Worksheets

To understand erosion risks and how to manage them you need to understand how much water is likely to fall on and flow through your land, know how steep a slope is and what percentage of groundcover you have. The worksheets in this section will help you calculate these values.

Catchment information answers

Results from Worksheets 1A to 1E

Throughout this guide we suggest there are times when it may be useful to understand the amounts of water likely to concentrate at particular site – the peak discharge. We have prepared five activities to guide you through working out a site's peak discharge. You can use the table below to fill in your answers from the activities.

Name of site: _____

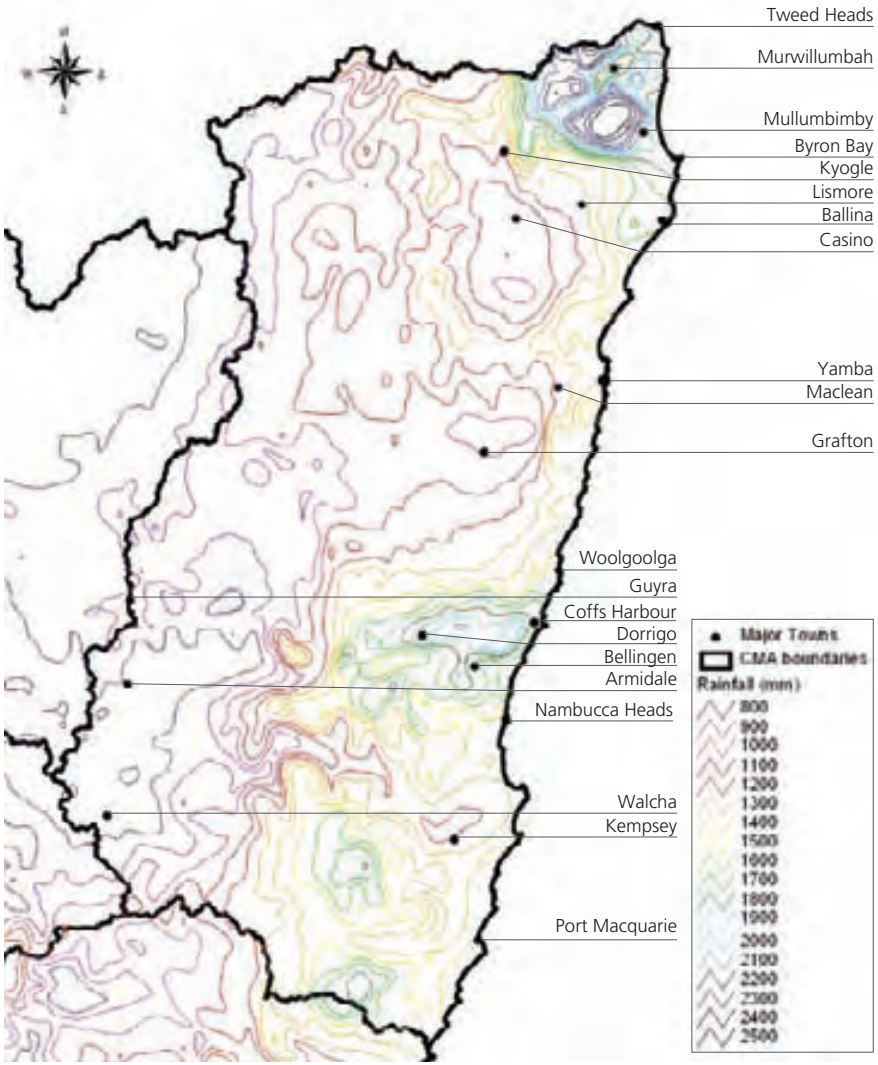
Location: _____

Type of structure
(eg contour bank, dam spillway): _____

Worksheet Number	Catchment Information	Units
1A – Annual rainfall		mm
1B – Catchment area		ha
1C – Annual runoff yield		m^3
1D – Peak discharge in 1 in 10 year event		m^3/sec
1E – Risk period required		years
– Peak discharge for required risk interval		m^3/sec

1A: Finding average annual rainfall

To find the average annual rainfall, locate your property on the map below and match the colour to the rainfall legend.



For more accurate and detailed rainfall information (essential when designing structures) go to the Bureau of Meteorology (BOM) website at www.bom.gov.au, or contact the BOM NSW Regional Office on (02) 9296 1555.

1B: Estimating the size of a catchment

The catchment is all the area of land that water can drain from to a specific point the catchment outlet.

To complete this activity you will need:

» A 1:25000 topographic map for your area, and

» a dot grid overlay (available from newsagents). If you cannot purchase a dot grid overlay for your map you can make one yourself from a piece of clear plastic. Draw a grid with 1 cm squares, with 10 dots in each square.

1. Locate the catchment outlet – the point from which you want to know the size of the catchment above.

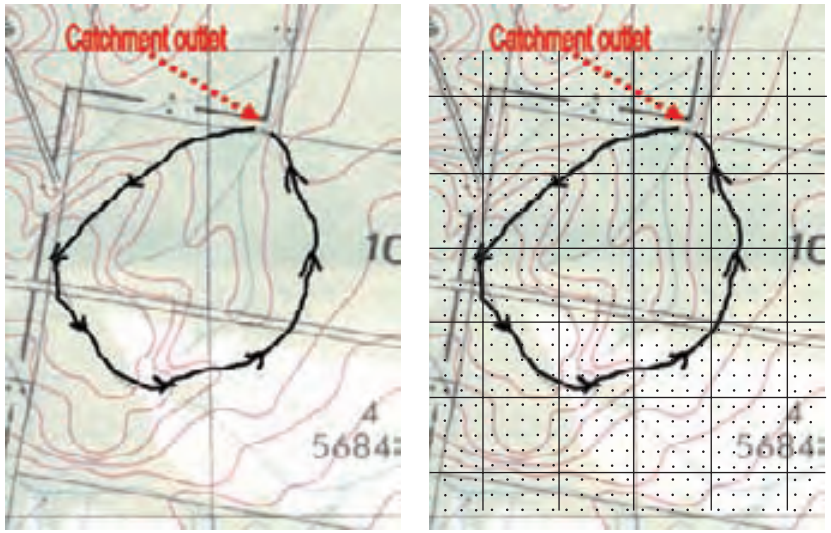
2. Draw a line around all the area that is uphill of your point of interest.
   - From one side of the point take a line out to follow where the contour lines make a convex bend away from your feature up to the ridge top or a higher drainage structure that diverts water away.
   - Do the same from the other side of your point.
   - Join the lines by following along the top of the ridge or higher drainage line.

   The line you have drawn is the catchment boundary.

3. Place your dot grid overlay over the map and count all the whole grid squares that lie within it. (Include dots that the catchment boundary is on top of). In the example shown there are 4 whole squares.

4. Count all of the dots in grid squares that are cut by the catchment boundary. In the example there are 114 dots in 10 incomplete squares.

5. To work out the area use the directions that came with your dot grid overlay, or if you are using a home-made one each grid square represents an area of 250 m x 250 m or 6.25 ha, and each extra dot represents an area of 0.25 hectare.



Catchment area (ha) = (number of whole squares x 6.25) + (number of dots from incomplete grid squares x 0.25)

From the example Catchment area = (4 x 6.25) + (114 x 0.25)
= 25.0 + 28.5
= 53.5 ha

If you are working from a map with a scale other than 1:25000 use this table to select the figures to multiply your numbers of squares and dots by.

Conversion factors for the dot grid overlay with different map scales.

Map scale	Hectares / dot	Hectares / cm²
1:500	0.0001	0.0025
1:1000	0.0004	0.01
1:10000	0.04	1.0
1:12500	0.0625	1.5625
1:25000	0.25	6.25
1:50000	1.0	25.0
1:100000	4.0	100.0
1:250000	25.0	625.0

1C: Estimating annual runoff from a catchment (catchment yield)

There are several methods that can be used for estimating the amount of runoff you could expect in a given year from a catchment. The following process will give a rough estimate, and is simple to determine.

Average annual runoff (m^3) = A x R x P x 0.1

Where:

A is the catchment **area** in ha (from Worksheet 1B)
R is the average annual **rainfall** in mm (from Worksheet 1A)
P is the runoff **percentage** (select from table below).

Use the table below to estimate the percentage of rainfall that will run off your catchment with a reliability of 8 years out of 10. Find the range that your average annual rainfall would sit in and follow across to the column that describes the dominant soil properties in the catchment. The runoff percentage is given as a range, the lower limit would apply to a forested catchment, the upper to a farmed or developed catchment.

Catchment runoff

Source: Jackson, L. Earthmovers Training Course – Erosion control and design principles, 1992

Average annual rainfall (mm)	Runoff as a percentage of average annual runoff (P)			
	Shallow sand or loam soils (%)	Sandy clays (%)	Elastic clays (%)	Clay pans, inelastic clays, shales (%)
>1100	10–15	10–15	15–20	15–25
901–1100	10–12.5	10–15	12.5–20	15–20
501–900	7.5–10	7.5–15	7.5–15	10–15

1D: Estimating peak discharge

Peak discharge is an estimate of the largest amount of water that can be expected to flow out of a catchment during or immediately after a high rainfall event. The peak discharge is expressed as cubic metres of water per second (m^3/s) for a specified risk interval.

This is the amount of water that any structure at that point will need to be designed to accommodate.

There are a several ways to calculate an estimate of peak discharge. Some are quite complex and require detailed information resources. The method presented here is a simplified model that is applicable only for eastern NSW for catchment areas up to 260 ha in size.

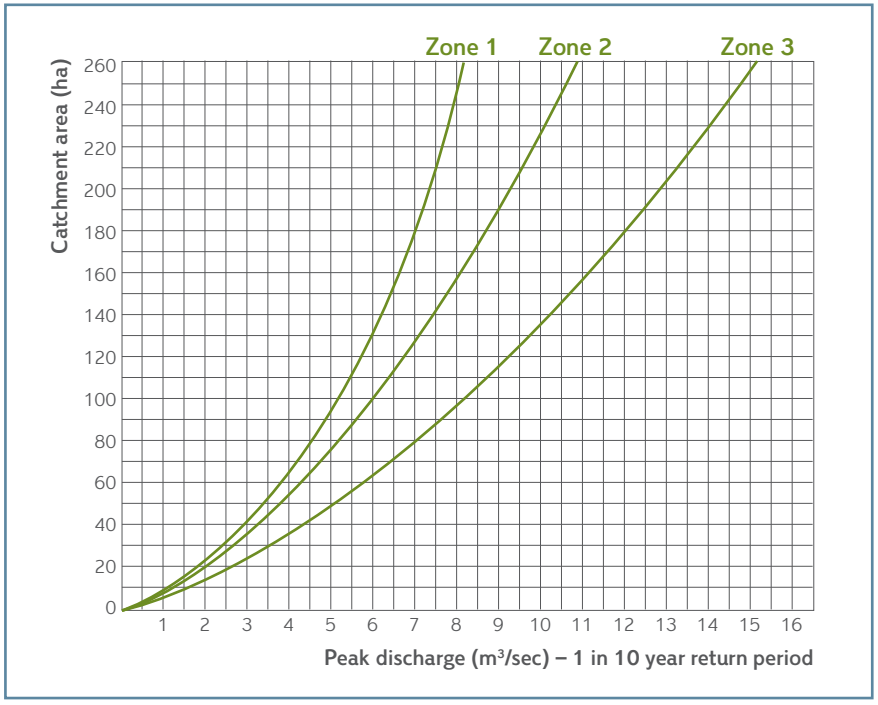
1. Identify your zone (1, 2 or 3) from the map below.

NSW discharge zones
Source: Jackson, L. Earthmovers Training Course – Erosion control and design principles, 1992

2. Using the grid diagram below:

- find the area of your catchment on the vertical axis to the left
- place a ruler horizontally across the diagram to draw a line across from that point
- mark the point where your line crosses the curve from your zone
- Turn the ruler so that it is lying vertically across the diagram, and draw a line from the point you have marked down to the bottom axis. This will give you the peak discharge for your catchment in m^3/sec for a 1 in 10 year flood. For example, the peak discharge for 1 in 10 years for a 15 ha catchment in Zone 3 is 2.2m^3/sec.

Estimate of peak discharge for eastern NSW
Source: Jackson, L. Earthmovers Training Course – Erosion control and design principles, 1992



Note: Increase discharge by 30% where catchments are continually farmed or for soils that have low infiltration rates. Decrease discharge by 20% for catchments not farmed or for soils with high infiltration rates.

1E: Calculating different risk intervals

The risk interval, or return period, is the average period in years between the occurrence of a storm of specified magnitude and an equal or greater storm. It is an average figure, not an interval. For example, a storm with a return period of 5 years does not occur regularly every 5 years, but would probably occur 5 times in a 50 year period.

A 10 year risk interval is the minimum you would want to use to design for drainage features like diversion banks. Small structures like a graded bank might use a lower risk interval such as 2 or 5 years. Dams and constructed waterways should be designed for 20 year risk intervals. Where there is risk of substantial damage should the structure fail use a higher risk interval.

To calculate a different risk interval multiply your 1 in 10 year peak discharge by the appropriate conversion factor.

Conversion factor for risk periods

Risk period (years)	2	5	10	20	50	100
Conversion factor	0.7	0.9	1.0	1.1	1.3	1.5

For example:

Where the peak discharge for a 1 in 10 year interval
= 2.2 m^3/sec

The peak discharge for a 1 in 50 year interval
= 2.2 m^3/sec x 1.3
= 2.86 m^3/sec

2: Estimating slope

Estimating slope over a paddock

Source: NSW Rural Fire Service, Building in bush fire prone areas – Guidelines for Single Dwelling Development Applications

1. Pick a spot between 40 m and 100 m away and have an assistant of similar height stand as a reference point. If you do not have an assistant pick a nearby tree as a reference point and tie a bright ribbon or tape around the trunk at your eye height.
2. Standing at the edge of the slope or at some point on the slope to be measured, hold one end of a centimetre rule 30 cm in front of your face, level with your eye so that it hangs down.
3. Looking past the rule at the assistants head or marker, note how many centimetres on the rule their head is below your eye level.
4. The table below will convert this to a slope range.
5. It is important to hold the end of the rule at eye level and let it hang straight down 30 cm in front so that a reasonable level of accuracy is gained.

Measurement on rule (cm)	Converted slope range
Less than or equal to 0	Upslope or flat
0–3	0–5°
3–5	5–10°
5–8	10–15°
8–10	15–18°
Greater than 10	Greater than 18°

Estimating slope over 1 metre

You can work out the grade of short slopes using a one metre builder's level and a tape measure. Rest one end of the bar (held level) on the track at a representative spot, and measure the distance down to the track surface at the point directly below the other end of your bar. This distance in centimetres is equal to the percent slope.

3: Assessing groundcover

Simple method – Quadrat measurement

Place a 50 cm x 50 cm square frame (quadrat) on the ground and estimate the percentage groundcover in it. Do this ten times across the paddock and average the results.

Simple method – Walking measurement

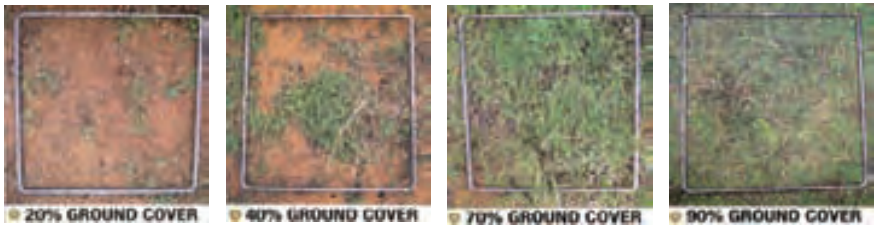
Take 10 paces and check how often your foot strikes bare soil or mud.

- 1–2 times means there is enough ground cover to protect the soil from erosion.
- 2–6 times means there is not enough groundcover to protect the soil.
- 7–10 times means the soil is likely to leave the paddock as dust or suspended in runoff water.

Detailed assessment – Step point method

(A more detailed version of the Walking measurement method). Using the field sheet overleaf:

1. Walk through the area and with each step record with a tally mark the groundcover type at the tip of your boot.
2. Count the tally marks for each category to give number of hits.
3. Add all hits together to give the total number of hits. (You need at least 100 hits to get meaningful results)
4. Calculate the percentage of hits by dividing the number of hits for each category by the total number of hits (check: percentage of hits column should add up to 100)
5. Subtract the bare soil percentage from the total (100%) to give an indication of your percentage groundcover.



Source: Greg Lodge NSW DPI

Field sheet for the Step point method

Paddock/area name: _____

Date assessed: _____

Groundcover type	Tally of hits	Number of hits	Percentage of hits
Grass			
Legume			
Weed			
Other plant			
Leaf litter			
Manure			
Rock			
Woody debris			
Bare soil			
	Total number of hits		
	Total		
	Groundcover = 100% – Bare soil %		

More information

The following pages list some useful publications that are referred to, or have been used to inform material in this guide.

Soil Erosion Solutions publications

Case studies 2005-06

Case studies 2007-08

Fact sheet 1

Types of erosion

Fact sheet 2

Indicators of erosion

Fact sheet 3

Monitoring erosion

Fact sheet 4

Groundcover

Fact sheet 5

Gully erosion

Fact sheet 6

Roads and tracks

Fact sheet 7

Planning your erosion project

All available from: http://www.dpi.nsw.gov.au/agriculture/resources/soils/erosion

NSW DPI

Establishing and managing smothergrass on macadamia orchard floors
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0018/242271/establishing-andmanaging-smothergrass-on-macadamia-orchard-floors.pdf

Leaking farm dams
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/164038/leaking-dams.pdf

Maintaining groundcover to reduce erosion and sustain production
http://www.dpi.nsw.gov.au/agriculture/field/pastures/management/production-management/groundcover

Managing in drought
http://www.dpi.nsw.gov.au/agriculture/emergency/drought/managing

Northern Rivers soil health card
http://www.dpi.nsw.gov.au/agriculture/resources/soils/testing/health-card

Protect your land - use cover crops
http://www.dpi.nsw.gov.au/agriculture/horticulture/vegetables/soil/protect

Protect your soil from compaction
http://www.dpi.nsw.gov.au/agriculture/resources/soils/structure/compaction

Sodic soils
http://www.dpi.nsw.gov.au/agriculture/resources/soils/sodic

Soil and water management practices for blueberry growers in northern NSW
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/197190/Blueberry-soil-water-management-northern-NSW.pdf

Soil and water best management practices for NSW banana growers
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/242359/soil-and-water-best-management-practices-for-nsw-banana-growers.pdf

SOILpak for vegetable growers
http://www.dpi.nsw.gov.au/agriculture/horticulture/vegetables/soil/soilpak

Soilwise pocket guide for looking after soils
http://www.dpi.nsw.gov.au/aboutus/resources/bookshop/soilwise

Other sources of information

Earthmovers training course. Soil Conservation Service 1992
http://www.lands.nsw.gov.au/soil_conservation/education_and_training

Farm dam - planning, construction and maintenance
Lewis, Barry (2002) Landlinks Press Collingwood.
http://www.publish.csiro.au/pid/2641.htm

Farm dams regulations
http://www.naturalresources.nsw.gov.au/water/dams.shtml

Keeping it in place: controlling sediment loss on grazing properties in the Burdekin River catchment
http://www.mla.com.au/NR/rdonlyres/F22B363E-5B5D-4DAD-8EDF-256F53E1F1B5/0/LPI395KeepingitinplaceFINAL.pdf

Northern Rivers soil BMP guide - coffee
http://www.soilcare.org

Northern Rivers soil BMP guide - macadamias
http://www.soilcare.org

Northern Rivers soil BMP guide - perennial horticulture
http://www.soilcare.org

Northern Rivers soil BMP guide - vegetables
http://www.soilcare.org

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Notes

Saving Soil

A landholder's guide to preventing and repairing soil erosion

Soil is the basis of land fertility and productivity. Soil erosion degrades the land that the soil is lost from, and when it gets into our creeks and rivers it's pollution. This book is a practical guide to keeping soil on north coast farms. It explains how to:

- manage erosion in grazing, cropping and orchard enterprises
- control water flow using drains and banks
- avoid erosion when building dams
- build roads and tracks with minimal erosion
- fix gullies, tunnels and landslips
- calculate erosion potential.

Northern Rivers CMA CATCHMENT MANAGEMENT AUTHORITY

NSW DEPARTMENT OF PRIMARY INDUSTRIES