

LDC Community Water Quality Sampling

for sediments and nutrients within the
Bowen-Broken-Bogie catchments

2018-2019 wet season



**LANDHOLDERS
DRIVING CHANGE**
BURDEKIN MAJOR INTEGRATED PROJECT

Project Overview

Nine river and creek sites across the Bowen-Broken-Bogie (BBB) catchment are being sampled by landholders during rainfall-generated high flow events of the 2018-2019 and 2019-2020 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)

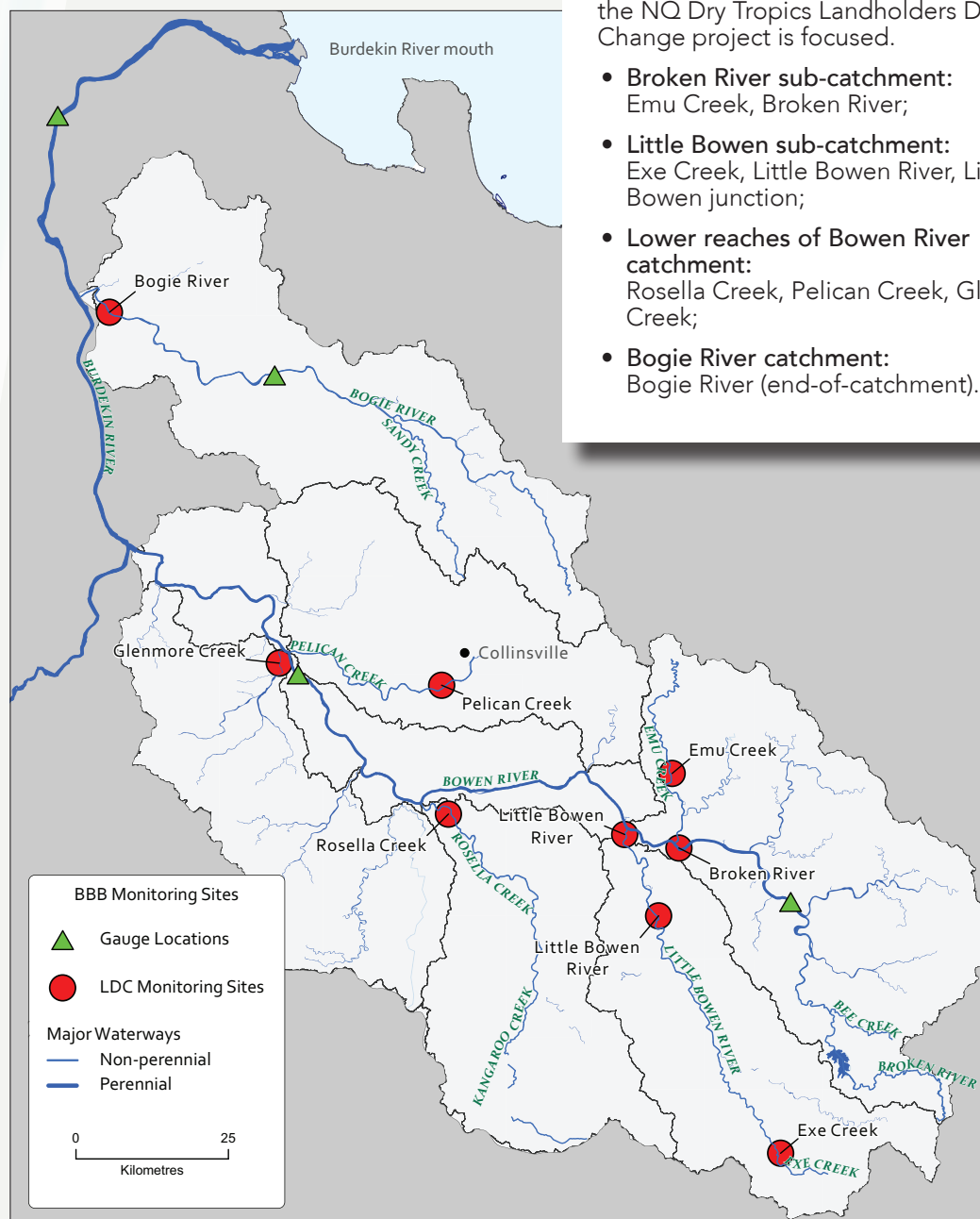
of our river catchments (i.e. provides a validation check against modelled concentrations for these same river and creek locations) and will also act as a baseline dataset to examine trends over time.

The identification of higher sediment and nutrient contributing sub-catchments can then be coupled with broader landscape understanding including slope, soil types, associated erosion processes and other factors for refined catchment characterisation and prioritisation.

Nine tributary sites

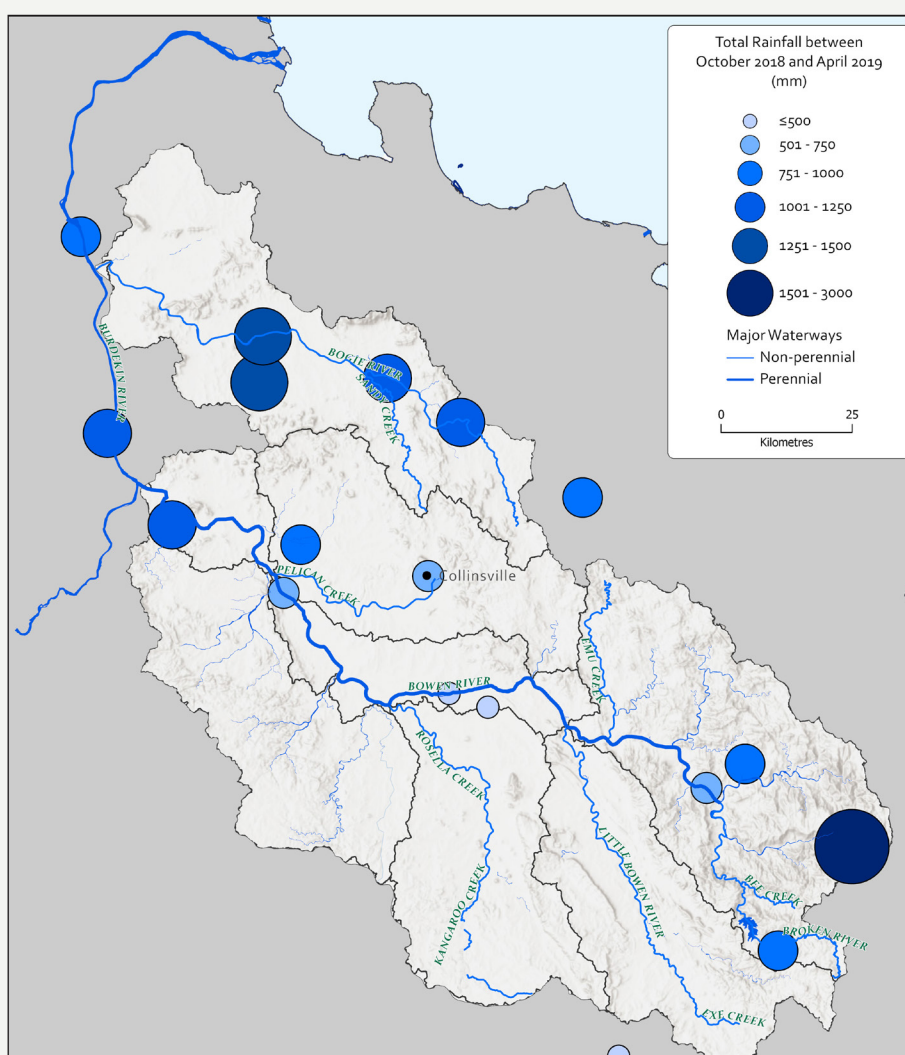
The Bowen-Broken-Bogie catchment centred on Collinsville is the area in which the NQ Dry Tropics Landholders Driving Change project is focused.

- **Broken River sub-catchment:**
Emu Creek, Broken River;
- **Little Bowen sub-catchment:**
Exe Creek, Little Bowen River, Little Bowen junction;
- **Lower reaches of Bowen River catchment:**
Rosella Creek, Pelican Creek, Glenmore Creek;
- **Bogie River catchment:**
Bogie River (end-of-catchment).





Bogie River (right) backed up by the turbid Burdekin River in the week following peak flood discharge (Image: Matt Curnock, 13 February).



Rainfall events

Rainfall generating runoff and stream flow events across the BBB catchment occurred mid-December, mid-January and late January/early February.

Wet season rainfall totals across the catchment ranged from 420mm to 3075mm.

Water sample collection

There were 103 water samples collected in total over the wet season, with samplers each typically collecting four to six samples per flow event.

Five stream flow events were sampled by landholders from October 2018 to March 2019.

Depending where the rain fell, one to four flow events were sampled by each landholder. All samplers captured the large catchment-wide flows that occurred during late January-early February.



Aerial view of the Burdekin River mouth in full flood, mid-February (Image: Matt Curnock)

Sampling from Catchment to Reef

Lewis NESP Project 2.1.5

The downstream Burdekin end-of-river flood peak (early February) was also sampled by TropWATER (JCU) at Inkerman Bridge (equivalent to 29 Sydney Harbours) over the flood hydrograph.

In the three-week flood period (30 January - 19 February), 14.5 million ML of water was discharged in the three-week flood period. Such an event has a ~1 in 5 year return interval.

This is the largest discharge event since the extreme flows of 2010-2011 eight years ago.

As Burdekin River water, sediment and nutrients

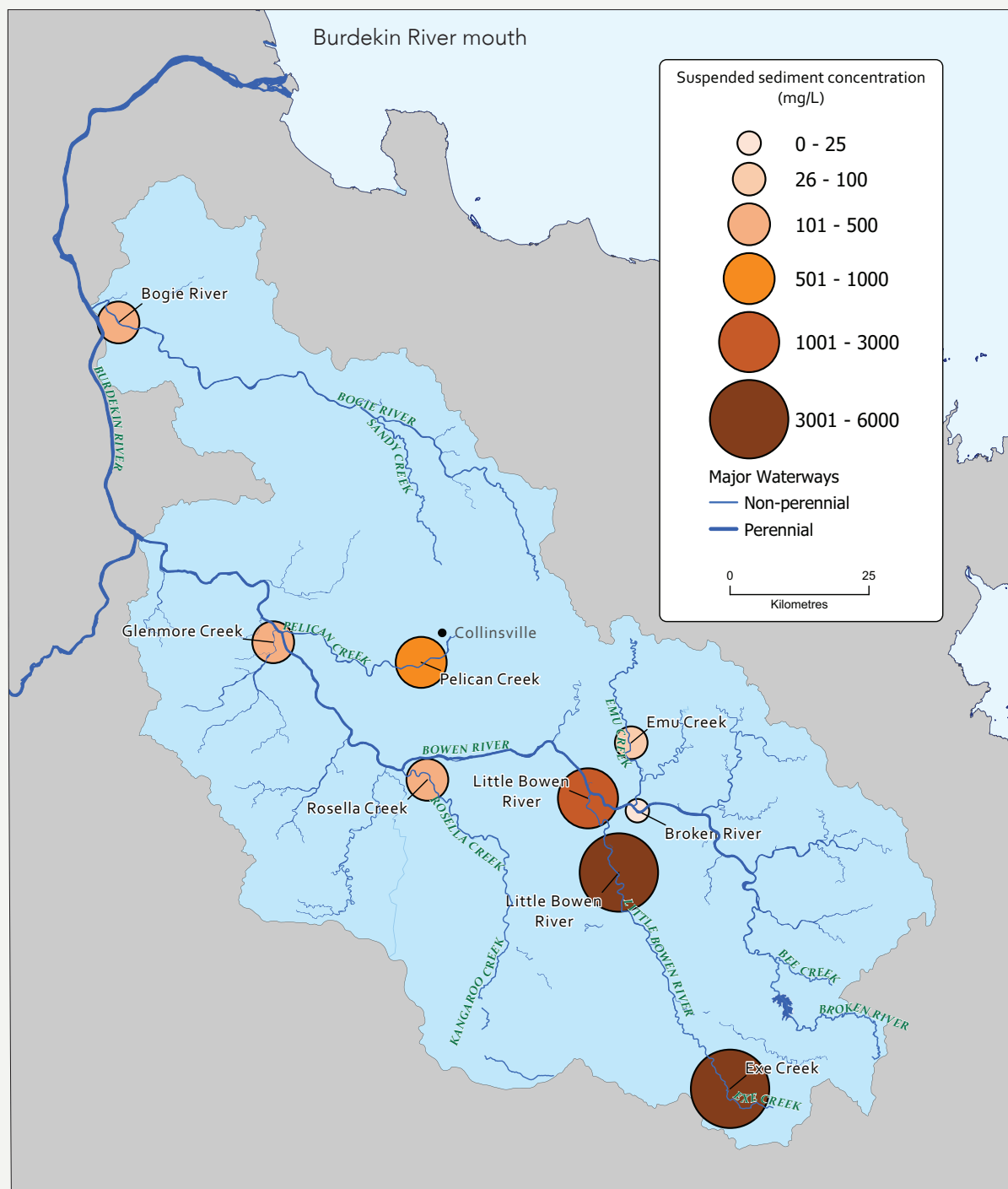
travelled into the adjacent marine waters, flood plume samples were collected in Upstart Bay, off Magnetic Island and in the Palm Island Group (above the seafloor sediment trap sites) to characterise and trace the sources of these sediments travelling within the Great Barrier Reef (GBR).

The TropWATER team also followed the turbid flood plume out to the GBR midshelf to capture aerial footage and plume water samples over Old Reef (see image).



Turbid plume waters inundate Old Reef on the midshelf, 60km offshore from the Burdekin River mouth, mid-February (Image: Matt Curnock).

Suspended sediments



There was a large variation in suspended sediments (SS) concentrations measured across the BBB sampling sites this wet season, with site averages ranging from 21 mg/L (Broken River) to >4800 mg/L across sites in the Little Bowen sub-catchment.

From previous catchment scale water quality sampling (2004 to 2011) we know suspended sediment (SS) and nutrient concentrations are highly variable across the Burdekin River catchment (Bainbridge et

al. 2014, 2016). Water quality measured in rivers and creeks reflect landscape-scale processes of the entire upstream catchment area, and high 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 to reduce runoff reaching the Great Barrier Reef.



Burdekin River in flood at Inkerman Bridge after the mid-February flood peak (Image: Matt Curnock).

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 river and streams as run-off, usually during the wet season

when heavy rain and flooding are common.

Most sediment washed to the Great Barrier Reef is very fine 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.



Highly turbid inner plume of the Burdekin River within Upstart Bay, five days following peak flood discharge (Image: Matt Curnock).

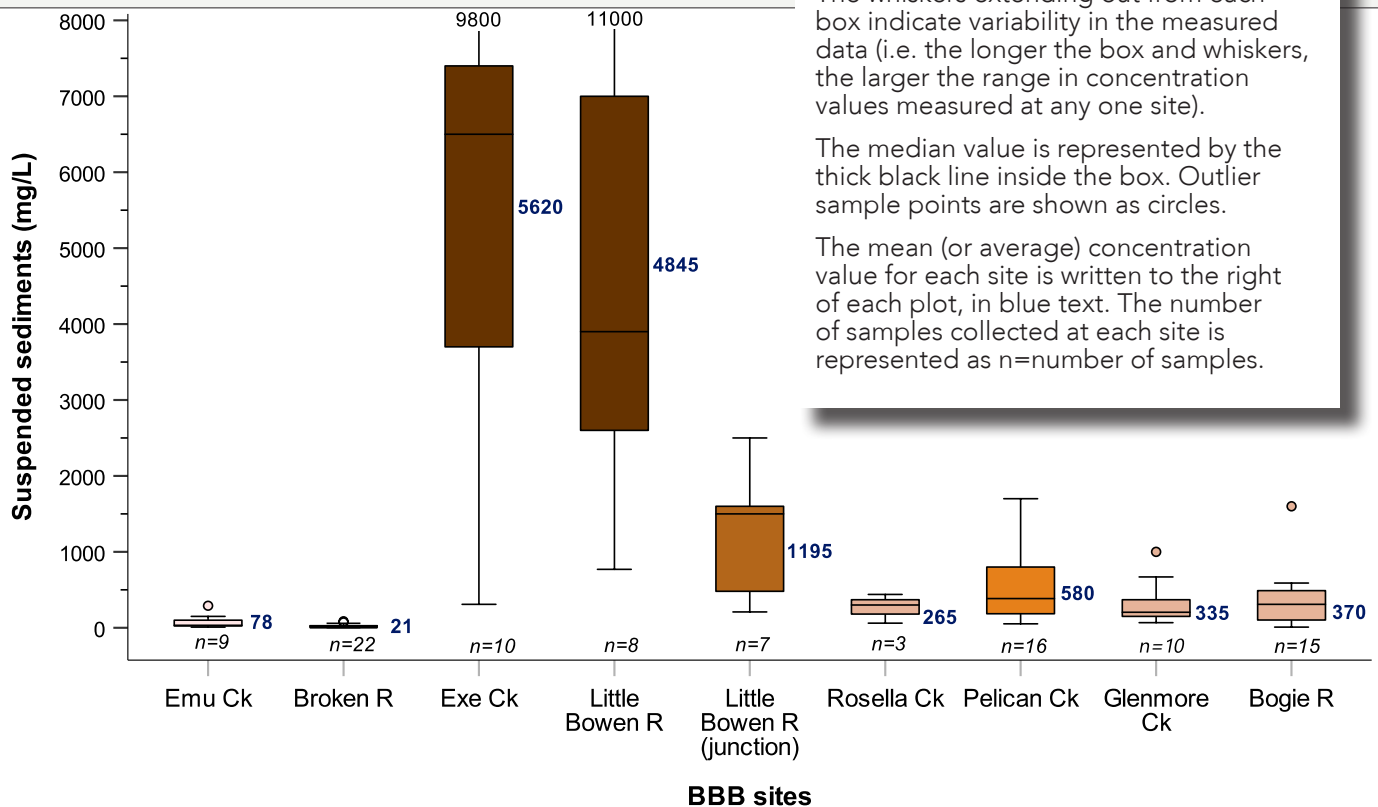
How to read a boxplot graph

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.

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 this wet season. For most BBB sites sampled this wet season, a wide range of suspended sediment concentrations were measured with the highest concentrations typically seen on the rising flow, and during larger flow events (see above).

Sediment data from this wet season

All samples collected at each site were pooled to determine an average site concentration for 2018-2019, displayed in blue text.

The highest average SS concentrations were measured at the three Little Bowen sub-catchment sites (Exe Ck, Little Bowen, Little Bowen junction).

Each of these sites also had the largest range of measured SS concentrations.

Average SS concentrations were substantially lower at the Broken River sub-catchment sites (Emu Ck = 78 mg/L, Broken River = 21 mg/L), with a high number of samples collected over multiple flow events at the Broken River site (n=22) providing good confidence in this data.

This sub-catchment is often the dominant flow

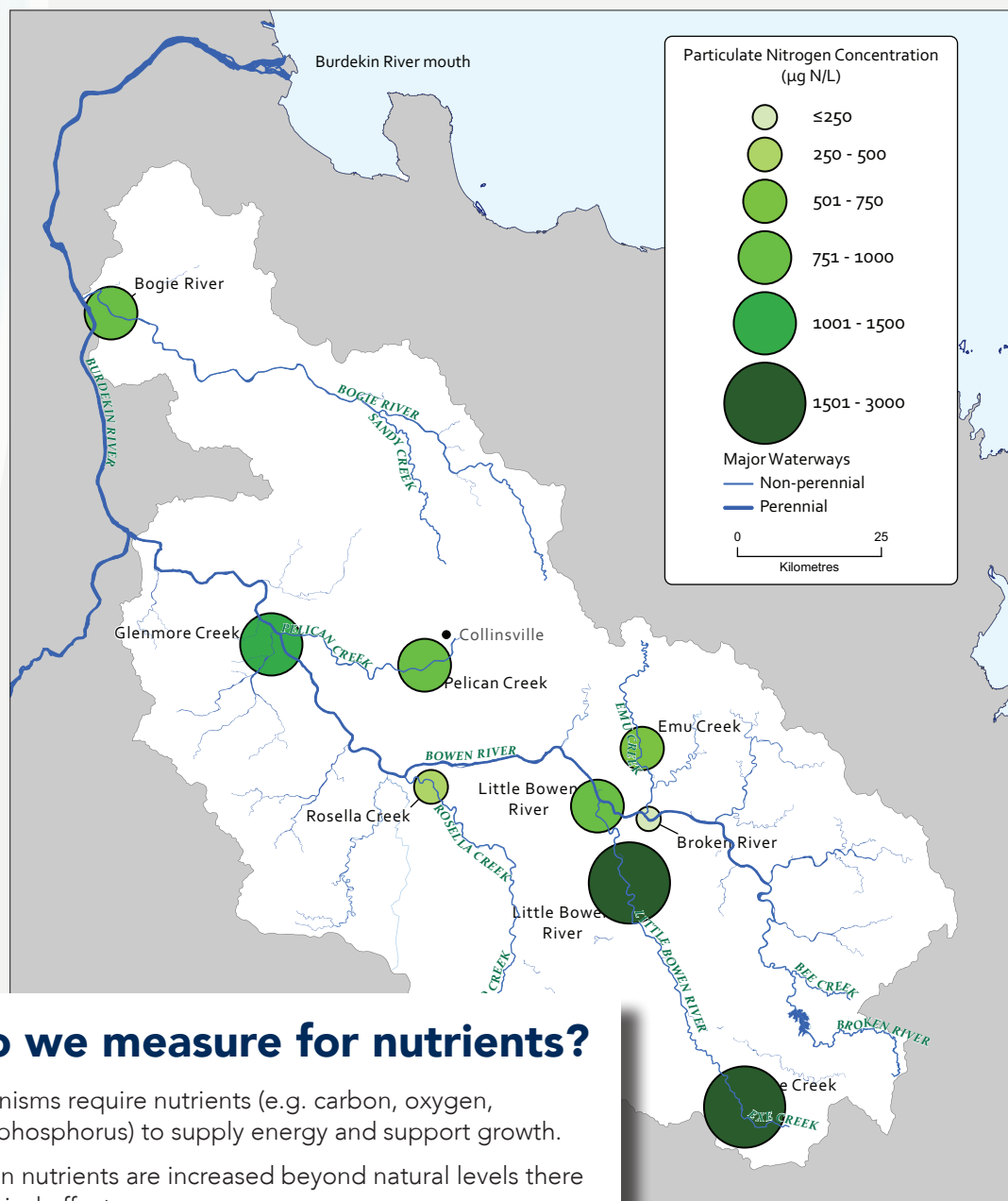
contributor to the Bowen River, draining steep forested and higher rainfall areas in the upper reaches (e.g. Eungella).

The creeks draining into the lower reaches of the Bowen River (Rosella, Pelican and Glenmore) had average SS concentrations ranging from 265 to 580 mg/L.

Limited rainfall (and associated flow events) in the Rosella Creek catchment restricted sampling at this site (n=3); additional sampling next wet season will provide stronger comparisons across all sampling sites.

The Bogie River average concentration (370 mg/L) was at the lower range, and is consistent with previous sampling at this site from 2006 to 2009, with a mean concentration of 510 mg/L calculated for this earlier period.

Particulate nitrogen



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 Great Barrier Reef (GBR) lagoon where excess nutrients encourage the growth of algae on inshore reefs.

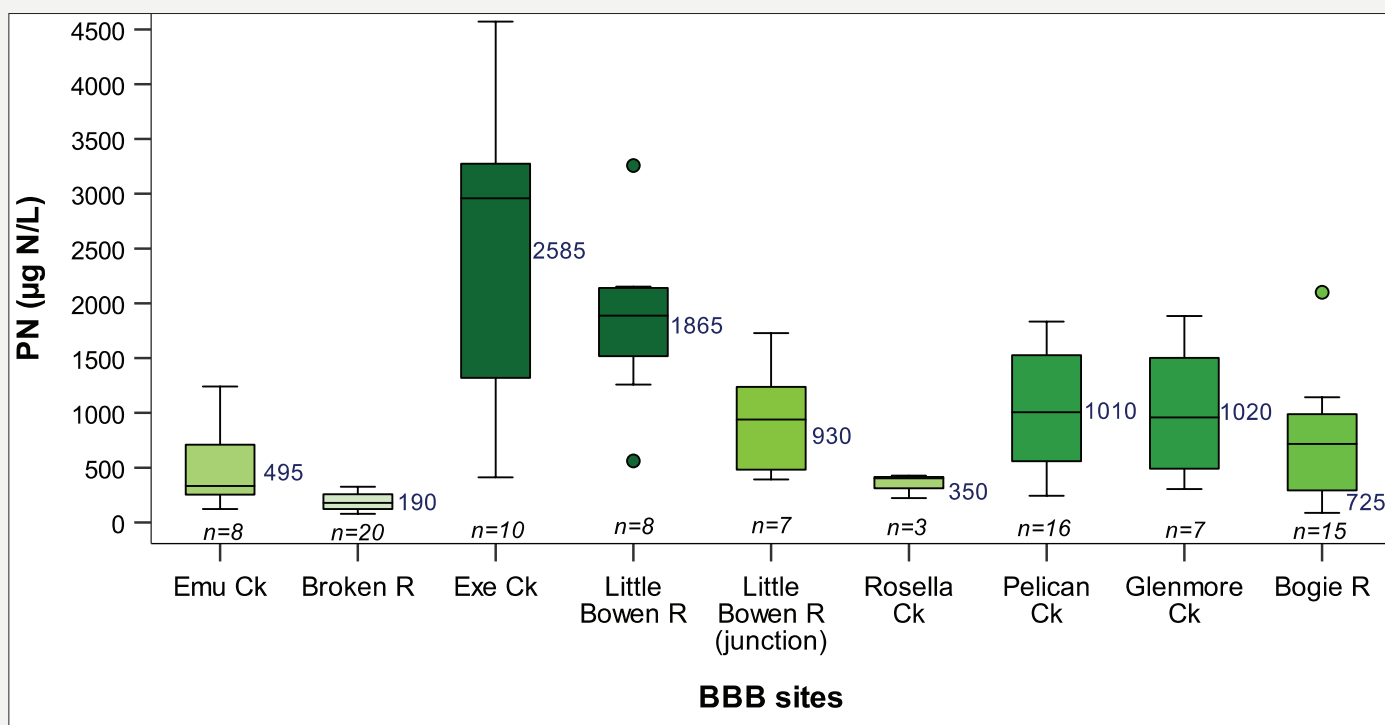
They also feed plankton whose remains bind with sediment to form 'marine snow', reducing light and smothering the juvenile corals that renew inshore reefs.

Nitrogen and phosphorus were measured in water samples collected this wet season.

Average particulate nitrogen (PN) concentrations for each site are shown above. Nitrogen in the particulate form (PN) is associated with organic matter and

is commonly attached to soil particles, and thus often elevated in runoff with high sediment concentrations.

Hence in most circumstances, the PN values closely match the SS concentrations which was the case this wet season.



Graph showing particulate nitrogen (PN) concentrations measured at each sampling site this wet season.

Highest and lowest concentrations of particulate nitrogen

The highest concentrations of PN were measured at the high sediment contributing Little Bowen sub-catchment sites, with average concentrations of 2585, 1865 and 930 µm N/L, respectively.

Average concentrations were also elevated in Pelican

and Glenmore creeks draining into the lower reaches of the Bowen River (1010 and 1020 µm N/L, respectively).

The Broken River site had the lowest PN concentrations (190 µm N/L) due to the low SS concentrations measured at this site.



Stephen Lewis of TropWATER (left) and Rodger Walker of ND Dry Tropics' Landholders Driving Change project.

What will the data be used for outside of the LDC project?

Suspended sediment and nutrient concentration data collected at each site will be provided to the Source Catchment's modelling team in July to improve the model's representation of water quality contributions from many of the BBB's major creeks and rivers.

Prior to this project, only limited water quality data have been collected during high flows across the BBB creeks and rivers, except for the long-running Bowen River at Myuna flow gauge site (active since 2003).

The TropWATER (JCU) team also ran a landholder sampling program for NQ Dry Tropics across the

entire Burdekin-Don-Haughton river catchments from 2004 to 2011, which included three sampling sites in the BBB: the Little Bowen River junction and upper and lower reaches of the Bogie River.

The TropWATER (JCU) team will also use any remaining water samples (after analysis for sediments and nutrients) to recover the fine sediment being transported at each of the nine sites, and link this data with Lewis' NESP Project 2.1.5 (see nesptropical.edu.au for more info) which seeks to trace fine sediment exported into the Great Barrier Reef lagoon from the Burdekin River back to a catchment source.



Glenmore Creek snapped in flood in February by Eileen Hillier.



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 (pictured) at TropWATER, James Cook University for the Landholders Driving Change BMIP.

Aerial images by Matt Curnock. Support for the aerial footage was provided by TropWATER JCU, the Marine Monitoring Program - Inshore Water Quality through the Great Barrier Reef Marine Park Authority, the Queensland Government,

the NQ Dry Tropics Landholders Driving Change project, CSIRO and the National Environmental Science Program Tropical Water Quality Hub.

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She can provide the cited journal publications (Bainbridge et al. 2014, 2016) on request.

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TropWATER scientist Zoe Bainbridge at Little Bowen River demonstrating the correct way to collect water samples. It was part of a two-day training tour of the BBB and an easy technique to demonstrate when the river was not raging in flood.