Central Coast Council
What's in the "Blue Book"?
2 July 2024

What's in the "Blue Book"?

Site Assessment

and E&SC Planning

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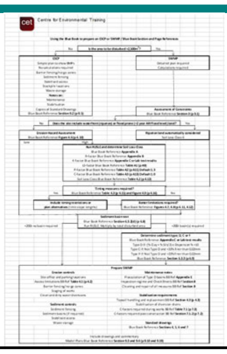
Using the Blue Book



- Flowchart guides you through a stepwise process
- References to relevant Chapters, Sections, Pages, Figures, Tables and Appendices
- Copy of flowchart at back of notes

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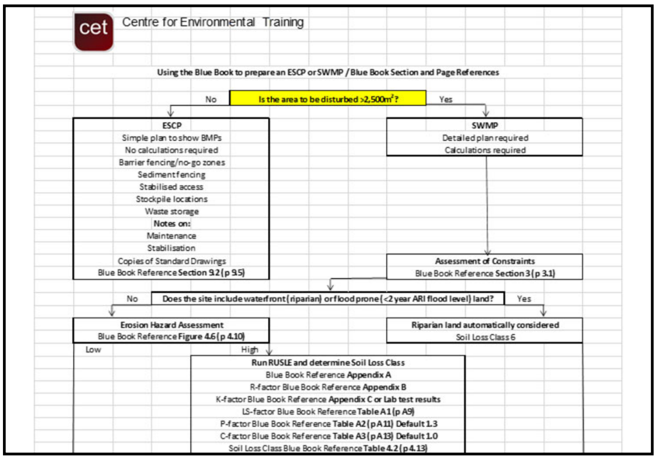

Plan Preparation

- What sort of plan do I require?
- Plan may comprise:
  - Drawing(s) to show layout of works
  - Commentary as annotated sketches or report
- If disturbed area < 250m² may not need a plan
- If disturbed area is >250m² and <2,500m² require an ESCP
- If disturbed area is >2,500m² require a SWMP

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Examples

- Disturbed area ~250m²: house extension, garage, small driveway
- Disturbed area ~1,000m²: housing, small commercial development or minor civil works
- Disturbed area 1,000-2,500m²: commercial development, minor subdivision or medium-high density housing
- Disturbed area >2,500m²: large subdivisions, roadway construction, community-scale housing and large civil works

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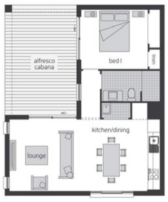
What sort of plan do I require?

- What sort of plan do I require if I am proposing to build a granny flat?
- House width 8.00m
- House length 9.60m
- Disturbed area 76.8m²
- No formal plan required
- Check with consent authority
- Exercise care
- BB Ch2 Table 2.1



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What's in the "Blue Book"?

2 July 2024

What sort of plan do I require?

- What sort of plan do I require if I am proposing to build a house?
- House width 12.74m
- House length 22.50m
- Disturbed area 286.65m^2
- Require ESCP
- Address soil erosion and sediment pollution only
- BB Ch2 Table 2.1

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What sort of plan do I require?

- What sort of plan do I require if I am proposing to build an industrial subdivision?
- Six lots:
  - 1,218m^2
  - 1,123m^2
  - 985m^2
  - 985m^2
  - 1,186m^2
  - 856m^2

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What sort of plan do I require?

- Total area: 6,353m^2
- Require SWMP
- Address soil erosion sediment pollution and sediment basin calculation
- BB Ch2 Table 2.1

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ESCP or SWMP?

- Chapter 2 of the Blue Book describes the key differences between an ESCP and SWMP
- ESCP:
  - Site plan (1:500 or larger) to show Site layout and locations of Best Management Practices (BMPs)
  - Standard Drawings from Blue Book
- SWMP, in addition, requires:
  - Supporting calculations for sediment basins and structures
  - Details of erosion and sediment controls
  - Inspection and Test Plans (ITPs), maintenance notes
  - Stabilisation requirements

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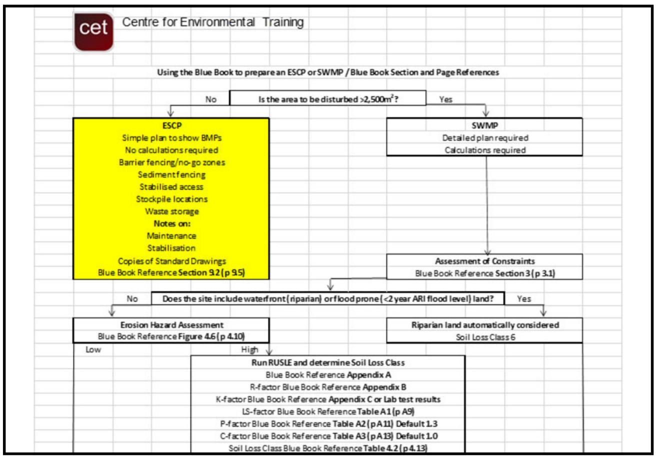

ESCP

Measures include:

- Clean water diversion
- Site access controls (barrier fence)
- Stabilised access
- Sediment fence
- Designated stockpile locations
- Waste disposal facilities/storage
- Stabilisation
- Maintenance
- BB Ch2.2, Ch9.2

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Clean water diversion

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Access controls/barrier fence

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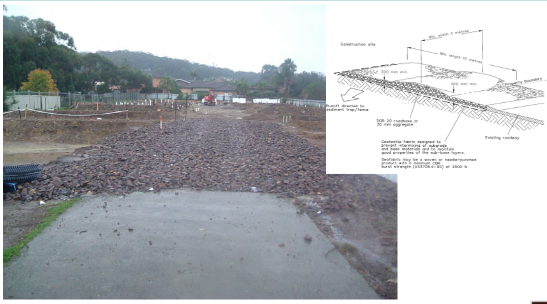
Stabilised access



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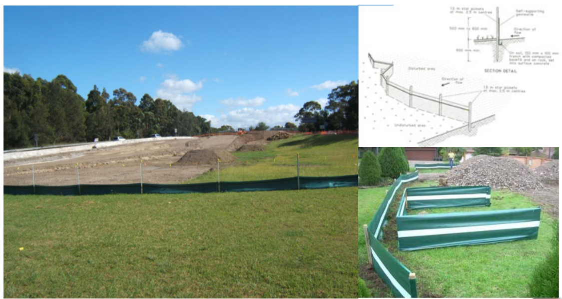
Sediment fence



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Stockpiles

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Waste storage

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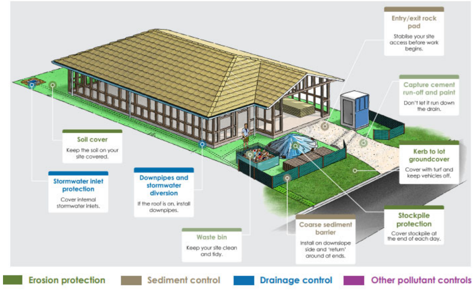
ESCP for small development



Source: Healthy Land and Water, QDES

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Single lot ESCP

- Mark up the A3 plan of a single lot residential development, which you will find at the back of the course notes booklet
- Show the various erosion and sediment control measures you would put in place and their appropriate location
- Locate and list the various Standard Drawings you would refer to illustrate the erosion and sediment control measures you have nominated

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What are we trying to avoid?

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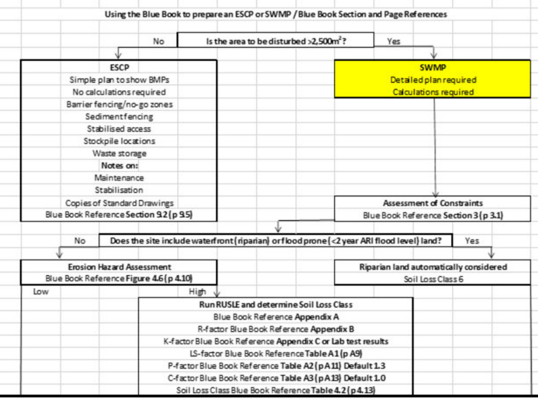

SWMP

- Applies same principles as ESCP
- Required for larger projects with:
  - Greater areas of disturbance (>2,500m^2)
  - Higher risk of polluting waters

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SWMP procedure

- Undertake constraints analysis
- Waterfront/riparian land or flood prone?
- Erosion hazard assessment
- Run RUSLE and determine Soil Loss Class
- Consider timing restrictions
- Batter limitations required?
- Sediment basin test (need should be investigated)
- Determine type of basin required
- Prepare SWMP to include erosion and sediment controls, maintenance notes, stabilisation requirements, Inspection and Test Plans (ITPs) and standard drawings
- BB Ch2 p2-3, Ch3 p3-1, Ch9 p9-10

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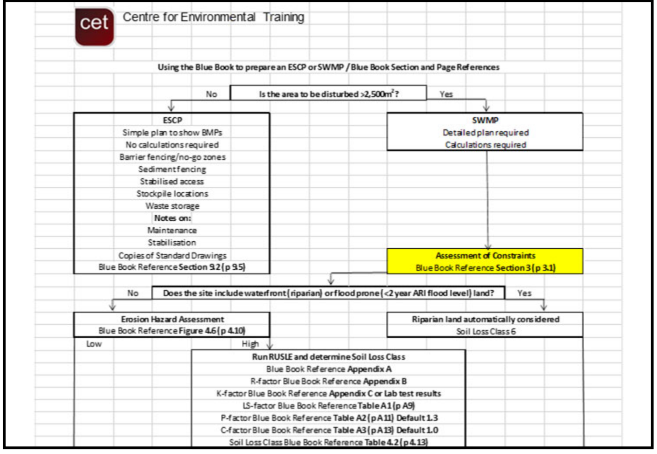

Assessment of constraints

Blue Book Reference Chapter 3

Consider:

- Waterfront (riparian) land: vegetated land adjacent to waterbodies Ch3.2.1
- Flooding: <2 year ARI flood level, automatically considered Soil Loss Class 6 – high erosion hazard Ch3.2.2
- Need to focus on erosion control
- Review soil characteristics p3-3 – 3-14 more on soils later

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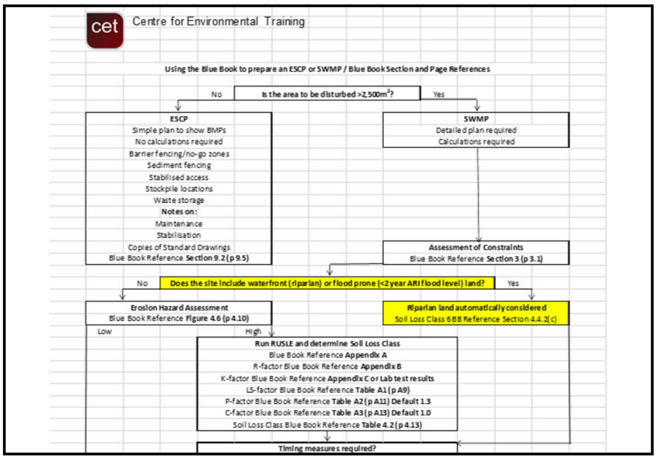

Riparian and flood prone land

- What are the E&SC implications for riparian and flood prone land?

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Riparian and flood prone land

- E&SC implications for riparian and flood prone land p3-2:
  - Protection of social, economic, cultural and heritage values of waterfront land
  - Avoid or minimise land degradation, soil erosion, compaction, instability, contamination, acidity, salinity and decline of native vegetation

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Water Tables/Groundwater

- How can groundwater affect E&SC? p3-8
  - Flow into bores, wells and open excavations
  - Collapse of excavations
  - Impede site access
  - Perched watertables
  - Moisture fluctuations
  - Seasonal and permanent watertables
  - Implications for plant growth and stabilisation

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Salinity

- How can salinity affect E&SC? p3-9
  - Implications for plant growth
  - Reduction in vegetational cover (C-factor) and consequent increase in erosion hazard
  - Blue Book Reference Appendix C lists constraints in various Soil Landscapes throughout NSW

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Salinity

- Implications in both rural and urban settings


R Muller/DPE


A Wooldridge/DPE

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Acid sulfate soils

- How can acid sulfate soils affect E&SC? p3-10
  - Acid Sulfate Soil Risk Mapping
  - Common in coastal NSW
  - Excavations in and near coast and estuaries
  - ASSMP - Procedures for handling and pH stabilisation

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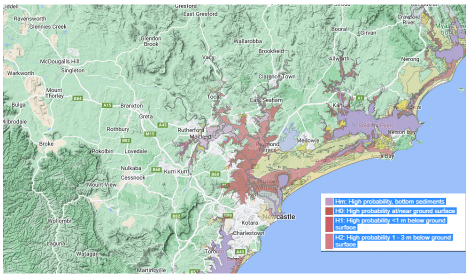
Acid sulfate soil probability

- https://www.environment.nsw.gov.au/eSpade2Webapp



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Acid sulfate soils


Tweed Shire Council


OzCoasts

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Soil Data Collection

Link soils to landscape by key features:

- Geology/rock type
- Soil type
- Position on slope
- Landforms
- Blue Book Reference Appendix C
- Similar information available from Reports on individual soils located on eSPADE

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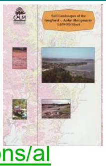
Soil Landscape mapping

NSW Soil Landscape Maps (OEH)



- 1:100,000 – 1:250,000 scale
- Detailed information in companion books
- Available at https://shop.regional.nsw.gov.au/collections/all/soil-landscapes

eSPADE in NSW NR atlas

- Electronic data, including borelogs
- http://www.environment.nsw.gov.au/eSpade2Webapp

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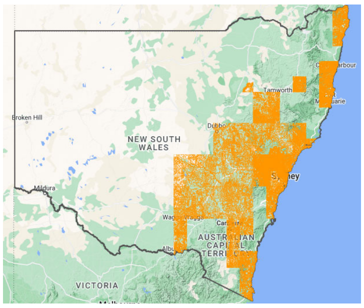
Mapping availability



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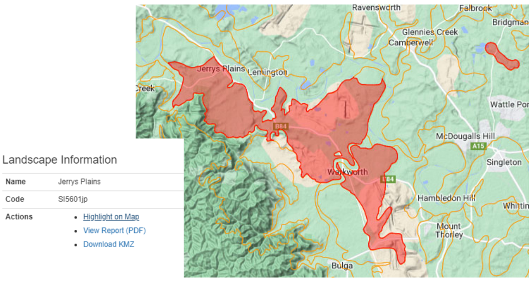
Soil Landscape mapping



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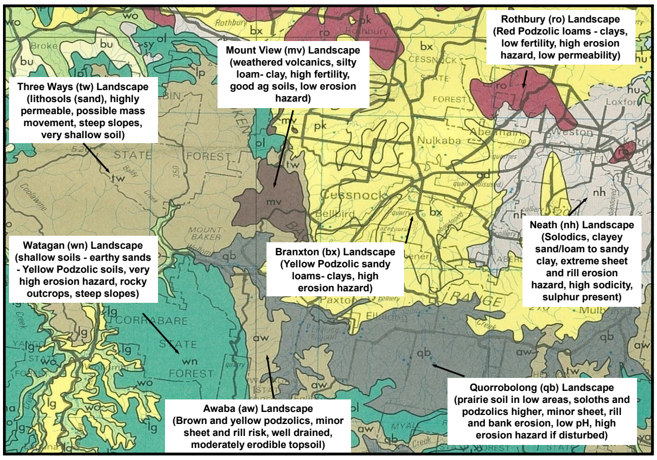

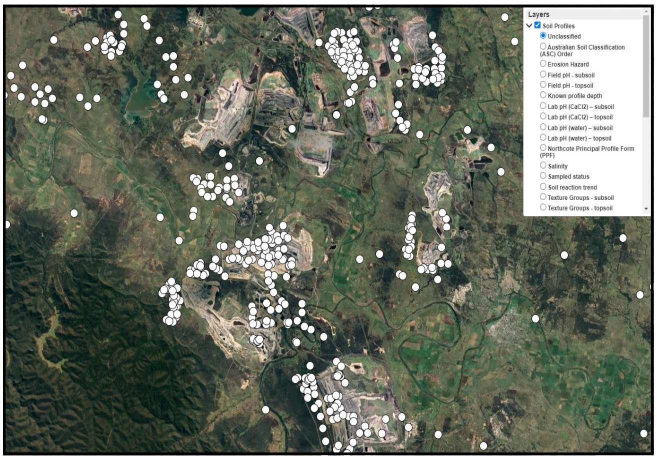

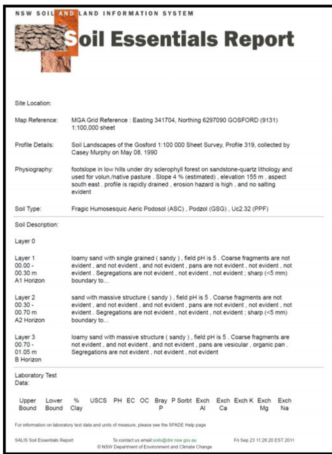

NSW SOIL AND LAND INFORMATION SYSTEM

Soil Essentials Report

Site Location:

Map Reference: MGA Grid Reference : Easting 341704, Northing 6297090 GOSFORD (9131) 1:100,000 sheet

Profile Details: Soil Landscapes of the Gosford 1:100 000 Sheet Survey, Profile 319, collected by Casey Murphy on May 08, 1990

Physiography: footslope in low hills under dry sclerophyll forest on sandstone-quartz lithology and used for volun./native pasture . Slope 4 % (estimated) , elevation 155 m , aspect south east . profile is rapidly drained , erosion hazard is high , and no salting evident

Soil Type: Fragic Humosesquic Aeric Podosol (ASC) , Podzol (GSG) , Uc2.32 (PPF)

Soil Description:

Layer 0

Layer 1 00.00 - 00.30 m A1 Horizon: loamy sand with single grained (sandy) , field pH is 5 . Coarse fragments are not evident , and not evident , and not evident , pans are not evident , not evident , not evident . Segregations are not evident , not evident , not evident ; sharp (<5 mm) boundary to...

Layer 2 00.30 - 00.70 m A2 Horizon: sand with massive structure (sandy) , field pH is 5 . Coarse fragments are not evident , and not evident , and not evident , pans are not evident , not evident , not evident . Segregations are not evident , not evident , not evident ; sharp (<5 mm) boundary to...

Layer 3 00.70 - 01.05 m B Horizon: loamy sand with massive structure (sandy) , field pH is 5 . Coarse fragments are not evident , and not evident , and not evident , pans are vesicular , organic pan . Segregations are not evident , not evident , not evident

Laboratory Test Data:

Upper Bound	Lower Bound	% Clay	USCS	PH	EC	OC	Bray P	P Sorbt	Exch Al	Exch Ca	Exch K	Exch Mg	Exch Na

For information on laboratory test data and units of measure, please see the SPADE Help page

SALIS Soil Essentials Report — To contact us email soils@dnr.nsw.gov.au — Fri Sep 23 11:28:20 EST 2011
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Three reports:

- Soil Essentials
- Soil Profile
- Soil Technical

(increasing level of detail)

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What's in the "Blue Book"?

2 July 2024

Table 13 Newcastle Soil Landscapes

Soil landscape	Common constraints	Slope range (%)	Soil hydrologic group	Acid sulfate risk	USCS class	K-factor USLE	Sediment type	Sediment basin wall construction (earth)
Nerong Waterholes (nw)	low areas of high run-on, high watertables, seasonal waterlogging and flood hazard; some permanent waterlogging; general risks to foundations	<2	Group C/D	endemic	CH CH-MH CH	0.025 0.017 0.026	*Type D* *Type D* *Type D*	B J B
Norah Head (nh)	extreme wind erosion and high water erosion hazards; non cohesive highly permeable soils with very low fertility	<15	Group A	na	SP-SM SP SM	0.016 0.015 0.021	*Type FC* *Type C* *Type C*	J J J
Paterson River (pa)	high water erosion and flood hazard; localised non cohesive soil, wind erosion hazard; general risks to foundations	<3	Group B	sporadic	SW SW	0.025 0.026	*Type F* *Type F*	I I
North Arm Cove (nc)	generally high erosion hazard; localised areas with high run-or	<15	Group C/D	sporadic	ML-CL CH ML-CL	0.051 0.024 0.043	*Type D* *Type F* *Type F*	E A J
Nungra (ng)	low-lying areas of high run-on, permanently high watertables, seasonal waterlogging and flood hazards; localised risks to foundations	<3	Group C/D	sporadic	ML-CL CL-ML	>0.079 >0.093	*Type D* *Type D*	I I
Rivermead (ri)	localised shallow soils, high run-on, seasonal waterlogging, and flooding; localised erosion hazard; general risks to foundations	<4	Group B Group C	sporadic	SC SC SC OL SM CH CH	0.031 0.025 0.027 0.028 0.044 0.028 0.035	*Type F* *Type D* *Type F* *Type F* *Type F* *Type D* *Type D*	J I B J J D D
River Road (rr)	generally high erosion hazard; localised steep slopes, shallow soils and rock outcrop; low areas with high run-on and seasonal waterlogging	<40	Group C/D	sporadic	CL-ML CL-ML CH	>0.032 0.042 0.020	*Type D* *Type D* *Type D*	I D A
Shoal Bay (sb)	non cohesive soils, wind erosion hazard; localised steep slopes; general risks of watertable pollution	<15	Group A	widespread	SW SW SW	0.000 0.000 0.009	*Type C* *Type C* *Type C*	I J I
Shoal Bay Swamp (ss)	low lying area with high run-on, permanently high watertable , permanent waterlogging and flood hazard; non cohesive materials with wind high erosion hazard; general risks to	<5	Group D	endemic	SW	0.009	*Type C*	I/J

SH-jp JERRYS PLAINS SOIL LANDSCAPE

GENERAL
This landscape covers the undulating low hills to the south and west of Jerrys Plains. The main soils are Solodics (Dy3.42, Dy3.22, Dy5.12, Dr2.12, Dr2.42, Db1.42) on the crests to midslopes with Solodic Soils (Dy2.52, Dy3.42, Dy2.82, Db2.42, Dr3.42, Db1.13) on the lower slopes and in drainage depressions. Brown Clays (Uf6.4, Ug5.32) occur in midslope depressions. Solodised Solonetz (Dy3.43) occur on slopes where drainage is severely impeded by bedrock. Areas of severe salting occur in many of the drainage lines. Other soils include Red Earths (Dr3.62) on upper slopes with some Euchrozem – Yellow Solodic Soil intergrades (Dy3.12).

CLIMATIC ZONE: 3B and 3E

LANDFORM
Undulating low hills ranging in elevation from 80 – 180 m. Slope range from 2 – 10%, with most around 6%. Local relief is around 60 m. Slope lengths range from 900 – 3,000 m. Numerous small drainage lines occur, flowing to the north and east, at intervals of 200 – 1,100 m.

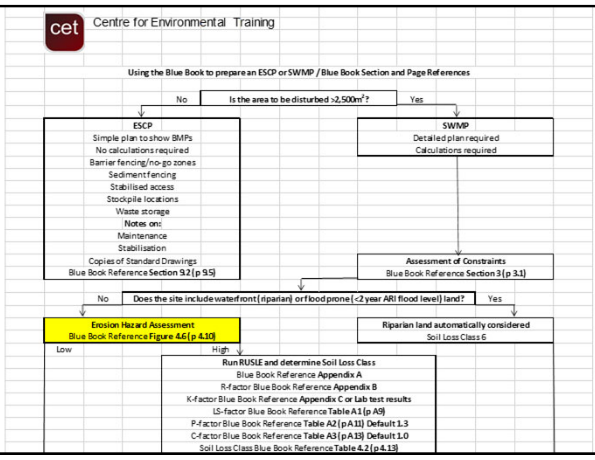
NATIVE VEGETATION
A woodland community of narrow-leaved red ironbark with forest red gum and grey gum with bull oak along drainage lines. Much regrowth occurs on unimproved pastures.

GEOLOGY
Geological Unit: Jerrys Plains Subgroup of the Wittingham Coal Measures.
Parent Rock: Lithic sandstone, mudstone, some siltstone lenses and polymictic conglomerates.
Parent Material: *In situ* weathered parent rock and derived colluvium.

SOIL EROSION
Severe gully erosion (1.5 – 3.0 m) in some drainage lines with occasional salt scalds. Minor sheet erosion in some disturbed areas on hillslopes.

Management of Soils

- Simple procedure for all works on low erosion hazard sites with >250m² disturbed, where ESCP or SWMP is required:
  - Vegetation protection and retention (cover)
  - Works limitations (disturbance and access areas)
  - Soil handling (topsoil handling and replacement)
  - Stabilisation restrictions
- Blue Book Chapter 4, Sections 4.1, 4.2 and 4.3, SD 4-1 stockpiles, SD 4-2 replacing topsoil



Assessment of erosion hazard

Blue Book Reference Chapter 4, Section 4.4

- Preliminary assessment of potential erosion hazard (A-line test)
- Special requirements for high erosion hazard land (Section 4.4.2):
  - Batter gradient restrictions Figures 4.7, 4.8
  - Timing of works (low rainfall intensity periods) Table 4.3, Figure 4.9
  - Stabilisation restrictions, C-factors >0.1 only when 3-day forecast suggests rain unlikely

Measured erosion rates

Natural conditions:	(t/ha/yr)
• Forest	0.005 – 0.05
• Grassland	0.1 – 1.0
Human Activity:	
• Grazing land	0.1 – 5.0
• Developed Residential	5 – 10
• Active Construction sites	60 – 100+

Measured erosion rates

By how many fold do we increase erosion rates by undertaking construction on land that was previously grassland?

Natural conditions:	(t/ha/yr)
• Grassland	0.1 – 1.0
• Active Construction sites	60 – 100+

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Measured erosion rates

By how many fold do we increase erosion rates by undertaking construction on land that was previously grassland?

- Between 60 and 1,000 fold!

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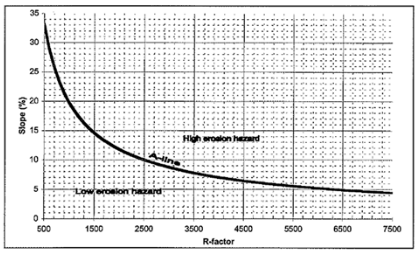
Erosion hazard assessment

- Blue Book Reference Figure 4.6 (page 4-10)



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Erosion hazard assessment

- Relates erosion hazard to Slope and Rainfall Erosivity
- Blue Book Reference Appendix B for R-factor maps
- What slope gradient would define land as high erosion hazard in Tamworth?
- Newcastle?
- Forster?

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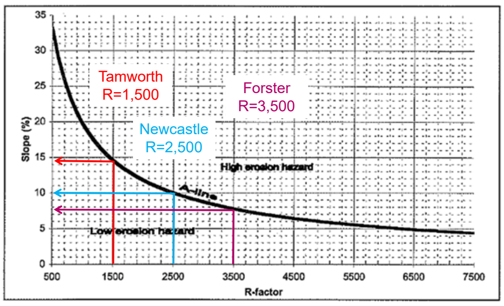
A-line test



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Erosion hazard assessment

- If you were planning to duplicate the width of an unsealed road and upgrade box culverts at a creek crossing at Singleton, where the slope was 13%, what would the erosion hazard be?

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Erosion hazard

Standard erosion controls apply to all sites:

- Stabilised access (SD 6-14)
- Water management (BB Ref Chapter 5)
- Stockpile management (SD 4-1, p4-5)
- Stabilisation requirements (BB Ref Chapter 7)

High erosion hazard sites also require:

- Timing of works (Table 4.3)
- If not possible, C-factor >0.1 (60% cover) only when 3-day forecast suggests rain is unlikely
- Management of batter gradients (Fig 4.7, 4.8)

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Assessing erosion hazard

Erosion hazard is the susceptibility or risk of land to erosion

- Depends on a combination of factors
- Varies from site to site

What factors do you think affect erosion hazard?

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Erosion factors

These factors are significant:

- **Rainfall** erosivity / intensity
- **Soil** type and erodibility
- **Slope** length/steepness
- **Conservation practice**
- **Cover** type

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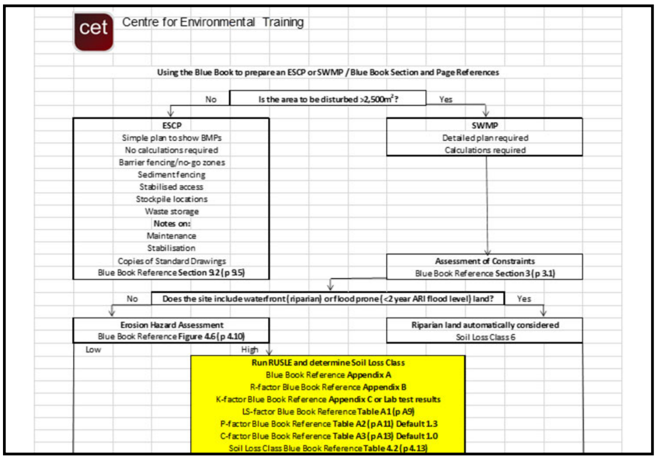

RUSLE

- Factors influencing erosion form the basis for the <u>R</u>evised <u>U</u>niversal <u>S</u>oil <u>L</u>oss <u>E</u>quation
  - Empirical equation used to estimate erosion hazard for a location
  - How much soil is likely to be lost from a site?
  - What factors influence the amount of erosion?

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RUSLE

- Equation:

$$A = R \times K \times LS \times P \times C$$

Where:

- A = Computed soil loss (tonnes/ha/year)
- R = rainfall erosivity factor
- K = soil erodibility factor
- LS = slope length / gradient factor
- P = erosion control practice factor
- C = ground cover and management factor

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RUSLE

- Equation:

$$A = R \times K \times LS \times P \times C$$

- If one factor increases, A (computed soil loss) increases
- Equally, if one factor decreases, A decreases
- Important to determine the relative influence of the factors

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RUSLE

- Blue Book Reference Appendix A
- Use to assess erosion hazard
- Use to estimate Soil Loss Class
- Use in sediment basin design
- Note that RUSLE only applies to non-channelised erosion (i.e. not concentrated flows)
- Also, RUSLE does not consider dispersibility
- RUSLE is a major element of the Blue Book approach

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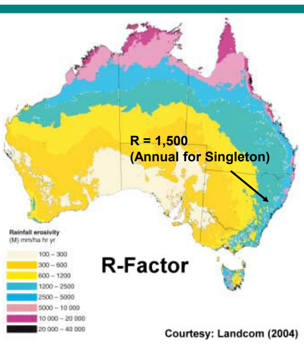
Rainfall Erosivity (R)



- A measure of the ability of rainfall to cause erosion
- Related to the energy and intensity of rainfall
- Varies throughout Australia and throughout the year
- BB Ref Appendix B for R-factor maps

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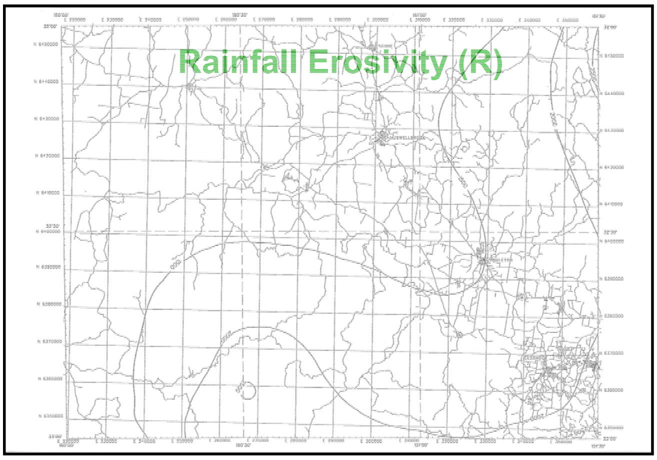
Rainfall Erosivity (R)



Rainfall Erosivity (R)

- Predominant rainfall droplet size (energy)
- Based on average annual rainfall data
- Ignores prevailing soil moisture
- $R = 164.74 \times 1.1177^S \times S^{0.6444}$, where
  - S is the 2-year, 6-hour storm event
- Calculate for Singleton R = 1,257 (new IFDs)

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Rainfall Erosivity (R-factor)

- Does not account for seasonality or antecedent conditions affecting peak flow and total runoff
- If a seasonal rainfall pattern is evident work on land with a high erosion hazard should be undertaken in the "drier" months

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Rainfall Erosivity (R-factor)

SINGLETON ARMY	61275											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean rainfall (mm)	94.3	88.9	72.7	58.4	59.7	37.9	28.2	37.1	45.3	69.1	68.5	63

Which months would you choose to work in Singleton?

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Soil type and Erodibility (K)

- A measure of the susceptibility of soil particles to erosion
- Affected by soil texture, structure, organic matter, profile permeability and other parameters
- Generally, fine sands and silts are most erodible, but dispersible clays can be highly erodible
- BB Ref Appendix C or Lab test results

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Soil texture

- Coarse sand 0.2 – 2.0 mm
- Fine sand 0.1 – 0.2 mm
- Very fine sand 0.02 – 0.1 mm
- Silt 0.002 – 0.02 mm
- Clay < 0.002 mm

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Soil organic matter

- % Organic carbon x 1.72
- Based on laboratory analysis

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Soil structure

- Very fine granular - particles mostly < 1mm diameter
- Fine granular – particles mostly 1 - 2 mm diameter
- Medium or coarse granular – particles mostly 2 – 10 mm diameter
- Blocky, platy or massive

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Soil profile permeability

- The rate of infiltration of water (K_{sat}) into the whole soil profile
- Rapid >130 mm/hour
- Moderate to rapid 60 - 130 mm/hour
- Moderate 20 - 60 mm/hour
- Slow to moderate 5 - 20 mm/hour
- Slow 1 - 5 mm/hour
- Very slow <1 mm/hour

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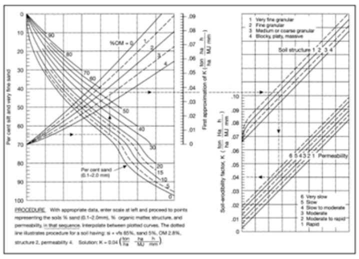
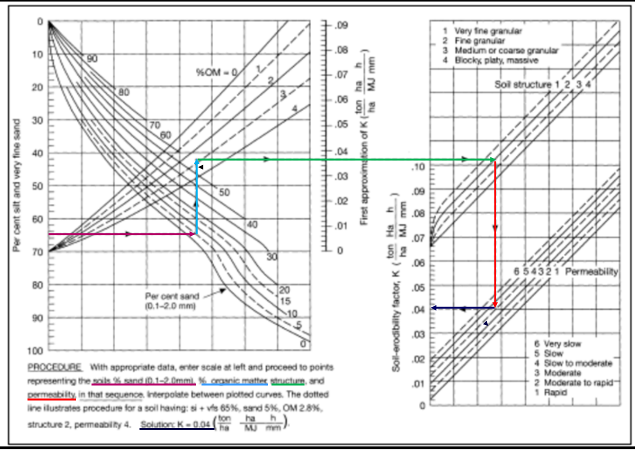
Soil Erodibility K-factor nomogram

- Blue Book Reference Figure A3 (page A7)





K-factors (after Rosewell 1993)

Table E4 – Default soil erodibility K-factors based on soil texture class

Soil texture	Symbol	Estimated clay content (%)	K-factor [1]
Sand	S	< 10	0.015
Clayey sand	CLS	5–10	0.025
Loamy sand	LS	5–10	0.020
Sandy loam	SL	10–15	0.030
Fine sandy loam	FSL	10–20	0.035
Sandy clay loam	SCL	15–20	0.025
Loam	L	about 25	0.040
Loam, fine sandy	Lfsy	about 25	0.050
Silt loam	SiL	about 25 and more than 25% silt	0.055
Sandy clay loam	SCL	20-30	[0.043]
Clay loam	CL	30–35	0.030
Silty clay loam	SiCL	30–35 and more than 25% silt	0.040
Fine sandy clay loam	FSCL	30–35	0.025
Sandy clay	SC	35–40	0.017
Silty clay	SiC	35–40 and more than 25% silt	0.025
Light clay	LC	35–40	0.025
Light medium clay	LMC	40–45	0.018
Medium clay	MC	45–55	0.015
Heavy clay	HC	> 50	0.012

Soil type and Erodibility (K-factor)

- K-factor is least accurate component of RUSLE
- Much data based on topsoils, yet subsoils are generally of more significance in construction
- Increase by 20% for dispersive soils (Emerson Class 1 and 2)

Soil type and Erodibility (K-factor)

- Soil is 600mm of silty clay loam topsoil
- Overlying light-medium clay

What is the K-factor of the topsoil?

0.040

How would the K-factor change if the subsoil was exposed?

0.018

Soil type and Erodibility (K-factor)

What is the implication of this for the A value (calculated soil loss)?

If you were working on a site with these soils what might be a good course of action to reduce erosion hazard?

Slope Length / Steepness (LS)

- A measure of the combined effect of slope length and gradient on soil loss
- Increases as slopes get steeper and longer
- Gradient has greater influence
- Blue Book Reference Appendix A, Section A4
- If >1,000m^2 is to be disturbed, Table A1 assumes slope lengths do not exceed 80 metres before forecast rainfall or during shutdown periods (i.e. 80 metres is default)

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LS-factor (Table A1)

Table A1 LS-factors on construction sites using the RUSLE

Slope ratio	Slope gradient (%)	Slope length (m)														
		5	10	20	30	40	50	60	70	80	90	100	150	200	250	300
100:1	1	0.09	0.11	0.13	0.15	0.16	0.17	0.18	0.19	0.19	0.20	0.20	0.23	0.24	0.26	0.27
50:1	2	0.14	0.18	0.24	0.28	0.31	0.34	0.36	0.39	0.41	0.43	0.44	0.52	0.58	0.64	0.69
33.3:1	3	0.17	0.24	0.34	0.41	0.47	0.52	0.57	0.61	0.65	0.69	0.72	0.87	1.00	1.11	1.22
25:1	4	0.21	0.30	0.44	0.54	0.63	0.71	0.78	0.85	0.91	0.97	1.03	1.26	1.47	1.65	1.82
20:1	5	0.24	0.36	0.54	0.68	0.80	0.91	1.01	1.10	1.19	1.27	1.35	1.70	2.00	2.28	2.53
16.6:1	6	0.28	0.42	0.64	0.81	0.97	1.11	1.24	1.36	1.47	1.58	1.68	2.14	2.54	2.91	3.25
12.5:1	8	0.34	0.53	0.83	1.08	1.31	1.51	1.70	1.88	2.05	2.21	2.37	3.07	3.70	4.28	4.82
10:1	10	0.42	0.68	1.09	1.44	1.75	2.04	2.31	2.56	2.81	3.04	3.27	4.06	4.94	5.75	6.52
8.3:1	12	0.52	0.85	1.39	1.85	2.27	2.66	3.02	3.37	3.70	4.02	4.33	5.77	7.07	8.28	9.42
7.1:1	14	0.62	1.02	1.69	2.26	2.79	3.28	3.74	4.18	4.61	5.02	5.42	7.27	8.95	10.52	12.01
6.3:1	16	0.71	1.19	1.98	2.67	3.31	3.90	4.46	5.00	5.52	6.02	6.51	8.78	10.86	12.81	14.65
5.5:1	18	0.80	1.35	2.27	3.07	3.82	4.51	5.17	5.81	6.42	7.02	7.59	10.30	12.78		
5:1	20	0.89	1.50	2.55	3.47	4.32	5.12	5.88	6.61	7.32	8.01	8.68	11.92	14.84		
4:1	25	1.09	1.88	3.23	4.43	5.54	6.59	7.60	8.57	9.51	10.43	11.32				
3.3:1	30	1.28	2.23	3.86	5.32	6.69	7.99	9.23	10.43	11.60	12.74	13.85				
2.5:1	40	1.61	2.83	4.98	6.92	8.74	10.48	12.15	13.77							
2:1	50	1.88	3.33	5.89	8.22	10.42	12.52	14.55								

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Slope Length / Steepness (LS)

- Assume slope is 4% and slope length is 100 metres

Calculate the LS-factor?

- Assume slope is 4% but the slope length can be limited to 20 metres

What is the LS-factor?

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LS-factor

Table A1 LS-factors on construction sites using the RUSLE

Slope ratio	Slope gradient (%)	Slope length (m)														
		5	10	20	30	40	50	60	70	80	90	100	150	200	250	300
100:1	1	0.09	0.11	0.13	0.15	0.16	0.17	0.18	0.19	0.19	0.20	0.20	0.23	0.24	0.26	0.27
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33.3:1	3	0.17	0.24	0.34	0.41	0.47	0.52	0.57	0.61	0.65	0.69	0.72	0.87	1.00	1.11	1.22
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8.3:1	12	0.52	0.85	1.39	1.85	2.27	2.66	3.02	3.37	3.70	4.02	4.33	5.77	7.07	8.28	9.42
7.1:1	14	0.62	1.02	1.69	2.26	2.79	3.28	3.74	4.18	4.61	5.02	5.42	7.27	8.95	10.52	12.01
6.3:1	16	0.71	1.19	1.98	2.67	3.31	3.90	4.46	5.00	5.52	6.02	6.51	8.78	10.86	12.81	14.65
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2:1	50	1.88	3.33	5.89	8.22	10.42	12.52	14.55								

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LS-factor

Table A1 LS-factors on construction sites using the RUSLE

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16.6:1	6	0.28	0.42	0.64	0.81	0.97	1.11	1.24	1.36	1.47	1.58	1.68	2.14	2.54	2.91	3.25
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6.3:1	16	0.71	1.19	1.98	2.67	3.31	3.90	4.46	5.00	5.52	6.02	6.51	8.78	10.86	12.81	14.65
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2:1	50	1.88	3.33	5.89	8.22	10.42	12.52	14.55								

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Temporary earth banks

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Slope Length / Steepness (LS)

- If temporary earth banks were introduced every 20 metres, what implication would this have for the A value (Calculated soil loss)?

Erosion Control Practice (P)

- Relates to surface condition rather than cover
- Reduced by practices that reduce both the velocity of runoff and the tendency of runoff to flow directly downhill, e.g.
  - Track walking up/down slope rather than across slope
  - Straw crimping
  - Loose soil surface
- Blue Book Reference Appendix A, Section A5

Erosion Control Practice (P)

Table A2 P-factors for construction sites (Goldman et al., 1986)

Surface condition	P-factor
Compacted and smooth	1.3
Track-walked along the contour[6]	1.2
Track-walked up and down the slope[7]	0.9
Punched straw[8]	0.9
Loose to 0.3 metres depth	0.8

- Default P factor is 1.3

Erosion Control Practice (P)

- Now assume the surface has been track walked along the contour

What is the P-factor?

- Now assume the surface has been track up and down the slope
- Why would track walking up and down the slope be better?

What is the P-factor?

Cover Type (C-factor)

- Blue Book Reference Appendix A, Section A6
- A measure of the amount and effectiveness of ground cover
- Reduce the erosion hazard by maintaining good ground cover (lower C-factor) – a key erosion control practice!
- Proper rehabilitation should ensure C-factors drop to below 0.15 within 20 days of completing work

Cover Type (C-factor) for grass

Grass Cover	C-Factor
No cover, soil smooth and compacted	1.0 **(High)**
20 %	0.45 **(Med)**
50 %	0.15 **(Low)**
70 %	0.05
100%	< 0.01

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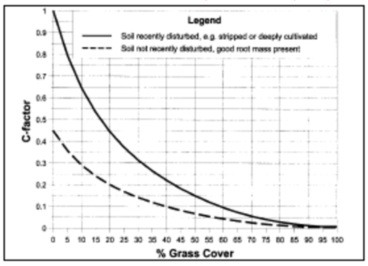
C-factor in RUSLE

- Blue Book Reference Figure A5 (page A-12)



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Cover Type (C-factor)

- Assume there is no grass cover and the surface is smooth and compacted

What is the C-factor?

What effect would 20% of newly established grass cover have on the C-factor?

- BB Ref Appendix A, Table A3 Soil Stabilisation Control Matrix shows C-factors for various surface treatments
- Default C factor is 1.0

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Cover Type (C)

- Reduce the erosion hazard by maintaining good ground cover (lower C-factor) – a key erosion control practice!
- Proper rehabilitation should ensure C-factors drop to below 0.15 within 20 days of completing work
- So, how do we achieve a suitable C-factor?

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Estimates of soil loss

Estimates of soil loss helps to:

- Assess erosion risk
- Identify measures to overcome erosion risk
- Compare effectiveness of erosion control measures
- Estimate capacity of sediment basins

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RUSLE

- Equation:

$$A = R \times K \times LS \times P \times C$$

Where:

- A = Computed soil loss (tonnes/ha/year)
- R = rainfall erosivity factor
- K = soil erodibility factor
- LS = slope length / gradient factor
- P = erosion control practice factor
- C = ground cover and management factor

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RUSLE

Limitations:
- Only predicts sediment entrained by erosion
- Predicts average annual soil loss, not soil loss for one storm event
- Effective for sheet and rill erosion on slopes <300 metres, but not concentrated flow or long slopes
- Does not adequately take into consideration dispersibility in K-factor

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RUSLE worked exercise

- Consider you are to prepare a laydown area 100m x 50m at your site in Singleton
- Prior to construction the site has 70% grass cover
- The topsoil will be stripped and stockpiled and the surface graded
- The resultant soil surface will be smooth and compacted
- How will the C-factor change?

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RUSLE worked exercise

- The slope is 4% along the long axis of the site
- The soils are 600mm of silty clay loam topsoil (K = 0.04) overlying light-medium clay subsoil (K = 0.018)
- Calculate the post construction A value (estimated soil loss)

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RUSLE worked exercise

- Post-construction soil loss
- Equation:

A = R x K x LS x P x C

A = R x K x LS x P x C

A = 1,500 x 0.018 x 1.03 x 1.3 x 1.0

A = 36.15 tonnes/ha/year

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RUSLE exercise

- How much will you have reduced soil loss by stripping and stockpiling the topsoil?

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RUSLE exercise

- How much will you have reduced soil loss by stripping and stockpiling the topsoil?
- Equation:

A = R x K x LS x P x C

A = R x K x LS x P x C

A = 1,500 x 0.04 x 1.03 x 1.3 x 1.0

A = 80.34 tonnes/ha/year

Soil loss is reduced from 80.34 tonnes/ha/year to 36.15 tonnes/ha/year, a reduction of 44.19 tonnes/ha/year

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Discussion

Which of the previous erosion factors can be readily manipulated to reduce the erosion hazard on your construction site, and how?

- Rainfall, soil type – NO
- Slope length, cover type - Possible
- Conservation practice – DEFINITELY!

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RUSLE

- What is the A value if improved practices are adopted including track walking up and down the slope and installation of temporary earth banks at 20 metre spacing?

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RUSLE

- What is the A value if improved practices are adopted including track walking up and down the slope and installation of temporary earth banks at 20 metre spacing?
- Equation:

A = R x K x LS x P x C

A = R x K x LS x P x C

A = 1,500 x 0.018 x 0.44 x 0.9 x 1.0

A = 10.69 tonnes/ha/year

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RUSLE exercise

- What is the estimated annual soil loss for a three hectare construction site on the Killingworth (ki) Soil Landscape near Newcastle where:
- The topsoil K-factor is 0.027 and the subsoil 0.036, and
- The slopes are 8%?

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Soil loss classes

- Seven Soil Loss Classes based on RUSLE, BB Ref Table 4.2 (p 4-13)

Soil Loss Class	Calculated soil loss (tonnes/ha/yr)	Erosion hazard
1	0 to 150	very low
2	151 to 225	low
3	226 to 350	low-moderate
4	351 to 500	moderate
5	501 to 750	high
6	751 to 1,500	very high
7	>1,500	extremely high

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Soil loss classes

Soil Loss Class	Calculated soil loss (tonnes/ha/yr)	Erosion hazard
1	0 to 150	very low
2	151 to 225	low
3	226 to 350	low-moderate
4	351 to 500	moderate
5	501 to 750	high
6	751 to 1,500	very high
7	>1,500	extremely high

- To calculate Soil Loss Class, use local R and K-factors, local slope gradient, P-factor of 1.3 and C-factor of 1.0. Assume slope length 80m unless a lesser value can be justified

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Soil loss classes

- Class 1-2 low erosion hazard
  - Gently sloping
  - Stable soils
  - Low R-factor
- Class 6-7 high erosion hazard
  - Steeply sloping
  - Erodible soils
  - High R-factor

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Soil loss class - examples

- Northern Tablelands/Southern Highlands
  - Stable soils on basalt
  - Gentle slopes, 2%
  - Class 1
- Blue Mountains/Upper Hunter
  - Erodible and dispersible soils
  - Steeper slopes, 12%
  - Class 3
- Far North Coast/South Coast
  - Erodible, silty soils
  - Steep slopes, over 25%
  - Class 7

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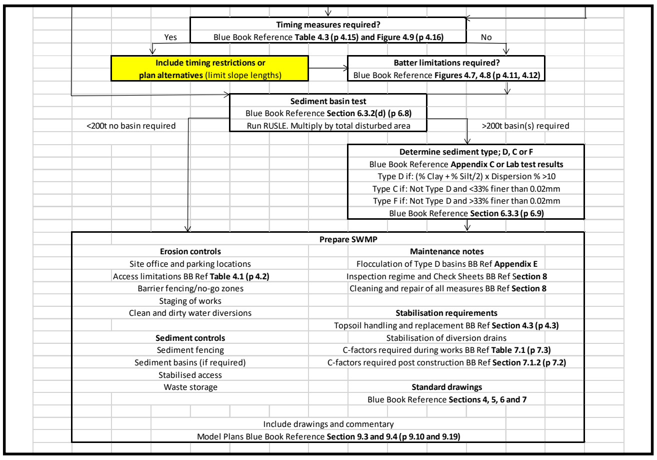

Timing restrictions

- Soil Loss Class dictates recommended timing restrictions for works
- Blue Book Reference Table 4.3 (p 4.15)
- Highlights months when work should or should not proceed
- At time when activity should be avoided:
  - C-factor >0.1 only when 3-day forecast suggests rain unlikely
  - Management regime in place for rapid stabilisation if required (RECPs etc.)

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Soil loss class - exercise

- Calculate the Soil Loss Class for a 2.0ha subdivision site on the Dorrigo Soil Landscape with a slope gradient of 20%?
- How would soil loss change if the default slope length could be reduced to 20m?
- Which are the optimum months to work on this site?
- What would be the requirements outside of this window?

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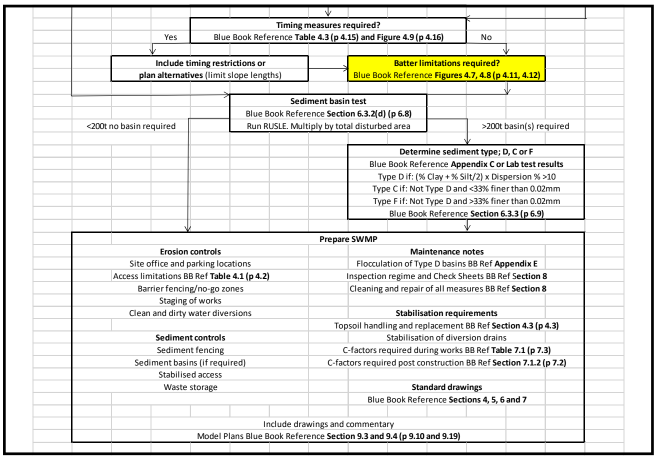


Batter limitations

- Blue Book Reference Section 4, Figure 4.7 and 4.8 (pages 4-11 and 4-12)


Batter limitations

Relates batter gradients on constructed slopes to:

- R-factor (select correct chart)
- K-factor and Slope Length (metres)
- Read off maximum batter gradient recommendation

Batter limitations - exercise

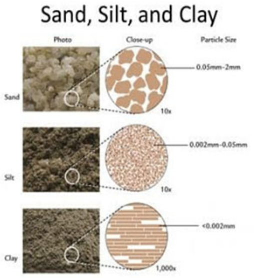
- Review for Dorrigo site
- R-factor = 7,000
- K-factor = 0.011-0.024
- Slope length = 20 metres
- Ref Figure 4.8 p4-12
- What are the maximum batter gradients for the topsoil and the subsoil?

Soil texture class

- Clay particles are <0.002mm
- Silt particles are 0.002 – 0.02mm
- Fine sand particles are 0.02 – 0.2mm
- Coarse sand particles are 0.2 – 2.0mm
- Sediment fence typically has pore openings typically ~ 0.035 mm
- Which particles would you expect to be trapped and which to pass through?
- Clay, slit and fine sand will pass through

Soil Texture

- Sand grains
  - Visible to the eye
  - Roll between fingers
- Silt grains
  - Not visible to the eye
  - Roll between the fingers
- Clay grains
  - Not visible to the eye
  - Smooth to the touch



Soil texture group

Blue Book described three (3) groups:

- Type C: Coarse
- Type F: Fine
- Type D: Dispersible

Soil texture group

- Type C: Coarse
  - Easier to capture or settle out
  - <33% clay and silt
  - Sediment basin not likely required or design relatively simple
- Type F: Fine
  - Harder to capture
  - Require longer time to settle out
  - >33% clay and silt
  - Require "total storm capture" sediment basins
  - Higher emphasis on erosion control

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Soil texture group

- Type D: Dispersible
  - Structurally unstable (slaking and dispersion)
  - Primarily affects clay and silt fraction
  - Not all clays are dispersible
  - Use Emerson test to check
  - Highly erodible if exposed
  - Hard setting and low permeability
  - Particles are kept apart by negative electrical charge
- Soil (stability) Demonstration

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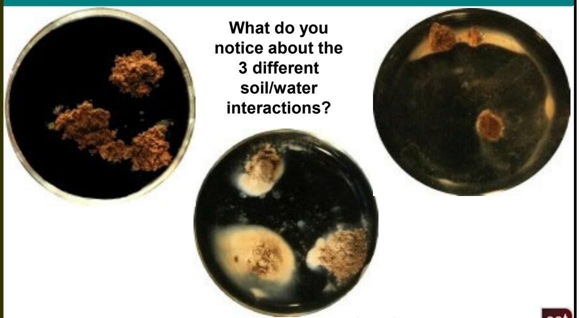
Unstable soils



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Soil texture group

- Type D: Dispersible
  - Severe rilling of exposed (vertical) surfaces
  - Dispersive soils subject to gully and tunnel erosion
  - High risk of tunnel erosion or piping when used for earthworks
  - Generates turbid runoff. May remain turbid for a long time, or never clear
  - Negatively charged clay particles leaving a site can transport positively charged contaminants including heavy metals and nutrients

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Piping and tunnelling

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Sodic soils

- All sodic soils are dispersive but not all dispersive soils are sodic
- Cation Exchange Capacity (CEC) (K^+, Na^+, H^+, Ca^{++}, Mg^{++}, Al^{+++}) dominated by sodium (Exchangeable Sodium Percentage, ESP)
- Fluting is a common indicator of sodic soils
- Sodosol and solonised terms

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Management of soil

- (1) Expose only by necessity
- (2) Cover with non-dispersive soil before applying further treatments (erosion controls) or revegetation
- (3) Soil Amelioration:
  - Gypsum application can significantly improve soil stability (dry preferred to liquid form)
  - Blending best approach at application rates 5 – 35 t/ha

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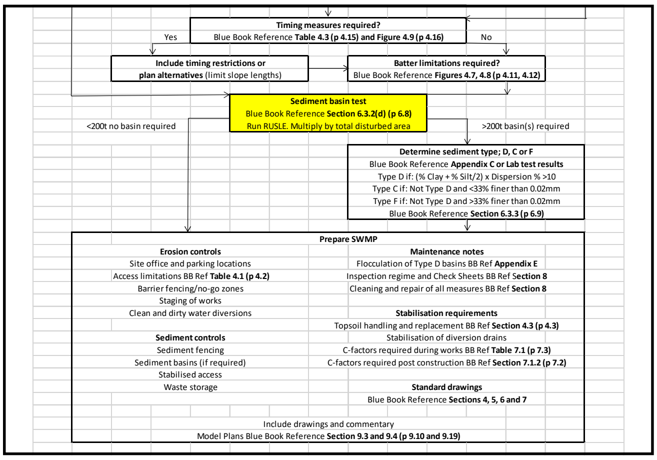

Sediment basin test

- Blue Book Reference Section 6.3.2(d) p6-8
- Some small and flat sites may not warrant construction of a sediment basin i.e. those <2,500m^2 disturbed area for which a ECSP (rather than a SWMP) is required
- Run RUSLE to check the annual soil loss from the 'total disturbed area'
- If annual soil loss <150m^3 (150m^3 = 200 tonnes) a sediment basin may not be required
- If so, employ alternative measures

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Sediment basin test - exercise

Is a sediment basin required for the following?

- A 2.5ha site at Tamworth, of which 1.3ha will be disturbed
- Located on the Orchard Creek Soil Landscape
- Site gradient (slope) is 4%?

- If a sediment basin is not required, what other measures would be appropriate?

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RUSLE solution

- Sediment Basin test – Tamworth site
- Equation: A = R x K x LS x P x C

  A = 1,500 x 0.08 x 0.91 x 1.3 x 1.0

  A = 142 tonnes/ha/year

- Result = 142 x 1.3ha = 184.6 tonnes (~142m^3 @ 1.3)

Sediment basin not required

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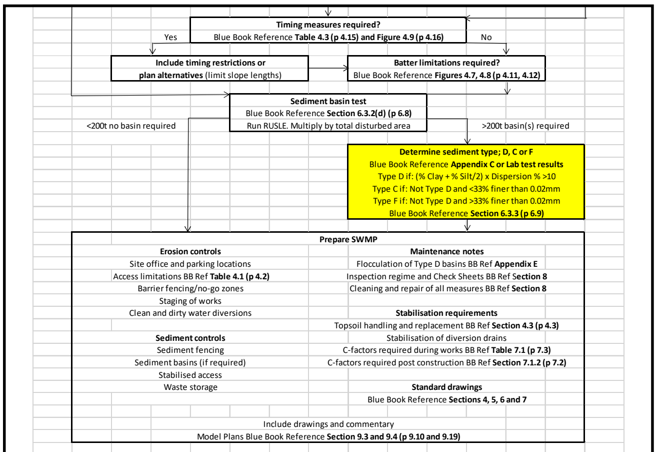

Sediment types

- Type C: Coarse soils have <33% clay + silt (finer than 0.02mm)
- Type F: Fine soils have >33% clay + silt (finer than 0.02mm)
- Type D: Dispersive soils have (clay + silt/2) x dispersion % ≥10 and will not settle unless flocculated
- Use Emerson Aggregate Test to determine if dispersive. Also shows if soils slake.

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Soil texture group

- Blue Book Reference Section 3.2.6
- A soil is "significantly dispersible" if the percentage of clay (<0.002 mm) plus half the silt (0.002-0.005 mm) x dispersion percentage is greater than or equal to 10

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Sediment types - exercise

What is the sediment type for a site:

- At Boolaroo on the Cockle Creek (cc) Soil Landscape?
- At Gosford on the Somersby (so) Soil Landscape?

- How would you manage each?
- Refer BB Appendix C

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Sediment types - exercise

- For each of the following soils described by Particle Size Analysis and Dispersion Percentage (DP), determine the sediment type, C, F or D (use design spreadsheet)

Clay	Silt	Fine Sand	Coarse sand	Gravel	DP	Sed type
26%	20%	15%	35%	4%	25%	F (9.0)
5%	20%	62%	10%	3%	55%	C (8.25)
52%	14%	20%	13%	1%	23%	D (13.57)

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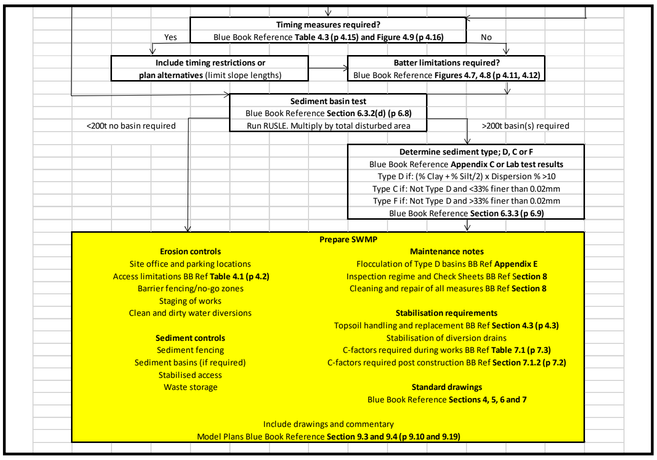

SWMP

- Now we have worked our way through the Flow Chart we are in a position to begin preparing a SWMP!
- Split into groups of 3 or 4 and discuss, then list the issues you would consider and tasks you would undertake to prepare a SWMP for:
  - Construction of a 200m x 50m equipment storage and maintenance hardstand on a newly cleared, previously grassed, gently sloping site at an Upper Hunter open-cut mine site

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Applying to a site

- Review site background data and sensitivity
- Consider both upslope and downslope catchment
- Take particular note of slopes, soils and watercourses
- Consider water management – clean and dirty
- Determine if sediment basins are required
- Consider site management – barrier fencing and no-go areas
- Identify erosion and sediment control measures that need to be put in place before work commences, and in which order
- Identify and list the specific erosion and sediment control BMPs and Standard Drawings

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Applying to a site

- Install stabilised access
- Install barrier fencing
- Install sediment fencing
- Construct sediment basins
- Provide temporary access to sediment basins
- Construct dirty water catch drains and conveyances to sediment basins
- Construct clean water diversion
- Strip and stockpile topsoil
- Undertake any works around watercourses at appropriate times and with appropriate C-factors

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Applying to a site

- Construct roads
- Undertake other construction (staged)
- Maintain E&SC measures throughout
- Decommission measures and rehabilitate progressively
- Complete checks and fill out check sheets during construction (at least weekly, after all storms >5mm in 24 hours and before site closure)
- Check sheets include condition of all BMPs, maintenance and cleaning, flocculation of sediment basins
- Reporting to Project Manager and Regulatory Agency

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Sediment basin design

- Sediment basin test
- If required, consider location(s)
- Basin design criteria
- Basin maintenance requirements
- Basin design depends on sediment type
- Different basin designs and maintenance regimes for Types C, F and D basins
- Blue Book Reference Section 6.3.3, p6-9

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Purpose

- Collect sediment-laden stormwater runoff and retain pollutants
- Probably the most effective of all sediment control devices due to their large water and sediment storage capacity
- Generally used on larger (>2,500 m^2 construction sites)
- Types C and F (non-dispersive) and D (dispersive)

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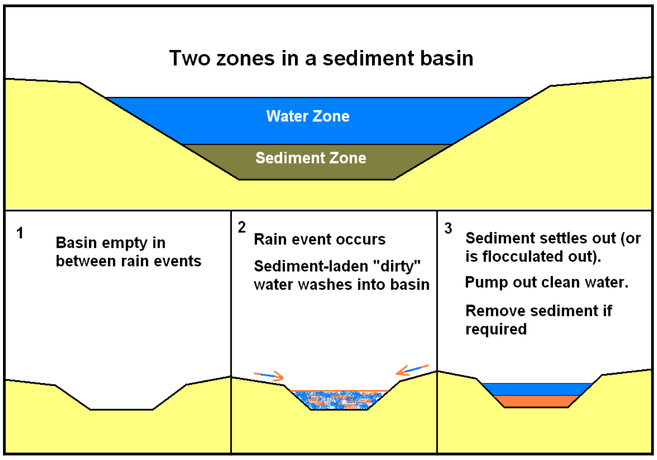

Permanent basins

- Designed by experienced professionals, having regard to the volumes of runoff, quantity and types of sediment expected
- Size includes a sediment settling and a sediment storage zone, mark with pegs
- Prioritise public safety
- Provide length/width ratio > 3:1 – use baffles if necessary
- Ensure inlet/outlet structures are stabilised against erosion

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Wet basins

- Watertight structures that store water for sufficient time to allow settling of fine and dispersed suspended solids
- Complete storm capture devices
- Storage zone for 2 months soil loss (RUSLE) or 50% of water zone on low erosion hazard sites
- Often flocculated to enhance performance if sediments are dispersive (colloidal)
- Pump water out once settling has occurred

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Sediment Basin Design Criteria

- Settling zone (Type D) = 10 x Cv x A x R, where:
  - Cv = (Volumetric runoff coefficient) (proportion of rainfall that runs off as stormwater)
  - A = catchment area of basin (ha)
  - R = design rainfall depth (mm)
- Storage (soil) zone design = 50% of settling volume or 2 months soil loss (RUSLE)

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Settling zone capacity – Types D and F basins

Blue Book Reference Table 6.3 (pages 6-24 and 6-25) and Appendix L (spreadsheets)

- 5 day, 75th percentile is default design parameter
- 80th percentile for highly sensitive receiving waters, OR where rehabilitation to take longer than 6 months
- 85th percentile (or higher) if receiving waters are highly sensitive AND rehabilitation to take longer than 6 months

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Example – Wet basin

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Wyong Site problem

- Construction of a 200m x 50m equipment storage and maintenance hardstand
- Assumptions:
  - Total Catchment Area = 1.5ha
  - Disturbance Area = 1.0ha (200m x 50m)
  - Average annual soil loss = 36.15 t/ha/year
  - Average slope = <5% (20:1)
  - Sediment type = 'D' (dispersible)
  - Hydrologic group = C (fine clay)

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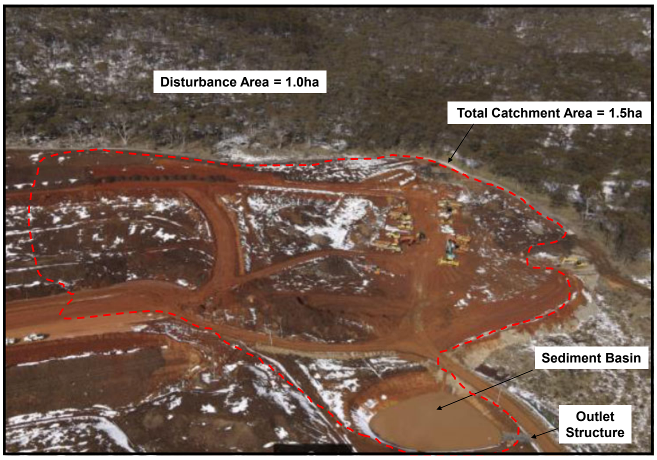

Design Rainfall depth

Table 6.3a 75th, 80th, 85th, 90th and 95th-percentile 2 and 5-day rainfall depths for 59 sites in New South Wales

Location	2-day rainfall depths (mm)					5-day rainfall depths (mm)				
	75th %ile	80th %ile	85th %ile	90th %ile	95th %ile	75th %ile	80th %ile	85th %ile	90th %ile	95th %ile
North Coast										
Coffs Harbour	18.3	23.6	31.8	44.4	70.8	33.6	42.7	55.8	74.9	117.6
Dorrigo	22.1	27.9	36.4	49.0	77.0	40.3	49.3	63.7	84.8	132.0
Grafton	14.0	17.8	22.9	31.2	48.9	23.3	29.0	37.2	50.1	75.4
Lismore	16.3	20.6	26.4	36.3	57.0	28.6	35.3	45.2	60.2	95.3
Port Macquarie	18.0	22.9	29.8	41.4	65.3	32.0	40.1	51.8	70.0	106.2
Taree	15.0	19.0	24.9	35.5	56.4	25.0	31.7	41.2	55.9	90.6
Tweed Heads	23.4	29.5	37.6	50.8	78.7	39.6	48.5	62.5	82.5	126.8
Central Coast/Hunter										
Cessnock	13.4	16.5	21.1	28.5	45.0	20.3	24.4	31.0	42.8	63.0
Gosford (Narara)	16.7	21.3	28.4	39.8	63.0	27.9	35.0	45.8	62.2	99.3
Nelson Bay	17.5	22.3	28.9	39.4	58.9	30.4	38.1	48.3	63.5	91.5
Newcastle	13.7	17.6	23.0	31.8	48.1	24.4	30.5	38.9	51.8	76.7
Scone	12.4	15.3	19.3	25.0	37.8	19.0	22.6	27.7	35.9	51.3
Wyong	16.8	20.8	26.9	37.2	58.8	26.8	33.8	43.2	58.7	90.1
Sydney/Blue Mountains										

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"Coefficient of Runoff"

- "C" is a calibration term
- Each term only suitable on catchment of similar characteristics to those from which it was derived
  - C_v = Volumetric Runoff coefficient
  - C_{10} = 'Peak' Flow Runoff coefficient
- Based on 'soil hydrologic group' and 'design rainfall' Blue Book Reference Appendix F

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"Coefficient of Runoff"

Table F2. Runoff coefficients (Cv) for volumetric data in disturbed catchments (adapted from USDA, 1996)

Soil Hydrologic Group	Design Rainfall depth (mm)							Runoff potential
	<20	21-25	26–30	31–40	41-50	51-60	61-80	
A	0.01	0.05	0.08	0.15	0.22	0.28	0.37	very low
B	0.10	0.19	0.25	0.34	0.42	0.48	0.57	low to moderate
C	0.25	0.35	0.42	0.51	0.58	0.63	0.70	moderate to high
D	0.39	0.50	0.56	0.64	0.69	0.74	0.79	high

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Mine Site problem – solution

- Design Criteria:
  - Design rainfall depth = 5-day, 75th percentile (19.0 Scone - 24.4 Newcastle) = 26.8mm
  - R-factor = 1,500 (Singleton)
  - Volumetric runoff (Cv) = 0.42 (mod-high)
- Design Solution:
  - Settling zone (Type D) = 10 x Cv x A x R
    = 10 x 0.42 x 1.5 x 26.8 = 169m^3
  - Storage Zone = 84.5m^3

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Maintenance

- Pump out wet basins after sufficient settling time / flocculation has occurred, to restore design capacity in time for the next storm
- Inspect / test the quality of outlet waters to assess performance
- Remove sediment once the sediment storage zone is full
- Regularly check the integrity of the basin, particularly inlet/outlet structures, and repair any damage

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Channel Design

- Drainage channels (catch drains, table drains, slope drains, diversion banks etc.) are an important tool for managing both clean and dirty water in and around construction sites
- Critical design characteristic for channel is 'design discharge' or "Q"

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Design Discharge "Q"

- The estimated 'peak' discharge (m^3/s) for a given storm ARI (Y)
- ARI – Average Recurrence Interval
- For example, Q_{10} is the peak discharge from a 1 in 10 year design storm event
- "Q" can be estimated many ways

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Design Methods

- Complex numerical models:
  - DRAINS
  - RORB
  - RAFTS
- The 'Rational Method' – simple empirical formula, 50-200% of real values, but tends to overestimate.
- OK for temporary structures

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"Rational Method"

Uses key hydraulic parameters to estimate peak discharge Q=CIA/360

Including:

- Catchment Area – (A) (ha)
- Design Rainfall Intensity – (I) (mm/hr)
- Coefficient of Discharge – (C_{10})
- Critical Storm duration – (t_c) (mins)

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"Catchment Area"

- "A" is the effective catchment area upstream of the point of interest (i.e. discharge point)
- Should be calculated for each sub-catchment area feeding individual structures
- Remember to divert all unnecessary water

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"Average Rainfall Intensity"

- "I" is compound function for a given storm duration (t_c) and storm frequency (Y)
- Typically selected from Intensity-Frequency-Duration (IFD) charts developed for specific locations
- Design storm selection is task specific

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"Time of Concentration"

- "t_c" is the theoretical time required for runoff to flow from the furthest part of the sun-catchment to the point of interest (where discharge is being calculated)
- Determines the shortest storm duration that will contribute flow from the whole sub-catchment at one time
- Can determine from tables/graphs

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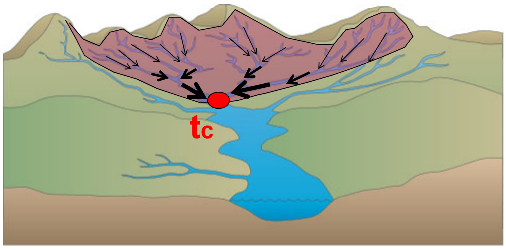
"Time of Concentration"



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"Time of Concentration"

For Urban Areas, either reduce rural t_c values by 50% or undertake detailed calculations:

- Sheet flow estimate
- Kerb flow estimate
- Pipe flow estimate
- Channel flow estimate

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Design Application

- Assume we are to design a temporary catch drain to collect and transfer 'dirty water' from a 1.5ha compound area to the sediment basin
- Assume the drain will be used throughout the 18 month construction period

What is the Design Storm Event (Y)?

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"Design Storm Event"

- "Y" is a fictitious, isolated storm event of varying frequency and duration
- Selection based on the expected design life of the structure, typically:

Drainage Structure	Design Life (months)		
	<12	12-24	>24
Catch drains, flow diversion berms etc.	1 in 5 year	1 in 10 year	1 in 10 year

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"Coefficient of Discharge"

Table F3 Runoff coefficients (C10) for peak flow data in disturbed catchments

Soil Hydrologic Group	Rainfall intensity (mm) in the design storm						Runoff potential
	<20	21-40	41-60	61-80	81-100	>100	
A	0.20	0.37	0.55	0.64	0.68	0.75	very low
B	0.46	0.58	0.70	0.75	0.78	0.82	low to moderate
C	0.69	0.76	0.83	0.85	0.86	0.88	moderate to high
D	0.80	0.86	0.89	0.90	0.90	0.90	high

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Design Application

- Assume the catchment is highly compacted, with slopes between 2-5% and the distance from the furthest point to the discharge location is <50m

What is the Time of Concentration (t_c)?

- ~5 minutes (estimated)

What is the average rainfall intensity for the design storm duration?

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Design Storm Duration/Intensity

Location

Label: Mt Thorley
Latitude: -32.6259 [Nearest grid cell: 32.6375 (S)]
Longitude: 151.1064 [Nearest grid cell: 151.1125 (E)]

IFD Design Rainfall Depth (mm)

Issued: 17 August 2022

Rainfall depth for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).
FAQ for New ARR probability terminology

Unit: mm

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	1.75	1.98	2.75	3.32	3.91	4.75	5.44
2 min	2.94	3.30	4.49	5.35	6.23	7.34	8.26
3 min	4.08	4.59	6.27	7.49	8.74	10.4	11.7
4 min	5.11	5.76	7.92	9.49	11.1	13.3	15.1
5 min	6.04	6.82	9.42	11.3	13.3	16.0	18.3
10 min	9.57	10.8	15.1	18.3	21.6	26.4	30.4
15 min	12.0	13.6	18.9	22.9	27.1	33.2	38.2
20 min	13.8	15.6	21.7	26.3	31.0	37.9	43.6
25 min	15.2	17.2	23.9	28.8	34.0	41.5	47.6
30 min	16.4	18.5	25.7	30.9	36.4	44.2	50.7

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Design Solution

- Now we can solve for the peak discharge in the 1 in 10 year (Q_{10}) event, remembering:
- Q = C.I.A / 360 (m^3/s)
- Q = (0.76) x (11.3) x (1.5) / 360
- Q = 0.036 m^3 per second or (36 L/sec)

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Stabilisation at project completion

- In periods of low rainfall erosivity, must achieve and maintain C-factor of 0.15
- In periods of moderate to high rainfall erosivity, must achieve C-factor of 0.1 in 20 days and further reduce the C-factor to 0.05 within 60 days

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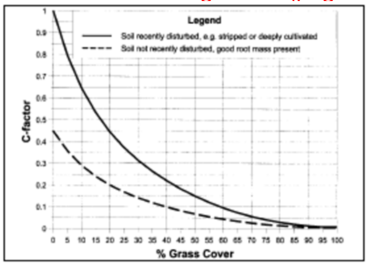
C-factor

- Blue Book Reference Figure A5 (page A-12)



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Rainfall erosivity

- Blue Book Reference Table 6.2 (page 6-23) and Rainfall Zone map Figure 4.9 (page 4-16)
- R-factor x % Average Annual Erosion Index (EI) in each month
- Less than 100 = Low
- 100 or more = Moderate or High
- Use half-monthly figures with caution

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Rainfall erosivity - Exercise

What would the rainfall erosivity be for:

- Port Stephens, R-factor 2,900, Rainfall Zone 1, in January, and July?
- Wagga Wagga, R-factor 1,100, rainfall Zone 10, in January, and July?

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Finally

- Note that every site is different and requires an individual plan
- Note the special requirements of high hazard sites
- Take particular care when working in and around watercourses
- Remember the strict requirements below the 2-year ARI flood level
- Ensure that your plan considers all constraints

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Finally

- You should now be able to confidently and competently use the Blue Book
- You should understand which type of plan is required and what should go into it
- You should be able to consider and assess all issues relevant to a site
- You should be able to use RUSLE and understand how it is used in the Blue Book

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