



Australian Government



Queensland Government

# Riparian Vegetation Extent

## Methods

**Reef Water Quality Report Card 2017 and 2018**

**Reef 2050 Water Quality Improvement Plan**



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# 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, 2018):

- 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 riparian forest (trees > 5m height with dense foliage cover (Specht, 1970); riparian woodlands (trees >5m in height with sparse foliage cover (Specht, 1970) and shrublands (shrubs < 8m in height) (Specht, 1970). 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 (GBR) 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 also leverages monitoring of woody vegetation from the Statewide Landcover and Trees Study (SLATS) (DES, 2018), and monitoring of ground cover as part of Queensland Ground Cover Monitoring Program.

For the Reef Water Quality Protection Plan 2013, the riparian area was defined as any area within 100m of a (mapped) stream or riverine wetland. The riparian extent monitoring provided historical and current data and information about riparian vegetation extent and cover in the GBR catchments. Previous results include 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.

The 2017 and historical extent results will be presented as part of the Reef Water Quality Report Card 2017 and 2018.

For the Reef 2050 WQIP, the riparian area has been revised to be any area within 50m of a (mapped) stream or wetland, to better align reporting with areas identified as Category R vegetation (i.e. high value regrowth in riparian areas) for the purposes of the Vegetation Management Act 1999. The riparian woody vegetation extent has also been revised to a spatial resolution of 10m (using Sentinel data) which is more appropriate for riparian areas. It is important to note that this change in spatial resolution will mean that there will be scale differences with current and previous reporting.

## Methods

Riparian vegetation is measured using Sentinel-2 Multi-Spectral Instrument (MSI) satellite imagery, while clearing changes in riparian areas are assessed using data derived from Landsat satellite imagery. The Department of Environment and Science's Remote Sensing Centre has an extensive archive of Landsat 5, 7 and 8 data acquired since 1984, and Sentinel-2 data acquired since 2015. The Landsat datasets have been pre-processed to standardised surface reflectance to enable comparison over time (Flood et al., 2013). Landsat data have been used by various riparian studies, as reviewed in Goetz (2006). Landsat data have a moderate spatial resolution, with a pixel size of 30m. The return interval of each Landsat satellite is 16 days, however the intervals are phased resulting in coverage every eight days or better. Sentinel-2 data have a finer spatial resolution than Landsat, with pixel sizes of 10-20m, depending on the band. Since the launch of Sentinel-2B in 2017, Sentinel-2 imagery is available every five days. Sentinel-2 data has been pre-processed to standardised surface reflectance, with an algorithm applied to reduce the difference between Sentinel-2 and Landsat reflectance values, in order to provide comparable measurements over time (Flood, 2017).

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 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 will be 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. The same drainage data will be used as is used for defining Category R areas for the Vegetation Management Act 1999 to ensure consistency. As this is a new dataset, results in this report will not be directly comparable with previous reports.

### Mapping riparian woody vegetation extent

The extent of riparian woody vegetation is mapped using Sentinel-2 satellite imagery. The imagery has been cross-calibrated to enable transition between Sentinel-2 and the previously used Landsat imagery (see historical assessments below) (Flood, 2017).

An index of woody vegetation, known as Foliage Projective Cover, calibrated using a database of over 2,000 quantitative field observations of woody vegetation cover, is applied to the Sentinel-2 satellite imagery to predict areas of woody vegetation cover within the riparian area. An Foliage Projective Cover threshold of 11% is selected to distinguish areas of woody vegetation. This may include areas of vegetation with low height but dense cover, such as heathlands.

The extent of riparian woody vegetation will be revised and updated in 2021-2022 to report on net change in extent between 2017-2018 and 2021-2022.

## **Measuring changes to riparian extent over time**

Historical and recent losses of riparian vegetation are analysed using woody vegetation clearing data from the SLATS and 'pre-development' forest data. Due to the historical time-series required for this component of the reporting, these analyses rely on the use of SLATS Landsat-based data, which has an archive extending to the mid-1980s (for Landsat's 5, 7 and 8). Some scale/resolution differences may reduce the precision and accuracy of some of the reporting statistics derived from this component, particularly when comparing losses mapped by SLATS using Landsat imagery with current woody vegetation extent mapped using Sentinel-2 imagery.

The pre-clearing woody vegetation areas are defined as areas assessed as woody (forests, woodlands and tall shrublands) before European settlement. These data are derived from pre-clearing Regional Ecosystem mapping (Accad et al., 2001). 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.

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

1. Pre-clearing baseline to 2016-2017, to provide an approximate estimate of the extent of modification to riparian woody vegetation in each of the regions
2. From 1988 to 2016-2017, for historical woody vegetation clearing summaries
3. From 2001 to 2005, 2005 to 2009, 2009 to 2013 and 2013 to 2017 for recent woody vegetation clearing trends.

## **Estimating riparian ground cover**

For riparian areas with up to 11% Foliage Projective Cover, 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 the late dry season 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 2019 for data from 2017 and in 2021 for data from 2020. Specifically, the extent of riparian woody vegetation in 2017 will be compared to the extent in 2020 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.

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.

## Qualitative confidence ranking

Confidence



A multi-criteria analysis was used to qualitatively 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 bar 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 |
| Peer reviewed method                       | Remote sensed data with regular ground truthing (not comprehensive)                              | 1:100,000          | Measurement of data that have a quantifiable relationship to reported indicators | 10-25% error                     |
| 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><math>2 \times 0.5 = 1</math></b>       | <b>2</b>   | <b>2</b>           | <b>2</b>   | <b>2</b>                         |

Bolded cells indicate assessment ranking

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

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