Frequently Asked Questions: Draft Reef 2050 Water Quality Improvement Plan and 2017 Scientific Consensus Statement

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Status of the Great Barrier Reef

1. How healthy is the Reef?

The latest scientific consensus is that important marine and freshwater ecosystems are in poor condition. However, this varies along the length (2300 kilometres) and breadth of the Reef.

Inshore marine water quality from the Wet Tropics in the north to the Fitzroy in the central region of the Reef remains in moderate to poor condition. This is linked to pollutant inputs from land run-off, especially when there is a large amount of rainfall. There is no regular marine water quality data collection in the Burnett Mary region, in the southern part of the Reef; however, modelled results indicate that water quality is in good condition. Marine water quality in the Cape York region in the far north is less affected by land-based runoff due to limited catchment development.

The condition of **coastal freshwater wetlands** in the Great Barrier Reef catchment has declined considerably, and many wetlands are under high threat of degradation by a range of chronic and acute pressures such as excess nutrients and sediment, high concentrations of pesticides, loss of connectivity, changes in hydrology and invasive species.

On **inshore coral reefs**, the cumulative impact of tropical cyclones, extreme flood events, and recent outbreaks of crown-of-thorns starfish resulted in declines in **coral community** condition between 2012 and 2014. More positively, indicators of coral reef resilience improved between 2014 and 2016, coinciding with a period of below average rainfall (resulting in reduced run-off from land). However, a severe mass thermal coral bleaching event in 2016 resulted in significant coral mortality, especially north of Port Douglas. Ongoing, warmer-than-average sea temperatures resulted in further, widespread, mass coral bleaching in 2017 which was most intense on reefs between Cairns and Townsville. In addition, severe Tropical Cyclone Debbie affected reefs in the Mackay Whitsunday region and subsequent flooding also affected the Fitzroy region. The full impacts of these events are still emerging and we continue to monitor the Reef's condition.

Inshore seagrass meadows continue to recover from previous losses during the period of major run-off events and cyclones from 2007 to 2013, but remain in very poor to moderate condition across the Great Barrier Reef.

Threats to the Reef

2. What are the biggest threats to the Great Barrier Reef?

The cumulative effects of multiple pressures substantially reduce the health and resilience of the Great Barrier Reef. This includes the combined impact of land run-off associated with past and ongoing catchment development, coastal development activities, extreme weather events and climate change impacts such as the recent coral bleaching events. Additionally, **coastal ecosystems have been highly modified** and continue to be exposed to a range of catchment development pressures.

In addition to exposure to degraded water quality from land-based runoff, the systems have been severely impacted by a number of recent events—including prolonged periods of extreme sea surface temperatures, tropical cyclones and the progression of the fourth wave of crown of thorns starfish population outbreaks. Climate change is predicted to increase the frequency of large scale bleaching events and the intensity of extreme weather events.

3. What is ocean acidification, what causes it, and how does this affect the Great Barrier Reef?

Ocean acidification is the lowering of seawater pH, caused by the absorption of carbon dioxide (CO_2) by the oceans from the atmosphere. The ocean absorbs about a quarter of the CO_2 released into the atmosphere every year, so as atmospheric CO_2 levels increase, so do the levels in the ocean. Ocean acidification is increasingly recognised as an important water quality pressure on the Great Barrier Reef and on coral reefs globally.

Biological processing of the abundant organic matter (such as decaying plants and animals) in inshore waters releases additional CO_2 during the night, which reduces pH. As a result, the levels of CO_2 on Great Barrier Reef inshore reefs have disproportionately increased compared to atmospheric levels. There is strong evidence for adverse effects of increased CO_2 levels on many coral reef organisms, ranging from microbes to fish.

Research tells us that ocean acidification can:

- reduce coral calcification and coral growth
- affect the mega-diversity of coral reefs
- reduce crustose coralline algae (which provides a settlement platform for coral larvae)
- increase the abundance of macroalgae and seagrasses

- increase bio-erosion and coral disease which are exacerbated by high nutrient availability.

4. What are the impacts of sediments, nutrients and pesticides on the Reef, and where do they come from?

Sediments, nutrients and pesticides are the three biggest pollutants that affect the health of the Great Barrier Reef.

(a) Sediments

What are sediments and what impact do they have on the Reef?

Sediments in water are measured as 'total suspended solids' or 'total suspended sediment', and are characterised by different particle sizes, for example, clay, silt and sand. It is the fine fraction (silt and clay) that is of greatest concern to marine ecosystem health. Fine (<16 µm) sediment moves furthest into the marine environment. This leads to increased turbidity and reduced light for seagrasses and coral, reducing their growth. When this sediment settles, it can have detrimental effects on the early life stages of corals, and in more extreme conditions, can smother corals and seagrass.

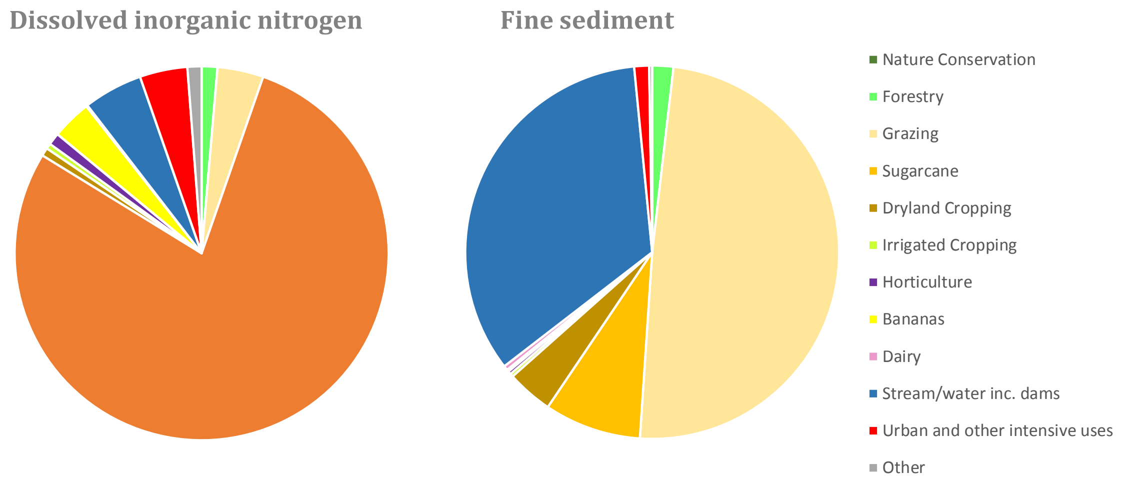
Where do sediments come from?

Monitoring and scientific modelling indicate the main source of sediments from the Great Barrier Reef catchment is from agricultural land uses.

Grazing (49%) and streambank erosion (34%) are the greatest contributors of anthropogenic fine sediments delivered to the Reef. Sugarcane cropping (8%) and dryland (non-irrigated) cropping (4%) also contribute to the fine sediment loads delivered to the Reef.

All other land uses have minor contributions. Urban and other land uses, including mining and industrial, contribute less than 1% to the fine sediments discharged onto the Reef.

Proportion of dissolved inorganic nitrogen and fine sediments generated by the type of land use in the Great Barrier Reef catchments



(b) Nutrients

What are nutrients?

Nutrients are the natural chemical elements and compounds that plants and animals need to grow. Carbon, hydrogen and oxygen are abundant nutrients in nature, but nitrogen and phosphorus are not always so freely available. They promote plant growth, making increased levels (e.g. from excess fertilisers) an issue for the Great Barrier Reef.

Nitrogen and phosphorus are transported in run-off as tiny particles (particulates) often attached to sediment and dissolved in water. The dissolved fraction can be organic (a compound including carbon) or inorganic (a compound without carbon). The dissolved nutrients are immediately available for biological uptake. While particulate nutrients may also become biologically available, the time scales and processes are not well known.

Particulate nutrients are mostly deposited close to river mouths. Once they settle, they can be broken down by bacteria into dissolved inorganic nutrients; nitrogen can also become a gas. The dissolved nutrients may then travel further into the Great Barrier Reef lagoon where they are consumed by phytoplankton, algae and bacteria. Further transport of the nutrients may also occur outside of the wet season and can be released from the sediments for years after they are deposited.

What impacts do nutrients have on the Reef?

Excess nutrients can upset the natural balance of reef ecosystems. There is strong evidence for several effects of nutrients on Great Barrier Reef ecosystems, including increased outbreaks of crown-of-thorns starfish, macroalgae abundance resulting in lower coral diversity, increased coral bleaching susceptibility, increased bioerosion and some coral diseases, reduced benthic light due to algal blooms and increased macroalgae and epiphytes on seagrass. While most effects occur in the wet season during river discharge conditions, some effects have consequences beyond the wet season and continue for many years, for example crown-of-thorns starfish outbreaks.

Most of the land-based nitrogen and phosphorus discharged into the Great Barrier Reef is in particulate form, but this varies greatly between catchments. However, **dissolved inorganic nitrogen and phosphorus are of greatest concern** because they are immediately and completely available for uptake by marine plants.

Where do nutrients come from?

Monitoring and scientific modelling show that sugarcane is by far the greatest contributor to the dissolved inorganic nitrogen that is transported to the Great Barrier Reef (contributing 78% of the anthropogenic load). This is primarily from applied fertilisers.

Urban areas contribute 9% of the anthropogenic dissolved inorganic nitrogen load, and may be important at local scales.

Grazing areas contribute approximately 4% of the anthropogenic dissolved inorganic nitrogen load transported to the Reef, but this mostly originates from low concentrations of dissolved inorganic nitrogen over very large areas.

Most particulate nutrients come from grazing areas, although sugarcane land-use dominates contributions in the Wet Tropics and Mackay Whitsunday regions.

(c) Pesticides

What are pesticides?

Pesticides, including herbicides, insecticides and fungicides – for protecting agriculture against pest organisms (e.g. weeds and insects) – have been detected in sediments and waters of rivers, creeks, wetlands, estuaries, and the inshore parts of the Great Barrier Reef lagoon.

The types and concentrations of pesticides in the fresh, estuarine and marine ecosystems vary between catchments and regions, reflecting the main land use type in each area.

What impacts do pesticides have on the Reef?

Pesticides are man-made compounds, not found in the natural environment. Pesticides are carried in river run-off and take a long time to break down in the environment (months to years). Pesticides have been detected inshore at concentrations high enough to affect the health of plants and corals in the Great Barrier Reef. The pesticides commonly used in sugarcane for weed control, act by inhibiting photosynthesis, which is why they are so good at controlling weeds, and thus can affect non-target species such as seagrasses.

Based on laboratory studies, pesticides have been reported to affect a range of marine organisms including corals, microalgae, crustose coralline algae and seagrass. The effects of ongoing low level pesticide exposures in inshore Great Barrier Reef environments are unknown but are likely to affect coral fertility and reproduction. Less is known of the adverse effects of pesticides to the Great Barrier Reef freshwater, wetland and estuarine ecosystems, although the proximity of these ecosystems to pesticide sources would suggest that exposure to high levels, and associated toxic effects is likely.

Pesticide mixtures produce an additive effect in organisms, and when combined with other stressors the combined effects are often found to be greater.

Where do pesticides come from?

Monitoring and scientific modelling indicate the main source of pesticides from the Great Barrier Reef catchment is in runoff from agricultural activities.

Sugarcane areas are the largest contributors of pesticides (more than 95% of the total load).

5. How much pollution comes from urban, industry and mining compared to agriculture?

The main source of excess nutrients, fine sediments and pesticides from Great Barrier Reef catchments is agriculture which dominates land use areas. Sugarcane-growing areas are the largest contributors of:

- dissolved inorganic nitrogen: 78% of the anthropogenic load
- pesticides: more than 95% of the load.

Grazing contributes the largest proportion of sediment (49% of the anthropogenic total load) – mostly through erosion from gullies, streambanks and deep rill hillslope erosion (called 'sub-surface' erosion).

Combined other land use – including urban areas, mining and industrial – contribute relatively small but concentrated pollution loads; for example, less than 1% of the total fine sediments. Urban areas including sewage treatment plants contribute 9% of the anthropogenic dissolved inorganic nitrogen loads delivered to the Great Barrier Reef.

While, the loads of pollutants that are measured per unit area can be high for more intensive land uses such as urban development, mining or intensive cropping, they usually only cover small areas, so the total load delivered to the Great Barrier Reef is comparatively small – though they can have important local impacts.

6. What are the impacts of other pollutants on the Reef?

We know there are pollutants other than sediment, nutrients and pesticides in the waters of the Great Barrier Reef. These include anti-fouling paints, coal particles, metals and metalloids, marine debris/microplastics, personal care products, petroleum hydrocarbons and pharmaceuticals.

Sources of some of these pollutants – for example sewage treatment plants – are regulated to control pollution.

Scientists have assessed marine plastic pollution as the highest risk emerging pollutant for the Reef. This is greatest in the Cape York region because of that region's exposure to oceanic and local shipping activities.

South of Cape York, chronic contamination of water and sediments with anti-fouling paints and exposure to certain personal care products is also important. The qualitative risks of all other emerging pollutants are relatively low with some minor differences between natural resource management regions.

7. What impact does port expansion and dredging have on the Great Barrier Reef?

Port development has been the major reason for filling in areas of ocean, wetlands or other water bodies (coastal reclamation) along the Great Barrier Reef coast.

The total area reclaimed is approximately eight km^2. Most of the reclamation was in the Gladstone region. Port development can also create artificial barriers to freshwater flow, such as bund walls and infrastructure in waterways.

There are 20 operational ports along the Queensland coastline, including 12 ports within or near the Great Barrier Reef World Heritage Area.

Dredging is important for maintaining safe movement within a port.

However, dredging can directly damage local inshore marine habitats (e.g. seagrasses) by burying or removing them. It can also increase the amount of sediments suspended in the water, the turbidity and coverage in sediments after dredging – this indirectly affects animals and plants, and their habitats. They may also be exposed to pollutants released during dredging that were attached to fine sediments.

Does dredged material affect water quality?

Disposing of dredge material affects water quality. The impacts depend on the quantity of material, the method of disposal, how close it is to sensitive ecosystems, and how much the material will disperse.

The Queensland *Sustainable Ports Development Act 2015* prohibits disposing of capital dredge material (from creating new areas) at sea in the Great Barrier Reef World Heritage Area.

There is a lack of research into the coastal effects of disposing of dredge material on land.

Dredging and its disposal may be a significant source of fine sediments in specific locations within the World Heritage Area. However, with the *Sustainable Ports Development Act 2015* in place, current projections indicate that dredging will contribute much less fine sediment in the future – potentially about 5–10% of the sediments from rivers, in comparison.

Management actions to protect Great Barrier Reef

8. How does improving water quality help the Great Barrier Reef compared to the increasing threat of climate change?

The current poor state of Great Barrier Reef ecosystems is from the combined impacts of land run-off from development in the catchment now and in the past, coastal development, extreme weather events, and climate change impacts such as coral bleaching events.

The environment is changing with more extreme weather events occurring, and ocean warming and ocean acidification predicted to intensify.

This means it is **even more important** to increase and accelerate efforts to mitigate local stressors such as land-based sources of pollution, coastal development, and the management of direct uses including fishing. This will buy time for coastal and marine organisms to adapt to the continued intensification of global pressures.

We know reefs can recover from acute disturbances, as has happened in periods of low rainfall (and therefore reduced run-off). This makes a strong case for reducing the pollution being delivered to the Great Barrier Reef.

Research demonstrates that the future resilience of the Reef's coastal and marine ecosystem can be improved by more intensively managing catchment water quality and, at the same time, managing other local pressures such as fishing. We also need to actively protect landscapes, and undertake direct restoration to maintain as much of the Great Barrier Reef's biodiversity and ecosystem function as possible.

This must be supported by more effective measures to reduce global climate change.

9. How will the priorities in the risk assessment of the Scientific Consensus Statement inform investment?

To support the 2017 Scientific Consensus Statement, an ecological risk assessment approach provided an improved analysis of the likelihood of exposure of land-based pollutants (nutrients, sediments and pesticides) to coastal (floodplain wetlands and floodplains) and marine (coral reefs and seagrass meadows) ecosystems.

The new assessment included all 35 catchments that discharge into the Great Barrier Reef. The risk to marine ecosystems was assessed within eight marine zones to reflect the collective influence of rivers which may extend across current management boundaries: Cape York North, Cape York Central, Cape York South, Wet Tropics, Burdekin, Mackay Whitsunday, Fitzroy and Burnett Mary.

A risk assessment of emerging pollutants (recently completed as part of the National Environmental Science Program) in Great Barrier Reef ecosystems was also incorporated.

Increased loads of fine sediments, nutrients (nitrogen and phosphorus) and pesticides were shown to all be important at different scales and different locations in the Great Barrier Reef. The risks also differ between the individual pollutants, source catchments and the distance from the coast.

Several catchments contribute to the highest exposure of coastal or marine ecosystems to pollutants and are considered a high priority for water quality improvement: Russell-Mulgrave, Johnstone, Tully, Herbert, Haughton, Burdekin, Pioneer, Plane, Fitzroy and Mary catchments. Social and economic information is needed to prioritise efforts within these catchments.

The results of the assessment can be used to inform management priorities for improving water quality from catchments that discharge into the Great Barrier Reef World Heritage Area.

- Exposure to **fine sediment** is most significant to areas of shallow seagrass and coral reefs on the inner shelf next to catchments with high **anthropogenic fine sediment** loads. The greatest coral reef and seagrass exposure to **fine sediment** is from the Burdekin, Fitzroy, Mary, Herbert, Johnstone and Burnett catchments. The Burdekin and Fitzroy catchments also contribute the greatest **fine sediment** risk to seagrass ecosystems.
- Exposure to **dissolved inorganic nitrogen** is most significant to all inner shelf areas and the mid-shelf area between Lizard Island and Townsville next to catchments with high **anthropogenic dissolved inorganic nitrogen** loads. The relative importance of **dissolved inorganic nitrogen** to seagrass ecosystems is still uncertain, but it may influence light availability for deepwater seagrass in areas deeper than 10 to 15 metres, due to increased phytoplankton (microalgae) growth.
- The greatest coral reef and seagrass exposure to **dissolved inorganic nitrogen** is from the Herbert, Haughton, Johnstone, Russell-Mulgrave, Tully, Plane and Murray catchments. The Herbert, Johnstone, Russell-Mulgrave and Tully catchments also contribute the **greatest dissolved inorganic nitrogen risk** to coral reefs and primary crown-of-thorns starfish outbreaks. **Anthropogenic particulate nitrogen** is also likely to be of some importance in the same areas, as well as the Fitzroy Catchment. But we still have only limited knowledge about the bioavailability of particulate nitrogen to the marine ecosystems relative to that of dissolved inorganic nitrogen.

10. Why is it important to manage ground cover when a lot of the sediment comes from gullies and streambanks?

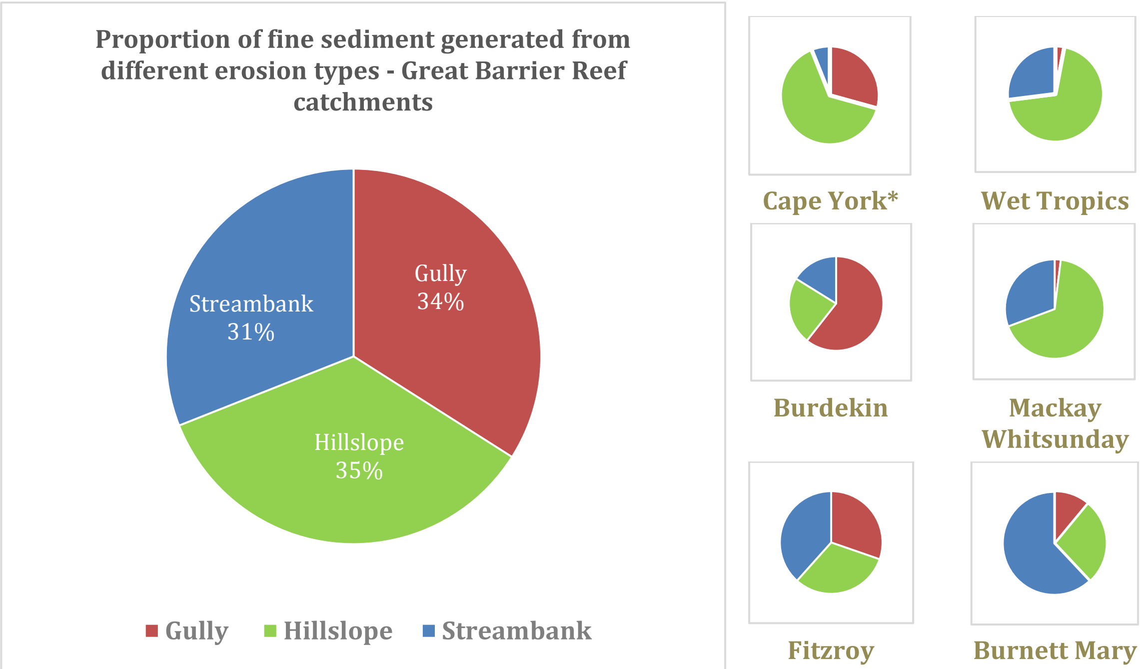
There are two main types of sediment erosion:

- sediment eroded from hillslopes or paddocks, which is known as **surface erosion**
- sediment eroded from gullies, streambanks and deep rill erosion and scalds on hillslopes, which are considered as **sub-surface erosion**.

Soil loss from grazed hillslopes increases as vegetation cover decreases, with the rate decreasing sharply as cover increases beyond 40%. Improving land condition on hillslopes above gullies also helps reduce gully erosion.

Based on the most recent Source Catchments modelling, the proportion of sediment from the different sources is similar:

- 35% estimated to be generated from hillslope erosion
- 34% from gully erosion
- 31% from streambank erosion.



These numbers vary between regions. For example, hillslope erosion dominates sediment sources in the Wet Tropics, Mackay Whitsunday and Cape York (except the Normanby Catchment) regions, while sub-surface erosion dominates sediment sources in the Burdekin, Fitzroy and Burnett Mary regions.

The modelling results are supported by tracing studies that suggest that sub-surface erosion is the primary source of sediment.

To reduce sediment loss in rangeland grazing, particularly hillslope and streambank erosion processes, established practices include:

- maintaining ground cover (particularly of native grasses and perennials) and forage biomass, especially at the end of the dry season
- setting appropriate stocking rates
- excluding stock from riparian/frontage country and rilled, scalded and gullied areas
- locating and constructing linear features (roads, tracks, fences, firebreaks and water points) using best practice management techniques to help minimise erosion risk.

11. Is managing run-off of particulate nutrients and sediments different? What do we know, and what more could we find out?

Rangeland grazing dominates sediment and particulate nutrient loads delivered to the Great Barrier Reef.

These are mobilised by hillslope, streambank and gully erosion processes. This means the best management recommendations for reducing sediment and particulate nutrient loads are also minimising soil erosion. Therefore, the management recommendations for reducing the loss of sediments and particulate nutrients are currently similar.

Hillslope erosion is the main source of particulate nutrients from grazing lands, because the surface soil is typically the most nutrient-enriched. New knowledge indicates that alluvial gullies in grazed catchments are also likely to be important sources of bioavailable nutrients, because there are large areas of these erosion features in the Reef catchments.

This demonstrates how important it is for us to increase our understanding of the sources, transport, transformation and processing, fate and impact of bioavailable nutrients on the Reef. It may also shed light on the relative importance of managing erosion (and certain erosion processes, depending on the catchment) compared to reducing fertiliser losses at a catchment or smaller scale to meet nutrient load reduction targets.

Despite these uncertainties, the most recent water quality risk assessment for the Great Barrier Reef indicates that it is important to reduce both nutrients and sediments entering Great Barrier Reef ecosystems. If we can better understand the sources, delivery and transformation of particulate nutrients, we can refine catchment-specific management priorities.

12. How does land clearing affect sediment erosion?

If the soil surface is exposed or disturbed through tree clearing or a change in land use, water and sediment loss is likely to increase.

For example, studies in semi-arid rangeland areas in Queensland suggest that converting (Brigalow) forest to pasture can increase run-off by approximately 80% at sub-catchment scales and approximately 40% at catchment scales. Essentially, these studies suggest clearing of forest can result in run-off doubling.

Maintaining ground cover and forage biomass of vegetation, including through droughts, is important to protect the soil from:

- rain splash and rill (small channel) erosion
- gully incision (large channel erosion)
- overland run-off during small rainstorms.

Some tree cover can also help run-off soak into the soil.

Given their beneficial effects on soil health, removing trees could have long-term negative effects on soil nutrients, soil fertility, pasture production and the amount of pasture.

Are trees different to pasture in terms of run-off and sediment loss?
There is much debate about the difference between trees and pasture cover for sediment loss. Studies have shown that once sown pastures are fully established after tree clearing, which can take a number of years, run-off may be similar to natural woodlands. However, because trees are good for soil health, removing them may have longer term negative biological and ecological effects in rangelands.

13. Why is land next to streams and rivers important for the Great Barrier Reef?

There are an enormous number of studies demonstrating that vegetation in riparian zones (the area between streams/rivers/wetlands and the surrounding land) reduces streambank and gully erosion.

For example, a study in the Daintree catchment demonstrated that erosion on banks with vegetation had 6.5 times (or 85%) less erosion than sites without vegetation. Subtropical Queensland rivers surrounded by riparian vegetation had 50–200 times less sediment loads than rivers without.

Riparian vegetation can work in different ways. In headwater areas, trees can provide woody debris in the channel that slows water flow, leading to better channel and bank stability. In middle reaches, tree roots can strengthen the bank. In lower reaches, where channels are often wider and banks are higher, vegetation can maintain steeper banks.

Local studies have shown that vegetated riparian zones may have some, but only a modest direct influence on nutrient removal, and that this largely depends on surrounding land uses, rainfall conditions, slope and the type of vegetation cover.

14. Why are wetlands important for the Great Barrier Reef?

The ecological health and the economic value of the Great Barrier Reef depends, in part, on the health of its wetlands.

Wetlands make a significant contribution to the biodiversity, carbon sequestration and improvement of water quality of the Great Barrier Reef, even though they are a relatively small area of the Great Barrier Reef coastal landscape.

Freshwater wetlands in Reef catchments can provide nurseries for freshwater and marine animals, slow the flow of water over land and, in some cases, retain sediment, and absorb and transform pollutants.

Each wetland is different – in size, type, location, condition, connection to other water – and so is their capacity to improve water quality for the Reef.

Wetlands and floodplain protection, management and restoration, as well as engineered treatment systems have a role in complementing on-farm practices to reduce nutrient, sediment and pesticide run-off.

Has the extent of wetlands near the Reef changed?
The area of natural and near-natural wetlands in the Great Barrier Reef catchment has decreased by about 15% compared to pre-development times (as measured in 2013), and the area of mapped freshwater swamps ('palustrine wetlands') has decreased by just under a quarter.

However, more than 80% of floodplain wetlands have been lost in the lowland areas of some catchments, such as the Herbert.

The 2014 Outlook for the Great Barrier Reef indicated that wetland condition in Reef catchments has declined considerably, and many wetlands are under high threat of degradation.

Pressures that threaten wetlands include: excess nutrients, sediments, pesticide loads, loss of connectivity, changes in how water moves (hydrology), and invasive species.

15. Has Reef water quality improved?
Government, industry, agriculture and community investment is reducing pollution of our waterways, improving the quality of water flowing to the Reef. This is largely a result of land managers changing the way they use the land, including farmers leading with innovative management practices.

The Smartcane Best Management Practice (BMP) and Grazing BMP programs are examples of strong partnerships involving the agricultural industry, landholders and governments to improve the productivity, profitability and sustainability of farm enterprises.

Momentum is building and needs to continue. Adopting key practices to stop pollution is not yet sufficiently widespread or rapid enough. As there is a time lag between these land-use changes and improvements in water quality accelerated adoption of improved practices is essential.

Reef 2050 Water Quality Improvement Plan

16. What is the Reef 2050 Water Quality Improvement Plan?
In 2015, the Australian and Queensland governments released the Reef 2050 Long-Term Sustainability Plan (Reef 2050). Reef 2050 has seven themes for managing the Great Barrier Reef World Heritage Area:

- ecosystem health
- biodiversity
- heritage
- **water quality**
- community benefits

- economic benefits
- governance.

The Reef 2050 Water Quality Improvement Plan 2017-2022 (the Plan) is nested under the water quality theme of Reef 2050 and will replace the Reef Water Quality Protection Plan 2013.

It is a joint commitment of the Australian and Queensland governments to address all land-based run-off flowing from the 35 catchments next to the Great Barrier Reef. Note: water quality actions relating to ports and dredging are only captured in the Reef 2050 Long-Term Sustainability Plan.

The plan builds on previous water quality plans developed in 2003, 2009 and 2013, and now:

- includes all sources of land-based water pollution (agriculture, industry, urban and public lands) while recognising that most water pollution still arises from agriculture
- incorporates human dimensions of change: our social, cultural and economic values and why we take action to improve water quality
- sets individual catchment targets for reducing water pollution, enabling better prioritising where most action is needed.

17. How were the targets set? Are they the same as the government's earlier commitments? What is different?

The Plan's targets are:

- aimed at improving water quality by reducing water pollution and managing how the land, catchment and humans affect water quality
- based on the best available science, brought together within a Scientific Consensus Statement written by reputable scientists from a wide range of disciplines
- built on what we already knew from the scientific evidence that informed the previous 2003, 2009 and 2013 Reef Water Quality Protection Plans
- set based on the Great Barrier Reef Marine Park Authority's Reef water quality guidelines which used a combination of catchment modelling (to estimate reductions from improved land management practices), eReefs marine water modelling (to calculate how pollutants impact the Reef), and expert science advice and technical knowledge.
- Progress made since 2013 will count towards the targets. Progress between 2009 and 2013 has been accounted for when setting the targets, with the new targets additional to the gains already made.

The government's earlier commitments, set in the Reef 2050 Long-Term Sustainability Plan, were up to an 80% reduction in dissolved inorganic nitrogen from priority catchments and up to a 50% reduction in sediment from priority catchments. The new water quality nutrient and fine sediment targets are set as reductions to the end-of-catchment loads for the catchments that flow into the Great Barrier Reef. This provides specific reductions for each catchment, taking us to a higher level of precision from the previous Great Barrier Reef-wide targets. However, there was not enough available information to set specific targets for the Black River, or to set sediment and particulate nutrient targets for the Ross River.

To measure ecosystem protection we use pesticide concentrations rather than loads, as pesticide concentrations are a better determinant for measuring their effect on aquatic ecosystems. In line with this, the **pesticide** target has been changed from a load reduction target to an ecosystem protection target that makes sure at least 99% of aquatic species are protected from pesticide impacts.

18. Why are the targets now at a catchment level? Shouldn't we be looking at the whole Reef?

The catchment level targets have been aggregated to give regional targets for the six natural resource management regions and overall targets for the Great Barrier Reef.

The catchment-level targets consider how local rivers and situations individually affect an area of the Reef. This means funding and interventions are better targeted to local issues, and the best on-ground interventions are prioritised.

Past Reef Water Quality Protection Plans and the Reef 2050 Long-Term Sustainability Plan set Great Barrier Reef-wide targets. The new targets provide greater definition of the current Reef 2050 Long-Term Sustainability Plan targets that commit to achieving reductions of up to 80% in dissolved inorganic nitrogen and 50% in sediments by 2025.

19. What does a zero target mean?

Catchments with a zero target have minimal anthropogenic pollutant loads. The aim in these catchments is to maintain current water quality so that there are no increases in pollutant loads.

20. Will targets be set in future for catchments that were not able to be determined?

Catchment specific targets have not been defined for the Black Catchment for fine sediment, dissolved inorganic nitrogen and particulate nutrients, and for the Ross Catchment for fine sediment and particulate nutrients. This is because no eReefs marine modelling was available, targets had not been set in the Burdekin Water Quality Improvement Plan and there were limited alternative methods to set ecologically relevant targets. A dissolved inorganic nitrogen load reduction target was set for the Ross Catchment based on comparison with similar catchments. Targets for the Black and Ross catchments could be set in the future if new information becomes available.

21. Is there a link between the management priorities and the water quality targets?

The management prioritisation results are closely linked with the catchment scale targets for fine sediment, dissolved inorganic nitrogen, particulate nitrogen and particulate phosphorus. A comparison of the tonnage reductions shows a good correlation between the highest target reductions and the highest priority catchments for each parameter. There are some exceptions due to the different methodologies used and the differing purposes of the two approaches.

The targets are based on water quality thresholds at which coral reefs and seagrass are able to survive with no damaging effects. As the analysis is performed on a catchment scale, it shows those areas which need large reductions in pollutant loads to reverse the decline in coral or seagrass health across the Great Barrier Reef. Accordingly, the targets also inform where intensive management actions will be required to achieve satisfactory coral or seagrass health outcomes.

For example, rivers in the Wet Tropics flow to the zone where crown-of-thorns starfish initiate and are, therefore, a higher priority for reducing dissolved inorganic nitrogen which leads to increased outbreaks of crown-of-thorns starfish. The Mary River flows out onto the important seagrass beds in Hervey Bay and is, therefore, a higher priority for reducing sediment which blocks the light available to seagrass and restricts its growth.

22. How are local priorities for improving water quality created from the larger scale Plan?

The Plan aims to improve the quality of water flowing to the Reef.

The Plan sets the strategic priorities for the whole Reef catchment. It identifies and prioritises the sources of pollution that pose the highest risks to the Reef from land-based activities, and identifies key priorities and efforts to deliver reductions.

Regional Water Quality Improvement Plans, developed by regional natural resource management bodies, and other catchment based plans including those developed by local government and catchment care groups, support the Plan's priorities by providing locally relevant information and guiding local priority actions within regions.

23. Given the sheer scale of the Reef and the predicted impacts of climate change, what can people do to make a difference?

We need to focus on giving the Reef the best chance to adapt to and recover from the impacts of climate change, by working to reduce other significant, local pressures on the Reef, such as water pollution. People living in or visiting Reef catchments can make sure their actions are not contributing to local water pollution from littering, polluting stormwater, or land development.

In the meantime, our governments, councils and community groups are making considerable, ongoing efforts to reduce the impacts of climate change and improve water quality. Landholders are also working hard to revegetate streambanks, restore degraded areas, follow best management practices and protect wetlands. Vegetation helps to improve water quality and stores carbon.

Everyone can act to reduce their individual impacts on the climate and improve water quality.

24. The Plan mentions the problem of plastic pollution in oceans. Why are there no actions in the Plan to reduce plastic pollution?

The Reef 2050 Plan includes actions for cleaning up of marine debris, but we don't have enough scientific evidence to set appropriate local targets to reduce plastic pollution.

The Plan includes ensuring that all water quality impacts are appropriately addressed through legislation and regulation, which includes existing legislation that already prohibits littering of land or waterways with plastics, and future proposals such as banning single use, lightweight plastic bags. Many community groups also contribute through marine debris clean up and reduction initiatives in addition to the Reef 2050 Plan clean-up actions.

25. Who is funding the actions in the Plan?

The Australian and Queensland governments are investing $763 million (2013-2022) to improve the quality of water entering the Reef.

That government investment is coordinated and prioritised based on risk to the Reef, and supported by local decision-making.

Work is also funded by a range of other stakeholders including industry, local governments, philanthropic organisations, conservation groups and the community.

26. How will we know if the Plan is working or not?

We assess progress towards the Plan's targets by collecting and analysing data through the Paddock to Reef Integrated Monitoring, Modelling and Reporting Program and making it available through the Great Barrier Reef Report Card.

27. What does 'adaptive management approach' mean for the Plan?

An adaptive management approach means the initiatives and activities governments and partners deliver are regularly monitored to ensure they are delivering the actions and outcomes in the plan. The results of monitoring and evaluation, as well as emerging science and other knowledge, are used to guide decision making, so that activities and investments can be adapted or changed to improve results.

The Reef 2050 Water Quality Improvement Plan is implemented using this approach – we are continuously adapting and improving. This approach acknowledges that it is important to look at scientific evidence when we think about any management responses.

People involved in Reef science and management

28. Who developed the Scientific Consensus Statement? Have the results been independently reviewed?

The 2017 Scientific Consensus Statement was prepared by a panel of 48 scientists with expertise in Great Barrier Reef water quality science and management.

The scientists brought together new scientific knowledge about water quality issues in the Great Barrier Reef since the 2013 Scientific Consensus Statement was published. They checked, reviewed and synthesised this knowledge.

Each chapter was reviewed by:

- other scientists involved in the process ('internal peer review')
- at least two independent, external scientists ('independent external peer review')
- government policy experts
- the Independent Science Panel.

Preparing the 2017 Scientific Consensus Statement was led by TropWATER James Cook University with contributions from people from the Australian Institute of Marine Science, the Commonwealth Scientific and Industrial Research Organisation, University of Queensland, Central Queensland University, Griffith University, Queensland Department of Agriculture and Fisheries, Queensland Department of Environment and Heritage Protection, Queensland Department of Natural Resources and Mines, Queensland Department of Science, Information Technology and Innovation, Eberhard Consulting, C_2O Consulting, Alluvium and Earth Environmental.

Funding was provided by the Office of the Great Barrier Reef (within the Queensland Department of Environment and Heritage Protection) and the Australian Government Department of the Environment and Energy, with in-kind support from the organisations of the co-authors.

29. Who developed the Reef 2050 Water Quality Improvement Plan?

The Plan is part of the Australian and Queensland governments' ongoing commitment to and evaluation of water quality programs, and is based on the best available scientific information and advice.

Representatives of agricultural and industry groups, conservation and community organisations, natural resource management groups, Traditional Owners and local government were consulted on the Plan's development, including the Reef Water Quality Partnership Committee and Great Barrier Reef Marine Park Authority's Indigenous Reef Advisory Committee.

The science behind Reef planning and policy

30. Why do plans and policies rely on scientific models instead of monitoring and measuring what is really happening on our land and in our waterways?

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 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.

31. Why are the assessments for some regions shown as 'less confident' in the Scientific Consensus Statement? (For example: Cape York and Burnett Mary regions)

Given the great expanse of the Great Barrier Reef and its catchments, it is not possible to conduct routine monitoring in all of the marine regions or in all of the 35 catchments.

The Paddock to Reef Integrated Monitoring, Modelling and Reporting Program is designed to monitor inshore ecosystem health and assess the progress towards the Reef 2050 Water Quality Improvement Plan (formerly Reef Water Quality Protection Plan) targets.

Some tools are applied across all regions and catchments (such as the Source Catchments end-of-catchment load modelling and ground cover monitoring). However, due to resource constraints, many of the marine monitoring applications that assess ecosystem condition or pollutant loads have not been extended into the Cape York and Burnett Mary regions. This means that our confidence in assessments for these regions is lower than in the Wet Tropics, Burdekin, Mackay Whitsunday and Fitzroy regions where routine monitoring and additional research studies are, or have been, conducted.

The Australian and Queensland governments are continually trying to increase the level of monitoring and modelling information to support on-going evaluation of reef programs. Routine marine water quality monitoring started in the Cape York region in the 2016–2017 wet season. In addition, the Queensland Government has provided an extra $9 million of funding over four years for

Great Barrier Reef catchment monitoring and evaluation activities, including catchment monitoring at 16 new sites.

Find out more

32. Where can I get more information? Is there someone I can talk to?

Call 13 QGOV (13 74 68) or email officeofthegbr@qld.gov.au. The Reef 2050 Water Quality Improvement Plan website also has more information.