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Primary Erosion and Sediment Control Plan

for proposed 7-lot subdivision of Portion 14, Parish of Narrabarba and Lot B DP 33573, Wonboyn Lake

Prepared by:

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22 February 2008

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Document Certification

This report has been developed based on agreed requirements as understood by SEEC Morse McVey at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations should not be made, including changes in scale or application to other projects.

Any recommendations contained in this report are based on an honest appraisal of the opportunities and constraints that existed at the site at the time of investigation, subject to the limited scope and resources available. Within the confines of the above statements and to the best of my knowledge, this report does not contain any incomplete or misleading information.

Mark Passfield
Director
SEEC Morse McVey

22 February 2008

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Contents

1 Introduction

SEEC Morse McVey have been commissioned by Mr Doug Hemmingway of Picnic Point P/L to provide this *Primary Erosion and Sediment Control Plan* (ESCP). It is required to accompany an application to subdivide Portion 14, Narrabarba ("the site" Figure 1) into seven new rural lots as shown on the layout plan in Figure 2.

It has been prepared following guidelines contained in:

(i) *Managing Urban Stormwater: Soils and Construction* Volume 1(Landcom 2004) (The "Blue Book");

(ii) *Managing Urban Stormwater: Soils and Construction* Volume 2D, Sealed Roads, DECC, DRAFT, 2007 and

(iii) *Managing Urban Stormwater: Soils and Construction* Volume 2C, Unsealed Roads, DECC, 2007.

This plan contains detailed background information, risk assessments, and discussion. It provides preliminary calculations and sufficient detail to show clearly that the works could proceed without undue pollution to receiving waters. Subject to any conditions of consent, one or more Progressive ESCPs might be required at construction stage but the project is considered small enough to only require minor alterations to this primary plan.

This Primary ESCP consists of two parts:

(iv) This commentary, containing supporting text, diagrams and engineering calculations; and

(v) A series of drawings (Drawing Numbers 07000168–ESCP-01-03) that shows the layout of appropriate soil and water management works.

The site is in the Wonboyn Lake Catchment and Bega Valley Shire's DCP 36 applies. SEEC Morse McVey staff inspected the site on 19th October 2007. At that time the weather was cool and dry.

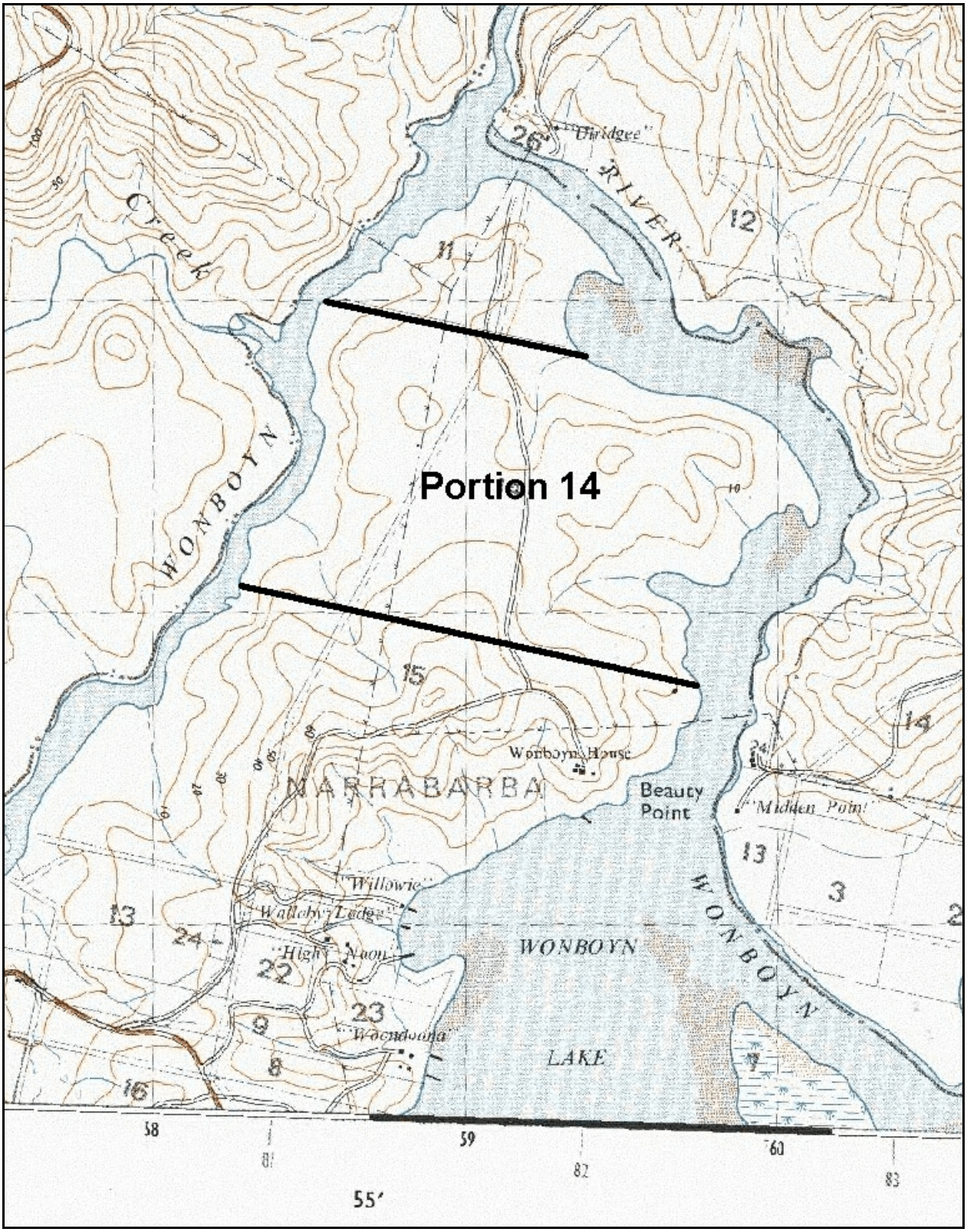

Figure 1 - The site, topographic map © Dept Lands

2 Proposed Development

The proposed development involves (Figure 2):

(i) subdividing the site into seven new rural lots as follows:

- Lot 1 at 3.91 ha
- Lot 2 at 3.95 ha
- Lot 3 at 3.22 ha
- Lot 4 at 4.07 ha
- Lot 5 at 2.83 ha
- Lot 6 at 3.54 ha; and
- Lot 7 = residual

(ii) building an new right of carriageway (ROW) to access each new lot (see SEEC Morse McVey drawing number 07000168-01);

(iii) building seven new driveways from the ROW to access each lot; and

(iv) building a new fire trail from the end of the ROW to Portion 11 (Picnic Point)

Although we expect a house will be constructed on all new lots these are not included as part of this DA.

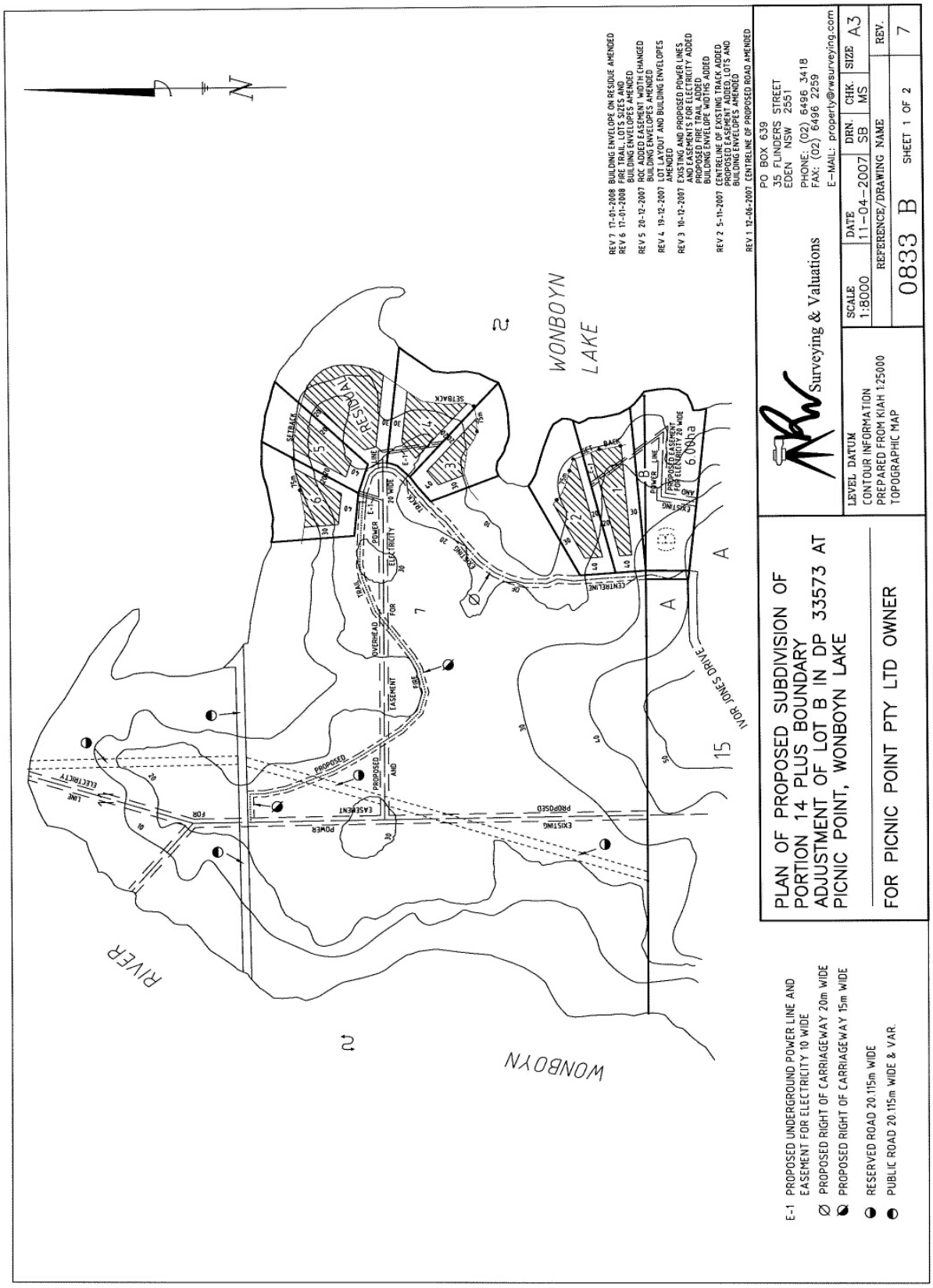

Figure 2 – Proposed Subdivision

3 Site Description

3.1 General Topographic Conditions

Portion 14 occupies part of a peninsula of land located on the western shore of Wonboyn Lake (Figure 1). It is bound in the east and west by Wonboyn River. The ROW will be built on the east of the peninsular but the fire trail will be built in the central north of the site (Figure 2).

Much of Portion 14 occupies a broad plateau with slope gradients less than 10 percent. Most of the proposed ROW and the fire trail will be in this area. Figure 3 shows the typical conditions on the land.

Figure 3 – Typical conditions in the building areas.

3.2 Soils and Geology

3.2.1 Mapping

Soil Landscape mapping for this area was conducted by M. Tulau (2005), Department of Natural Resources (DNR, now part of the Department of Environment and Climate Change, DECC). It shows that Portion 14 lies on four soil landscapes (Figure 4). Site and soil investigations by SEEC Morse McVey staff was limited to the areas proposed for development, i.e. the ROW and the dwelling envelopes. Here we confirmed the mapping to be mostly accurate.

The four soil landscapes mapped on the development site are:

(i) The Bournda SL in the west

(ii) The Timbillica SL in the centre and centre-east;

(iii) The Merrica SL in the east; and

(iv) The Wonboyn Lake SL in a small area in the far east of Lot 7.

Most of the proposed ROW is on the Merrica Soil Landscape, facet "mec". This is a colluvial soil landscape derived on the Merimbula Group sandstones and siltstones. The soil landscape descriptions note "mec" facet as very rocky on steep slopes but that is not the case here – none of the lands inspected had rock outcrop (except on the shore) and the soils had a low to moderate percentage of coarse fragments. Therefore, I believe the soil facets present here are:

- me2 (a brown sandy loam); and
- me3 (a dull yellowish sandy clay).

Subsoils on the Merrica SL can vary within short distances and can be dispersive. M. Tulau (2005) recommends that these soils be site-specific tested before earthworks, and that has been undertaken here . The soils are noted as having a moderate susceptibility to erosion by concentrated flow but a low susceptibility to erosion by wind or sheet flow.

A small part of the ROW, and most of the fire trail, will be on the Timbillica Soil Landscape. It consists of coarse grained sandy topsoils and sandy clay subsoils derived on Tertiary fluvial sediments. Generally, this soil landscape is very similar to the Merrica SL although where it was sampled (on the proposed road alignment, near to Lot 2) the clay subsoil was absent (replaced with a clayey sand).

Both soil landscapes are classified as Hydrological Class C - even though rainfall is expected to infiltrate the permeable near-surface soils. This is because they are shallow in nature and clayey at depth. Soils of this classification shed rainfall under moderate to high rainfall events.

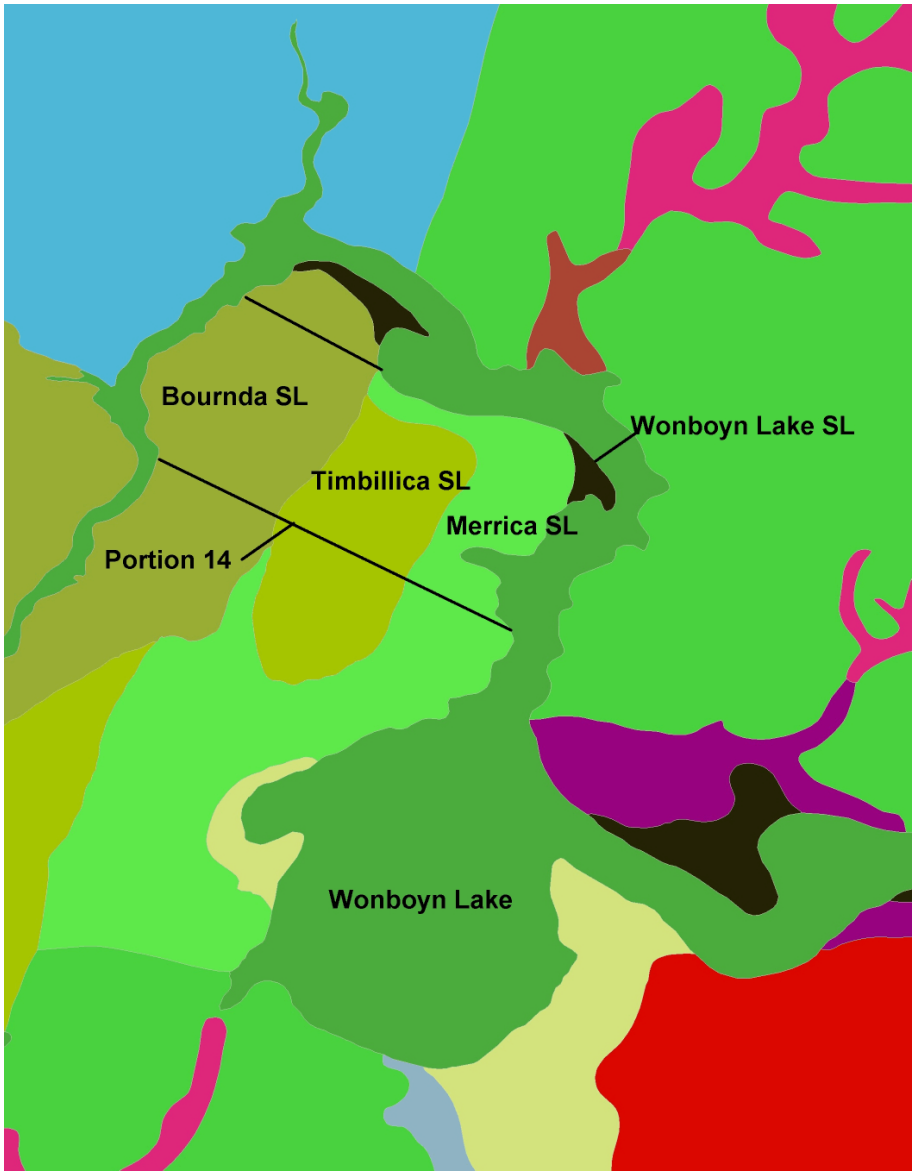

Figure 4 – Soil mapping of Portion 14

3.2.2 Site Specific

Test pits were dug by hand and supplemented by Dynamic Cone Penetrometer (DCP) tests to prove depth to bedrock. All test pits except TP1 showed a consistent soil profile of:

0 - (200-300) mm	Grey sandy loam, massive
(200-300) - (800-900) mm	yellow brown sandy clay loam to light clay, moderately pedal.

Bedrock was normally encountered within 1,000 mm although one DCP test (near Lots 5 and 6) proved a soil depth of 1,200 mm.

TP1 represents the Timbillica Soil Landscape. It showed gritty and sandier soils than elsewhere. As these soils would be less erodible than the Merrica SL, they were not sent for testing (i.e we have assumed the worst case).

3.2.3 Laboratory Testing

Soil samples representing the Merrica Soil Landscape we sent to Scone Research Laboratories for an "erosion and sediment control" suite of tests. The results are given in Table 1.

Table 1 - Soil Testing Results (Dept. Lands)

Lab No	Method	C1A/4	C2A/3	C5A/3 CEC & exchangeable cations (me/100g)						C8B/1		C6A/2	P9B/2
	Sample Id	EC (dS/m)	pH	CEC	Na	K	Ca	Mg	Al	P sorp (mg/kg)	P sorp index	OC (%)	EAT
1	07000168 Layer 1	0.01	5.1	6.6	0.4	0.2	0.9	1.0	<0.1	152	1.5	1.38	2(1)
2	07000168 Layer2	0.01	5.6	9.1	0.5	0.2	0.4	1.6	1.5	401	3.0	0.44	2(1)

Lab No	Method	P7B/1 Particle Size Analysis (%)						P8A/2	P7C/1 Particle Size Analysis – mechanical dispersion (%)					
	Sample Id	clay	silt	vf sand	cf sand	c sand	gravel	D%	clay	silt	vf sand	cf sand	c sand	gravel
1	07000168 Layer 1	7	12	32	13	32	4	54	4	13	31	13	35	4
2	07000168 Layer2	26	15	21	9	26	3	82	23	18	19	9	28	3

END OF TEST REPORT

They show that soils:

- are silty sand (topsoil) or silty clayey sand (subsoil)
- are strongly acidic
- are marginally sodic;
- are significantly dispersive (subsoils) (dispersion percentage of fines = 82%, dispersion percentage of whole soil = 26 percent);
- have a low K-Factor (erodibility) of 0.025
- have low CEC (low ability to entrain nutrients or pollutants)
- have low organic matter (coupled with their fine sandy loam texture this means they can be hard-setting)
- have low potassium.

3.3 Existing Drainage

Most of the proposed development is on the east-facing side slope of Lake Wonboyn, with the ROW and the fire trail proposed on the plateau. Stormwater is shed from the

plateau east and west towards the lake. On the eastern side it concentrates in three depressions (Figure 2) but there are no watercourses with defined bed or banks. The ROW crosses the upper reaches of these depressions. Up-slope catchments for these catchments vary from 4 ha to 15 ha.

The receiving waters are Lake Wonboyn, a near pristine and environmentally sensitive lake that has oyster leases and recreational fishing.

3.4 Climate

Wonboyn has a temperate climate, with warm summers and temperatures below 15°C in winter. Mean annual rainfall at nearby Eden or Green Cape is about 750 mm (Australian Bureau of Meteorology). Rainfall is fairly consistent throughout the year. The estimated rainfall erosivity for Wonboyn is 2,620, which is moderate, the site is (generally) not exposed to high intensity rainfall.

3.5 Summary

The important site and soil characteristics are summarised in Table 2.

Table 2: Important Site and Soil Physical Characteristics.

Constraint/Opportunity		Value
Soil erodibility:	sheet flow	low, K-factor = 0.025
	concentrated flow	moderate
	wind	low
Slope gradient		mostly less than or equal to 7 percent but some areas to 13 percent
Rainfall Erosivity		2,620 (moderate)
Soil Loss Class [1]		≤7% slope = 1 (very low) 8-9 % slope = 2 (low) 10-13% = 3 (low to moderate)
Soil Texture Group		Type D (dispersive)
Rainfall Zone		1 (coupled with Soil Loss Class this means construction may occur at any time during the year)
Soil Hydrologic Group		Group C
LS-factor		Usually <1.8 but up to 3.7

1 Based on a disturbed slope length of 80 m, P-Factor = 1.3, C-Factor = 1.0

4 Background

4.1 Key Assumptions

(i) Figure 2 shows the latest development proposal;

(ii) The site is on the Merrica Soil Landscape which is significantly dispersive.

4.2 Key Management Principles

- minimising site disturbance to that necessary only for works;
- minimise forward clearing - especially near to drainage depressions or watercourses (see section 4.3). If forward clearing is done then clear with a tritter machine and leave the litter on the ground surface;
- conserve topsoil for rehabilitation and lining table drains;
- mulch cleared vegetation and stockpile it for use on site;
- minimising cut and fill;
- control "clean water" flow from upslope;
- ensuring subsoils are exposed for as shorter time as possible;
- very promptly line table drains with grass, aided by organic matting and soil amelioration;
- rapid rehabilitation of disturbed lands; and
- having ready measures to mitigate unforseen erosion during heavy rainfall events.

4.3 Sediment Control Basins

Sediment control basins are required in individual catchments where the predicated annual soil loss is more than 150 m^3 (Landcom, 2004). This is a function of slope (and hence soil loss) and area (road length x 20 m [2]) (Table 3).

Table 3 - Length of road required in an individual catchment to trigger a sediment basin

Slope	Estimated Soil Loss	Length of road to trigger a sediment basin
≤6%	114 m^3/h/y	680 m
7≤9%	154 m^3/h/y	500 m
10≤13%	351 m^3/h/y	225 m

Individually these are not exceeded but, if both sides of the main depression were cleared at once, the limit would be reached. Therefore, to negate the need for sediment basins, only one side of the main depression should be cleared at once (Section 4.2).

2 The estimated maximum width of disturbance

4.4 Design Assumptions

- the IFD data is given in Appendix 2.
- the peak flow runoff coefficient (C_{10}) is assumed to be 0.4 for undisturbed catchments and 0.86 for disturbed areas.
- project duration is less than 6 months.
- Stability of temporary erosion and sediment control measures (e.g. earth banks, catch drains, sediment fences etc.) must be designed to the 5-year ARI storm event (DECC, 2007).
- Stability of permanent measures (e.g. table drains) must be designed for the 20-year ARI storm event (DECC, 2007).
- Maximum cut or fill batters expected = 1.0 m long at 3:1
- The disturbed width of road or fire trail alignment is 20 m.

5 General Instructions

(i) The contractors must read this ESCP commentary together with:

- any engineering plans
- drawing numbers 07000168-ESCP-01 to 03

(ii) Contractors will be informed (inducted) of their responsibilities in minimising the potential for erosion and pollution of receiving waters. Contractors will be informed of their responsibilities under relevant legislation (e.g. POEO Act, 1997).

(iii) The contractors will prepare one or more Progressive ESCPs that refer to this primary ESCP. The Progressive ESCPs will be reviewed regularly (at least once per week) for the duration of the construction period. The Progressive Plan(s) will be:

- reviewed by a certified professional in erosion and sediment control (CPESC)
- prepared on relevant copies of the Drainage Drawings for:
  - different stages of construction
  - areas of high hazard (i.e. slopes more than 9 percent)
  - specific areas outside the road alignment (e.g. site compound, access tracks etc.)
- integrated with:
  - Work procedures
  - Work Method Statements
  - Activity Statements
- given a sequential number (if more than one supplied)
- controlled and distributed in accordance with the contractor's Quality System

6 The Plan

6.1 Site Preparation

Site preparation must be complete before construction begins and works must be undertaken in the order they are given. Refer to Drawing numbers 07000168-ESCP-01 to 03. Note that access for machinery at this stage should be limited to only that required to undertake the preparation works.

(i) Establish a single site entrance to the requirements of Standard Drawing (SD) 6-14 (Appendix 3);

(ii) Establish the site sheds and any services required to the sheds, stabilise any disturbed areas;

(iii) Clear vegetation as the road progresses, mulch it and stockpile it for use as groundcover;

(iv) Define the alignment of the works by installing

- temporary barrier tape upslope; or
- sediment fence downslope of the alignment.

6.2 Construction Phase

Works must be undertaken in the order they are given.

(i) Road work can now begin;

(ii) Build the upslope table drains first as these will collect clean water from upslope and divert it around the construction works. Stabilise their downstream outlets;

(iii) Open up only a length of road that can be built efficiently;

(iv) Strip and stockpile the topsoil from the road alignment. Stockpile the topsoil as shown in SD 4-1;

(v) Undertake the required earthworks following the engineering plans;

(vi) When roadworks for that stage are complete rehabilitate any disturbed land (see Section 8) and begin the next stage of construction;

(vii) When roadworks are finished provide final stabilisation and rehabilitation.

7 Methods of Erosion Control

The subsoils are significantly dispersible. Section 4.3 determined that sediment basins are not required, based on calculated soil losses. However, in their absence it is critical that subsoils are not exposed to concentrated flow and that all disturbed lands are promptly rehabilitated. To ensure this is so:

(i) Site disturbance will be limited to that shown in the Progressive ESCP(s).

(ii) Barrier fencing will be erected to prevent access to restricted areas.

(iii) Vehicular access to disturbed lands will be confined to that essential for construction work.

(iv) The soil erosion hazard will be kept as low as possible by minimising land disturbance and ensuring quick rehabilitation. Some ways of doing this are outlined in Table 4.

Table 4 - Limitations to Access

Land use	Limitation	Comments
Construction areas	Limited to 5 (preferably 2) metres from the edge of any essential construction activity as shown on the engineering plans	All site workers should clearly recognise these areas that, where appropriate, are identified with barrier fencing (upslope) and sediment fencing (downslope) or similar materials.
Access areas	Limited to a maximum width of 5 metres	
Remaining lands	Entry prohibited except for essential management works	This will ensure existing vegetative cover is maintained

(v) Before construction activities, topsoil material will be stripped and stockpiled (SD 4-1). Stockpiles must be at least five metres from areas of likely concentrated water flow. If necessary provide an earth bank upslope. Provide sediment fence downslope.

(vi) Where practicable the construction programme will be scheduled so that the time from starting land disturbance in a particular phase to final stabilisation of that phase is a duration of less than 6 months. Here stabilisation means achieving a C-Factor (Appendix 1) of less than 0.1 and setting in motion a program that will ensure it stays there. While C-Factors are likely to rise to 1.0 during construction they will not exceed those given in Table 5.

The requirements of Table 5 can be achieved with a temporary vegetative cover and a suggested listing of suitable plant species is shown in Table 6 (note, these plants only protect the ground surface for up to six months). Depending on the Landscape Plan, sterile seed may be used to prevent unwanted spread of these species.

Table 5 - Maximum Acceptable C-factors at Nominated Times During Works

Lands	Maximum *C*-factor	Remarks
Waterways and other areas subjected to concentrated flows, post construction	0.05	Applies after ten working days from completion of formation and **before** they are allowed to carry any concentrated flows. Flows will be limited to those shown in Table 5.2 of the Blue Book. Foot and vehicular traffic will be prohibited in these areas
Stockpiles, post construction	0.1	Applies after ten working days from completion of formation. Maximum *C*-factor of 0.10 equals 60% ground cover
All lands, waterways and stockpiles during construction	0.15	Applies after 20 working days of inactivity, even though works might continue later. Maximum *C*-factor of 0.15 equals 50% ground cover

Table 6 - Plant Species for Temporary Cover

Growing Season	Seed Mix
Autumn / Winter	oats @ 40 kg/ha
	Japanese millet @ 10 kg/ha
Spring / Summer	Japanese millet @ 20 kg/ha
	oats @ 20 kg/ha

(vii) Use sheet-flow interceptors every 50 m on any exposed subgrade. This will reduce the effective slope length on bare soils and keep the soil loss class to no more than Class 2. They will be directed onto existing vegetated lands;

(viii) Have rolls of geotextile matting available at all times. Use it to provide temporary surface protection in areas of concentrated flow (SD 5-7);

(ix) Use stockpiled mulch for emergency ground cover in areas subject to sheet or wind erosion;

(x) Ensure the site is left stable during periods of inactivity, ensure table drains are lined and flow interceptor are in place;

(xi) On completion of major works, and before revegetation of the disturbed areas, leave disturbed soils with a loose surface to encourage water infiltration and help with keying topsoil;

(xii) Spread topsoil to a minimum depth of 75 mm in revegetation areas (including table drains) (SD 4-2). Do this quickly as the topsoils are not dispersive;

(xiii) Use lime (at about 250 gsm) to neutralise the soil's natural strong acidity and help establish vegetation;

(xiv) Final site landscaping will be undertaken as soon as possible and within 10 working days from completion of construction activities. This will include revegetation to provide a quick, temporary cover before a more permanent cover is established (Hydromulching could be used here);

(xv) Plants will be watered regularly until an effective cover has established and plants are growing vigorously;

(xvi) Plants will be fertilised as required to assist growth. Watering, lime and fertiliser requirements should be described in the landscape plan.

In addition to the above, the following special measures will apply for a distance of 50 m either side of a depression:

- if it is raining or is forecast to rain within 3 days, all lands in this zone will be stabilised to rapidly achieve a C-factor (see Appendix 1) of 0.15. The simplest way to achieve this at this site is to lay erosion control materials (e.g. organic fibre blankets) over any bare soil areas. These must remain in place until the 3-day weather forecast suggests that rain is not likely; AND
- a management plan must be in place to rapidly stabilise any exposed soils (including fill batters) in this zone if a rain event occurs (i.e. if the forecast is wrong). This means having erosion control materials (e.g. organic fibre blankets) available on site to lay over bare soils to protect them during the rain event.

8 Methods of Pollution Control

(i) **The primary method of pollution control at this site will be ensuring that the potentially dispersive subsoils are not exposed to concentrated rainfall;**

(ii) Sediment Fencing (SD 6-8) will be installed where shown on the Progressive ESCP(s) and at the discretion of the site manager;

(iii) Use cleared vegetation for timber windrow sediment traps and filters;

(iv) Sediment trapped in any trapping device will be disposed in locations where further erosion can not occur.

(v) Safe storage areas will be provided for fuels, oils, chemicals or other hazardous substances. Such areas will be placed strategically around the site where they can be easily accessed by workers and also by licensed waste contractors.

(vi) Provide a water quality monitoring program in the receiving waters just before they meet the Lake, to ensure the effectiveness of the measures. Runoff should contain no more than 50 mg/L of suspended solids.

9 Site Monitoring and Maintenance

(i) A rain monitoring station will be installed, measuring daily rainfall. The site superintendent will maintain a full rainfall record, for submission to the supervising authorities in the event of a pollution event. Pluviograph data (for measuring storm intensities) is available from the BOM for Green Cape, which is close by.

(ii) The site superintendent will inspect the site after:

- each rainfall event;
- before closure;
- and, otherwise, at least weekly.

(iii) Following the guidelines of Chapter 8 in Landcom, 2004 he/she will pay particular attention to:

- removal of spilled materials from near hazard areas;
- ensuring barrier fencing is maintained and exclusion zones are being observed by all site workers and contractors;
- ensuring progressive and prompt rehabilitation of lands, that rehabilitation has effectively reduced the erosion hazard – initiate upgrading or repair as appropriate;
- constructing additional erosion and/or sediment control works as might become necessary to ensure the desired water control is achieved, i.e. make ongoing changes to the Progressive ESCPs;
- maintaining erosion and sediment control measures in a functioning condition until all earthwork activities are completed and the site is rehabilitated;
- removal of trapped sediment and disposal to safe areas;
- ensuring drains are unobstructed, including removing excessive vegetation as necessary;
- ensuring the stability of drainage structures (earth banks etc.); and
- ensuring stockpiles are stable and protected from run-on.

(iv) A self-audit check sheet will be prepared to aid the inspections.

(v) Post construction

- Regularly inspect revegetation areas, investigate failures and replant as necessary;
- Ensure an adequate watering and fertilising system is maintained in revegetation areas;
- Remove any accumulated debris from stormwater traps;
- Identify any areas of localised soil erosion and use preventive measures.

This might include:

- Planting additional stabilising vegetation or wind breaks
- Stabilising soils with mulch or alternative soil binder
- Taking steps to minimise any concentrated stormwater flows.

10 Appendices

10.1 Appendix 1: Site and Soil Terms

***R*-factor**

The rainfall erosivity factor, *R*, is a measure of the ability of rainfall to cause erosion. It is the product of two components: total energy (*E)* and maximum 30 minute intensity for each storm (I_{30}). However, Rosewell and Turner (1992) have identified a strong correlation between the *R*-factor and the 2-year ARI, 6-hour storm event. The *R*-factor is calculated using the Department of Infrastructure, Planning and Natural Resource's computer program, *RAINER*. This program calculates IFD tables and computes the *R*-factor from interpolated rainfall values drawn directly from Pilgrim (1987). An IFD table for the site is contained in Appendix B. R-factors for NSW usually range between about 750 in the western zone and 9,500 on the north coast. The *R*-factor for this site is 2,620 which is moderate. Note however, that this is the long term average annual rainfall erosivity and in reality the rainfall erosivity varies markedly throughout the year. The site is within rainfall Zone 1 (Figure 4.9 and Table 4.3 in the Blue Book).

***K*-factor**

The soil erodibility factor, *K*, is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff. Texture is the principle component affecting *K*, but structure, organic matter and permeability also contribute. In the RUSLE, it is a quantitative value that is normally experimentally determined. In NSW the K-factor normally ranges between about 0.005 and 0.075. In this case the *K*-factor adopted is 0.025 and is based on site-specific soil testing.

***LS*-factor**

The slope length–gradient factor, *LS*, describes the combined effect of slope length and slope gradient on soil loss. It is the ratio of soil loss per unit area at any particular site to the corresponding loss from a specific experimental plot of known length and gradient. Slope length and gradient for this site vary (Table 1).

***P*-factor**

The erosion control practice factor, *P*, is the ratio of soil loss with a nominated surface condition ploughed up and down the slope. It is reduced by practices that reduce both the velocity of runoff and the tendency of runoff to flow directly downhill. At construction sites, it reflects the roughening or smoothing of the soil surface by machinery. The *P*-factor here is 1.3, that normally assigned to urban construction sites.

***C*-factor**

The cover factor, *C*, is the ratio of soil loss from land under specified crop or mulch conditions to the corresponding loss from continuously tilled, bare soil. The *C*-factor is different from the runoff coefficient used in the rational method. The most effective method of reducing the *C*-factor is maintenance of, or formation of, a good ground cover. The best practices are those that reduce both the soil exposed to raindrop impact

and the erosive effects of runoff. The *C*-factor assigned here during construction works is 1.0, typical of that for bare soil. Table A3 in the Blue Book provides estimated C-factors for various cover types. It should be referenced by the contractor.

Soil Loss Class

The Soil Loss Class system described here places sites into seven groups that differ because of varying calculated soil loss. These groups assume that a soil loss of 37.5 tonnes per hectare per fortnight (half-month) can be managed easily using conventional erosion and sediment control techniques (Morse and Rosewell, 1996). Table A2 describes the soil loss classes. The soil loss class for this site is Class 1 (very low) to Class 3 (low to moderate) depending on the gradient.

Table A2 - The 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	extreme

10.2 Appendix 2: IFD Data

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********************** RAINER ******************************
       DEPARTMENT of CONSERVATION and LAND MANAGEMENT
Date: 22/11/2007


Rainfall Intensity (mm/h) for EDEN
       1 hour, 2 years : 38.00
      12 hour, 2 years :  6.90
      72 hour, 2 years :  2.10
       1 hour, 50 years : 81.00
      12 hour, 50 years : 17.20
      72 hour, 50 years :  4.90
                Skewness :  0.15
Geographical factor F2 :  4.20
Geographical factor F50: 15.75
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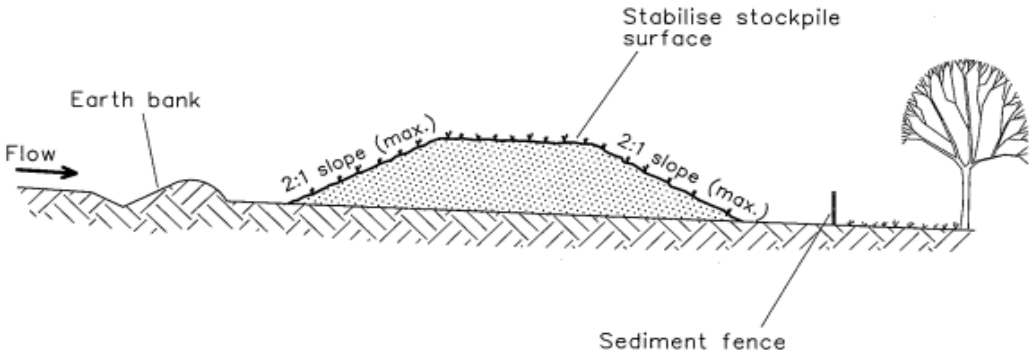
\DUR ARI	5m	6m	10m	20m	30m	1h	2h	3h	6h	12h	24h	48h	72h	User
1	90	85	70	51	41.6	28.6	17.8	13.4	8.22	5.06	3.29	2.09	1.56	0.00
2	117	110	90	67	54	37.6	23.5	17.8	11.0	6.81	4.42	2.79	2.08	0.00
5	152	143	118	88	72	50	32.2	24.6	15.5	9.76	6.26	3.91	2.89	0.00
10	173	163	136	101	84	59	37.7	29.0	18.4	11.7	7.49	4.66	3.43	0.00
20	202	190	159	119	98	69	44.9	34.7	22.2	14.3	9.08	5.62	4.12	0.00
50	240	227	190	143	118	84	55	42.6	27.6	17.9	11.3	6.96	5.09	0.00
100	271	256	214	161	134	95	63	49.0	31.9	20.9	13.1	8.05	5.87	0.00
User	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

```
Estimated Rainfall Factor (R): 2620   Estimated 1:10 Storm (S10): 2230
```

	Years						
min	1	2	5	10	20	50	100
7	80	104	135	155	181	216	243
8	76	99	129	148	172	206	232
9	73	94	123	141	165	197	222
10	70	90	118	136	159	190	214
11	67	87	114	131	153	183	206
12	64	84	110	126	148	177	199
13	62	81	106	122	143	171	193
14	60	78	103	118	139	166	188
15	58	76	100	115	135	161	182
16	57	74	97	112	131	157	178
17	55	72	95	109	128	153	173
18	54	70	92	106	124	149	169
19	52	68	90	104	121	146	165
20	51	67	88	101	119	143	161
21	49.8	65	86	99	116	139	158
22	48.7	64	84	97	114	137	155
23	47.6	62	82	95	111	134	152
24	46.6	61	81	93	109	131	149
25	45.7	60	79	91	107	129	146
26	44.8	59	78	90	105	127	143
27	44.0	57	76	88	103	124	141
28	43.2	56	75	86	102	122	139
29	42.4	55	74	85	100	120	136
30	41.6	54	72	84	98	118	134
31	40.9	54	71	82	97	116	132
32	40.3	53	70	81	95	115	130
33	39.6	52	69	80	94	113	128
34	39.0	51	68	79	92	111	126
35	38.4	50	67	77	91	110	125
36	37.9	49.6	66	76	90	108	123
37	37.3	48.9	65	75	89	107	121
38	36.8	48.2	64	74	87	106	120
39	36.3	47.5	63	73	86	104	118
40	35.8	46.9	63	72	85	103	117
41	35.3	46.3	62	71	84	102	115
42	34.9	45.7	61	71	83	100	114
43	34.4	45.1	60	70	82	99	113
44	34.0	44.6	59	69	81	98	112
45	33.6	44.0	59	68	80	97	110
46	33.2	43.5	58	67	79	96	109
47	32.8	43.0	57	67	79	95	108
48	32.4	42.5	57	66	78	94	107
49	32.0	42.0	56	65	77	93	106
50	31.7	41.6	56	64	76	92	105
51	31.3	41.1	55	64	75	91	104
52	31.0	40.7	54	63	75	90	103
53	30.7	40.3	54	63	74	89	102
54	30.4	39.9	53	62	73	88	101
55	30.1	39.5	53	61	72	88	100
56	29.8	39.1	52	61	72	87	99
57	29.5	38.7	52	60	71	86	98
58	29.2	38.3	51	60	70	85	97
59	28.9	37.9	51	59	70	85	96

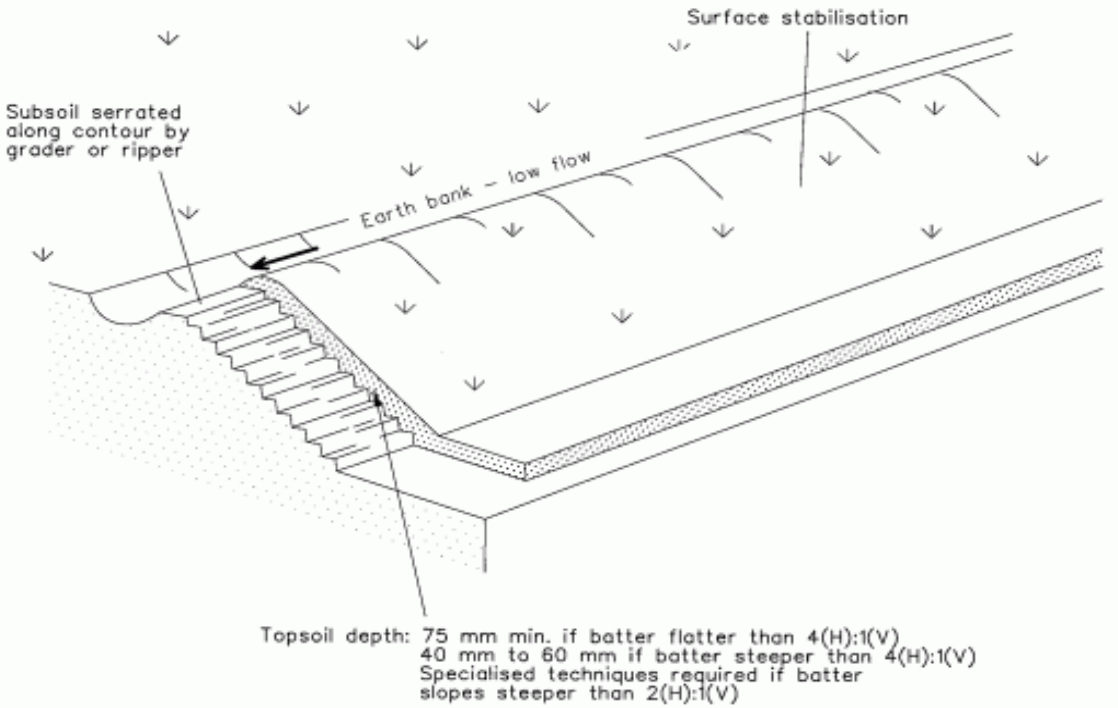
10.3 Appendix 3: Standard Drawings



Construction Notes

1. Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
2. Construct on the contour as low, flat, elongated mounds.
3. Where there is sufficient area, topsoil stockpiles shall be less than 2 metres in height.
4. Where they are to be in place for more than 10 days, stabilise following the approved ESCP or SWMP to reduce the C-factor to less than 0.10.
5. Construct earth banks (Standard Drawing 5-5) on the upslope side to divert water around stockpiles and sediment fences (Standard Drawing 6-8) 1 to 2 metres downslope.

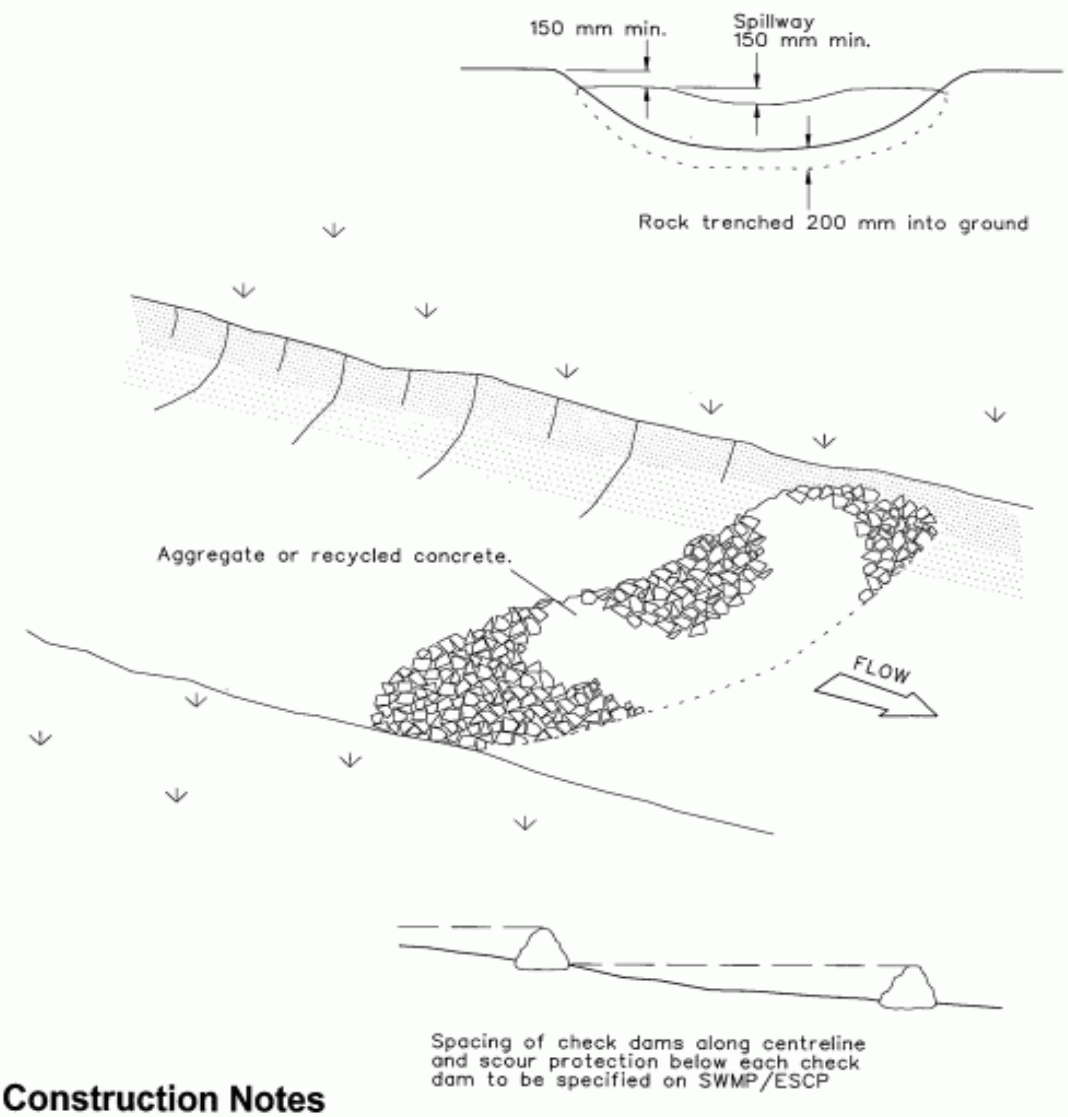
STOCKPILES **SD 4-1**



Construction Notes

1. Scarify the ground surface along the line of the contour to a depth of 50 mm to 100 mm to break up any hardsetting surfaces and to provide a good bond between the respread material and subsoil.
2. Add soil ameliorants as required by the ESCP or SWMP.
3. Rip to a depth of 300 mm if compacted layers occur.
4. Where possible, replace topsoil to a depth of 40 to 60 mm on lands where the slope exceeds 4(H):1(V) and to at least 75 mm on lower gradients.

REPLACING TOPSOIL **SD 4-2**

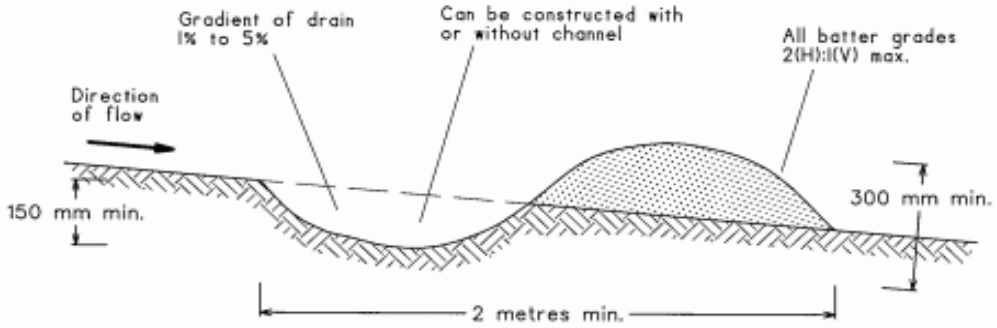


Construction Notes

1. Check dams can be built with various materials, including rocks, logs, sandbags and straw bales. The maintenance program should ensure their integrity is retained, especially where constructed with straw bales. In the case of bales, this might require their replacement each two to four months.
2. Trench the check dam 200 mm into the ground across its whole width. Where rock is used, fill the trenches to at least 100 mm above the ground surface to reduce the risk of undercutting.
3. Normally, their maximum height should not exceed 600 mm above the gully floor. The centre should act as a spillway, being at least 150 mm lower than the outer edges.
4. Space the dams so the toe of the upstream dam is level with the spillway of the next downstream dam.

ROCK CHECK DAM

SD 5-4

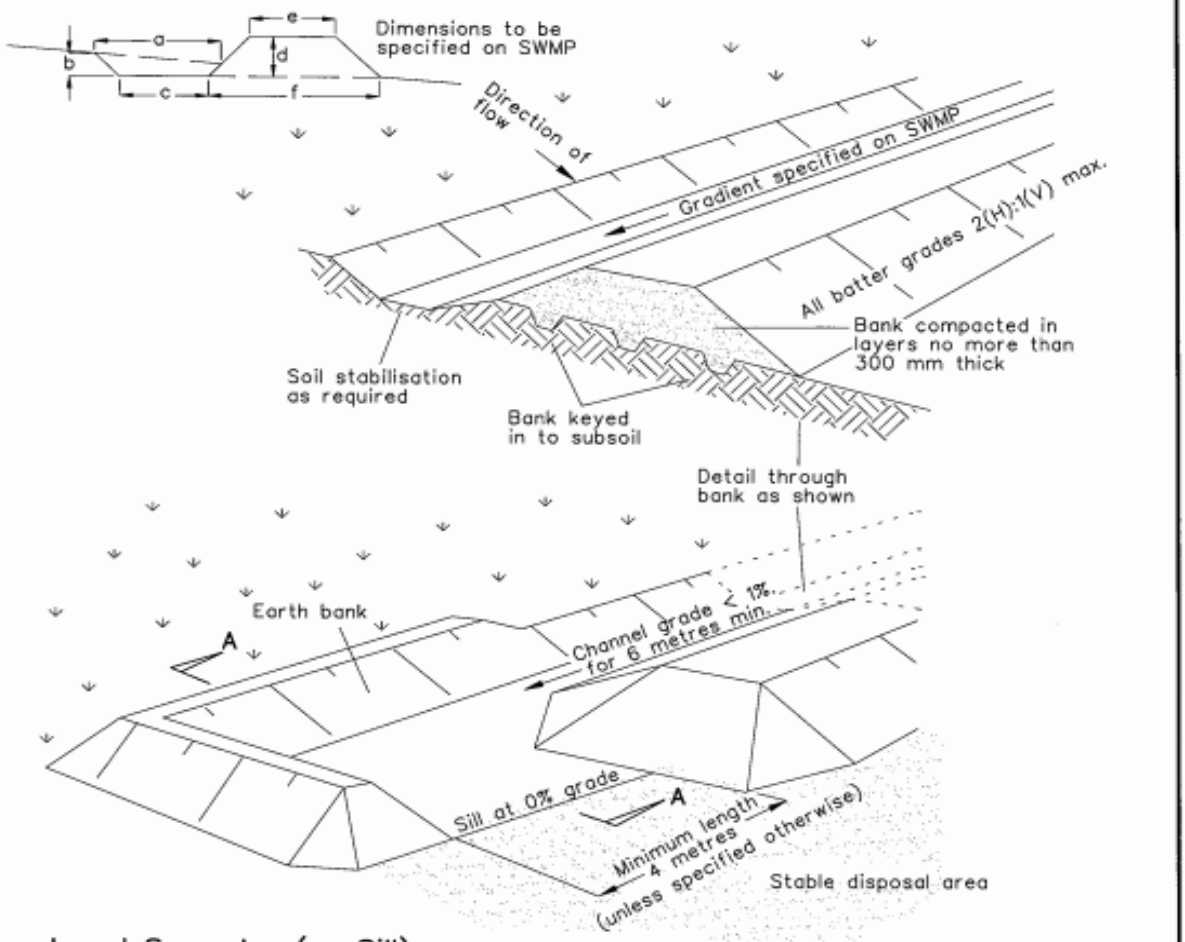


NOTE: Only to be used as temporary bank where maximum upslope length is 80 metres.

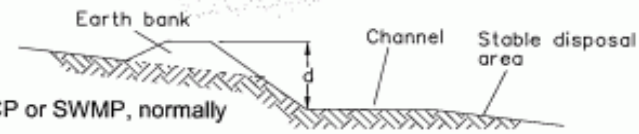
Construction Notes

1. Build with gradients between 1 percent and 5 percent.
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V shaped.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction.

EARTH BANK (LOW FLOW) **SD 5-5**



Level Spreader (or Sill)

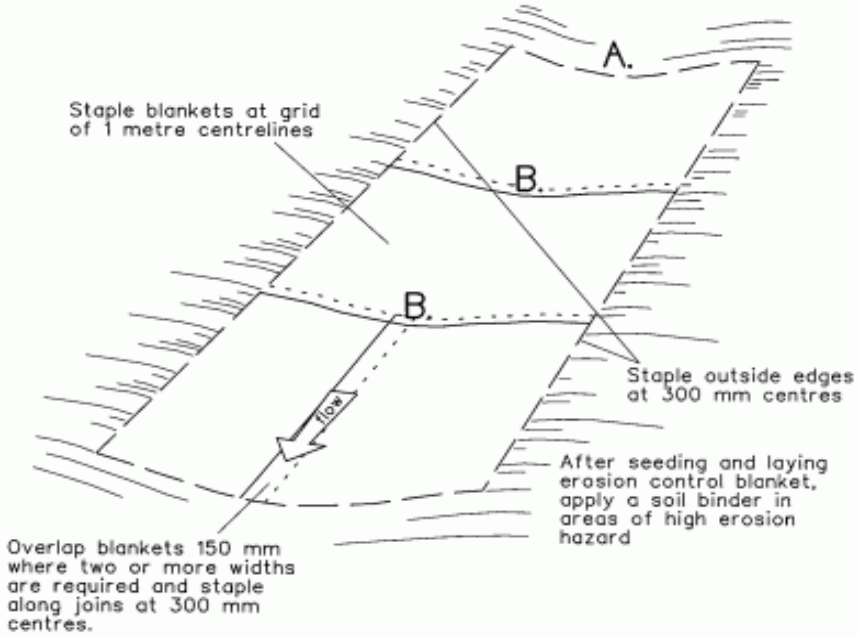


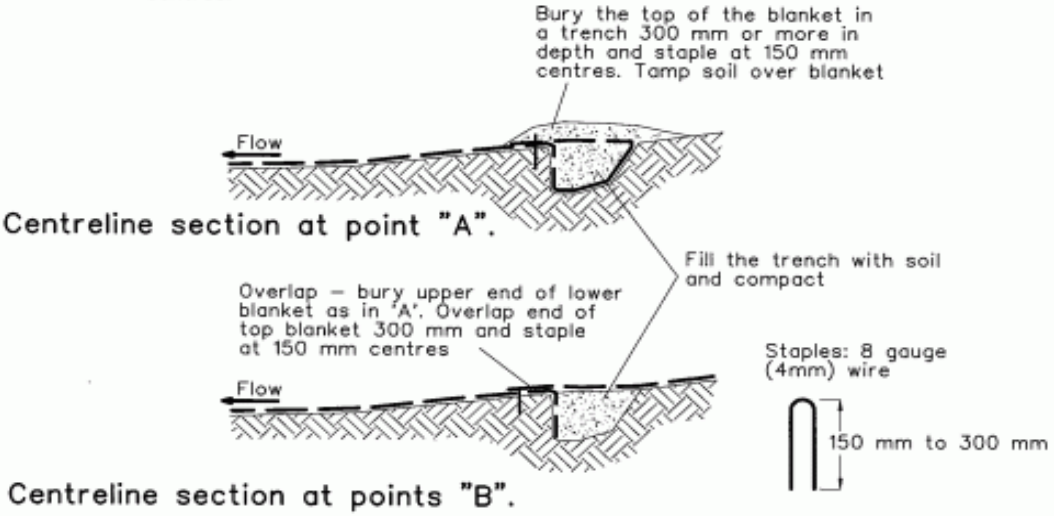
Section AA

Construction Notes

1. Construct at the gradient specified on the ESCP or SWMP, normally between 1 and 5 percent
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V-shaped, at the dimensions shown on the SWMP.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction following Table 5.2 in Landcom (2004).
7. Where discharging to erodible lands, ensure they outlet through a properly constructed level spreader.
8. Construct the level spreader at the gradient specified on the ESCP or SWMP, normally less than 1 percent or level.
9. Where possible, ensure they discharge waters onto either stabilised or undisturbed disposal sites within the same subcatchment area from which the water originated. Approval might be required to discharge into other subcatchments.

EARTH BANK (HIGH FLOWS) **SD 5-6**

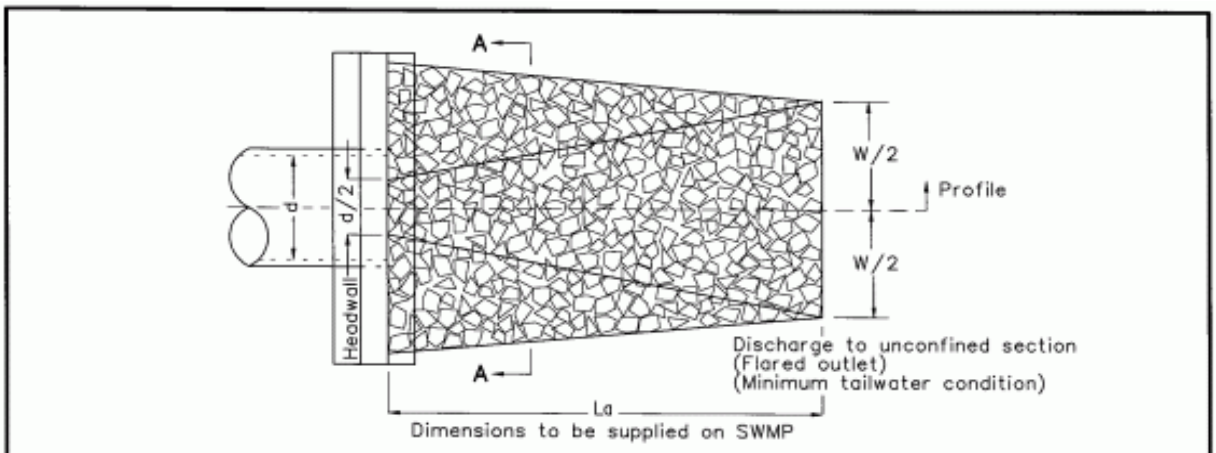




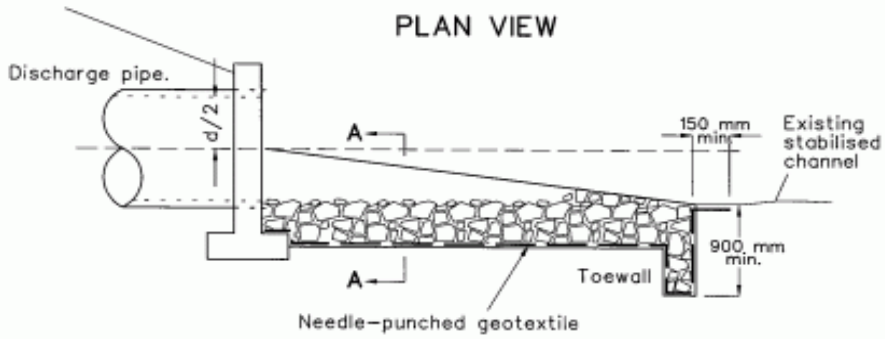
Construction Notes

1. Remove any rocks, clods, sticks or grass from the surface before laying matting
2. Ensure that topsoil is at least 75 mm deep.
3. Complete fertilising and seeding before laying the matting.
4. Ensure fabric will be continuously in contact with the soil by grading the surface carefully first.
5. Lay the fabric in "shingle-fashion", with the end of each upstream roll overlapping those downstream. Ensure each roll is anchored properly at its upslope end (Standard Drawing 5-7b).
6. Ensure that the full width of flow in the channel is covered by the matting up to the design storm event, usually in the 10-year ARI time of concentration storm event.
7. Divert water from the structure until vegetation is stabilised properly.

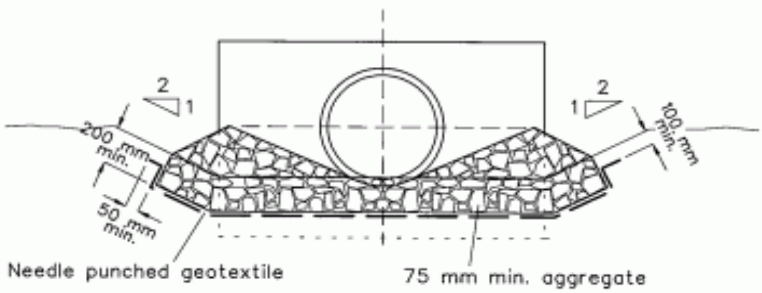
RECP : CONCENTRATED FLOW **SD 5-7**



PLAN VIEW



PLAN VIEW

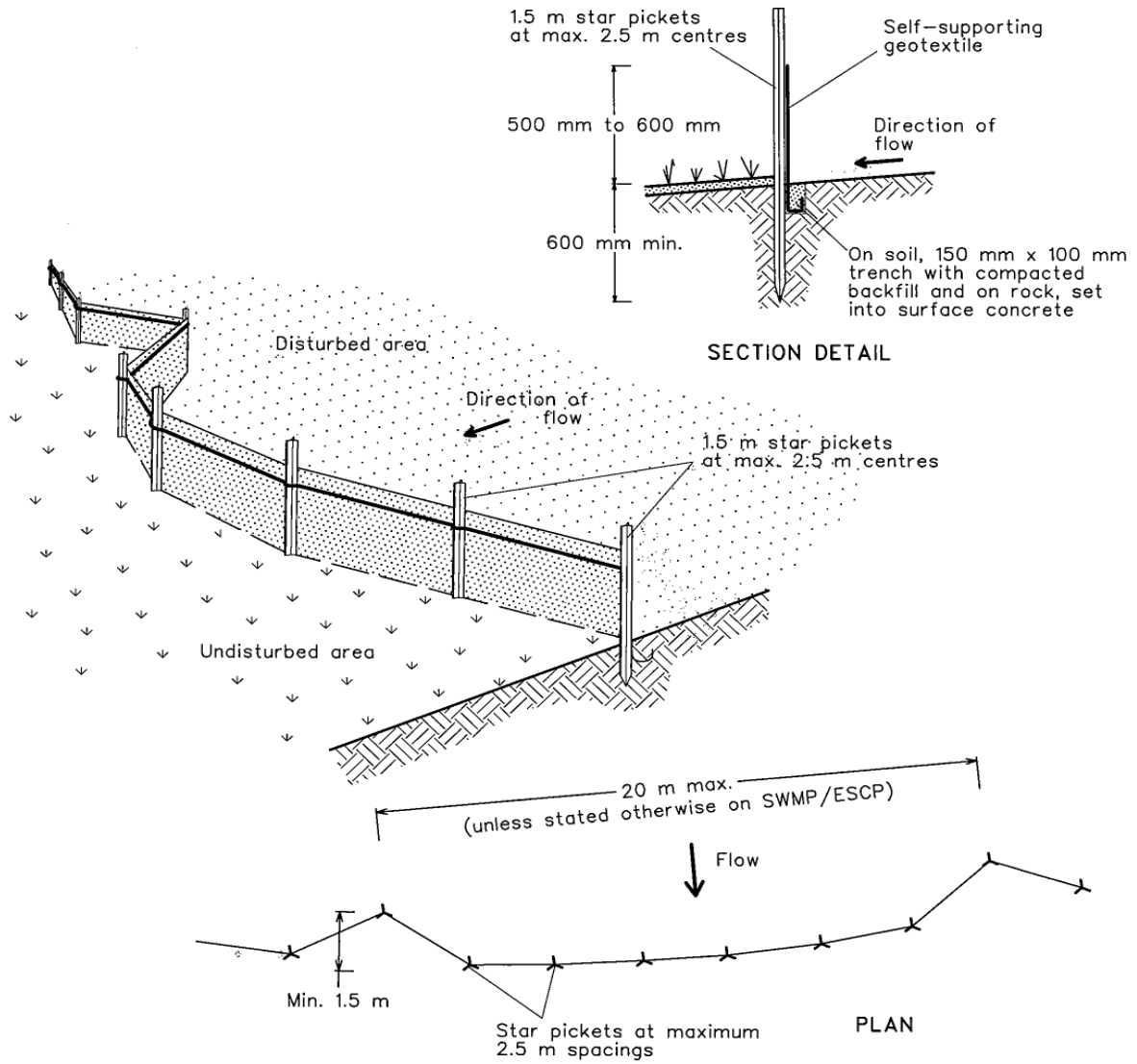


CROSS SECTION AA

Construction Notes

1. Compact the subgrade fill to the density of the surrounding undisturbed material.
2. Prepare a smooth, even foundation for the structure that will ensure that the needle-punched geotextile does not sustain serious damage when covered with rock.
3. Should any minor damage to the geotextile occur, repair it before spreading any aggregate. For repairs, patch one piece of fabric over the damage, making sure that all joints and patches overlap more than 300 mm.
4. Lay rock following the drawing, according to Table 5.2 of Landcom (2004) and with a minimum diameter of 75 mm.
5. Ensure that any concrete or riprap used for the energy dissipater or the outlet protection conforms to the grading limits specified on the SWMP.

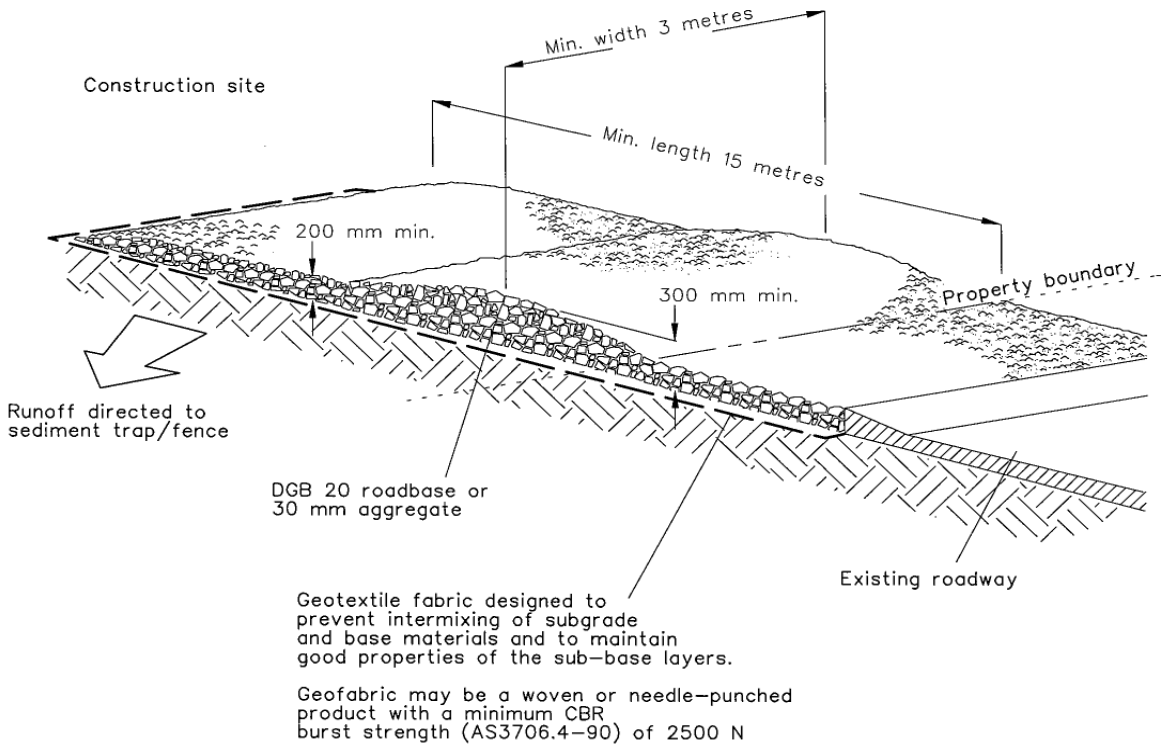
ENERGY DISSIPATER **SD 5-8**



Construction Notes

1. Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow if concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.
2. Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
3. Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope edge of the trench. Ensure any star pickets are fitted with safety caps.
4. Fix self-supporting geotextile to the upslope side of the posts ensuring it goes to the base of the trench. Fix the geotextile with wire ties or as recommended by the manufacturer. Only use geotextile specifically produced for sediment fencing. The use of shade cloth for this purpose is not satisfactory.
5. Join sections of fabric at a support post with a 150-mm overlap.
6. Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

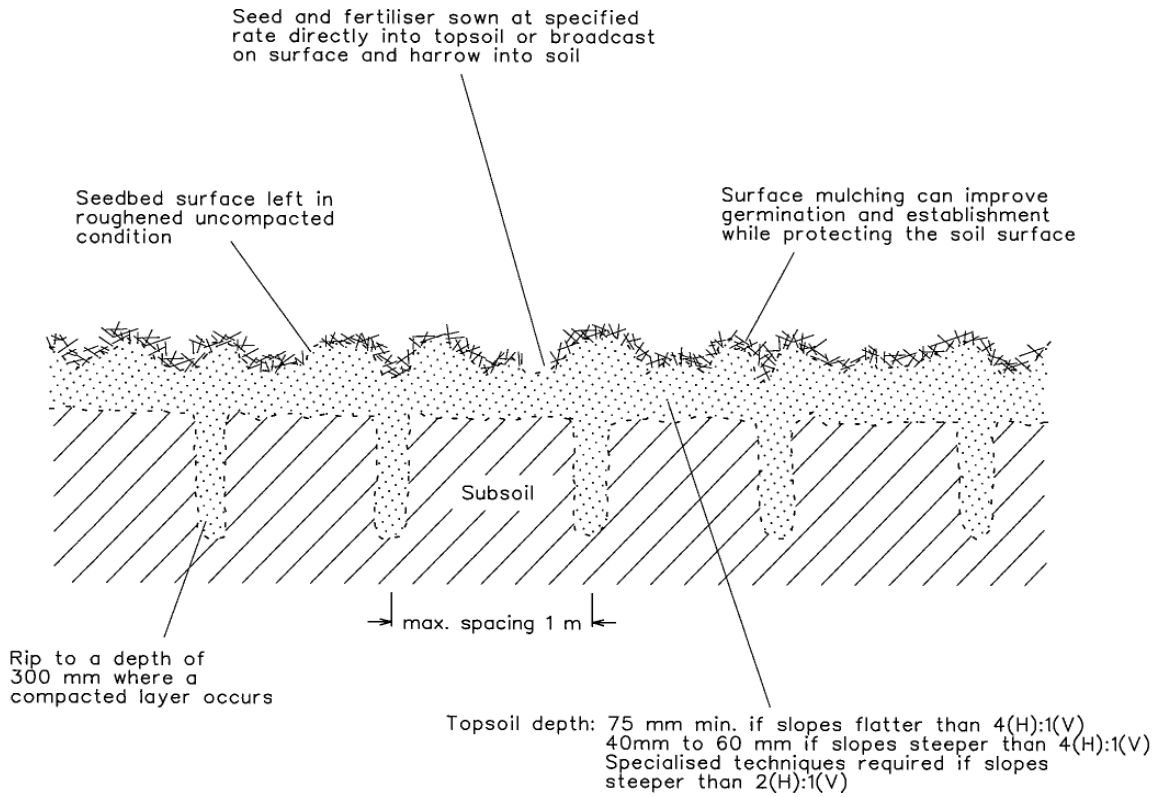
SEDIMENT FENCE **SD 6-8**



Construction Notes

1. Strip the topsoil, level the site and compact the subgrade.
2. Cover the area with needle-punched geotextile.
3. Construct a 200-mm thick pad over the geotextile using road base or 30-mm aggregate.
4. Ensure the structure is at least 15 metres long or to building alignment and at least 3 metres wide.
5. Where a sediment fence joins onto the stabilised access, construct a hump in the stabilised access to divert water to the sediment fence

STABILISED SITE ACCESS **SD 6-14**



Construction Notes

1. Loosen compacted soil before sowing any seed. If necessary, rip the soil to a depth of 300 mm. Avoid rotary hoe cultivation.
2. Work the ground only as much as necessary to achieve the desired tilth and prepare a good seedbed.
3. Avoid cultivation in very wet or very dry conditions.
4. Cultivate on or close to the contour where possible, not up and down the slope.

SEEDBED PREPARATION **SD 7-1**