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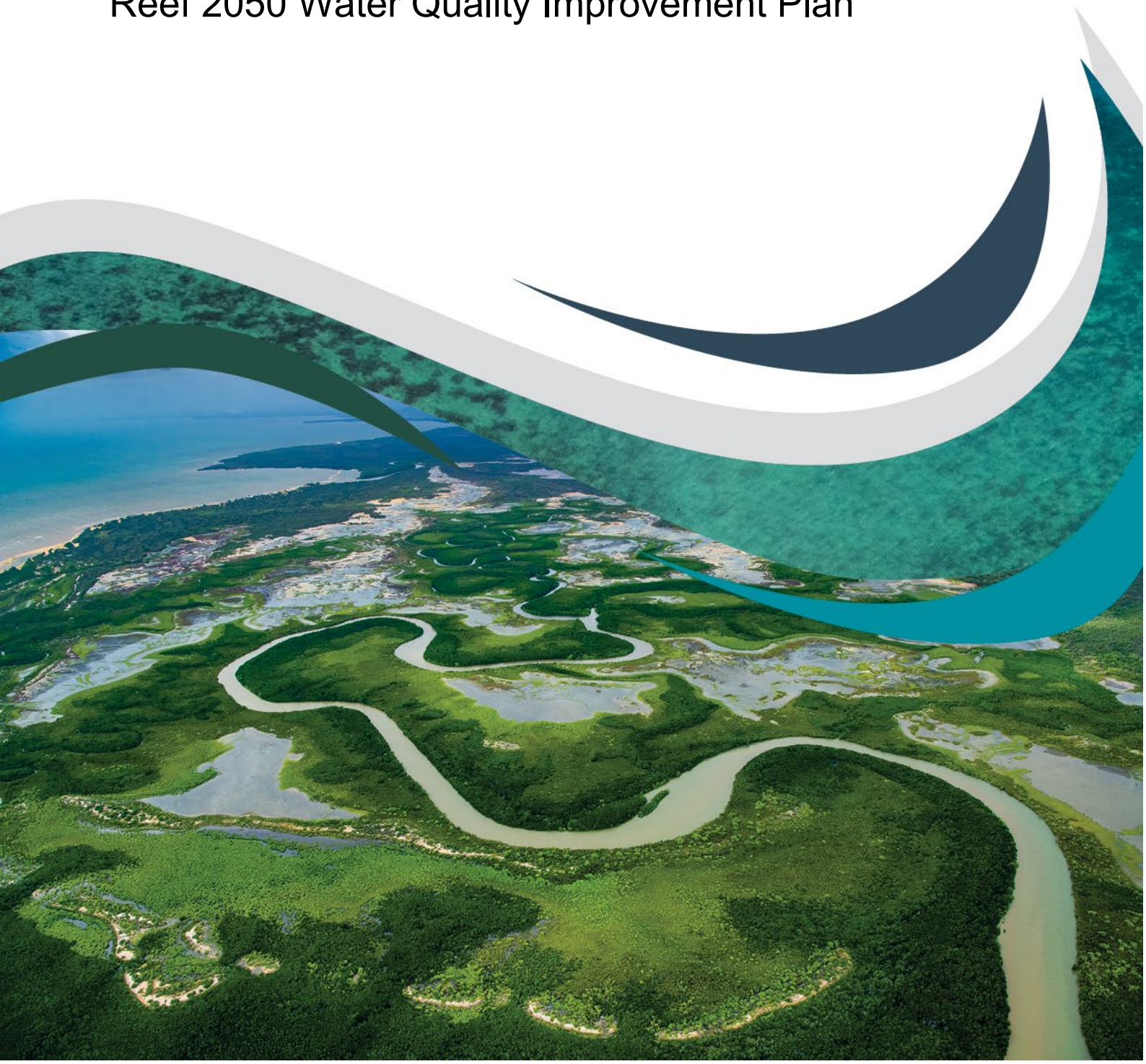


Queensland Government

# Catchment Condition

Riparian Vegetation Extent Monitoring Methods

Reef 2050 Water Quality Improvement Plan



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# CATCHMENT CONDITION – RIPARIAN VEGETATION EXTENT MONITORING

This report summarises the data and methods used for reporting progress towards the Reef 2050 Water Quality Improvement Plan (Reef 2050 WQIP) 2025 catchment management target for riparian vegetation extent. The target is as follows (Australian and Queensland governments, 2017):

- The extent of riparian vegetation is increased.

Riparian woody vegetation and ground cover are the vegetation adjacent to waterways which can help reduce pollutant flow to the waterways and stabilise the streambank (Lyons et al., 2000). For the current era, *riparian woody vegetation* areas include those areas within the riparian zone that meet the following structural criteria, after Specht (1970): forest (trees > 5m height with dense foliage cover); woodlands (trees >5m in height with sparse foliage cover); and, shrublands (shrubs < 8m in height). Riparian areas that are non-woody and have very low ground cover levels may be areas of concern for soil and nutrient loss to the stream (Lyons et al., 2000). Maintaining and enhancing riparian woody vegetation and ground cover in riparian areas is, therefore, important to minimise impacts on water quality in Great Barrier Reef catchments.

Monitoring of riparian vegetation extent is based on analysis of satellite imagery to map woody vegetation and ground cover in riparian areas. The program leverages monitoring of woody vegetation from the Statewide Landcover and Trees Study (SLATS) (Queensland Department of Environment and Science, 2022), and monitoring of ground cover as part of Queensland Ground Cover Monitoring Program.

## Methods

Monitoring and reporting of riparian vegetation extent (and cover) is made up of three key components:

1. Defining and mapping riparian areas
2. Mapping riparian woody vegetation extent and measuring changes to this extent over time
3. Estimating riparian ground cover and analysing how it changes over time within riparian areas.

### Defining and mapping riparian areas

Riparian areas range from small headwater creeks to major rivers. Many studies have shown the benefits of using geographic information systems (GIS) and remote sensing to analyse vegetation within a range of specified distances to a stream (Goetz, 2006; Yang, 2007, Apan et al., 2002). For the purposes of meeting the range of objectives for this component of the Paddock to Reef Integrated Monitoring, Modelling and Reporting program (Paddock to Reef program), riparian areas were defined by a 50m buffer zone applied to a combination of topographic drainage line data and riverine wetlands, as mapped by the Queensland Wetlands Program. Estuarine areas were excluded from the analysis. The same drainage data that is used for defining Category R areas for the *Vegetation Management Act 1999* is used here to ensure consistency. This is the same riparian area dataset used in the 2017 era mapping (reported in 2019), converted to a 10m resolution raster dataset, aligned to the underlying Sentinel-2 datasets. The raster conversion will lead to slight differences in area measurements, but has greatly increased processing speed, as well as more appropriately reflecting the scale of the source datasets.

Previous reporting included mapping of the original (pre-clearing) and current (2001, 2005, 2009, 2013) extent of riparian vegetation based on Landsat satellite imagery, which has a spatial resolution of approximately 30m. The spatial resolution of Landsat has some limitations and uncertainty for reporting

on riparian vegetation, and riparian woody vegetation in particular, as these areas are often very narrow (i.e. < 30m) and fragmented as a result of historical clearing.

## Mapping riparian woody vegetation extent

In previous reporting, riparian woody vegetation was mapped using Landsat (prior to 2017) and Sentinel-2 (2017 reporting) satellite imagery. An index of woody vegetation density or cover, known as Foliage Projective Cover (FPC) was applied to the satellite imagery to predict areas of woody vegetation cover within the riparian area. Riparian woody vegetation or forest were defined as those areas in the riparian area with an FPC greater than or equal to 11%. These FPC datasets generally provided a good indication of woody vegetation but required selection of an appropriate threshold and were also affected by missed cloud or other data issues. Predictions were also sensitive to annual variability in greenness. This can affect reliable change estimates and monitoring when FPC is compared between years, regardless of the thresholds used.

For this report, the extent of riparian woody vegetation was mapped using the Statewide Landcover and Trees Study (SLATS) Sentinel-2 - 2021 woody vegetation extent layer for 2021 (Queensland Department of Environment and Science, 2023). The 2021 layer is an update of the SLATS 2018 baseline woody extent layer.

The 2018 baseline layer was based on a U-net convolutional neural network classification, fitted on very high spatial resolution (i.e. ~1m) Earth-i satellite imagery to produce an initial binary woody presence/absence classification, as described in Flood et al (2019). The classification was subsequently down-sampled to 10m to approximate the spatial resolution of Sentinel-2, given it will be used for ongoing monitoring. The initial predictions were then manually edited, and quality checked by a team of remote sensing scientists through an extensive editing and quality assurance process. Features were categorised as either woody or non-woody, where woody vegetation is defined as stands of woody vegetation greater than 0.5ha with a crown cover greater than 10% (Queensland Department of Environment and Science, 2022). A minimum width of 20m was applied to linear features. Both woody and nonwoody features smaller than these sizes have been filtered out of the data set. No distinction is made between native and non-native vegetation; woody vegetation such as woody weeds and horticultural crops are included as woody in the final classification.

To produce the 2021 woody extent dataset, the 2018 baseline extent was updated using SLATS clearing data for the 2018-2019, 2019-2020 and 2020-2021, and SLATS regrowth data for 2019-20 and 2020-21 reporting to produce a 2021 woody extent. SLATS did not include regrowth data in the 2018-19 report as it was considered the existing regrowth had been captured in the 2018 baseline extent and insufficient time has elapsed for new regrowth to be reliably detected and mapped for the 2018-19 report. The recent losses relate only to anthropogenic clearing, and do not include vegetation loss from natural events such as cyclones and drought stress, which typically have a faster recovery time than regrowth after clearing. This distinction is determined through the SLATS classification process. Ancillary data on dams and waterbodies were also used to further refine the woody classification for the riparian analysis. These waterbodies were classified as 'no data'.

It is important to note that this reporting focusses solely on presence or absence of riparian vegetation, given its overall significance for streambank stability, slowing overland flows, and maintaining and improving water quality. The analysis does not examine vegetation type, structure, cover, age or the policy settings that protect vegetation in the landscape. No distinction is made between remnant and non-remnant woody vegetation, and no analysis is made regarding potential non-compliance of riparian vegetation losses (i.e. clearing) under Queensland's Vegetation Management framework. Future methods could include analysis of the age and structure of woody vegetation, as well as the remnant and non-remnant status. Compliance status of vegetation clearing is assessed separately by the Department of Resources.

**It is important to note direct comparisons with previous reporting cannot be made**, due to the change from FPC to woody extent datasets, and the change in SLATS methodology.

## Measuring changes to riparian extent over time

Riparian woody vegetation loss in extent is reported for two time periods for the Great Barrier Reef catchments:

1. From 2018 to 2021, based on losses from the 2018 woody extent baseline. Regrowth is not included in this analysis
2. From 2005 to 2009, 2009 to 2013 and 2013 to 2017 for context on relatively recent woody vegetation clearing trends. These results **cannot be directly compared** due to the change in SLATS methodology.

## Estimating riparian ground cover

For non-woody riparian areas, ground cover is estimated and reported for the current reporting year. Ground cover monitoring is included to recognise the importance of having some level of vegetation cover in riparian areas to help minimise erosion, particularly where woody vegetation is not present to stabilise the soil. Ground cover reporting in riparian areas is based on Sentinel-2 seasonal fractional cover data derived using the method described by Flood. (2017). The Sentinel-2 fractional cover product is not specifically a ground cover product and does contain woody vegetation. However, as its use is restricted to non-forested areas it is suitable for the purposes of assessing ground cover. Ground cover levels will be assessed in the late dry season (i.e. the Spring seasonal image) for the reporting year of interest.

## Assessing progress towards the target

The Reef 2050 WQIP 2025 target that *'the extent of riparian vegetation is increased'*, will be reported in 2023 for data from 2018-2021. Specifically, the extent of riparian woody vegetation in 2021 will be compared to the extent in 2018 with progress measured by the net change between those two dates. A positive change in extent will indicate progress. A negative change would indicate that no progress has been made. As this reporting period is only three years compared to previous 4-year periods, the grade cut-offs have been adjusted as follows:

Assessment against the target as per the below criteria:

Status/progress	Criteria	Grade/Colour
Very poor progress towards target	Greater than 0.75% loss of riparian vegetation	E - Red
Poor progress towards target 0.51	Greater than 0.37% and less than or equal to 0.75% loss of riparian vegetation	D - Orange
Moderate progress towards target	Greater than 0.07% and less than or equal to 0.37% loss of riparian vegetation	C - Yellow
Good progress towards target	Greater than 0 and less than or equal to 0.07% loss of riparian vegetation	B - Light green
Target met	Increase of riparian vegetation	A - Dark green

Additional reporting on progress towards the target will be derived from analysis of the ground cover levels in riparian areas. Reporting the ground cover levels will help to report on the maintenance of ground cover in the riparian areas over time, providing some indication of the management of those areas in terms of grazing or other pressures such as cropping.

## Semiquantitative confidence ranking

Data confidence ●●●○○

A multi-criteria analysis was used to score the confidence in each indicator used in the report card from low to high. The approach combined the use of expert opinion and direct measures of error for program components where available. Riparian vegetation extent received a three dot confidence ranking.

### Riparian extent

Maturity of methodology (weighting 0.5)	Validation	Representativeness	Directness	Measured error
New or experimental methodology	Remote sensed data with no or limited ground truthing	1:1,000,000	Measurement of data that have conceptual relationship to reported indicator	Error not measured or >25% error
<b>Peer reviewed method</b>	<b>Remote sensed data with regular ground truthing (not comprehensive)</b>	<b>1:100,000</b>	<b>Measurement of data that have a quantifiable relationship to reported indicators</b>	<b>10-25% error</b>
Established methodology in published paper	Remote sensed data with comprehensive validation program supporting (statistical error measured)	1:10,000	Direct measurement of reported indicator with error	Less than 10% error
<b>2 x 0.5 = 1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>

Bolded cells indicate assessment ranking

Total score = 9, equates to **Three dots**.

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