Bioavailable nutrients from sediment data (BAN data) - Queensland Government

This document details the methods used to obtain the data presented in the Bioavailable nutrients from sediment data (BAN data) dataset.

Fractionation method
Parent soil <2mm

Surface soil samples (0-10 cm) were collected at all sampling points after removing vegetation, loose leaves and woody litter from the surface. Surface soil was sampled from inter-rows at cane sites, rows at banana sites, hillslopes or terraces (floodplains) in hillslope or alluvial gully catchments respectively (grazing land).
Subsurface soil samples were taken at sampling points of high erodibility (e.g., Bowen River catchment) by sampling all vertical strata differentiated by soil colour on an exposed gully bank. When the sample was taking using a corer in a terrace this is specified.
Samples from each stratum were integrated by scraping approximately 20 cm into the exposed face of the bank within each of the vertical strata with a spade.
Soil samples were dried at 40°C until constant weight was achieved and then sieved to <2 mm or ground in a jaw crusher so that the soil would pass through a <2 mm sieve.
Large litter fragments (>2 mm) were either removed manually or by the sieving process. A sample splitter was used to take representative subsamples of the sieved soil.

<10 um stokes/dried or/wet

This size fraction (clays and fine silt) is the dominant fraction transported to the GBR lagoon in large events (Bainbridge et al., 2012).
Briefly, a soil subsample (100 gm unless stated otherwise) was suspended in deionised (DI) water after sonication for 2 minutes to break aggregates and left undisturbed for the time necessary for a 10-um-diameter particle to settle through the settling column height at 20°C according to Stoke's Law (48 min).
The sediment slurry was recovered to either (1) centrifuge the slurry at 4500 RPM for 20 minutes and dried at 40°C to recover the fine sediment until constant weight was achieved (dried metho) or (2) a subsample of the slurry was recovered to process bioavailable nutrient parameters directly on the slurry (wet).

<63 um stokes/dried or /wet

This size fraction (clays and fine silt) is the dominant fraction transported to the GBR lagoon in large events (Bainbridge et al., 2012).
Briefly, a soil subsample (100 gm unless stated otherwise) was suspended in deionised (DI) water after sonication for 2 minutes to break aggregates and left undisturbed for the time necessary for a 63-um-diameter particle to settle through the settling column height at 20°C according to Stoke's Law (1 min 12 sec).
The sediment slurry was recovered to either (1) centrifuge the slurry at 4500 RPM for 20 minutes and dried at 40°C to recover the fine sediment until constant weight was achieved (dried method) or (2) a subsample of the slurry was recovered to process bioavailable nutrient parameters directly on the slurry (wet).

Water or Potasium sulphate extractable soluble organic carbon W_DNOC_DOC and water extractable soluble nitrogen W_DNOC_DN

Soils or recovered sediments (/dried method) are extracted with deionised (DI) water using a 3:10 soil/sediment to DI water ratio (for 1 h at 25°C in an end over end shaker) or a subsample of the S_POTS_NH4_N solution is used. For the /wet fractionation method, a subsample of the slurry is used. The suspension is centrifuged at 4500 rpm for 20-30 minutes, then filtered (0.45µm). The filtrate may need to be diluted to have enough volume to perform the following analytical procedures. The dilution factor needs to be recorded and the resulting concentrations from the analyses corrected for this dilution factor. This method was adapted from the potential production of soluble organic carbon method, which in turn is an adaptation of the Potential Mineralisable Nitrogen in soils method (Bremner 1965).
Soluble Organic Carbon and soluble nitrogen are determined on the filtrate by high temperature combustion or wet oxidation with persulfate (APHA/AWWA/WEF (2012) method 5310). The results from this method are reported on a mg/kg basis using the extracting soil to water ratio.
Soluble organic nitrogen obtained from the S_POTS_SON method can also be added to the water extractable Nox-N and NH4-N to obtain W_DNOC_DN.

Water extractable soluble ammonium-N, nitrous oxide-N, phosphate-P, dissolve Kjeldahl-N and dissolved Kjeldahl-P- W_FIL_AA_NH4-N, W_FIL_AA_Nox-N, W_KJD_AA_DKN, W_KJD_AA_DKP

These methods were only carried out for the /wet sediment fractionation method. A subsample of the slurry was taken. The suspension is centrifuged at 4500 rpm for 20-30 minutes, then filtered (0.45µm) to measure NH4-N, NOx-N, PO4-P, DKN and DKP on the filtrate as per water lab analytical methods.
The results from this method are reported on a mg/kg basis using the extracting soil to water ratio in the fractionation method .

S_POTSN_NH4_N and SPOTSN_NOX_N (for /wet fractionation)

A slurry 40 mL subsample is taken into a pre-made tube with K2SO4 salt (3.49g). The tube is shaken for 10 seconds and left to sit chilled shaking occasionally for 10 minutes.
It is then filtered using a <0.4 um filter into an empty tube at around the same time water extractable nutrients are carried out. The sample is frozen immediately to submit for W_FIL_AA (only NH4+-N needed).
The adsorbed ammonium reported here as S_POTS_NH4_N is calculated by subtracting the water extractable ammonium from the K2SO4 extracted ammonium and reported on a mg/kg basis using the soil to water ratio of the fractionation method.

Soluble organic nitrogen S_KC2_SON

Soluble organic nitrogen is calculated by subtracting S_KC2_NH4_N and S_KC2_NO3_N from W_DNOC_SN. When below detection the value was assumed to be 1/2 the detection value, when calculation was negative it was assumed to be 0.

Particulate organic nitrogen S_KC2_PON

Particulate organic nitrogen is calculated by subtracting S_KC2_NH4_N from S_KJNP_TKN in mg/kg. When below detection the value was assumed to be 1/2 the detection value, when calculation was negative it was assumed to be 0.

Soluble organic nitrogen S_POTSN_SON

Soluble organic nitrogen is calculated by subtracting S_POTS_NH4_N and S_POTSN_NO3_N from W_DNOC_SN. When below detection the value was assumed to be 1/2 the detection value, when calculation was negative it was assumed to be 0.

Particulate organic nitrogen S_POTSN_PON

Particulate organic nitrogen is calculated by subtracting S_POTSN_NH4_N from S_KJNP_TKN in mg/kg. When below detection the value was assumed to be 1/2 the detection value, when calculation was negative it was assumed to be 0.

Potential mineralisable nitrogen in parent soil (<2mm) (S_KC2_PMN1, S_KC2_PMN3, S_KC2_PMN7)

This is a biological method, based on a method described by Bremner (1965), to provide an index of plant-available soil N. Samples were incubated at field capacity and at 30 °C under aerobic conditions for 0, 1, 3 and 7 days, respectively.
The amounts of mineral-N formed at different times are measured by 2M KCl extraction (lab method S_KC2_NH4_N and SKC2_NO3-N) followed by automated colorimetric determination. Potentially mineralisable-N is calculated as the difference between the mineral-N before and after incubation.

Potential mineralisable nitrogen in sediment (<63um, <10 um stokes/dried) (S_KC2_PMN1, S_KC2_PMN3, S_KC2_PMN7)

The method used with soils was adapted for sediments. The main difference is that sediments were incubated using a 3:10 sediment:DI water ratio instead of at field capacity at 25 °C.
The suspension was extracted at 0, 1, 3 and 7 days using 3M KCl (this gives a 1:10 sediment:solution ratio in a 2M KCl solution) to estimate mineralisable N at each timeframe.

Potential mineralisable nitrogen in parent soil (<2mm) (S_POTSN_PMN1, S_POTSN_PMN3, S_POTSN_PMN7)

This is a biological method, based on a method described by Bremner (1965), to provide an index of plant-available soil N. Samples were incubated at field capacity and at 30 °C under aerobic conditions for 0, 1, 3 and 7 days, respectively.
The amounts of mineral-N formed at different times are measured by 0.5M K2SO4 extraction on a 1:10 soil solution followed by automated colorimetric determination. Potentially mineralisable-N is calculated as the difference between the mineral-N before (day 0) and after incubation (days 1, 3 and 7).

Potential mineralisable nitrogen in sediment (<63um, <10 um stokes/dried and stokes/wet) (S_POTSN_PMN1, S_POTSN_PMN3, S_POTSN_PMN7)

The method used with soils was adapted for sediments. For the /dry fractionation method, the main difference is that sediments were incubated using a 3:10 sediment:DI water ratio instead of at field capacity at 25 °C.
The suspension was extracted at 0, 1, 3 and 7 days using 0.6M K2SO4 solution (this gives a 1:10 sediment:solution ratio in a 0.5M K2SO4 solution) and potential mineralisable N was calculated similar to the parent soil at each timeframe for mineralisation.
For the sediment /wet fractionation method, the difference is slurry subsamples were taken directly from the sediment fractionation column for incubation as follows:
- A set of 4 x D bottles (300 ml) is filled with each soil slurry leaving an empty headspace to incubate for 0d, 1d, 3d or 7d. Bottles marked 1d, 3d, and 7d are placed in the shaker incubator at 25°C in the dark with the shaker at a speed in which the sediment in the bottles is kept in suspension (75 RPM).
- The 0 day bottle is used for accounting water extractable total and filterable carbon and nutrients (W_DNOC_DOC, W_DNOC_DN, W_FIL_AA_NH4-N, W_FIL_AA_Nox-N, W_KJD_AA_DKN, W_KJD_AA_DKP) and to carry out a K2SO4 extraction to account for extractable ammonium and nitrate (S_POTSN_NH4_N, S_POTSN_NOX_N)
- The previous step could be repeated for all or some bioavailable nutrient fractions at day 1, 3 and 7 days. The potential mineralisable nitrogen in sediment only needs the K2SO4 extraction for the calculation which is the same as carried out for the parent soil method.

Potential production of soluble organic carbon in parent soil (<2mm) (S_W_PPOC1d, S_W_PPOC3d, S_W_PPOC7d)

This is a similar method to the Potentially Mineralisable Nitrogen in soils method. Incubations are carried out the same way (field capacity at 30 °C under aerobic conditions for 0, 1, 3 and 7 days). At each incubation time, the soil is extracted with water or 0.5M K2SO4 to measure soluble organic carbon (see method W_DNOC_DOC). The potential production of soluble organic carbon is calculated as the difference between soluble organic carbon before and after the incubation.

Potential production of soluble organic carbon in sediment (<63um, <10um stokes/dried) (S_W_PPOC1d, S_W_PPOC3d, S_W_PPOC7d)
This is a similar method to the Potentially Mineralisable Nitrogen in sediments method. Incubations are carried out the same way (3:10 sediment to DI water ratio) at 25 °C under aerobic conditions for 0, 1, 3 and 7 days), except there is no need for extractions.
At each incubation time, the suspension is centrifuged and filtered and the recovered solution is diluted to a volume of 25mL to measure dissolved organic C (DOC), dissolved Kjeldahl nitrogen (DKN) and ammonium in the lab.
The DOC result at 0 days is referred to as SOC (soluble organic carbon) and the DKN minus the ammonium measured at 0 days is referred to as SON (soluble organic nitrogen).