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New cropping and horticulture Guide to standard conditions (5–100 hectares)

(Environmentally relevant activity 13A
for commercial cropping and horticulture)

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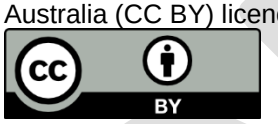
Queensland
Government

Prepared by:
Office of the Great Barrier Reef, Environmental Policy and Programs, Department of Environment and Science



June 2021

STANDARD CONDITIONS FOR CROPPING AND HORTICULTURE (ERA13A)

The Environmentally Relevant Activity (ERA) standard for commercial cropping and horticulture in the **Great Barrier Reef catchment** (prescribed ERA 13A) – Version X contains the following standard conditions. You can obtain a copy of the standard by searching for ESR/2020/5270 at www.qld.gov.au or by phoning 1300 130 372 (and select option 4) to request a copy.

Your permit (known as an Environmental Authority) authorises the commercial cropping and horticulture activity and will state which standard conditions you must comply with. If you submit a standard application for ERA 13A, it will be a requirement of your environmental authority to comply with all of the standard conditions. If you submit a variation application for ERA 13A, it will be a requirement of your environmental authority to comply with the standard conditions specified on the authority.

General

Standard condition 1: All reasonable steps must be taken to ensure the **activity** complies with the eligibility criteria.

Standard condition 2: The activity must not be undertaken within at least five (5) metres of the **defining bank** of a **natural waterway**.

Standard condition 3: Prior to 1 November each calendar year a **waterway buffer** must be implemented and maintained between the defining bank of all **downslope waterways** and the edge of any adjacent cropping or **fallow** areas, such that it minimises sediment run-off.

Erosion and sediment control

Standard condition 4: Prior to commencing the planting of crops for the activity and when **preparatory work** for the activity is in progress, **measures** must be designed and implemented to **avoid and mitigate** soil loss and **surface water** run-off to **receiving waters**.

Standard condition 5: Where an **agricultural ERA standard** is not in effect for the cropping or horticulture, after commencing the activity, erosion and sediment control measures must be maintained to avoid and mitigate soil loss and surface water run-off to receiving waters.

Irrigation

Standard condition 6: Measures that avoid and mitigate the loss of irrigation water to natural waterways must be implemented and maintained.

Record keeping

Standard condition 7: Plan(s) of the **activity area** must be kept showing:

1. The cadastral lot(s) boundaries; and
2. The activity area(s) within the cadastral lot(s) boundaries; and
3. Irrigation and drainage areas; and
4. Natural waterway; and
5. Receiving waterways; and
6. Downslope waterways; and
7. Waterway buffers.
8.

Standard condition 8: The plan(s) required by condition SC7 must be updated periodically so that the plan(s) is current as at 1 November each year.

Standard condition 9: The plan(s) required by condition SC7 must be provided to the administering authority on request within the timeframe stipulated by the administering authority in the request.

Contents

Glossary

Activity: Means the environmentally relevant activity (ERA) which this environmental authority is issued for, which is commercial cropping and horticulture.

Activity area: Means the area(s) of land in the river basin(s) in the **Great Barrier Reef catchment** where the ERA is being carried out.

Agricultural Environmentally Relevant Activity (agricultural ERA): Has the same meaning as Chapter 4A of the *Environmental Protection Act 1994:*

(1) An activity is an agricultural ERA if it is—
  (a) carrying on any of the following on a commercial basis—
    (i) cattle grazing;
    (ii) horticulture;
    (iii) cultivation of another crop.
  (b) carried out on a lot that is in the Great Barrier Reef catchment.

(2) However, if only part of the lot is in the Great Barrier Reef catchment, the activity is an agricultural ERA if the part of the lot that is in the catchment is –
  (a) More than 75 percent of the lot; or
  (b) More than 20,000 hectares.

Agricultural ERA standard: Means an agricultural ERA standard created in accordance with section 318 and 768 of the *Environmental Protection Act 1994* for the purposes of section 81 of the Act.

Appropriate person: Means a person who has professional qualifications, training or skills or experience relevant to the nominated subject matters and can give authoritative assessment, advice and analysis relevant to the subject matters using relevant protocols, conditions, methods or literature.

Average Return Interval (ARI): Means the average period, in years, between the occurrence of an event of a specified magnitude and an equal or greater magnitude event, Design rainfalls and intensity-frequency-duration (IFD) information for a location can be downloaded from http://www.bom.gov.au/water/designRainfalls/revised-ifd/.

Avoid and mitigate: Means that in the first instance, any loss of irrigation water, sediment and nutrients from the activity area(s) to receiving waters be avoided. Any loss of irrigation water, sediment and nutrients from the activity area(s) must be mitigated as much as possible including to both lessen the force or intensity of the flow of water as much as possible and to lessen sediment and nutrient loads as much as possible.

Commercial: as defined in Schedule 19 of the Environmental Protection Regulation 2019 to mean *'…carried out for a fee or reward'.*

Cropping and horticulture: As defined in Schedule 2, Part 2A, Section 13A of the Environmental Protection Regulation 2019 to mean:

1. Commercial cropping and horticulture (the relevant activity) consists of the cultivation of 1 or more crops, or horticulture carried out-
    a. On at least 5 ha of land in the Great Barrier Reef catchment, whether or not the land is contiguous; and
    b. On a commercial basis, whether or not as a **single enterprise**; and
    c. If the crop cultivation or horticulture is carried out on land in more than 1 river basin- as a single enterprise on at least 5 ha in at least 1 river basin, whether or not the land is contiguous.
2. The relevant activity includes preparatory work for the crop cultivation or horticulture.
3. Without limiting subsection (1)(c), an activity, or more than 1 activity, is carried out as a single enterprise if the activity or activities are carried out-

a. by the same person; and
b. on 1 or more parcels of land-
    i. Of which the person is the owner; or
    ii. Under an arrangement about the use of the land with the owner of the land.

4. The relevant activity does not include crop cultivation or horticulture (the current activity) if the land on which the current activity is carried out was used to carry out crop cultivation or horticulture, on a commercial basis, for-
    a. At least 3 of the 10 years before the current activity was started on the land, whether or not the years were consecutive; and
    b. At least 1 of the 5 years before the current activity was started on the land.
5. Also, the relevant activity does not include-
    a. Crop cultivation or horticulture using a closed system that prevents fine sediment, or dissolved inorganic nitrogen, from being released on to land, or into water, in the Great Barrier Reef catchment; or
    Example-hydroponics where water is recycled on site
    b. The cultivation of trees in the following areas-
        i. a State forest, timber reserve or forest consent area within the meaning of the *Forestry Act 1959*; or
        ii. a forest entitlement area within the meaning of the *Land Act 1994*;
    c. A forest practice within the meaning of the *Vegetation Management Act 1999*; or
    d. Preparatory work for commercial cropping and horticulture mentioned in paragraph (a), (b) or (c).

Constructed wetland: Means a constructed treatment system designed to mimic the water treatment processes of natural wetlands to remove sediment and nutrients from surface water run-off. Could also be referred to as a treatment wetland.

Contour bank: Means a constructed earth embankment, incorporating a channel on the upslope side, typically traversing a slope on or close to the contour to control and/or prevent the erosion of that slope. Also referred to as graded banks, terraces, or bunds.

Defining bank: Means the bank that confines seasonal flows, but which may be inundated by flooding from time to time, and can be either:

- the bank that confines the water before the point of flooding; or
- where there is no bank, the **seasonal high water line** which represents the point of flooding, or
- where a crop is grown on a terrace between the defining bank and the centre of the natural watercourse or downslope waterway, the defining bank will also be the point on the terrace that confines the water before the point of flooding of that terrace.

This definition refers to one side of the natural watercourse or downslope waterway and may apply differently on different sections of the natural watercourse or downslope waterway.

Diversion bank: Means a structure used to direct surface water runoff around and away from areas where soil is susceptible to erosion (such as cultivated paddocks) to areas where it can safely be disposed of, such as stable watercourses, natural depressions or water storages.

Downslope waterway: For the purposes of this environmental authority means any natural watercourse or artificial structures or features, including a farm drain or artificial channel, storm water channel, storm water drain or roadside gutter, that receives surface water from the activity area and which may reasonably be expected to drain to a natural waterway.

Any **drainage structures** as defined in the terms and definitions of this environmental authority are not considered to be downslope waterways.

Any structures or features that do not receive surface water from the activity area or do not direct water to a natural waterway are not considered to be downslope waterways.

Drainage structures: Means structures designed, implemented and maintained to reduce soil loss or surface water run-off or the loss of irrigation water, and may include a:
(a) **Vegetated spoon drain**; or

(b) **Contour bank**; or
(c) **Diversion bank**; or
(d) **Sediment trap**; or
(e) **Recycle pit**; or
(f) **Constructed wetland;** or
(g) Another measure that meets this intent.

Environmental authority: means a permit issued by the department under Chapter 5 of the *Environmental Protection Act 1994*.

Fallow: For banana cultivation, means an area of land that is typically used to grow bananas, that is left without that crop for a period of at least 6 months.

For sugarcane cultivation, means 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.

For cropping and horticulture other than banana or sugarcane cultivation, means an area of land that is typically used to grow a crop or crops that is left without that crop or crops for any period of time.

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

Great Barrier Reef catchment: As defined in Chapter 4A of 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.' The area is shown on the Great Barrier Reef catchment and river basins map, accessible from www.qld.gov.au/ReefRegulations.

Irrigation system: Means a system of supplying land with water by means of channels/furrows, sprinkler systems, or drip systems to meet crop water needs.

Measures: Means actions or procedures planned and implemented to avoid and mitigate the loss of soil or surface water run-off to receiving waters, or irrigation water to natural waterways.

For erosion and sediment control measures in conditions SC4 and SC5, measures include:

- designing, implementing and maintaining drainage structures to avoid and mitigate soil loss and surface water run-off to receiving waters; and
  designing and maintaining the cropped area (for the activity) to reduce the velocity of surface water run-off and avoid and mitigate soil loss and surface water run-off to receiving waters

For measures to avoid and mitigate the loss of irrigation water in condition SC6, measures include:

- matching the amount of irrigation water applied to the water requirement of the soil and crop, so any excess water not needed by the crop and available to be lost to natural waterways is avoided and mitigated; and
- designing, implementing and maintaining the activity area to avoid and mitigate the loss of irrigation water to natural waterways; and
- designing, implementing and maintaining drainage structures to avoid and mitigate the loss of irrigation water to natural waterways.

Natural waterway: For the purposes of commercial cropping and horticulture, means all or any part of a natural waterway (including bed and bank), including a creek, river, stream, lake, lagoon, swamp, wetland, spring, non-tidal or tidal waters (including the sea) that drain to the Great Barrier Reef.

Nutrients: For the purpose of this ERA standard means dissolved inorganic nitrogen.

Permanent bed system: Means maintaining the same row location and successive crops are planted back into the same row.

Preparatory work: As defined in Schedule 2, Part 2A, Section 13A of the Environmental Protection Regulation 2019:
'*preparatory work*, for an activity, means work, other than building work, plumbing work or drainage work, carried out to prepare land for the activity, including, for example—
(a) excavating or filling the land; or
(b) clearing or destroying vegetation on the land; or
(c) ploughing the land, or otherwise preparing soil on the land for planting; or
(d) other work in, on, over or under the land that materially affects the land or its use.'

Receiving waters: Means any *waters* into which the activity area drains. *Waters* has the same meaning as in the *Environmental Protection Act 1994* and includes all or any part of a creek, river, stream, lake, lagoon, swamp, wetland, spring, unconfined surface water, unconfined water in natural or artificial waterways, bed and bank of any waters, non-tidal or tidal waters (including the sea), and underground water. For the purposes of commercial cropping and horticulture, receiving waters also includes structures or features which may reasonably be expected to drain to *waters* including a farm drain or channel, storm water channel, storm water drain or roadside gutter.

Recycle pit: Means a retention basin designed to capture irrigation water loss for re-use on the farm.

Riparian area: Means land adjoining a natural waterway, directly influencing, or influenced by water quality.

Seasonal high water line: Means a zone that represents the usual peak seasonal flow level, identifiable by deposition, debris or characteristic vegetation zonation.

Sediment trap: Means a basin that removes sediment, debris and litter from run-off water by allowing it to settle out and be left behind when the water moves.

Single enterprise: An activity, or more than one activity, is carried out as a single enterprise if the activity or activities are carried out by the same person and on one or more parcels of land of which the person is the owner or under an arrangement about the use of the land with the owner of the land.

Soil conditioners: 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.

Surface water: As defined in Schedule 2 of the Environmental Protection (Water and Wetland Biodiversity) Policy 2019: "means waters other than ground waters".

Vegetated cover: Means living, attached non-woody vegetation (e.g. grasses).

Vegetated spoon drain: Means shallow, open, vegetated channels between crop rows or blocks/paddocks primarily designed for conveying water along a drainage pathway.

Waterway buffer: Means a strip of retained or planted vegetation of a minimum of (5) five metres in width and has at least 80% **vegetated cover** in between the cropping (or fallow) area (of the activity) and a downslope waterway. The waterway buffer must not consist, in whole or in part, of the crop or crops being produced as part of the activity.

Introduction

The *Environmental Protection Act 1994* requires new commercial cropping and horticulture activities on five hectares or more of land within the same river basin in the **Great Barrier Reef catchment** to hold an Environmental Authority (ERA13A).

The standard conditions are based on the best available science and agricultural industry expertise to deliver significant water quality benefits while driving better land management practices for profitable and productive farming.

The explanatory information in this document is to be used by growers, and others involved in providing advice on setting up new cropping enterprises, including avoiding and mitigating sediment and nutrient loss on agricultural properties.

The development of a new or expanded cropping area provides the opportunity to include **measures** that will ensure efficiency, productivity and environmental benefits. Topsoil is the most valuable layer in a soil profile. Its removal by erosion reduces the productivity of land, and limits the ability of soil to store both carbon and water. Susceptibility to erosion depends on a number of factors, including rainfall intensity, how prone soil is to erosion, and the landscape, for example, steepness and length of slopes and the amount of surface cover. All soil types are susceptible to erosion during intense rainfall if there is no run-off control or surface cover. Where crops are irrigated, ensuring that the **irrigation system** is set up to avoid and mitigate the loss of irrigation water into receiving waters ensures the most efficient use of water.

It is important to make sure that any measures you take do not cause problems elsewhere on your property or on neighbouring properties. You may be required to obtain other approvals under other legislation or regulations in regards to erosion and sediment control measures, in particular to meet requirements under the *Soil Conservation Act 1986*, *Vegetation Management Act 1999* and *Biosecurity Act 2014*.

Ongoing best management practices consolidate water quality benefits by further preventing soil and nutrient loss.

Great Barrier Reef catchment and basins

The Great Barrier Reef catchment consists of Cape York, Wet Tropics, Burdekin, Mackay Whitsunday, Fitzroy and Burnett Mary natural resource management regions (Figure 1).

You can find out if your property is in one of these regions by completing this online form available at www.qld.gov.au/ReefRegulations.

The online form gives you the number of hectares of your Lot/s in each Reef catchment and each river basin. If a Lot is located across the boundary of two Reef regions or river basins, the Lot is taken to be in the region and river basin where more than 50 percent of the Lot is located.

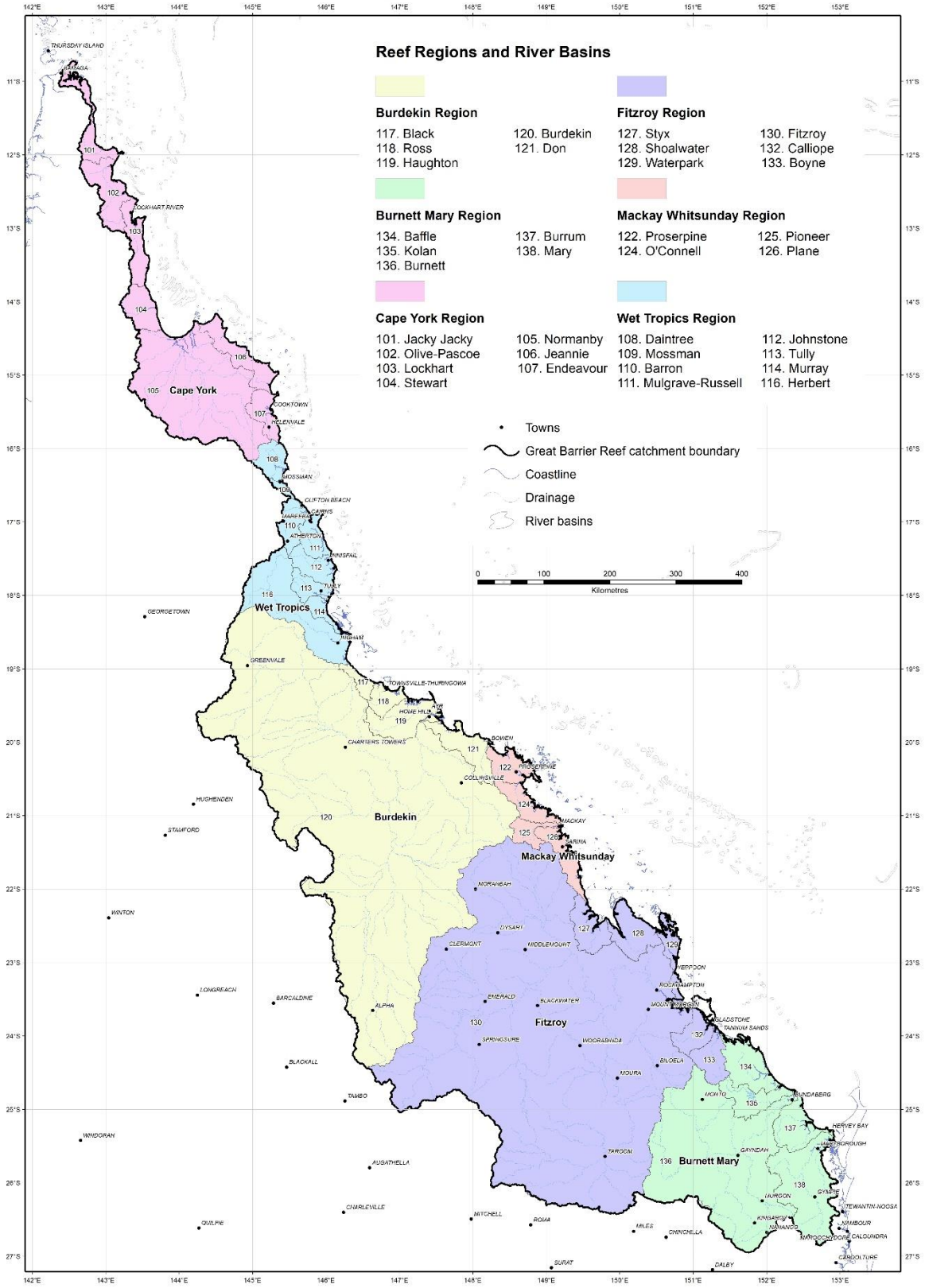


Figure 1: The Great Barrier Reef stretches more than 2,300 kilometres along Queensland's coastline. It receives run-off from 35 river basins which are spread over six natural resource management regions.

Purpose of this guide

The purpose of this guide is to provide practical information to enable you to comply with the standard conditions for commercial cropping and horticulture development, which are contained in the Environmentally Relevant Activity (ERA) standard for Commercial cropping and horticulture in the Great Barrier Reef catchment (prescribed 13A) – version X.

The *Guide to applying for an environmental authority to undertake new commercial cropping and horticulture*, available at www.qld.gov.au/XXXX, provides detailed information to help producers work out if they need an environmental authority and, if so, what type of application to make and how to apply.

The following provides an overview of the circumstances in which you can submit a standard, variation or site-specific application.

Standard applications

You can make a standard application if you can meet the eligibility criteria[1] and comply with the standard conditions. The eligibility criteria are:

- The commercial cropping and horticulture will be undertaken on no more than 100 hectares of land in a particular river basin; or
- The commercial cropping and horticulture is banana cultivation that is being relocated due to the presence of Panama disease tropical race 4 on other land for which a Notice has been issued under the Biosecurity Act 2014 (Qld).

The standard conditions outlined in this guide are the minimum operating requirements that a producer issued with an environmental authority for a standard application must comply with.

Variation applications

If you can meet the eligibility criteria but need to vary one or more of the standard conditions to suit your operational needs, then you can make a variation application, which may allow you to substitute other measures that achieve the same outcome.

Site-specific applications

If you cannot meet the eligibility criteria, you will need to submit a site-specific application.

Important

In addition to obtaining and complying with the conditions of your Environmental Authority, you must comply with any minimum practice agricultural standard contained in an Agricultural ERA standard for your crop. The minimum practice agricultural standards outline nutrient application, erosion and sediment control, and record keeping requirements and apply as soon as you receive your Environmental Authority. There are currently minimum practice agricultural standards for sugarcane and banana cultivation. Minimum practice agricultural standards are yet to be developed for other crops such as rice, corn, avocados, macadamias, and mangoes etc.

[1] The eligibility criteria are prescribed in the *Environmentally relevant activity (ERA) standard for Commercial cropping and horticulture in the Great Barrier Reef catchment (prescribed ERA 13A) – Version 1.*

Standard Condition 1

You must take all reasonable steps to make sure your cropping or horticulture activity complies with the eligibility criteria.

Standard Condition 2

As an environmental authority holder, you must ensure that cropping is not carried out within at least five metres of the **defining bank** of **a natural waterway** (Figure 2). This means that the cropped area must be set back at least five metres from the defining bank of any natural waterways, including any creek, river, stream, lake, lagoon, swamp, wetland, spring, non-tidal or tidal waters.

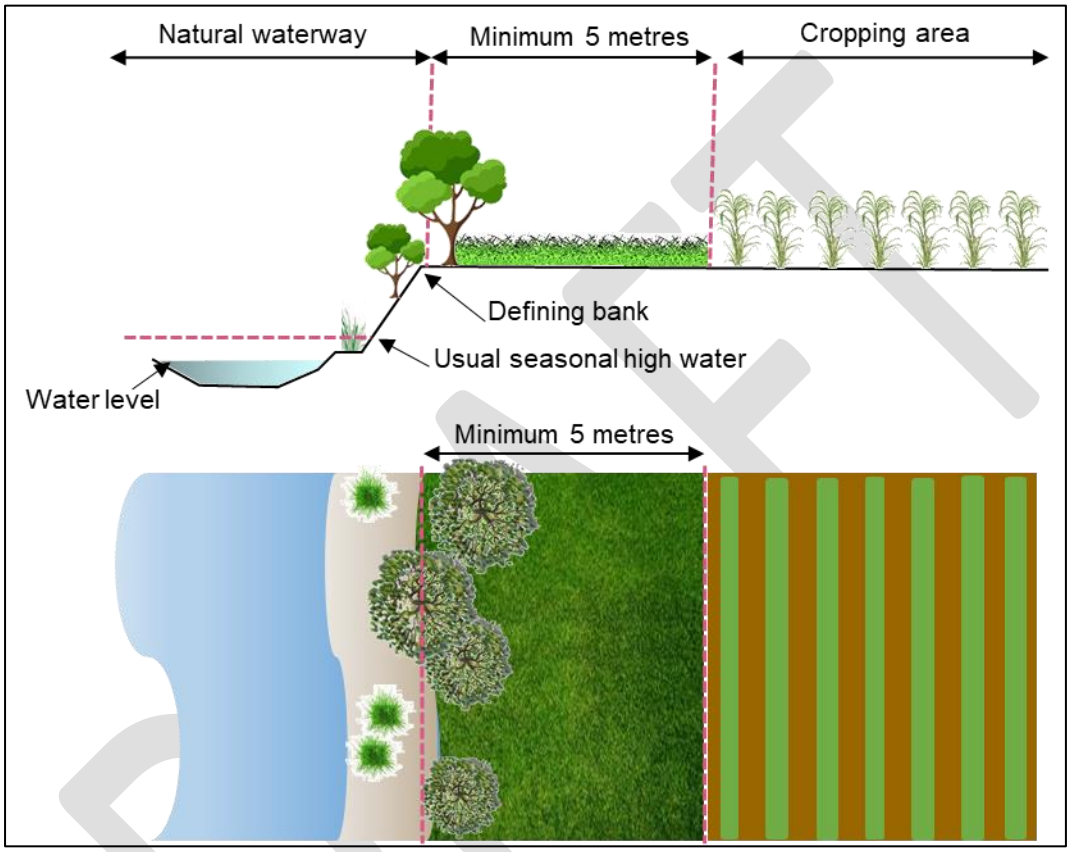


Figure 2: Top: Diagram to show location of defining bank (adapted from *Vegetation Management Act* guideline). Bottom: Plan view.

Standard condition 3 - Waterway buffers

Prior to 1 November each calendar year a waterway buffer must be in place between the defining bank of all downslope waterways and the edge of the cropping area (see Figure 3) i.e. between the cropping area and the waterway. Waterway buffers refer to a strip of retained or planted vegetation that separates the length of the cropped area from waterways. They are used to minimise sediment run-off by slowing run-off velocity to allow deposition of sediment (Figure 4). Buffers in **riparian areas** can also help reduce stream bank erosion (Karssies and Prosser 1999). Prior to 1 November each calendar year, the waterway buffer must be a minimum of 5 metres in width and have at least 80% vegetated cover in between the cropping (or fallow) area and the downslope waterway. The waterway buffer must not consist, in whole or in part, of the crop or crops being produced as part of the activity.

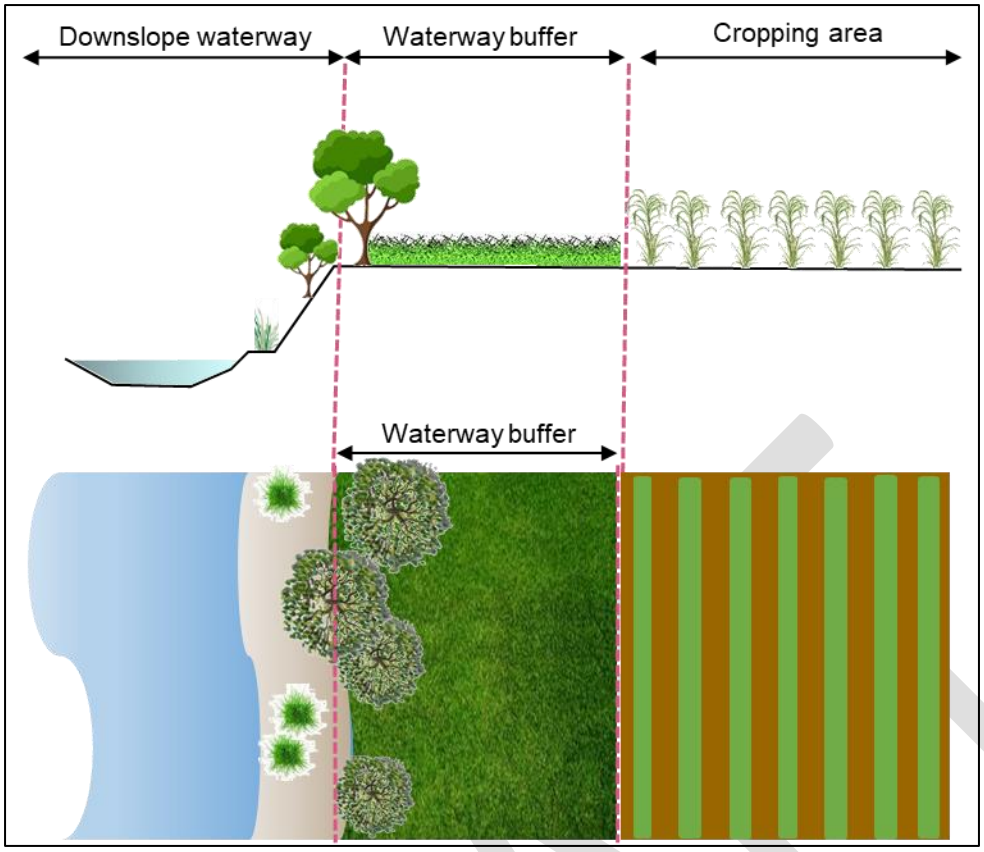


Figure 3: Top: Diagram to show location of waterway buffer (adapted from *Vegetation Management Act* guideline). Bottom: Plan view.

To support the waterway buffer minimising sediment loss from the cropped area, it is beneficial if it:

- is comprised of dense, non-woody, well-distributed vegetation
- is relatively smooth i.e. no ruts or tyre tread impressions deeper than 5 cm from the soil surface, or other evidence of erosion
- has a slope of less than 2 percent.

Well-maintained riparian areas and grassed headlands can form the waterway buffer if they meet the outcome of minimising sediment run-off.

A well-designed buffer strip will trap sediment generated during intense storms. While a buffer must have a minimum width of 5 meters, a wider buffer could be more effective in some circumstances. There is no upper limit under the conditions as to how wide the buffer can be. Consideration of factors such as: the quantity of water; soil types and loss rates; paddock size; land slope; area available for the buffer strip, will help make sure impacts to receiving waters are minimised (Carey et al 2015a; Prosser and Karssies 2001; Karssies and Prosser 1999).

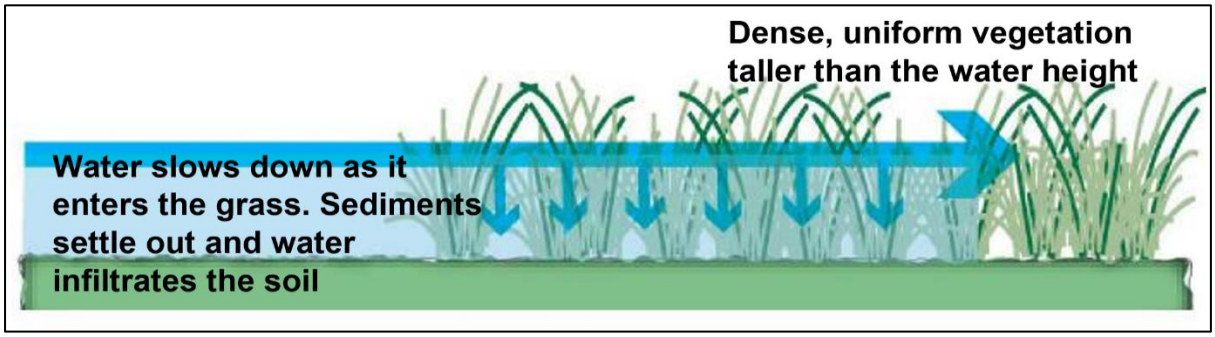


Figure 4: Diagram to show how waterway buffers slow and filter run-off (Source: WetlandInfo 2018a).

It is important that vegetation in the buffer is maintained so that the buffer remains effective in preventing sediment run-off from reaching waterways. In times of drought or long dry spells, maintenance of ground cover on the buffer will be more difficult. During such periods, you should try not to disturb the buffer area so that grass can re-establish quickly after rain. You can find detailed information on maintenance of buffers on WetlandInfo and in Chapter 12 of the Soil Conservation Guidelines for Queensland. If you need to remove any vegetation from the buffer, for example to remove weeds, you should undertake this work so that there is at least 80% vegetated cover in place by 1 November of that year.

NOTE: High-value regrowth vegetation is protected in the Great Barrier Reef catchment. Waterway buffers must comply with the requirements of the *Vegetation Management Act 1999* in addition to the conditions for new cropping. The buffers can overlap. Refer to the Vegetation Management guidelines, at www.qld.gov.au, for further information.

NOTE: If high impact earthworks are proposed as part of cropping or as part of a buffer, they must be carried out outside the wetland protection area that surrounds wetlands of high ecological significance (HES) in the catchments of the Great Barrier Reef, on the map of referrable wetlands (State Planning Policy 4/11: Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments).

Further resources

You can access detailed information, including specifications, on the design and construction of buffers at:

- Soil Conservation Guidelines for Queensland: Chapter 12 Soil conservation in horticulture, available at www.publications.qld.gov.au
- Buffer strips fact sheet, available at Department of Environment and Science Wetland Info website, www.wetlandinfo.des.qld.gov.au
- Guidelines for riparian filter strips for Queensland irrigators, available from the CSIRO website, www.csiro.com.au.

Standard conditions 4 and 5 - Erosion and sediment control

To meet standard conditions 4 and 5, the activity area must be designed and measures implemented to avoid and mitigate soil loss and surface water run-off to receiving waters before any cropping takes place. These measures must be maintained once cropping has started.

Erosion and sediment control mitigation measures should aim to achieve an outcome at least equivalent to measures contained in the Soil conservation guidelines for Queensland (Carey BW, Stone B, Norman PL, Shilton P (2015), Department of Science, Information Technology and Innovation, Brisbane). This includes designing and maintaining measures to a minimum of a 1 in 10 year Average Return Interval rainfall event. All measures need to be well-maintained to ensure continued effectiveness.

Measures may include:

- designing, implementing and maintaining drainage structures so that soil loss and surface water run-off to receiving waters is avoided or mitigated; and
- designing and maintaining the cropped area to reduce the velocity of surface water run-off, for example by considering surface cover, row direction, row length, and cultivation methods.

When planning and designing erosion and sediment control measures it is important to understand how the natural landscape interacts with water, nutrient and erosion processes and their drivers (for example management practices and weather events) (WetlandInfo 2018b). Taking these factors into account, along with professional advice from an **appropriate person**, before undertaking any erosion and sediment control measures, will help you to determine which measures are most suitable for your property. If you do not believe that you have sufficient experience with these measures, you are

recommended to seek advice from an appropriate person on which measures are most suitable for your property, and their correct placement, construction and maintenance. See the Contacts section for more information.

> Appropriate person
>
> This term refers to a person who has professional qualifications, training or skills or experience relevant to the nominated subject matters and can give authoritative assessment, advice and analysis relevant to the subject matters using relevant protocols, conditions, methods or literature.

An example of where these measures might be placed is shown in Figure 5.

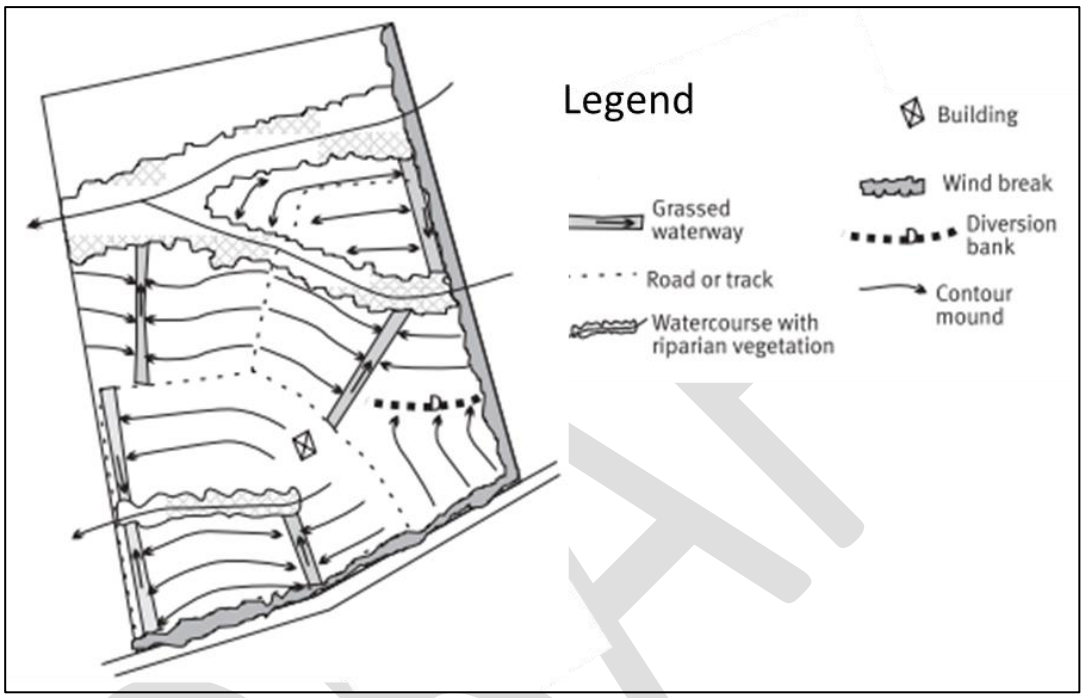


Figure 5: Example of a banana plantation layout taking advantage of natural slope and drainage, and incorporating several of the measures described in this guide (source: NRM Facts - Erosion control for bananas).

Erosion and sediment control structures should be designed to ensure that they have enough capacity to carry estimated run-off at rates that will not erode the channel of the structure. The size and/or gradient of these structures will depend on the:

- size and land use of the contributing catchment
- soil type
- land slope
- surface condition of the channel structure: either bare or the amount of vegetation cover.

Chapters 2 and 6 to 9 of the Soil Conservation Guidelines for Queensland provide detailed information on soil conservation planning and run-off control structures, including design specifications, and can be accessed from the Soil Conservation Guidelines for Queensland or at www.publications.qld.gov.au. In addition, detailed soil and land resource information is available from the Queensland Globe at www.qldglobe.information.qld.gov.au/.

Examples of erosion and sediment control measures for a standard application

Drainage structures

Surface water drainage structures are structures designed and implemented to minimise soil loss from a cropping or horticulture activity. If you use these structures, they must be in place before any cropping takes place on the activity area. For any vegetated spoon drains, contour banks or diversion banks, establishing vegetated cover on the structure should start immediately following construction.

Vegetated spoon drains

These structures (also known as constructed waterways or vegetated swales) are shallow, open, vegetated channels designed to transport water along drainage pathways (Figure 6). They should be located where they can transport run-off along a drainage pathway into a water storage (WetlandInfo 2018a). Their shallow form helps to prevent slumping and slows run-off velocity, allowing coarse and medium sized sediments to settle. Because sediment can be deposited within the drainage structure over time, especially where run-off is collected from areas with poor ground cover, the spoon drains may require reconstruction to ensure discharge capacity is maintained. You must establish vegetated cover immediately following any reconstruction.

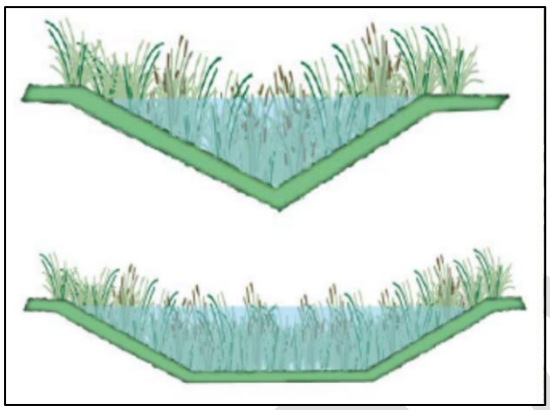


Figure 6: Left: Diagram to show cross sections of vegetated spoon drains and swales (bottom). (Source: QDAFF/WetlandInfo 2018a).

Regional considerations

Based on recommendations in the Soil Conservation Guidelines for Queensland, Bureau of Meteorology and Australian Rainfall and Runoff guidelines, surface water drainage structures should be designed to a minimum of a 1 in 10 year Average Return Interval. Design rainfalls and intensity-frequency-duration (IFD) information for your location can be downloaded from the Bureau of Meteorology. In addition, in areas with large volumes of intense rainfall, such as the Wet Tropics surface water drainage structures may need to take into account other factors such as the need for good drainage at the top of slopes in addition to good vegetation in the drainage structures to maintain stability.

Further resources

You can access detailed information on the design and construction of surface water drainage structures, including spoon drains at:

- Vegetated swales and drains factsheet, available from the Department of Environment and Science Wetland Info website at www.wetlandinfo.des.qld.gov.au.
- Chapter 9 – Waterways of the Soil Conservation Guidelines for Queensland, available at www.publications.qld.gov.au.
- Banana Best Management Practices Environmental Guideline (pages 46–7), available from the Australian Banana Growers' Council website at www.abgc.org.au.
- Soil conservation waterways – construction and management available at www.publications.qld.gov.au
- Soil conservation waterways – planning and design available at www.publications.qld.gov.au

You can find a list of plant species suitable for vegetating waterways and/or drains in Appendix 4 of the Soil Conservation Guidelines for Queensland, available at:

- Appendix 4 of the Soil Conservation Guidelines for Queensland, which can be accessed from www.publications.qld.gov.au.

Contour banks

Contour banks (also known as graded banks, terraces or bunds) are earthen banks constructed at intervals across a slope, with a slight gradient that is close to the natural contours of the land (Figure 7) (Queensland Government 2016). They ensure that the flow velocity of run-off is slow enough to avoid erosion (Carey et al 2015a). In general, as the gradient of the land increases, contour banks should be constructed more closely together (Carey et al 2015b). Contour banks should be designed so that run-off is channelled into surface water drainage structures such as grassed waterways.

Figure 7: Left: Example of contour bank layout on a banana farm (Source: Figure 7.1, Chapter 7 Soil Conservation Guidelines). Right: Example of well-maintained contour banks on a Queensland farm (Source: https://www.qld.gov.au/environment/land/management/soil/erosion/management).

Further resources

You can access detailed information and specifications on the design and construction of contour banks, available at www.publications.qld.gov.au:

- Soil Conservation Guidelines for Queensland: Chapter 7 Contour banks
- Soil Conservation Guidelines for Queensland: Chapter 12 Soil conservation in horticulture
- Run-off control measures for erosion control in cropping land.
  Banana Best Management Practices Environmental Guideline (pages 45–46), available from the Australian Banana Growers' Council website at www.abgc.org.au.

Contour banks should be implemented before cropping takes place.

Diversion banks

Diversion banks are usually constructed above a paddock and are used to divert run-off from areas where it could cause problems (for example, cultivated paddocks or buildings) into a stable waterway such as a grassed channel, drainage line or water storage, where it can be safely disposed of (Figure 8; Carey et al 2015c; Queensland Government 2016).

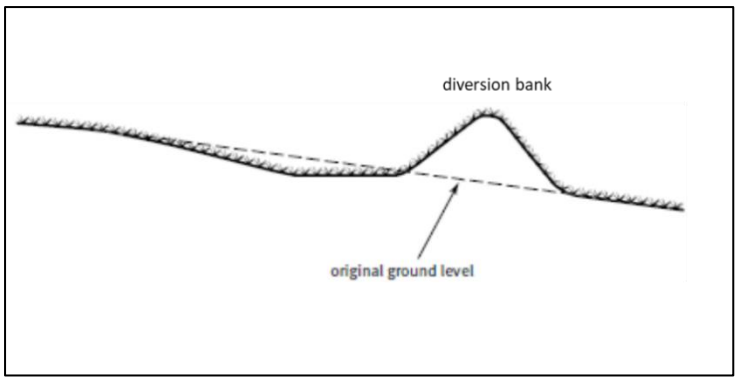


Figure 8: Cross profile of a diversion bank (Source: Soil Conservation Guidelines for Queensland Chapter 8).

Further resources

You can access detailed information and specifications on the design and construction of diversion banks, including information on creating a safe disposal area for run-off water from the following, available at www.publications.qld.gov.au:

- Run-off control measures for erosion control in cropping land
- Queensland Soil Conservation Guidelines: Chapter 2 Soil conservation planning
- Queensland Soil Conservation Guidelines: Chapter 8 Diversion banks.
- Banana Best Management Practices Environmental Guideline (pages 45–46), available from the Australian Banana Growers' Council website at www.abgc.org.au.

Diversion banks should be implemented before cropping takes place. You are recommended to seek specialist advice on the correct placement, construction and maintenance of diversion banks.

Sediment traps

Sediment traps (also known as silt traps or sediment basins) are structures that treat water by removing sediment, debris and litter from run-off water, by allowing it to settle out and be left behind when the water moves on. The size of the trap needed will depend on the area or size of the catchment and the expected size of rainfall events to be treated. As a minimum, sediment traps should be constructed to a 1 in 10 year Average Return Interval standard. You can access design rainfall data (intensity-frequency-duration) from the Bureau of Meteorology, including frequently asked questions.

Sediment traps should be designed so that all run-off water from the catchment area is collected and detained long enough to allow coarse and medium sized sediment, debris and litter to settle. Regular maintenance will be required to remove sediment that has built up and to retain the capacity of the sediment trap (WetlandInfo 2018c; Figure 9).

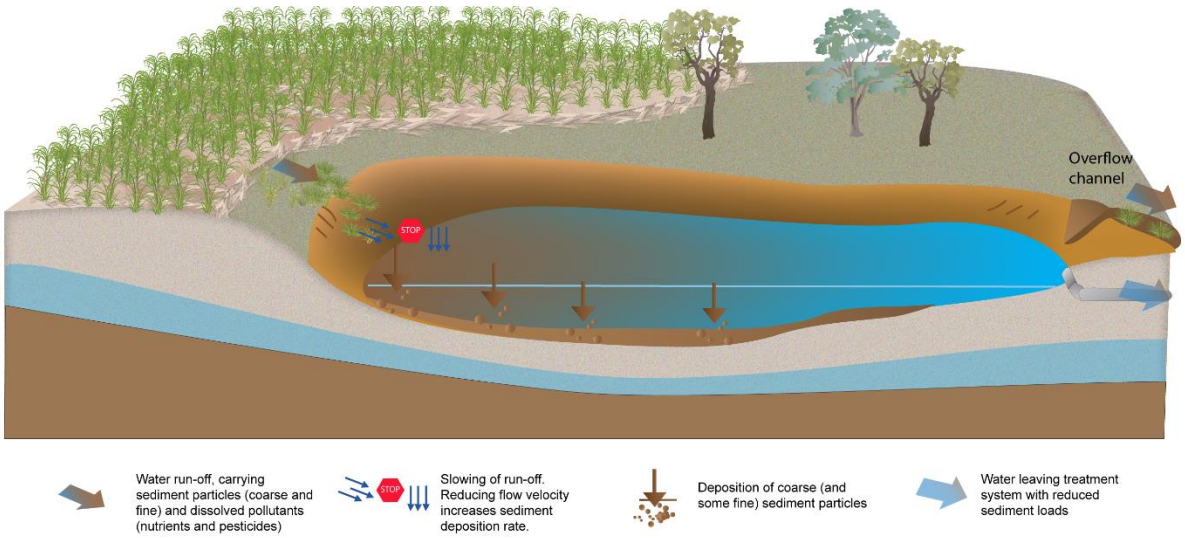


Figure 9: Diagram to show how a sediment trap captures run-off water (Source: WetlandInfo 2018c).

Further resources

You can access further information on the placement, construction and maintenance of sediment traps at:

- Sediment basins factsheet, available at the Department of Environment and Science Wetland Info website, www.wetlandinfo.des.qld.gov.au.
- Soil Conservation Guidelines for Queensland: Chapter 12 Soil conservation in horticulture, available at www.publications.qld.gov.au.
- Banana Best Management Practices Environmental Guideline (page 46), available from the Australian Banana Growers' Council website at www.abgc.org.au.

Recycle pits

Recycle pits (also known as tailwater storage pits/return systems, sediment ponds or retention ponds) are structures designed to collect irrigation run-off water (also known as tailwater) for re-use on-farm (Figure 10). They are used in areas where surface furrow irrigation results in tailwater. Recycle pits do not treat the water but provide water quality benefits by ensuring that run-off water (including some storm run-off) along with any sediment and nutrients it may contain, is re-used and does not enter waterways. You should monitor water levels in the recycle pit regularly and re-use the captured water as quickly as possible to ensure that enough capacity is maintained to capture future run-off (WetlandInfo 2018d).

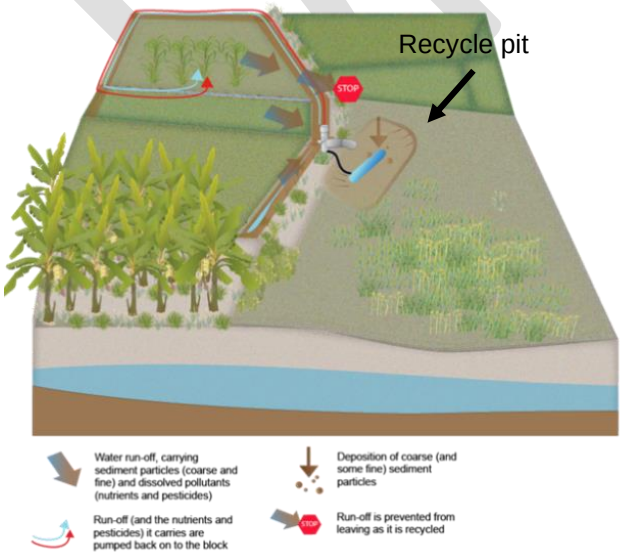


Figure 10: Diagram to show how a recycle pit can be integrated into a farming system. (Source WetlandInfo 2018d).

Further resources

You can find further information on recycle pits, including important considerations, design and construction at the Department of Environment and Science Wetland Info website, at https://wetlandinfo.des.qld.gov.au/wetlands/ and in section 5.2 of WATERpak.

Constructed wetlands

Constructed wetlands (also known as treatment wetlands) mimic the conditions found in natural wetlands but can be built in a range of locations for a variety of purposes (Department of Employment, Economic Development and Innovation 2011; WetlandInfo 2018e; Figure 11). They improve water quality by removing fine sediments, nutrients and other pollutants from surface water run-off.

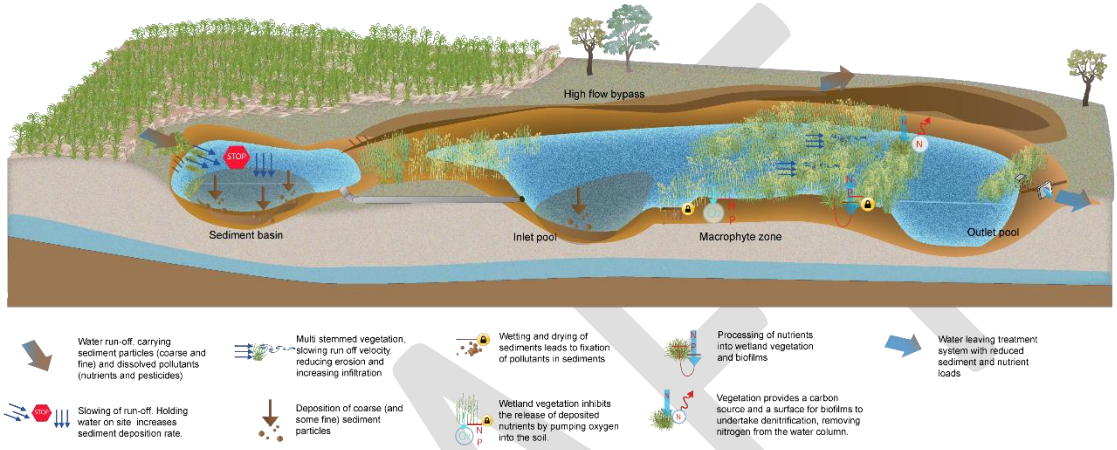


Figure 11: Features of a constructed wetland (Source: WetlandInfo 2018e).

Further resources

You can find further information about the design, construction and management of wetlands on sugarcane farms in the SmartCane Riparian and Wetland Areas on Cane Farms booklet (Smith 2008), available online at www.smartcane.com.au.

Detailed information on the general design and construction of constructed wetlands can be found online at WetlandInfo, including:

- Constructed (treatment) wetlands factsheet
- Treatment wetlands website information.

Reducing the impact and velocity of surface water run-off

Measures to reduce the velocity of surface water run-off may include designing and maintaining the cropped area so that the crop row direction and length avoids soil loss and surface water run-off. You can find detailed information on managing run-off in chapter 12 of the Soil Conservation Guidelines for Queensland, available at www.publications.qld.gov.au.

In addition, certain cultivation methods can help to slow run-off velocity and therefore help to avoid and mitigate soil loss. These methods include:

Surface cover

Establishing surface cover on fallow blocks protects the soil surface by reducing the impact of raindrops, and therefore minimising erosion. Surface cover may be provided by a cover crop, organic matter or mulch.

Cover crops (Figure 12) are widely used in some cropping systems to provide protection of the soil surface during the fallow period. In sugarcane, for example, cover crops are often used between the destruction of the final ratoon crop and establishment of the next plant crop (Carey et al 2015a).

The benefits of using cover crops include:

- protecting soil from erosion by reducing the impact of heavy raindrops
- reducing the volume and speed of run-off
- conserving soil moisture
- protecting the crop from weed competition
- helping break disease cycles
- creating microclimatic conditions in and near the soil surface which can enhance soil health and fertility by increasing soil carbon and microbial activity (Carey et al 2015a; Department of Environment and Resource Management 2010).

A number of cover crops are used in Queensland. You can access detailed information on suitable cover crops, including those best suited to different climates in Chapter 12 of the Soil Conservation Guidelines for Queensland, available at www.publications.qld.gov.au or by seeking expert local advice (see Contacts section for more information).

Figure 12: A legume cover crop.

Permanent beds

Cultivation methods such as using a **permanent bed system** (also known as raised beds) maintains the same row location so that only the row is cultivated during planting. Use of permanent beds is particularly relevant in irrigated cropping systems. Successive crops are planted back into the same row. The inter-row space is not cultivated and is used as a traffic corridor for machinery (Department of Agriculture and Fisheries 2016b; Carey et al 2015a). Permanent beds can form part of a controlled traffic system, where row spacing is matched to the track width of the machinery used for both farming and harvesting. The bed width will depend on the wheel track width of the machinery you use. When planning a permanent bed system, you should take into account the local catchment, ridge lines, land slope and drainage layout (Carey et al 2015a).

A permanent bed system does not prevent you from carrying out periodic renovation works to re-configure blocks. Block renovation may be carried out at any time of year, however as it can remove ground cover, all reasonable and practicable measures should be taken to minimise the release of sediment as a result of the works, such as timing works to coincide with drier periods, and/or installing temporary sediment and erosion control measures.

Further resources

For detailed specifications on permanent beds, including protecting the beds against erosion between forming and planting, you can access Chapter 12 of the Soil Conservation Guidelines for Queensland available at www.publications.qld.gov.au

You can find information on permanent bed systems on banana farms in the Banana Best Management Practices Environmental Guideline available from the Australian Banana Growers' Council website at www.abgc.org.au.

Zonal tillage

Zonal and zero tillage cultivation methods can be used once your farm is in operation to further reduce the risk of erosion and soil loss.

Zonal tillage involves only preparing the crop row area for planting. The inter-row is not cultivated and can be used as a traffic zone (Calcino et al 2008). This provides a number of benefits, including:

- reducing compaction of the soil,
- reduced costs in terms of fuel and machinery wear and time,
- soil moisture is retained,
- soil erosion is reduced,
- beneficial soil organisms and soil organic matter are retained (Calcino et al 2008).

Zero tillage

Zero tillage involves direct drilling into the undisturbed soil with no prior cultivation. You can plant directly into any legume stubble left from a fallow crop. Benefits of this method include:

- reduced costs,
- soil moisture is retained,
- beneficial soil organisms are retained,
- ensuring the paddock remains covered throughout the cropping cycle (Roth and Visser 2003).

Use of zero tillage is less common, but may be suitable for certain soils in sugarcane cropping systems (Calcino et al 2008). You may wish to consult an appropriate person for advice on whether this practice is suitable for your farm (see Contacts section for more information).

Standard condition 6 - Irrigation requirements for standard applications

To meet standard condition 6, if you plan to irrigate crops you must implement and maintain measures to avoid and mitigate the loss of irrigation water to natural waterways. This condition needs to be implemented on the activity area and may be coordinated with existing irrigation infrastructure on the farm.

Measures to mitigate the loss of irrigation water should aim to achieve an outcome at least equivalent to measures contained in the Soil conservation guidelines for Queensland (Carey et al 2015). Some additional matters that may require particular consideration include drainage, tail water, storages and channels (Carey et al 2015d, section 14.7.1)

Measures may include, but are not limited to:

- matching the amount of irrigation water applied to the water requirement of the soil and crop, so any excess water not needed by the crop and available to be lost to natural waterways is minimised;
- installing and managing an **irrigation system** that maximises water use efficiency;
- considering the farm layout and designing, implementing and maintaining the activity area to avoid and mitigate the loss of irrigation water to natural waterways;
- designing, implementing and maintaining drainage structures to avoid and mitigate the loss of irrigation water to natural waterways.

Good design and good irrigation practice can help you to achieve this standard. For example, installing drainage structures such as Recycle pits will capture any irrigation tail water for re-use on-farm. You can find further information on drainage structures in Standard conditions 4 and 5 - Erosion

and sediment control. The Soil Conservation Guidelines for Queensland provide detailed information on how to avoid erosion from the implementation of irrigation systems. You can access this information at Soil Conservation Guidelines for Queensland: Chapter 14 Property Infrastructure (section 14.7.1), available at www.publications.qld.gov.au.

If your crop requires irrigation, the irrigation system you use should be designed with the assistance of an appropriate person with specialist knowledge of water supply technologies. You should regularly check the system to make sure it is delivering the correct amount and rate of irrigation water.

There are two broad groups of irrigation systems (Cotton Research and Development Corporation, 2012):

- Surface irrigation systems, which include furrow, border check and contour bay systems.
- Pressurised irrigation systems, which include centre pivot and lateral move, travelling irrigator and drip systems.

Section 5 of WATERpak provides detail on each type of irrigation system, along with considerations for choosing the best system for your business.

Whichever system you use, the application rate should be matched to soil type and crop requirements.

Maximising crop water use efficiency

When designing your irrigation system, you should take into account the site and soil characteristics, and crop water requirements to ensure maximisation of crop water use and minimisation of loss of irrigation water off-farm, either through run-off or deep drainage.

Soil characteristics that you should consider:

- soil type;
- the soil's moisture holding capacity.

Site characteristics that you should consider:

- water availability/topography/area of land to be irrigated/climate/crop types (Cotton Research and Development Corporation, 2012);
- management practices; for example:
    - whether there is adequate surface cover,
    - whether **soil conditioners** have been added,
    - other factors that improve or affect water penetration.

Irrigation water volumes should match the requirements of the crop and be able to be varied in accordance with crop water use. You should consider the amount of water needed by the plants by evaluating:

- the age of the plant in combination with evapotranspiration and soil moisture content;
- how often you apply irrigation;
- timing of irrigation events with application of **fertiliser** and soil conditioners.

By scheduling irrigation according to the plant's needs and soil conditions, you can optimise water use, decrease losses of nitrogen and prevent excessive run-off. Soil moisture monitoring equipment (such as capacitance probes, tensiometers, gypsum blocks) and online scheduling tools can help you to schedule your irrigation and work out irrigation volumes (Department of Agriculture and Fisheries 2016a). Examples include:

- Irrigweb for sugarcane cropping systems
- www.waterschedpro.net.au for broadacre grains systems
- WATERpak, in particular section 2.

In addition, it is important to monitor weather conditions and forecasts before irrigating and during the crop cycle, to ensure soil contains sufficient moisture (Cotton Research and Development Corporation

2012). Bureau of Meteorology climate outlooks may be a useful source of information for planning purposes. Rainfall and temperature outlooks for the coming few weeks and months, as well as forecast information for evapotranspiration, climate drivers such as ENSO and seasonal streamflow is available from www.bom.gov.au. You can access the outlook maps (see Figure 13 as an example) at www.bom.gov.au and zoom in to your location to see more detail. Once irrigation has started, soil moisture reserves should be managed by monitoring soil moisture levels (Cotton Research and Development Corporation 2012).

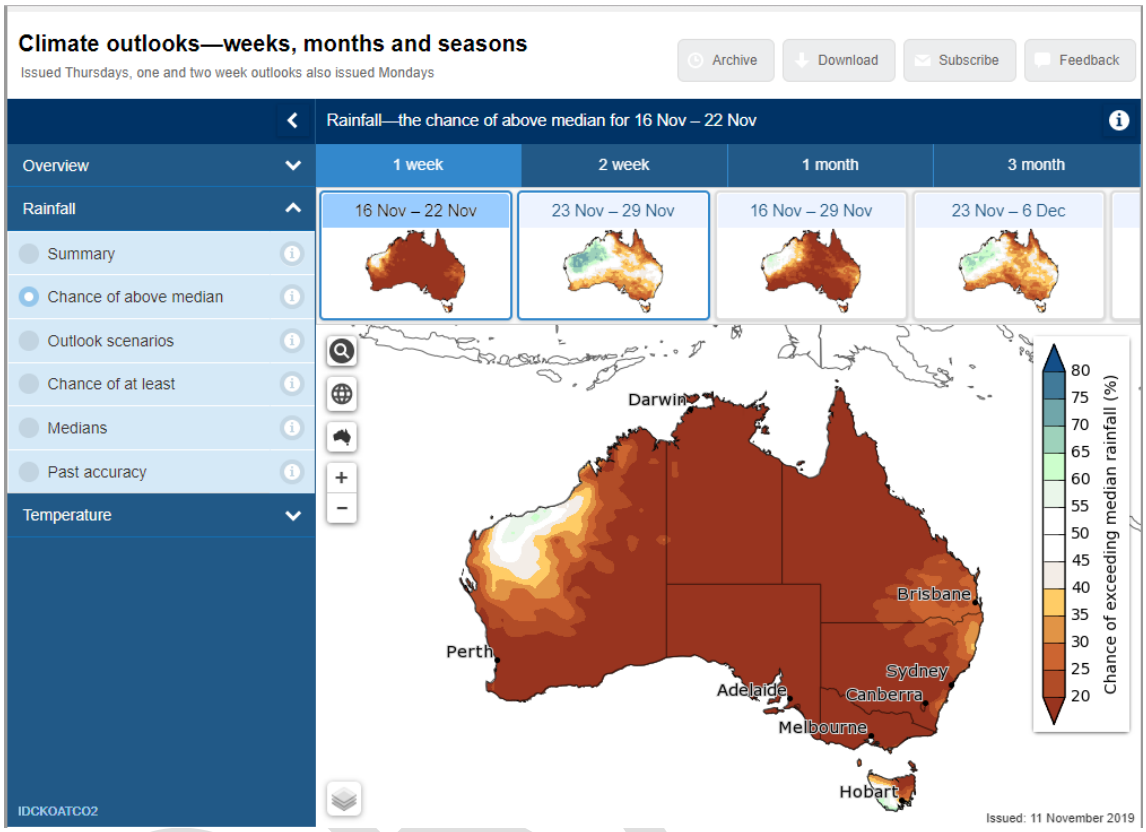


Figure 13: Example of Bureau of Meteorology rainfall outlook over the coming weeks and months.

Irrigation water should be tested at least annually for nutrient content (as well as for other water quality factors such as salinity), as it can supply large amounts of nitrogen to the crop, in particular in established irrigated, coastal agricultural districts (Holden and McGuire 1998). You may wish to take this nitrogen content into account when working out the fertiliser rate for your crop.

Further resources

You can access considerations for implementing an irrigation system in Chapter 14: Property Infrastructure of the Soil Conservation Guidelines for Queensland, available at www.publications.qld.gov.au

You can find detailed information on irrigation systems for sugar cane farms, including design considerations and specifications by viewing the Irrigation of sugarcane manual, available at www.sugarresearch.com.au.

You can find detailed information on irrigation systems, including design considerations and specifications in general (including broadacre) cropping and horticulture at:

- Rural irrigation system design, available at www.hort360.com.au
- Irrigation information and factsheets, available at www.hort360.com.au
- WATERpak is a guide for irrigation management in cotton and grains farming systems, available at CottonInfo

Chapter 12 of the Soil conservation guidelines for Queensland, available at www.publications.qld.gov.au, contains information on measures you may wish to use to minimise surface water run-off.

Checking your irrigation system

It is best practice to review your irrigation systems at least annually to ensure that:

- crop water use is being optimised;
- loss of irrigation water off-farm is minimised;
- Pooling, run-off and deep drainage of irrigation water is minimised.

An irrigation system should provide uniform distribution of water to the crop. There are several methods that you can use to check the distribution, and you can find instructions for some of these at www.hort360.com.au and WATERpak.

These checks are important because poor distribution uniformity can lead to:

- uneven crop yield and quality
- low water use efficiency
- increased leaching of nutrients from the crop root zone.

Maintaining the efficiency of your irrigation system can lead to reduced energy costs, as well as ensuring that the application of irrigation water is efficient (Holden and McGuire 1998).

Further resources

You can find detailed information on irrigation infrastructure, in-field application, and management (including efficiency testing for several different systems) for irrigation systems in:

- horticulture, available at www.hort360.com.au and
- sugarcane at Irrigation of sugarcane manual, available at www.sugarresearch.com.au
- broadacre crops in WATERpak, available at CottonInfo

Standard conditions 7, 8 and 9 - Record keeping

The standard conditions require you to keep a current plan(s) of the activity area within your lot(s) on plan. While your plan(s) can be either electronic or hand-drawn, it must show the following information:

- cadastral lot(s) boundaries; and
- the activity area within the cadastral lot(s) boundaries; and
- irrigation and drainage areas; and
- natural waterways (see definition in the **Glossary**); and
- receiving waters (see definition in the **Glossary**); and
- downslope waterways; and
- waterway buffers.

Your plan must be updated periodically so that it is always current as at 1 November each year.

You must make the plan available to the Department of Environment and Science (or its successor) on request.

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 **www** www.qld.gov.au/ReefRegulations	**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 Contact details for regional offices can be found here: **www** www.daf.qld.gov.au/contact/offices
Sugar Research Australia extension staff can be contacted on: 07 3331 3333 sra@sugarresearch.com.au **www** www.sugarresearch.com.au/contact/	**Australian Banana Growers Council** 07 4015 2797 info@abgc.org.au **www** www.abgc.org.au
Growcom – Hort360 07 3620 3844 growcom@growcom.com.au **www** www.hort360.com.au	**SmartCane BMP** 07 3864 6444 info@smartcane.com.au **www** www.smartcane.com.au
Natural Resource Management (NRM) groups **www** www.nrmrg.org.au/find-your-regional-group	**Farming in Reef Catchments Rebate Scheme** Eligible graziers, sugarcane producers and banana growers can receive a rebate of up to $1,000 to help offset the costs of obtaining professional and agronomic advice from an Accredited Agricultural Advisor. For further information, visit the Queensland Rural and Industry Development Authority (QRIDA) website and look for the rebate scheme, or contact them via the details below. 1800 623 946 FiRC@qrida.qld.gov.au **www** www.qrida.qld.gov.au

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