



Paddock to Reef Integrated Monitoring, Modelling and Reporting Program

2017-2022

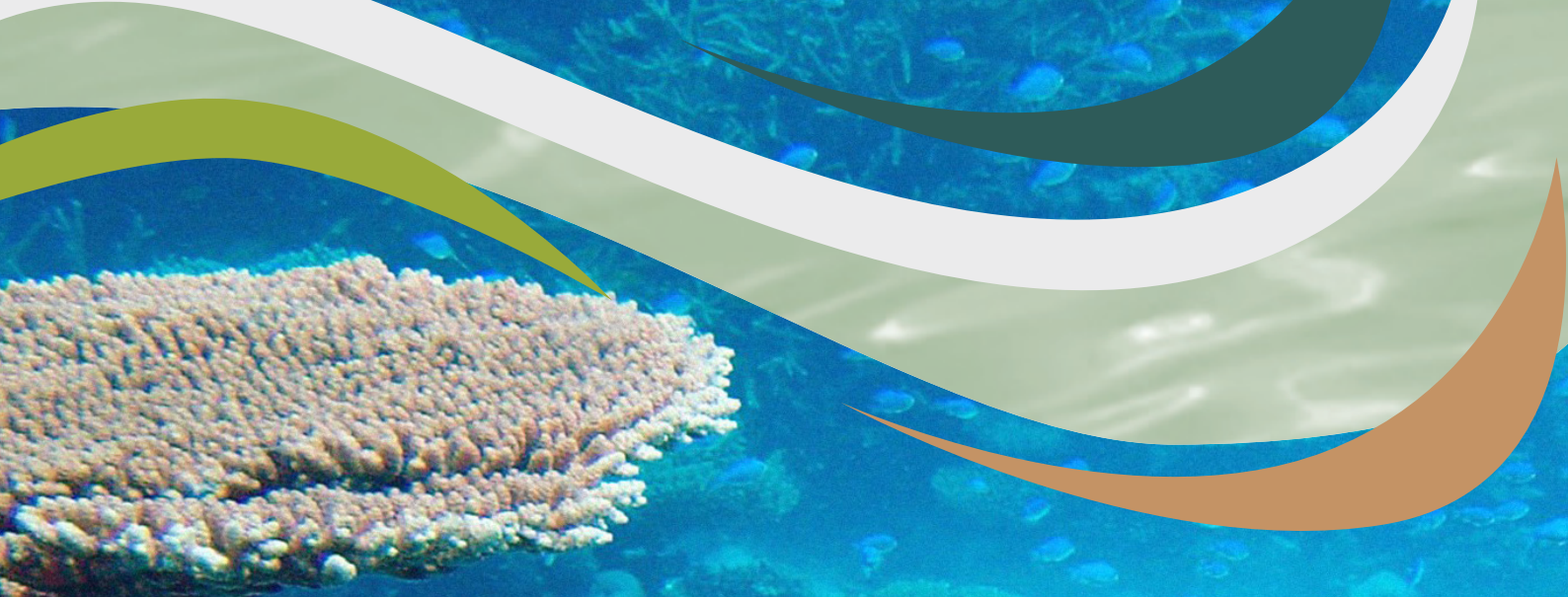
Summary



Australian Government



Queensland Government



Program overview

The Paddock to Reef Integrated Monitoring, Modelling and Reporting Program (Paddock to Reef program) is a collaboration involving Australian and Queensland government agencies, industry bodies, regional Natural Resource Management bodies, landholders and research organisations. It is jointly funded by the Australian and Queensland governments, and has continued to improve in terms of scope, methodology and application over 10 years.

The Paddock to Reef program integrates monitoring and modelling across a range of attributes and at a range of scales including paddock, sub-catchment, catchment, regional and Great Barrier Reef-wide. In line with the Reef 2050 Water Quality Improvement Plan (Reef 2050 WQIP), the program evaluates management practice adoption, management practice effectiveness (in terms of water quality benefits and economic outcomes), catchment condition (riparian, wetlands and ground cover), pollutant run-off and marine condition.

The program areas are inter-linked and form the framework for evaluating and reporting on progress towards the Reef 2050 WQIP targets and objectives through the Reef Water Quality Report Card.

Total funding for the program is approximately \$8 million annually. The majority of the funding is dedicated to capturing data and generating information through monitoring and modelling.

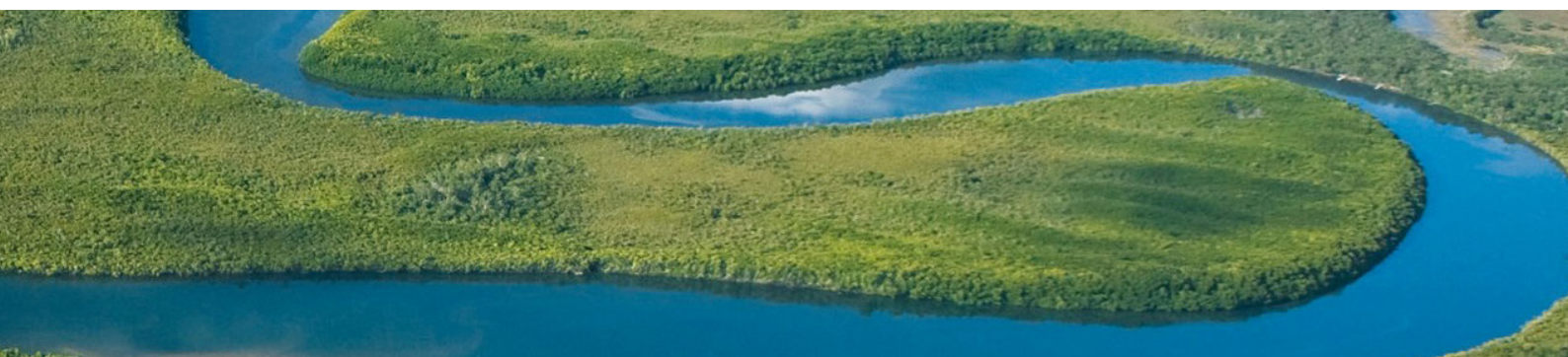
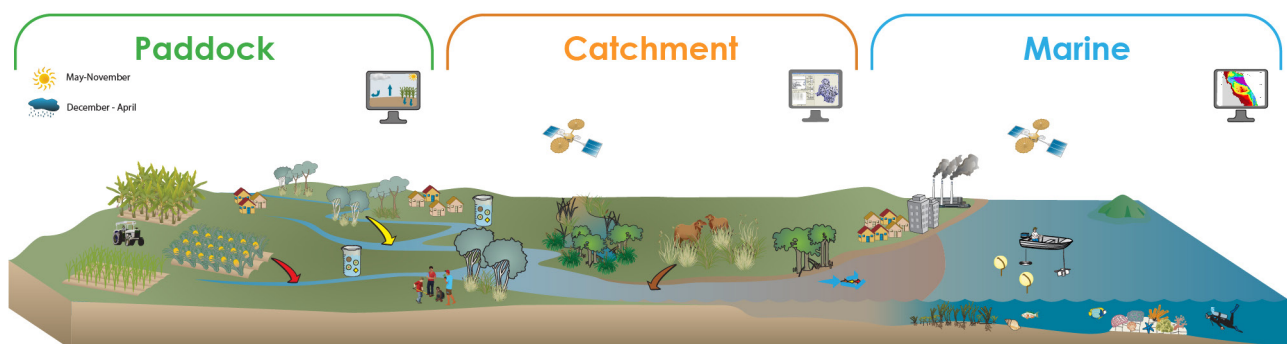




Program objectives

The objectives of the Paddock to Reef program are to:

1. Monitor, interpret and report on water quality status and trends and related ecosystem health in the Great Barrier Reef, and the pressures and drivers of water quality condition from the Great Barrier Reef catchment.
2. Report on the progress towards the Reef 2050 WQIP targets for community engagement, land and catchment management and water quality; objectives for ecosystem health and social benefits and resilience; and the 2050 outcome through the Reef Water Quality Report Card.
3. Develop and improve the evidence base that provides the foundation for learning and improvement to support adaptive management for actions within the Reef 2050 WQIP.
4. Provide knowledge and insights to enable partners to evaluate, prioritise and continuously improve the efficiency and effectiveness of Reef 2050 WQIP delivery and implementation at Great Barrier Reef-wide, regional and catchment scales.
5. Provide the primary mechanism for evaluating the water quality theme of the Reef 2050 Long-Term Sustainability Plan and, in conjunction with the regional report cards, the catchment and estuaries theme of the Reef Integrated Monitoring and Reporting Program.





Program improvements

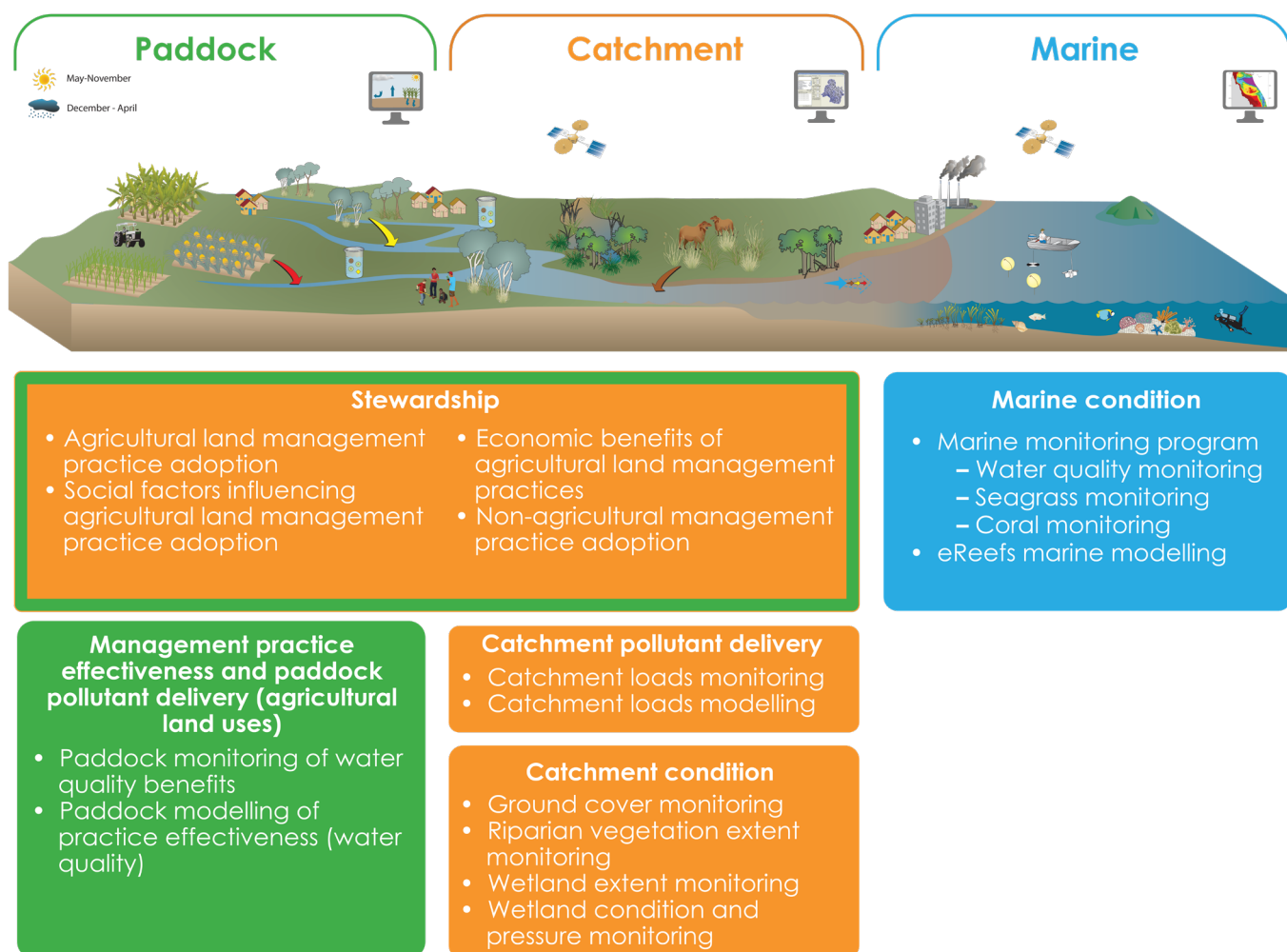
The Paddock to Reef program actively applies the principle of continuous improvement and maintains a high standard of quality assurance and scientific review. The 2018–2022 design incorporates several improvements and highlights include:

- Updating the agricultural management practice adoption water quality risk frameworks for each of the key agricultural industries to better align terminology and incorporate additional practices.
- More detailed modelling of sugarcane, bananas and grains management practice, soil and climate scenarios.
- Expanding water quality monitoring from 14 to 20 catchments, and 25 to 43 sites, with a further 19 sites sampled for pesticides in 2017–2018 and 2018–2019.
- Incorporating improved inputs into the catchment pollutant load models including seasonal ground cover data, an improved soils layer, an extended modelling climate period and hydrology recalibration, finer resolution topographic data, and expanded water quality monitoring data.
- Improving the spatial representation of gullies in the catchment models through a desktop and field gully mapping program.
- Increased calibration of the ground cover method based on approximately 3,600 field sites (previously approximately 1,800 field sites) and improved estimations of highly bare areas to better predict erosion from gullies, scalds, tracks and cattle pads etc.
- Using higher resolution imagery to report a 50 metre riparian vegetation buffer (previously 100 metres).
- Separating wetland hydrological modification when defining changes in wetland extent.
- Developing and implementing the wetland condition and pressures monitoring program.
- Expanding the Marine Monitoring Program spatial/temporal sampling in the Wet Tropics (Tully and Mulgrave-Russell basins), Burdekin and Mackay Whitsunday (O'Connell basin) and introducing marine water quality sampling in Cape York.
- Incorporating eReefs marine modelling outputs into marine condition reporting products.



Program components

There are 14 program components, which are integrated through a common assessment and reporting framework.





Stewardship

Agricultural land management practice adoption

Develops estimates of management practice adoption and annual practice change for sugarcane, grazing, horticulture, grains and bananas. The adoption of improved management practices is reported using industry specific water quality risk frameworks. Practices are ranked from lowest risk (innovative or commercially unproven) to high

risk (superseded practices) for sugarcane, horticulture and grains. They are ranked from very low soil erosion and water quality risk to moderate-to-high soil erosion and water quality risk for grazing. Land management practice adoption information forms the basis for modelling water quality improvements resulting from improved management practices.

Terminology	Practice standard			
Water quality risk framework	Lowest risk, commercial feasibility may be unproven	Moderate-low risk	Moderate risk	High risk
	Innovative	Best practice	Minimum standard	Superseded
Industry best management practice (BMP) (generalised)	Above industry standard (typically aligns with moderate-low risk but in some instances aligns with lowest risk state)		Industry standard	Below industry standard





Social factors influencing agricultural land management practice adoption

Progresses understanding of the influence of human dimensions (social, economic, institutional, environmental and cultural factors) on innovation and stewardship. It develops a baseline for a variety of practice, behavioural and attitudinal drivers for agricultural management practice adoption and outcomes for Reef water quality. It provides a clearer understanding of project participants' attitudes and motivations to being involved in government-funded projects, as well as barriers to practice uptake/change. This will allow adaptive management of projects and communication content to be designed to suit landholders.

Economic benefits of agricultural land management practices

Provides a systematic set of comparative cost-effectiveness and profitability modelled data as it relates to priority Great Barrier Reef catchments, agricultural industries and practices. It helps programs to optimise their investments by providing economic information to facilitate the prioritisation and adoption of

the most cost-effective and profitable land management practices based on water quality risk. It also supports the development of regional Water Quality Improvement Plans and provides data to inform analysis of the costs of meeting the Reef 2050 WQIP water quality targets.

Non-agricultural land management practice adoption

Develops estimates of management practice adoption and management practice change for major urban land uses in Great Barrier Reef catchments (industrial and public lands will be introduced using a phased approach). It uses an urban water management practice assessment and reporting framework to assess and report the level of urban water stewardship to demonstrate the degree to which urban water managers are contributing to improving water quality. It also fosters innovation and stewardship of point source pollution management.





Management practice effectiveness and paddock pollutant delivery (agricultural land uses)

Paddock monitoring of water quality benefits

Conducts a range of paddock-scale water quality run-off trials (under natural and simulated rainfall conditions) in various regions, to provide on-ground evidence of water quality improvements from different land management practices under local climatic conditions and soil types. Paddock monitoring and rainfall simulation field trials provide measured evidence of the relative effectiveness of on-ground management practices for the models. Field trials also play an important role in extension through demonstrating practice effectiveness to landholders.

Paddock modelling of practice effectiveness (water quality)

Models a suite of defined farming systems which represent plausible management practice combinations and scenarios for a number of soils and climates. It links the management practice adoption data with the catchment model by providing estimates of sediment and nutrient loads and pesticide concentrations for management practice scenarios for the sugarcane, grazing, banana and grains industries. Paddock modelling results are a critical input to the catchment modelling.





Catchment condition

Ground cover monitoring

Maps and reports annually on ground cover levels in grazing lands in Great Barrier Reef catchments at a range of scales. Ground cover is important for reducing run-off and erosion. The program provides data to improve the water quality models. It also provides data and decision-support tools to help with land management practice improvement and evaluating the effectiveness of practice change programs and on-ground investments to improve ground cover.

Riparian vegetation extent monitoring

Maps and reports changes in the extent of riparian woody vegetation for Great Barrier Reef catchments every four years at a range of scales. Vegetation in riparian areas helps increase streambank stability and reduce erosion. The data is used to improve the water quality models. The information also helps prioritise investment activities.

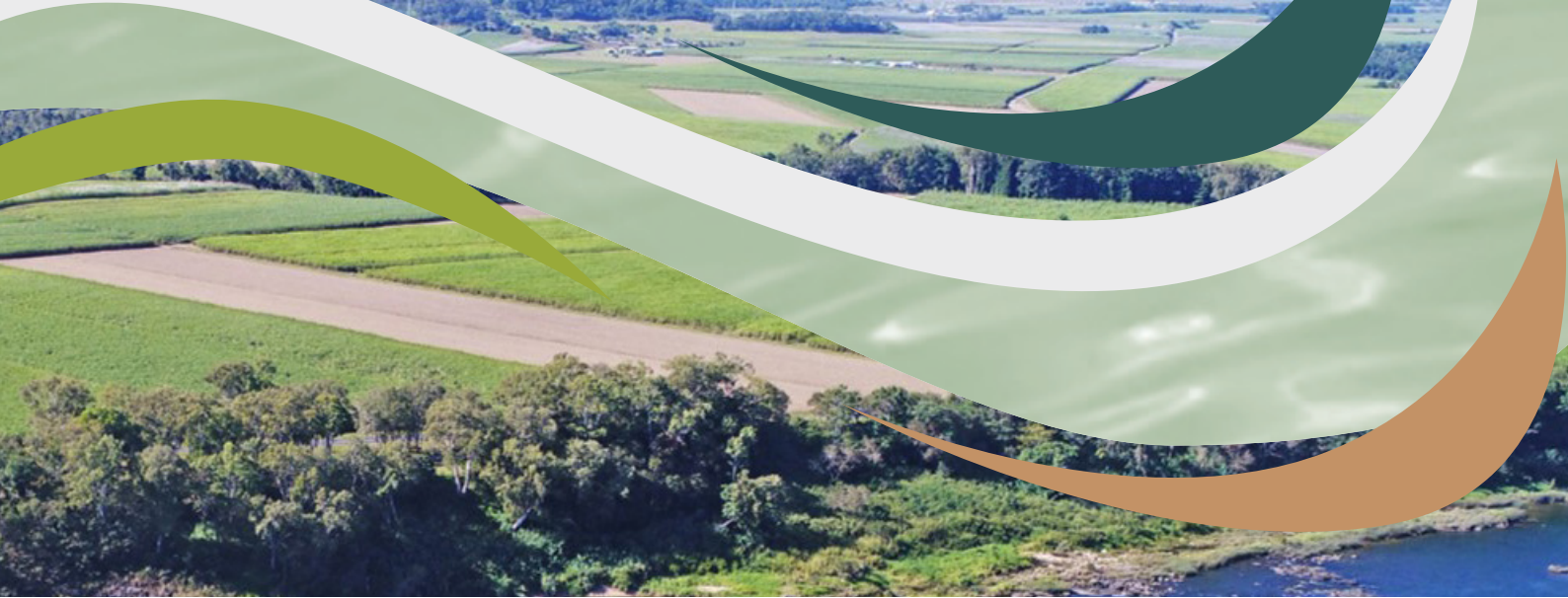
Wetland extent monitoring

Maps and reports on the historic (pre-clearing) and current extent of wetlands and change in natural and hydrologically modified wetland extent in Great Barrier Reef catchments every four years. The program identifies areas for targeting management to provide greater protection for natural wetlands and informs catchment restoration efforts.

Wetland condition and pressure monitoring

Assesses, monitors and reports on the condition of natural freshwater floodplain wetlands in Great Barrier Reef catchments and the pressures on them. Results inform the development of overarching programs directed towards restoring and best practice management of wetlands, reducing pressures and improving wetland condition.





Catchment pollutant delivery

Catchment loads monitoring

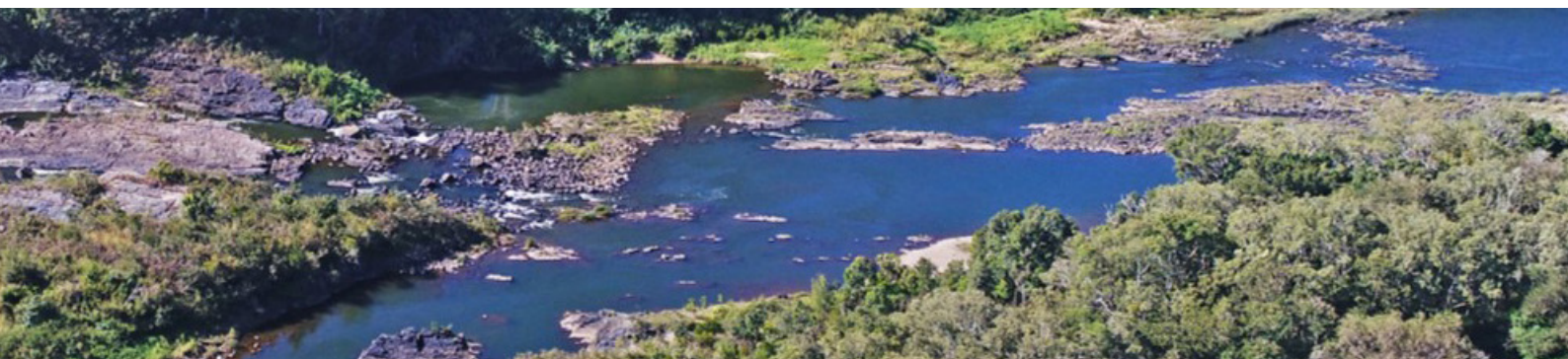
Monitors event and ambient concentrations of sediment (total suspended sediment), nutrients (nitrogen and phosphorus) and pesticides in 20 priority catchments that discharge to the Great Barrier Reef. It calculates sediment and nutrient loads (annual and daily) and the annual pesticide risk metric. This program delivers the primary monitoring data set used to validate and calibrate the catchment water quality models.

Catchment loads modelling

Models progress towards the pollutant load reduction targets by synthesising agricultural land management practice adoption, paddock monitoring, paddock modelling, catchment condition and catchment load monitoring data to estimate end-of-catchment pollutant loads. Total suspended sediment, nutrient and pesticide loads are calculated relative to a baseline, as a result of improved management practice adoption for each year. It is not possible to measure the impact of land management practice change on water quality through monitoring data alone so models are used in conjunction with monitoring data to predict long-term changes in water quality.

Why use modelling to measure pollutant load reductions?

Monitored pollutant loads leaving catchments vary significantly from year to year, mainly due to differences in annual rainfall and run-off. Therefore, catchment modelling is used to estimate the long-term annual pollutant load reductions due to the adoption of improved land management practices. This removes the impact of factors such as climate variability. Research suggests time lags to monitor the improvements from land management practice change could range from years for pesticides, up to decades for nutrients and sediments, due to the high level of climate variability. The models use measured changes in on-ground management and well-documented and accepted methods and assumptions. Long-term water quality monitoring data is used to validate and improve the models, continuously improving confidence in the estimates of water quality over time.





Marine condition

Marine Monitoring Program

Assesses trends in ecosystem health and resilience indicators for the Great Barrier Reef in relation to water quality and its links to end-of-catchment loads. There are three monitoring sub-components—water quality (including pesticides), seagrass and coral. The objectives for each sub-program are:

Water quality:

1. Report the three-dimensional extent and duration of flood plumes and link concentrations of suspended sediment and nutrients to end-of-catchment loads, and end-of-catchment pesticide concentrations to marine concentrations.
2. Report trends in inshore concentrations of sediment, chlorophyll-a, nutrients and pesticides against the Water Quality Guidelines for the Great Barrier Reef Marine Park.
3. Report trends in turbidity and light attenuation for key inshore habitats.

Seagrass:

1. Report the condition and trend of Great Barrier Reef inshore seagrass meadows.
2. Report the extent, frequency and intensity of acute and chronic impacts on the

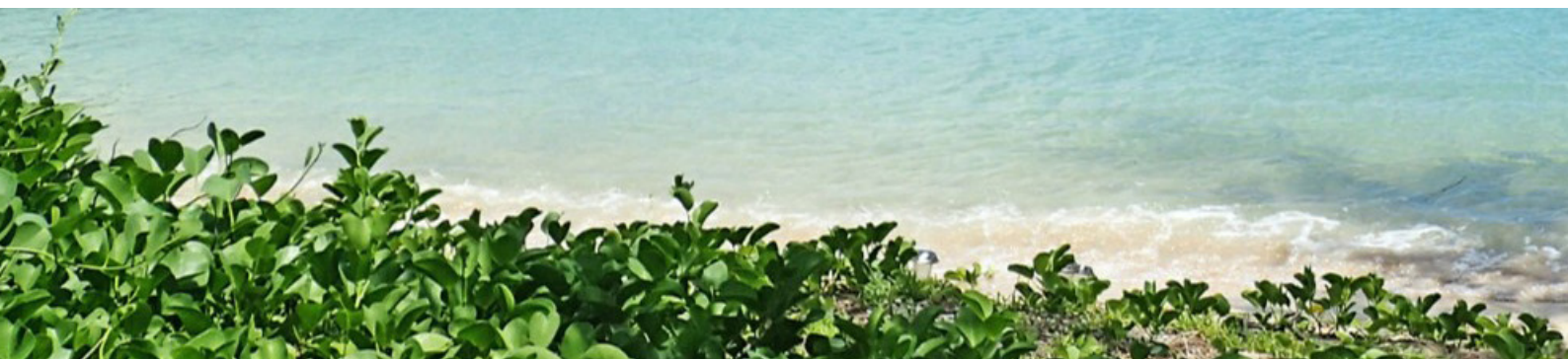
condition of Great Barrier Reef inshore seagrass meadows from sediment, nutrients and pesticides.

3. Report the recovery of Great Barrier Reef inshore seagrass meadows from exposure to flood plumes, sediment, nutrients and pesticides

Coral:

1. Report the condition and trend of Great Barrier Reef inshore coral reefs.
2. Report the extent, frequency and intensity of acute and chronic impacts on the condition of Great Barrier Reef inshore coral reefs from sediment, nutrients and pesticides.
3. Report the recovery of Great Barrier Reef inshore coral reefs from exposure to flood plumes, sediment, nutrients and pesticides.
4. Report trends in coral reef resilience indicators.

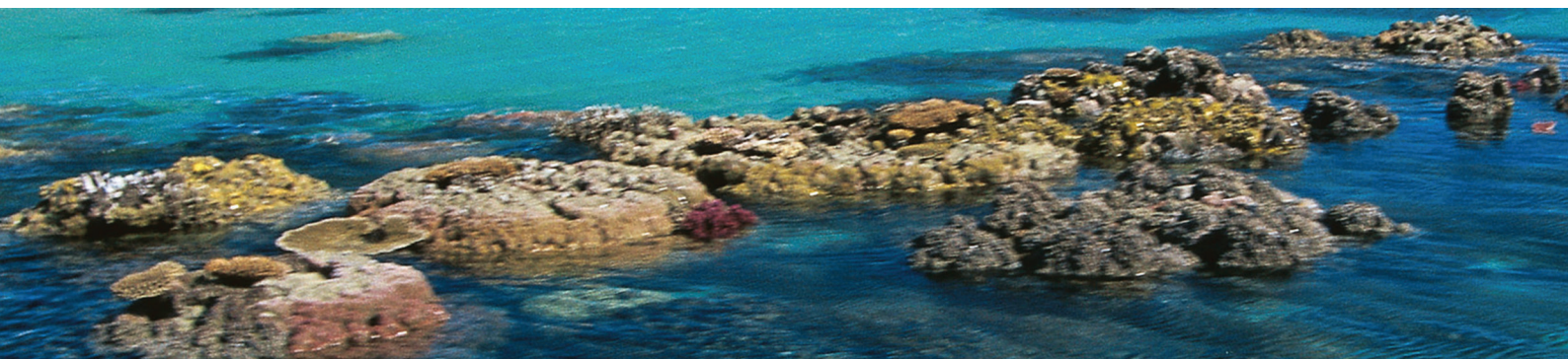
The Great Barrier Reef Marine Park Authority leads management of this program with monitoring and reporting undertaken in partnership with a variety of research and management partners.





Marine modelling

Uses a modelling framework in conjunction with monitoring data and satellite observations to report marine water quality condition across the Great Barrier Reef. eReefs can also assess the impact of individual rivers flowing into the Great Barrier Reef and estimate the extent and properties of flood plumes. It can also be used to simulate the impact of different management practices on downstream marine water quality. eReefs models variables covering physical properties (temperature, current, light penetration) as well as biogeochemical parameters (concentration of nutrients, sediments, plankton and chlorophyll-a).





Program management

The Paddock to Reef program is a collaborative program involving approximately 20 organisations and more than 100 individuals. Sound governance and coordination arrangements are critical to the success of such a complex and interdisciplinary program.

More information about the program is available on the Reef 2050 WQIP website:

www.reefplan.qld.gov.au

