

Queensland
**REEF WATER
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Program



Reef protection regulations
Farming in Reef catchments

**Standard conditions guide
(5–100 hectares)**

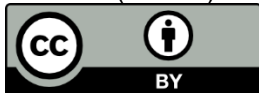
Commercial cropping and horticulture
in the Great Barrier Reef catchment (ERA 13A)

Prepared by:

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May 2021.

STANDARD CONDITIONS FOR CROPPING AND HORTICULTURE (ERA 13A)

The Environmentally relevant activity (ERA) standard - **Commercial cropping and horticulture in the Great Barrier Reef catchment (prescribed ERA 13A) – version 1** contains the following standard conditions. You can obtain a copy of the standard online at www.qld.gov.au/ReefRegulations or by contacting the department's Permits and Licensing Management area at palm@des.qld.gov.au or calling 1300 130 372 (select option 4).

Eligibility criteria

- a) The commercial cropping and horticulture will be undertaken on no more than 100 hectares of land in a particular river basin; or
- b) 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 given under the Biosecurity Act 2014 (Qld).

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 permit to comply with all of the standard conditions. If you submit a variation application for ERA 13A, it will be a requirement of your permit to comply with the conditions specified on the permit.

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 five (5) metres of the **defining bank** of a **natural waterway**.

Nutrient and sediment control

Standard condition 3: **Measures** and structures must be designed and implemented to minimise nutrient and sediment from the **activity** being released from the **location** to **receiving waters**.

Standard condition 4: Where an **agricultural ERA standard** is not in effect for the cropping or horticulture, **measures** and structures must be maintained to minimise nutrients and sediment from the **activity** being released from the **location** to **receiving waters**.

Irrigation

Standard condition 5: **Measures** and structures that minimise the loss of irrigation water to **natural waterways** must be implemented and maintained.

Record keeping

Standard condition 6: Plan(s) must be kept showing:

- a) The **location**; and
- b) The **activity area(s)** within the location; and
- c) Irrigation features; and
- d) **Natural waterways**; and
- e) **Receiving waters**; and
- f) **Measures** and structures implemented under SC3 and SC5.

Standard condition 7: The plan(s) required by condition SC6 must be updated and kept current as at 1 November each calendar year.

Standard condition 8: The plan(s) required by condition SC6 must be provided to the **administering authority** on request within the timeframe stipulated by the **administering authority**.

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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 in the Great Barrier Reef catchment, which are contained in the Environmentally relevant activity standard for *Commercial cropping and horticulture in the Great Barrier Reef catchment (prescribed ERA 13A) – version 1*.

The guide, *Applying for an environmental authority to undertake new commercial cropping and horticulture*, available at www.qld.gov.au/ReefRegulations, provides detailed information to help growers work out if they need a permit (i.e. an environmental authority) and, if so, what type of application to make and how to apply.

Key words:

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

Cropping and horticulture: means the commercial cultivation of one or more crops or horticulture carried out on at least five hectares of uncropped land in a particular river basin (see Figure 1), whether or not the land is adjoining/connected/neighbouring/bordering.

Uncropped land: means land that:

- has not been used to cultivate crops or horticulture, either commercially or non-commercially, in at least three of the last 10 calendar years before the activity is due to start. The calendar years do not have to be consecutive; and
- has not had a permit (environmental authority) issued for the land.

OR

- was *not* cropped at least once during 1 June 2018 to May 2021.
If the land was used for cropping or horticulture, either commercially or non-commercially and including preparatory work, between 1 June 2018 and 31 May 2021, you do not need a permit until 1 June 2026.
From the 1 June 2026, a permit will only be required if the land was not cropped in at least three of the last ten calendar years before the **activity** is due to start.

Introduction

From 1 June 2021, new or expanding commercial cropping and horticulture activities on five hectares or more of uncropped land in the Great Barrier Reef catchment will require a permit. The requirements allow for the expansion of agriculture while ensuring that this does not worsen the Reef water quality problem.

These 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 information in this guide is for growers and others involved in providing advice on setting up new cropping enterprises on agricultural properties.

Setting up a new or expanded cropping area provides the opportunity to include soil conservation measures that will ensure efficiency, productivity and environmental benefits. The removal of valuable topsoil by erosion reduces the productivity of land and limits the ability of soil to store carbon and water. Susceptibility to erosion depends on several factors, including rainfall intensity, soil type, slope and surface cover. However, all soil types are susceptible to erosion during intense rainfall if there is no run-off control or surface cover.

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

It is important to make sure that any soil conservation 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 nutrient and sediment control measures, in particular to meet requirements under the *Soil Conservation Act 1986*, *Vegetation Management Act 1999*, *Water Act 2000* and *Biosecurity Act 2014*.

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](http://www.qld.gov.au/ReefRegulations) available at www.qld.gov.au/ReefRegulations.

The online form gives you the number of hectares of your Lot/s on plan 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.

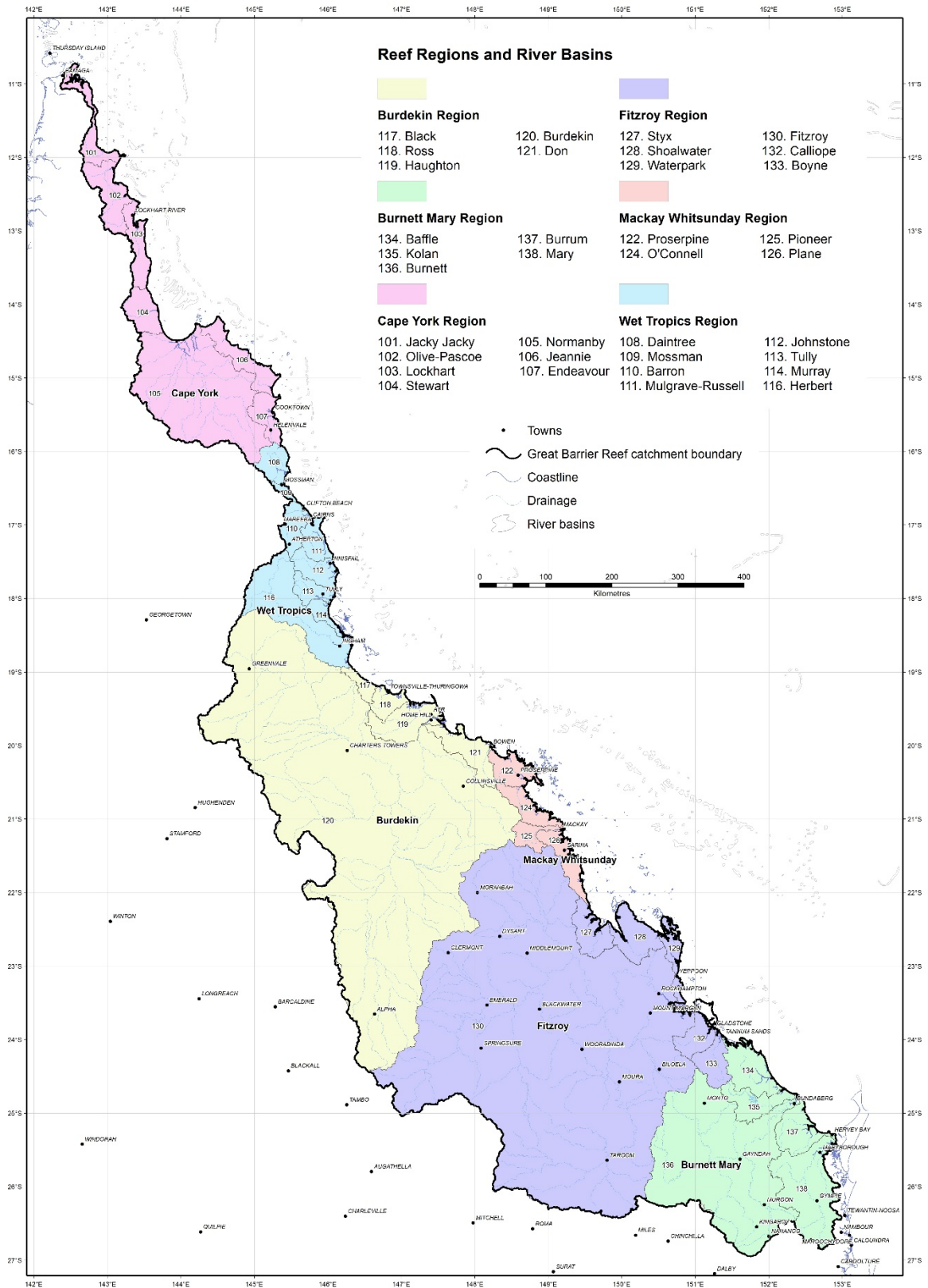


Figure 1: The Great Barrier Reef stretches more than 2,300 kilometres along Queensland's coastline. It receives run-off from 35 river basins which are spread over six natural resource management regions.

To apply for your permit, you can make a standard, variation or site-specific application. The following information gives an overview of the circumstances for each application type.

Standard applications

You can make a standard application if you can meet the eligibility criteria and comply with the standard conditions in the ERA 13A standard. 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 given under the Biosecurity Act 2014 (Qld).

The standard conditions outlined in this guide are the minimum operating requirements that a grower issued with a permit 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 grain and horticulture crops such as rice, corn, avocados, macadamias, and mangoes.

Standard condition 1 - meeting the eligibility criteria

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

Key words:

Activity: Means the commercial cropping and horticulture that the permit (environmental authority) has been issued for, as defined in Schedule 2, Part 2A, Section 13A of the Environmental Protection Regulation 2019.



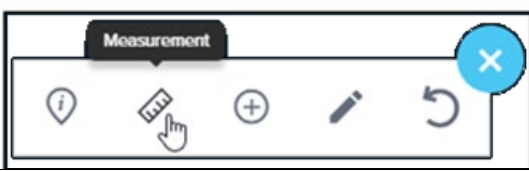
Activity area: Means the area(s) of land where the activity is being carried out.

You must take all reasonable steps to make sure your cropping or horticulture activity complies with the eligibility criteria, which are:

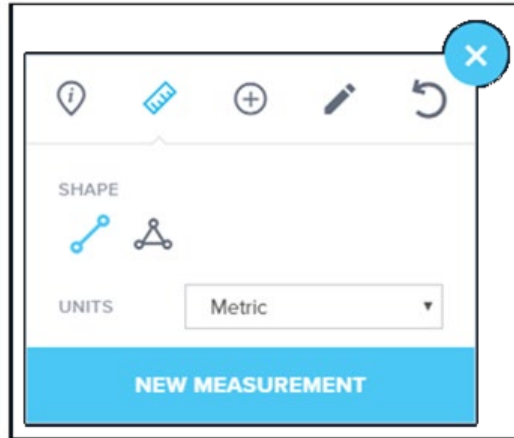
- The commercial cropping and horticulture will be undertaken on no more than 100 hectares of land in a particular river basin; or
- The commercial cropping and horticulture is banana cultivation that is being relocated due to the presence of Panama disease tropical race 4 on other land for which a Notice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

The minimum size threshold for needing a permit is five hectares.

The thresholds are about the activity area (e.g. the area that will be cropped), rather than the size of the whole property. You can use tools such as Google Earth or the [Queensland Globe](#) (see instructions below) to measure your cropping area.

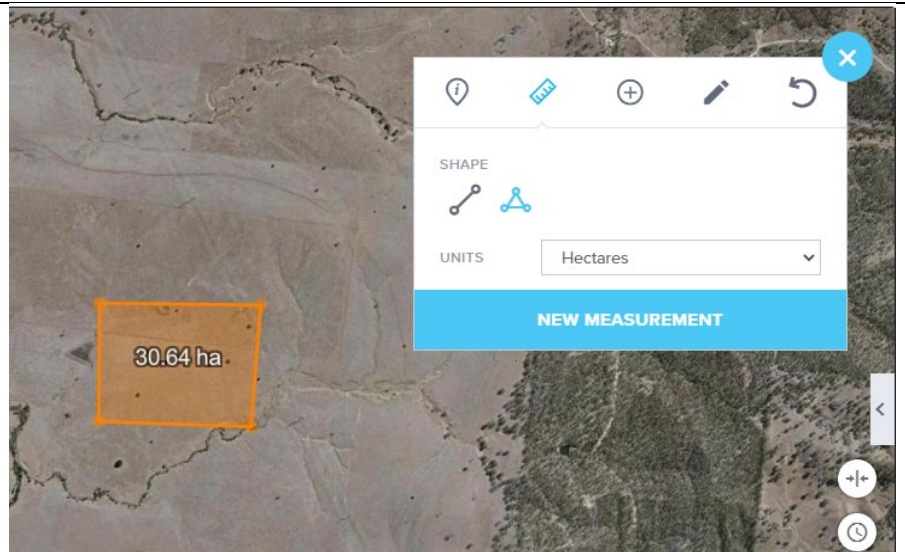
| | |
|---|--|
| Zoom into your area. |  |
| Click on the tool symbol in the top right of the map. |  |
| Then click the measurement icon. |  |

Choose measure area (the triangle symbol) and select hectares from the drop-down units menu.



Use the mouse to click around the boundary that you want to measure.

The area will be displayed on screen.



Standard condition 2 - set back the cropping area from natural waterways

The **activity** must not be undertaken within five (5) metres of the **defining bank** of a **natural waterway**.

Key words:

Activity: Means the commercial cropping and horticulture that the permit (environmental authority) has been issued for, as defined in Schedule 2, Part 2A, Section 13A of the Environmental Protection Regulation 2019.

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 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 waterway and may apply differently on different sections of the natural waterway.

Natural waterway: For the purposes of the environmental authority, 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.

As a permit holder, you must ensure that cropping is not carried out within five metres of the defining bank of a natural waterway (Figures 2 and 3). 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.

Any requirements for a buffer under the *Vegetation Management Act 1999* are in addition to the requirements of these standard conditions. If the *Vegetation Management Act* Category R 50 metre buffer applies in your circumstance, the Category R 50 metre buffer takes precedence.

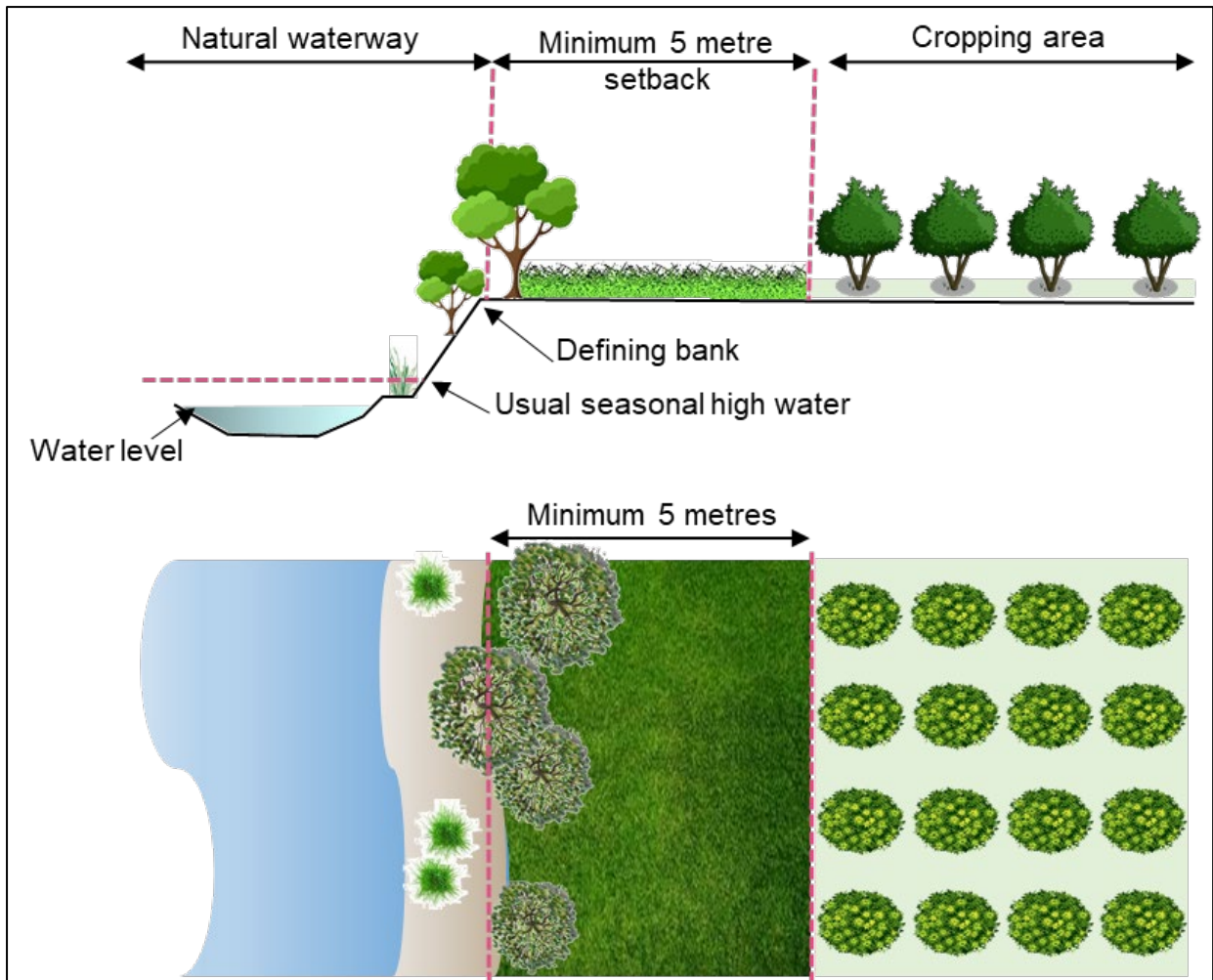


Figure 2: Top: Diagram to indicate position of defining bank and set back area required under standard condition 2 (adapted from *Vegetation Management Act* guideline). Bottom: Aerial view of the same area.

In drier, inland areas (or any other area) where there is no clear defining bank, use the seasonal high-water line to represent the point of flooding, as the start of the five metre buffer. The seasonal high-water line means a zone that represents the usual peak seasonal flow level and will typically have features such as evidence of deposition, debris or characteristic vegetation zonation (Figure 3).

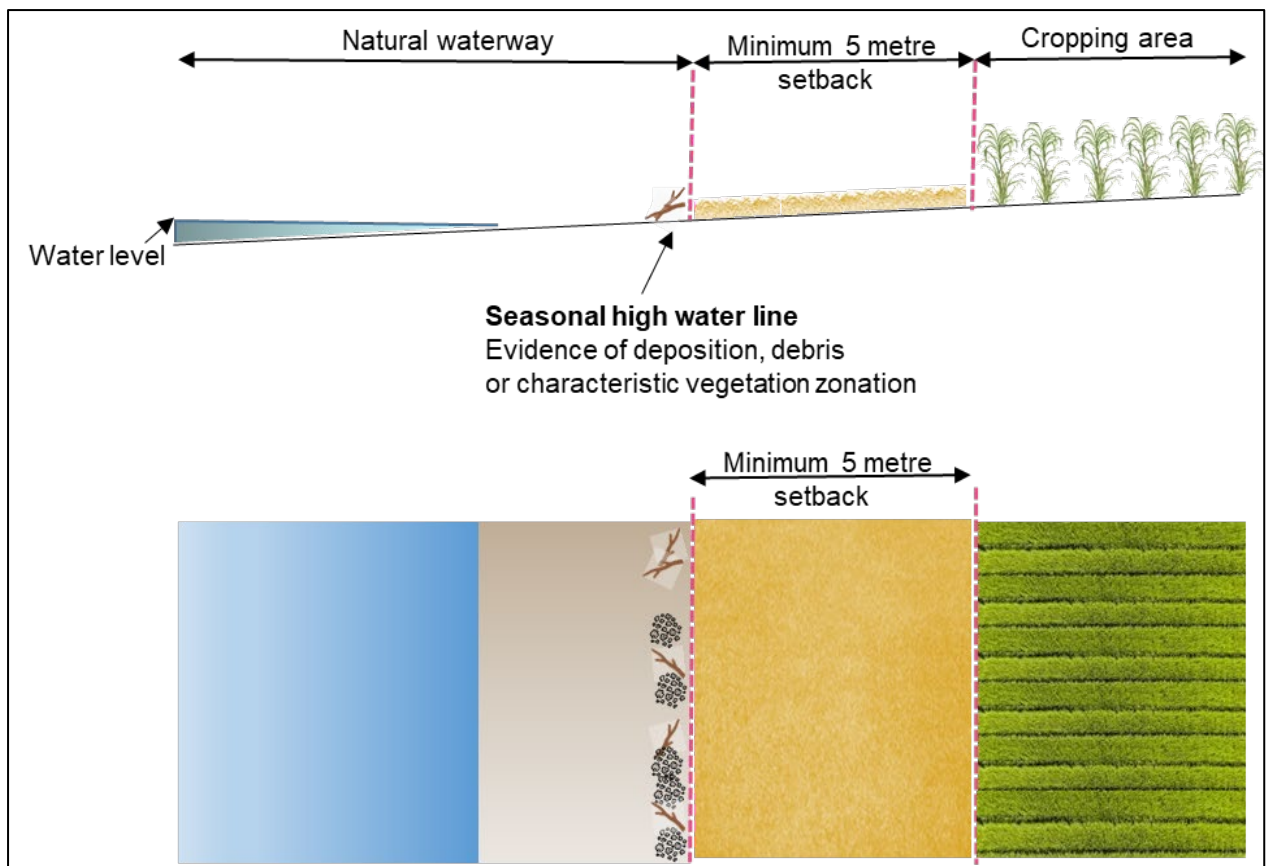


Figure 3: Top: Diagram to indicate position of defining bank and set back area required under standard condition 2 where there is no clear defining bank. Bottom: Aerial view of the same area.

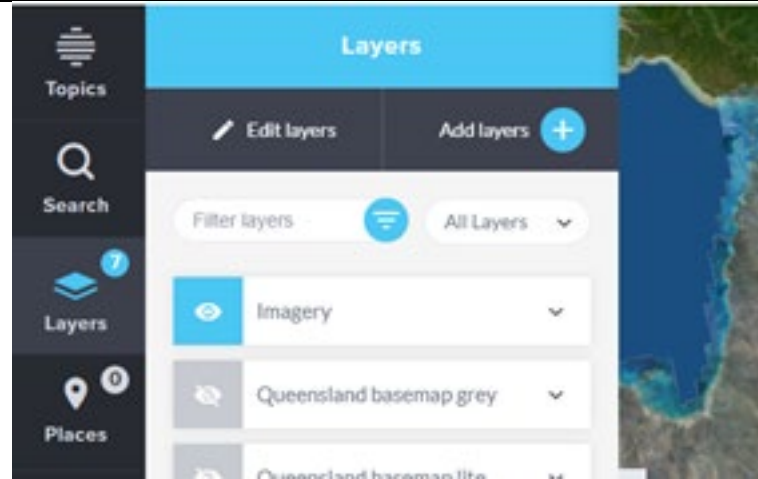
The set-back area can comprise headlands and areas used for farm traffic. It is acknowledged that natural waterways shift due to natural processes. Standard condition 6 requires you to keep a plan, which must include your location, the area of your cropping activity and any natural waterways and receiving waters. Your plan is therefore a good record to show that you complied with this condition when setting up your new cropping area or farm.

You can use the watercourse and wetlands data on the [Queensland Globe](#) as a starting point for identifying natural waterways on your property, using the instructions below. It is not the intent of the regulations for natural waterways (and the subsequent five metre set-back) to include in-paddock natural drainage features, or those natural features that are present within a cropped area, such as a natural small depression. Therefore, because you will know your land best, it is important to ground truth the mapping when making a decision on what you consider to be a natural waterway.

Note – The Queensland Globe “Watercourse” layer identifies natural and some artificial watercourses such as farm drains. The five metre setback requirement only applies to natural waterways and does not apply to artificial waterways e.g. farm drains.

Zoom into your area.

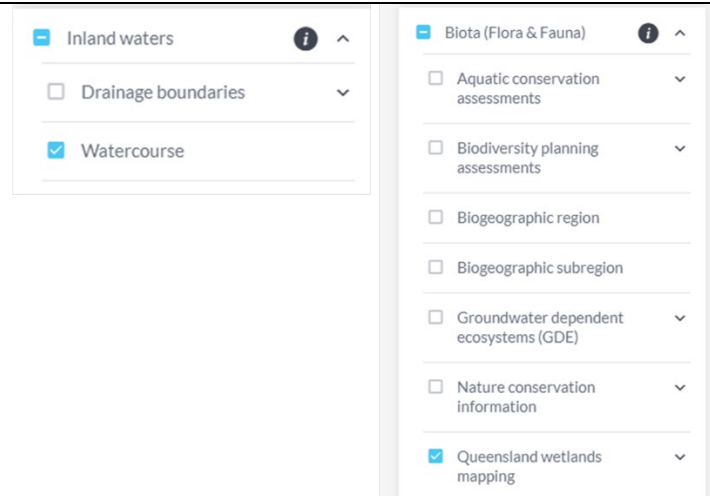
Click on Layers on the left hand side of the screen, then click Add layers.



Scroll down and expand the Inland waters section.

Click the box next to Watercourse to turn on this information, which identifies natural waterways (e.g. creeks, rivers, lakes) as well as farm drains.

In the same way, expand the Biota (Flora & Fauna) section and click the box next to Queensland wetlands mapping.

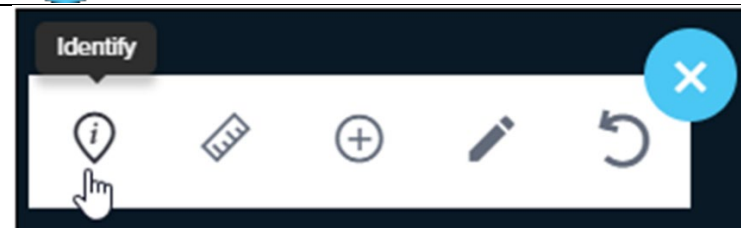


To find out about the watercourses and wetlands, click on the tool symbol.



Click on the identify icon.

Clicking on a feature on the map will show information about that feature.



Standard condition 3 – designing and implementing nutrient and sediment control measures

Measures and structures must be designed and implemented to minimise nutrient and sediment from the **activity** being released from the **location** to **receiving waters**.

Key words:

Measures: Means an action or procedure designed and implemented to minimise the risk to the environment of releases of **sediment** or **nutrients** into receiving waters as a result of the activity. For nutrient and sediment control measures in standard condition 3, measures include:

- designing, implementing and maintaining **drainage structures** to minimise 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 minimise soil loss and surface water run-off to receiving waters.

Drainage structures: Means structures designed, implemented and maintained to minimise 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) **Diversions bank**; or
- (d) **Sediment trap**; or
- (e) **Recycle pit**; or
- (f) **Constructed wetland**; or
- (g) Another measure that meets this intent.

Activity: Means the commercial cropping and horticulture that the permit (environmental authority) has been issued for, as defined in Schedule 2, Part 2A, Section 13A of the Environmental Protection Regulation 2019.

Location: Means the area within and boundaries of the lot on plan(s) listed on the environmental authority (permit) issued by the department.

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 the environmental authority, 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.

Wetland protection area: Means an area shown as a wetland protection area on the map of Great Barrier Reef wetland protection areas.

Wetlands of high ecological significance: Means the wetlands included in the Map of Referrable Wetlands that have been assessed as containing high ecological values by a bioregional aquatic conservation assessment.

To meet standard condition 3, the cropped area must be designed to minimise nutrients and sediments being released to receiving waters. Measures and structures must be implemented before any cropping takes place, including while preparatory work takes place. Preparatory work is work carried out to prepare the land for the cropping activity. This may include clearing and ploughing the land, or otherwise preparing the land for planting.

If you do not believe that you have sufficient experience planning and designing these measures, it is strongly recommended that you seek professional advice from an appropriate person to help you determine which measures are most suitable for your property (see box below). An appropriate person can also offer advice on the correct placement, construction and maintenance of suitable measures. 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 appropriate person could include someone with any or all of the following:

- demonstrated and current background of experience in providing professional advice or consultancy services in relation to farming systems, for example soil survey, and/or land resource management services
- tertiary qualifications appropriate to providing relevant advice
- over five years' experience in the field of soil assessment and agricultural land suitability analysis and have experience and / or knowledge of the proposed crops.

It would also be worth considering if the person:

- holds a membership with the Ag Institute Australia or with Soil Science Australia
- is a Certified Professional Soil Scientist (CPSS)
- is a Certified Practising Agriculturalist (CPAg).

It is the owner of the property and/or the manager of the property who has responsibility for implementing measures on the property. However, anyone acting under the permit is required to comply with the permit. For example, if you, as the permit holder, hire a contractor, then you would need to instruct the contractor to ensure conditions are met.

Before starting any nutrient and sediment control works, you should contact your local council and your nearest Department of Resources Business Centre to check if you require approvals under other legislation, for example the *Vegetation Management Act 1999* or *Water Act 2000* (see [Contacts](#) section).

NOTE: If high impact earthworks are proposed as part of preparing the land for cropping or other parts of the cropping activity, 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. See the map of referable wetlands for more information ([State Planning Policy 4/11: Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments](#)).

The best way to control pollutant loss is to prevent their generation in the first place. A good example of this is the ability of good ground cover to control sediment loss. In some cases, however, the generation of pollutants is not avoidable. In these cases, pollutants are generally removed from water in a sequence from coarse and medium sediment to finer and soluble sediment and nutrients. This is known as a treatment train approach and can help achieve the best water quality outcomes. For example:

- structures placed above the cropping area can divert run-off around the cropping area
- measures implemented within the cropping area itself intercept and treat water and are most efficient at removing coarse and medium sediment
- structures below the cropping area act as a 'last resort' to remove finer and soluble sediment and nutrients that make it beyond the cropped area, before the water is either re-used on farm or flows out into receiving waters or natural waterways (Department of Environment and Science 2018a).

Standard condition 3 should achieve the following outcomes:

- Maintaining the highest possible ground cover across the property as possible.
- Managing the movement of water across the property to minimise erosion and nutrient loss.
- Capturing as much sediment and nutrients from water as possible before the water leaves the property.

You may wish to use farm maps and topographic maps to help design the farm layout. Blocks can be travelled in a tractor fitted with a GPS to measure gradients, and you can then use this information to

help decide where to place contour banks and drains for example (Department of Agriculture and Fisheries 2016a).

Examples of where nutrient and sediment control measures might be placed in two different cropping systems are shown in Figure 4.

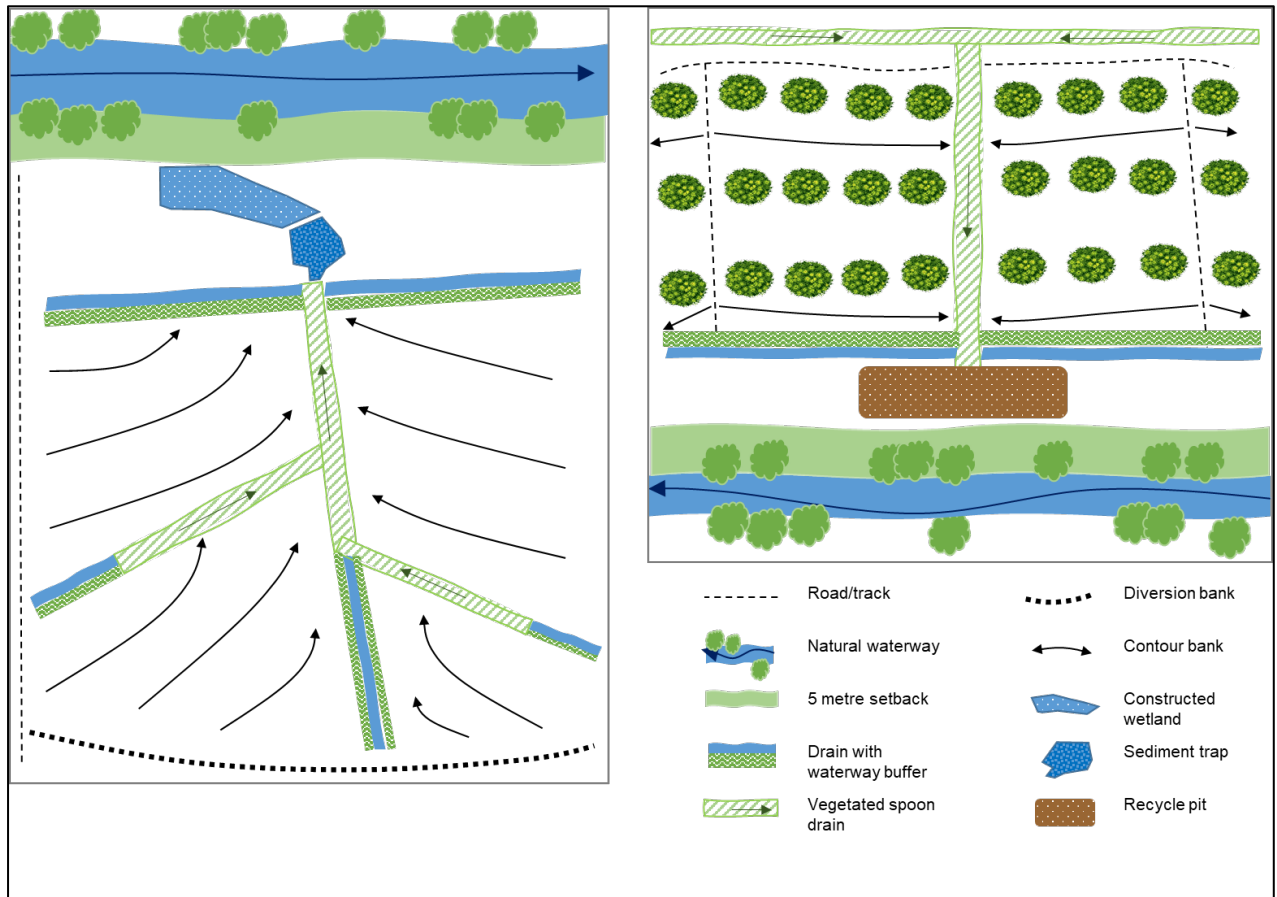


Figure 4: Left: Example of a farm layout taking advantage of natural slope and drainage. Right: Example of a macadamia plantation layout (adapted from Queensland Government 2004). Each layout incorporates several of the measures described in this guide.

Drainage structures should be designed to achieve an outcome at least equivalent to measures contained in the relevant chapters of the [Soil conservation guidelines for Queensland](#). This includes:

- ensuring that they have enough capacity to carry estimated run-off at rates that will not erode the channel of the structure
- regularly maintaining structures to ensure continued effectiveness.

In general, the size 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, 6–10 of the [Soil Conservation Guidelines for Queensland](#) provide detailed information on soil conservation planning and run-off control structures, including design specifications and

maintenance requirements. This information can be accessed from the [Soil Conservation Guidelines for Queensland](#) or at www.publications.qld.gov.au. Further information on maintenance can be accessed from [Run-off control measures for erosion control in cropping land](#). In addition, detailed soil and land resource information is available from the [Queensland Globe](#) at www.qldglobe.information.qld.gov.au/.

Examples of nutrient and sediment control measures for a standard application

This section provides examples of measures that may be suitable for your property. You do not have to implement all of these measures. Rather, it is important to choose measures (whether listed here or not) that are most appropriate to your cropping activity and property. For example, some measures will be better suited to irrigated cropping and others to rain-fed systems. You may use measures not listed in this guide as long as they meet the outcome of minimising nutrient and sediment loss.

Above-paddock structures

An important part of minimising sediment and nutrient runoff from your property involves diverting (wherever practical) water away from cropping areas, areas with inadequate ground cover or areas prone to erosion. Minimising the volume of water entering your property that can cause erosion and release nutrients, will lower your risk of soil and nutrient loss to the environment. It also means you will have less water to manage using in-paddock and below-paddock structures. The most common structures used for diverting water are diversion banks, drains and swales.

Diversion banks, drains and swales

Diversion banks are usually constructed above a paddock and are used to divert up-slope run-off away from areas where it could cause problems (for example, cultivated paddocks or buildings) into a stable structure such as a grassed channel, drainage line or water storage, where it can be safely disposed of (Figure 5; Carey et al 2015a).

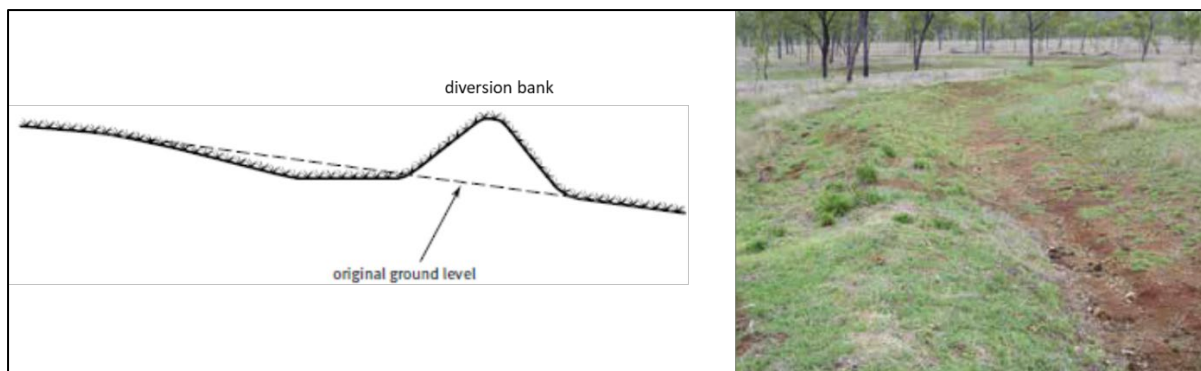


Figure 5: Left: Cross profile of an on-ground photograph of a diversion bank; Right: on-ground photograph of a diversion bank (Source: Soil Conservation Guidelines for Queensland Chapter 8).

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.

You are recommended to seek specialist advice on the correct placement, construction and maintenance of diversion banks.

Information on drains and swales can be found in the [vegetated spoon drain](#) section.

Within-paddock structures

Nutrients and sediment can be lost from within cropped areas if ground cover is inadequate. Effectively managing run-off lowers the risk of soil and nutrient loss to waterways. Implementing measures within the cropped area forms the next part of the treatment train system. The way you set up your farm will depend on your cropping system. For example, for tree crops and small vegetables, the cropping area should be designed to quickly remove water from the paddock to avoid waterlogging around the root zones. Some of the most common structures used for managing water within a paddock are described below. Other structures, however, may be used as long as the same outcome is achieved.

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 6) (Queensland Government 2015a). They are often used in rainfed, broadacre cropping systems. In horticulture areas other structures are often used instead of contour banks to intercept and manage run-off, including [Permanent beds](#), [raised beds and mounds](#) (Carey et al 2015b; Queensland Government 2015a).

Contour bank design should ensure that the speed of run-off is slow enough to avoid erosion (Carey et al 2015b). It is advised to use contour banks where slopes are greater than one percent. In general, as the slope of the land increases, contour banks should be constructed more closely together (Carey et al 2015c). Contour banks should be designed so that run-off is channelled into surface water drainage structures such as grassed waterways.

On slopes of less than one percent, contour banks are not advised, and floodplain management approaches should be used instead. See [Chapter 10](#) of the Soil Conservation Guidelines for Queensland for information on land management on floodplain areas (Carey et al 2015d).

Contour bank bays should be protected from erosion by either a crop or crop residues. This will minimise build-up of sediment into the contour bank channel and help reduce maintenance costs (Queensland Government 2015a).

You should regularly inspect the contour banks for any issues and make necessary repairs. Maintenance may involve using earth moving equipment to move sediment and soil out of the channel and onto the contour bank to increase its height. Maintenance is best done during dry periods when the land is **fallow** (Queensland Government 2015b).

Key words:

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 six 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 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.



Figure 6: Left: Example of contour bank layout (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](#)
- [Contour bank specifications](#)
- [Maintaining contour banks](#), including how to check capacity [Banana Best Management Practices Environmental Guideline](#) (pages 45–46), available from the Australian Banana Growers' Council website at www.abgc.org.au.

Vegetated spoon drains

These structures (also known as constructed waterways or vegetated swales) are shallow, open, vegetated channels between crop rows or blocks/paddocks designed to transport water along drainage pathways (Figure 7). They should follow natural drainage lines where practical and be designed to safely transport run-off to the receiving waters by avoiding concentration of flow (Department of Environment and Science 2018b; Queensland Government 2015c). Their shallow shape helps to prevent slumping and slows run-off, which allows coarse and medium sized sediments to settle. A lining of vegetation protects the drain from erosion. Vegetation with stolons or rhizomes offers the ideal protection (Queensland Government 2015d). Advice on the best species to use can be found in [Soil conservation waterways-plants for stabilisation](#).

Maintenance of drains is essential to avoid the structure failing and to make sure their capacity to transport water is maintained. In particular, sediment build-up, gullyng or overtopping can all lead to failure of the spoon drain. This means that drains should be regularly inspected, sediment removed and the bank or channel reshaped as required (Carey et al 2015b). You should establish vegetated cover within the drain immediately following any reconstruction.

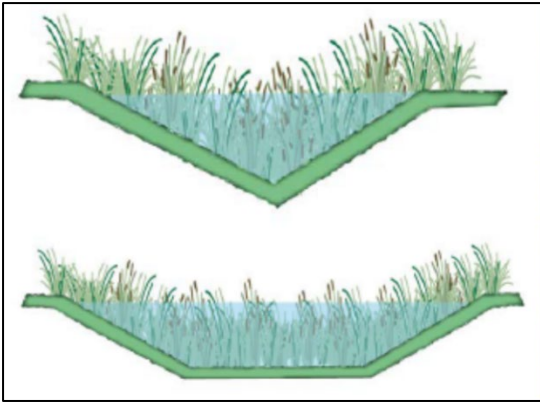


Figure 7: Diagram to show cross section profiles of vegetated spoon drains and swales. (Source: QDAFF/Department of Environment and Science 2018b).

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.

Waterway buffers

Key words:

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 the environmental authority, 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.

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

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

Waterway buffers refer to a continuous strip of retained or planted vegetation that separates the length of the cropped area from receiving waters (Figure 8). Buffers are used to treat run-off by slowing run-off velocity to allow sediment to drop out (Figure 9). However, even if buffers are not used for treating run-off, they are still a valuable addition to the farm layout as an effective way to prevent

erosion between the production area and receiving waters (Department of Environment and Science 2018b). Buffers in riparian areas can also help reduce stream bank erosion (Karssies and Prosser 1999).

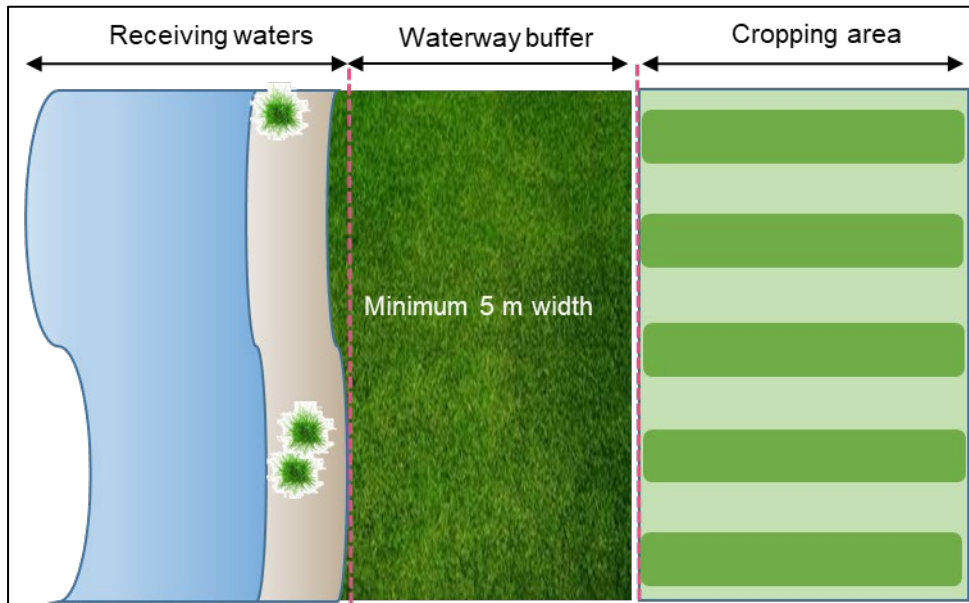


Figure 8: Diagram to show position of a waterway buffer between the cropping area and receiving waters.

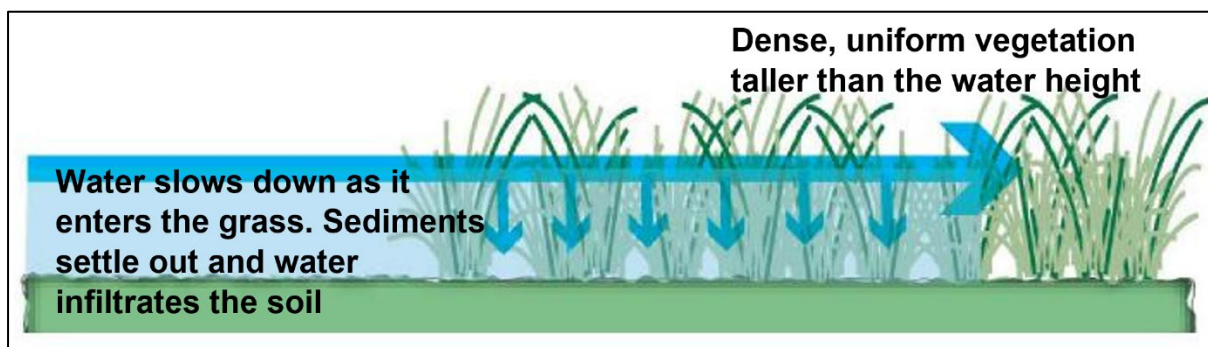


Figure 9: Diagram to show how waterway buffers slow and filter run-off (Source: Department of Environment and Science 2018b).

If you choose to incorporate a waterway buffer into your paddock design, it should be at least five metres wide along its entire length and have good cover (e.g. 80 percent vegetated cover), maintained so that it remains effective in preventing sediment run-off from reaching waterways (Department of Environment and Science 2018b). There is no upper limit under the standard conditions for how wide the buffer can be. Consideration of factors such as: the quantity of water; soil types and loss rates; paddock size; land slope; and area available for the buffer strip will help make sure the risk of sediment and nutrient loss to receiving waters is minimised. A well-designed buffer strip will continue to trap sediment generated during intense storms (Carey et al 2015b; Prosser and Karssies 2001; Karssies and Prosser 1999). The buffer can include either annual or perennial vegetation (including pasture seed). If the buffer is in a riparian area, any existing riparian vegetation should be retained and may be protected under the *Vegetation Management Act 1999*.

To support the waterway buffer in treating run-off from the cropped area, it should ideally:

- contain dense, non-woody, well-distributed vegetated cover, that is maintained at a height of approximately 15 - 20 centimetres (Department of Environment and Science 2018b)

- be relatively smooth i.e. no ruts or tyre tread impressions deeper than five centimetres from the soil surface, or other evidence of erosion
- have a slope of less than two percent. Buffers can still be effective on steeper slopes as a way to prevent erosion. In general, buffer width should increase as slope increases.

The upslope edge of the buffer should be on the contour to avoid concentration of run-off, and any rills should be levelled before sowing. The buffer can form part of the trafficable area of the farm. Well-maintained riparian areas and grassed headlands can form the waterway buffer if they meet the outcome of minimising sediment run-off.

Ways in which you can estimate ground cover on the buffer are shown in Figure 10.

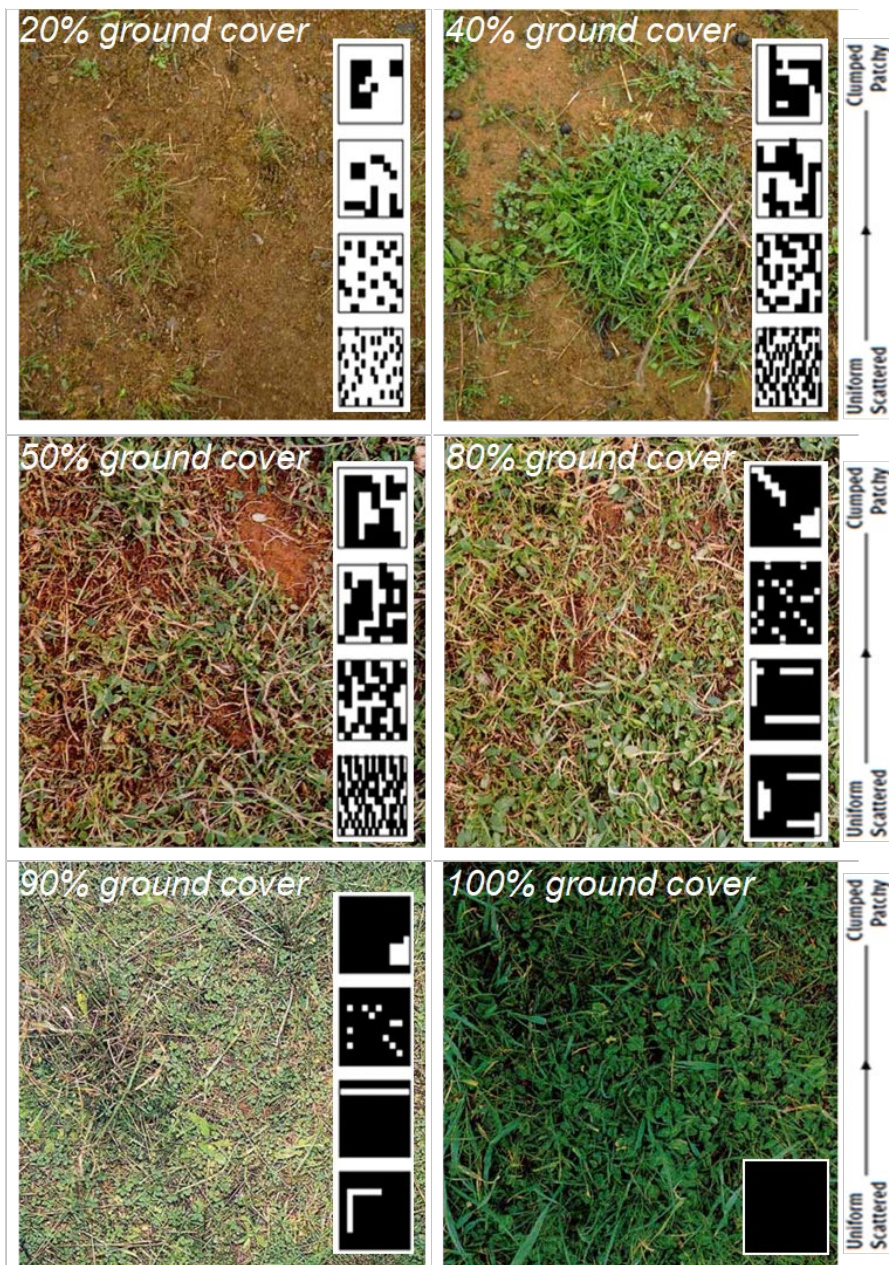


Figure 10: Indicative patterns and corresponding percentage of ground cover. For the inset squares, black represents ground cover and white represents bare ground (adapted from Meat & Livestock Australia, 2013).

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 [Wetland-Info](#) and in [Chapter 12 of the Soil Conservation Guidelines for Queensland](#). You can find information on suitable grass species for a range of cropping areas, including some drought tolerant species in the [appendices](#) (page 36 and 37) of the Soil Conservation Guidelines for Queensland. If you need to remove any vegetation from the buffer, for example to remove weeds, you should put in place additional nutrient and sediment control measures, such as those in other sections of this guide, until the buffer is fully re-vegetated.

NOTE: High-value regrowth vegetation (regrowth vegetation that has not been cleared in the past 15 years) 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 standard conditions for new cropping. The buffers can overlap. Refer to the [Vegetation Management guidelines](#), at www.qld.gov.au, for further information.

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.

Permanent beds, raised beds and mounds

Using a **permanent or raised bed system** is particularly relevant in irrigated cropping systems and for small vegetable crops. These methods maintain the same row location so that only the row is cultivated during planting. Successive crops are planted back into the same row. In general, raised beds are re-established after each crop cycle, whereas permanent beds are used for several crop cycles. Mounds are generally used with tree row crops and provide a good depth of well-drained soil in the root zone to aid good root-zone drainage. Mounds may be aligned close to the contour, up-and-down the slope or at any angle in relation to the contour (e.g. diagonal to the slope) (Figure 11). It is advised that you seek advice from an appropriate person to identify the best design for your situation.

In each case, the inter-row space is not cultivated and can be used as a traffic corridor for machinery (Department of Agriculture and Fisheries 2016a; Carey et al 2015b). 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 consider the local catchment, ridge lines, land slope and drainage layout (Carey et al 2015b).

Maintenance: A permanent bed system does not stop you from carrying out periodic renovation works to re-configure blocks. Block renovation may be carried out at any time of year, but 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 control measures. Inter-row or inter-mound areas should retain good vegetative cover to reduce the risk of erosion and be slashed regularly to allow flow of run-off water. You should aim to use shade-tolerant species for vegetative cover to avoid decline in cover as crops grow.

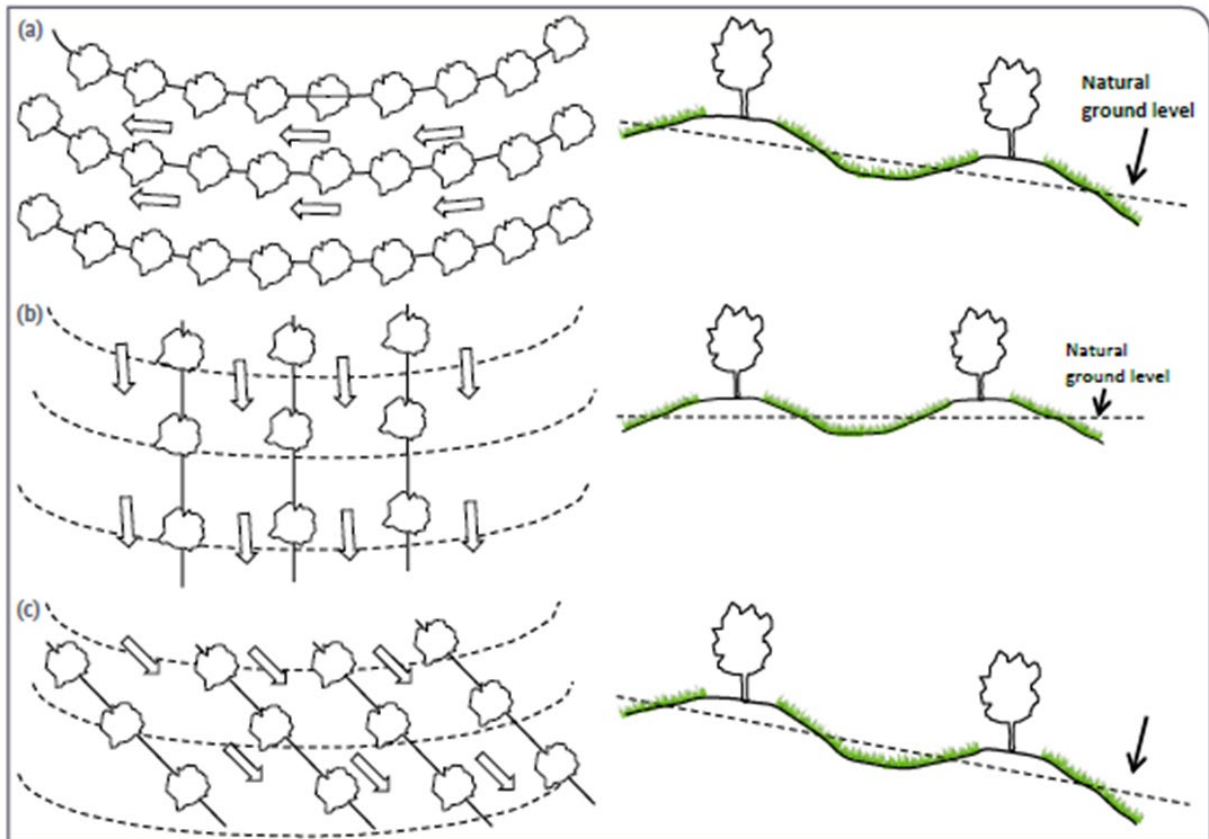
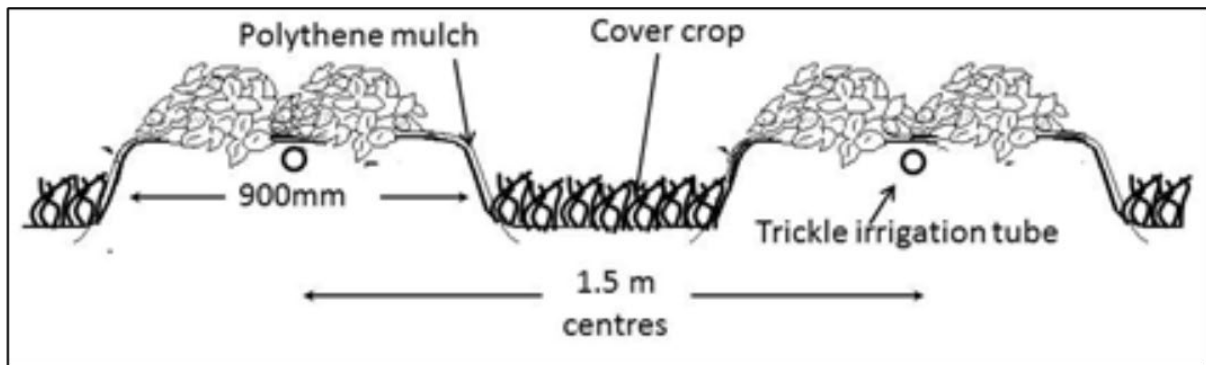


Figure 11: Top: Diagram to show raised beds in a small crop system. Bottom: Diagram to show mounds in a tree crop system. (a) mounds aligned to the contour, (b) mounds up and down the slope, (c) mounds at an angle to the contour. (Source: Figures 12.9 and 12.14 Soil Conservation Guidelines for Queensland).

Further resources

For detailed specifications on permanent beds, raised beds and mounds, 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 farming systems in the [Banana Best Management Practices Environmental Guideline](#) available from the Australian Banana Growers' Council website at www.abgc.org.au
- Vegetable growing systems in the [cultivation and soil structure chapter](#) of [SOILpak for Vegetable Growers](#).

Row length and direction

Crop rows may need to be aligned in a particular direction to aid plant growth. For example, a north-south direction is typically used for crops such as pineapples. Longer beds or furrows result in greater volumes of run-off, therefore the risk of erosion is higher. Installing contour banks or cross-drains to intercept run-off can help mitigate this risk. You should also take into account the type of irrigation system to be used when considering row length. You can find more information in [Chapter 12 of the Soil Conservation Guidelines for Queensland](#) and [WATERpak](#).

Below-paddock structures

Installing measures below the cropping area is the last part of the treatment train system, and should be regarded as last resort measures. Detention of water in these measures allows sediments to settle out of the water, while dissolved nutrients are taken up by vegetation. Different cropping systems will need to consider different factors when designing any drainage structures that will sit below the cropped area. This may include whether the crop is irrigated or not.

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.

Sediment traps should be designed so that all run-off water from the catchment area is collected and detained for long enough to ensure any remaining coarse- and medium-sized sediment, debris and litter has a chance to settle. 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. It is strongly recommended that you seek advice from an appropriate person when designing a sediment trap.

Regular maintenance will be required to remove sediment that has built up and to retain the capacity of the sediment trap (Department of Environment and Science 2018c; Figure 12).

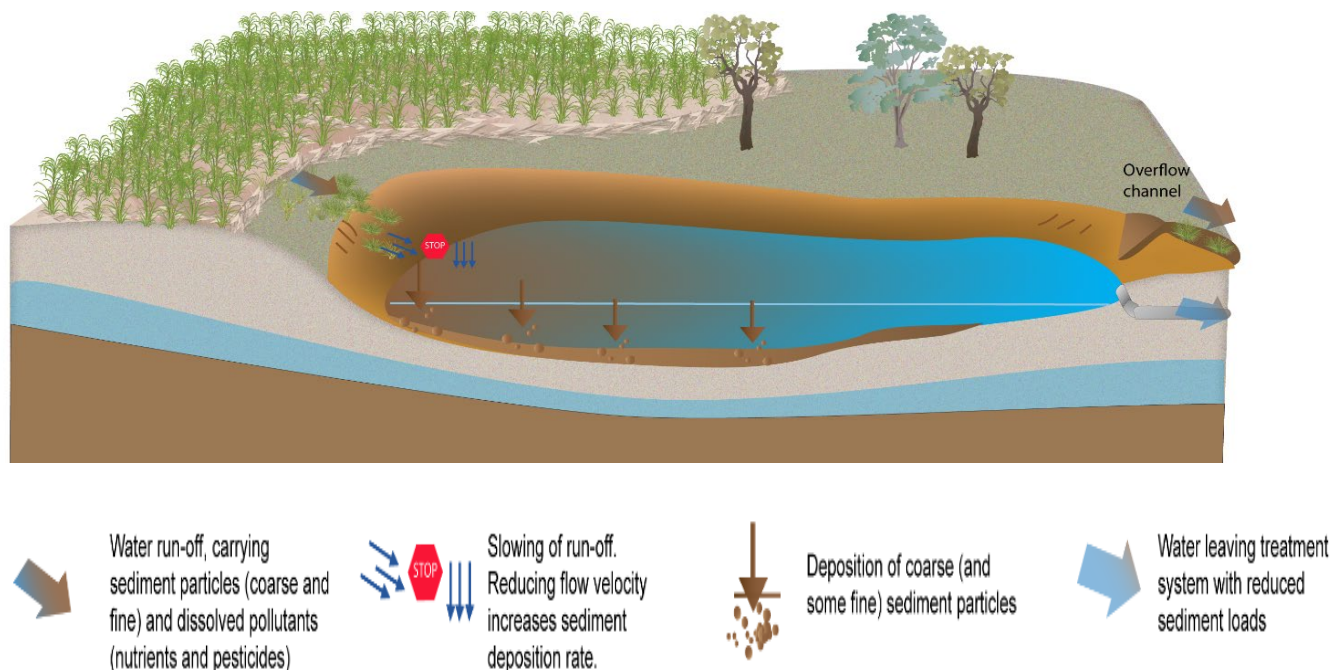


Figure 12: Diagram to show how a sediment trap captures run-off water (Source: Department of Environment and Science 2018c).

Further resources

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

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

Recycle pits

Paddock designs for irrigated cropping systems need to ensure that tailwater production is minimised and captured for re-use. 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 13). 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.

Sediment accumulation can lead to failure of these structures. Therefore, you should monitor water and sediment 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 from both irrigation and rainfall (Department of Environment and Science 2018d). Maintaining storage capacity is especially important during periods when fertilising is undertaken.

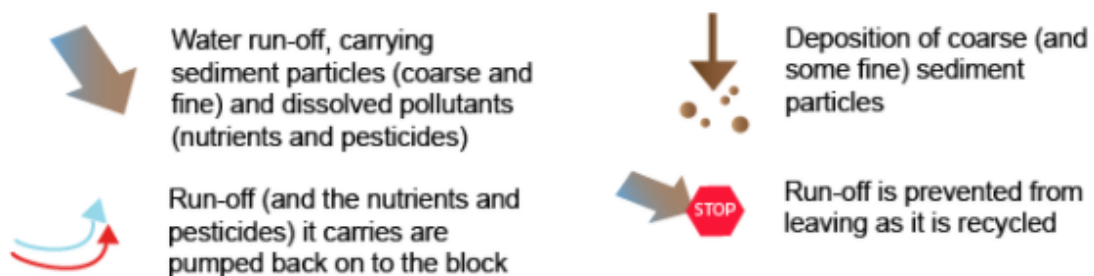
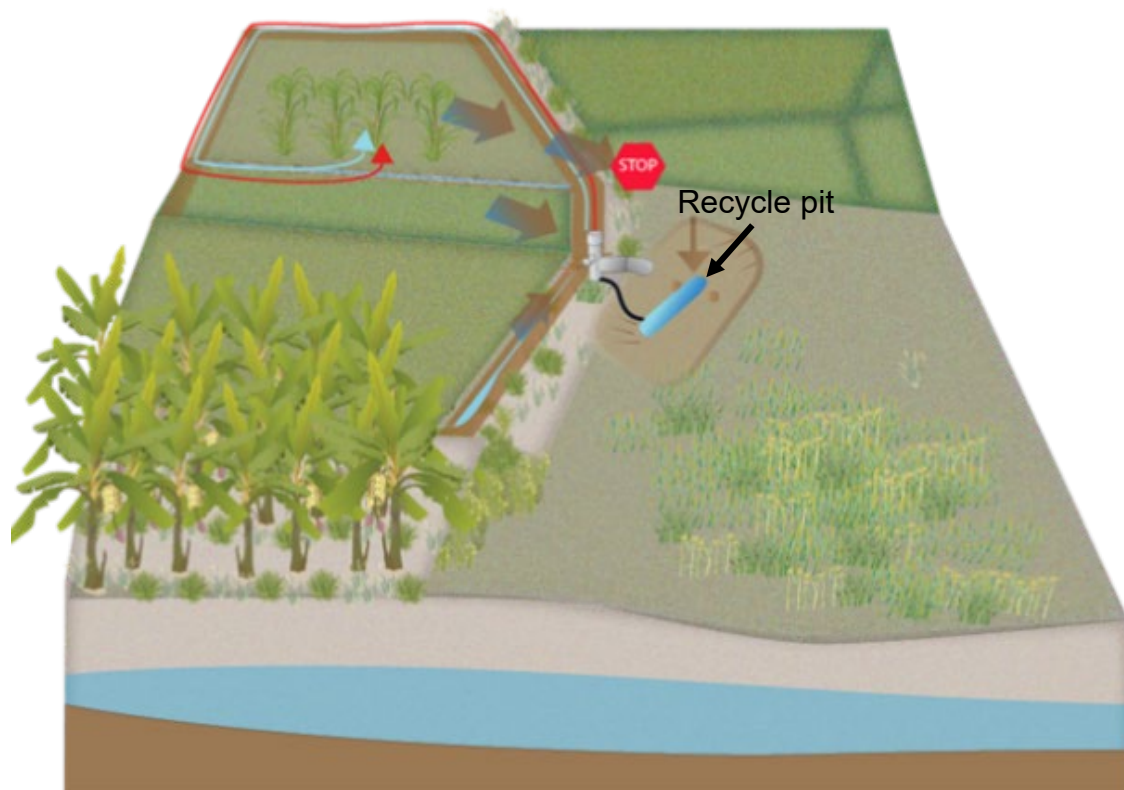


Figure 13: Diagram to show how a recycle pit can be integrated into a farming system. (Source Department of Environment and Science 2018d).

Further resources

You can find further information on [recycle pits](#), including important design and construction considerations at the Department of Environment and Science [Wetland-Info](#) website 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; Department of Environment and Science 2018e; Figure 14). They improve water quality by removing fine sediments, nutrients and other pollutants from surface water run-off.

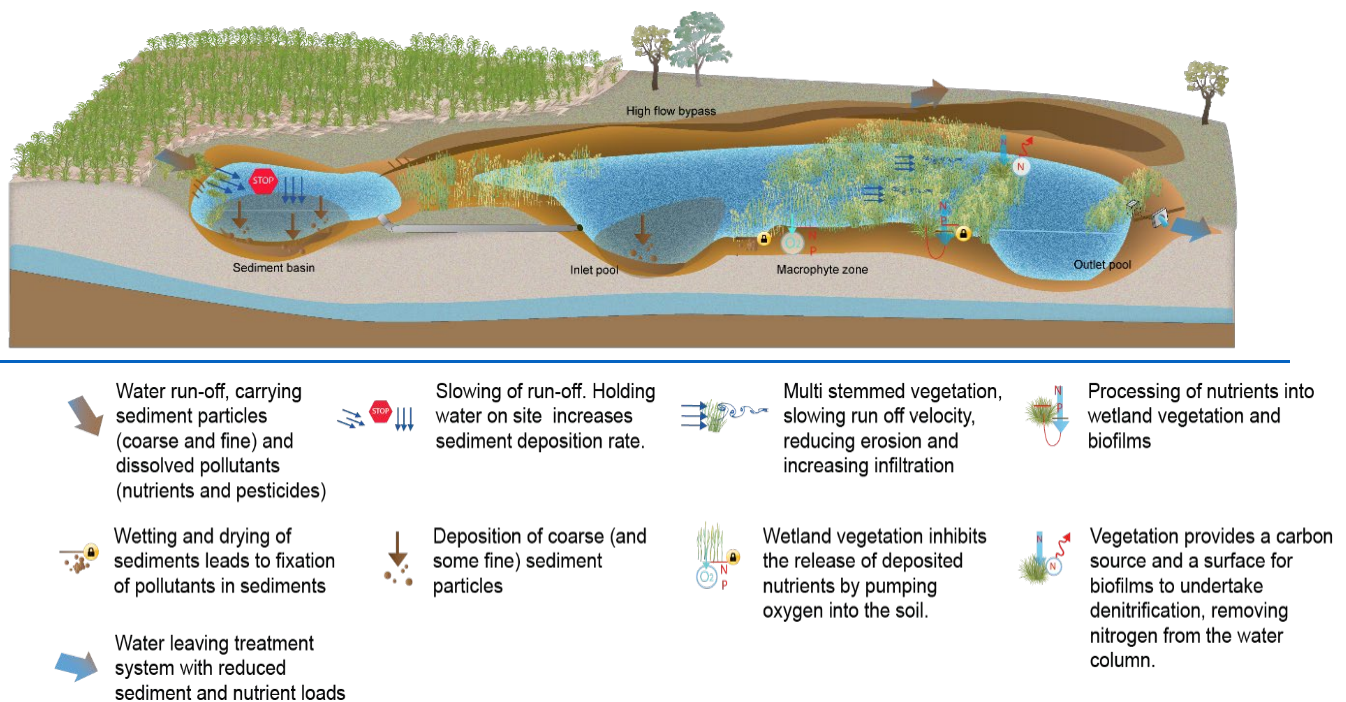


Figure 14: Features of a constructed wetland (Source: Department of Environment and Science 2018e).

Maintaining healthy vegetation and an even flow of water are the key maintenance objectives for a constructed wetland. Most maintenance is typically needed during the first two years when weed removal and replanting may be required to ensure correct densities of plants are achieved (Department of Environment and Science 2018e). Further information about ongoing maintenance can be found on [Wetland-Info](#).

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 [Wetland-Info](#), including:

- [Constructed \(treatment\) wetlands factsheet](#)
- [Treatment wetlands](#) website information.

Standard condition 4 – maintaining nutrient and sediment control measures

Where an **agricultural ERA standard** is not in effect for the cropping or horticulture, **measures** and structures must be maintained to minimise nutrients and sediment from the **activity** being released from the **location to receiving waters**.

Key words:

Agricultural ERA standard: Means the three current minimum practice agricultural standards for [bananas](#), [sugarcane](#) and [grazing](#), which can be accessed on the Reef protection regulations [website](#).

Measures: Means an action or procedure designed and implemented to minimise the risk to the environment of releases of sediment or nutrients into receiving waters as a result of the activity. For nutrient and sediment control measures in condition SC3, measures include:

- designing, implementing and maintaining **drainage structures** to minimise 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 minimise soil loss and surface water run-off to receiving waters.

Drainage structures: **Drainage structures:** Means structures designed, implemented and maintained to minimise soil loss or surface water run-off or the loss of irrigation water, and may include a:

- (h) **Vegetated spoon drain**; or
- (i) **Contour bank**; or
- (j) **Diversion bank**; or
- (k) **Sediment trap**; or
- (l) **Recycle pit**; or
- (m) **Constructed wetland**; or
- (n) Another measure that meets this intent.

Activity: Means the commercial cropping and horticulture that the permit (environmental authority) has been issued for, as defined in Schedule 2, Part 2A, Section 13A of the Environmental Protection Regulation 2019.

Location: Means the area within and boundaries of the lot on plan(s) listed on the environmental authority (permit) issued by the department.

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 the environmental authority, 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.

To meet standard condition 4, all measures and structures must be maintained at appropriate intervals once cropping has started to ensure their capacity remains sufficient. For example, this may involve:

- regular inspections of structures for erosion or signs of deterioration throughout the year
- inspecting structures before a rain event or wet season to determine if any adjustments are required before the event occurs
- inspecting structures during a rain event to determine effectiveness
- inspecting structures after rain events to check for any failures that need maintenance before the next rain event.

Regular maintenance that you may need to carry out includes:

- removing silt from channels and waterways
- maintaining the recommended contour or diversion bank height

- repairing any breaks or low spots in contour and diversion banks and buffers
- maintaining grass cover in waterways
- mowing/slashing grass buffers to maintain good cover and growth.

You can find more information on maintaining nutrient and sediment control structures within the section for each measure and within the [Soil Conservation Guidelines for Queensland](#).

If minimum practice agricultural standards exist for your crop (currently sugarcane and bananas), then the erosion and sediment control requirements included in those minimum standards will ensure you meet these new cropping requirements.

Standard condition 5 - irrigation requirements for standard applications

Measures and structures that minimise the loss of irrigation water to **natural waterways** must be implemented and maintained.

Key words:

Measures: Means an action or procedure designed and implemented to minimise the risk of releases of sediment or nutrients from irrigation water into natural waterways as a result of the activity.

Measures to minimise the loss of irrigation water 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 minimised; and
- designing, implementing and maintaining the activity area to minimise the loss of irrigation water to natural waterways; and
- designing, implementing and maintaining drainage structures to minimise the loss of irrigation water to natural waterways.

Natural waterways: For the purposes of the environmental authority, 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.

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.

Stubble: The above ground plant residue left in the field after harvest, including stem, leaf and glume of cereals.

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

To meet standard condition 5, if you plan to irrigate crops (including fertigation) you must implement and maintain measures on the activity area to minimise the loss of irrigation water via surface water to natural waterways. Any measures may be coordinated with existing irrigation infrastructure on the farm.

Good design and good irrigation practice can help you to achieve this standard. For example, maximising water use efficiency by ensuring appropriate flow rates according to slope and soil type; and installing drainage structures such as [recycle pits](#) to capture any irrigation tail water for re-use on-farm. The Soil Conservation Guidelines for Queensland provide 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. You can also find further information in [Chapter 10 of the Soil Conservation Guidelines for Queensland](#), in particular sections 6.4 and 6.5.

The irrigation system you use should be designed with the assistance of an appropriate person with specialist knowledge of irrigation technologies.

There are two broad groups of irrigation systems:

- Surface irrigation systems, which include furrow and trickle 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.

Maximising crop water use efficiency

When designing your irrigation system, and whichever system you use, you should consider the site and soil characteristics, and crop water requirements. This helps to ensure maximum water use efficiency and the least loss of irrigation water off-farm through run-off.

Soil characteristics that you should consider are:

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

Site characteristics that you should consider are:

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

You can find more information in [SOILpak](#) and [WATERpak](#).

As an example, for furrow irrigation, you should ensure appropriate flow rates according to slope and soil type so that tailwater production is minimised. For overhead systems, ensure sufficient **stubble** is left after harvest and/or surface roughness to improve water infiltration and reduce run-off (Cotton Research and Development Corporation 2012).

By scheduling irrigation according to the plant's needs and the soil conditions, you can optimise water use, decrease losses of nitrogen and prevent excessive run-off. The amount of water needed by the plants can be assessed from:

- 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.

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 2016b). Some examples of scheduling tools are:

- [Irrigweb](#) for sugarcane cropping systems
- www.waterschedpro.net.au for broadacre grains systems
- [WATERpak](#) for a range of systems (sections 2.1 and 2.3).

It is also 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 and should be checked regularly as outlooks can change. 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 (Figure 15) at www.bom.gov.au and zoom in to your location to see more detail. Once irrigation has started, monitoring soil moisture levels is critical for information on reaching target deficit/refill points (Cotton Research and Development Corporation 2012).

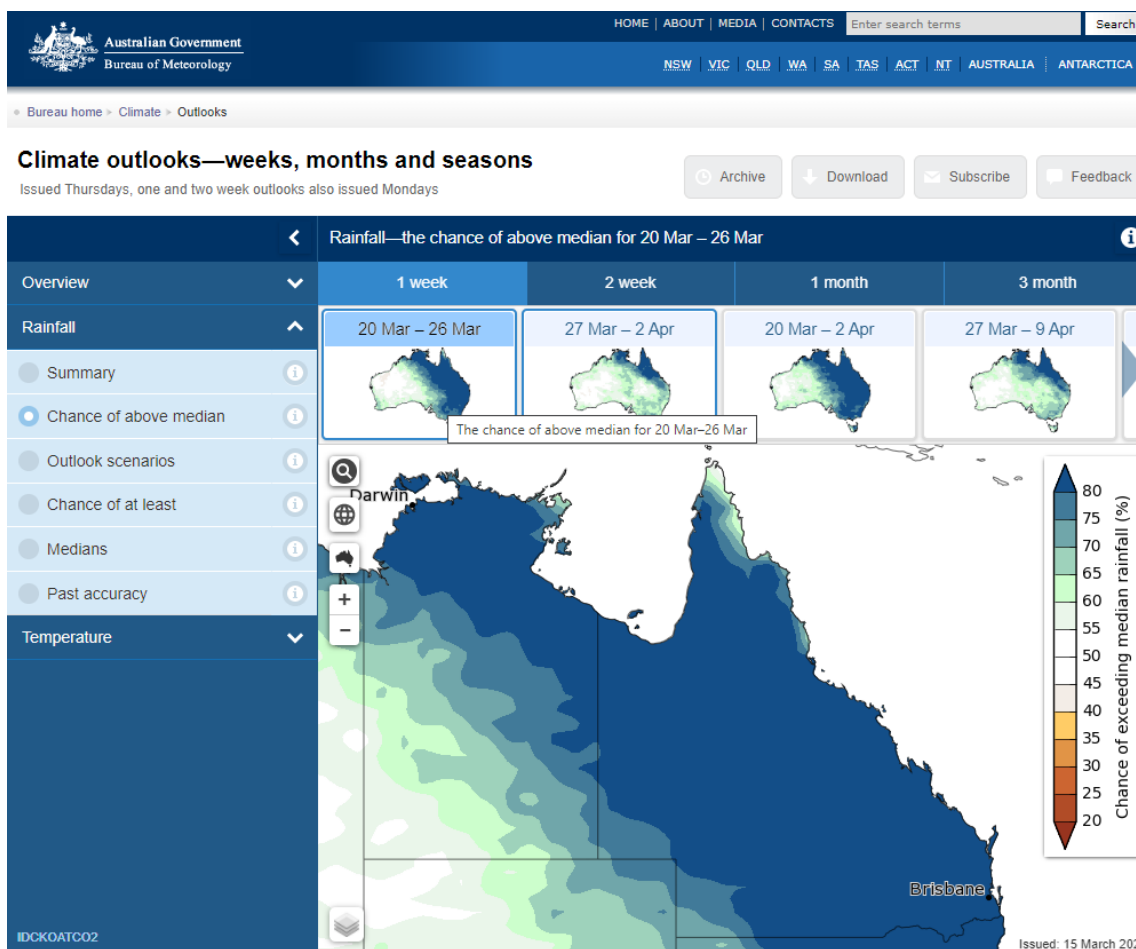


Figure 15: An example of a Bureau of Meteorology rainfall outlook from March 2021 for the next few weeks and months.

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 information on things to consider when implementing an irrigation system in Chapter 14: Property Infrastructure of the [Soil Conservation Guidelines for Queensland](http://www.publications.qld.gov.au), 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](http://www.sugarresearch.com.au), available at www.sugarresearch.com.au.

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

- [Rural irrigation system design](http://www.hort360.com.au), available at www.hort360.com.au
- [Irrigation](http://www.hort360.com.au) information and factsheets, available at www.hort360.com.au
- [WATERpak](http://www.cottoninfo.com.au) - a guide for irrigation management in cotton and grains farming systems, available at [CottonInfo](http://www.cottoninfo.com.au)
- Chapter 12 of the [Soil conservation guidelines for Queensland](http://www.publications.qld.gov.au), 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 or [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; Cotton Research and Development Corporation 2012).

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](#), at www.hort360.com.au
- sugarcane at [Irrigation of sugarcane manual](#), available at www.sugarresearch.com.au
- broadacre crops in [WATERpak](#), available at [CottonInfo](#).

Standard condition 6 - record keeping

Plan(s) must be kept showing:

- a) The **location**; and
- b) The **activity area(s)** within the **location**; and
- c) Irrigation features; and
- d) **Natural waterways**; and
- e) **Receiving waters**; and
- f) **Measures** and structures implemented under SC3 and SC5.

Key words:

Location: Means the area within and boundaries of the lot on plan(s) listed on the environmental authority (permit) issued by the department.

Activity area: Means the area(s) of land where the activity is being carried out.

Natural waterways: For the purposes of the environmental authority, 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.

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 the environmental authority, 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.

Measures: Means an action or procedure designed and implemented to minimise the risk to the environment of releases of sediment or nutrients into receiving waters as a result of the activity.

The standard conditions require you to keep a current plan(s) showing the information listed in the box above.

Your plan can be kept in any format. It may be hand-drawn or electronic, but should be drawn to scale, with the scale noted on the plan. As an example, you may choose to print an aerial map or photograph of your property and mark features on the print-out by hand (Figure 16). Make a note if you notice that any features on the print-out are inaccurate on the ground, for example a drainage line that does not exist, or a stream that has changed course. You may already have a plan, such as one required under various accreditation schemes, that would meet this condition, or could be readily adapted to meet this condition.

You can access satellite imagery, lot on plan boundaries, as well as data layers showing waterways for free from the [Queensland Globe](#). Regional Natural Resource Management groups may run mapping workshops in your area. See the [Contacts](#) section for how to find your local group.

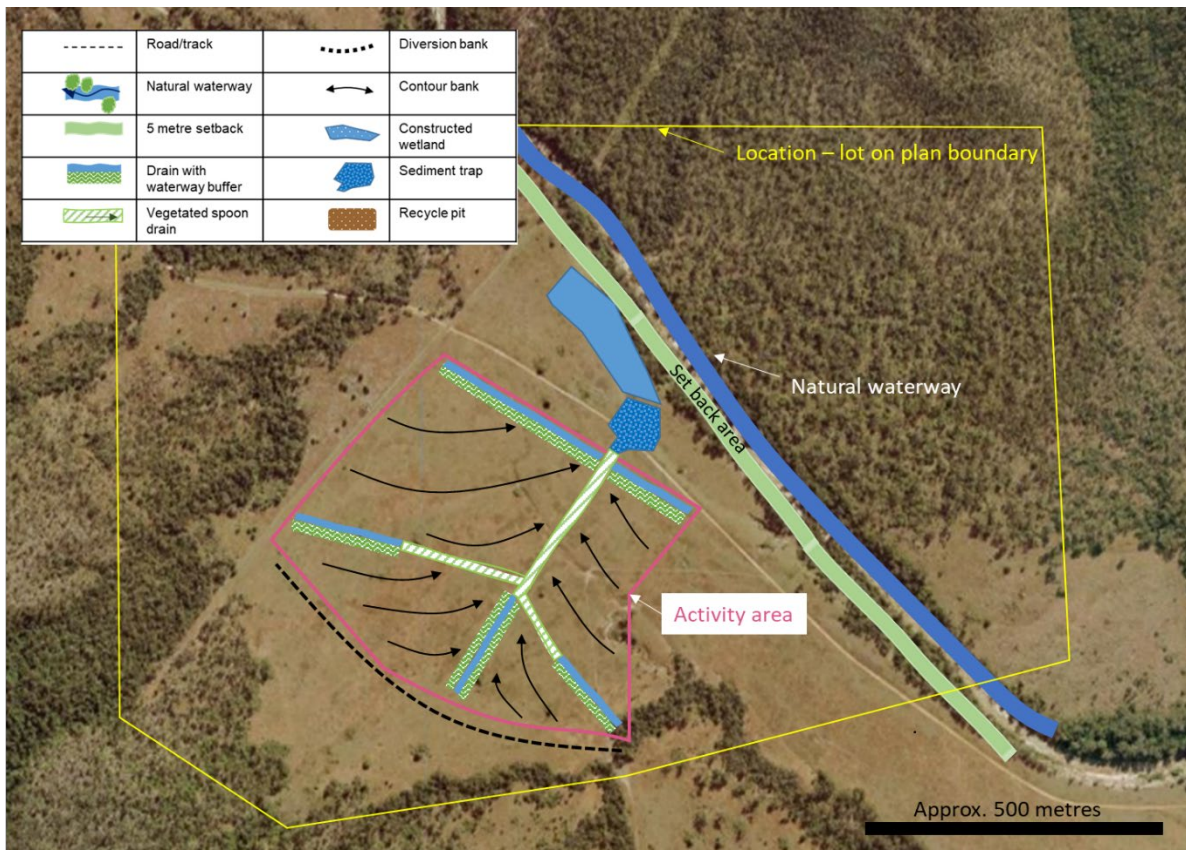


Figure 16: Example of a plan required under standard condition 6, using aerial imagery from Queensland Globe and hand-drawn measures. In this example, drains are receiving waters.

Standard condition 7 - record keeping

The plan(s) required by condition SC6 must be updated and kept current as at 1 November each calendar year.

Your plan must be updated as and when you make any changes so that it is always current as at 1 November each calendar year. If you do not make any changes to the area for which you hold a permit, you do not have to make any updates to the plan.

Standard condition 8 - record keeping

The plan(s) required by condition SC6 must be provided to the **administering authority** on request within the timeframe stipulated by the administering authority.

Key words:

Administering authority: Means the Department of Environment and Science or its successors.

You do not have to submit the plan to the department each year, but you must make the plan available if it is requested.

Contacts

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

| | |
|--|--|
| <p>Department of Environment and Science (DES) ☎ 13 QGOV (13 74 68) Permits and Licensing: ☎ 1300 130 372 (select option 4) ✉ palm@des.qld.gov.au</p> <p>Office of the Great Barrier Reef: ✉ officeoftheGBR@des.qld.gov.au www www.qld.gov.au/ReefRegulations</p> | <p>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</p> |
| <p>Local Government Association of Queensland Find your local council ☎ 1300 542 700 ✉ ask@lgaq.asn.au www www.lgaq.asn.au/find-council</p> | <p>Australian Banana Growers Council ☎ 07 4015 2797 ✉ info@abgc.org.au www www.abgc.org.au</p> |
| <p>Growcom – Hort360 ☎ 07 3620 3844 ✉ growcom@growcom.com.au www www.hort360.com.au</p> | <p>Department of Resources Find your local Business Centre ☎ 13 QGOV (13 74 68) www www.dnrme.qld.gov.au/?contact=water</p> |
| <p>Natural Resource Management (NRM) groups ☎ 0419 790 943 ✉ admin@nrmrq.org.au www www.nrmrq.org.au/find-your-regional-group</p> | <p>Soil Science Australia Find a Certified Professional Soil Scientist ☎ 0476 450 321 ✉ office@soilscienceaustralia.org.au www www.soilscienceaustralia.org.au</p> |
| <p>Engineers Australia Find a Chartered Professional Engineer ☎ 1300 653 113 ✉ memberservices@engineersaustralia.org.au www www.engineersaustralia.org.au/</p> | <p>International Erosion Control Association Australasia Find technical expertise in erosion control and soil conservation ☎ 1300 653 113 ✉ admin@austieca.com.au www www.austieca.com.au</p> |
| <p>Ag Institute of Australia Find a Certified Practising Agriculturist ☎ 02 9431 8657 ✉ admin@aginstitute.com.au www www.aginstitute.com.au</p> | |

References

- Carey, B.W., Stone, B., Norman, P.L., Shilton, P., 2015a. Chapter 8 Diversion Banks. In: Soil conservation guidelines for Queensland, Department of Science, Information Technology and Innovation, Brisbane <https://publications.qld.gov.au/dataset/soil-conservation-guidelines/resource/8850848a-11c0-43b9-9463-855cd1cc943b>
- Carey, B.W., Stone, B., Norman, P.L., Shilton, P., 2015b. Chapter 12 Soil conservation in horticulture. In: Soil conservation guidelines for Queensland, Department of Science, Information Technology and Innovation, Brisbane <https://publications.qld.gov.au/dataset/soil-conservation-guidelines/resource/e416f81e-d0e6-4245-a1d1-961070a566a2>
- Carey, B.W., Stone, B., Norman, P.L., Shilton, P., 2015c. Chapter 7 Contour banks. In: Soil conservation guidelines for Queensland, Department of Science, Information Technology and Innovation, Brisbane <https://publications.qld.gov.au/dataset/soil-conservation-guidelines/resource/8850848a-11c0-43b9-9463-855cd1cc943b>
- Carey, B.W., Stone, B., Norman, P.L., Shilton, P., 2015d. Chapter 14 Property infrastructure. In: Soil conservation guidelines for Queensland, Department of Science, Information Technology and Innovation, Brisbane <https://www.publications.qld.gov.au/dataset/soil-conservation-guidelines/resource/51f7740c-2435-4209-a56c-e97ac8157850>
- Carey, B.W., Stone, B., Norman, P.L., Shilton, P., 2015e. Chapter 10 Land management on flood plains. In: Soil conservation guidelines for Queensland, Department of Science, Information Technology and Innovation, Brisbane <https://www.publications.qld.gov.au/dataset/soil-conservation-guidelines/resource/e2e63824-a0de-430b-bbb8-8bc5046721f1>
- Cotton Research and Development Corporation, 2012. WATERpak – a guide for irrigation management in cotton and grain farming systems. Accessed at <https://www.cottoninfo.com.au/sites/default/files/documents/WATERpak.pdf>
- Department of Agriculture and Fisheries, 2016a. Banana Best Management Practices – Environmental Guidelines for the Australian Banana Industry, State of Queensland, Version 2 – May 2016.
- Department of Agriculture and Fisheries, 2016b. Sugarcane Improved Practices Guide: Burdekin. Accessed at <https://publications.qld.gov.au/dataset/sugarcane-economics/resource/0de77def-fd92-4cf7-a325-bcd51cde562e>
- Department of Employment, Economic Development and Innovation, 2011. Wetland Management Handbook: Farm Management Systems (FMS) guidelines for managing wetlands in intensive agriculture, Queensland Wetlands Program, Brisbane Queensland.
- Department of Environment and Science, Queensland, 2018a. Treatment systems for agriculture, Department of Environment and Science, Queensland, accessed 29 October 2019, <<https://wetlandinfo.des.qld.gov.au/wetlands/management/treatment-systems/for-agriculture/>>
- Department of Environment and Science, Queensland, 2018b. Vegetated buffers and swales, Department of Environment and Science, Queensland, accessed 29 October 2019, <<https://wetlandinfo.des.qld.gov.au/wetlands/management/treatment-systems/for-agriculture/treatment-sys-nav-page/vegetated-buffers/>> and <<https://wetlandinfo.des.qld.gov.au/resources/static/pdf/management/buffer-strip-factsheet-220114-v1.pdf>>

Department of Environment and Science, Queensland, 2018c. Sediment basins, Department of Environment and Science, Queensland, accessed 29 October 2019, <<https://wetlandinfo.des.qld.gov.au/wetlands/management/treatment-systems/for-agriculture/treatment-sys-nav-page/sediment-basins/>>

Department of Environment and Science, Queensland, 2018d. Recycle pits, Department of Environment and Science, Queensland, accessed 29 October 2019, <<https://wetlandinfo.des.qld.gov.au/wetlands/management/treatment-systems/for-agriculture/treatment-sys-nav-page/recycle-pits/>>

Department of Environment and Science, Queensland, 2018e. Treatment wetlands, Department of Environment and Science, Queensland, accessed 29 October 2019, <<https://wetlandinfo.des.qld.gov.au/wetlands/management/treatment-systems/for-agriculture/treatment-sys-nav-page/constructed-wetlands/>>

Holden, J., and P. McGuire, 1998. Irrigation of Sugarcane Manual (published in 1998 by BSES Limited, 2014 edition) Accessed at <https://sugarresearch.com.au/wp-content/uploads/2017/02/Irrigation-Manual-F-LowRes2.pdf>

Karssies, L. E., and I. P Prosser, 1999. Guidelines for Riparian Filter Strips for Queensland Irrigators. CSIRO Land and Water, Canberra Technical Report 21/99, September 1999.

Meat & Livestock Australia, 2013. More Beef from Pastures, Tool 2.2 Assessing groundcover, accessed at <https://mbfp.mla.com.au/pasture-growth/tool-22-assessing-groundcover/>

Prosser, I., and L. Karssies, 2001. Designing filter strips to trap sediment and attached nutrients, River and Riparian Land Management Technical Guideline No. 1, Land & Water Australia, Canberra. Accessed at <http://27.111.91.222/xmlui/bitstream/handle/1/1742/pr010328.pdf?sequence=2&isAllowed=y>

Queensland Government, 2015a. Runoff control measures for erosion control in cropping land. Science notes, Land series L35, <https://publications.qld.gov.au/storage/f/2015-01-16T05%3A48%3A21.554Z/sn-l35-runoff-control-measures-for-erosion-control-in-cropping-land.pdf>

Queensland Government, 2015b. Maintaining Contour Banks. Science notes, Land series L202, <https://www.publications.qld.gov.au/dataset/05c87bc5-6048-4767-85c8-36e660c38b1d/resource>

Queensland Government, 2015c. Soil conservation waterways – planning and design. Science notes, Land series L272, https://www.publications.qld.gov.au/dataset/science-notes-soils/resource/969ffb82-c11e-49c7-b319-4d8977d64ed4?truncate=30&inner_span=True

Queensland Government, 2015d. Soil conservation waterways – construction and management. Science notes, Land series L270, https://www.publications.qld.gov.au/dataset/science-notes-soils/resource/5bfb8622-f091-4dd1-a712-d45b841cc72e?truncate=30&inner_span=True

Queensland Government, 2004. Macadamia Growers Handbook Part 4, http://era.daf.qld.gov.au/id/eprint/1964/4/mac-growing_guide_Part4.pdf