predominantly near state forest and national park areas
	Medium to high	Reportedly increasing in Port Macquarie-Hastings and Coffs Harbour LGAs
Cats	Presence	All of North Coast Region - reportedly increasing
Rabbits	Presence	An issue in Tweed Shire
Indian mynas	Presence	Increasing in all LGAs despite major trapping efforts in some areas
Freshwater fish pest species		
Eastern gambusia (Mosquito fish)	Presence	All of North Coast Region freshwater river reaches
Carp	Presence	All of North Coast Region freshwater river reaches
Redfin	Presence	All of North Coast Region freshwater river reaches
Banded grunter	Presence	Clarence River system freshwater river reaches, but not noted in recent years
Goldfish	Presence	Lowland freshwater rivers throughout Region
Swordtails (*Xiphophorus helleri*)	Presence	Found in Tweed Shire only
Pearl cichlid	Presence	Found in Tweed Shire only
Redclaw crayfish	Presence	Only found in Emigrant Creek Dam
Mozambique tilapia	Presence	Discovered in 2014 on Cabarita Beach, Tweed Shire

Table 14: Pest control programs in the reporting region (Source: Councils)

Local Government Area	Vertebrate pest control program
Ballina	Indian myna trap loan
Bellingen	Indian myna trap loan
Byron	Cane Toad Musters
	Exclusion fencing for cane toads
	Community education
	Indian myna trap loan
	Feral animal trapping (wild dogs, foxes, cats)
Clarence Valley	Indian myna trap loan and trapping program
	Cane toad control (seek & hand removal)
	Wild dog, fox control (Baited)
	Pig control
	Feral cat control
Coffs Harbour	Indian myna trap loan
Kempsey	Feral cat trap loan
Kyogle	Refer pest issues to LLS
Lismore	Indian myna trap loan
Nambucca	Indian myna and feral cat trapping
Port Macquarie-Hastings	Indian myna program
	Feral deer program
	Limeburners to Crowdy Head National Park Coastal Corridor Project
Richmond Valley	Indian myna trap loan
	Annual carp muster which is undertaken by the Casino RSM Social Fishing Club
Tweed	Indian myna trap loan
	Cane toad control program — musters and breeding habitat exclusion
	Wild dog and fox control
	Rabbit trap loan

Since 2012, there appears to have been a reduction in vertebrate pest management by councils within the reporting region, with most relying on volunteer groups to provide basic trapping and education services or referring all enquiries to Local Land Services. The majority of reports are that pest species abundance is increasing except for cane toads, which are reported to be steady. There is still limited information on the distribution and abundance of vertebrate pest in the region. Local Land Services and DPI are supporting research as well as on-ground control for vertebrate pests. Recent research into wild dogs involved radio-tracking collared wild dogs caught in Coffs Harbour. One dog "Midnight" has astounded researchers by travelling incredible distances. See figure 37, courtesy of Dr Guy Ballard, Dr Paul Meek and DPI.

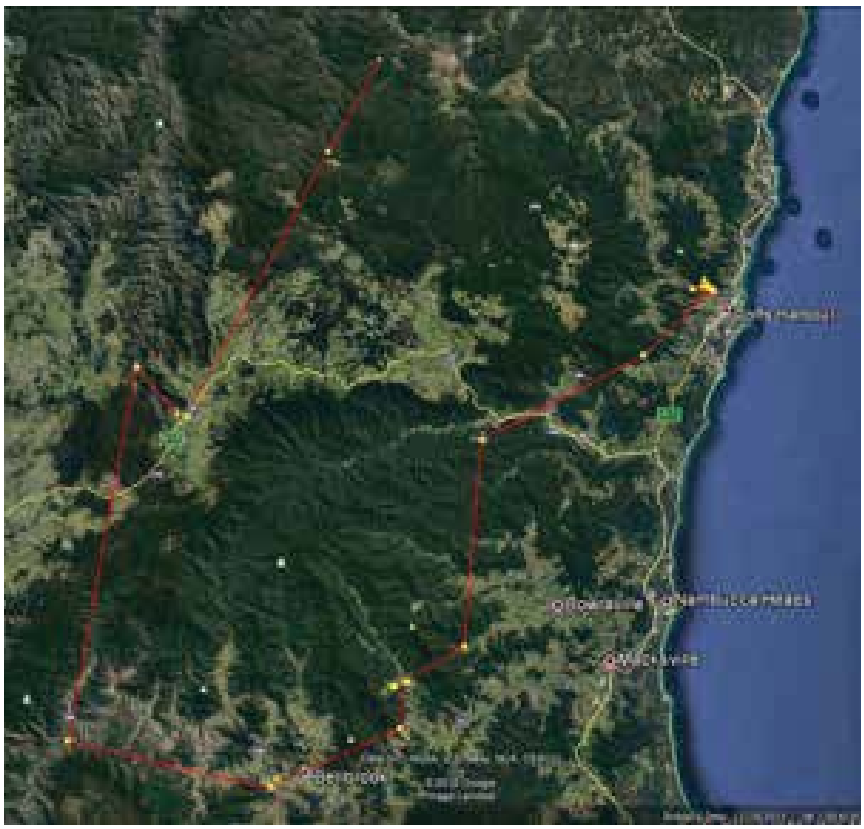


Figure 37: Tracking of the wild dog "Midnight" (by DPI 2016)

THREE

Land use and Soils

The landscape of the North Coast region has been significantly altered since European settlement. The large-scale clearing of forests for timber and agriculture in the region in the late 1800s and early 1900s created a vastly different landscape to the original native vegetation, and more recent coastal urban and infrastructure expansion has increasingly applied pressure to our soil resources either through increasing soil loss or removing fertile land and soils from agricultural production. Soils are non-renewable, and some consider that declining land and soil condition is the greatest ecological threat facing Australia (e.g. Chapman et al. 2011), as it impacts ecological functioning and can be irreversible. Soil security is fundamental to food production and livestock health. Where soil is managed continually beyond its capability it has had detrimental effects on the socio-economic well-being of communities.

In the 2012 RSoE report, soil condition and lands management within capability were reported on using data collected as part of the 'NSW Natural Resources Monitoring, Evaluation and Reporting Strategy' (NSW MER Strategy) and analysed by OEH in 2012, expanding on monitoring conducted for the State of the Catchments 2010 report (DECCW 2010b). At that time, the Natural Resources Commission had two state-wide targets for soil and land:The Natural Resources Commission has two state-wide targets for soil and land:

- by 2015 there is an improvement in soil condition
- by 2015 there is an increase in the area of land that is managed within its capability.

Unfortunately there have been no updates to the monitoring or targets so in this section the 2012 soils and land management information will be repeated. Activities targeting soils and land management are reported here for the 2012 to 2016 period.

The pressures acting on soil condition primarily relate to land management practices, so these two indicators are discussed together, with acid sulfate soils discussed separately as they are a major soil issue for this region.

3.1 Soil condition

INDICATOR:	Soil condition (CONDITION)
DATA SOURCE:	OEH
DATA QUALITY:	Medium to high
TREND:	Unknown

Soil condition was assessed in 2010 and 2012 by the Office of the Environment and Heritage (DECCW 2010b) The reporting region was divided into 10 soil monitoring units (SMUs) which cover approximately 21% of the reporting region and monitoring sites are located within each SMU (see Figure 38).

The data in Table 15 shows the current condition of soils in the 10 soil management units. The condition of each SMU was determined through comparison of test sites with a reference site (considered to be in ideal condition) within the same SMU.

Photo: Tweed Shire Council

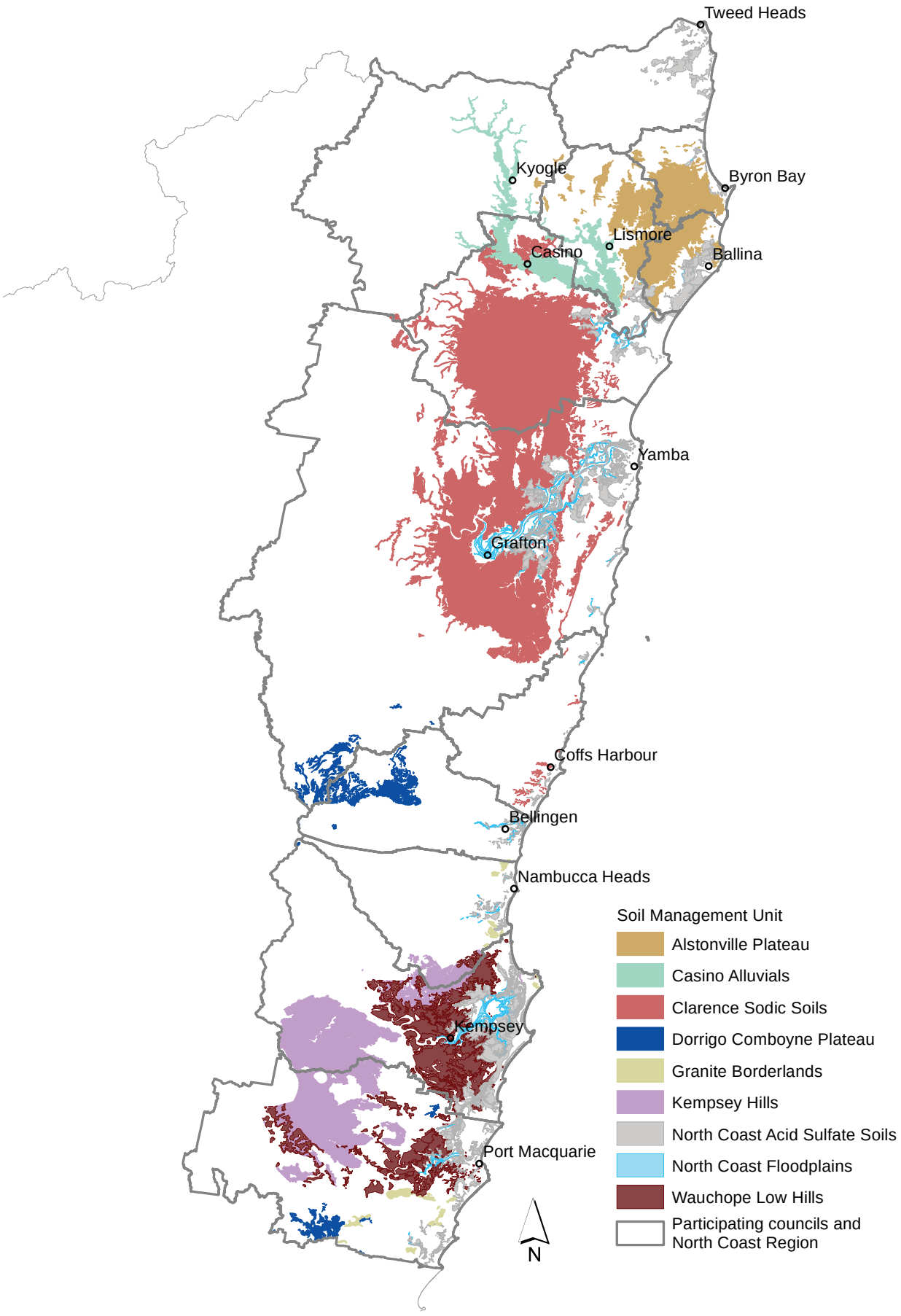


Figure 38: Soil Management Units within the region (OEH 2010)

Table 15: Soil management unit condition by indicator for 2012 (Source: OEH)

Soil management unit	Sheet erosion	Gully erosion	Wind erosion	Acidity	Organic carbon	Soil Structure	Acid sulfate soils	Soil salinity
North Coast Floodplains	3.6	5.0	5.0	3.6	1.1	4.0	no data	4.4
Dorrigo-Comboyne Plateau	2.7	4.0	5.0	no data	no data	no data	no data	5.0
Alstonville Plateau	2.2	4.0	5.0	3.9	4.0	4.6	no data	5.0
Casino Alluvials	2.4	4.0	3.1	3.9	3.2	3.1	no data	4.1
Walcha Metasediments	2.9	3.5	5.0	3.7	2.1	3.4	no data	3.0
Clarence Sodic Soils	2.9	2	4	3.1	2.6	3.7	no data	4.2
Kempsey Hills	2.5	2.5	5.0	2.7	2.7	4.0	no data	5.0
Granite Borderlands	2.8	3.0	3.0	3.5	2.8	4.1	no data	3.8
Wauchope Low Hills	2.4	4	5.0	3.9	3.5	4.3	no data	4.7
North Coast Acid Sulfate Soils	3.7	5.0	5.0	2.2	3.3	5.0	3.0	5.0

Legend for tables

4.6 – 5.0	Very good	No loss of soil function. Either no deterioration or an improvement on reference condition.
3.6 – 4.5	Good	Slight loss of soil function. Noticeable but not significant deterioration against reference condition.
2.6 – 3.5	Fair	Noticeable loss of soil function. Noticeable deterioration against reference condition.
1.6 – 2.5	Poor	Significant loss of soil function. Considerable deterioration against reference condition.
<1.5	Very poor	Profound loss of soil function. Severe deterioration against reference condition.

Each SMU varied in its condition for each indicator. Generally, all SMUs averaged as fair to good for overall soil condition; however, sheet erosion is an issue for most SMUs, followed by organic carbon depletion, which is an issue for most SMUs, particularly coastal floodplains. The reduction in soil carbon is of particular concern and will require response from a range of landowners and stakeholders. There is a slight decline for acidity, the indicators of soil structure and acid sulfate soils are improving, and the others remain steady. Wind erosion, soil salinity and soil structure are the best of the indicators, showing these are less of an issue for land management in the region.

However, continued good land management practices are needed to maintain this good status (Chapman et al. 2011). The indicators also respond well to land management practices, which are discussed next.

Photo: M Asquith

3.2 Land management within capability

INDICATOR: Land managed within its capability (PRESSURE)
DATA SOURCE: OEH
DATA QUALITY: Medium to high
TREND: Unknown

Land management practices are the primary pressure on soil condition (Chapman et al. 2011). Fortunately, this means that soil condition can be improved through changes in land management, with the associated benefits of increased agricultural productivity and better ecological functioning. Land management within capability is also being monitored as part of the NSW MER Strategy, although current status of the program is unknown.

This involves assessing how well land types are being managed and whether the land can be maintained in good condition under these management practices. For example, different levels of tilling, fertiliser use, length of time land is left fallow, and amount of vegetation or ground cover all affect how well the land and soil cope. Some practices will degrade land and soil faster than others.

The land management information reported here was gathered by OEH under its MER program in 2010 and 2012, and includes data gathered from landholders themselves, from actual site soil samples and land assessment, and expert knowledge (Chapman et al. 2011). This information was then used to derive a score, or index, shown in Table 16 below.

Table 16: Land management within capability by indicator for 2012 (OEH 2012)

Soil management unit	Sheet erosion	Gully erosion	Wind erosion	Acidification	Organic carbon decline	Soil Structure decline	Acid sulfate soils	Salinity/ water logging
North Coast Floodplains	4.1	4.1	4.1	3	4.4	4.4	no data	4.9
Dorrigo-Comboyne Plateau	2.9	2.9	4.4	3.3	5	5	no data	5
Alstonville Plateau	2.8	2.9	4.2	3.3	4.8	5	no data	5
Casino Alluvials	4.7	4.7	4.8	3.2	4.2	4.2	no data	4.6
Walcha Metasediments	2.8	2.8	4	2.9	3.1	3.1	no data	3.8
Clarence Sodic Soils	3.8	3.8	4.7	2.2	3.2	3.3	no data	1.7
Kempsey Hills	1.7	1.7	4.7	3.7	4.7	4.7	no data	4.7
Granite Borderlands	4.5	4.7	4.6	3	4.6	4.4	no data	5
Wauchope Low Hills	3	3	4.5	3	4.1	4.1	no data	4.9
North Coast Acid Sulfate Soils	4.9	4.9	2.6	2.3	1.4	1.7	3.7	1

4.6 – 5.0	Very good
3.6 – 4.5	Good
2.6 – 3.5	Fair
1.6 – 2.5	Poor
<1.5	Very poor

The data indicates that for the reporting region, land management is generally “fair” to “good”. Erosion and acidity are the primary issues affecting land management regionally, with salinity or waterlogging affecting Clarence Sodic Soils. Acid sulphate soils (ASS) require ongoing management as they are the poorest performing soil management unit in the region.

3.3 Funded land and soils management activities

INDICATOR:	State- and federally-funded soil and land management activities (RESPONSE)
DATA SOURCE:	North Coast Local Land Services
DATA QUALITY:	Medium

Soil improvements and erosion controls are funded in many instances by North Coast Local Land Services, however data on the area under improvements was not available for this report but will be reported on as soon as data becomes available. Improvements to acid sulfate soils are not included here as they are detailed in section 3.4.

3.4 Acid sulfate soils

INDICATOR:	Extent of acid sulfate soils: hotspots and drainage density (PRESSURE)
DATA SOURCE:	Former Department of Land and Water Conservation
DATA QUALITY:	High
INDICATOR:	Area of remediated acid sulfate soils, drains and associated wetl ands (RESPONSE)
DATA SOURCE:	Councils, county councils, Northern Rivers CMA
DATA QUALITY:	Medium
TREND:	Improving condition

Acid sulfate soils (ASS) are naturally occurring soils that contain iron sulfides. In the North Coast region, the acid sulfate soils of most concern are those which formed within the past 10,000 years, after the last major sea level rise. When the sea level rose and inundated land, sulfate in the sea water mixed with land sediments containing iron oxides and organic matter. The resulting chemical reaction produced large quantities of iron sulphides in the waterlogged sediments. Generally lying under alluvial soils, ASS are harmless if left alone and inundated, but when disturbed they react with oxygen to release sulfuric acid into the surrounding environment. This acid also dissolves and then transports heavy metals including iron and aluminium. This toxic combination severely affects vegetation, fish and other aquatic life (invertebrates and aquatic vegetation), and reduces the condition and productivity of the soil it comes into contact with (Johnston et al. 2003). It also corrodes and decreases the lifespan of any concrete and steel infrastructure it encounters.

In the North Coast region, ASS are found in all coastal council areas from Port Macquarie-Hastings north to Tweed. Urbanisation, agriculture and development have disturbed many areas of ASS. In particular, the broadscale excavation of flood mitigation drainage systems across the coastal floodplains has exacerbated ASS issues by increasing oxidisation of these soils. Much remediation work is now focusing on restoring higher groundwater levels in key drainage systems to minimise the potential for further oxidation and export of acidic contents.

ASS have been comprehensively mapped for the North Coast region, and best practice remediation techniques employed. At a state level, NSW Department of Primary Industries (NSW DPI) and North Coast Local Land Services are involved in remediation works and funding remediation programs. At a local level, councils have their own restoration programs which complement the state-level programs and are often funded by state agencies. The current state of ASS in the region and by each LGA is detailed in Table 17.

Table 17: Acid sulphate soils status by LGA for the region (Source: Councils)

	Bellingen	Byron	Clarence Valley	Coffs Harbour	Kempsey	Nambucca	Port Macquarie-Hastings	Richmond River County Council *
Total area identified high risk ASS (ha)	4,243	1,518	67,109	4,707	41,791	4,542	19,513	36,421
Total area identified low risk ASS (ha)	772	6,371	14,978	4,431	9,261	2,111	6,874	33,988
Total area of ASS hot spots (ha)	-	1,265	10,001	-	15,781	-	3,711	15,139
Area of ASS remediated to 2016 (ha)	-	-	5,170	-	174	-	5,122	3,939
Area of associated wetland remediated to 2016 (ha)	-	-	1,184	-	40	-	942	1176
Number of drains remediated to 2016	-	-	229	-	8	-	57	29
Length of drains remediated (km) to 2016	-	-	97	-	3.45	-	145	109.7
Area of ASS under management (ha)	-	-	5,250	-	184	Gumma Swamp project commenced	all ASS remediated in LGA	-

In the North Coast region, just over 280,000 hectares of acid sulfate soils have been identified. Of these, 70% are considered high risk and 30% low risk. Nearly 50,000 hectares of land is considered to contain ASS hot spots, which prioritises them for remediation works. Drainage channels (both natural creeks and streams, and channels constructed for agriculture) increase the transport of ASS into river systems. All 4,546 km of ASS drains have been mapped for the North Coast region. Drained wetlands often adjoin or overlay areas of ASS and remediation of these wetlands is critical to maintain their important ecosystem functions.

Many councils are actively remediating ASS in their areas, with 20,249 hectares of land, 439 km of drainage, and 3,462 hectares of adjoining wetland remediated in the region. Over 12,000 hectares of ASS are under ongoing management. Management plans and agreements are in place for remediated areas to guide ongoing maintenance. Management of ASS is generally covered under each council's LEP and associated development control plans which specify what activities can be undertaken on identified ASS.

Port Macquarie-Hastings has remediated all its ASS and associated wetlands. Clarence Valley has remediated half of it area of ASS hot-spots, and Tweed is continuing to work with cane growers to manage ASS and cane drains. Richmond River County Council also continues to work closely with cane growers and manage flood gates and tidal flushing for river health. Nambucca has just commenced a remediation project for Gumma Swamp, and Bellingen and Coffs Harbour Councils have development controls in place for their low risk ASS.

3.5 Mining and Exploration

INDICATOR:	Extent and status of mining and exploration activity in the reporting region (PRESSURE)
DATA:	Minview (Department of Primary Industries
DATA QUALITY:	High

Mineral exploration and mining is an activity that creates tension within communities, with many in the North Coast region concerned with the potential for expansion of mining activities. Currently, mining activity is very low, as is the number of applications and exploration licences within the region.

A summary of current mineral exploration and mining activity within the region is presented in figure 39. Currently, there are:

- 9 current mining licences in the region – 4 for brick, clay, and shale, 1 for gold (George's Gold mine Coffs Harbour), 1 for tin and tungsten (Port Macquarie-Hastings), 3 for gold, silver & antimony (all Kyogle west)
- 2 current mineral applications for Clarence Valley and Port Macquarie-Hastings
- 18 current exploration licences covering all LGAs except Lismore. Tweed, Byron and Ballina
- No known active coal seam gas boreholes in the region after the buy-back of some licences in 2014 and 2015
- 2 expired coal mining titles in Clarence Valley

This information is publically available at MinView – the Department of Industry: Resources and Energy geoscience information website (http://www.resourcesandenergy.nsw.gov.au/miners-and-explorers/geoscience-information/services/online-services/minview).

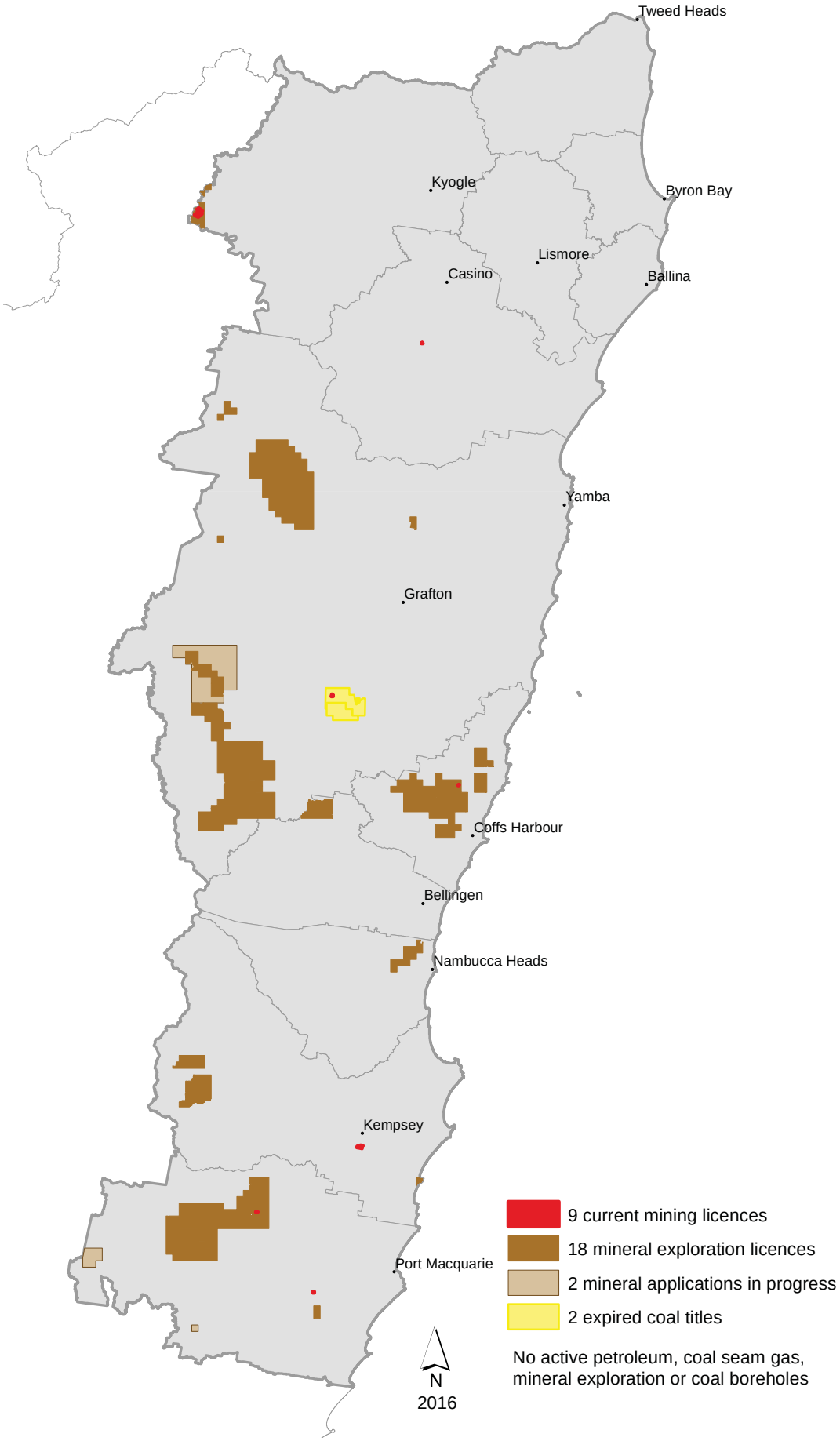


Figure 39: Mining activity and exploration in the region 2016 (MinView 2016)

Photo: C Stehn

FOUR

Water

The North Coast region of NSW has some of the largest river systems in the state. The Clarence River system is the largest coastal river system in NSW, the Richmond River drains the largest coastal floodplain in NSW, and the region has the highest rainfall in the state.

Along the region's coast there two main estuary types: wave-dominated barrier estuaries and intermittently closed or open lakes and lagoons (ICOLLS). Groundwater is also a feature of the region, with a number of groundwater sources many of which supply both urban and rural areas with water. The marine environment adjacent to the mainland is incredibly diverse and includes two marine parks and an aquatic reserve. We are dependent on these river and estuary systems for our water supply, our recreation (swimming, fishing), and for some, our livelihood (oyster production, commercial fishing, tourism). Our rivers, creeks and estuaries are subject to increasing pressures from agriculture, land modification, urban expansion and associated pollution and alterations. Fortunately some rivers and estuaries are contained within the national park estate, thus removing them from urban pressures, but others are highly impacted by pollution and alteration. Maintaining clean, healthy waterways is critical to sustain our current lifestyle, so monitoring and appropriate management are vital.

In this section, the current condition of rivers and estuaries, wetlands, groundwater and the near-shore marine environment are detailed, along with key pressures and major responses.

Photo: S Morris

Photo page 76: A Harrison

4.1 Estuarine and freshwater rivers

INDICATORS:	Water quality, macro invertebrates and fish assemblages (CONDITION) Presence of riparian vegetation (CONDITION)
DATA SOURCES:	Water quality: Ecosystem health programs,
DATA QUALITY:	High
INDICATORS:	Macroinvertebrates: OEH, Ecosystem health programs
DATA QUALITY:	High (Macroinvertebrates)
INDICATORS:	Fish assemblages: DPI
DATA QUALITY:	High
INDICATORS:	Riparian vegetation: NSW Office of Water, councils, ecosystem health programs.
DATA QUALITY:	Low to medium
TREND:	Decline in water quality and river health

Estuarine and freshwater river condition is generally assessed using a number of indicators, including:

- water quality, particularly chlorophyll-a, turbidity, total nitrogen, total phosphorous and dissolved oxygen
- macroinvertebrate levels — i.e. the type and number of water bugs
- riparian/riverbank vegetation and riverbank stability
- fish condition — i.e. the number, type and age of fish species.
- zooplankton — a simple water quality indi cator for estuaries

The Ecohealth aquatic ecosystem monitoring program, now led by the University of New England (UNE) uses these indicators when assessing river health. In 2012, only three LGAs within the region had conducted a full ecohealth assessment, with a fourth completing the South east Queensland (SEQ) catchments version of the program. In October 2016, all but one of the LGAs in the region had either completed or were in the process of conducting an Ecohealth assessment. Three LGAs were completing a second comprehensive ecohealth assessment. This has resulted in a much greater level of understanding of river and estuarine health in the region.

Due to the resource intensive, time consuming and costly nature of the assessment, there is currently a regional Ecohealth proposal which would allow a more streamlined and more resource and cost-effective approach to assessing the waterways of the region. All Councils are supportive of the proposal and are awaiting the outcome of negotiations with the Office of Environment and Heritage (OEH) who will ideally assist with funding the program. OEH Coasts and Estuaries program have match-funded the Ecohealth program in the past assisting Councils greatly with the costs.

In addition to the Ecohealth program, OEH conducts three-yearly estuarine water quality monitoring along the coast assessing chlorophyll-a and turbidity using parameters specifically developed for NSW estuaries. All councils within the region conduct standard basic water quality testing as part of their licence conditions for operating waste water treatment plants (WWTP) or water reclamation plants, and also for drinking water quality, however this does not give a comprehensive picture of the river or estuary condition.

As part of the former NSW MER Strategy, OEH and DPI conducted macroinvertebrates and fish condition assessments throughout the region, with updated fish condition information presented here. The level of information on the health of the region's rivers and estuaries has increased greatly since 2012, providing us with a true regional picture.

4.1.1 Comprehensive river health assessment

In 2012, only four LGAs within the reporting region had conducted comprehensive ecosystem health assessments for rivers and estuaries. In October 2016, eleven of the twelve LGAs in the region had either completed or were in the process of completing the NSW Ecohealth or the SEQ Catchments program, with three LGAs conducting a second assessment, as they are designed to be run at 4-yearly intervals. It is hoped the proposed regional Ecohealth program will proceed allowing ongoing streamlined assessment of the region's waterways.

Ecohealth and the SEQ Catchments programs both assess water quality, riparian vegetation, macroinvertebrates and fish condition in estuaries and freshwater reaches of rivers and creeks. Some LGAs have included zooplankton in their assessments as this can provide a quick indication of estuary health. Combined, these indicators give

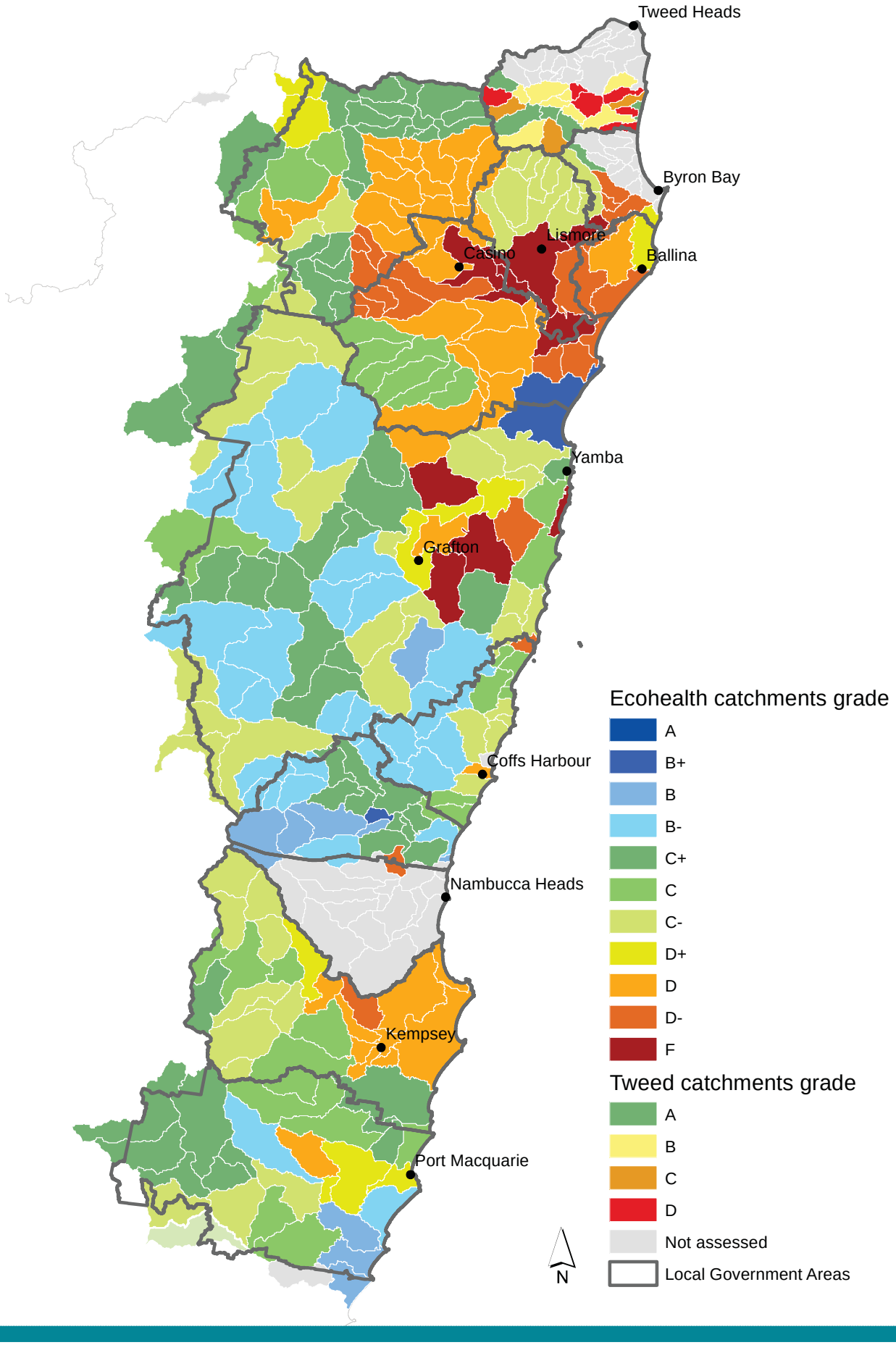


Figure 40: Ecohealth grades by catchment and Tweed catchment grades

Table 18: River condition grades by LGA (see figure 40 for legend)

LGA	Year of assessment	Overall grade	Water quality	Riparian	Macroin-vertebrate	Geomor-phic	Fish	Trend/Status
Ballina	2014	D	D-	D-	D	D+	-	High nutrient levels and poor riparian condition reduced grades
Bellingen	2009 Bellinger	B-	A-	C+	B	-	-	Riparian vegetation poorest indicator
	2009 Kalang	C+	C+	D	C-	-	-	Estuary poorer than freshwater
	2016	In progress						
Byron		Not assessed						
Clarence Valley	2013	C-	C	C-	C-	-	C+	Coastal tributaries poorest for water quality and macroinvertebrates; main river poorest for riparian vegetation
Coffs Harbour	2015	C-	C	C+	F	C+	B-	Slight decline since 2011; Macroinvertebrates poorest; estuaries suffering from poor flushing
Kempsey	2015	C-	D+	D	D+	C+	C+	
Kyogle	2013	D+	D	D+	D	C	-	High nutrient levels and poor riparian condition reduced grades
Lismore	2013	D-	D-	D-	D	C+	-	High nutrient levels and poor riparian condition reduced grades
Nambucca	2016	In progress						
Port Macquarie-Hastings	2015 Camden Haven	C	D-	C	F	B	-	Good health generally water quality poorer in estuaries
	2015 Hastings	C+	D-	B+	C-	B+	-	Good health generally, riparian veg poorer in estuaries
Richmond Valley	2013	D-	F	D	D-	C-	-	High nutrient loads and poor riparian veg reduced grades
Tweed	2011-15	C	-	-	-	-	-	SEQ program High nutrient loads in estuaries Upper catchment better condition - nutrient loads an issue
Richmond River County Council	2013	C	D+	D	B-	B	-	Entire Richmond River catchment. Consistently high nutrients and poor riparian veg key issues

an overall score for river and estuary condition. Scores and key trends are summarised in Table 18 and in Figure 40 for all LGAs who have undertaken this comprehensive assessment (for full details of results, see each Council's website, or UNE's web-page http://aerlabcomau.ipage.com).

Results of the Ecohealth and other river health assessments indicate catchment grades ranged from B+ (good) to F (fail) for overall catchment health across the region. The highest grades were in waterways with good riparian vegetation and lower nutrient levels, whereas poor grades were the result of consistently high levels of nutrients, very altered waterways and riparian zones (such as cane drains) and an absence of riparian vegetation. Macroinvertebrate communities tended to be dominated by pollution-tolerant species. Water quality was consistently poorer in estuaries than in freshwater, with the tidal limit a key deposition point for nutrients. In some areas, water quality improvements were linked to sewering of towns highlighting the contribution of septics to nutrient loads. Fish condition was generally good in the region with few invasive species and a range of native species. However, recruitment was an issue for all species which lowered scores. A summary by indicator follows (Ryder et al 2011, 2012a and b, 2014, 2015, 2016 in press).

Water quality

Water quality varied across catchments with the highest grades occurring in protected areas, and the poorest on the floodplains where intensive agriculture occurs and within urban areas where run-off is a key source of pollutants. In freshwater reaches, elevated phosphorus, nitrogen and turbidity reduced condition scores, whereas in estuary reaches low dissolved oxygen, acid drainage and high nutrients reduced scores. The sources of elevated nutrients appear to be primarily from agriculture (intensive more than extensive) and also septics when too close to rivers. In estuarine reaches, inputs from urban run-off appear to be the primary issue. Poorest water quality was consistently found across all systems at the sites closest to the tidal limit (where freshwater meets salt water) indicating this zone acts as a deposition point for both freshwater and estuarine contaminants and sediments.

High nutrient and sediment loads were strongly linked to high rainfall, however in some systems water quality issues occurred in both high and low flow conditions. In some freshwater reaches, poor water quality was directly linked to elevated nutrients from agriculture and onsite sewage management systems (septics), with high silt loads from absent or poor riparian vegetation.

Some recent studies have detected an improvement in nutrient loads on waterways when towns are connected to the sewer. In the Tweed LGA, a decrease in faecal contaminants and chlorophyll-a was found after the town of Uki was connected to the sewer (Hydrosphere Consulting 2015). In Bellingen, the sewering of the low-lying areas along the Kalang River has allowed the NSW Food Authority to re-assess the water quality with a view to re-opening the area to oyster aquaculture, which was closed in 2008 due to contamination from septics. Results will be known by the end of 2016 along with the results of the 2015/16 water quality monitoring program.

Macroinvertabrates

Diverse and abundant aquatic macroinvertebrate communities were found throughout the upper freshwater reaches of the various river systems, but most locations were dominated by organisms tolerant of poor water quality and poor habitat. A lack of good habitat rather than poor water quality may be reducing the condition of macroinvertebrates. Macroinvertebrate condition improved after flooding suggesting they are more affected by prolonged periods of low flows than floods. Highest grades for macroinvertebrates were in streams with intact riparian zones and little sediment sources. Poorest scores occurred in catchments dominated by poor water quality, high sediment loads, poor riparian vegetation and eroding riverbanks.

Riparian vegetation

Riparian condition was generally low across the region outside of protected or forested areas. Poor riparian condition included issues with invasive species, a poor diversity of native vegetation, reduced vegetation structure, and small isolated pockets that were poorly connected to other native vegetation. Poor riverbank stability (geomorphic condition) was linked to cleared or damaged riparian zones due to agriculture and urbanisation in the lower reaches, and livestock accessing the river in freshwater reaches. Other reaches showed evidence of eroding river banks and sediment deposited in the channel. Estuarine reaches were generally dominated by riverbanks with little or no vegetation present.

Fish condition

Fish condition was assessed for the Tweed, Clarence, Bellinger, Macleay and Hastings catchments as part of the Ecohealth and Tweed programs. Generally, fish condition was characterised by good nativeness, with only three invasive species found across the region – Eastern gambusia (mosquito fish), carp and goldfish, and a good number of native species when compared with pre-European times. However recruitment was poor. Estuaries and protected catchments performed better than upland areas. The Tweed studies found additional invasive species - Swordtails (Xiphophorus helleri), and in 2014 Mozambique Tilapia was identified in Cabarita Beach (DPI 2016). Fish condition is discussed in more detail in section 4.1.4.

Zooplankton

Zooplankton has only been assessed for the Port Macquarie-Hastings LGA. It is a simple measure of estuarine water quality useful for those coastal LGAs with large estuaries. Results indicate that for the Hastings and Camden Haven estuaries, zooplankton condition is good to very good, reflecting the good water quality for those estuaries.

The program has identified a trend for declining water quality and river health in the region. The continuation of this is likely to impact the aquatic species dependent on rivers (including not only fish, but also frogs, turtles, platypus), the quality of water we use for town water supply, and the water that we swim and play in. Many popular swimming locations across the region scored an “F” (fail) for water quality indicating it is probably not suitable for swimming in safely.

The ‘mystery virus’ affecting the Bellinger River snapping turtle, and the closure of areas to shellfish production indicate the impacts poor water quality can have on biodiversity and our livelihood.

Overall the Ecohealth findings and recommendations across the region were consistent. Improving riparian vegetation condition, stabilisation of river backs, and managing nutrient and sediment inputs from the various types of land use are critical to maintaining or improving river health.

For detailed information on the region’s river health monitoring, see individual Council websites, the UNE Ecohealth website http://aerlabcomau.ipage.com and Tweed Shire Council’s website.

Section 4.1.7 details responses from Councils regarding riparian rehabilitation projects.

Photo: S Hessey

4.1.2 Estuarine water quality

As part of the NSW Monitoring, Evaluation and Reporting program, water quality is monitored every three years at 32 estuaries, lakes and lagoons along the North Coast of NSW by OEH. Turbidity and chlorophyll-a were the key measures used to determine water quality, as they indicate levels of nutrients, sediments and other contaminants in waterways that may lead to algal blooms, impacting aquatic and human health. Increases in turbidity and chlorophyll-a levels are normal after heavy rains and in summer with warmer water temperatures. However increased levels that persist over time indicate poor water quality (OzCoasts 2012). Acceptable levels are set nationally under the ANZECC guidelines, however levels have been modified for regional and local use by OEH (Roper et al 2011). Estuaries sampled are also classified for disturbance level.

Results indicate that in 2015, 29 percent of estuaries are in 'very good' condition (down from 43% in 2012), 42% of estuaries are in 'good' condition, 29% are in 'fair' condition, and none are in poor or very poor condition (see Table 19). There were less estuaries scoring in the 'very good' grade in 2015 compared to 2012, and more scoring in the 'fair' grade, indicating a slight decline in estuarine water quality.

The poorest performing estuaries for chlorophyll-a concentrations in 2015 from north to south were:

- Cudgera Creek and Salty Lagoon waste water treatment plant site ('F')
- Broken Head Creek, Brunswick River, Flat Top Point creek, Coffs Creek, Bonville Creek and Korogoro Creek ('D')

The poorest performing estuaries for turbidity in 2015 from north to south were:

- Belongil Creek and Hearnes Lake

The best performing sites for both indicators were, from north to south:

- Jerusalem Creek, Sandon River, Darkum Creek, Woolgoolga Lake, Dalhousie Creek, Deep Creek

Results indicate that nutrient loads in the region's estuaries are of concern and are impacting water quality in many estuaries (see Figure 41).

Table 19: Estuarine water quality (source: OEH)

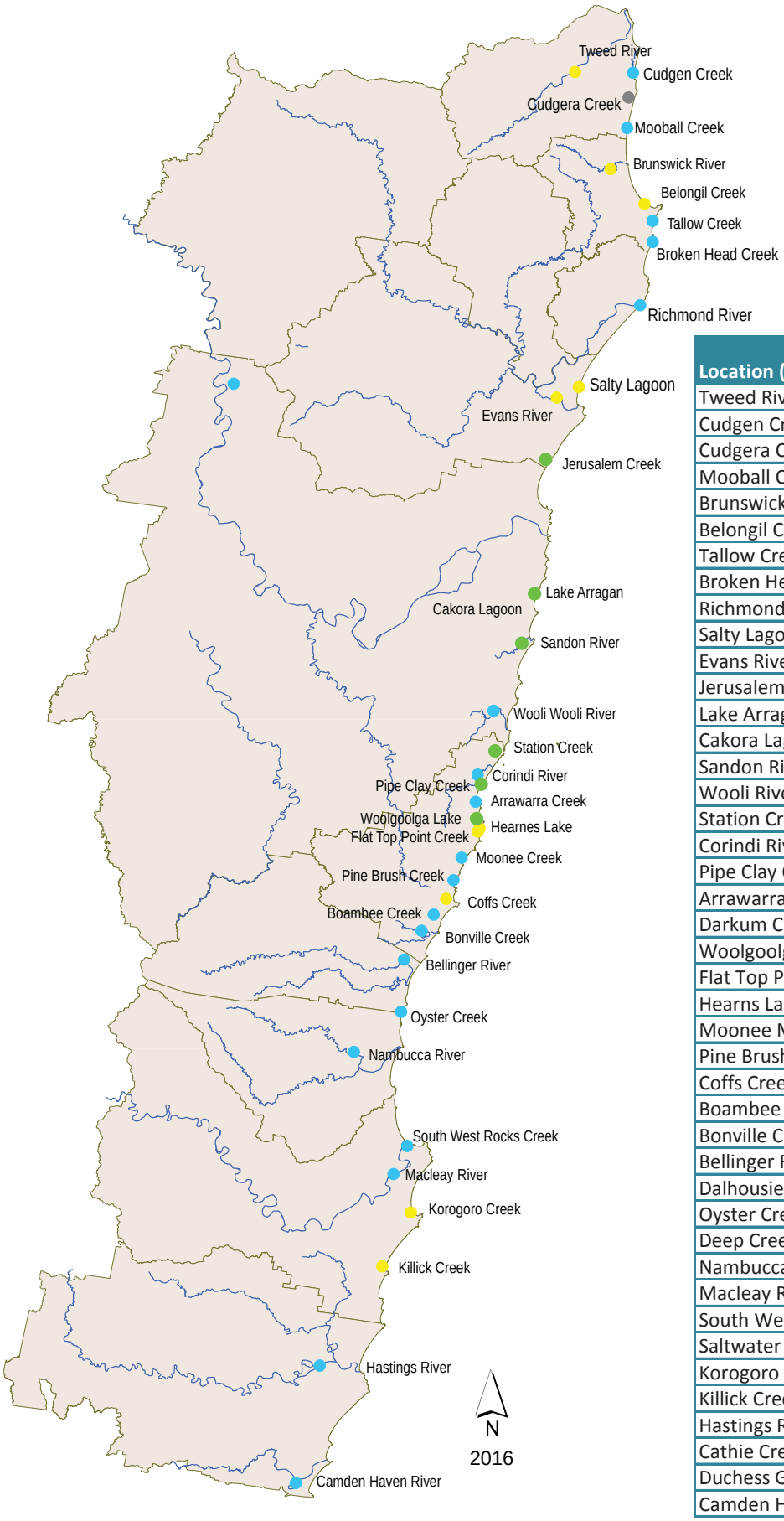
Estuarine Water Quality Grade (OEH MER program)

Percentage of estuaries attaining each grade

	A	B	C	D	F
2009	0	61	26	10	3
2012	43	40	17	0	0
2015	28	41	28	3	0

Key

A	Very good
B	Good
C	Fair
D	Poor
F	Very poor



Location (north to south)	2009	2012	2015
Tweed River	B		
Cudgen Creek	B	C	B
Cudgera Creek		C	D
Mooball Creek		B	B
Brunswick River	C	C	C
Belongil Creek	C	C	C
Tallow Creek	B	A	B
Broken Head Creek			B
Richmond River		B	C
Salty Lagoon		A	B
Evans River	C		
Jerusalem Creek	B	A	A
Lake Arragan	C	A	
Cakora Lagoon			
Sandon River	B	A	A
Wooli River	B	A	B
Station Creek	B	A	A
Corindi River	B	A	B
Pipe Clay Creek	C	B	A
Arrawarra Creek	D	B	B
Darkum Creek		B	A
Woolgoolga Lake	B	B	A
Flat Top Point	F	B	C
Hearns Lake	D	A	C
Moonee Moonee River	B	A	B
Pine Brush Creek	C	B	B
Coffs Creek	D	C	C
Boambee Creek	B		
Bonville Creek	B	B	B
Bellinger River	B		
Dalhousie Creek		A	A
Oyster Creek	B		
Deep Creek		B	A
Nambucca River	B	A	B
Macleay River	B		
South West Rocks Creek	B		
Saltwater Creek (Frederickton)		B	
Korogoro Creek	C		C
Killick Creek	C		C
Hastings River	B	A	B
Cathie Creek		B	A
Duchess Gully		C	C
Camden Haven	B		

Figure 41: Estuarine and coastal lake water quality
(Source: OEH)

4.1.3 Aquatic macroinvertebrates

Aquatic macroinvertebrates, or water bugs, are a key indicator of river health and hence why they are part of the Ecosystem assessment of river condition. Certain types of water bugs are sensitive to pollution and others are pollution-tolerant. The numbers and different species of water bug can therefore indicate how clean a waterway is. Water bugs also provide a crucial role in the food chain as consumers of almost all types of organic matter (leaves, algae, wood, plants) and are a major food source for many other species such as frogs, fish, birds, turtles, platypus and water rats (Chessman 2003). As such, a good macroinvertebrate population equals a healthy, pollution-free river with plenty of fish and other fauna.

OEH previously monitored macro-invertebrates as part of the former NSW MER Strategy; however there is no new information since the 2012 Regional SoE report, so the same information is repeated here. Samples were collected from 1994 to mid-2010 from all parts of the reporting region. The samples collected were compared with the samples collected from reference sites and scored accordingly. The region–wide data from the program is displayed in Figure 42. Scores by LGA are shown in Table 20.

Analysis of the data shows that generally the region is performing well for aquatic macroinvertebrates.

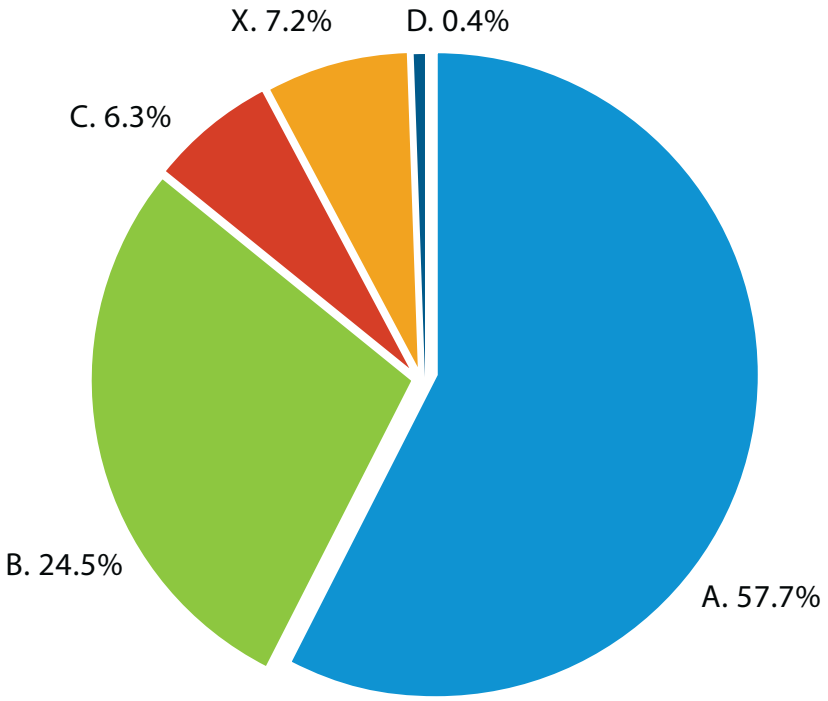


Figure 42: Macroinvertebrate health — percentage of sites in the region in each health category, 1994 to mid-2010 (Source: OEH)

Score	Key	Description
X	More biologically diverse than reference	More families found than expected. Potential biodiversity 'hot-spot' or mild organic enrichment.
A	Similar to reference condition	Expected number of families within the range found at 80% of the reference sites.
B	Significantly impaired	Fewer families than expected. Potential impact either on water and/or habitat quality resulting in a loss of families
C	Severely impaired	Many fewer families than expected. Loss of families from substantial impairment of expected biota caused by water and/or habitat quality.
D	Extremely impaired	Few of the expected families and only the hardy, pollution-tolerant families remain. Severe impairment.

Over 7% of all sites scored in the highest band (X), meaning these sites had more species diversity than expected and are in very good condition. The majority of the region scored an 'A', meaning 80% of the sites had the expected species families. Less than 10% of the region scored 'C' or 'D' (severe to extreme impairment). When analysed, the sites with poor water quality as assessed by macroinvertebrates were located downstream from towns or agricultural areas.

Table 20: Macroinvertebrate health: percentage of sites in each health category by LGA (source: OEH)

Local Government Area	X	A	B	C	D
Ballina	-	11.1%	50.0%	33.3%	5.6%
Bellingen	14.5%	58.7%	23.9%	2.9%	-
Byron	-	24.1%	55.2%	20.7%	-
Clarence Valley	3.6%	61.3%	25.8%	8.8%	0.5%
Coffs Harbour	-	28.3%	41.7%	28.3%	1.7%
Kempsey	13.4%	55.4%	29.5%	1.8%	-
Kyogle	7.5%	61.2%	31.3%	-	-
Lismore	6.8%	43.2%	38.6%	11.4%	-
Nambucca	1.5%	40.3%	40.3%	16.4%	1.5%
Port Macquarie – Hastings	7.0%	63.1%	29.3%	0.6%	-
Richmond Valley	3.4%	27.6%	58.6%	10.3%	-
Tweed	4.7%	60.5%	25.6%	9.3%	-

Photo: Eastern Freshwater Cod by B Vercoe

4.1.4 Fish condition

Fish condition (i.e. the number, variety and age of fish species in a river system) is an indicator of river health as it reflects disturbance (both natural and human), the presence of introduced fish species, and the number and type of fish species that would be expected in a river prior to European settlement (IWC 2009).

Fish condition monitoring has been conducted by DPI Fisheries in the reporting region as part of the former NSW MER Strategy as well as for the Ecohealth program, and results are displayed in Figure 43. Fish monitoring has been specifically assessed as part of the Ecohealth monitoring program for the Camden Haven, Hastings, Macleay, Kalang, Bellinger, and Clarence catchments, and Tweed conducted its own assessment of fish condition for its coastal estuaries.

Results of the monitoring indicate that 'nativeness' (the number of native fish versus introduced or pest fish) is generally high, with pest species showing relatively little impact in the region (see section 2.5.2 for invasive species information). 'Expectedness' (the number and type of species expected to occur in a river) was variable, with the highland areas having the poorest expectedness across all river systems. So, although the fish found in the highland areas were native, there were far fewer species than expected. Best species occurrence or expectedness was found in the Clarence River (alpine and coastal plains regions), with good expectedness for the coastal plain for all other river systems. Recruitment (the number of fish determined to be smaller than an adult of its species) was generally poor across all rivers systems except in the slopes, where a score of 'fair' was achieved, however the alpine region scored 'very poor '(see figure 25; Butler et al 2009, 2012, 2014, 2015). The low recruitment may have been related to the very wet years due to the La Niña conditions during sampling for the 2019-12 period, and repeat surveys will determine the true recruitment pattern in the North Coast region (Butler et al. 2012).

Generally, the coastal regions have better fish condition than the tablelands and highlands. Pest species impacts are low, but in some areas there are fewer species in our rivers than expected, and fewer juveniles across most of the region.

The specific assessment of fish condition conducted as part of the Ecohealth assessments are incorporated into the above results, with more detailed information provided here.

Fish condition in the Bellinger and Kalang rivers was assessed across 18 sites in 2009–10. Results indicated that fish communities in the freshwater reaches were good in the coastal plain, moderate in the lowlands, and poor in the slopes, upland and highland zones (Gilligan 2010). Only one introduced species was found (eastern mosquito fish Gambusia holbrooki), however, the number of native species was below expected levels with only 18 of 24 species found, and the 18 found were at fewer locations than expected indicating the number of fish species occurring in these rivers is poor (Butler et al 2009).

Fish condition was also assessed in the Tweed, where 18 native species and two introduced species were found, however, the two introduced species made up 26% of the total catch. Two expected species were not found: olive perchlet and ornate rainbowfish. This indicates the Tweed system is moderately impacted by introduced species, and although most expected native species were found, their distribution was patchy. Duroby Creek was the poorest performing system (IWC 2009).

Fish condition assessed for the Clarence system in 2013 found 32 species of fish were caught across all sites in the Clarence Basin, including 24 of the 30 expected native freshwater species, three estuarine species, and five exotic species. The Expectedness Indicator value for 49 of the 50 sites sampled across was either "Good" or "Excellent", with the remaining site rated as "Moderate". For Nativeness, 46 sites scored an "Excellent" rating, three a "Good" rating and only one a "Very Poor", reflecting the relatively low occurrence of exotic species in samples. Of the exotic species, eastern mosquitofish (Gambusia holbrooki) and goldfish (Carassius auratus) were the most abundant, while rainbow trout (Oncorhynchus mykiss), brown trout (Salmo trutta) and silver perch (Bidyanus bidyanus) were recorded at one site each and only in low numbers. The high Expectedness and Nativeness scores for most sites suggest that the overall structure of the fish community in the Clarence Basin has changed little since European settlement. In contrast, the Recruitment Indicator values were lower, with the Coastal Plains, Lowlands, Slopes and Highlands scoring a "Moderate" rating, and the Midland and Upland zones scoring a "Poor" rating. The low recruitment values may simply reflect natural spatio-temporal variation in fish recruitment in dynamic coastal freshwater systems like the Clarence. The weighted average scores for the Basin as a whole were 87.8 ("Excellent") for Expectedness, 96.1 ("Excellent") for Nativeness and 44 ("Moderate") for Recruitment. The weighted average Fish Condition for the Basin as a whole was 69.1 ("Good") (Butler et al 2014).

For the Hastings and Camden Haven Rivers, twenty species of fish were sampled, including 17 of the 24 native freshwater fish that were expected to be present, two alien species and a single estuarine/marine vagrant species. The Expectedness Indicator values were either “Excellent” or “Good” for the coastal plains, lowland and midland altitude zones. Sites in the slopes and upland zones scored either “Poor” or “Very poor” for Expectedness. All sites across all altitude zones scored an “Excellent” rating for Nativeness, reflecting the low abundance of introduced species. Only the introduced eastern mosquitofish (Gambusia holbrooki) and rainbow trout (Oncorhynchus mykiss) were caught, and both species were in low abundance. The relatively high Expectedness and Nativeness scores for most sites suggest that the overall structure of the fish community in the Hastings Basin has changed little since European settlement. Recruitment Indicator values were relatively low across all catchment zones, with all sites scoring either a “Poor” or “Very Poor” rating. While the Recruitment scores were generally low for most sites, these results may in part be due to flooding that occurred in the year prior to sampling, and also in some cases possibly related to the breeding strategy of particular species. The weighted average score for Fish Condition across the entire catchment area was 38.6 (Confidence Interval (95%): 36.4 – 39.4) giving the Hastings Basin fish community an overall rating of “Poor” (Butler et al 2012).

In the Macleay River in 2014-15, 24 species of fish were caught across all sites, including 18 of the ‘expected’ 25 native freshwater species, three estuarine species, and two alien species. The Expectedness Indicator value for the majority of sites sampled was either “Good” or “Excellent” However, four sites rated as only “Moderate” and the Oaky Power Station site scored a rating of “Poor”. In general Nativeness was high at most sites, with 15 scoring a rating of “Excellent”, eight a “Good” and three a “Moderate”. However, the alien eastern mosquitofish was by far the most abundant of any the species sampled and it was also one of the more widespread having been caught in all altitudes except in the Upland Zone and at 16 of the 27 sites sampled. The high Expectedness and Nativeness scores suggest that the overall structure of the fish community in the Macleay Basin has changed little since European settlement; particularly in the lower altitude reaches of the system.

In general, the Recruitment Indicator values were considerably lower than the other indices; “Moderate” in the Coastal Plains, Lowlands, Midlands and Slopes zones, and “Very Poor” in the Upland and Highland zones. The Overall Fish Condition score was 48.8, giving the Macleay Basin fish community an overall rating of “Moderate” (Butler et al 2015).

The main threats to nativeness are from the invasive species found in the region. Currently, the main invasive species found across the region are carp and Eastern gambusia (Mosquitofish). In the Tweed LGA, Pearl Cichlid is an issue, and Mozambique Tilapia found in 2014. In Lismore LGA, Redclaw crayfish has been found in Emigrant Creek Dam. Banded grunter was found in the Clarence system in the 1990s but has not been found since. The Pacific oyster is the only marine species in the region considered invasive (DPI 2016).

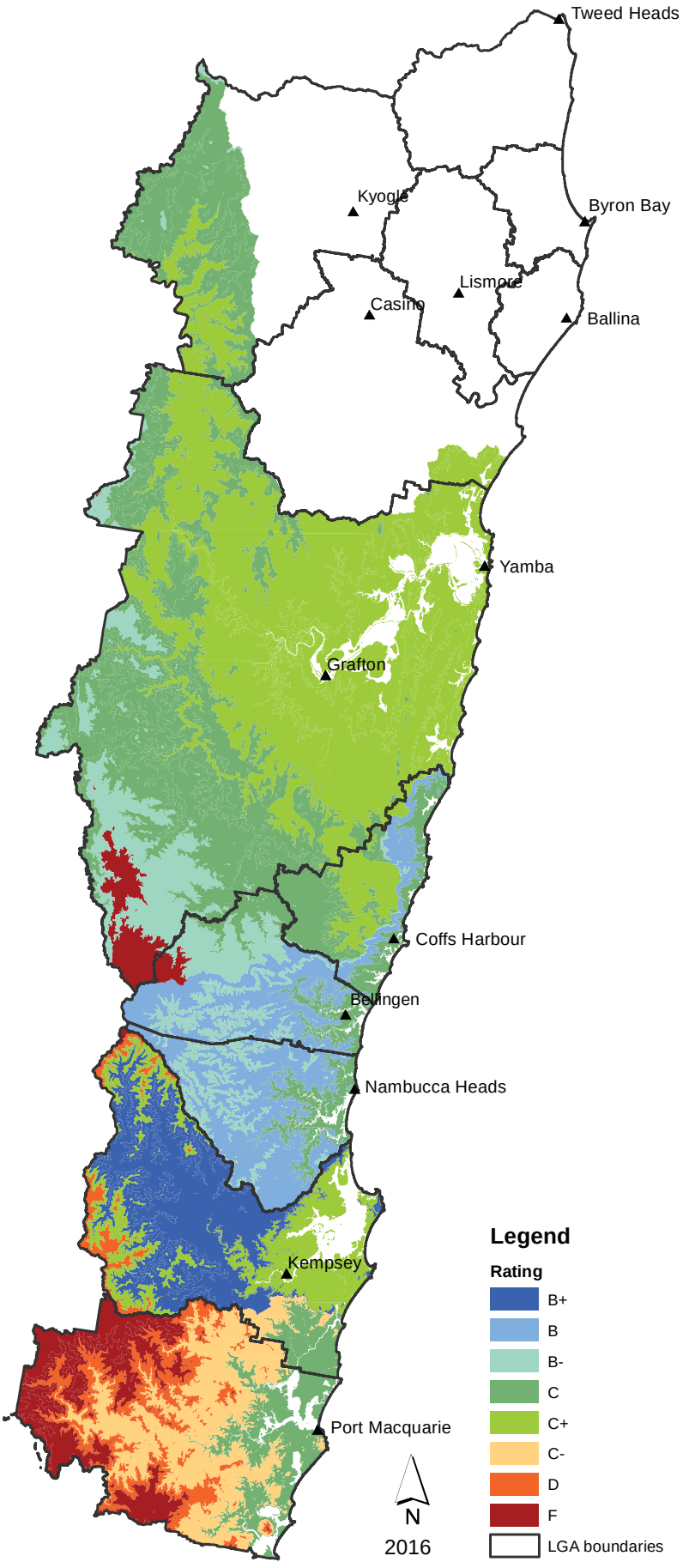


Figure 43: Fish condition in the region assessed by the Ecohealth program

4.1.5 Riparian vegetation

Riparian vegetation (i.e. vegetation lining rivers, creeks and estuaries) provides important ecosystem functions, such as reducing pollutants and sediment entering waterways, providing connected habitat for fauna, and stabilising river banks. Riparian vegetation in good condition influences biodiversity and system productivity.

Riparian vegetation condition is used as an indicator of river and estuary health. The Ecohealth program includes riparian assessment, however, there is little comprehensive data available for the North Coast region. Regionally, urbanisation and agriculture have impacted riparian vegetation, as vegetation is frequently removed or modified to provide stream access for people and livestock. Weeds are another major issue for riparian vegetation condition due to their impact on biodiversity (Davies & Boulton 2009).

The biological importance of riparian vegetation makes it a high priority for assessment and restoration, and degradation of riparian vegetation has been listed as a key threatening process.

The NSW MER Strategy assessed riparian vegetation condition as part of its estuary condition monitoring program in 2010 to 2012. There has been no new information since the 2012 RSoE report, so the information is repeated here. Table 21 shows all assessed estuaries from north to south, and the percent of riparian vegetation disturbed. Results indicate that in many locations, 65 to 82% of riparian vegetation has been disturbed (Tweed, Macleay, Richmond, Clarence, Nambucca and Bellinger Rivers, Woolgoolga Lake, and Coffs Creek). Other locations including Salty Lagoon, Jerusalem Creek, Lake Arragan, Sandon River, Station Creek and Goolawah Lagoon have less than 1% disturbance, indicating these estuaries have maintained the important ecological functions of intact riparian vegetation, which include filtering runoff and improving water quality; protecting against bank erosion from wind, currents or boat wakes and providing a food source and habitat for estuarine-dependent fauna including mammals, reptiles and birds (Roper et al. 2011).

Riparian vegetation has also been assessed as part of the comprehensive ecosystem health assessments, and some councils have conducted comprehensive vegetation mapping which has identified and classified riparian vegetation.

Ballina LGA mapping of riparian vegetation condition indicates that 42% remains highly vegetated, 15% has medium vegetation cover, 22% has no vegetation cover, and the remaining 21% was classified as low density vegetation or modified for horticulture (Moore 2003).

Clarence Valley LGA has also mapped riparian vegetation and prepared a riparian action strategy. Results of the mapping outside the floodplain region of the Clarence River indicates that approximately 85% of mapped riparian vegetation is in good condition, 13% is in moderate condition and 1.3% is degraded. Riparian vegetation condition within the floodplain area is less positive, with only 2% of riparian vegetation in good condition, 97.5% in moderate condition and 0.5% in poor condition.

Photo: N Cotsell

Table 21: Riparian condition in estuaries and coastal lakes in the region 2011 (source: OEH)

Estuary or lake (north to south)	% disturbed riparian vegetation	Estuary or lake (north to south)	% disturbed riparian vegetation
Tweed River	81.8	Flat Top Point Creek	20.8
Cudgen Creek	48	Hearns Lake	31.1
Cudgera Creek	44.2	Moonee Creek	39.9
Mooball Creek	64.4	Pine Brush Creek	73.7
Brunswick River	56.1	Coffs Creek	66.3
Belongil Creek	46.7	Boambee Creek	35.8
Tallow Creek	40.5	Bonville Creek	40.5
Broken Head Creek	0.1	Bundageree Creek	5
Richmond River	74.9	Bellinger River	68.2
Salty Lagoon	0	Dalhousie Creek	17.5
Evans River	21.8	Oyster Creek	16.8
Jerusalem Creek	0	Deep Creek	50.3
Clarence River	67.6	Nambucca River	65.7
Lake Arragan	0	Macleay River	75.5
Cakora Lagoon	11.2	South West Rocks Creek	40.4
Sandon River	0.5	Saltwater Creek	12.6
Wooli Wooli River	4.8	Korogoro Creek	26.9
Station Creek	0	Killick Creek	24.5
Corindi River	16.8	Goolawah Lagoon	1.4
Pipe Clay Creek	20	Hastings River	55.8
Arrawarra Creek	30.4	Cathie Creek	9.1
Darkum Creek	50.9	Duchess Gully	22.1
Woolgoolga Lake	70.1	Camden Haven River	41.9

4.1.6 Waste water treatment plant and onsite sewage management system performance

INDICATOR: Waste water treatment plant (WWTP) and on-site sewage management system (OSMS) performance (PRESSURE and RESPONSE)
DATA: Councils
DATA QUALITY: High
TREND: Improving compliance / Decreasing impact

Nutrient inputs into rivers and estuaries can severely impact river health and can also impact human health. In April 2006 the Bellinger River was closed to oyster harvesting by the NSW Food Authority, and the Kalang River remains closed due to poor water quality, suspected to be due on-site sewage management systems (OSMS - such as septics) too close to the river and water table. However, the sewering of low-lying areas of the Bellingen LGA has improved water quality to the extent that testing is currently underway to determine if the Kalang River can re-open to oyster cultivation (Nambucca Guardian 2016).

As waste water treatment plants (WWTP) and on-site sewage management systems (OSMS) such as septics and composting toilets, are a primary source of contaminants, it is essential that they are functioning adequately. This will ensure a healthy river and estuary that is safe for aquatic biodiversity, water supply, swimming, fishing and oyster production. Many WWTPs discharge treated effluent into rivers and estuaries, so any malfunctions in operations can immediately impact water quality. Some OSMS are inappropriately located (e.g. too close to rivers and estuaries) and are known to impact water quality. With two marine parks and one aquatic reserve in the region, the minimisation of contaminants and pollutants entering estuaries and the ocean is imperative. The current functioning of WWTPs and OSMS by LGA is detailed in this section.

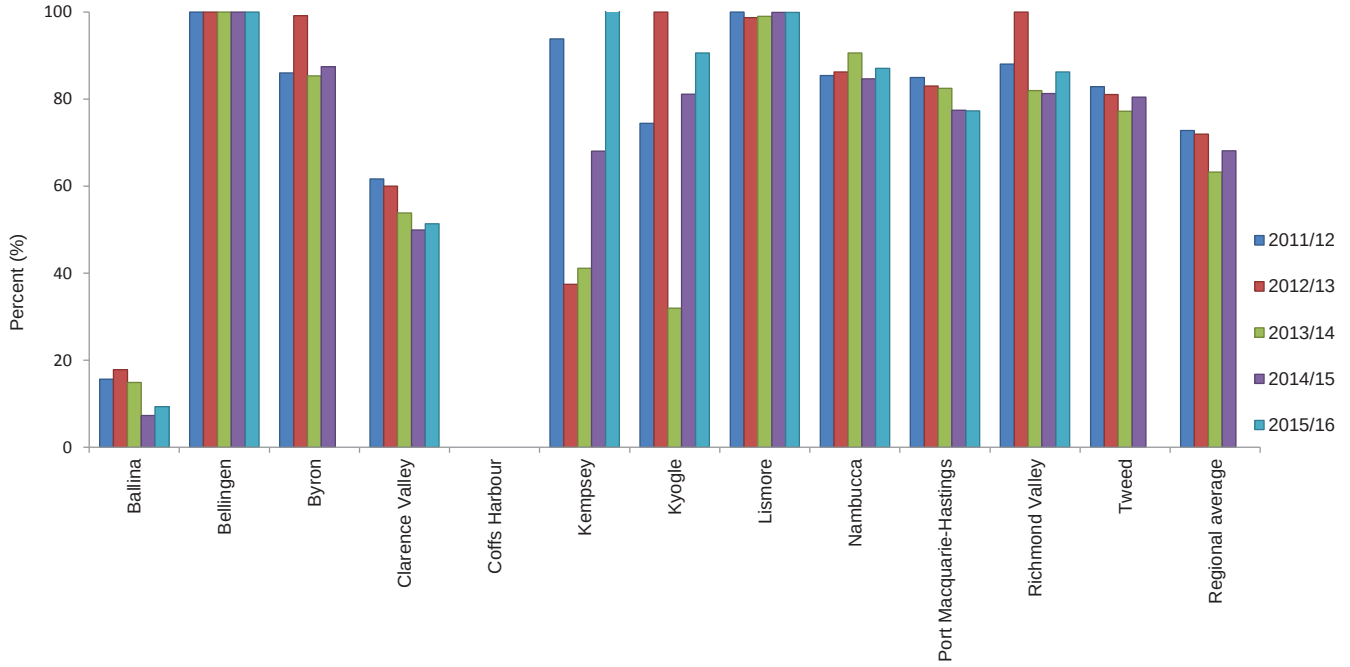
Waste water treatment plant performance

All LGAs in the reporting region manage more than one WWTP. They are all licensed by the Environment Protection Authority (EPA) and must supply regular information on any breaches or nutrient exceedences that occur. All WWTPs have strict water quality monitoring to rapidly identify breaches. Figures 44 and 45 show the percentage of treated waste water discharged to waterways by LGA and the percentage of waste water reused. In 2015, 68% of waste water was discharged to waterways, 20% to the ocean, 4% to land, and 8% was recycled.

Figure 46 shows the percentage of waste water discharged by location in 2015.

The data indicates that there is a slight reduction in waterway discharge and increase in waste water reuse across the region since 2012. Waste water reuse is highest in Kyogle LGA at 18.9% of all waste water treated in 2015, followed by Richmond Valley at 18.7%, Coffs Harbour LGA at 13.8% and Byron at 12.6%. The highest levels of reuse in the region were in 2013/14, which had slightly lower than average rainfall.

Ten of the twelve LGAs in the region are now composting biosolids, resulting in approximately 25,000 tonnes of biosolids waste diverted from landfill annually.



Note: Coffs Harbour City Council discharges to ocean outfalls, not to waterways

Figure 44: Percentage of waste water discharged to waterways by LGA

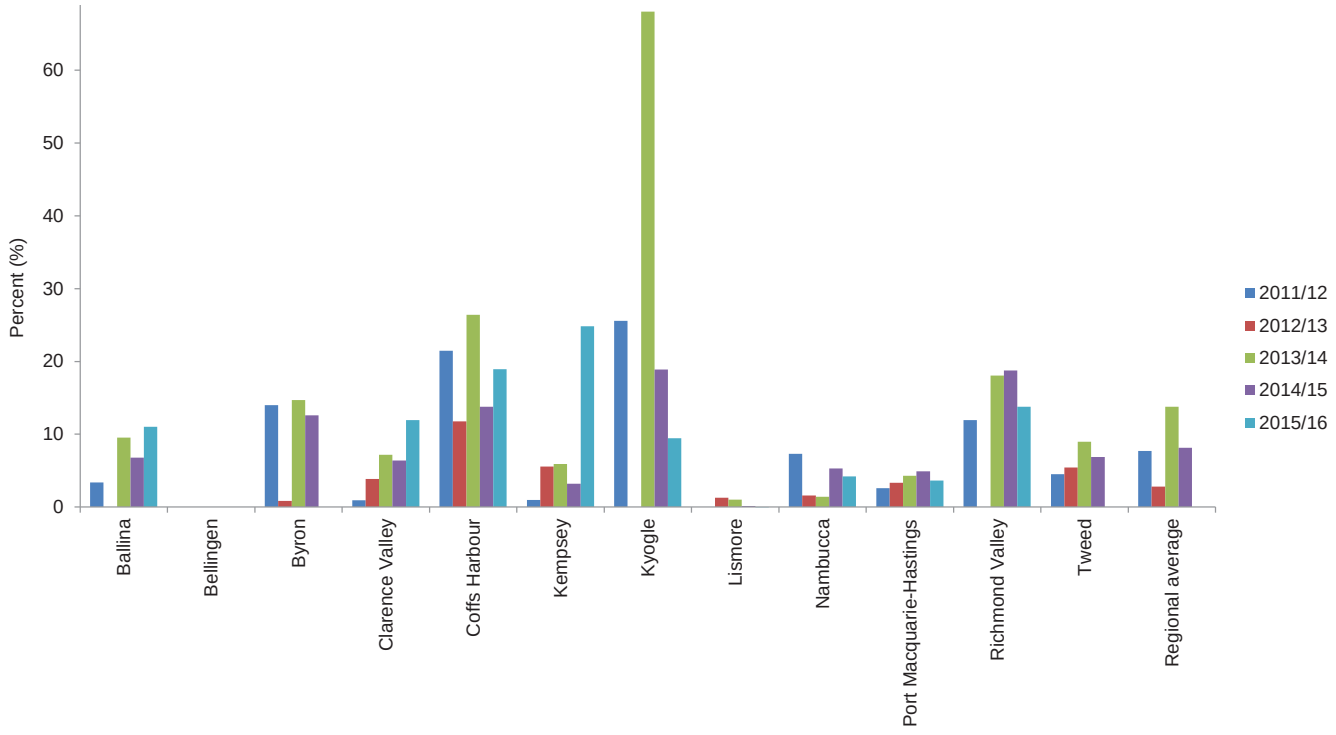


Figure 45: Percentage of waste water reused by LGA

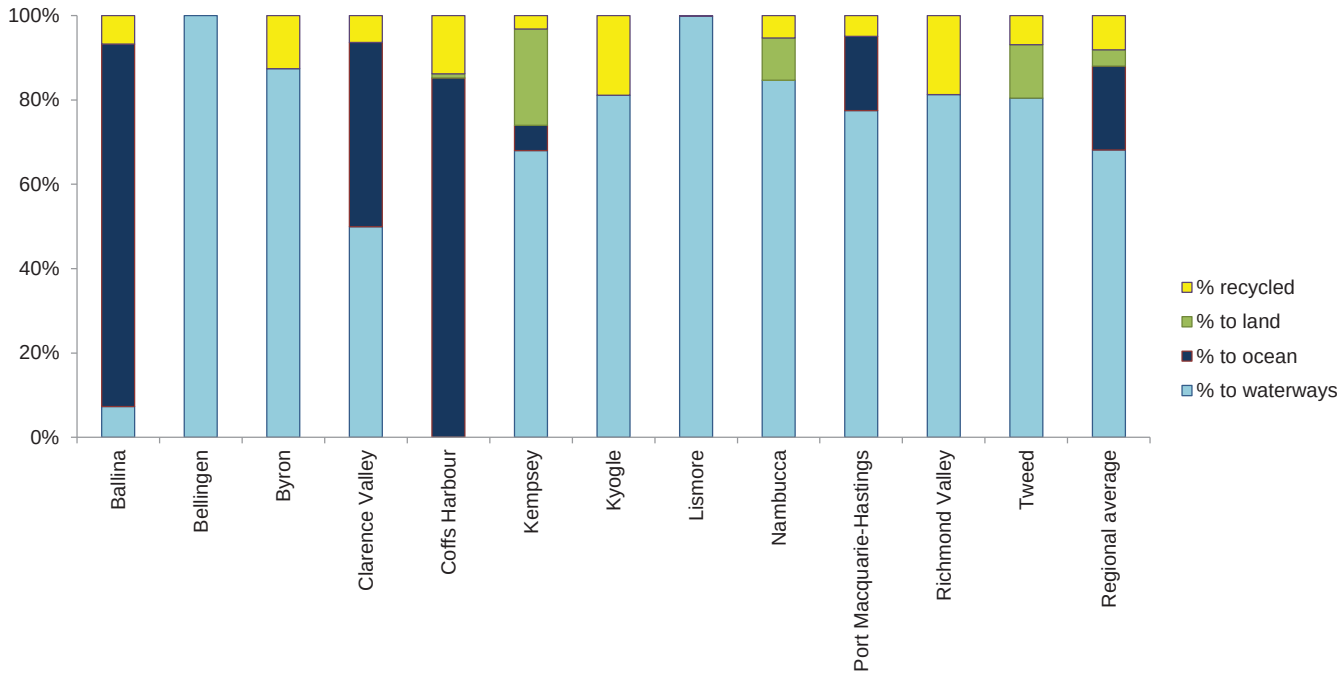


Figure 46: Percentage of waste water discharged by location in 2016

The majority of treated waste water - 68% - is discharged to waterways. This waste water can be a significant contributor to flows but can also contribute nutrient loads particularly in low or medium flow times (ABER 2012). If not treated to the highest level, these nutrients may contribute to high levels of phytoplankton (algal blooms). In the region, 15% of waste water discharged to waterways only receives secondary or advanced secondary level waste water treatment, which does not remove nutrients in processing.

These tend to be smaller inland WWTPs which may contribute to nutrient loads downstream. However the majority of waste water discharged to waterways in the region is treated to a tertiary (52%) or advanced tertiary level (33%), minimising the impact of waste water on nutrient levels. Figure 47 shows percentage waste water treated by level for 2015 in the region.

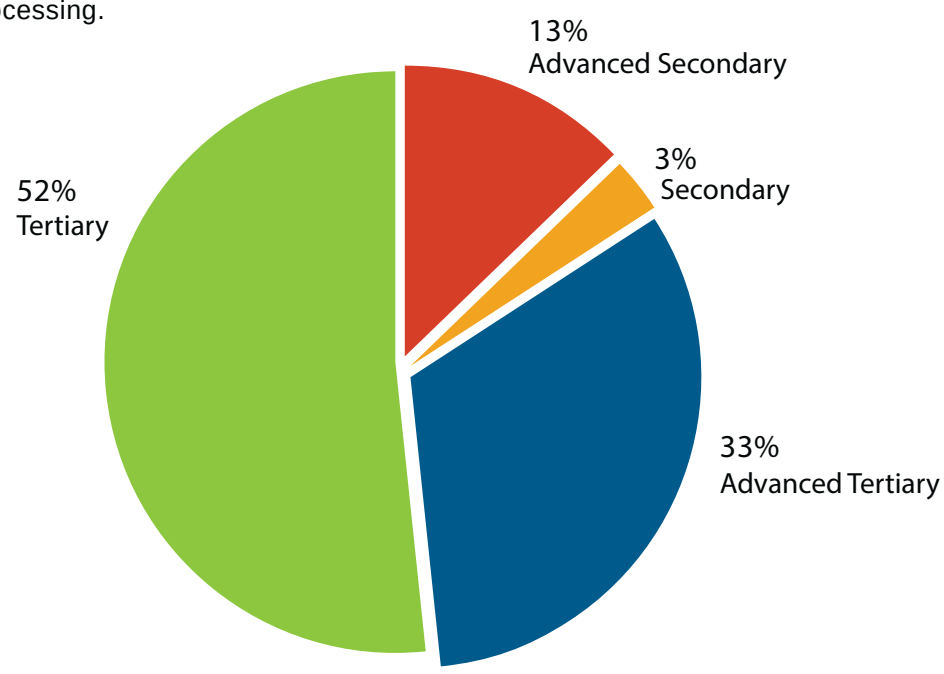


Figure 47: Treatment level for waste water discharged to waterways

On-site sewage management system performance

On-site sewage management systems (OSMS) include septics, aerated waste water treatment systems, reed beds, greywater systems and composting toilets. Many systems are old and do not function adequately. When situated too close to waterways, OSMS can release contaminants into the water and impact river and human health, as well as groundwater health.

The status of OSMS in the reporting region is detailed in Table 22 and Figure 48. The results indicate that for most LGAs, the failure rate of inspected OSMS is between 38% and 99%. An additional concern is the high estimated number of unregistered or illegal systems in place which are not monitored. At this point the impact of OSMS on waterways cannot be fully considered as we have neither the water quality data nor the OSMS location data to quantify the risks and impacts, although this information is being gathered. In years of high rainfall, there tend to be increased failure rates for OSMS as waterlogged ground results in issues such as non-functioning absorption trenches. Conversely, drier years have higher compliance rates.

Table 22: OSMS compliance rates by year and LGA

LGA	2011/12	2012/13	2013/14	2014/15	2015/16
Ballina	74	84.5	96.8	88.8	95.5
Bellingen	85.8	97.9	98.6	97.7	97.7
Byron	62		67	67	38
Clarence Valley	85.1	89.8	81.7	81.2	87.8
Coffs Harbour	59.3	89.9	63.6	90.1	93.7
Kempsey	75.6	72.6	70.7	69	77.6
Kyogle	85.1	83.3	89.4	87.9	86.7
Lismore	63	87	68	66	89.4
Nambucca	95.9	92.1	94.4	93.5	93.4
Port Macquarie-Hastings	96	94.9	99.4	98.8	98.8
Richmond Valley	63	96.5	77.9	81	58
Tweed	94.4	91.2	93.4	92	88.1
Regional average	78.3	89.1	83.4	84.4	91.3

To improve compliance levels for OSMS the majority of councils in the region have mapped known OSMS locations, developed inspection databases, identified high-risk systems, and have an inspection program based on assigned risk level, with high-risk systems inspected annually, medium risk systems every 3 years, and low risk ones every five or seven years. This risk-based management has resulted in the now very high level of compliance within many LGAs.

One issue currently for some LGAs is a lack of funding to increase the number of OSMS inspections and to adequately document and map high risk systems. With the location of so many OSMS unknown, and high levels of unapproved systems in some areas, a comprehensive mapping and documentation system is required to allow identification of high risk systems and an adequate inspection program which will minimise risk of aquatic contamination.

Some councils are recommending alternative systems to the traditional septic, such as aerated waste water treatment systems and composting toilets, which are better suited to certain soil types and reduce impacts. Many councils are also connecting houses in growing urban areas to the sewer, which will lead to a reduction in issues associated with OSMS and ideally improve water quality locally. Clarence Valley Council connected the coastal town of Iluka to the sewer in 2012, reducing the impact of septics on the sensitive marine and estuarine environment which is within national and marine park.

The sewering of part of the Bellingen LGA has had very positive water quality outcomes (Nambucca Guardian 2016), and in the Tweed Shire, the connection of Uki to the sewer resulted in reduced nutrient loads on the adjacent waterway (Hydrosphere Consulting 2015) .

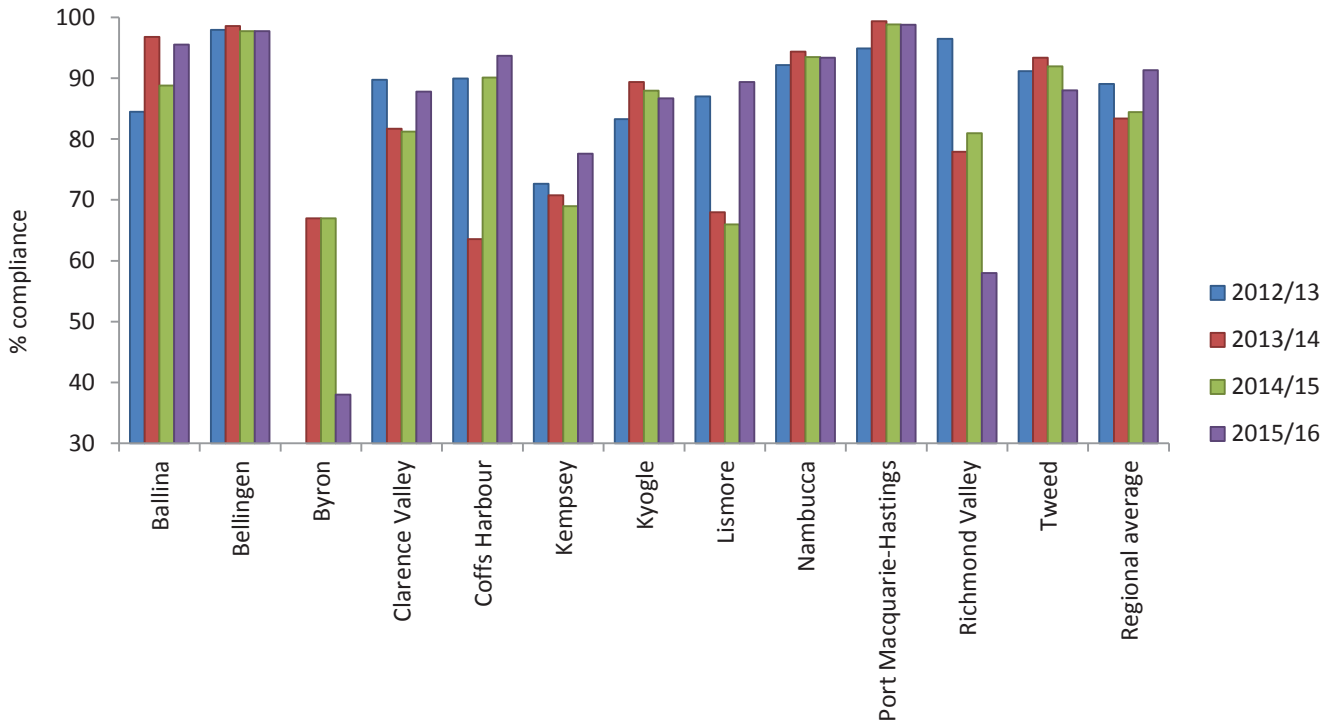


Figure 48: Percent compliance annually for inspected on-site sewage management systems

Photo: Orara River by L Foster

4.1.7 River restoration works and riparian vegetation restoration

INDICATORS: River rehabilitation works (RESPONSE)
Length of riparian vegetation restoration and recovery (RESPONSE)
DATA: Councils and North Coast Local Land Services
DATA QUALITY: Medium

Restoration of riverine and riparian habitat has great benefits for aquatic species and river health. The degradation of both aquatic habitat and riparian areas are classified as key threatening processes, and the Ecohealth reports for the North Coast catchments all stated that riparian rehabilitation works are the priority for river health (Ryder et al all years). River and riparian restoration works are conducted at state and local level, and works conducted within the reporting region are reported below in Table 23 (and Table 27 for wetlands rehabilitation) shows the dependence on grant funding for habitat restoration projects, and the large volunteer contribution. Many landholders also restore riparian vegetation on their own properties which is not reported here. Despite the degradation of streams and riparian vegetation being a key threatening process, rehabilitation of the riparian zone in all LGAs remains under resourced. The lack of condition information, as detailed previously, highlights the need for increased resourcing and research into river and riparian vegetation restoration.

Data collated indicates there is a rehabilitation focus on riparian vegetation over other habitat types. For some areas, all rehabilitation is riparian, and it appears to be a major investment area for many Councils and grant funding bodies.

Coffs Harbour City Council and Clarence Valley Council both support long-term riparian rehabilitation projects which are focused on areas upstream of urban water supply areas. The Orara River Rehabilitation Project has rehabilitated riparian vegetation for 20 years supported by Coffs Harbour City Council and supplemented by other grants from various sources. The project has the support and oversight of three local Landcare and Rivercare groups, has over 120 properties on the project, and dedicated landholders working to restore the riparian vegetation. The current good water quality in the Orara Catchment (B+) as assessed by the Ecohealth program indicates the project has contributed to improved water quality.

Table 23: Riparian rehabilitation works by LGA

LGA or County Council	Year	Area restored (ha)	Trees planted	Land type	Activity	Funding	Volunteer hours *
Ballina	2012/13	56	400	Private and public land	Weed removal and planting	Council, Landcare, LLS, Environmental Trust, OEH, Community Groups	500
	2013/14	54	1,200				840
	2014/15	77	0		Weeding and regeneration		350
	2015/16	5	100	Public	Weed removal and planting	Community group	200
Bellingen	2012/13	11	6,400	Private and public land	Weed removal and planting	Council, Landcare, LLS, Environmental Trust, OEH, Community Groups	530
	2013/14	12	3,322				100
	2014/15	21	370				100
	2015/16	5	6,883				-
Byron	2012/13	20	850	Private and public land	Weed removal and planting	Council, Landcare, NSW Enviromental Trust	many
	2013/14	61	17,000			Council, Landcare, NSW Enviromental Trust, Federal Clean Energy Fund, Koala Connections	5,000
	2014/15	32	13,500			Landcare, landholders, Council	3,500
	2015/16	-	-			-	-

Table 23: Riparian rehabilitation cont.

LGA or County Council	Year	Area restored (ha)	Trees planted	Land type	Activity	Funding	Volunteer hours *
Clarence Valley	2012/13	20	-	Private and public land	Weed removal and planting	Council, LLS, Biodiversity Fund, Landholders	100
	2013/14	20	3,500				100
	2014/15	20	5,500				100
	2015/16	-	-	-	-	-	-
Coffs Harbour	2012/13	620	6,650	Private and public land	Weed removal and planting	Council, LLS, Environmental Trust, DPI, Landcare	10,000
	2013/14	1,011	13,000				10,000
	2014/15	1,667	7,430				-
	2015/16	1,210	5,900				-
Kempsey	2012/13	26	21,295	Private and public land	Weed removal and planting	Council, Landcare, Community groups, Biodiversity Fund	500
	2013/14	7	8,500	Public land		Council, Biodiversity Fund, Landcare	100
	2014/15	3	8,700			Council, Biodiversity Fund	-
	2015/16	-	-	-	-	-	-
Kyogle		Nil riparian					
Lismore	2012/13	3.4	-	Public land	Regeneration	Council	-
	2013/14	3.4	-				-
	2014/15	3.4	-				-
	2015/16	3.4	-				-
Nambucca	2015/16	7	-	Public land	Bank stabilisation, weed control, regeneration	Council, DPI, OEH	-
Port Macquarie-Hastings		Included with general rehabilitation in section 2.2					
Richmond Valley	2012/13	5	-	Public	Weed control	Council	-
	2013/14	5	-		Weed control	Council	-
	2014/15	5	3,500		Planting and weed control	Council	200
	2015/16	5	-		Weed control	Council	-
Tweed	2012/13	15.7	7,130	Public and private land	Planting and weed control, education	Council, Landcare, communty groups	800
	2013/14	16	10,000		Planting and weed control		3100
	2014/15	74	8,700		Planting and weed control		8600
	2015/16	-	-	-	-	-	-
Richmond River County Council	2012/13	2	4,500	Public and private land	Planting and weed control	County Council, LLS, Community Groups, FNCW	-
	2013/14	2.5	6,000				78
	2014/15	3	20				154
	2015/16	2	5,500				26

4.1.8 Stormwater improvement works and water sensitive urban design (WSUD)

INDICATOR: Stormwater improvement works and WSUD plans (RESPONSE)
DATA: Councils
DATA QUALITY: High
TREND: Increasing management of stormwater

Stormwater is a diffuse source of pollutants entering rivers and estuaries. Stormwater includes run-off after heavy rains, and often contains soil sediments, nutrients from fertilisers and manure, oil and grease, rubbish, and on occasion, sewage. This large pollution load can have a significant impact on water quality in our waterways and on our beaches. To better manage stormwater and reduce impacts, councils have developed and implemented water sensitive urban design (WSUD) plans. These plans provide specific guidance for urban settings on the methods required to reduce pollutants and sediments entering waterways, for example, through use of vegetated buffers, stormwater reuse, stormwater retention and evaporation, and stormwater treatment systems. The aim is not only to reduce pollutant loads, but also to reduce the traditional use of pipes and waterway modifications to dispose of stormwater.

Table 24 details what policies and plans are in place for the councils in the reporting region to better manage stormwater. Information received from councils indicates that 8 of the 12 councils in the reporting region have dedicated stormwater management plans for their areas, and some have no specific stormwater provisions.

Table 24: Stormwater management plans and WSUD policies by LGA

LGA	Stormwater plans in place
Ballina	Urban Stormwater Management Plan 2012; stormwater quality improvement devices (SQIDs) plan; specific location plans
Bellingen	Stormwater Management Plan and Water Quality Urban Design (WSUD)
Byron	Adopted engineering specification (Northern Rivers Local Government Handbook of Stormwater Drainage Design) advising WSUD components to be designed to Brisbane City Council standards
Clarence Valley	No specific plans; Integrated Water Cycle Strategy
Coffs Harbour	Coffs Harbour City Council Water Sensitive Urban Design (WSUD) Policy'
Kempsey	Location-specific stormwater improvement projects
Kyogle	Kyogle Council Urban Stormwater Management Strategy 2002 and a WSUD policy
Lismore	Urban stormwater management plan 2007 and WSUD Development control plan
Nambucca	Included in 2010 LEP
Port Macquarie-Hastings	'Hastings Urban Stormwater Management Plan' 2000 (LGA wide)
Richmond Valley	WSUD policy
Tweed	Tweed urban stormwater quality management plan 2012, Tweed development control plan section 5A – subdivision manual section 7D - stormwater quality

Table 25 shows the annual works required for the maintenance and construction of stormwater infrastructure, which is why WSUD policies put the onus on property developers to implement WSUD in their developments, and why council rates often include a stormwater levy.

The maintenance of good riparian vegetation along waterways and community education also play a large role in reducing the impacts of stormwater.

Table 25: Key stormwater works by LGA

Local Government Area	Improvement works for 2012-16
Ballina	Emptying of gross pollutant traps
	Restoration of Chikiba wetlands for stormwater drainage
	Ongoing stormwater quality improvement program
Bellingen	Stormwater sediment basin
	Multiple stormwater treatment swales
	Sub-surface stormwater infrastructure
Byron	Gross pollutant and sediment traps
	Bangalow constructed wetlands for stormwater retention
	Open vegetated swales
Clarence Valley	Improvement works near estuaries and wetlands
	Gross pollutant trap maintenance
	Drainage improvements
Coffs Harbour	Bioretention basins
	Stormwater treatment for new developments
	Stormwater reuse storage
	Vegetated swales
Kempsey	New drainage works for west Kempsey
	Gross pollutant trap maintencen
Kyogle	Numerous vegetated swales
	Wetland for stormwater retention
Lismore	Vegetated swales
	Gross pollutant trap maintenance
	Constructed wetlands
	Biofiltration raingardens
Nambucca	Gross pollutant trap maintenance
Port Macquarie-Hastings	Flood easement works in multiple locations
	Open drain construction and maintenance
	Upgrading infrastructure for new roads
Richmond Valley	Filtration garden
	Maintenance of existing drainage
Tweed	Gross pollutant trap maintenance
	Upgrades of existing infrastructure

Table 25 shows that many councils are incorporating a range of WSUD principles into their works. Almost all councils have gross pollutant traps to capture solid waste and debris, which is then collected and put into the waste stream, although nutrients and pollutants are discharged. Developments in many areas are required to have stormwater detention areas to prevent the discharge of pollutants and nutrients into waterways, and some must filter stormwater prior to discharge to remove nutrients. Councils are also constructing large scale detention basins to deal with stormwater from large rain events. Use of vegetated swales rather than kerb and guttering helps reduce stormwater impacts.

The range of measures councils are taking to reduce the impact of stormwater is broad and commendable. Port Macquarie Hastings Council collects approximately 60 tonnes of waste annually from its gross pollutant traps, with most other councils doing the same; Coffs Harbour City Council has incorporated WSUD into approximately 10 development approvals annually including requirements for bioretention basins, filtration of stormwater, and gross pollutant traps. Ballina Shire Council is actively improving stormwater management near wetlands to restore more natural water levels and reduce pollutant loads; and most councils are improving drainage in urban areas to reduce flooding and retain stormwater, preventing pollutants from entering waterways.

It is hoped these ongoing improvements to stormwater management in conjunction with improved riparian vegetation will translate to improved water quality for our waterways.

Photo: Byron Shire Council

4.2 Wetlands

INDICATORS:	Wetland condition (CONDITION) WETLAND PRESSURE (PRESSURE)		
DATA SOURCE:	OEH	DATA QUALITY:	Low
INDICATOR:	Wetland remediation (RESPONSE)		
DATA SOURCE:	Councils	DATA QUALITY:	Medium
TREND:	UNKNOWN		

Wetlands are biologically important. They support a range of ecosystem functions including providing habitats, breeding grounds and nurseries for waterbirds, frogs, fish, invertebrates and plants; and supporting threatened species and endangered ecological communities.

Many migratory birds travel vast distances to visit our wetlands (DECCW 2010b). Wetlands are significantly impacted by changes to water availability, and environmental flows are provided for now in the North Coast region of NSW since the implementation of the majority of the water sharing plans for the region by DPI Water in July 2016.

Despite the important ecosystem services provided by wetlands, there is very little information on the location, type or condition of wetlands in the North Coast region. At a state level, only 9 wetlands were assessed in the region as part of State of the Catchments 2010, and most of those had little supporting data (see Table 26). There has been no new information gathered since 2010 on those wetlands, although Everlasting Swamp in Clarence Valley is now within a new National Park created in 2014. Various studies have been conducted to accurately map the wetlands of the region, but all have significant inaccuracies and do not describe wetland condition.

To rectify this, some councils have conducted their own mapping of wetlands, however, no condition information is available. This indicates a continuing severe gap in data for wetlands across the North Coast region.

As no new information on wetland condition has been gathered since the previous report, the same information is repeated here. The condition of and pressures on the 9 assessed wetlands from 2010 are summarised in Table 26. Catchment disturbance includes urbanisation, agriculture, vegetation removal, infrastructure and fire. Hydrological disturbance involves nutrients entering the wetland, water and soils quality, vegetation patterns, the biota (flora and fauna) present, alteration of the wetland's structure and the wetland's productivity. Habitat disturbance includes any activity that modifies or removes a wetland such as agriculture, urbanisation etc.

For condition, biological indicators are presence, abundance and health of wetland flora and fauna. Pest species measures the ratio of native to introduced species. Water quality measures pH, salinity and turbidity. Soil quality measures soil pH, salinity, moisture, erosion and modifications.

Photo: Clarence Valley Council

Table 26: Wetland pressure and condition in the North Coast Region (source: OEH)

Wetland	Type	Overall Pressure	Overall Condition	Pressure			Condition			
				Catchment	Hydrological	Habitat	Biota	Biota - Pests	Water Quality	Soil Quality
Belmore Swamp/ Swan Pool (Kempsey)	Coastal floodplain swamp	4	5	3	4	4	nd	5	nd	nd
Bundjalung National Park Swamps (Clarence Valley)	Coastal dune swamp	4	5	2	1	4	nd	5	nd	nd
Bunyip Swamp (Clarence Valley)	Coastal floodplain swamp	4	2	4	1	4	nd	nd	nd	nd
Cowans Pond (Clarence Valley)	Coastal freshwater lake	4	5	4	1	4	nd	5	nd	nd
Everlasting Swamp (Clarence Valley)	Coastal floodplain swamp	4	5	4	3	4	nd	5	nd	nd
Lake Hiawatha and Minnie Waters (Clarence Valley)	Coastal dune lake & lagoon	3	5	1	1	4	nd	5	nd	nd
Lower Bungawalbin Wetland (Richmond Valley)	Coastal floodplain swamp	4	2	4	3	4	nd	nd	nd	nd
Tuckean Swamp (Ballina-Lismore)	Coastal floodplain swamp	4	5	4	4	4	nd	5	nd	nd
Upper Coldstream (Clarence Valley)	Coastal floodplain swamp	4	5	4	3	4	nd	5	nd	nd

Rating	Pressure	Condition
1	very low	very good
2	low	good
3	moderate	fair
4	high	poor
5	very high	very poor
nd	no data	no data

The summary in Table 26 indicates overall poor condition with high pressure. In relation to pressures on wetlands, the positive is that most have not had their hydrological structure altered, however, habitat and catchment impacts are high. Some are now protected within National Park, reducing the pressures. There is little condition information available other than for pest species.

There has been some degree of wetland remediation in most LGAs in the reporting region from 2012-2016. Table 27 shows the area remediated in each LGA. The primary activity was weed removal.
Table 26: Rehabilitation works on wetlands by LGA

Table 27: Rehabilitation works on wetlands by LGA

LGA or County Council	Year	Area restored (ha)	Trees planted	Land type	Activity	Funding	Volunteer hours *
Ballina	2012/13	101	1,080	Public land	Weed control and planting	Landcare, Dunecare	1,135
	2015/16	-	-	Public land	Restoring Chikiba & North Lakes wetlands to former water levels	Council, OEH	-
Bellingen	2014/15	15	-	Public land	Urunga Lagoon restoration	Council, LLS, Biodiversity Fund	-
Byron	2012/13	44	-	Public land	Weed control	Council, LLS, Environmental Trust	-
	2013/14	104	1,300	Public land	Weed control and planting	Council, LLS, Environmental Trust	-
	2014/15	25		Public land	Weed control	Council	-
Clarence Valley	2012/13	20	-	Public and private land	Weed control	Council, Landcare, landholders, fishing clubs	-
	2013/14	20	3,321		Weed control and planting		-
	2014/15	20			Weed control		-
Nambucca	2015/16	115	-	Public and private land	Wetland management, weed control	Council, Wetland Care Aust, LLS, DPI, Landholders	-
Tweed	2012/13	157	1,555	Public and private land	Weed control, planting	Council, LLS, Environmental Trust, Landholders, Community Groups	-

4.3 Groundwater

INDICATOR:	Groundwater quality (CONDITION) Groundwater extraction (PRESSURE) Number of groundwater dependent ecosystems under water sharing plans (RESPONSE)
DATA SOURCE:	NSW Office of Water
DATA QUALITY:	Medium
TREND:	Increasing extraction pressure but increased management due to water sharing plan introduction

Groundwater is an important contributor to ecosystem functioning because in some locations it may be the only water supply for wetlands, streams and surrounding habitats. It is also an important source of water for rural areas and for some towns in the North Coast region. For example, Kempsey supplies 100% of its water from groundwater. Nambucca and Rous Water also have bores for groundwater supply.

Groundwater in NSW is now managed in conjunction with surface water under new water sharing plans which specify the sharing of the surface and ground water resource between users and the environment. The plans also recognise the connectivity of surface and ground water (DPI Water 2016). The reporting region is now covered by 9 water sharing plan regions. In 2012, only four water sharing plans were in place for the region. As of 1st July 2016, almost the entire reporting region is now under water sharing plans, apart from Port Macquarie-Hastings, which still has the water sharing plan for the Hastings Unregulated and Alluvial Water Sources water sources in draft form (see Figure 48).

In terms of monitoring, at this point there is little groundwater quality data available, and metering of groundwater extraction has not yet been introduced (it is to be phased in). However, this report includes information on the current long-term annual groundwater extraction limits by water source, number of active water sharing plans, and number of groundwater dependent ecosystems under water sharing plans.

4.3.1 Groundwater extraction and status of groundwater water sharing plans

As groundwater extraction is not yet metered (except in large urban areas) it is difficult to accurately quantify groundwater usage. Metering is gradually being introduced, but at this stage pressure reporting is based on the allocation of groundwater compared to the long-term annual average extraction limit. Table 28 shows allocation by water source and water sharing plan status as of October 2016, as well as unallocated water. Under the new water sharing plans (WSP), many of the individual groundwater sources have been grouped into a single plan, with allocations by source determined at the beginning of each financial year.

The only overallocated groundwater source identified is Alstonville Basalt Zone 1 (Alstonville to Tuckean). No other water sources in the reporting region are considered to be at risk of allocation.

Groundwater dependent ecosystems (GDE) are those that depend on groundwater sources for some or all of their functions. Some ecosystems may be specialised subterranean ones such as karsts and caves, and some may be surface wetlands.

Within the reporting region there are 1,532 known groundwater dependent ecosystems. However information on these is scarce and more may be present but not yet identified. The majority of GDEs are protected under the recently implemented water sharing plans, with others protected within National Parks. Figure 48 shows the location of GDEs in relation to the current water sharing plan regions (NSW Water). The majority of GDEs are located on the Alstonville Plateau, which is over allocated in the Alstonville – Tuckean Zone (Zone 1 in the new WSP) but is effectively capped, minimising any further impacts on GDEs. There are specific rules in place for bores to minimise interference with GDEs, and in the over allocated zones, no new bores should be granted (DPI Water 2016).

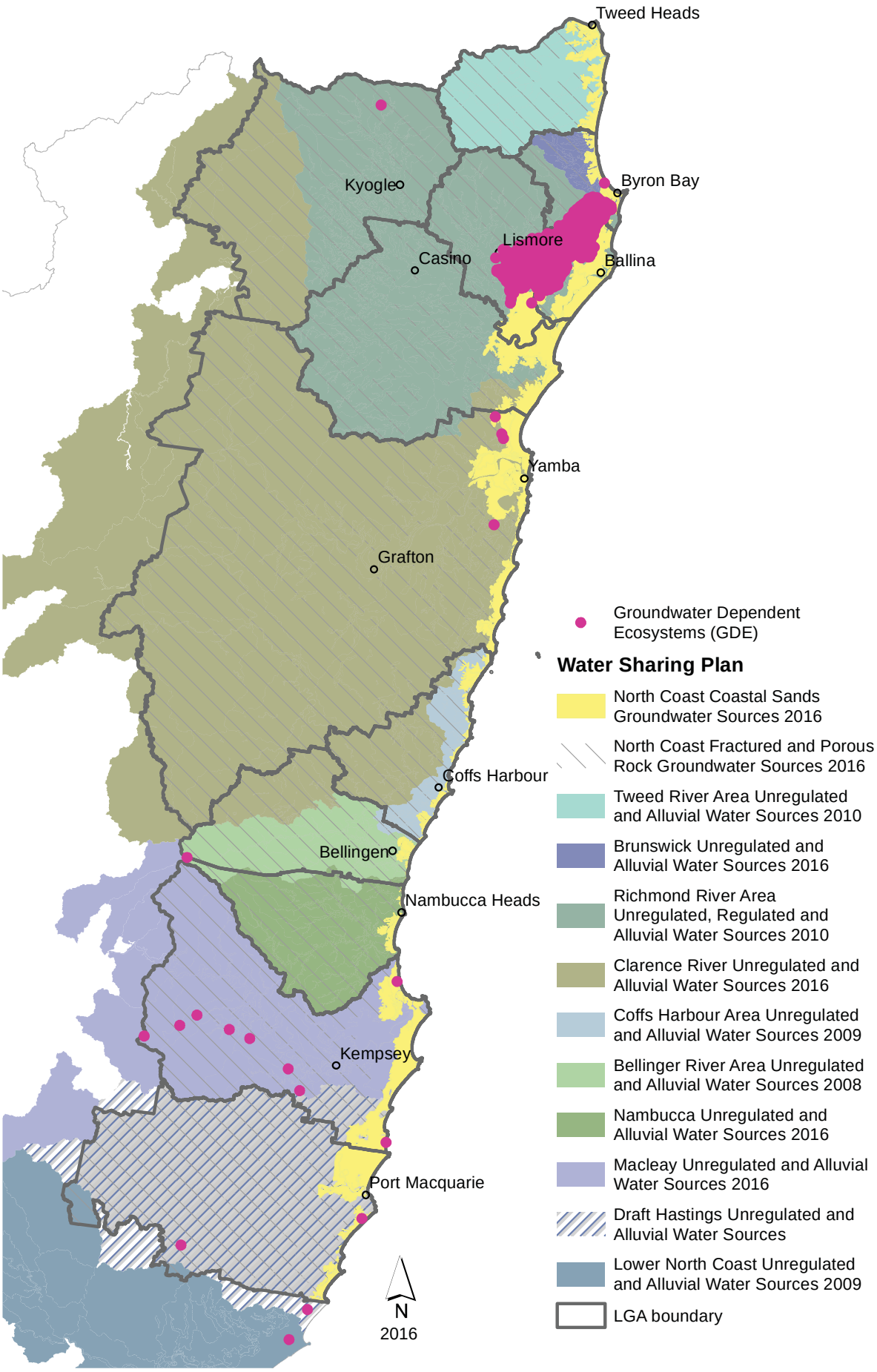


Figure 48: Water sharing plans by LGA and groundwater-dependent ecosystems (DPI Water)

Table 28: Groundwater sources, extraction limits, 2016 water sharing plan status and unassigned water (source: DPI Water)

Ground water source	Rainfall recharge (ML)	2012 Annual extraction limit (ML/yr)	Total requirements ML/yr	Risk Category ^	% allocated	2016 Annual extraction limit (ML/Y)	2016 Unassigned water	Water Sharing Plan name	Date of commencement
Alstonville Basalt — Bangalow, Zone 3	11,667	2,333	1,268	2	54.3	8895	-	North Coast Fractured and Porous Rock Groundwater	1/07/2016
Alstonville Basalt — Coopers, Zone 4	3,533	707	0	1	0				
Alstonville Basalt — Alstonville, Zone1	11,575	2,315	2,791	3	120.5				
Alstonville Basalt — Lennox, Zone 6	1,720	344	25	1	7.3				
Alstonville Basalt — Tuckean, Zone 2	12,404	2,481	3,003	3	121				
Alstonville Basalt — Wyrallah, Zone 5	3,573	715	38	1	5.3				
Bellinger Alluvium	-	-	1,300	1	-	not specified	not specified	Bellinger River Area Unregulated and Alluvial	1/07/2008
Bellinger Coastal Sands	10,358	5,180	10	1	0.2	1,175 (combined total with Nambucca Coastal Sands)	1,070 (combined total with Nambucca Coastal Sands)	North Coast Coastal Sands	1/07/2016
Brunswick Coastal Sands	45,847	12,014	352	1	2.9	19,000 (upper limit 21,750 combined with Tweed Coastal Sands)	18,287 (combined total with Tweed Coastal Sands)	North Coast Coastal Sands	1/07/2016
Brunswick River Alluvium	9,656	4,828	270	1	5.6	763	set annually	Brunswick Unregulated and Alluvial	1/07/2016
Brunswick River Fractured Rock	11,944	7,204	457	1	6.3	-	-	North Coast Fractured and Porous Rock Groundwater	1/07/2016
Clarence and Coffs Harbour Alluvium	149,459	0	4,695	1	no limit set	-	-	Clarence Unregulated and Alluvial	1/07/2016

Table 28: Groundwater sources, extraction limits, 2016 water sharing plan status and unassigned water Cont.

Ground water source	Rainfall recharge (ML)	2012 Annual extraction limit (ML/yr)	Total requirements ML/yr	Risk Category ^	% allocated	2016 Annual extraction limit (ML/Y)	2016 Unassigned water	Water Sharing Plan name	Date of commencement
Clarence Coastal Sands	77,042	24,317	45	1	0.2	4,200 (upper limit 9,550)	4,050	North Coast Coastal Sands	1/07/2016
Clarence Moreton Basin — Bellinger River	4,704	3,537	0	1	0	300,000	295,438	North Coast Fractured and Porous Rock Groundwater	1/07/2016
Clarence Moreton Basin — Brunswick River	649	488	4	1	0.8				
Clarence Moreton Basin — Clarence River	357,065	270,496	,517	1	0.6				
Clarence Moreton Basin — Richmond River	147,418	111,486	1,743	1	1.6				
Clarence Moreton Basin — Tweed River	31,187	23,800	70	1	0.3				
Clarence River Fractured Rock	20,456	13,060	320	1	2.5	-	-	North Coast Fractured and Porous Rock Groundwater	1/07/2016
Coffs Harbour Coastal Sands	20,294	5,825	123	1	2.1	3,110	2,982	North Coast Coastal Sands	1/07/2016
Coffs Harbour Metasediments	400,660	206,731	1,433	1	0.7	-	-	-	-
Comboyne Basalt	-	-	-	-	-	2,600	1,791	North Coast Fractured and Porous Rock Groundwater	1/07/2016
Dorrigo Basalt	-	5,000	131	1	2.6	5,000	4,231	North Coast Fractured and Porous Rock Groundwater	1/07/2016
Hastings Coastal Sands	77,192	48,731	1,333	1	2.7	7,100 (upper limit 17,700)	5,931	North Coast Coastal Sands	1/07/2016
Hastings River Alluvium	37,955	capped	1,757	1	capped	-	-	Draft Hastings Unregulated and Alluvial Water Sources	draft

Table 28: Groundwater sources, extraction limits, 2016 water sharing plan status and unassigned water Cont.

Ground water source	Rainfall recharge (ML)	2012 Annual extraction limit (ML/yr)	Total requirements ML/yr	Risk Category ^	% allocated	2016 Annual extraction limit (ML/Y)	2016 Unassigned water	Water Sharing Plan name	Date of commencement
Lorne Basin Groundwater Source	40,215	28,151	48	1	0.2	9,500	9,143	North Coast Fractured and Porous Rock Groundwater	1/07/2016
Macleay Coastal Sands	37,535	24,277	3,488	1	14.4	11,300	7,939	North Coast Coastal Sands	1/07/2016
Macleay River Alluvium	52,391	capped	10,702	1	capped	-	-	Macleay Unregulated and Alluvial Water Sources	-
Nambucca Alluvium	21,091	capped	3,437	1	capped	-	-	Nambucca Unregulated and Alluvial Water Sources	30/09/2016
Nambucca Coastal Sands	9,987	5,112	61	1	1.2	1,175 (combined total with Bellinger Coastal Sands)	1,070 (combined total with Bellinger Coastal Sands)	North Coast Coastal Sands	1/07/2016
New England Fold Belt Coast — Bellinger River	37,115	20,084	1,606	1	8	60,000 (option to increase to 375,000)	24,532	North Coast Fractured and Porous Rock Groundwater	1/07/2016
New England Fold Belt Coast — Brunswick River	16,492	8,246	224	1	2.7				
New England Fold Belt Coast — Clarence River	427,987	221,552	364	1	0.2				
New England Fold Belt Coast — Hastings River	148,239	74,119	1,922	1	2.6				
New England Fold Belt Coast — Macleay River	310,153	155,076	10,795	1	7				
New England Fold Belt Coast — Nambucca River	59,535	29,768	3,549	1	11.9				
New England Fold Belt Coast — Richmond River	2,477	1,241	30	1	2.4				
New England Fold Belt Coast — Tweed River	69	34	0	1	0				

Table 28: Groundwater sources, extraction limits, 2016 water sharing plan status and unassigned water Cont.

Ground water source	Rainfall recharge (ML)	2012 Annual extraction limit (ML/yr)	Total requirements ML/yr	Risk Category ^	% allocated	2016 Annual extraction limit (ML/Y)	2016 Unassigned water	Water Sharing Plan name	Date of commencement
North Coast Fractured Rock	72,922	43,753	533	1	1.2	13,000 (upper extraction limit of 55,0000)	7,093	North Coast Fractured and Porous Rock Groundwater	-
Richmond Coastal Sands	191,770	116,625	1,254	1	1.1	19,000 (upper limit 48,900)	17,545	North Coast Coastal Sands	1/07/2016
Richmond River Alluvium	182,414	109,448	4,530	1	4.1	-	-	-	-
Richmond River Fractured Rock	2,007,254	1,233,859	2,310	1	0.2	-	-	North Coast Coastal Sands	1/07/2016
Stuarts Point	7,032	3,868	3,564	2	92.1	4180	410	North Coast Coastal Sands	1/07/2016
Tweed Coastal Sands	47,988	24,169	755	1	3.1	19,000 (upper limit 21,750 combined with Brunswick Coastal Sands)	18,287 (combined total with Brunswick Coastal Sands)	North Coast Coastal Sands	1/07/2016
Tweed River Alluvium	27,520	capped	60	1	capped	122	-	Tweed River Area Unregulated and Alluvial	17/12/2010

4.4 Near-shore marine

INDICATOR:	Marine water quality (CONDITION)	
DATA SOURCE:	OEH, councils	DATA QUALITY: Medium
INDICATOR:	Rocky reef biota (CONDITION)	
DATA SOURCE:	OEH, Southern Cross University	DATA QUALITY: High, Medium
INDICATOR:	Area of marine protected areas (RESPONSE)	
DATA SOURCE:	DPI	DATA QUALITY: High
INDICATOR:	Coastline management (RESPONSE)	
DATA SOURCE:	Councils, county councils	DATA QUALITY: High

The near-shore marine environment includes beaches, rock platforms, and shallow reefs along the coast, and is one of the most utilised of all environments. It is subject to urban development on foreshores (which results in habitat loss and disturbance), it is a primary area for recreation (such as walking, beach going, swimming, surfing, fishing and boating), and it also receives discharges from stormwater, waste water treatment plants and rivers. It is a dynamic environment, with storms and ocean swell altering the shape of the beaches and river mouths changing shape as flows rise and fall.

The near-shore marine environment in the North Coast of NSW is valued for its high biodiversity, with two marine parks and an aquatic reserve adjacent to the mainland, and a third marine park in the waters off Lord Howe Island. To maintain this high level of biodiversity, and to ensure coastal waters and beaches are clean for our use, monitoring of condition and impacts is required. As there is little information on the near-shore environment itself, this section includes summaries of a number of programs investigating the marine waters of the North Coast region

4.4.1 Marine water quality

Marine water quality has been monitored at a state level under the former NSW MER Strategy, measuring chlorophyll-a levels to determine the presence of algal blooms, and locally through council Beachwatch programs supported by OEH, which monitor levels of bacterial contamination in beach waters. There is no current assessment of marine algal blooms as the trigger values are currently being reviewed (EPA 2016).

The Beachwatch program aims to provide information on water quality at key swimming beaches to ensure the public knows when at where it is safe to swim. In 2012, the program was conducted by four councils in the reporting region: Ballina, Byron, Kempsey and Richmond Valley. In 2016, only two councils in the region are still participating.

Results of the program are shown in Table 29. Generally, results indicate water quality at ocean sites is good to very good across all monitored locations, but lagoons and some estuarine locations can have a poor rating, indicating swimming is not advised as there may be high levels of bacterial contamination.

Photo: S Morris

Table 29: Beach watch suitability grades for the North Coast of NSW

LGA	Location	Site type	2010	2011	2012	2013	2014	2015
Ballina	Shaws Bay East	Estuarine	G	G	P	G	G	G
	Lake Ainsworth West	Lake/Lagoon	G	G	G	P	P	P
	Shelly Beach	Ocean	G	VG	G	G	G	G
	Lighthouse Beach	Ocean	VG	G	G	G	G	VG
	Seven Mile Beach	Ocean	VG	VG	VG	VG	VG	VG
	The Serpentine	Estuarine	F	G	G	G	G	G
Byron	The Strand	Ocean beach	VG	VG	VG	-	-	-
	South Beach, Brunswick Heads	Ocean beach	G	G	G	-	-	-
	Torakina Beach	Estuarine	F	G	G	-	-	-
	Simpsons Creek	Estuarine	VP	P	P	-	-	-
	Belongil Beach	Ocean beach	VG	VG	VG	-	-	-
	Tallow Beach Suffolk Park	Ocean beach	VG	VG	VG	-	-	-
	Tallow Beach Byron Bay	Ocean beach	VG	VG	VG	-	-	-
	Wategos Beach	Ocean beach	VG	VG	VG	-	-	-
	Clarkes Beach	Ocean beach	G	VG	VG	-	-	-
	Main Beach Byron Bay	Ocean beach	G	VG	VG	-	-	-
	Broken Head	Ocean beach	-	VG	VG	-	-	-
Clarence Valley	Wooli estuary north (police station)	Estuarine	G	G	-	-	-	-
	Wooli estuary south (boat ramp)	Estuarine	G	G	-	-	-	-
	Iluka Bay	Estuarine	G	P	-	-	-	-
	Kolora Lake	Lagoon/lake	P	P	-	-	-	-
Kempsey	Grassy Head	Ocean beach	-	-	VG	VG	-	-
	Stuarts Point	Estuarine	-	-	P	P	-	-
	Back Creek	Estuarine	-	-	P	P	-	-
	Horseshoe Bay	Ocean beach	-	-	G	G	-	-
	Trial Bay	Ocean beach	-	-	G	G	-	-
	Saltwater Creek	Estuarine	-	-	P	P	-	-
	Hat Head Beach	Ocean beach	-	-	G	G	-	-
	Korogoro Creek	Estuarine	-	-	P	P	-	-
	Killick Beach	Ocean beach	-	-	P	P	-	-
	Killick Creek	Estuarine	-	-	P	P	-	-
Port Macquarie-Hastings	Town Beach	Ocean beach	G	-	-	-	-	-
	Flynns Beach	Ocean beach	VG	-	-	-	-	-
	Lake Cathie	Lagoon/lake	P	P	-	-	-	-
	Rainbow beach	Ocean beach	G	-		-	-	-
Richmond Valley	Airforce Beach	Ocean beach	VG	VG	VG	G	VG	VG
	Main Beach	Ocean beach	VG	VG	VG	VG	VG	VG
	Shark Bay	Ocean beach	VG	VG	VG	VG	VG	VG
	Evans River	Estuarine	G	VG	G	G	P	P

Key: Very Good | Good | Fair | Poor | Very Poor

4.4.2 Rocky reef biota

There is little state-wide information on the status of rocky reef biota (i.e. the flora and fauna that inhabit the reefs along the coast). However, there is some local research conducted by Solitary Islands Marine Park since 2012 that provides some locally-focused research to give an indication of condition. There has been no further sea bed mapping since 2012, but the previous mapping of 736 square kilometres of seabed (73,600 hectares or nearly 30% of the region's marine waters) identified and classified areas of sediments (fine sands, coarser sand, muddy sand, gravel, cobble and boulders), areas of reef and reef complexes far greater than previously identified, and benthic communities (fauna and flora of the seabed). Reef complexity is an indicator of marine biodiversity, as more complex reef structures support a greater number of different species (DECCW 2010c).

Benthic surveys conducted during the program show a mix of tropical, subtropical and temperate species, reflecting the mix of ocean currents from the north, south and east, and the change in water temperature with depth and location. Shallow inshore reefs are characterised by macroalgae (seaweed), while shallow mid-shelf reefs, just a few kilometres further offshore, were often characterised by corals. Species assemblages (the mix of different species found within a location) varied considerably even between locations of the same reef-type, indicating that individual reef locations within a small area may have unique species assemblages.

For example, Anemone Bay, at North Solitary Island (offshore from Wooli) has the highest density of host anemones recorded in the southern hemisphere, and Fish Soup, off north West Rock not far from Anemone Bay, has a unique aggregation of tropical and temperate predatory fishes not found at any of the other monitored sites.

Research projects on reef fish within the Solitary Islands Marine Park (Malcolm et al. 2010,a and b) show that the warm east Australian current influences the patterns of reef fish in the region, with the inshore areas characterised by endemic (local) temperate fish species, and warmer, offshore areas influenced by the east Australia current having more tropical species and far more species overall. This results in a high regional biodiversity. The same pattern was observed for benthic (bottom dwelling) communities, with very different communities found on inshore reefs (less than 1.5 km from the coast), as compared to mid-shelf (1.5–3 km from the coast) and offshore reefs (greater than 3 km from the coast).

This has a number of management implications:

- protection of species and habitats is required at all distances from shore to ensure protection of the full range of biodiversity
- impacts on the inshore or near-shore environment may have permanent effects because communities here cannot recruit from offshore reefs as different fish and benthic communities exist there.

In 2016, results of long-term monitoring of fish abundance and size using diver and remote video methods has found in 2016 larger and more target species, such as snapper, in sanctuary zones versus other zones and outside of marine parks. Ongoing integration of fine-scale geoswath habitat mapping and extensive fish surveys in the SIMP has enabled predictive species distribution models to be developed and habitat classification systems to be further refined for spatial planning purposes. Overall coral communities have been impacted in 2016 but are still in reasonable condition. There was a major coral bleaching event in subtropical water in March/April 2016 coinciding with a much larger global coral bleaching event. Subtropical Pocillopora, Porites and Turbinaria corals were most affected. There has been a lot of mortality in the Pocillopora but a lot of recovery in everything else. The large east coast low June 2016 caused localised coral damage (H. Malcolm, pers . comm. 2016).

The above series of studies provides some information on the condition of marine habitats and species, but further research over a larger area is required to get true baseline information on individual habitat types and species, and studies over longer time periods are required to examine trends in condition.

Photo: D Harasti

4.4.3 Marine protected areas (MPA)

There are three marine parks and one aquatic reserve in the North Coast region. As it is outside of the reporting region, Lord Howe Island (LHI) Marine Park is not included in this statistics presented in this section.

MPAs aim to conserve marine biodiversity and maintain ecological processes. Marine parks are generally large areas designed to protect a sample of each type of marine habitat within protective zones, whereas aquatic reserves are smaller and protect a single significant feature (Creese et al. 2011). Activities within each MPA are regulated by a zoning scheme, which allows different activities in different areas. Some zones totally protect areas and do not permit fishing, others allow only low impact fishing methods, and others allow a wide range of fishing methods.

In 2014, the former *Marine Parks Act 1997* was replaced by the *Marine Estate Management Act 2014* administered by DPI and encompassing not only marine protected areas but all NSW waters out to the 3 nautical mile limit. There are plans for a range of marine park management reforms under the new legislation.

Table 30 shows that currently, 38% of the marine waters of the North Coast region (excluding LHI waters) are contained within marine parks and reserves. Complete protection zoning (sanctuary zones) is in place for 6% of the region's waters, and 17% is zoned for low impact activities (habitat protection zones).

In 2013 an amnesty on beach fishing within sanctuary zones (no-take zones) was applied to all NSW MPAs. After extensive surveys on use and conservation value of these areas, the majority of sanctuary zoned beaches were returned to sanctuary zone status, while two locations in each of the region's marine parks remained open for recreational beach fishing. The research reported that the sanctuary zone areas were of high conservation value and some areas were not highly utilised by fishers. Other areas were utilised well and of lower conservation value so have remained open for beach fishing (MPA 2016).

Photo: D Harasti

Table 30: Marine protected areas within the region (source: DPI)

Marine protected area	Total reserve area (ha)	Area zoned for complete protection — no fishing (ha)	Area zoned for low impact fishing activities — recreational and commercial (ha)
Solitary Islands Marine Park	71,829	8,650	38,860
Cape Byron Marine Park	22,048	6,105	4,160
Cook Island Aquatic Reserve	78	35	43
TOTAL	93,955	14,790	43,063
% of North Coast Region marine area under protection (excl. Lord Howe Island)	38%	6%	17%
TOTAL marine area of North Coast Region (excl. Lord Howe Island waters) (ha)	247,233		

4.4.4 Coastal zone management

Coasts are under increasing pressure from urbanisation, coastal recession and sea level rise. In 2010 the NSW Government introduced a requirement for all coastal councils to prepare coastal zone management plans (CZMP) under the *Coastal Protection Act 1997.* The primary aim of these plans was to better manage coastal erosion risks and inundation by identifying the areas where these impacts are most likely to occur.

The NSW Government has now drafted a new Coastal Management Act which directly integrates coastal management and planning requirements into councils' land use planning responsibilities under the Environmental Planning and Assessment Act 1979 (EP&A Act) and their community and strategic planning responsibilities under the *Local Government Act 1993.*

This means land use planning decisions will better reflect coastal management issues, and coastal management activities will be linked to and delivered as part of councils' central service delivery system, the Integrated Planning and Reporting (IP&R) framework (OEH 2016).

The new Act will also incorporate a new Coastal Management State Environmental Planning Policy (SEPP) consolidating a number of current SEPPs that apply to the coast, and will better target development controls and considerations to the diverse values and characteristics of different coastal environments.

Councils in the region are now in the process of converting their coastal zone management plans (CZMP) to the new coastal management programs (CMP) that must be integrated with each councils' Integrated Planning and Reporting (IP&R) plans under the Local Government Act. This will ensure timely and effective implementation of coastal management programs (OEH 2016c).

At this stage, the legislation is still to be finalised, so Table 31 shows the current status of the Coastal Plans across the region, which are currently guiding coastal management.

Table 31: Status of coastal zone management planning by LGA

Local Government Area	Coastal hazards mapping status	CZMP status
Ballina	Complete	Coastal Zone Management Plan for the Ballina Shire Coastline 2016
Bellingen	Complete	Coastal Zone Management Plan for the Bellingen Shire coastline 2014
Byron	Complete	draft Coastal Zone Management Plan for the Byron Bay Embayment
Clarence	Complete	Coastal Zone Management Plans have been completed for much of the coastline
Coffs Harbour	Complete	Coastal Zone Management Plans have been prepared for a number of Coffs numerous estuaries
Kempsey	Complete	The Coastal Zone Management Plan for the entire Kempsey LGA Coastline was completed in 2015
Nambucca	Complete	Coastal Zone Management Plan for the Nambucca Shire coastline 2012
Port Macquarie-Hastings	Complete	Coastal Zone Management Plans have been completed for 2 sections of the coastline
Richmond River County Council (now Rous County Council)	Complete	Coastal Zone Management Plan for the Richmond River 2012 on behalf of Ballina, Lismore and Richmond Valley councils
Richmond Valley	Complete	Evans Head Coastal Management Plan 2014
Tweed	Complete	Tweed Coastline Management Plan, Draft Coastal Zone Management Plan for Kingscliff to Dreamtime Beach

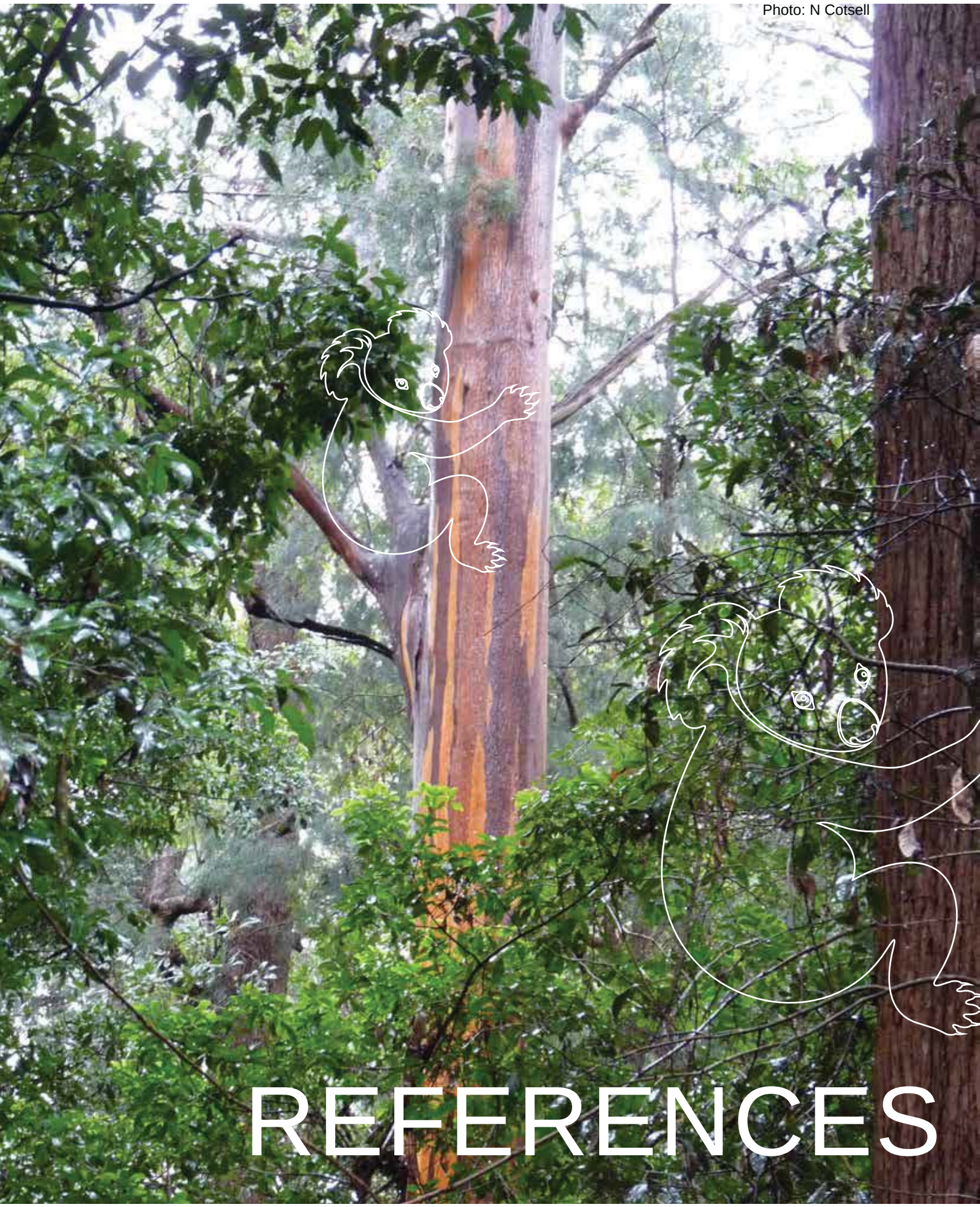


Photo: N Cotsell

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