LANDHOLDERS DRIVING CHANGE
BURDEKIN MAJOR INTEGRATED PROJECT

LDC COMMUNITY WATER QUALITY SAMPLING

FOR SEDIMENTS AND NUTRIENTS WITHIN THE BOWEN-BROKEN-BOGIE CATCHMENTS

2020-2021 Wet Season Update

NQ DRY TROPICS

Nine properties in the Bowen, Broken and Bogie (BBB) catchment make up the LDC Community Water Quality Monitoring Group.

This group has been established to better understand the water quality variations throughout the BBB catchment, with a focus on sediment and nutrient concentrations throughout a range of flow events.

Scientists Zoe Bainbridge and Steve Lewis from The Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER), James Cook University, trained landholders on how to collect and store water samples.

The Community Water Quality Monitoring Group data is shared with the Queensland Government modelling team. The results are being used to enhance the Paddock to Reef Integrated Monitoring, Modelling and Reporting Program (Paddock to Reef Program) model and improve confidence in load estimates and results for the BBB catchment.

With monitoring, LDC is learning more about how, when and where sediment (and nutrients attached to sediment) moves. This means graziers can respond better to help reduce sediment flowing out into the Great Barrier Reef lagoon.

This publication outlines the results of the water samples collected by landholders during the 2020-2021 wet season, and summarises data collected over the past three wet seasons.

This publication, along with the 2018-2019 and 2019-2020 wet season booklets, are available on the LDC website: ldc.nqdrytropics.com.au.

"Being part of the water quality monitoring program has provided an opportunity for graziers to help find the missing pieces of the puzzle to enable them to have a more accurate picture of water quality in the BBB.

Understanding local water quality means landholders can adopt land management practices based on the best available science.

This information can also be shared with other land managers including utility companies, councils, and mines, to ensure everyone is doing their part to help improve water quality.

Grazier knowledge and innovation can complement the formal science - I see this as a partnership between graziers and scientists."

Buster O'Loughlin, Exevale Station.

PROJECT OVERVIEW

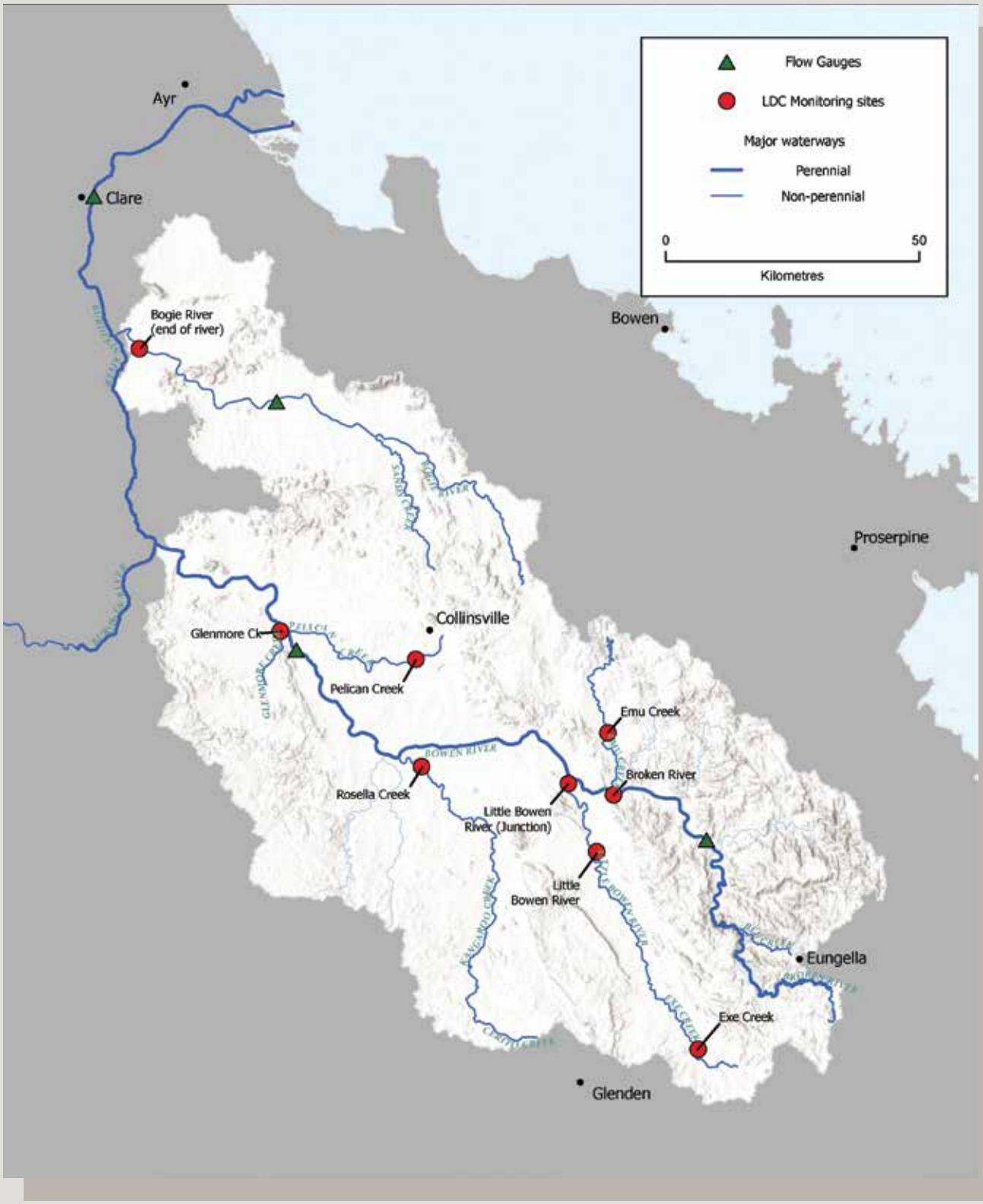
Nine river and creek sites across the BBB catchment are being sampled by landholders during rainfall-generated high flow events in the 2018-2019, 2019-2020 and 2020-2021 wet seasons.

Multiple water samples are collected during each flow event to capture changing suspended sediment and nutrient (nitrogen and phosphorus) concentrations over the rising, peak and falling stages of stream flow.

Data collected for this project aims to improve our understanding of the loss of soil (and the nutrients attached to this soil) from the land into waterways during high rainfall events, and to quantify differences in the contribution of sediments and nutrients from each of the BBB sub-catchments.

Sub-catchment sediment and nutrient concentration data collected will be used to improve scientific modelling (Source Catchments) of our river catchments (that is, provide a validation check against modelled concentrations for these same river and creek locations) and will also act as a baseline dataset to examine trends over time.

The aim is to identify sub-catchments delivering higher sediment and nutrient loads. This knowledge, coupled with a broader understanding of the landscape (including factors such as slope, soil types and erosion processes), will improve and refine the process of characterising and prioritising the catchments.


Flow Gauges
LDC Monitoring sites
Major waterways
Perennial
Non-perennial
0
50
Kilometres
Ayr
Clare
Bogie River
(end of river)
Bowen
Proserpine
Collinsville
Glenmore Ck
Pelican Creek
Emu Creek
Broken River
Rosella Creek
Little Bowen
River (Junction)
Little
Bowen River
Eungella
Exe Creek
Glenden

RAINFALL EVENTS AND RIVER FLOW EVENTS

The Burdekin River catchment had an average-sized water year (October 2020 to September 2021), with 8.5 million megalitres (ML) measured at the Clare flow gauge. Most of the discharge was sourced from the catchment area above the Burdekin Falls Dam.

Within the BBB catchment area, below average to average rainfall occurred. Rainfall totals for the 2020-2021 wet season ranged from 370mm at Gatton Vale to 1630mm at Mt William, Dalrymple Heights.

For the 2020-2021 water year, the Bowen River at Myuna flow gauge has recorded ~217,000 ML, well below its long-term annual average of 866,000 ML (based on a 60-year flow record).

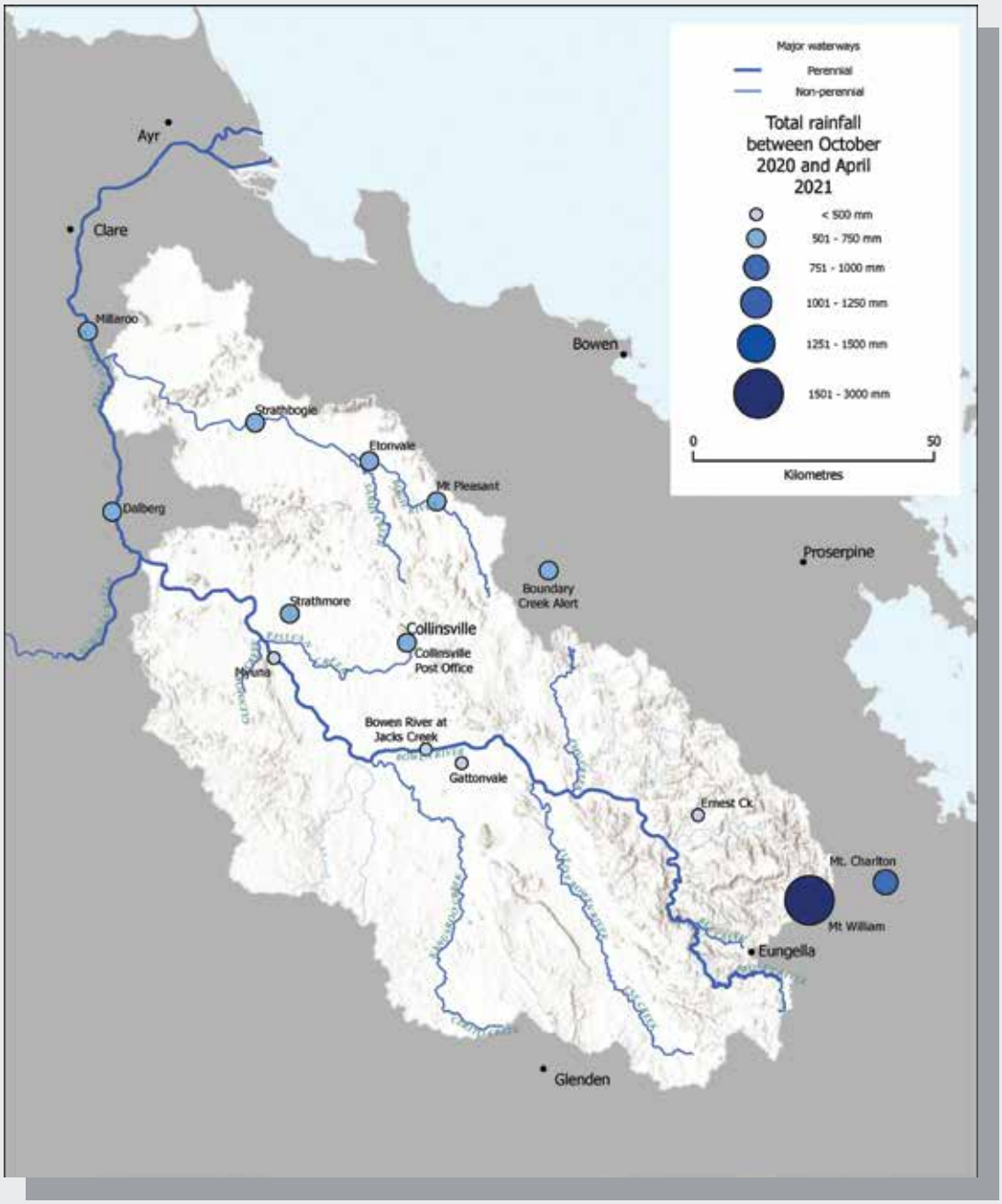
WATER SAMPLE COLLECTION

16 water samples were collected this wet season, with samplers reporting lower intensity and patchy falls.

Depending where the rain fell, one to two flow events were sampled by landholders at five of our sampling sites:

- December 2020 (Christmas) flows: Pelican Creek, Rosella Creek
- January 2021 flows: Little Bowen (Junction), Rosella Creek
- March 2021 flows: Broken River, Little Bowen (Junction), Pelican Creek and Bogie River.

Combined with the previous wet seasons, a total of 163 water samples have now been collected under this project.



SAMPLING FROM CATCHMENT TO REEF

NATIONAL ENVIRONMENTAL SCIENCE PROGRAM (NESP) PROJECT 5.8

The final report for the linked NESP Tropical Water Quality Hub Project 5.8 was released in early 2021.

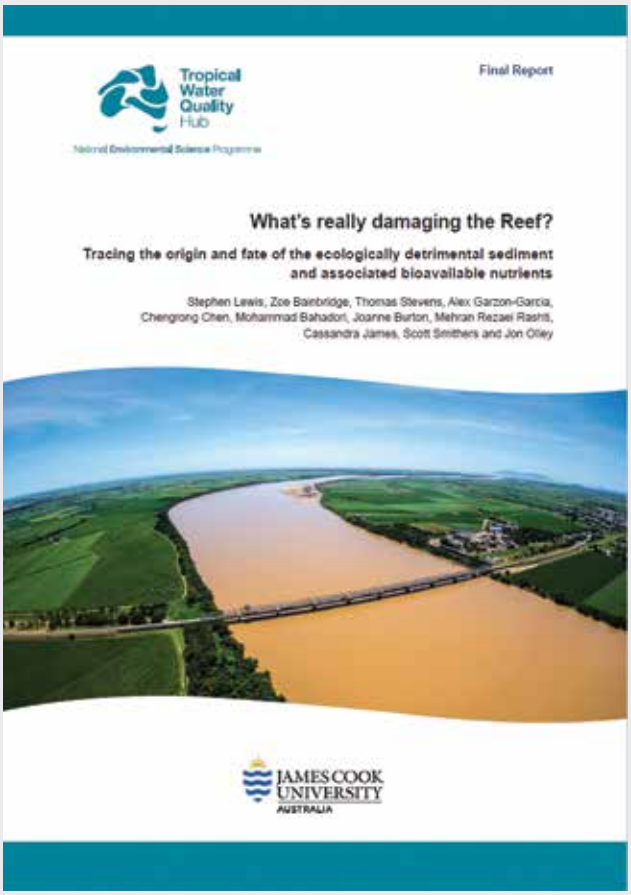
"This project involved one of the most coordinated and extensive sampling efforts ever taken in the Great Barrier Reef to document and trace suspended sediments across the catchment to marine environment," Dr Stephen Lewis, of TropWATER said.

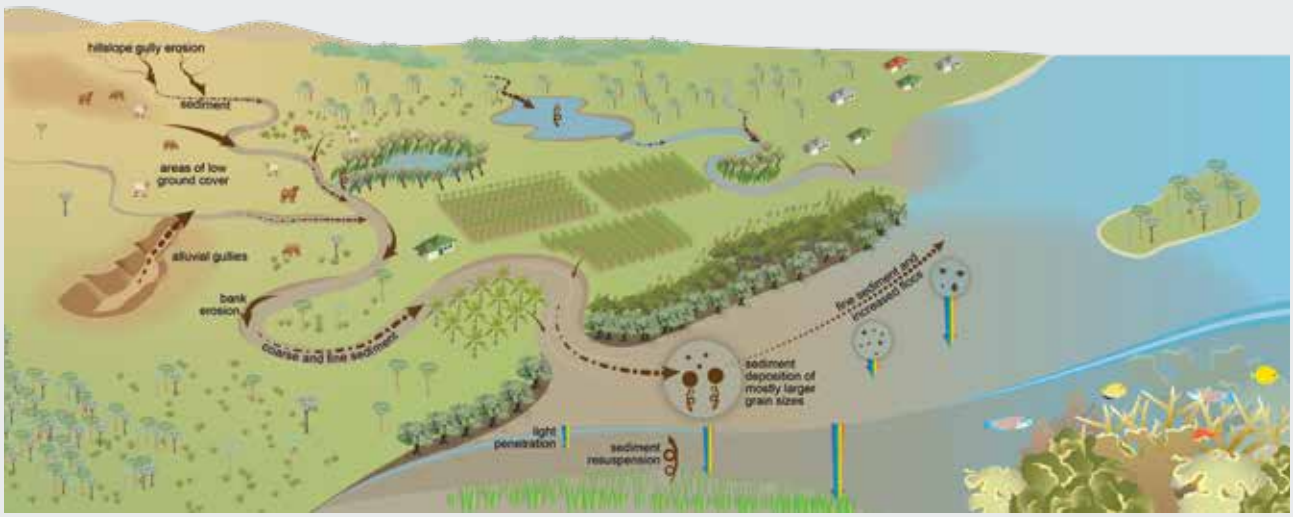
During this five-year project, samples from the Burdekin, Haughton, Ross, Black, Herbert, Tully and Johnstone Rivers were collected for sediment characterisation. Flood plumes from multiple wet seasons including the large 2019 floods were sampled from the Burdekin, Ross, Tully and Johnstone Rivers using new technology that enabled recovery of enough sediment to analyse.

Loggers that take continuous 10 minute measurements of water quality and sea condition, coupled with sediment traps, were deployed at seven sites along the central inshore Great Barrier Reef. The loggers and sediment traps were changed over every three months and were deployed over a continuous four-year period.

"Collectively, the data from the study provide valuable insight on the sources, transport and fate of suspended sediment as it is carried by floodwaters into the Great Barrier Reef," Dr Lewis said.

For more information visit nesptropical.edu.au





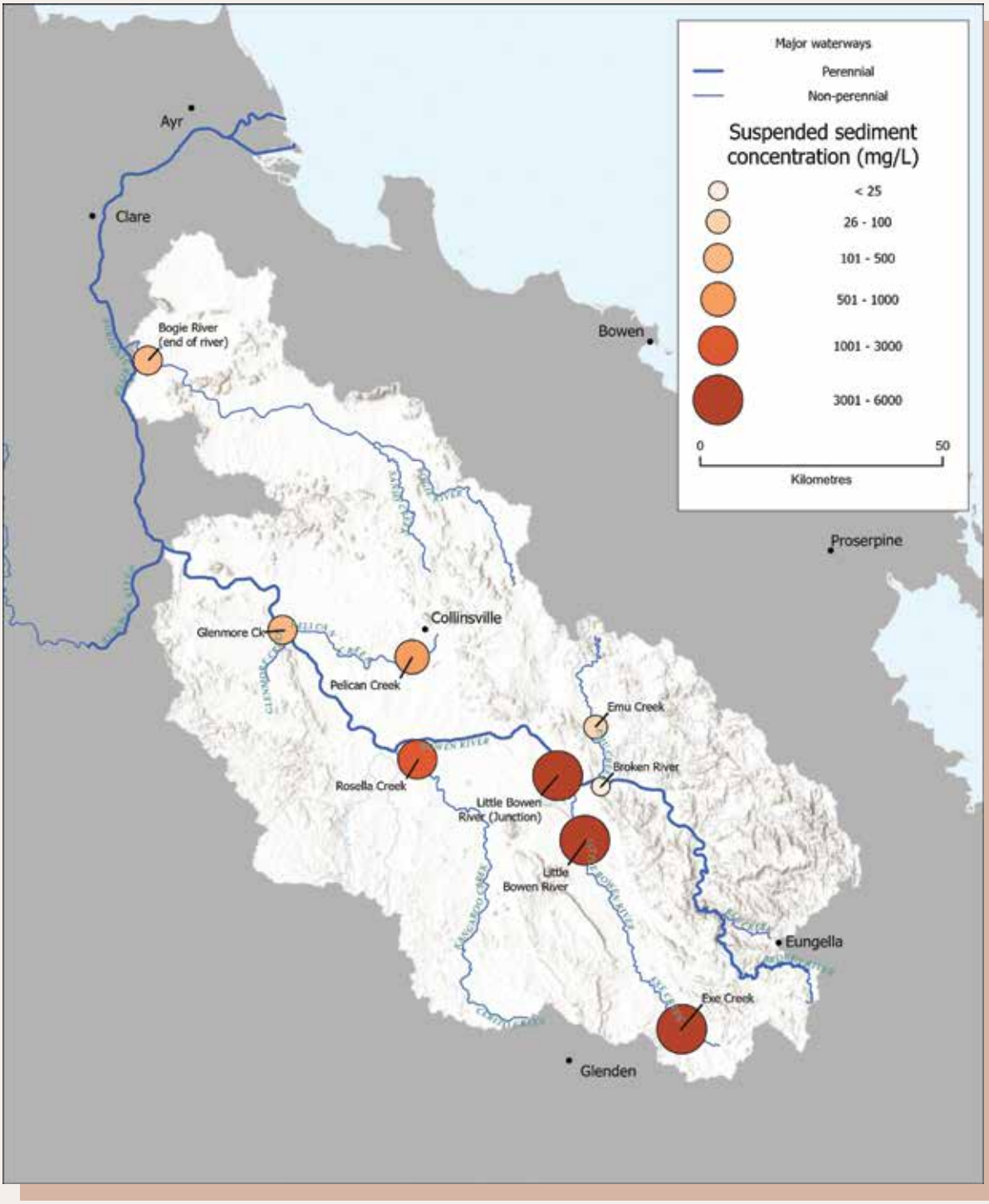
Conceptual understanding of fine sediment sources and transport in dry tropical river catchments of the Great Barrier Reef (Source: NESP Tropical Water Quality Hub).

SUSPENDED SEDIMENTS

Suspended sediments are a direct measure of the amount of suspended particulate material (organic or inorganic) in the water column. The lab method (total suspended solids) measures all solids in the water sample that can be trapped by a filter, including sand, silts and clays, organic detritus, microbes or plankton.

Soil eroded from the catchment becomes sediment carried to coastal areas by streams as runoff, usually during the wet season when heavy rain and flooding are common.

Most sediment washed to the Great Barrier Reef is very fine-grained and can stay suspended in the water for a long time, often travelling a great distance away from or along the coast. It causes elevated turbidity (the water loses its transparency and looks murky or muddy), reducing the light available for seagrasses and coral, and can be harmful if concentrations are elevated for extended periods.



Where landholders were able to sample in the 2020-2021 wet season, the additional data provides greater confidence in the average concentrations for those sampled sites. When all data points are combined across the three wet seasons, average suspended sediment (SS) concentrations for each of the sampled BBB river and creek sites show large variation across the catchment (see map). The 2020-2021 wet season sediment concentration data increased the site averages for the Little Bowen River (Junction), Pelican and Rosella Creek sites.

Water quality measured in rivers and creeks reflect landscape-scale processes of the entire upstream catchment area, and higher SS and nutrient concentrations often relate to highly erodible soil types, the underlying geologies and areas of steep slopes. Improved knowledge of, and support towards managing these land types is critical in keeping soil in place, and reducing runoff reaching the GBR.

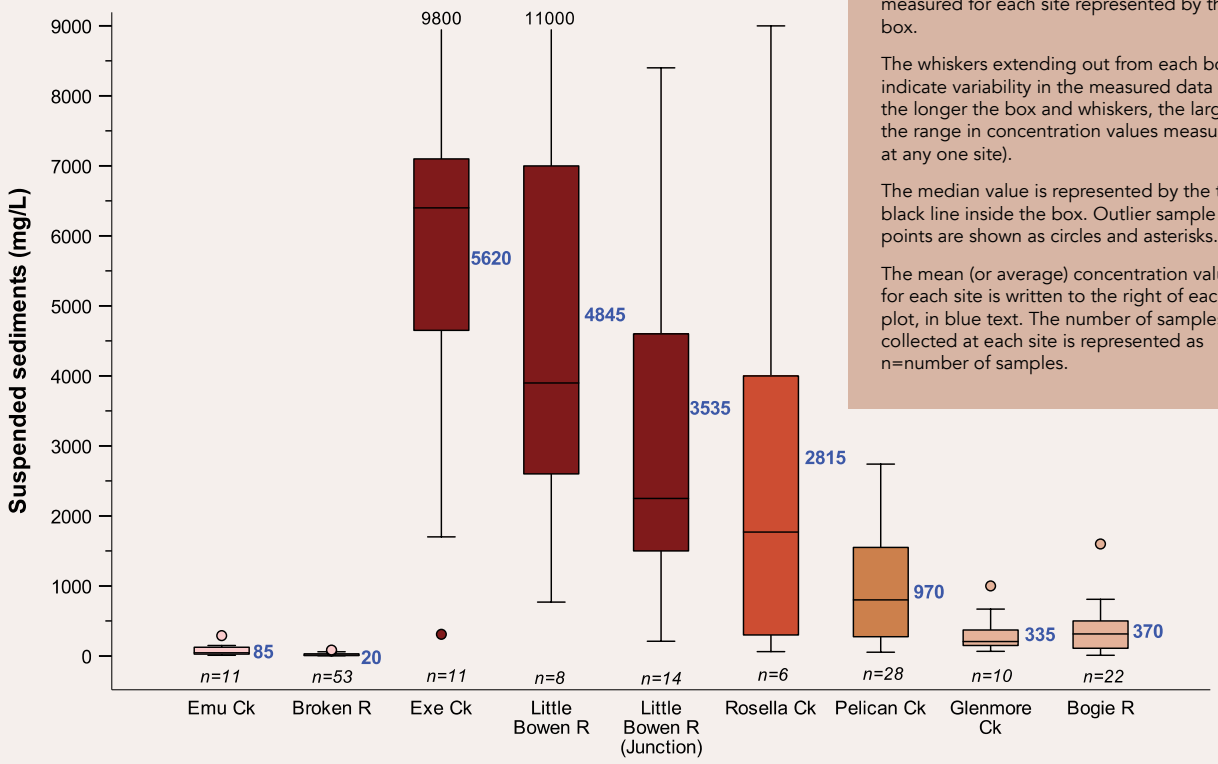
HOW TO READ A BOXPLOT GRAPH

Box and whisker plots (boxplots) show the distribution of the measured concentration data for each site; with 75 per cent of all data measured for each site represented by the box.

The whiskers extending out from each box indicate variability in the measured data (i.e. the longer the box and whiskers, the larger the range in concentration values measured at any one site).

The median value is represented by the thick black line inside the box. Outlier sample points are shown as circles and asterisks.

The mean (or average) concentration value for each site is written to the right of each plot, in blue text. The number of samples collected at each site is represented as n=number of samples.



Graph showing the full range of SS concentrations measured at each sampling site over the three wet seasons.

GRAPH RESULTS

All samples collected at each site over the three wet seasons were pooled to determine an average site concentration, displayed in blue text.

Over the three sampled wet seasons site averages ranged from 20 mg/L (Broken River) to >4800 mg/L across sites in the Little Bowen sub-catchment.

Additional sampling at the Little Bowen River (Junction), Rosella and Pelican Creek sites this wet season have increased the number of individual water samples collected at each of these sites to 14, 6 and 28, respectively.

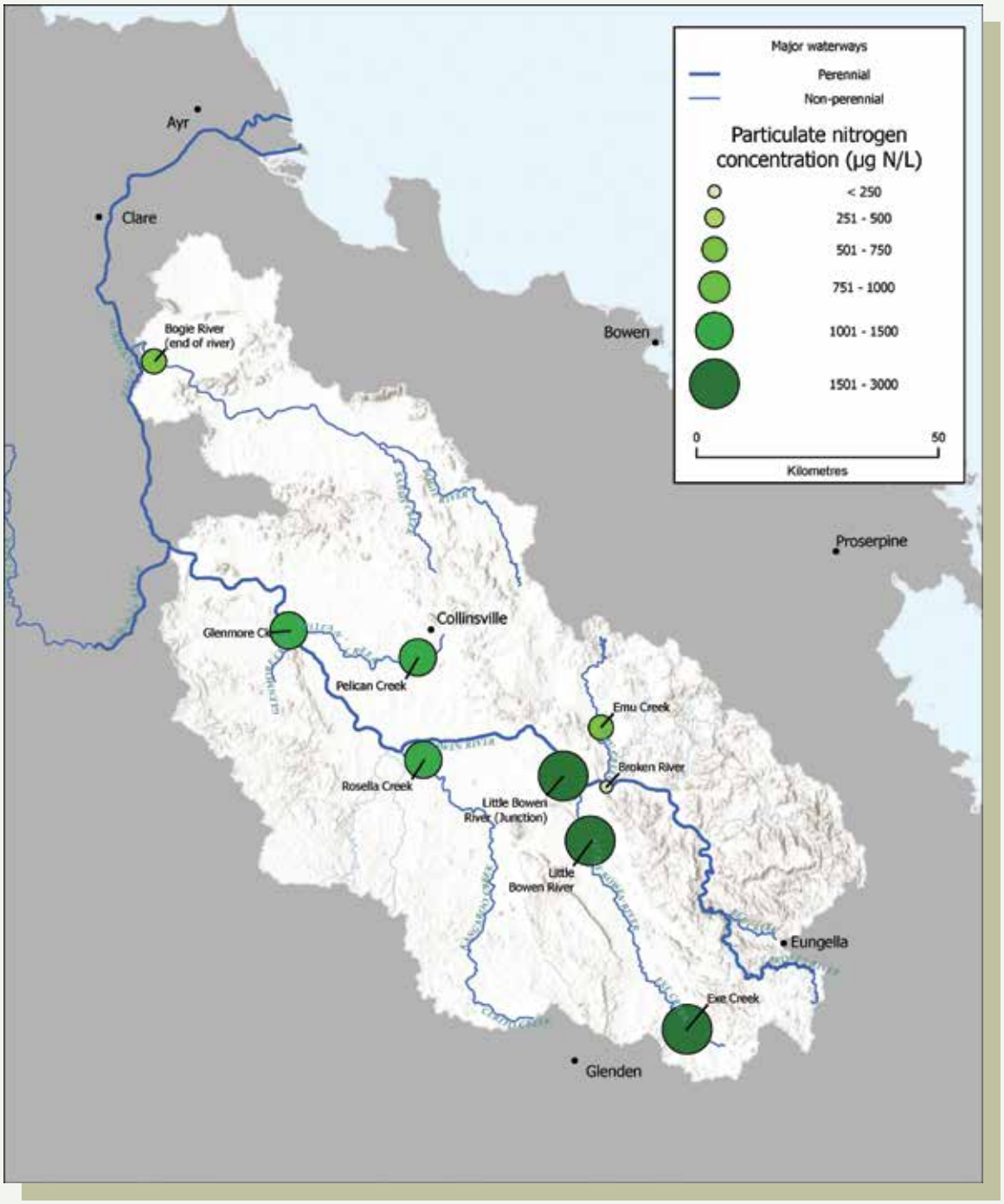
The creeks draining into the middle and lower reaches of the Bowen River (Rosella, Pelican and Glenmore) had average SS concentrations ranging from 335 to 2815mg/L. The sediment concentrations of water samples collected from flow events in Rosella and Pelican Creeks this wet season were higher than previous years. A larger flow event in Rosella Creek (sourced from the upper reaches) was sampled this year, with a concentration range of 3100-9000mg/L compared to <1000mg/L in the smaller 2018-2019 sampled flow event. Capturing additional samples in larger flow events in these western creeks is still required to increase sample numbers and improve our data confidence.

Only one smaller flow event occurred in the Broken River this wet season, with all four samples measuring <15mg/L; the significantly lower site average (20mg/L) remained unchanged by these additional samples. 53 samples have now been collected at this site.

PARTICULATE NITROGEN (PN) AND PHOSPHORUS (PP)

Why do we measure for nutrients?

All living organisms require nutrients (e.g. carbon, oxygen, nitrogen and phosphorus) to supply energy and support growth. However, when nutrients are increased beyond natural levels there can be ecological effects. During high-flow events nutrient loads accumulate downstream and into the GBR lagoon where excess nutrients encourage the growth of algae on inshore Reefs. They also feed plankton whose remains bind with sediment to form 'marine snow', reducing light and smothering the juvenile corals that renew inshore Reefs.

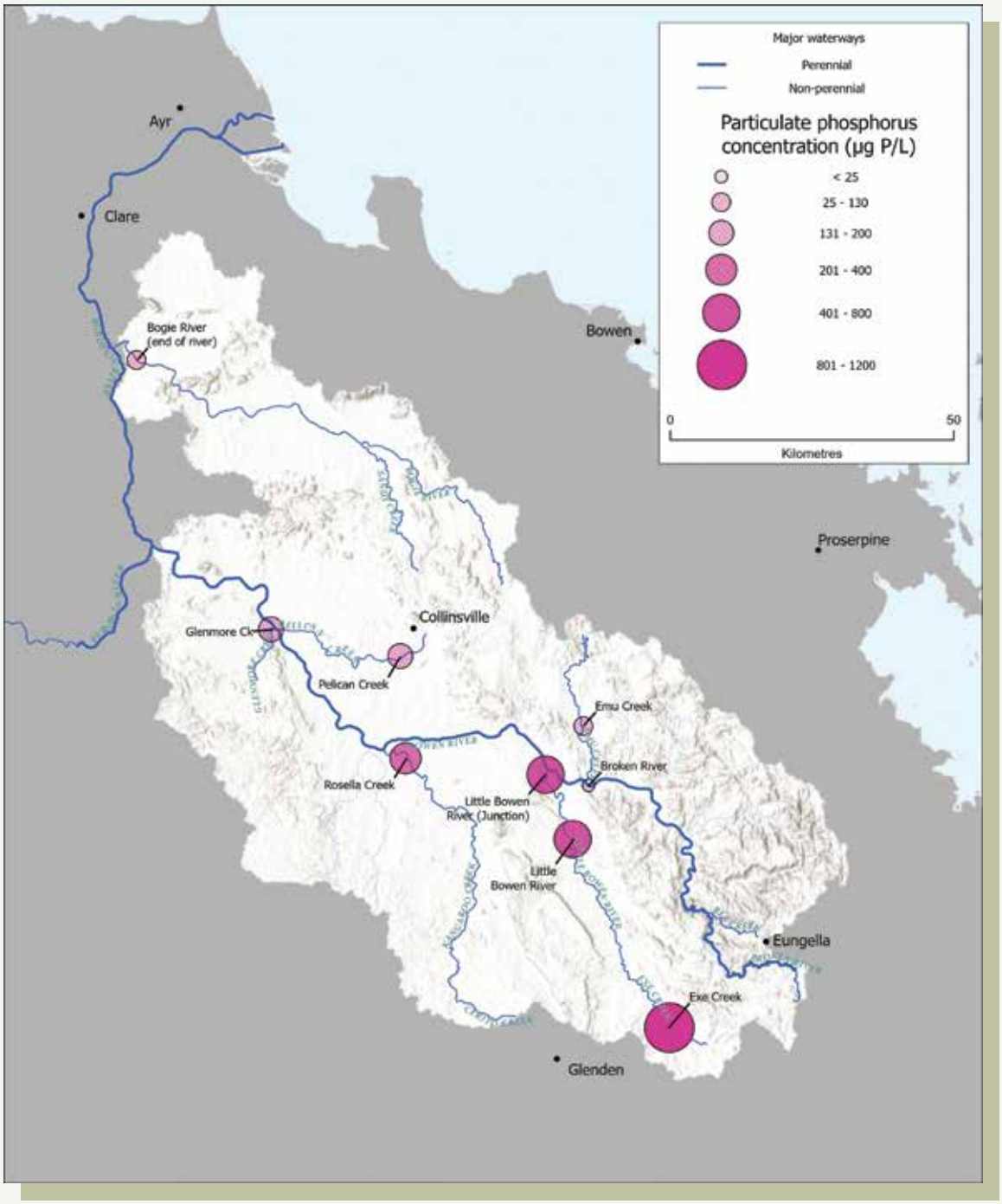


We also measured nitrogen and phosphorus concentrations in all water samples collected. Average particulate nitrogen (PN) and particulate phosphorus (PP) concentrations for each site are shown below. Nitrogen and phosphorus in the particulate form (PN and PP) are associated with organic matter and commonly attached to soil particles, and thus often elevated in runoff with higher sediment concentrations. Hence in most circumstances, the PN and PP values closely match the SS concentrations which was the case over the three sampled wet seasons.

Over the three wet seasons, the highest particulate nutrient concentrations were measured at the high sediment contributing Little Bowen sub-catchment sites, with site average PN concentrations higher than those for PP. Average PN concentrations of 2750, 1865 and 1645 µg N/L were measured at the Exe Ck, Little Bowen and Little Bowen (Junction) sites, respectively. Average PP concentrations of 1135, 765 and 635 µg P/L were measured for these three sites, respectively.

Average concentrations were also elevated in Pelican, Rosella and Glenmore Creeks draining into the lower reaches of the Bowen River.

The Broken River site had the lowest PN (190 µg N/L) and PP (22 µg N/L) concentrations due to the relatively low SS concentrations measured at this site.



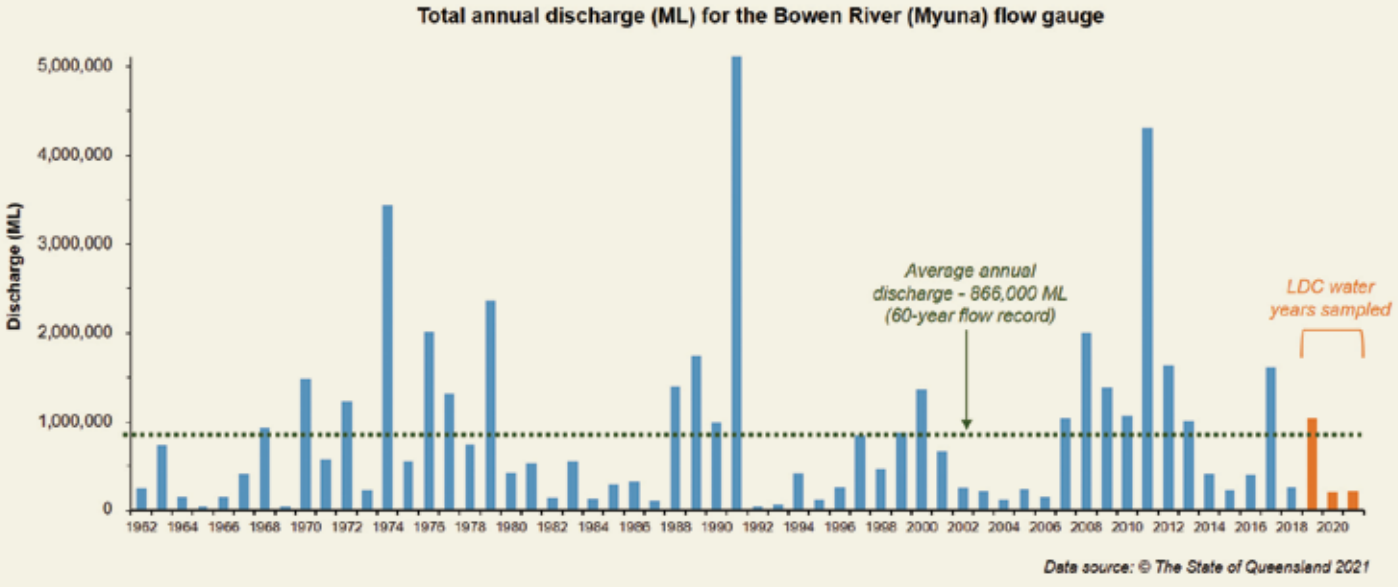
HOW WILL THIS DATA BE USED AND FUTURE SAMPLING?

Thanks to the collective efforts of the landholder samplers we now have an improved understanding of sediment and particulate nutrient sources within the BBB catchment. In particular we now have a valuable dataset that can be used by catchment modellers to improve the model's representation of water quality across the BBB. Steve and Zoe are working directly with the Paddock to Reef program's Source Catchments modelling team to work through this data incorporation. Zoe is also developing a project to further facilitate this knowledge transfer between researchers and catchment modellers, highlighting the valuable role of citizen science to improve model outputs.

Over the project life, two of the three water years were well below average rainfall and discharge for the BBB region (see graph; the first year had above average rainfall and discharge in only some areas of the catchment). This was despite the La Nina conditions for the 2020-21 wet season. In this respect the BBB catchment 'missed out'. For greater confidence in comparing this dataset to the longer term data of the Source Catchments model (e.g. 30-year climate average), additional sampling of average and above average wet seasons is required.

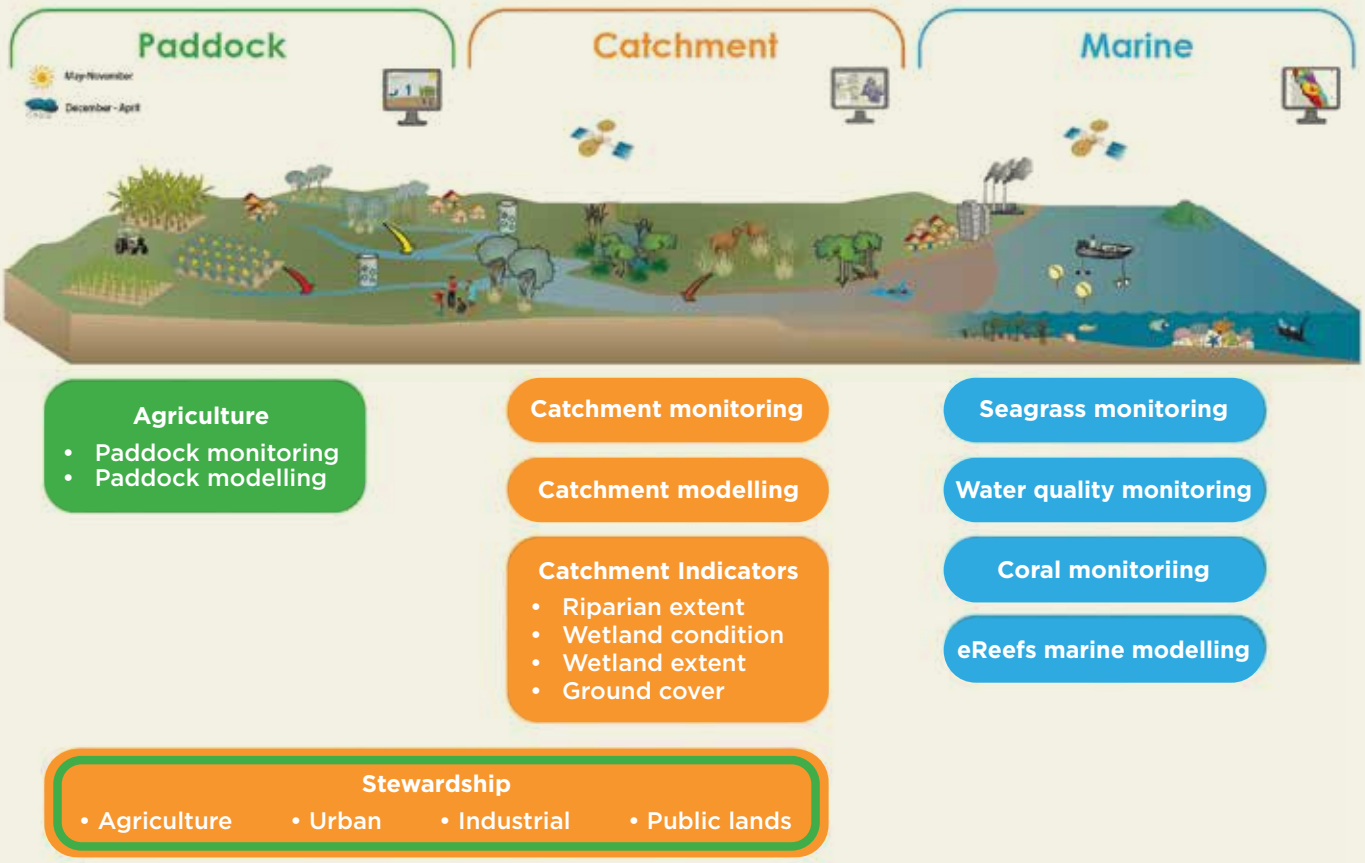
By analysing the geochemistry of the recovered sediment from the water samples collected during this project, we now have a large sediment tracing database that can be paired with historical data collected in this catchment by CSIRO, TropWATER and the Queensland Government. This combined dataset provides an additional line of evidence to quantify BBB tributary contributions to the end-of-river (Burdekin at Inkerman) fine sediment export, and to the marine environment using flood plume samples collected under our NESP project.

TropWATER hopes this landholder-based sampling program can be continued into future wet seasons, to build on the valuable dataset already collected, examine trends over time and document the water quality improvements achieved due to the LDC project. Zoe and Steve have found this project highly rewarding and appreciate the opportunity to engage and learn from landholder samplers, and to share their latest catchment to Reef water quality research.



What is the Paddock to Reef program?

The Paddock to Reef program evaluates management practice adoption and effectiveness, catchment condition, sediment, nutrient and pesticide runoff and marine condition including inshore GBR water quality and seagrass and coral heath.



Source: Paddock to Reef Integrated Monitoring, Modelling and Reporting Program (Paddock to Reef Program)

Graphical representation of the program areas within the Paddock to Reef program, including catchment monitoring and modelling.

At the broader catchment scale, this includes both monitoring and modelling programs:

Monitoring program

The Great Barrier Reef Catchment Loads Monitoring Program tracks long-term trends in water quality entering the GBR lagoon from adjacent catchments as part of the Paddock to Reef program. The monitoring data is used to validate the catchment water quality models that track progress towards the Reef targets.

This involves monitoring 43 sites in 20 key catchments for sediment and nutrients and a further 19 sites for pesticides. Samples are collected on a monthly basis during ambient (low flow, dry season) conditions and every few hours to daily during high flow events in the wet season. This includes both automated and manual grab sampling from these end-of-river sites.

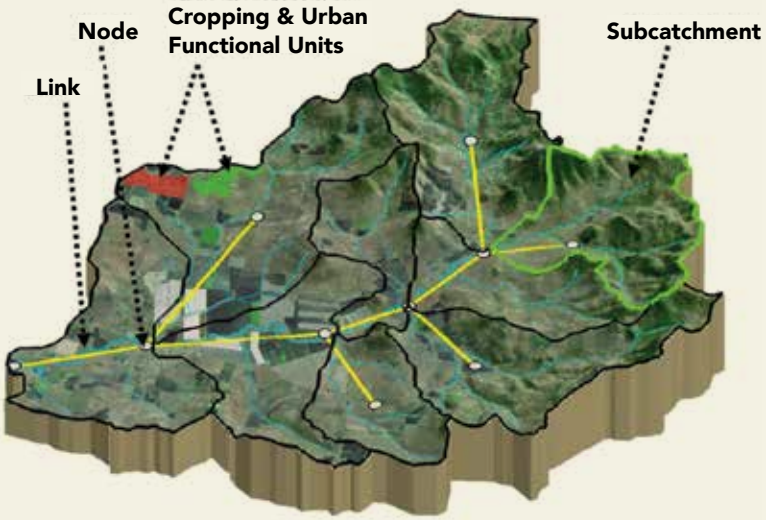
Manual grab sampling methods are similar to those used in our LDC project. For the Burdekin catchment, these sites include the Bowen River (Myuna), Upper Burdekin River (Sellheim), Burdekin Falls Dam outflow (Hydro) sites, and to capture the end-of-river, the Burdekin River at Inkerman Bridge.

The concentrations of sediments and nutrients are determined and the volume of water flowing in the rivers is then used to determine the total amount (i.e. the load) of sediments and nutrients that flow past the sampling sites each year.

Modelling program

The GBR Catchment Loads Modelling Program calculates average annual sediment and nutrient loads for each of the 35 catchments draining to the Great Barrier Reef as part of the Paddock to Reef program. The Source Catchment model reports on baseline levels (i.e. a baseline year to refer back to) and the change in loads for each subsequent year due to adoption of improved land management practices. This assesses progress towards the Reef water quality targets with the latest results available in the Report Card 2019.

Importantly, the model uses a fixed long-term climate period, averaging out the influence of extreme weather years (e.g. floods and droughts). Effectively the latest model produces an annual average load over the 1986-2019 time period.



Source: Paddock to Reef Integrated Monitoring, Modelling and Reporting Program (Paddock to Reef Program)

Australian Government

REEF TRUST

Great Barrier Reef Foundation

The LDC Community Water Quality Sampling program for the 2020-2021 wet season update was also funded from the partnership between the Australian Government's Reef Trust and Great Barrier Reef Foundation.

Landholders Driving Change is a Major Integrated Project funded by the Queensland Government through the Queensland Reef Water Quality Program.

Queensland Government

NQ DRY TROPICS

LANDHOLDERS DRIVING CHANGE
BURDEKIN MAJOR INTEGRATED PROJECT

TropWATER

JAMES COOK UNIVERSITY
AUSTRALIA

This publication is a joint initiative of NQ Dry Tropics' Landholders Driving Change project and TropWATER, James Cook University.

Prepared by Zoe Bainbridge and Stephen Lewis, TropWATER, James Cook University for the Landholders Driving Change (Burdekin Major Integrated Project). The LDC's Barb Colls, Rodger Walker and Adrienne Hall are gratefully acknowledged for their support within this collaborative project. This project is also supported by Zoe Bainbridge's Advance Queensland Research Fellowship.

Pages 13-15 contain text extracted from the Australian and Queensland Government's Reef Plan website, with locally relevant information added for regional and project context.

For general project enquires, contact NQ Dry Tropics via phone: (07) 4799 3500 or email: ldc@nqdrytropics.com.au.

For further information on water sample results, contact Zoe Bainbridge (TropWATER) via email: zoe.bainbridge@jcu.edu.au.