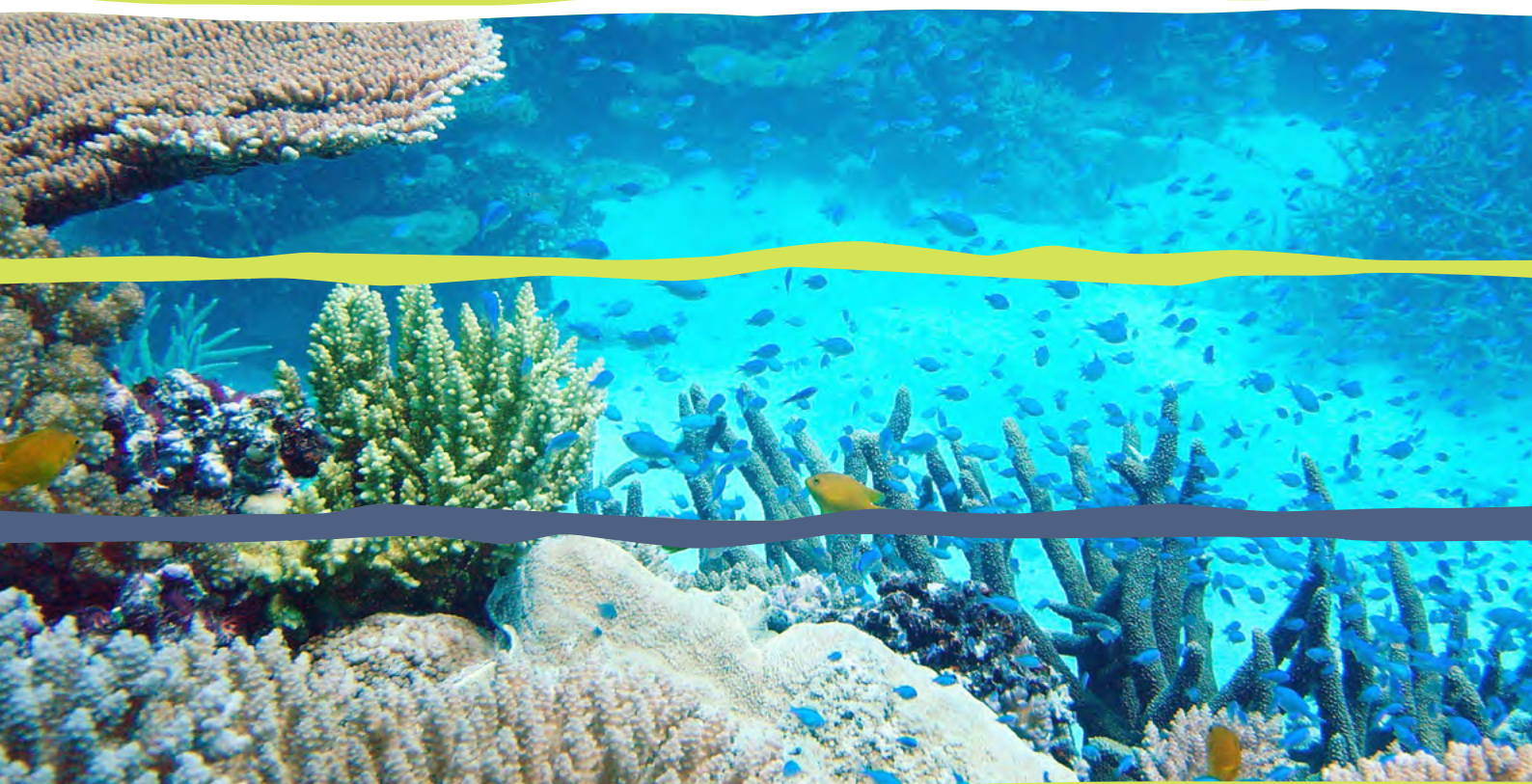


Reef Water Quality Protection Plan

Investment Strategy 2013–2018



Australian Government



Queensland
Government

Contents

● Introduction	3
● Scope	3
● Achieving Reef Plan targets	4
● Relevant Reef Plan 2013 actions	5
● Governments' commitment to Reef Plan	5
● Principles for investment	6
● Investment across key work areas	7
1. Prioritising investment and knowledge	8
<i>Past investment</i>	8
<i>Future investment</i>	8
2. Responding to the challenge	9
<i>Incentives and grants</i>	9
<i>Best Management Practice programs</i>	9
<i>Extension and education</i>	9
<i>Regulations</i>	10
<i>Oversight</i>	10
3. Evaluating performance	11
● Other sources of funding	11
- Reef Trust	11
- Non-government organisation investment	11
- Industry and landholder contributions	11
● Prioritisation of investment	12
- Risk assessment	12
- Multi-criteria analysis	18
- Prioritisation of coastal repair works	18
● Investment risks	19

Introduction

It is now more than 10 years since the Reef Water Quality Protection Plan (Reef Plan) was launched in 2003 as a joint Australian and Queensland government commitment to halt and reverse the decline in water quality entering the Great Barrier Reef lagoon.

Reef Plan was updated to re-focus actions on improving water quality in 2009. The updated Reef Plan was more strategic and outcome focused, with improved accountability for actions and better monitoring to measure success.

An updated Reef Plan was released in 2013 and sets the direction from 2013 to 2018, building strongly upon past activities and maintaining a focus on partnerships.

One of the key deliverables of Reef Plan 2013 is agreement on a coordinated Investment Strategy for implementing Reef Plan actions.

This Investment Strategy broadly describes the Queensland and Australian governments' investment in activities that contribute to Reef Plan. It builds upon the previous Investment Strategy 2009 to 2013.

This Investment Strategy also showcases investments from non-government partners and non-government organisations. It is hoped that the strategy may provide useful guidance to non-government investors with a desire to invest in Great Barrier Reef related water quality activities (e.g. non-profit organisations and industry etc).

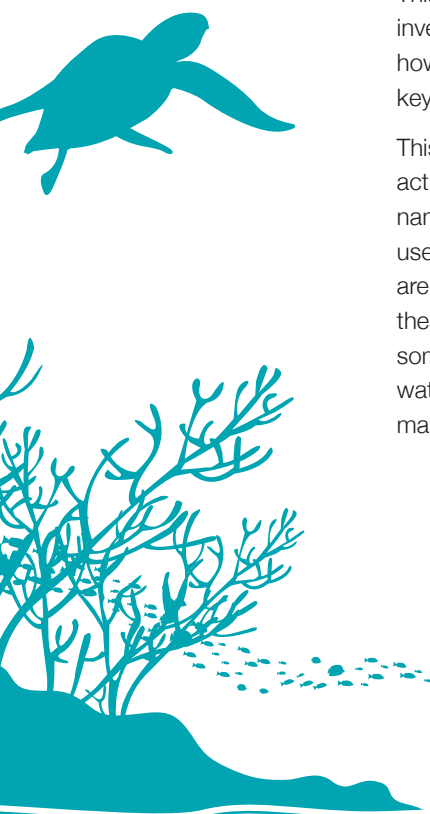
Scope

This strategy provides details on the level of investment committed to Reef Plan activities and how this investment contributes to Reef Plan's key work areas.

This strategy is primarily restricted to those activities that are within the scope of Reef Plan, namely activities related to broadscale land use. However, it also includes investments that are designed to reduce urban runoff, improve the condition and extent of native habitats and some land use planning activities that affect water quality. It does not include the day-to-day management of the Great Barrier Reef which

is the joint responsibility of the Great Barrier Reef Marine Park Authority and the Queensland Government.

This strategy does not attempt to detail expenditure on every individual program that contributes to Reef Plan, rather it provides a general overview of major investments across program areas. Figures are indicative investments for 2013 to 2018, based primarily on actual investments in 2013–2014. It is acknowledged that investments may vary over time as priorities are revised based on new information and new initiatives.





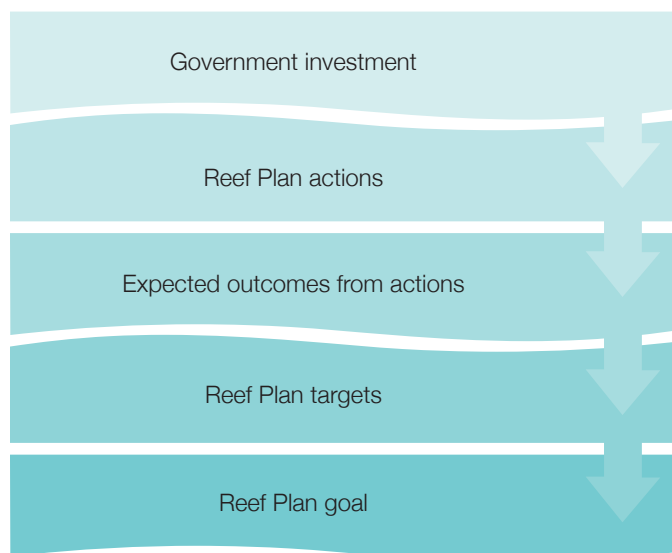
Achieving Reef Plan targets



Reef Plan provides the coordination and oversight to ensure investments result in the best possible outcomes for the Great Barrier Reef. The Australian Government, Queensland Government and Reef Plan partners all invest in actions that directly contribute to achieving Reef Plan's targets and goal.

There is no single action or entity that will achieve the targets alone. Rather, the targets will be achieved through the coordinated and collaborative delivery of a suite of actions including those related to incentives, Best Management Practice (BMP) programs, regulations, planning, research and education. This coordinated and collaborative approach is fundamental to Reef Plan.

Industry and private organisations are strongly encouraged to maximise the chances of achieving the goal and targets through their own complementary investments.





Relevant Reef Plan 2013 actions

Action three of Reef Plan 2013 aims to:

Prioritise and align investments based on risk assessments of key pollutants, source areas and the risk they pose to Great Barrier Reef ecosystems, as well as information on priority areas for rehabilitation.

This action includes two investment related deliverables:

- Investment through Reef Plan is informed by an investment prioritisation process that identifies priority pollutants, industries and areas (see section on multi-criteria analysis).
- Agree on a coordinated Reef Plan Investment Strategy for implementing Reef Plan (this strategy).

Governments' commitment to Reef Plan

Both the Queensland and Australian governments have invested significant funding and resources in initiatives to improve Reef water quality. As part of the release of Reef Plan 2013, the Australian and Queensland governments collectively committed \$375 million from 2013 to 2018 to help achieve the Reef Plan 2013 goal and targets.

The Australian Government continues to support a number of initiatives to improve the quality of water entering the Reef. Funding of approximately \$160 million has been committed for a suite of activities, the majority of which are

supported through the Australian Government Reef Programme. Building on this will be a suite of investments in the new \$40 million Reef Trust.

The Queensland Government will maintain its annual investment of \$35 million a year (\$175 million over five years), which supports the roll out of Best Management Practice (BMP) programs and broader Reef water quality initiatives.

The Reef 2050 Long-Term Sustainability Plan is an overarching framework for protecting and managing the Great Barrier Reef from 2015 to 2050. Measures implemented through Reef Plan are key components which will help meet the water quality outcome identified in the Reef 2050 Long-Term Sustainability Plan.

Principles for investment



A number of investment principles guide this Investment Strategy (see Figure 1).

Figure 1: Reef Plan principles for investment

Investment principles

Investment should be targeted at the most cost-effective practices that deliver the greatest water quality benefit.

Investment should be targeted to maximise reef water quality outcomes, particularly by focusing on the highest risk pollutants in the highest risk areas.

Investment should be coordinated and integrated wherever possible across programs to avoid duplication and help leverage resources.

Prioritisation of investment should be based on the best and most up-to-date information.

Investments should be flexible and regularly reviewed to encourage adaptive management based on the latest emerging information.

Opportunities to pool resources and invest more strategically should be explored and adopted where advantageous.



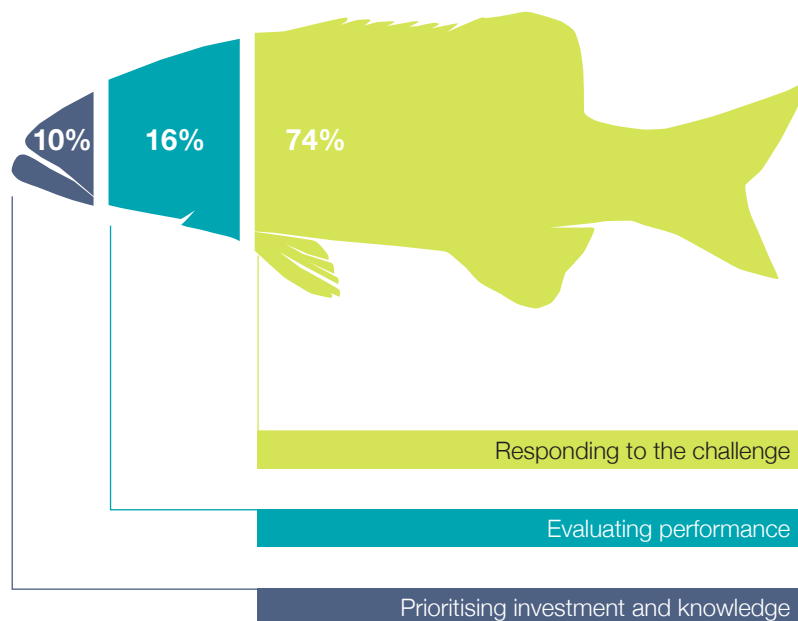
Investment across key work areas

Three priority work areas have been established to improve water quality outcomes:

1. **Prioritising investment and knowledge** — Prioritise, coordinate and integrate programs to maximise Reef water quality outcomes.
2. **Responding to the challenge** — Landholders adopt management systems that maximise Reef water quality improvements while maintaining and enhancing resilience, business performance and environmental outcomes. Government policies and programs that support Reef Plan's goal and targets are maintained.
3. **Evaluating performance** — The efficiency and effectiveness of Reef Plan is measured through monitoring, evaluation and reporting.

Figure 2 shows the breakdown of government investment across these three key work areas.

Figure 2: Broad government funding breakdown for Reef Plan 2013 (indicative based on 2013–2014 and 2014–2015 anticipated expenditure)



1. Prioritising investment and knowledge

Past investment

There was a significant investment in water quality research, development and innovation over the five years to 2013. This included more than \$8 million through the Queensland Government's Reef Water Quality Research and Development Program (with finalisation and dissemination of outputs ongoing to the end of 2014) and \$10 million through the Australian Government Reef Rescue Research and Development program, as well as up to \$7 million a year through the National Environment Research Program (NERP) Tropical Ecosystems Hub (which continues to the end of 2014). The Australian Government also allocated more than \$500,000 to extend six Reef Rescue research and development projects for a further year due to climate difficulties.

The results from research and development projects were presented at five Reef Rescue regional science forums from September to October 2013 to inform the prioritisation of on-ground investments over the next three to five years. This information was also considered in updating the research and development priorities for Reef Plan 2013, outlined in the *Reef Plan Research, Development and Innovation Strategy 2013–2018*.

Future investment

The Australian Government has committed \$1 million to fund research on new crown-of-thorns starfish control methods, total abundance estimates and population genetics. The Australian Government has also committed \$12.5 million over four years (2013–2014 to 2016–2017) to the Great Barrier Reef Foundation to implement its research vision of 'Resilient Coral Reefs Successfully Adapting to Climate Change'. The Great Barrier Reef Foundation is an Australian not-for-profit organisation that supports research to protect, enhance and preserve coral reefs through its strategic links to private sector and philanthropic organisations.

The organisation also seeks to identify gaps in research investment to avoid duplication with other research programs. Funding will be used for a four-year devolved grants program to support research projects that will:

- better define the attributes of a Great Barrier Reef ecosystem that is resilient to climate change
- test the feasibility of minimising the impacts of climate change on the ecosystem
- increase the adaptive capacity of the ecosystem to climate change.

The Queensland Government through the Department of Agriculture, Fisheries and Forestry has committed \$16 million over four years to Sugar Research Australia to address industry research priorities, some of which will have benefits for Reef water quality. The Queensland Government Reef Water Quality Program is also reviewing ongoing investment in research and development from 2014 until 2019.

To address key knowledge gaps and inform Reef Programme and Reef Trust investment priorities, the Australian Government funded research and development supporting science synthesis and integration activities in 2013–2014.

Projects include investigating bioavailability of particulate nitrogen, rangelands grazing operations and herd management practices, and the economic costs and benefits of the adoption of innovative land management practices. This research will improve the understanding of agricultural impacts on the Reef. Future Australian Government Reef related research and development needs will be addressed primarily through the National Environmental Science Programme.

Further information on research priorities can be found in the *Reef Plan Research, Development and Innovation Strategy 2013–2018*.



2. Responding to the challenge



The major focus of investment to date has been addressing poor water quality by working with industry and regional Natural Resource Management organisations to improve land management through a combination of mechanisms including grants, industry led Best Management Practice programs, extension and education, and regulations. A summary of investment in these areas is provided below.

Incentives and grants

The Australian Government has committed to the following investments over the next three to five years:

- \$61 million for Water Quality Grants (2013–2014 to 2015–2016)—including support for farm planning, training, extension and water quality grants
- \$3 million for Water Quality Partnerships (2013–2014 to 2017–2018)—including support for industry management practice benchmarking, coordination and communication activities
- \$23.5 million for Systems Repair and Urban Water Quality on-ground grants (2013–2014 to 2017–2018)
- \$2.75 million for Systems Repair and Urban Water Quality planning grants (2013–2014)
- \$5.1 million for crown-of-thorns starfish (COTS) control, which aims to decrease the impact of COTS by supporting tourism operators to continue removing COTS from reefs in high value tourism sites (2013–2014). The Australian Government has also committed a further \$2 million for COTS control through the Reef Trust initiative (2014–2015 to 2015–2016).

Funding of \$10 million has also been committed to Land and Sea Country Partnerships to continue to strengthen communications between local communities, Reef managers and Reef stakeholders and build a better understanding of Traditional Owner use of the Great Barrier Reef Marine Park.

The Australian Government is providing \$41 million from 2013–2014 to 2017–2018 to regional Natural Resource Management organisations in the Reef catchments to address sustainable environment and sustainable agriculture priorities. These include improving the management of agriculture and the natural resource base, promoting innovation in Australian agriculture, maintaining ecosystem services and protecting the conservation estate, which will subsequently lead to improving the health and resilience of the Great Barrier Reef.

The Queensland Government invests in on-ground grants through the Queensland Natural Resource Management Investment Program which will provide \$30 million over five years for natural resource management in the catchments adjacent to the Reef. Queensland's Everyone's Environment grants program also provides around \$0.5 million a year to community groups to improve water quality in the catchments adjacent to the Reef.


Best Management Practice programs

The Queensland Government has invested \$5.4 million to support the establishment of industry-led Best Management Practice programs for the cane and grazing industries to mid-2014. An extension of Queensland Government support to cane and grazing Best Management Practice programs for a further three years is being negotiated.

Extension and education

The Queensland Government through the Department of Agriculture, Fisheries and Forestry invests around \$2 million a year in additional extension services to assist the cane and grazing industries in priority areas where land management practice improvements are most needed to improve Reef water quality.





The Australian Government as part of its grants and partnerships funding (outlined earlier) is supporting an integrated programme of farm planning, training, extension and education, run by regional Natural Resource Management organisations and industry organisations.

Industry organisations also invest in extension services, with the Australian Government matching industry levies paid through rural research and development organisations such as Sugar Research Australia and Meat and Livestock Australia. There is significant scope to better coordinate and integrate extension services across providers and tap into other advisors (e.g. the fertiliser industry). This will be the focus of the *Reef Plan Extension and Education Strategy 2013–2018*.

The Australian Government is providing critical operational support to the Great Barrier Reef Marine Park Authority to maintain its role as the cornerstone institution for community, business, monitoring and government management of the Great Barrier Reef.

This operational support will allow the Great Barrier Reef Marine Park Authority to enhance the conservation of the Reef, maintain and develop Reef resilience and continue the Reef Guardians programs. Reef Guardians recognises the good environmental work undertaken by communities and industries to protect the Great Barrier Reef and involves a significant education component which aims to create awareness, understanding and appreciation for the Reef and its connected ecosystems.

Regulations

The Queensland Government continues to maintain a number of core pieces of legislation (including vegetation management, water resource and land use planning) that provide a strong foundation for continued improvement in water quality.

Reef protection regulations under the *Environment Protection Act 1994* are being maintained until voluntary, industry-led Best Management Practice programs for the sugar cane and grazing industries are shown to be effective in increasing the adoption of improved land management practices.

Total Queensland Government investment in all relevant regulatory and policy development is approximately \$13 million a year. This includes funding towards:

- development of Best Management Practice programs for the cane and grazing industries
- coastal planning
- statutory planning (e.g. regional planning, state planning policies etc.)
- Queensland Wetland Program
- Great Barrier Reef strategic assessment
- vegetation management
- water resource planning
- catchment planning
- Reef 2050 Long-Term Sustainability Plan.

Oversight

The Queensland Government provides support and oversight for Reef Plan (around \$1 million a year). The Australian Government through the Department of the Environment, Department of Agriculture and the Great Barrier Reef Marine Park Authority also provides support and oversight for Reef Plan.

3. Evaluating performance

Monitoring and evaluation remains a key focus of investment to ensure that governments and the public can assess the effectiveness of collective efforts to improve water quality.

The Paddock to Reef Integrated Monitoring, Modelling and Reporting Program continues to be the main vehicle for joint monitoring and evaluation with contributions from both governments totalling approximately \$8 million a year. Further information can be found in the *Reef Plan Monitoring and Evaluation Strategy 2013–2018*.

The Queensland Government is also funding the establishment of the Gladstone Healthy Harbour Partnership, which has a strong water quality management and reporting focus. The Queensland Government has committed \$4 million over two years and the Australian Government has committed \$1 million over two years to the Gladstone Healthy Harbour Partnership.

The Queensland Government is a major contributor of data, information and tools which help to prioritise investment and knowledge through research, monitoring and modelling programs.

Other sources of funding

A range of parties invest in Reef management and water quality improvement including the agricultural, pesticide, fertiliser and tourism industries, not-for-profit organisations and other private sector investors.

Reef Trust

The Australian Government has committed \$40 million to establish a Reef Trust. The Reef Trust commenced operation in 2014–2015 and will combine both Commonwealth and private funds to focus on improving coastal habitat and water quality along the Great Barrier Reef. The Trust will be jointly coordinated with the Queensland Government.

After the initial injection from the Commonwealth, funding will also be derived from the pooling of offset funds for significant projects under the *Environment Protection and Biodiversity Conservation Act 1999* and potentially Queensland legislation. The aim is to provide a strategic and transparent approach to addressing the multiple threats to the Reef. The Trust will

ensure that there is strong coordination of coastal and water quality management.

Non-government organisation investment

Increasingly in recent years, non-government organisations have invested directly in water quality initiatives. This includes funding to support Project Catalyst, a joint initiative of the World Wildlife Fund and Coca Cola Corporation. The Australian Government has previously provided \$2 million funding through the Reef Water Quality Grants programme for growers who are involved in Project Catalyst. These grants fund projects and supply technical support.

Industry and landholder contributions

As a condition of receiving Australian Government Reef water quality grants, landholders make a co-contribution of cash and/or in-kind investment, dependent on the relative public-private benefit of the funding outcomes.

The \$96 million invested in Australian Government Reef Rescue grants from 2008 until 2013 was matched by \$157 million of industry investment (\$108 million in cash and \$49 million in-kind). Industry has therefore co-invested over \$1.60 (in kind and in cash) for every \$1 of grant money received. Total on-ground project costs (i.e. grants and landholder cash co-contribution, in-kind and labour) amount to nearly \$250 million, \$204 million of which are direct cash injections in local economies. It is anticipated that similar ratios of co-contribution will occur through the current Australian Government funding committed for water quality improvements.

The Great Barrier Reef Marine Park Authority's Reef Guardian Farmers and Graziers program results in farmers and graziers promoting sustainable farming practices that make economic sense and are also good for the environment. The program provides a mechanism to recognise and support the efforts of participants who are sustainably managing natural resources. It also provides an opportunity for participants to network and share information and ideas with other producers across the Great Barrier Reef catchments.

Prioritisation of investment

Risk assessment

The 2013 Scientific Consensus Statement provides the most up-to-date information on the sources of pollutants and their relative risks which are critical in prioritising investment. The statement combined qualitative and semi-quantitative assessments to estimate the relative risk of water quality constituents to Great Barrier Reef ecosystem health from major sources in the catchments, focusing on agricultural land uses. The relevant conclusions from the consensus statement follow. A summary of the relative risks and pollutant loads from different regions is provided in Table 1 (page 16) and Figure 3 (page 17).

The risk assessment results were a key consideration in the *Reef Rescue Water Quality Grants and Partnerships: Priorities for Further Action 2013–14 to 2015–16 Summary of the Outcomes* and *Great Barrier Reef toolbox* documents, which were prepared to assist with the development of water quality grant applications. The priorities identified as key investment areas and room for improvement were used when developing, assessing and approving grant applications. This has resulted in a targeted approach where Australian Government investments reflect the need for action to address the highest risk pollutants in the highest risk areas.





Relative risks between pollutants and regions:

- Overall, **nitrogen poses the greatest risk of pollution to coral reefs from catchments between the Daintree and Burdekin Rivers.**

Runoff from these rivers during extreme and early wet seasons is associated with outbreak cycles of the coral-eating crown-of-thorns starfish on the northern Great Barrier Reef shelf (15 to 17 degrees south) that subsequently generate secondary outbreaks throughout the central Great Barrier Reef. Great Barrier Reef-wide loss of coral cover due to crown-of-thorns starfish is estimated to be 1.4 per cent per year over the past 25 years and a new outbreak is underway. It is estimated that crown-of-thorns starfish have affected more than 1000 of the approximately 3000 reefs within the Great Barrier Reef over the past 60 years.

- **Of equal importance is the risk to seagrass from suspended sediments** discharged from rivers in excess of natural erosion rates, especially the fine fractions (clays). Whether carried in flood plumes, or re-suspended by waves, suspended solids create a turbid water column that reduces the light available to seagrass and corals. High turbidity affects approximately 200 inshore reefs and most seagrass areas.

Seagrass loss severely impacts green turtle and dugong populations. On a regional basis, the **Burdekin and Fitzroy regions present the greatest risk to the Great Barrier Reef in terms of sediment loads.**

- At smaller scales, particularly in coastal seagrass habitats and freshwater and estuarine wetlands, pesticides can pose a high risk. Concentrations of a range of pesticides exceed water quality guidelines in many fresh and estuarine water bodies downstream of cropping lands. Based on a risk assessment of the six commonly used photosystem II inhibiting herbicides, the Mackay Whitsunday and Burdekin regions are considered to be at highest risk, followed by the Wet Tropics, Fitzroy and Burnett Mary regions. However, the risk of only a fraction of pesticides has been assessed, with only six of the 34 pesticides currently detected included in the assessment, and therefore the effect of pesticides is most likely to have been underestimated.
- The ranking of the relative risk of degraded water quality between the regions in the Great Barrier Reef is (from highest risk to lowest): 1. Wet Tropics 2. Fitzroy 3. Burdekin 4. Mackay Whitsunday 5. Burnett Mary 6. Cape York.

Priority areas for managing degraded water quality in the Great Barrier Reef are Wet Tropics for nitrogen management, Mackay Whitsunday and the lower Burdekin for photosystem II inhibiting herbicide management, and Burdekin and Fitzroy for suspended sediment management.

- From a combined assessment of relative risk of water quality variables in the Great Barrier Reef (using the total area of habitat affected in the areas identified to be of highest relative risk) and end-of-catchment anthropogenic loads of nutrients, sediments and photosystem II inhibiting herbicides, the regional ranking of water quality risk to coral reefs is (from highest risk to lowest):
1. Wet Tropics 2. Fitzroy 3. Mackay Whitsunday 4. Burdekin 5. Cape York 6. Burnett Mary.
- The regional ranking of water quality risk to seagrass is (from highest risk to lowest):
1. Burdekin 2. Wet Tropics 3. Fitzroy 4. Mackay Whitsunday 5. Burnett Mary 6. Cape York.

- Importantly in the Mackay Whitsunday region, 40 per cent of the seagrass area is in the highest relative risk class compared to less than 10 per cent for all other regions. The highly valuable seagrass meadows in Hervey Bay, and the importance to associated dugong and turtle populations in the Burnett Mary region, were not included in the ranking analysis, as they are outside the Great Barrier Reef Marine Park boundaries.
- Both dissolved (inorganic and organic) and particulate forms of nutrients discharged into the Great Barrier Reef are important in driving ecological effects. Overall, increased nitrogen inputs are more important than phosphorus inputs. Dissolved inorganic forms of nitrogen and phosphorus are considered to be of greater concern than dissolved organic and particulate forms as they are immediately bioavailable for supporting algal growth. Particulate forms of nitrogen and phosphorus mostly become bioavailable, but over longer time frames. Most dissolved organic nitrogen typically has limited and delayed bioavailability.



Sources of pollutants

- The Fitzroy and Burdekin regions contribute at least 70 per cent to the modelled total suspended solids load to the Great Barrier Reef lagoon from human activity. Grazing lands contribute over three quarters of this load. The dominant sediment supply to many rivers is from a combination of gully and streambank erosion, and subsoil erosion from hillslope rilling, rather than broadscale hillslope sheetwash erosion. Fine sediment (less than 16 micrometres) material is the fraction most likely to reach the Great Barrier Reef lagoon, and is present at high proportions in monitored total suspended solids in the Burdekin, Fitzroy, Plane, Burnett, and Normanby catchments.
- The Fitzroy, Burdekin and Wet Tropics regions contribute over 75 per cent to the modelled total nitrogen load to the Great Barrier Reef lagoon from human activity. Particulate nitrogen comprises by far the largest proportion, followed by dissolved inorganic and dissolved organic nitrogen respectively. Sediment erosion processes, particularly in grazing lands, are sources of particulate nitrogen; sugarcane, other cropping and grazing are sources of dissolved inorganic nitrogen; and land use changes in filter and buffer capacity are the main sources of dissolved organic nitrogen.
- The Fitzroy and Burdekin regions contribute approximately 55 per cent to the modelled total phosphorus load to the Great Barrier Reef lagoon from human activity. Particulate phosphorus comprises by far the largest proportion, followed by dissolved inorganic and dissolved organic phosphorus respectively. Sediment erosion processes, particularly in grazing lands, are sources of particulate phosphorus; sources of dissolved inorganic phosphorus and dissolved organic phosphorus are unclear.
- Most particulate nitrogen and phosphorus is lost or mineralised from fine sediment following delivery to the Great Barrier Reef lagoon and could be readily available for uptake in marine ecosystems.
- The Wet Tropics, Burdekin and Mackay Whitsunday regions contribute over 85 per cent of the modelled total photosystem II inhibiting herbicides load to the Great Barrier Reef lagoon from human activity. Sugarcane contributes 94 per cent of this load. Groundwater potentially may be an important source of photosystem II inhibiting herbicides (as well as dissolved nutrients) to critical near-shore ecosystems of the Great Barrier Reef lagoon; however, insufficient information is available to evaluate the risks.
- Compared to diffuse sources, most contributions to suspended sediment, nutrient and pesticide loads from point sources such as intensive animal production, manufacturing and industrial processing, mining, rural and urban residences, waste treatment and disposal, ports and shipping are relatively small but could be locally, and over short-time periods, highly significant. Point sources are the major sources of pollutants such as metals, industrial chemicals and pharmaceuticals. Whilst point sources are generally regulated activities, monitoring may not include this broad range of chemicals, and monitoring and permit information is not always available. In contrast to nutrients, sediments and pesticides, there is a lack of knowledge of the risks posed by these chemicals to Great Barrier Reef ecosystems.

Table 1: Summary of the outcomes of the overall assessment of the relative risk of water quality in the Great Barrier Reef. Note that the Burnett Mary region is shaded in grey to represent the fact that most reefs and seagrass in this region were not included formally in the analysis and thus the validity of the result has high uncertainty. Source: Brodie et al., (2013a).

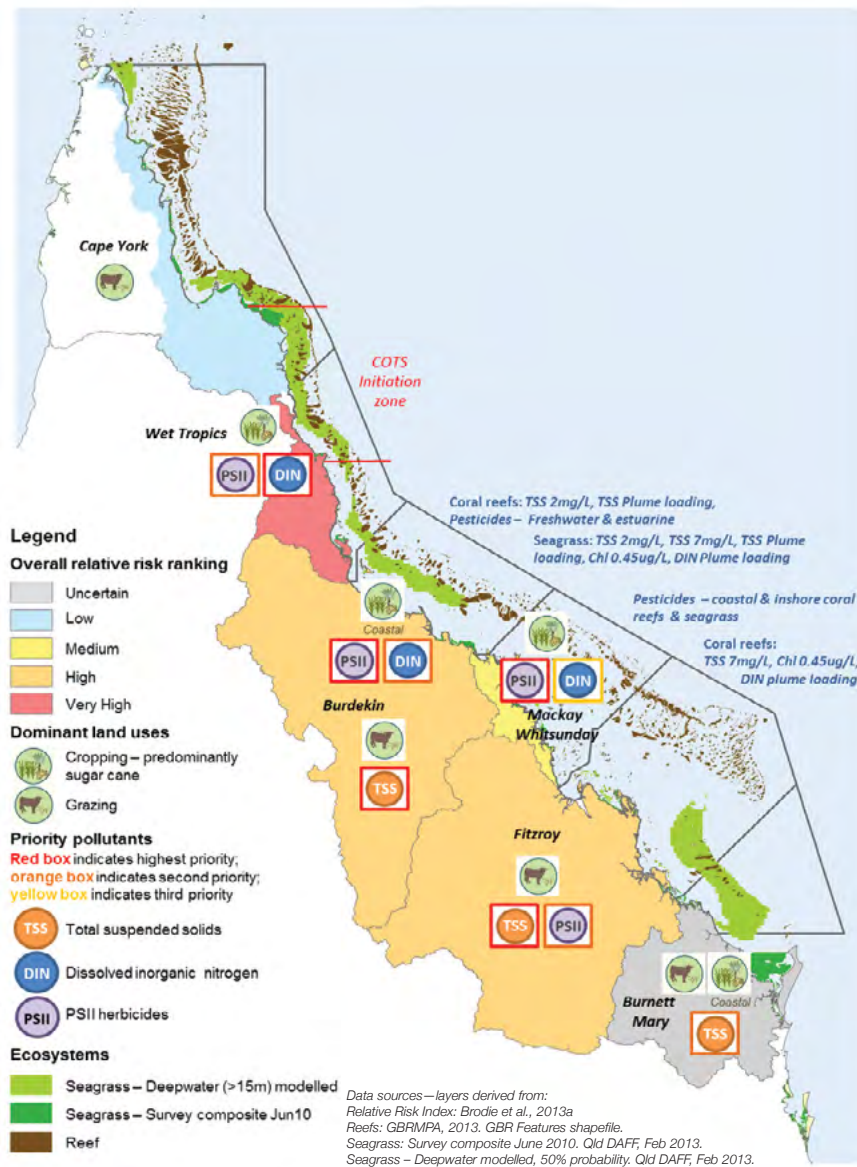
Region	Dominant variables in marine assessment <i>Variables where max area is in region</i>	Marine risk index		Regional anthropogenic load as a proportion of the total Great Barrier Reef load				Loads index	Additional factors	Relative risk index	Management issues	Associated land uses	Overall ranking of relative risk
		Coral reef	Sea grass	TSS	DIN	PSII							
Cape York	Crown-of-thorns starfish Initiation Zone (CR)	12	4	3	<1	<1	0	Influence from catchment runoff is predominantly from Wet Tropics Rivers	9	The data in this region are highly uncertain due to limited validation of marine datasets			LOW
Wet Tropics		100	83	9	20	61	100	86% volumetric contribution to COTS Initiation Zone	100	Nutrients Pesticides	Sugarcane Bananas		VERY HIGH
Burdekin	TSS 2mg/L (SG, CR) TSS 7mg/L (SG) TSS Plume loading (CR, SG) Chlorophyll 0.45µg/L (SG) DIN Plume loading (SG)	40	100	32	11	13	62	14% volumetric contribution to COTS Initiation Zone. High risk from PSII herbicides to Ramsar listed freshwater wetlands in the lower Burdekin catchments	76	Sediments Pesticides Nutrients	Grazing Sugarcane (coastal)		HIGH
Mackay Whitsunday	Pesticide exposure (CR, SG)	54	37	4	6	12	25	High risk from PSII herbicides in Sandy Creek	50	Pesticides Nutrients	Sugarcane		MODERATE
Fitzroy	TSS 7mg/L (CR) Chlorophyll 0.45µg/L (CR) DIN Plume loading (CR)	86	59	17	5	4	28	Monitored loads of PSII herbicides were high in 2011 (not reflected in modelled baseline)	80	Sediments Pesticides <i>Nutrients</i> ¹	Grazing Cropping		HIGH
Burnett Mary	All variables rank relatively low	11	23	4	4	9	20	The Mary River has the fourth highest total and anthropogenic TSS load of all Great Barrier Reef catchments	19	Sediments	Grazing	All variables rank relatively low, however, there is high uncertainty in this result given the lack of data on the full extent and condition of corals	UNCERTAIN

¹ There is insufficient knowledge of the sources of dissolved inorganic nitrogen in the Fitzroy region to make recommendations about management priorities for these. Further knowledge of the role of particulate nitrogen, which is largely derived from grazing lands, and the processing of this into dissolved inorganic nitrogen is important for making future management recommendations in the large grazing catchments of the Fitzroy region. TSS: total suspended solids; DIN: dissolved inorganic nitrogen; PSII: photosystem II inhibiting; CR: coral reefs; SG: seagrass; COTS: crown-of-thorns starfish; GBRWHA: Great Barrier Reef World Heritage Area.



Figure 3: Overall relative risk ranking

The relative risk of degraded water quality to the Great Barrier Reef among the NRM regions, June 2013. The marine water quality variables are listed adjacent to the region where they received the primary ranking.





Multi-criteria analysis

Information from investments made by the Australian Government from 2008 until 2013 and Reef Plan water quality monitoring, modelling and research provide an opportunity to sharpen the focus of future investment in practice change by estimating the:

- relative contribution of each of the 35 major sub-catchments to pollutant loads flowing to the Reef lagoon
- relative contribution of agricultural industries in each sub-catchment to pollutant loads generated
- room for improvement in agricultural industries' nutrient, pesticide and sediment management practices
- management practices expected to deliver the biggest load reductions for sub-catchments.

The Multi-Criteria Analysis Shell for Spatial Decision Support (MCAS-S) approach (see www.daff.gov.au/abares/data/mcass) has been used to draw together the lines of evidence from water quality monitoring, modelling, research and management practice change in a way that enables input from Reef stakeholders and exploration of data inputs and potential solutions.

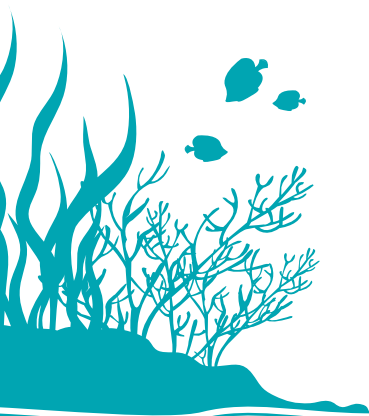
The results of this analysis have helped to identify the sub-catchments, industries and practices where investments are likely to deliver the biggest improvements in water quality. A MCAS-S tool, maps, data pack and report will help to focus investment opportunities at the sub-catchment level and deliver the greatest Great Barrier Reef water quality improvements for the resources available.

A regional MCAS-S spreadsheet was provided to regional Natural Resource Management organisations to improve access to data generated through the Reef Plan Paddock to Reef Integrated Monitoring, Modelling and Reporting Program and, in addition to other information, this will assist their prioritisation processes. This sets the scene for more detailed assessments by regional Natural Resource Management organisations at a sub-catchment level, where local data is available.

Prioritisation of coastal repair works

Between 2010 and 2013, the Australian and Queensland governments developed a methodology to understand the pressures on and changes to coastal ecosystems and their role in improving the water quality and ecosystem health of the Great Barrier Reef.

This project provided a framework to assess the status of coastal ecosystems and risks from future development pressures or changes in land use (<http://elibrary.gbrmpa.gov.au/jspui/handle/11017/828>), as well as tools to prioritise the protection, rehabilitation or function restoration of Great Barrier Reef coastal ecosystems. One of the actions under Reef Plan 2013 specifically focuses on using this methodology and working with key stakeholders to prioritise investment in repairing these coastal ecosystems and their functions.



Investment risks

While co-investment across multiple partners is critical to deal with such a complex issue in a dynamic system, it also presents challenges and risks. This includes the risk of duplication and inefficiency as well as uncertainty about long-term investment from multiple partners.

Reef Plan has strong governance arrangements designed to help manage these risks, improve coordination and identify opportunities to better target investment to deliver the best possible outcomes, while minimising administrative burden. Continued emphasis in these areas will be important. The Management Practices Advisory Group has a key role in improving the coordination and collaboration of Best Management Practice programs and extension at state, regional and catchment levels.



