Queensland
REEF WATER
QUALITY
Program

Reef protection regulations
Farming in Reef catchments

Prescribed methodology for sugarcane cultivation

Version 2

(Agricultural environmentally relevant activity standard for sugarcane cultivation)

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Queensland Government

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Version	Date	Description of changes
1	1 December 2019	First published version
2	17 March 2022	Minor clarifications and technical edits

Introduction

The *Environmental Protection Act 1994* requires commercial beef graziers, sugarcane growers, banana growers, and horticulture and grain growers in the Wet Tropics, Burdekin, Mackay Whitsunday, Fitzroy or Burnett Mary regions of the **Great Barrier Reef catchment** to comply with commodity-specific minimum practice standards.

The minimum practice standards for each commodity are outlined in an Agricultural ERA standard that is prescribed by regulation. The minimum practice standards are based on the best available science and agricultural industry expertise to deliver significant water quality benefits for the Reef while driving better land management practices for profitable and productive farming.

In this document, the standards and associated regulatory provisions under the legislation are collectively referred to as the Reef protection regulations. The purpose of the Reef protection regulations is to protect the health of the Great Barrier Reef by reducing pollutant run-off (nutrients, sediment and pesticides) in waterways that flow to the Reef.

This document is directly referred to in the Agricultural ERA standard for sugarcane cultivation. This document includes:

- Part A - Soil sampling and analysis method
- Part B - Calculating the amount of nitrogen and phosphorus method

Glossary

Block: An area of land that is typically used to grow sugarcane.

Broadcast application: Means application of fertiliser across the entire surface of a block on the agricultural property. Ground-based broadcast application is not considered to be:

- surface banded application of fertiliser on the stool
- aerial broadcast application of fertiliser
- broadcast application of **soil conditioner**/s (including mill mud or mill mud/mill ash mix) in the fallow, if it is incorporated into the soil during the fallow period.

Calculated Amount: The 'calculated amount' (commonly known as the 'fertiliser rate') relates to the kilograms of nitrogen or phosphorus applied per hectare (kg/ha).

Crop cycle: For the purposes of this methodology a crop cycle is one plant and four ratoon crops.

District Yield Potential: Means the highest average yield of sugarcane obtained across a district over all soil types and is calculated by multiplying the estimated highest average annual district cane yield (tonnes cane/ha) by a factor of 1.2.

Fallow: An area of land that is typically used to grow sugarcane, and that is left with either grass/weedy cover, green manure or a leguminous crop (i.e. crop or ground cover with low or no nitrogen demand) for a period of at least six (6) months. The fallow period begins on the harvest date of the previous sugarcane crop.

Farm: For the purposes of this methodology, to determine which district yield potential to use in the Burdekin, "**farm**" is an area covered by one unique farm identity number.

Farm nitrogen and phosphorus budget: Includes the farm map and any other documents (including records, fertiliser recommendations, and soil test results) used to prepare the Farm Nitrogen and Phosphorus Budget under the *Agricultural ERA standard for sugarcane cultivation.* The Farm nitrogen and phosphorus budget is also referred to as the N&P Budget.

Fertiliser: Means any fertiliser product that has a quantified amount, obtained by analysis, of nitrogen and/or phosphorus.

Great Barrier Reef catchment: Has the same meaning in the *Environmental Protection Act 1994*. The Great Barrier Reef catchment is the area shown on a map prescribed by regulation as the Great Barrier Reef catchment.

Mill ash: Means a by-product produced by sugar mill boilers. Also known as boiler ash.

Mill by-product: Mill mud and mill mud/mill ash mixes.

Mill mud: Means the residual mud and fibre filtered from the raw sugar juice during the sugar refining process. Also called filter mud, filter cake or sugarcane press mud.

Phosphorus buffer index (PBI or P buffer index): A measure of the degree to which added phosphorus is held tightly onto soil particle surfaces and is unavailable for plant uptake.

Plant crop: For the purposes of this standard means the initial sugarcane crop after planting.

Ratoon crop: For the purposes of this standard means a new crop of sugarcane that regrows from the portion of stalk left underground after harvesting of the previous crop.

Smartcane BMP: A voluntary, industry-led program to encourage best practice.

Soil conditioner: Means a substance added to soil to improve the growing conditions for plant roots. Examples are gypsum, lime and organic matter. For the purpose of this standard, mill mud and mill ash are also considered soil conditioners.

Soil grouping: Where different soil types are grouped together based on colour and texture as identified in the Six Easy Steps 'Soil Reference Booklet' for the particular cane district.

Soil testing: Means a test of the characteristics of soil, analysed by a National Association of Testing Authorities (NATA) or Australasian Soil and Plant Analysis Council (ASPAC) accredited laboratory, or one holding an equivalent certification.

Whole-of-farm: Means the area of plant and ratoon blocks (and not fallow blocks) to which the farm nitrogen and phosphorus budget applies where:

(a) the activity is carried out under the day-to-day management of a single responsible individual, for example, a site or operations manager;

(b) the activity is operationally interrelated;

(c) the activity is, or will be, carried out at one (1) or more places;

(d) places where the activities are carried out are separated by distances short enough to make feasible the integrated day-to-day management of the activities;

(e) the activity is carried out within the same **sugarcane growing district**.

Whole of farm phosphorus amount: Means the total amount of phosphorus fertiliser (sum of each block calculated under the *Prescribed Methodology for Sugarcane Cultivation*) for the whole of farm for an annual period. Excludes blocks where phosphorus is being applied to supply multiple crops in the whole crop cycle.

Part A - Soil sampling and analysis method

Contents

Part A - Soil sampling and analysis method

Purpose

The purpose of this section is to describe the method for soil sampling and analysis required to determine the whole of farm amounts for nitrogen and phosphorus to develop your N&P budget. The intent of the N&P Budget is to encourage and assist growers to identify and address constraints to productivity, and to review and refine their nitrogen and phosphorus management at a finer scale. This should lead to improved nutrient use efficiency, improving production and profitability, whilst reducing the amount of surplus nitrogen and phosphorus that could be lost from the farm.

If you grow sugarcane commercially in the Wet Tropics, Burdekin, Mackay Whitsunday, Fitzroy or Burnett Mary regions of the Great Barrier Reef catchment, this method must be used when undertaking **soil testing** and analysis to determine nitrogen and phosphorus nutrient requirements to comply with the Reef protection regulations. You can check if your property is in the Reef catchment by completing this online form available at www.qld.gov.au/ReefRegulations.

The additional explanatory information in this method is intended for use by growers, and others involved in soil testing on sugarcane growing properties. This method outlines the standard required for soil sampling and analysis to determine nitrogen and phosphorus nutrient requirements on commercial sugarcane growing properties.

This method also recognises the soil sampling procedures outlined in the *Fertcare guide to fit for purpose soil sampling* (Gourley and Weaver 2019).

This method provides information to enable you to comply with the Reef protection regulations for soil sampling on commercial sugarcane growing properties by:

- helping you decide on the number of soil samples required to assess the fertility status of cane **blocks** being planted
- outlining the factors that should be considered when designing a soil sampling plan and collecting soil samples
- providing details on the required soil tests analysis methods that laboratories must conduct
- identifying the records and primary documents to be kept to meet the requirements of the Act.

Soil testing within the 12 months prior to **fertiliser** being applied provides a guide to nutrient concentrations in the soil and allows you to calculate the fertiliser rate for nitrogen and phosphorus needed for optimum yield and developing your N&P Budget. Using the soil test results will let you fine-tune your crop management, and apply nutrients at rates that meet the needs of the plants on a particular block of sugarcane.

> Soil testing also highlights other nutrients that may be required for optimum crop yield. By optimising nutrient application, there is less chance of surplus nutrients being lost to waterways, where they can harm the environment.

This method focuses on testing for nitrogen and phosphorus, the two (2) nutrients of environmental importance because of the risk they pose to water quality in Great Barrier Reef coastal and marine ecosystems.

To guide nutrient management, representative surface soil samples (0–20 cm) need to be tested to determine the organic carbon (OC), phosphorus (P) and **phosphorus buffer index** (PBI) of the cane blocks being planted each season.

The organic carbon status of the soil is used to define the potential for nitrogen to mineralise in the soil, which is then deducted from the total amount of nitrogen necessary to produce the potential cane yield for a block.

Soil phosphorus status is used to define phosphorus fertiliser requirements according to the *Six Easy Steps* guidelines developed by the BSES Limited (now known as Sugar Research Australia). It takes into account past applications of **mill by-products** such as **mill mud** and/or mill mud/**mill ash** mixes that can provide a significant contribution of nitrogen and phosphorus to the soil.

Part B of this document, *Calculating the amount of nitrogen and phosphorus method*, provides details about how to make nutrient application rate calculations each season.

Rather than sampling every plant cane block (a cane farm may have many small blocks), this document describes how to choose particular blocks to represent the fertility status of a number of plant cane blocks of the same soil type.

By keeping good records of soil tests and management practices, you can monitor trends in soil fertility over time, especially the organic carbon and phosphorus status of the soil which can assist in accurate nutrient management, improved soil health and cost savings.

What if I need help?
If you require assistance with soil testing on your farm, please contact your local productivity services board, an agronomist or a Fertcare accredited advisor.

Regulations timeframe for commercial sugarcane growing

The Reef protection regulations apply to different regions at different times. Please refer to the table below for when the Reef protection regulations take effect for commercial sugarcane growing.

Commodity	Region	General record keeping requirements	Minimum practice agricultural standards (including this method)	Farm nitrogen and phosphorus budget
Sugarcane	Burdekin, Mackay Whitsunday and Wet Tropics	1 December 2019	1 December 2019	1 December 2021
	Burnett Mary and Fitzroy	1 December 2019	1 December 2022	1 December 2022

What do I need to do?

Under the Reef protection regulations, soil must be tested and analysed. The information below outlines what needs to be tested for, how often it needs to be carried out and what preparation needs to be conducted prior to testing.

What needs to be tested?

Soil must be tested and analysed to determine the content of:

- Organic Carbon (OC) uncorrected Walkley Black (Method 6A1)
- BSES (acid) extractable P (Method 9G2 or 9G1)
- P buffer index (PBI) adjusted to Colwell extractable P (Method 9I2)
- pH (1:5 water) (Method 4A1) if using Colwell extractable P (Method 9B1 or 9B2)

Details of the tests and methods that must be applied are provided in Step 3.1: Laboratory selection in this document.

How often do soil tests need to be taken?

Soil must be sampled and tested, at a minimum, within the 12 months prior to fertiliser being applied to the first crop of a **crop cycle**. You can also take further soil samples at any time during the crop cycle to ensure your crop's nutritional requirements continue to be met.

What do I need to prepare before soil testing?

Before you conduct a soil test, you will need to ensure you have the right tools (see Stage 2. Soil sample collection).

A guide to the stages of soil testing

There are four important stages in the process of soil testing, with a number of distinct steps:

Stage 1. Developing a soil sampling plan

1.1 Obtain a soil map 

1.2 Identify blocks being planted with sugarcane 

1.3 Identify block management practices 

1.4 Select representative blocks for sampling 

1.5 Complete your soil sampling plan 

Stage 2. Collecting soil samples

2.1 Sample collection 

2.2 Labelling 

Stage 3. Soil analysis in the laboratory

3.1 Laboratory selection 

3.2 Send samples for analysis 

3.3 Record keeping 

Stage 4. Interpretation of the results

Stage 1. Developing a soil sampling plan

It is important to plan where and when samples will be taken on your property, taking into account the:

- stage in the cropping cycle
- different soil types on your property
- various nutrient management practices that may occur across your property
- size of the property.

The design of a soil sampling plan involves selecting an area for soil sampling that represents the fertility status of the blocks being planted on your farm that year. A single block can represent the fertility status of a number of plant cane blocks belonging to the same **soil grouping**, as identified in the *Six Easy Steps* 'Soil-Specific Nutrient Management Guidelines for Sugarcane Production' for the particular district*.

** These 'soil mapping units' group soils of similar profile characteristics and landscape position together, based on soil survey data. Such groupings are the most effective way of condensing intensive soil survey data into larger soil groupings with similar management requirements.*

You may use the soil sampling method outlined below or refer to the *Fertcare guide to fit for purpose soil sampling* (Gourley and Weaver 2019), which can be found at www.fertilizer.org.au. The Fertcare guide provides a detailed, practical guide to sampling soil in order to develop soil and plant nutrient recommendations.

Step 1.1: Obtain a soil map

Soil maps may be available through productivity organisations and/or professional agronomy advisors. You can also access soil maps for your property through the Queensland Globe (www.qldglobe.information.qld.gov.au/).

Soil map/s (Figure 1) describing the soil types and boundaries relevant to a farm are useful references, and when combined with growers' existing knowledge, identify the areas from where to collect soil samples as the basis to develop a soil sampling plan.

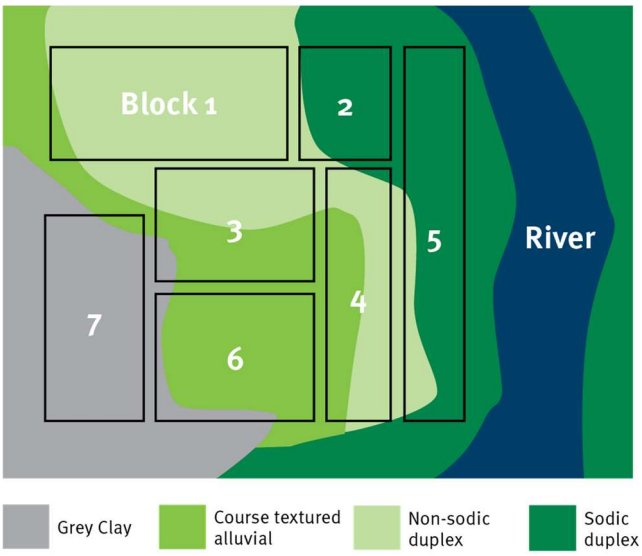

Figure 1: *A soil map of a hypothetical farm showing block boundaries (Adapted from Schroeder et al 2007-2009).*

Step 1.2: Identify blocks being planted with sugarcane

Once you have obtained a soil map you must identify all the blocks to be planted, in order to develop your soil sampling plan. A single block can represent the fertility status of a number of plant cane blocks belonging to the same soil grouping.

Step 1.3: Identify block management practices

To calculate the nutrient requirement for your crop it is important to collect soil samples that consider the management features and soil characteristics of the farm.

Using your soil map, mark the blocks that have the same soil types or proportion of soil types and then group them using a unique identifier (i.e. cross-hatching, shading or a label). Use a unique identifier or label for blocks that have had mill by-products applied prior to planting cane. Blocks that received applications of mill by-products in previous cane cycles potentially have a higher soil phosphorus status than blocks not receiving any by-products. To take account of this, separate soil samples must be taken from blocks that represent those that have (a) received and (b) not received previous applications of mill by-products.

Figure 2 provides an example of how to group blocks with similar soil types and management practices (based on fertiliser application, mill by-product application, irrigation, cropping and yield) to develop your soil sampling plan. The differing management of blocks requires separate soil samples.

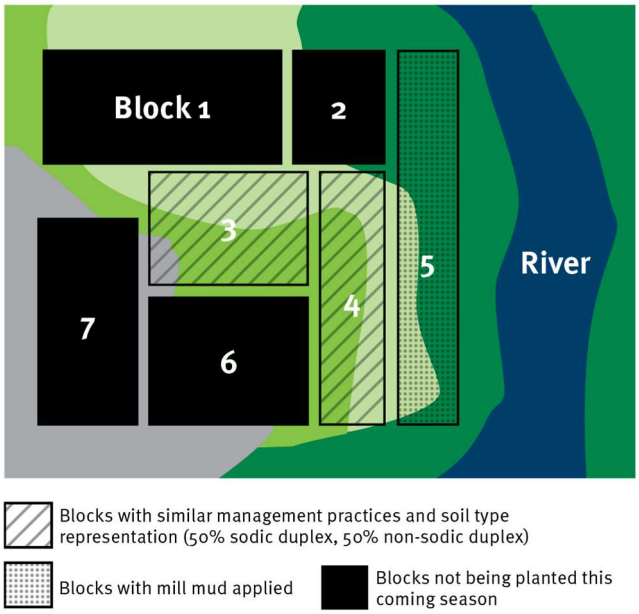

Figure 2: *A soil map of a hypothetical farm grouping blocks with similar soil types and nutrient management regimes (Adapted from Schroeder et al 2007-2009).*

Step 1.4: Select representative blocks for sampling

Select representative block/s from each group of blocks with an identifier or label from which you will collect soil samples, taking the following conditions into account.

Step 1.4.1: Sample site selection

For plant blocks with the same soil types or soil groupings, and that are farmed the same way (based on fertiliser application, mill by-product application, irrigation, cropping and yields), select a block of average productivity that you consider is representative of the rest of the plant blocks in the group.

Step 1.4.2: Soil type characteristics

Sampling blocks with one dominant soil type

For blocks with one dominant soil type, collect samples from a section of the block that best represents the dominant soil type from that block (Figure 3) using one of the suggested sampling patterns in Figure 6.

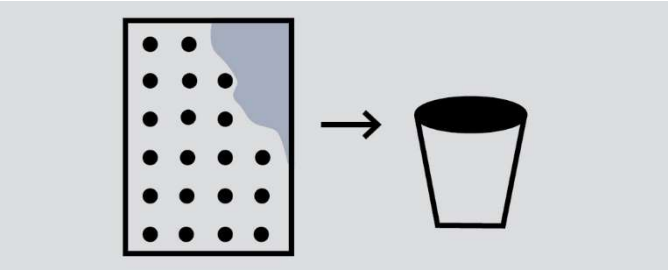

Figure 3: *Example for sampling a block where there is one dominant soil type using minimum standard core sample site selection. Shading indicates soil type differences. Black dots represent the core sampling sites. Samples from these sites are combined to form one composite sample.*

Sampling blocks with an unclear dominant soil type

Sample the block using your chosen sampling pattern regardless of soil type distinctions. The final soil sample will form a composite sample made up of a mixture of soil types from within the sampled block (Figure 4).

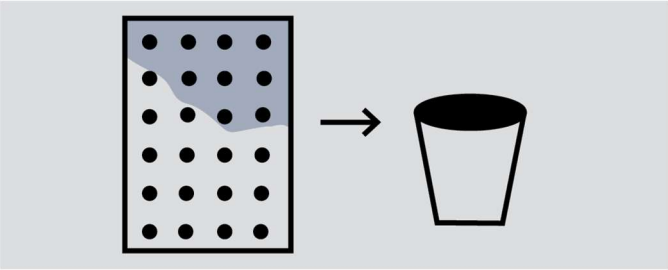

Figure 4: *Example for sampling a block where there is an unclear dominant soil type. Shading indicates soil type differences. Black dots represent the core sampling sites. Samples from these sites are combined to form one composite sample.*

More comprehensive sampling where block has unclear dominant soil type

More comprehensive sampling is used to apply more precise nutrient applications, rectify known constraints to yield or to investigate possible yield limitations etc. Sections 5 and 6 of the *Fertcare guide to fit for purpose soil sampling* (Gourley and Weaver 2019) outline practical guidance with regard to refining sampling areas based on soil type and past management practices.

Where it is possible to apply nutrients at different rates within a block based on soil type differences (i.e. with the use of a variable rate applicator), at least 20 soil cores should be obtained from each soil type to form separate composite samples that represent each individual soil type (Figure 5).

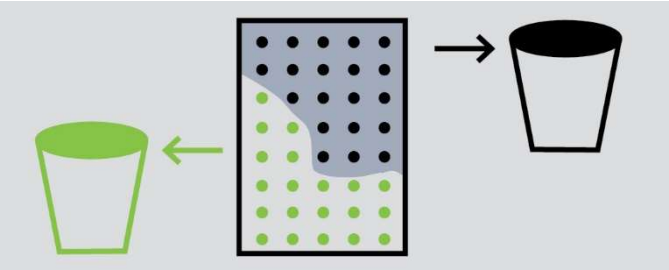

Figure 5: *Example for sampling a block where there is an unclear dominant soil type using the more comprehensive method. Shading indicates soil type differences. Black dots represent the core sampling sites forming composite sample 1, and green dots represent core sampling sites forming composite sample 2.*

If the more comprehensive sampling method is used and the soil analysis shows that different rates of nitrogen and/or phosphorus are required, then these nutrients should be applied at different rates within the block, however, if it is impractical to vary nutrients within the block, then the most limiting nutrient requirements defined by the samples can be used to inform fertiliser requirements.

Step 1.4.3: Sample area and pattern

For a representative block or area smaller than 15 hectares, at least 20 core soil samples need to be taken and mixed together to form the composite sample sent for testing. For example, if the block is 1 hectare, at least 20 core samples should be collected for the composite sample. If the block is 5 hectares, at least 4 core samples per hectare to total 20 core soil samples should be collected for the composite sample.

To sample a representative area or block greater than 15 hectares, at least 40 core sites must be selected in total. These 40 cores are then mixed together to form the composite sample. For example, if the block or area is 20 hectares, at least 2-3 cores are collected per hectare (see Figure 6 for suggested site selection patterns).

Note that the greater number of cores taken to form a composite sample, the more reliable the analytical results for that sample will be.

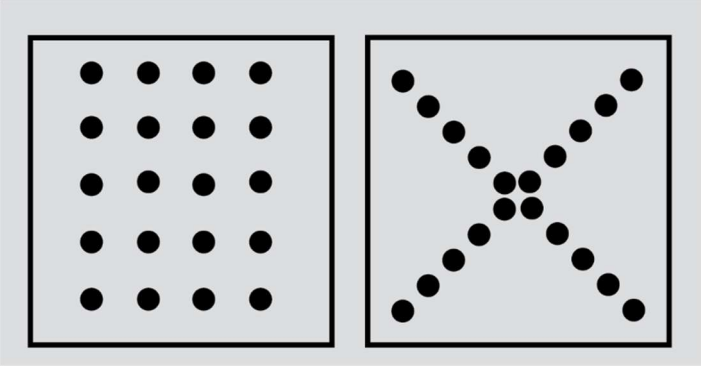

Figure 6: *Suggested sampling patterns within cane blocks or soil type distinctions (adapted from Schroeder et al 2007-2009).*

Stage 2. Soil sample collection

Remove all trash and organic matter from the surface before taking soil cores. If this is not done the analysis will return an inaccurate result. Take soil cores with an auger or soil tube from the surface of the soil to a depth of 20 centimetres. Provide a composite sample of 500 grams and submit as soon as possible to a soil testing laboratory.

To take soil samples, you'll need the following materials:

- a sampling tool (free from contaminating materials, e.g. not galvanised with zinc) such as:
  - a shallow probe
  - a thin-walled deep soil probe
  - a hydraulic/motor-driven probe/auger
  - an auger (either a turning auger or a soil tube)
- new plastic bags**
- a clean plastic bucket** and clean gloves** for mixing cores
- labels
- a marker for labelling samples
- a record sheet (the form in Attachment 1 can be used).

*** It is important to use clean equipment to avoid contaminating your soil samples.*

Step 2.1: How do I collect a soil sample?

Soil sampling should occur prior to incorporating a green cane trash blanket into the soil, as this can affect the soil test analysis and results. Also avoid sampling headlands, poorly drained areas and fertiliser dump sites. Areas that have been fertilised or had ameliorants applied should not be sampled for a minimum of six months following application.

Cores of soil should be taken from the shoulder of the cane row, about midway between the centre of the cane row and the centre of the inter-row, down to a depth of 20 cm from the surface, using a soil sampling tool. However, where fertiliser has been applied using a side-dress applicator (i.e., to either side of the row rather than centre of the stool) in the last six months, cores should not be taken from the fertilised area of the shoulder.

You can refer to the *Fertcare guide to fit for purpose soil sampling* (Gourley and Weaver 2019), Section 6.5 "Sampling pattern for selected areas with previous fertiliser banding" for alternative methods.

It is important to avoid collecting material such as trash or organic matter from the surface. If using a soil tube, the tube should not be lubricated or galvanised because this can cause inaccurate organic carbon results.

Collect all cores in a clean plastic bucket to form a composite sample.

After collecting cores in a clean bucket, thoroughly mix together those taken from the same block or soil type distinction (depending on the use of the *minimum standard* or *more comprehensive* sampling method) to form a composite sample (breaking large clods apart by hand).

Step 2.2: Labelling the soil sample

Using a permanent ink marker, label the composite sample with the date, block or area sampled and farm name/number and submit to a certified laboratory for testing (Figure 7).

Attachment 1 provides a form suitable for recording information about the block or sampled area and submitting with the soil sample to the testing laboratory. Keep a copy of this form for your records.

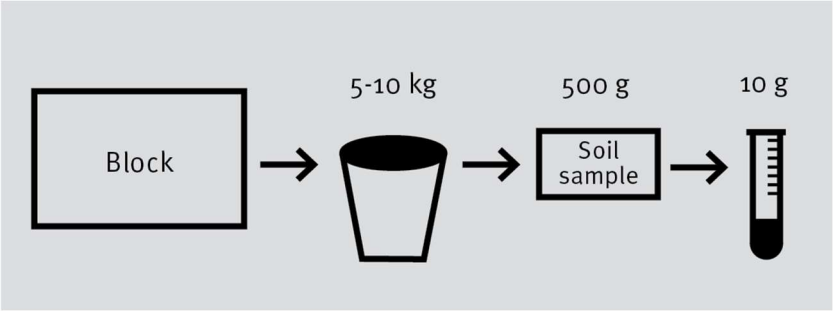

Figure 7: *Soil analysed in the laboratory is a sub-sample of the composite sample collected from the block or area (source: Schroeder et al 2004).*

The following information is required to support the calculation of the amount of nitrogen and phosphorus application. If you are using the services of a professional fertiliser industry advisor who is not familiar with your property, they will also need to understand your farm management practices with respect to the application of mill by-products and fallowing and any constraints to yield that are present. Recording yield constraints is a requirement of an N&P Budget.

Mill by-products: Did you apply mill by-products to the block? State what type, when they were applied and how much, i.e. at what rate?

Fallow management: Did you have a fallow before planting cane? Was it bare ground, grass or a legume crop? How was it managed? How long was the fallow period?

Constraints: Is there an underlying issue that affects productivity and yield, for example an area prone to waterlogging or a paddock with highly sodic soils?

The N&P Budget guide gives an example of how to record this information.

Stage 3. Soil analysis in the laboratory

Step 3.1: Laboratory selection

Identify a suitable laboratory to undertake the following analyses using the methods specified below. It is important that these methods are used as they are calibrated to the *Six Easy Steps* program for nutrient management in the sugarcane industry.

1. Organic Carbon (OC) uncorrected Walkley Black (Method 6A1)
2. BSES (acid) extractable P (Method 9G2 or 9G1)***
3. P buffer index (PBI) adjusted to Colwell extractable P (Method 9I2)
4. pH (1:5 water) (Method 4A1) if using Colwell extractable P (Method 9B1 or 9B2)

These methods can be found in *Rayment, G.E. and Lyons D.J. (2011) Soil Chemical Methods – Australasia*, *CSIRO Publishing*, available at the Department of Environment and Science (DES) website www.qld.gov.au/FarminginReefCatchments.

A full range of tests, such as those to determine the extent of constraints and crop nutrient requirements such as potassium (K) are encouraged, but not regulated, for assessing the overall fertility status of the soil to develop a balanced nutritional program.

**** Note that while the BSES (acid) extractable phosphorus soil test has been found to be well-suited to estimating plant available phosphorus in the acidic soils that occur in much of the Queensland sugarcane industry, investigation has found that it may overestimate available phosphorus in neutral to alkaline soils. It is therefore recommended that growers with neutral to alkaline soils seek professional advice in relation to the phosphorus application on their sugarcane block/property after receiving their soil test results. Colwell*

extractable phosphorus has not been calibrated in the Six Easy Steps program; it is included in this method based on significant consultation with sugarcane agronomic experts.

Step 3.2: Send samples for analysis

Send composite samples to a suitable laboratory for nutrient analysis.

Suitable laboratories performing the chemical analysis of soil samples are required to participate in Australasian Soil and Plant Analysis Council (ASPAC) proficiency trials and maintain certification for the nominated methods where available.

The ASPAC website is www.aspac-australasia.com.

It is recommended that laboratories are able to demonstrate that their operations comply with the Australian Standard AS ISO/IEC 17025-2005 'General requirements for the competence of testing and calibration laboratories' and have the technical expertise for the specified methods.

The National Association of Testing Authorities (NATA) accreditation would provide evidence of compliance to this standard. The NATA website is www.nata.com.au.

Step 3.3: Record-keeping requirements for soil testing

It is important to note that under the *Environmental Protection Act 1994* records must be kept of activities relating to soil testing on your sugarcane property. The following must be kept as records for six years:

- Date of soil testing and a description of the location and the dominant soil type sampled
- Map of the boundaries of blocks or management zones:
    - where soil sampling has been undertaken; and
    - where fertiliser and mill mud or mill mud/mill ash mix has been applied
- A soil map showing the dominant soil types covering the blocks or management zones where samples were taken
- Identification of constraints (on a farm map) relating to soil or position in the landscape for inclusion in N&P budget

Additional documents (relevant primary documents) must also be kept as proof of the information in the records e.g. -

- A soil test report which shows the results of soil testing; and
- A copy of any tailored advice in relation to soil testing.

Records must be made within three business days and can be kept in any format.

Further information is available from the Department of Environment and Science website www.qld.gov.au/FarminginReefCatchments.

Other records in addition to those listed above are required to be kept. A full list of all records required under the Reef protection regulations can be found in Appendices 1, 2 and 3 of the Agricultural ERA standard for sugarcane cultivation.

Stage 4. Interpretation of results

Soil test reports contain the analytical data from tests conducted in a laboratory using specific method. Most laboratories offer packages of soil tests, however it is important to ensure that the package chosen includes the analysis methods outlined above in Step 3.1.

Once you have obtained your soil test results, calculate the nutrient requirements for your crop using the following *Calculating the amount of nitrogen and phosphorus method* outlined in part B.

You could also engage a professional fertiliser advisor to calculate the crop's nutrient requirements for you. You can find an advisor by contacting your local productivity organisation, agronomy provider or fertiliser re-sellers.

References

Gourley C.J.P. and Weaver D.M. (2019), A guide for fit for purpose soil sampling, Fertilizer Australia, Canberra, Australia.

Rayment, G.E. and Lyons, D.J. (2011), Soil Chemical Methods - Australasia, CSIRO Publishing, Collingwood, VIC. Australia.

Schroeder, B.L., Wood, A.W., Hurney, A., Panitz, J.H. (2004), BSES Accelerating the adoption of best practice nutrient management: Herbert District.

Schroeder, B.L., Wood, A.W., Panitz, J.H. (2007-2009), Nutrient Management Series, *Canegrowers magazine*.

Attachments

If your chosen laboratory doesn't provide form/s to record your soil sampling details, you can complete the forms in Attachment 1 and Attachment 2 as records for the soil sampling that has taken place on your property. Alternatively, you can provide this information in any other format as long as you record the information included in these attachments. Whichever form you use, ensure that you retain a copy for your records.

Additional items to keep with the records are your:

- soil map showing the dominant soil types covering the blocks or management zones where samples were taken.
- map of the boundaries of blocks or management zones where:
    - soil sampling has been undertaken; and
    - fertiliser and mill mud or mill mud/mill ash mix has been applied
- date of soil testing and a description of the location and the dominant soil type sampled.

Attachment 1. Guidance form: Soil sample records - information on the representative block sampled

In the event that the accredited laboratory doesn't provide form/s to document your soil sampling details, you can complete this form for each soil sample that you submit to an accredited laboratory for testing and keep a copy for your records.

Person who carries out the agricultural ERA .....

Person making the record .....

Company name (if applicable) .....

Property address .....

Postal address .....

Farm name/ID number .....

Block/area sampled (specify below)

.....

Block/area identifier

.....

Sampled soil type/s

.....

List the blocks (using their identifiers) that this soil test represents

.....

.....

.....

.....

Date of soil sampling __ / __ / __

Attachment 2. Guidance form: Information required for the calculation of nitrogen fertiliser on your property

In the event that a laboratory doesn't provide form/s to document your soil sampling details, you can complete this form for each soil sample that you submit to an accredited laboratory for testing and keep a copy for your records.

Block management: Block/area name:..... Date soil sampled __ / ____ / ____

Mill by-products:

Did you apply mill by-products to the block? If so, specify the type by ticking the box below:

☐ mill mud

☐ mud/ash mixture

Date of application .....

Rate of application (wet t/ha) .....

Fallow management

☐ Did you have a fallow before planting cane?

If so, what type of fallow did you have?

☐ Bare/grass

☐ Legume If so, what legume crop .....

- Did you harvest the seed? Yes ☐ or No ☐
- Was it a poor legume crop or a good legume crop? Poor/good
- Did you leave the crop standing? Yes ☐ or No ☐
- Were residues left on the surface of the soil or did you plough in? Surface ☐ or Ploughed in ☐

☐ **Other crop** If so, what crop? .....

☐ **Other** Specify.....

Part B - Calculating the amount of nitrogen and phosphorus method

Contents

Purpose

The purpose of this document is to describe the method for calculating the amount of nitrogen and phosphorus that will determine the whole of farm amount for your N&P Budget.

If you grow sugarcane commercially in the Wet Tropics, Burdekin, Mackay Whitsunday, Fitzroy or Burnett Mary regions of the Great Barrier Reef catchment, this method must be used to calculate **fertiliser** application rates to comply with the Reef protection regulations. You can check if your property is in the Reef catchment by completing this online form available at www.qld.gov.au/ReefRegulations.

The additional explanatory information in this method is intended for use by growers, and others involved in recommending fertiliser products for agricultural properties. Applying the correct rate of fertiliser to match crop needs plays a critical role in reducing fertiliser losses in run-off, to the air or by leaching through the soil profile. It can also result in more efficient uptake of fertiliser by the plant, and increased farm profitability and productivity.

The method provided in this document is derived from procedures outlined in the *Six Easy Steps* program developed by BSES Limited (now Sugar Research Australia). The *Six Easy Steps* program is a complete nutrient management system, based on a site-specific approach to soil and nutrient management and is the accepted industry standard recognised in the **Smartcane BMP** program, available at www.smartcane.com.au.

In order to calculate the amount of fertiliser for your farm, develop your N&P Budget and work out your whole of farm amount, **soil testing** must be undertaken in accordance with the *Part A - Soil sampling and analysis method*, which is described earlier in this document. Records must be kept of activities relating to the application of fertilisers and **mill by-products** on your sugarcane property. Records must be made within three (3) business days and kept for at least six (6) years. Record keeping forms and further information are available from the Department of Environment and Science website at www.qld.gov.au/reefregulations.

What if I need help?

If you require assistance with soil testing or working out the appropriate rates of nitrogen and phosphorus on your farm, please contact your local productivity services board, an agronomist or a Fertcare accredited advisor.

Regulations timeframe for commercial sugarcane growing

The Reef protection regulations apply to different regions at different times. Please refer to the table below for when the Reef protection regulations take effect for commercial sugarcane growing.

Commodity	Region	General record keeping requirements	Minimum practice agricultural standards (including this method)	Farm nitrogen and phosphorus budget
Sugarcane	Burdekin, Mackay Whitsunday and Wet Tropics	1 December 2019	1 December 2019	1 December 2021
	Burnett Mary and Fitzroy	1 December 2019	1 December 2022	1 December 2022

NITROGEN

How do I calculate the rate of nitrogen fertiliser to apply?

Figure 1 below outlines the method you must use to calculate the rate of nitrogen fertiliser to apply. The rate only considers nitrogen sourced from fertiliser and mill by-products. The method requires the calculation of a baseline application rate, from which amounts are deducted based on the soil organic carbon content and **mill mud** applications.

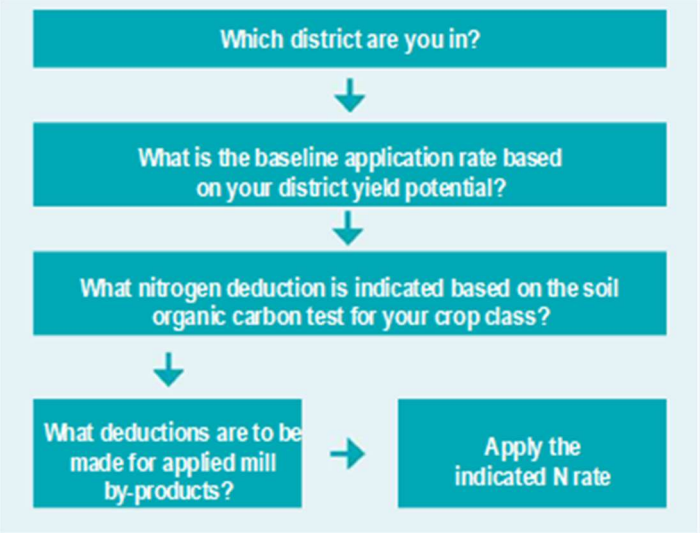

Figure 1: *The process for determining the application rate of nitrogen on cane* ***blocks*** *(Source: Schroeder (2009) unpublished).*

Stage 1 - Working out the baseline nitrogen application rate

The baseline application rate is the starting amount of nitrogen needed by the crop before deductions are made to account for the in-season mineralisation of available nitrogen from soil organic matter identified through soil testing. The baseline application rate is calculated by multiplying the **district yield potential** (refer to Table 2) by the nitrogen utilisation index (refer to step 1.2).

Step 1.1: What is the district yield potential?

The district yield potential represents the highest average yields of sugarcane obtained across a district over all soil types and is calculated by multiplying the estimated highest average annual district cane yield (tonnes cane/ha) by a factor of 1.2. For example, the highest average yield in the Tully district is 100 tonnes of cane to the hectare. This figure, multiplied by 1.2, gives a district yield potential of 120 tonnes of cane to the hectare.

How do I identify my district yield potential?

Table 1 shows the yield potential for 12 broad districts as defined by industry from sugar mill records. Identify the district your **farm** is located in from the left-hand column and find your district yield potential in the right-hand column. Use this figure for calculating the baseline nitrogen application rate.

Table 1: District yield potential for the 12 districts, defined by BSES Limited (now known as Sugar Research Australia) (Source: Schroeder et al 2007-2009; Calcino et al 2008).

District	District yield potential (tonnes of cane/ha)
Mossman/Cairns	120
Innisfail/Johnstone	120
Tully	120
Herbert*	120
Mareeba/Dimbulah	150
Burdekin	150 or 180**
Proserpine	130
Mackay	130
Plane Creek	120
Bundaberg/Isis/Maryborough	120
Fitzroy	See note below table^

** For the purposes of district yield potential, the Herbert district also applies to cane farms in the Black river basin.*

*****The Burdekin district has two yield potentials (150 and 180 tonnes of cane/ha). To work out if the higher potential applies to your farm, verifiable yield records or other reasonable evidence from the past fifteen years is required to show that blocks on your farm have produced yields higher than 150 tonnes of cane/ha in at least three (3) harvest periods (seasons) (to the satisfaction of the administering authority). If such records or evidence is available to demonstrate the higher potential of the farm, you may adopt the 180 tonnes of cane/ha yield potential figure to calculate your baseline application rate for that farm. Otherwise, you must use a district yield potential of 150 tonnes of cane/ha.***

Note: For the purposes of this method, to determine which district yield potential to use in the Burdekin, "**farm**" is an area covered by one (1) unique farm identity number.

^Growers in the Fitzroy region should use the yield potential for the district that is the closest match to your property in terms of factors such as region, climate and soil types. Alternatively, you can use the district yield potential for the district of the mill you supply.

Step 1.2: What is the nitrogen utilisation index?

The nitrogen utilisation index is a figure derived from field experiments and modelling by the Cooperative Research Centre (CRC) for Sustainable Sugar (Keating et al 1997) to calculate the amount of nitrogen fertiliser required by **plant crops** and ratoon crops to produce a certain yield of millable cane. The index is 1.4 kg of nitrogen applied for every tonne of cane up to a yield of 100 tonnes per hectare, plus 1.0 kg of nitrogen for every tonne of cane thereafter.

How do I calculate my baseline application rate?

Table 2 shows the baseline amount of nitrogen to be applied in the 12 different districts. These amounts were calculated by multiplying the district yield potential by the nitrogen utilisation index.

For example: A grower in Innisfail, where the district yield potential is 120 tonnes of cane per hectare, would start with a baseline nitrogen application rate of 160 kg per hectare. This is calculated by taking the first 100 tonnes of the district yield potential for Innisfail and multiplying it by the nitrogen utilisation index of 1.4 – which equals 140 (100 x 1.4). The remaining 20 tonnes (the amount above the 100 tonne threshold as explained above) is then

multiplied by 1.0 – which equals 20 (20 x 1.0). Add these two figures together (140 + 20) and the baseline application rate for nitrogen fertiliser in Innisfail is 160 kg per hectare.

Table 2: District yield potential and the corresponding baseline N application rates (Source: Schroeder et al 2007-2009).

District	District yield potential (tonnes of cane/ha)	Baseline nitrogen application rate (kg/ha) (for plant & ratoon crops)
Mossman / Cairns	120	160
Innisfail / Johnstone	120	160
Tully	120	160
Herbert	120	160
Mareeba / Dimbulah	150	190
Burdekin	150 or 180*	190 or 220*
Proserpine	130	170
Mackay	130	170
Plane Creek	120	160
Bundaberg/Isis/Maryborough	120	160
Fitzroy	See Table 1	See Table 1

*The Burdekin district has two baseline application rates (190 and 220 kg N/ha). If verifiable yield records or other reasonable evidence from the past 15 years show that blocks on your farm have produced yields higher than 150 tonnes of cane/ha in at least three (3) harvest periods (seasons) (to the satisfaction of the administering authority), you may adopt the 220 kg N/ha baseline figure to calculate your N application rate for the farm. Otherwise, you must use a baseline N application rate of 190 kg N/ha.

What if my average whole of farm yields are higher than the district yield potential?

If you can demonstrate through verifiable yield records or other reasonable evidence from the past 15 years to the satisfaction of the administering authority that the **whole of farm** average yield over the last 15 years exceeded the district yield potential in at least 3 of those last 15 years, the baseline nitrogen application rate for all blocks on that whole of farm can be adjusted to reflect that higher yield potential.

For example: If verified records or other reasonable evidence from the last 15 years show that a farm in the Proserpine district produced a whole of farm average yield of 140 tonnes of cane to the hectare in at least three (3) harvest periods (seasons) from the last 15 years, then the baseline nitrogen application rate can be increased to 180kg of nitrogen per hectare for each block within the whole of farm. This adjustment is reached by applying the same calculation as provided previously i.e. (100 x 1.4) + (40 x 1.0) = 180. This figure is 10 kg of nitrogen per hectare higher than the normal baseline rate applied in the Proserpine district (170kg/ha) shown in Table 2.

How do I identify opportunities to refine my rates for my N&P Budget?

You can use the SIX EASY STEPS Toolbox to help identify situations where refining rates on your property might be possible (access the Toolbox here). You may also have other methods or property specific information or advice to guide your refinement of rates. It is important that your N&P Budget records where and why you have refined rates.

Stage 2 - Calculating the combined nitrogen inputs to deduct from the baseline application rate

This section shows you how to calculate deductions from the baseline application rate calculated in Stage 1.

Step 2.1: What is the soil nitrogen mineralisation index?

One source of available nitrogen is in-season mineralisation of nitrogen from soil organic matter. The quantity of nitrogen made available from organic matter is estimated by measuring the organic carbon level of the soil. Very broadly, soil organic matter is made up of crop residues, living soil micro-organisms and stable, complex organic compounds called 'humus'. Different soils contain different amounts of organic matter. All organic matter contains carbon which can be measured and is used as an indicator of organic carbon content.

Organic nitrogen is a component of soil organic matter, and is converted by soil micro-organisms into the ammonium and nitrate nitrogen, both of which are available to plants. This process is called mineralisation. However, the actual quantity of nitrogen supplied to the sugarcane crop varies according to the soil type and seasonal conditions.

The soil nitrogen mineralisation index was developed to help you adjust the baseline nitrogen application rate by taking into account the nitrogen mineralised from soil organic matter during the crop season. These adjustments are based on the organic carbon (OC) content of your soil, which determines the soil nitrogen mineralisation index (see Table 3).

Once the soil mineralisation index has been determined, the amount of nitrogen to be deducted from the baseline application rate can be calculated.

The soil nitrogen mineralisation index step must be determined for each area that soil samples are taken in preparation of establishing plant cane, because different soil types may have different organic carbon contents.

Please refer to the *Soil sampling and analysis method*.

How do I adjust my baseline nitrogen application rate using the soil mineralisation index?

Once you have received the results of your soil test using the *Soil sampling and analysis method*, you will know the organic carbon content of the soil, which will be presented as a percentage (%).

Plant cane (plant after at least 6 months fallow)

To determine what your calculated amount of nitrogen is for plant crops established after a **fallow**, refer to Table 2 to identify your district yield potential then use Table 3 to calculate your application rate taking into account the organic carbon content of your soil. These numbers represent the regulated amount of nitrogen to apply, recognising the contribution of nitrogen that is mineralised in the soil during a fallow period of at least six (6) months.

Table 3: Nitrogen application rates for plant cane after a fallow of at least six (6) months, based on district yield potentials and the soil nitrogen mineralisation index (Adapted from Schroeder et al 2007-2009).

Soil nitrogen mineralisation index	Organic carbon (%)	District yield potential (tonnes of cane/ha)			
		120[1]	130[2]	150[3]	180[4]
		N application rate for plant cane (kg N/ha)			
Very Low	<0.4	140	150	150	180
Low	0.41–0.8	130	140	140	170
Medium/Low	0.81–1.2	120	130	130	160
Medium	1.21–1.6	110	120	120	150
Medium/High	1.61–2.0	100	110	110	140
High	2.01–2.4	90	100	100	-
Very High	>2.4	80	90	90	-

[1]Mossman/Cairns, Innisfail/Johnstone, Tully, Herbert, Plane Creek, Bundaberg, Isis, Maryborough
[2]Mackay and Proserpine districts
[3]Burdekin, Mareeba/Dimbulah districts
[4]Burdekin district - yield potential based on verifiable yield records

Growers in the Fitzroy region should use the yield potential for the district that is the closest match to your property in terms of factors such as region, climate and soil types. Alternatively, you can use the district yield potential for the district of the mill you supply.

Ratoon and replant cane (less than 6 months fallow)

Table 4 indicates the regulated amount of nitrogen to apply on ratoon and replant cane. Find the range of organic carbon percentage that matches your soil test result, and use the application rate shown under the district yield potential column identified earlier in Table 2. Note that the higher the organic carbon content of your soil, the greater the deduction from the baseline application rate.

Table 4: Nitrogen application rates for replant (less than six (6) months fallow) and ratoon cane based on district yield potentials and the soil nitrogen mineralisation index (Adapted from Schroeder et al 2007-2009).

Soil nitrogen mineralisation index	Organic carbon (%)	District yield potential (tonnes of cane/ha)			
		120[1]	130[2]	150[3]	180[4]
		N application rate for replant and ratoon cane (kg N/ha)			
Very Low	<0.4	160	170	190	220
Low	0.41–0.8	150	160	180	210
Medium/Low	0.81–1.2	140	150	170	200
Medium	1.21–1.6	130	140	160	190
Medium/High	1.61–2.0	120	130	150	180
High	2.01–2.4	110	120	140	-
Very High	>2.4	100	110	130	-

[1]Mossman / Cairns, Innisfail / Johnstone, Tully, Herbert, Plane Creek, Bundaberg, Isis, Maryborough
[2]Mackay and Proserpine districts
[3]Burdekin, Mareeba / Dimbulah districts
[4]Burdekin district - yield potential based on verifiable yield records

Growers in the Fitzroy region should use the yield potential for the district that is the closest match to your property in terms of factors such as region, climate and soil types. Alternatively, you can use the district yield potential for the district of the mill you supply.

How do I adjust my baseline application rate for ratoon crops established before 2010 if I did not undertake soil testing prior to the plant crop?

The rate of fertiliser for ratoon crops already established prior to the regulations commencing (1 January 2010 in Wet Tropics, Burdekin and Mackay Whitsunday, and 1 December 2022 in Burnett Mary and Fitzroy) must also be calculated and recorded before fertilising. However, as it was not compulsory to take a soil test before fertilising these ratoon crops, a simplified method is used.

In the Burdekin, Mackay Whitsunday and Wet Tropics regions the rate of fertiliser for ratoon crops already established at 1 January 2010 must not exceed the calculated baseline application rate for your district as outlined in Table 2.

In the Burnett Mary and Fitzroy regions the rate of fertiliser for ratoon crops already established at 1 December 2022 must not exceed the calculated baseline application rate for your district as outlined in Table 2.

Notes:

- This only applies to ratoon crops already established as at 1 January 2010 for the Wet Tropics, Burdekin, Mackay Whitsunday regions or as at 1 December 2022 for the Burnett Mary and Fitzroy regions.
- Plant crops and subsequent ratoons established after these dates must apply nitrogen at or below rates calculated using the full method as set out in Stage 1 and Stage 2 of *Calculating the amount of nitrogen and phosphorus method*.
- For the Wet Tropics, Burdekin and Mackay Whitsunday regions – nitrogen rates for ratoon crops that were planted after 1 January 2010, and still in place when developing an N&P Budget, must align with the soil tests taken for those blocks prior to planting and be used to form the N&P Budget.
  Note - As these ratoon blocks move to planting, new soil tests must be taken within 12 months prior to fertilising plant cane.

Step 2.2: Determine the nitrogen from mill by-products

There are a number of mill by-products applied to sugarcane lands, including mill mud (fibre, soil and other milling process residuals), boiler ash (particulate material collected after bagasse and other material burnt at the mill) and mill mud/mill ash mixes (Schroeder 2008).

Substantial amounts of nitrogen, phosphorus and other nutrients are added to cane blocks through the application of mill by-products. However, the amount of nitrogen that blocks receive from mill by-products is affected by the following:

- Variability of the nitrogen content of the by-products due to the variable nature of the source of the material, i.e. mill mud is derived from different soil types within a district.
- Application rates of the by-products, which can range from around 50 to 300 wet tonnes per hectare.
- Variability of nutrient losses via nitrogen and phosphorus loss pathways.
- The ratio of the components of the mill mud/mill ash mix. This ratio can differ from load to load of the product.

Due to the variable nutrient content of mill by-products, for the purposes of this method mill mud and mill mud/mill ash mixes are treated as one product (mill by-products). For the purpose of calculating the amount of nitrogen supplied by mill by-products, the lower documented value of their nitrogen content is used. Where mill ash is applied on its own no deduction for nitrogen is required from your fertiliser application rate. This approach will be further refined in the future as techniques for quantifying and/or reducing the variability of the product are developed. **Broadcast application** of mill by-products is only permitted during a fallow period where it is incorporated into the soil following its application.

How do I calculate the deduction for nitrogen supplied from mill by-products?

Three rates of mill by-products are considered:

1. less than 100 wet tonnes per ha
2. 100–200 wet tonnes per ha
3. 201–300 wet tonnes per ha

Mill by-products deductions from your nitrogen fertiliser application rate are required for the crop immediately following its application.

To work out the deductions required from your nitrogen fertiliser application rate (Tables 3 & 4) following the application of mill mud, refer to Table 5. These deductions reflect the low end of estimated nitrogen input from mill mud and mill mud/mill ash mixes and were chosen to remove the uncertainty created by the variable nutrient content of mill by-products.

Note that no deductions are required where mill ash alone is applied.

Table 5: Deductions from your nitrogen fertiliser application rate following the use of mill by-products (Adapted from Schroeder et al 2009).

Application rate (wet tonnes/ha)	Amount to be deducted from the N application rate in Table 3 and Table 4 (kg N/ha) in the plant or ratoon crop receiving mill by-products
less than 100	Nil
100 – 200	40
201 – 300	60

Note that sources of nitrogen other than mill mud or fertiliser (such as legume crops grown during a fallow or irrigation water containing nitrate) can contribute additional nitrogen to your farm for crop uptake.

To better match your nitrogen fertiliser rate to your crop nitrogen requirement, nitrate in irrigation water and nitrogen added by legume crops and mill mud applications less than 100 wet tonnes/ha can be considered when developing application rates under your N&P Budget. The *Six Easy Steps Toolbox* provides methodologies based on sound agronomic principles and extensive research to guide deductions to be made for nitrogen supplied by legumes and mill mud. Agronomic advice should be sought to determine appropriate deductions to be made for other nitrogen sources.

PHOSPHORUS

How do I calculate the rate of phosphorus fertiliser to apply?

This calculation method recognises sources of phosphorus from fertiliser products and mill by-products, and requires that deductions be made for these inputs to calculate the rate of phosphorus fertiliser to apply.

The method is based on the *Six Easy Steps* program which details the forms of phosphorus applied to sugarcane-producing soils, the fate of the applied phosphorus, a method for assessing the availability of phosphorus and management practices that aim to limit the risk of phosphorus losses from the farm (Schroeder 2008).

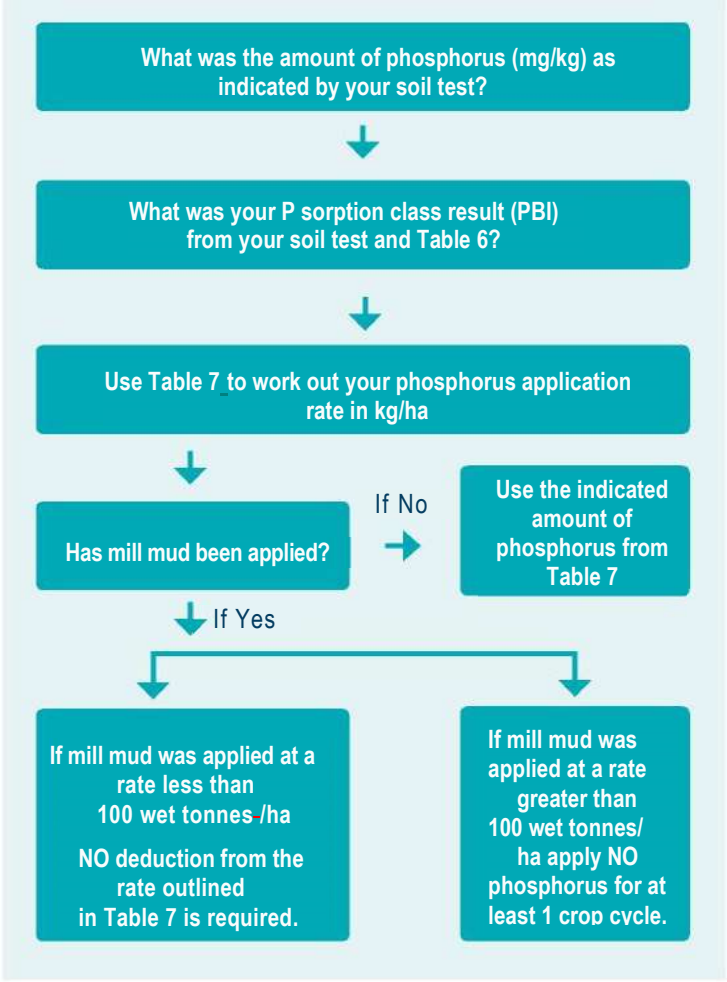

Figure 2: *The process for determining the application rate of phosphorus on cane blocks.*

Stage 1 - How do I determine the phosphorus requirements of my crop?

The diagram shown in Figure 2 outlines the method to calculate the rate of phosphorus fertiliser to apply. The phosphorus requirement of the crop is determined using soil testing to show how much phosphorus is in the soil and how much of that phosphorus is available for use by the sugarcane crop. It is important to highlight that different soil types 'fix' phosphorus to different extents, making it unavailable to the crop. This is called 'sorption' and the higher the sorption capacity of a soil, the less phosphorus is available to the plant.

Some older sugarcane-producing soils do not require any additional phosphorus fertiliser due to their long history of phosphorus fertilisation. New land, on the other hand, may be deficient in available phosphorus.

Two different soil tests are used to calculate the phosphorus requirements of a soil for growing sugarcane:

1. The first measures extractable phosphorus (i.e. BSES P or Colwell P [Colwell P should be used for soil samples with a pH (1:5 water) >7]), which provides an indication of the amount of phosphorus in the soil in mg/kg.
2. This value is then modified with a second test called the phosphorus buffer index (PBI) which is used to determine how much of the extractable phosphorus is available for plant uptake, based on the soil type and its sorption class. The higher the PBI value, the more phosphorus is 'fixed' by the soil, thereby lowering the amount available to the plant. Table 6 shows the soil phosphorus classes based on the PBI.

Please refer to the *Soil sampling and analysis method*.

Table 6: Phosphorus (P) sorption classes based on the PBI (Source: Schroeder et al (2009) unpublished).

P buffer index (PBI)	P sorption class
<140	Low
140–280	Moderate
281–420	High
>420	Very high

Recent research indicates that soils with very high PBIs require some phosphorus fertiliser at planting and for ratoon crops when BSES (acid) extractable phosphorus is greater than 50 mg/kg.

Once you have your soil test results, use Table 7 to determine the amount of phosphorus to apply.

Table 7: Phosphorus application rates based on extractable P (BSES acid method, or Colwell P for soils with a pH_{Water} above 7) and PBI (Schroeder et al 2009, unpublished).

Phosphorus in soil test (mg/kg)	P sorption class	Phosphorus application (kg/ha)	
		Plant	Ratoon
>120	Low, moderate and high	Nil	Nil
	Very high	Nil	Nil
61–120	Low	Nil	Nil
	Moderate	Nil	Nil
	High	Nil	Nil
	Very high	30	20
51–60	Low	Nil	Nil
	Moderate	Nil	Nil
	High	Nil	Nil
	Very high	30	20
41–50	Low	20	Nil
	Moderate	20	5
	High	20	10
	Very high	30	20

31–40	Low	20	10
	Moderate	20	15
	High	20	20
	Very high	30	20
21–30	Low	20	10
	Moderate	20	20
	High and very high	30	25
11–20	Low	30	15
	Moderate	30	20
	High and very high	40	30
5–10	Low	30	20
	Moderate	40	30
	High and very high	50	40
<5	Low	40	20
	Moderate	60	30
	High and very high	80	40

Note that if this method determines that an application rate lower than 10 kg P/ha is required for a plant crop, growers can either:

- forego any application of phosphorus, or
- apply the lowest amount that can be physically blended (10 kg P/ha), noting this allowance cannot be included in the whole of farm phosphorus amount in your N&P Budget (but must still be recorded in accordance with the *Agricultural ERA standard for sugarcane cultivation).*

Table 7 outlines the phosphorus application rates for each crop during a crop cycle. However, you may apply phosphorus at higher rates to a block or blocks throughout the crop cycle as long as:

- the PBI (from the representative soil test) is greater than 35
- the total amount of phosphorus applied during the crop cycle to those blocks, i.e. plant plus four (4) ratoons (five (5) crop years), does not exceed the amount calculated for the crop cycle, using Table 7
- the phosphorus is applied sub surface
- those blocks are not included in the whole of farm amount of phosphorus in the N&P Budget
- the amounts calculated and applied are recorded in accordance with the *Agricultural ERA standard for sugarcane cultivation*.

You may broadcast fertiliser containing phosphorus (but not nitrogen) during the fallow, as long as:

- it is incorporated into the soil
- soil testing has been undertaken to inform the coming crop cycle
- the amount applied does not exceed the amount calculated for the crop cycle, using Table 7.

An example for calculating the crop cycle amount using Table 7: Soil tests for a block in the Herbert undertaken prior to the establishment of plant cane gave a BSES P value of 45 mg/kg and a PBI of 290 (High sorption class). The crop cycle phosphorus amount is subsequently

split across plant and ratoons: 20 (plant) + 10 (1st ratoon) + 10 (2nd ratoon) + 10 (3rd ratoon) + 10 (4th ratoon) = 60 kg of phosphorus per hectare total for five (5) years.

Stage 2 - How do I calculate my phosphorus deduction after applying mill by-products?

When soil tests indicate that phosphorus is required for blocks producing sugarcane, mill by-products (mill mud and mill mud/mill ash mixes) are considered as a source of phosphorus. As with nitrogen, the phosphorus application rate is affected by the amount of phosphorus applied as mill by-products.

To calculate the deduction to be applied to the baseline rate of phosphorus application, refer to Table 8. This table indicates that due to the large amounts of available phosphorus in mill by-products, at application rates of 100–300 wet tonnes per hectare no phosphorus fertiliser is required and no further mill by-products can be applied for at least one (1) crop cycle (plant and four (4) ratoon crops). Where application rates of less than 100 wet tonnes per hectare have been used, no deduction is required.

Table 8: Phosphorus application strategies following the use of mill by-products (Source: Schroeder et al 2009, unpublished).

Mill by-product	Application rate (wet tonnes/ha)	Phosphorus application strategy
Mill mud	< 100	No deduction from the rate determined in Table 7
Mill mud	100–300	Nil P for at least one crop cycle

Following the methods outlined in this document is a regulated requirement to complete your N&P Budget.

Contacts

For further information and to seek advice, you can contact the following organisations:

Department of Environment and Science (DES)
13 QGOV (13 74 68)
officeoftheGBR@des.qld.gov.au

Department of Agriculture and Fisheries (DAF)
Extension officers can be contacted on:
13 25 23 (cost of a local call within Queensland), or 07 3403 6999
callweb@daf.qld.gov.au
WWW www.daf.qld.gov.au/about-us/contact-us

Sugar Research Australia
Extension staff can be contacted on:
07 3331 3333
sra@sugarresearch.com.au
WWW www.sugarresearch.com.au/contact/

Natural resource management groups
You can find your local natural resource management group at:
WWW www.nrmrq.org.au/find-your-regional-group

SmartCane BMP
07 3864 6444
info@smartcane.com.au
WWW www.smartcane.com.au/home.aspx

You can find out more information about some of the Reef water quality projects by visiting https://www.qld.gov.au/environment/agriculture/sustainable-farming/reef/reef-program-collaborations

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