Soil and Water Management Plan for Narrabri Gas Development Project Santos Energy NSW Exploration and Appraisal

Document Number: 0011-650-TEM-0004 Rev 4

Date: July 2017

SOIL AND WATER MANAGEMENT PLAN FOR NARRABRI GAS DEVELOPMENT PROJECT SANTOS ENERGY NSW EXPLORATION AND APPRAISAL

Prepared for:

Santos Limited
300 Yarrie Lake Road, Narrabri NSW 2390
02 6792 9000 www.santos.com

Prepared by:

Strategic Environmental and Engineering Consulting (SEEC) Pty Ltd
PO Box 1098 Bowral NSW 2576
02 4862 1633 reception@seec.com.au

Copyright and Disclaimer:

Version Register

Version	Date	Author	Reviewer	Notes
A -Draft	3 Dec 2013	[redacted]	[redacted]	Issued for Santos review
Rev 0	21 Jan 2014	[redacted]	[redacted]	Final Issue for Implementation
Rev 1	28 Mar 2014	[redacted]	[redacted]	Minor changes to align with Santos EHSMS
Rev 2	10 Oct 2014	[redacted]	[redacted]	Addition of Appendix E, SWMP implementation for existing sites
Rev 3	12 Dec 2014	[redacted]	[redacted]	Changes made to Appendix E
Rev 4	21 July 2017	[redacted]	[redacted]	Review for alignment with amended EPL20350

ENDORSEMENTS AND APPROVALS

This SWMP has been reviewed and endorsed by Santos and is approved for use in NSW.

Endorsed by:

[redacted]	Field Environmental Officer, Energy NSW Operations	Signature	Date
[redacted]			
[redacted]	Site Operations Manager Energy NSW Operations	Signature	Date

Contents

Appendices

1 INTRODUCTION

1.1 Background Information

Santos is the holder of Environmental Protection Licence (EPL) 20350 with the specific conditions relating to this Soil and Water Management Plan (SWMP) listed;

EPL20350 – PEL 238, PAL 2 and PPL3

> **Condition O6.1** A Soil and Water Management Plan (SWMP) must be prepared and implemented in accordance with the requirements outlined in Managing Urban Stormwater: Soils and Construction, Vol 1, 4th Edition (Landcom, 2004) within 3 months from the issue date of this licence.
> **Condition O6.2** The SWMP must include, but is not limited to, the following:
> 1. a discussion around the management of existing and future sediment basins, specifically, how these will be managed to prevent pollution, and
> 2. a description of the measures taken to minimise soil erosion and the discharge of sediment and other pollutants to lands and/or waters for the duration of the licence.
>
> **Condition O6.3** The SWMP should also refer to the relevant Volume 2 guidance including but not limited to Managing Urban Stormwater: Soils and Construction – Volume 2a Installation of Services and Managing Urban Stormwater: Soils and Construction – Volume 2c Unsealed Roads.
> **Condition O6.4** The SWMP must be updated to reflect the proposed irrigation of treated water at the premises, prior to irrigation occurring.

1.2 Scope

This Soil and Water Management Plan (SWMP) details erosion and sediment control strategies for typical Santos gas development work sites within Santos Energy NSW area PEL 238, PAL 2 and PPL 3 (i.e. Narrabri Gas Development Project). The locations of these are shown in Appendix 2.

This SWMP is based on the requirements within Landcom (2004) Managing Urban Stormwater: Soils and Construction, Vol 1, 4th Edition ("the Blue Book"), Managing Urban Stormwater: Soils and Construction – Volume 2a Installation of Services and Managing Urban Stormwater: Soils and Construction – Volume 2c Unsealed Roads.

2 SITE DETAILS

2.1 Climate

Typical rainfall and temperature statistics for the project works have been sourced from the Bureau of Meteorology (BOM) website for the following nearby weather stations:

- Rainfall statistics – Narrabri Bowling Club (BOM No. 54120)
- Temperature statistics – Gunnedah Pool (BOM No. 55023)

The weather stations above have been used here, since they are the closest stations to the project works which provide a reliable record of rainfall/temperature statistics representative of the area.

Average annual rainfall for Narrabri Bowling Club is 646mm/yr. Monthly rainfall and temperature statistics are in Table 1. They show that:

- Rainfall is summer dominant;
- Average rainfall is relatively low;
- Temperatures are hot in summer and mild in winter.

Table 1 – Monthly rainfall statistics

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean rainfall (mm)	80.2	73.9	53.6	38.2	48.9	50.9	44.9	37.4	39.1	51.2	59.9	67.7
Mean temp (ºC)	34.0	32.9	30.7	26.4	21.3	17.6	16.9	18.9	22.8	26.7	30.3	32.9

According to the map in Landcom (2004) (page 4-16), the site lies close to the borderline of rainfall zones 6 and 8. Therefore, the worst case scenario will be considered for design purposes.

An Intensity Frequency Distribution table has been produced for this area for design purposes. The table is provided within Appendix 3.

2.2 Topography, Soils and Landforms

The topography remains fairly consistent over the extent of the project area. It is made up of gently-inclined slopes generally in the range of 1-5% but up to 10% leading down to drainage lines.

Sodosols are common in the project area (BASL Site Verification Report, (RPS, 2013)). These soils exhibit high erodibililty, poor structure and low fertility (confirmed during SEEC site investigations).

Watercourses are generally ephemeral in nature with many resulting from poorly drained and highly dispersive soils causing areas of tunnel or gully erosion and consequent drainage lines. Open forest is the dominant vegetation community across most areas, dominated by eucalypt overstorey, cypress understory, with sedges and native grasses forming the ground cover (BASL Site Verification Report, (RPS, 2013)).

2.3 Erosion Hazard Assessment

An erosion hazard assessment was conducted in accordance with Landcom (2004) using the Revised Universal Soil Loss Equation (RUSLE).

RUSLE: A = R x K x LS x P x C

A description of the RUSLE equation and the values adopted at this site are contained in Table 2.

Table 2 – RUSLE factors and values used for this site

Factor	Description	Value Used Here
A	Computed soil loss (t/ha/yr)	Varies
R	Rainfall erosivity factor	1,600
K	Soil erodibility factor	0.060 (Assumed for inorganic silty sand, poorly graded topsoils and silty clay subsoils)
LS	Slope length and gradient factor	Varies dependent on slope and slope length
P	Soil conservation practice factor	1.3 (compacted)
C	Ground cover factor	1.0 (exposed soils)

The maximum slope gradient that applies to this SWMP is 10%. Soil loss for each work site or sub-catchment (ROWs) will be limited to a maximum of 200t/yr (150m^3/yr) using the strategies outlined within Section 3 of this SWMP.

3 KEY MANAGEMENT STRATEGIES

3.1 General Measures

a) Personnel dedicated for erosion and sediment control maintenance will be competent in the effective installation and construction of temporary controls including sediment fence installation, applying stabilising products, lining drains etc.

b) Erosion and sediment controls when required, will be implemented at all sites associated with construction activities, including:

- access roads and tracks;
- standard lease pads or similar;
- ROWs.

c) An environmental representative will monitor weather conditions and forecasts (including rainfall prediction maps) daily and pass on relevant information to the site foremen to allow for adequate planning for significant rain events.

d) Relevant documentation for recording erosion and sediment control activities will be implemented and incorporated into existing systems which may include:

- Santos Environment, Health and Safety (EHS) Toolbox;
- Compliance Checklists;
- Progressive erosion and sediment control plans (ESCPs) – stored within Santos' NSW SharePoint site;
- Applicable meeting minutes (i.e. icebreakers);
- Formal correspondence (e.g. EPA, Council, Resources Regulator);
- Water-quality monitoring results (e.g. receiving waters if required).

e) Relevant erosion and sediment control measures will be implemented for each particular section of works prior to or in conjunction with the commencement of topsoil stripping or earthworks.

f) Additional erosion and sediment control measures will be implemented as required during construction works.

g) Sufficient supplies of erosion and sediment control materials/products will be stored on site at all times. Storage locations will be provided in suitable location/s within the site.

3.2 Minimising Disturbance

a) Clearing limits and work boundaries will be established and well defined using barrier tape, survey marks or an effective alternative prior to any construction, clearing or stripping works commencing.

b) The extent of clearing will be minimised as much as possible.

c) All vegetation that is to be maintained will be clearly delineated.

d) Land clearing will occur progressively and will be limited to the areas associated with the current section/stage of works only.

e) Pipelines will be installed using the ploughing method rather than open trenching where possible.

f) Watercourses and adjacent areas will be left undisturbed until the point immediately prior to access track works or trenching in these areas commencing. Works in these areas are to be completed within a maximum of 10 days from the point of clearing to rehabilitation.

g) Disturbance and clearing in and around natural watercourses will be minimised as much as possible. Use rock causeway crossings for access tracks (where possible) and use directional drilling or ploughing method for pipeline installation rather than open trenching where necessary.

3.3 Controlling Stormwater Flows

a) Separate 'clean' (offsite) run-on water from 'dirty' (onsite) (e.g. turbid) construction area runoff as much as is practicable.

b) Wherever possible, construct drainage structures early in the project including clean and dirty water diversion drains/banks.

c) Maximise the diversion of turbid construction runoff into sediment filtration devices including (but not limited to):

- Sediment fence
- Mulch berms
- Excavated sediment traps with appropriate outlet controls

d) Install slope breaks (contour berms) in locations where required.

e) Establish appropriate surface drainage on all access tracks.

f) Implement appropriate measures within watercourses to maintain natural flows across the works.

g) Implement appropriate erosion control measures (refer to Appendix 4 for erosion control standard drawings) to control runoff volumes from construction areas.

3.4 Erosion Control Measures

a) The separation of 'clean' (offsite) run-on water from 'dirty' (onsite) (e.g. turbid) construction area runoff will be maximised as much as possible.

b) Offsite run-on water will be diverted around the works site as much as possible using stabilised diversion drains, banks and berms.

c) Slope lengths will be maintained at appropriate lengths (where necessary) to slow flows down and minimise erosion.

d) Exposed soils will be stabilised with soil stabilisers (where necessary) to minimise erosion.

e) Stockpiles of soil material will be sited in low-hazard areas clear of watercourses and outside of the flood prone lands.

f) Stockpiles will be stabilised in accordance with the requirements in Section 3.7 below.

g) Dust suppression will be carried out whenever necessary to minimise sediments becoming air borne due to wind erosion. The water source for dust suppression will be identified prior to starting works. Soil stabilisers will be used for dust suppression where possible.

3.5 Sediment Control Measures

a) Construct sediment control measures in appropriate areas.

b) Control the tracking of mud and soil material onto local roads using shakers or rubble pads (where necessary).

c) Sediment controls will be provided downslope of disturbed areas. Various types of sediment controls that may be used include (but are not limited to):

- Sediment fence
- Mulch berms
- Excavated sediment retention basins (Section 3.6)

d) Any active discharge of water from site must accord with the following water quality limits:

- Total suspended soils (TSS) < 50mg/L
- pH between 6.5 and 8.5
- No visible sign of oil/grease

e) Sediment will be removed from sediment controls when required.

f) Sediment controls will only be removed after adequate stabilisation of disturbed surfaces is achieved.

3.6 Sediment Retention Basins

a) Sediment retention basins will be implemented where appropriate and designed in accordance with Landcom 2004 ('The Blue Book').

b) Sediment retention basins are considered unnecessary for sites that have a soil loss value less than 150m^3 (Landcom 2004) as calculated using the RUSLE method (Section 2.3).

c) Sediment clean out will be conducted as required. Removed sediment will be relocated in locations that will not result in future erosion or pollution hazard.

d) Water levels in existing sediment retention basins will be managed appropriately with weather forecasts taken into consideration and made ready for the next storm event. Water may be taken and used for activities that will not result in a pollution hazard.

3.7 Stabilisation Measures

a) Where possible the seedbank (topsoil layer) will be stripped separately and pushed into a berm/bund on the high side of the worksite. This will be stabilised after formation. An erosion control product such as jute mesh, hydraulic-stabiliser or equivalent will be used to achieve this where appropriate.

b) Where applicable, gypsum may be spread over the topsoil surface prior to stripping. This will help to achieve final rehabilitation.

c) The depth of the remainder of the topsoil will be determined and the topsoil will be stripped and pushed into a berm/bund next to the seedbank berm on the high side of the worksite. This will be stabilised after formation.

d) Soil stabilisers or mulch will be used in conjunction with topsoil and seeding where required to achieve stabilisation requirements.

e) As per Landcom 2004, land clearing works during the period from May to September (inclusive) all areas (excluding lands taking concentrated flows) will be stabilised to achieve a C-factor of at least 0.15 (equivalent to 50% grass cover) within 20 working days of completion.

f) As per Landcom 2004, land clearing works during the period from October to April (inclusive) all areas (excluding lands taking concentrated flows) will be stabilised to achieve a C-factor of at least 0.1 (equivalent to 60% grass cover) within 20 working days of completion of formation AND a C-factor of at least 0.05 (equivalent to 70% grass cover) within a further 60 days.

g) At all times of the year, lands taking concentrated flows will be stabilised to achieve a C-factor of at least 0.05 (equivalent to 70% grass cover) within 10 days of completion.

h) Stabilisation of waterways including their beds and banks is to be commenced immediately after the completion of any works within these areas.

i) Temporary soil stabilisers will be used where necessary to stabilise exposed construction areas and access tracks.

3.8 Monitoring and Maintenance

a) Will ensure the progressive and continual implementation and maintenance of temporary erosion and sediment controls (e.g. sediment fences, diversion banks, diversion drains, sediment traps etc).

b) For construction, existing and temporary erosion and sediment control measures and structures will be inspected, cleaned, and appropriately repaired and maintained as required across all works.

3.9 Soils and Stockpile Management

The following management measures will be adopted for soil and stockpile management, in addition to the measures already detailed above:

a) Stockpiles will be established within the approved construction boundary.

b) Topsoils will be stripped and stockpiled separately from subsoils.

c) Generally topsoils will be stripped and pushed into a berm/bund on the high side of the worksite.

d) As much as possible, soil structure will be preserved by not over-handling soils, nor handling them when they are very wet or very dry.

e) Stockpiles will be located away from any watercourse, drainage line/creek, concentrated flow or hazard area.

f) Stockpiles (excluding those shaped into berms/bunds on the perimeter of the works area/s) will be secured with the appropriate sediment control downslope, a diversion berm/drain upslope, and will be stabilised within 10 days of completion of formation to a C-factor of 0.1 (i.e. at least 60% cover).

g) Topsoil and mulch stockpiles will be constructed to no more than 2m in height where possible.

h) The working face of the stockpile should be battered down to a maximum slope of 2:1 (H:V).

i) Activities that might over-compact topsoils will be avoided on topsoil stockpiles.

3.10 Works in Watercourses

Watercourses and adjacent areas are considered as sensitive environments and are particularly prone to erosion when vegetation has been removed and soils are exposed. Additional controls and provisions will be implemented within watercourses and across all lands within 40m from the top bank of a watercourse.

a) Vegetation and soil disturbance will be minimised as much as possible.

b) Directional drilling or plough method of pipeline installation will be used wherever possible to minimise disturbance.

c) Grass vegetation removal and stripping works will only commence in these locations immediately prior to pipeline installation works.

d) Waterway crossings will be installed for vehicle access in accordance with the ROW Watercourse Crossing Standard Drawing provided in Appendix 5.

e) Works are to be scheduled for a period when the 3-day weather forecast predicts rainfall is unlikely and where possible will be completed within this period.

f) All works within watercourses will be completed from clearing and stripping to stabilisation within a maximum period of 10 days.

g) If rainfall is imminent while works are occurring in watercourses, all exposed soils within the watercourse (up to the top bank of the watercourse, both sides) will be stabilised to achieve a C-factor of 0.1 (equivalent to 60% cover).

h) Where required, exposed access track surfaces will have a trafficable erosion control methodology applied.

3.11 Access Tracks

Unsealed roads and access tracks will be developed in accordance with Managing Urban Stormwater: Soils and Construction – Volume 2c Unsealed Roads. The management principles within this guidelines are:

- Assess the implications of potential soil loss and water quality during planning;
- Plan controls during the design phase;
- Minimise the area of disturbance;
- Control water flow from the top of and through the designated work area;
- Rehabilitate disturbed lands as soon as possible;
- Maintain erosion and sediment control measures appropriately.

A series of standard drawings for unsealed access tracks are provided within Appendix 6.

Appendix 1 EROSION AND SEDIMENT CONTROL PLAN

Form:	EROSION AND SEDIMENT CONTROL PLAN - LEASE PAD (100x100m MAX.)	Santos
Revision:	**This template is only to be used for sites with slopes less than or equal to 10%.**	We have the energy.

1. General
- Monitor weather forecasts for imminent rainfall.
- Ensure erosion and sediment controls are in place PRIOR to topsoil stripping (where possible) or IMMEDIATELY following topsoil stripping.

2. Site Access and Clearing
- Do not drive or park outside of the lease pad limits. Access via the nominated track only.
- As much as possible, existing vegetation cover (including grass) is to be left intact.
- Clearing and stripping is not to occur until construction works are about to commence.
- At track entry point install earthen bund/hump to divert water away (for upslope entry point or divert dirty water into a sediment control (for downslope entry point).

3. Soil & Clean Water Management
- Determine the seed bank depth (approx. 20mm) and strip separately to the underlying topsoil, (where possible). Push into a bund around the high side of the drill pad & stabilise.
- Topsoil will be gypsum treated - (YES or NO): ☐ - If YES, spread 2t/ha of gypsum over the topsoil prior to stripping.
- Determine the topsoil depth. Strip or push topsoil into a bund around the high side of the drill pad. This will act as a diversion berm for run-on from upslope so must be adequately stabilised around the toe of the bund.
- Avoid over-working soils when they are very wet or very dry and avoid excessive soil compaction.
- Topsoil stockpiles are to be no more than 2.0m high.
- Stockpiles & bunds that are in place for longer than 10 days are to be provided with at least 60% protective ground cover using polymer spray/binder (or equivalent).
- Stockpiles are to have a sediment fence, mulch berm (or equivalent) around their downslope edge.

4. Erosion Control Measure
- Is an additional erosion control measure required? (YES or NO): ☐
- If YES, provide at least one or a combination of the following (tick the chosen option):
  - ☐ A trafficable erosion control agent with a demonstrated C-factor of 0.1 or less applied over the entire site at least every 2 months and additionally when surface disturbace/degradation has occurred (applied as per manufacturer's specifications). This will also be adequate as the dust suppression control;
  - ☐ Slope breaks installed at ☐ m spacings prior to rainfall; OR
  - ☐ Temporary stabilisation of all exposed soils prior to rainfall with a polymer spray binder.

5. Dust Suppression
- Keep soil surfaces moist (not wet) to minimise dust rise. Tick the adopted dust suppression control to be used (choose either option):
  - ☐ Water application via a water cart, OR
  - ☐ Trafficable erosion control agent applied as above.

6. When Rainfall is Imminent
- If required (refer to Section 4 above) install slope breaks at the required intervals as 300mm high earth berms or drains cut in with a grader.
- If required (refer to Section 4 above) stabilise all exposed soils to achieve 60% cover with a temporary polymer spray binder.

7. Sediment Control
- The selected sediment control(s) are: ☐
- These controls are to be properly installed around the entire lower edge of the work area.

8. Site Management and Maintenance
- Ensure settlement tanks, skips or pits used for dirty water are suitably bunded.
- Water in settlement tanks or skips is to be tested (and, if required, treated) before being released from the work area. Preferably reuse water onsite.
- Any active water released from site must have: TSS <50mg/L (or an approved NTU correlation), no visible oil or grease, and pH between 6.5 and 8.5.
- Ground mats or stabilised rock access points are to be used to aid trafficability for machinery on soft or muddy areas (when required).
- All drilling chemicals are to be stored in adequately bunded areas.
- Inspect the entire site at least weekly, prior to forecast rainfall (>50% chance of rainfall 5mm or more) & site shutdown, daily during rainfall & within 24 hrs after rainfall causing runoff. Maintain/repair controls & any areas of erosion & modify or implement additional controls if required.

9. Stabilisation and Rehabilitation
- Where works (or sections of work areas) are put on hold for more than 20 days during construction, exposed soils to be temporarily stabilised to at least 50% cover with polymer spray/binder.
- Completed areas are to achieve the nominated level of cover within the timeframes detailed in the Table shown.
- Rehabilitation of general surfaces can be achieved by:
  - shallow ripping gypsum at 5t/ha into subgrade (only required where subgrade has been excessively disturbed); AND
  - spreading out topsoil (approx. 50mm thick), applying the stripped seed bank over the topsoil (or using a suitable local seed mix) & covering with site mulch.

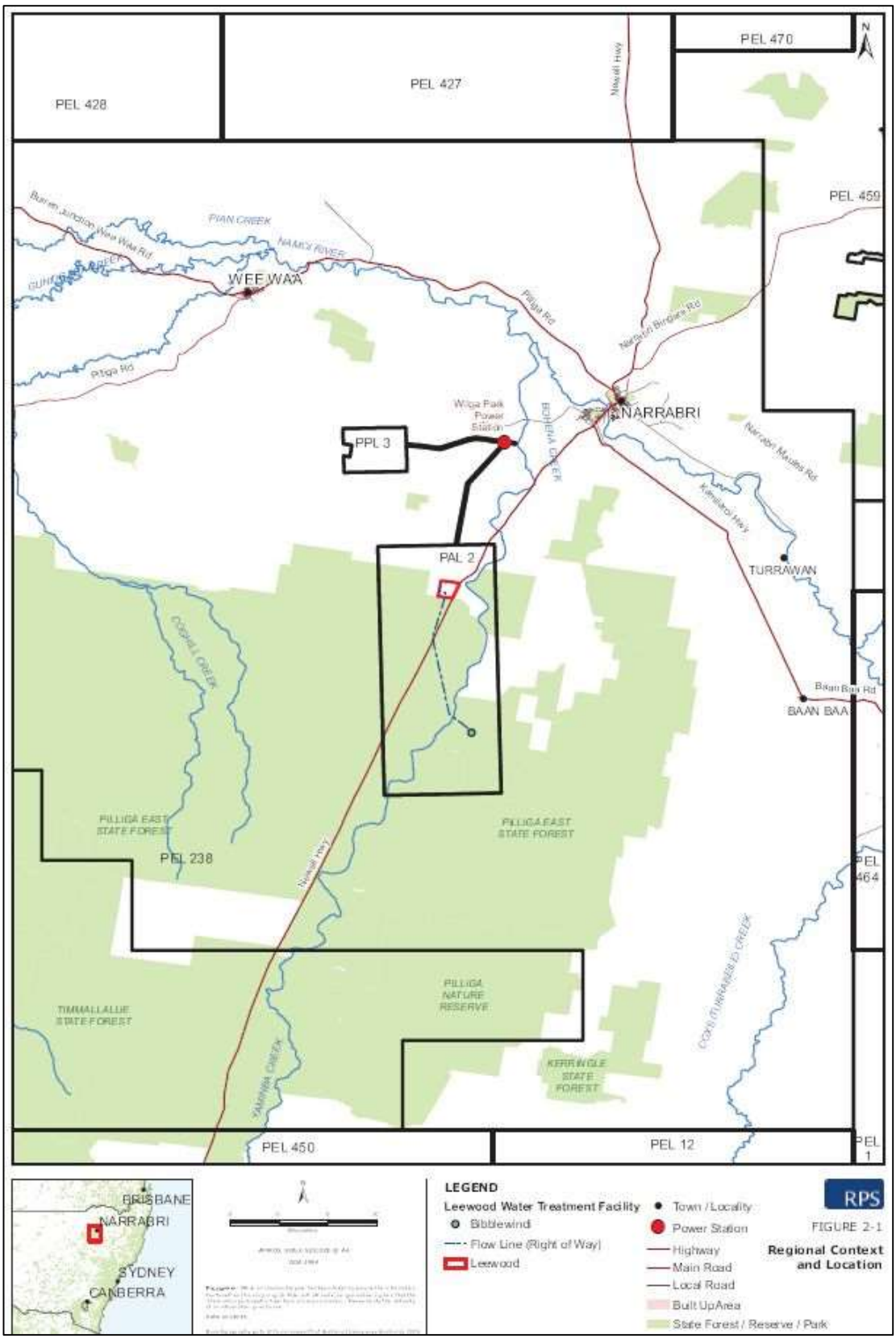
  (Note: If mulch is not adequate to achieve the required cover a suitable erosion control product with demonstrated C-factor should be applied every 2 months until vegetation cover is established.)
- Sediment controls (e.g. sediment fences) cannot be removed until the above nominated level of cover is achieved.

Lands	Rehabilitation period	Maximum C-factor	Approx. ground cover	Days to achieve stabilisation
General surfaces	Jan, Feb, Mar, Apr, Oct, Nov, Dec	0.1	50%	20 days
		0.05	70%	30 days
	May, Jun, Jul, Aug, Sep	0.15	50%	20 days
Waterways & concentrated flow areas	Anytime of year	0.05	70%	10 days

SITE DIAGRAM — SHOW ALL EROSION AND SEDIMENT CONTROLS. ENSURE THIS PLAN SHOWS SLOPE DIRECTION ARROWS

	Project Name/No.:	Date:	Approx Scale:	Meters
	Prepared By:	Signature:	Slope Direction and Gradient	North Point
	Reviewed By:	Signature:		
	Approved By:	Signature:		

Appendix 2 Santos Energy NSW area PEL 238, PAL 2 and PPL 3



Appendix 3 – Intensity Frequency Distribution (IFD) Table

Location: 30.375S 149.550E NEAR.. PPL 3 Issued: 22/11/2013

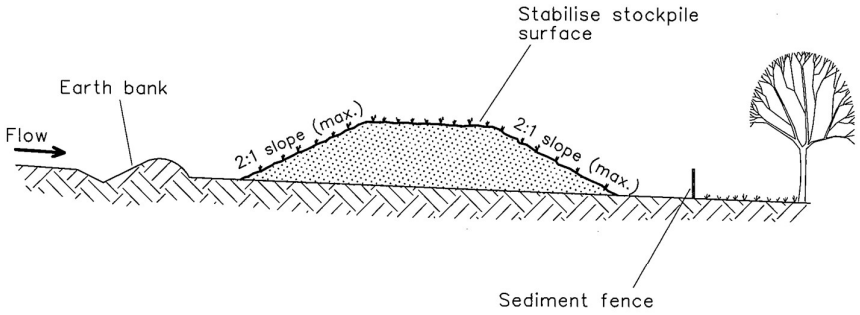
Rainfall intensity in mm/h for various durations and Average Recurrence Interval

Average Recurrence Interval

Duration	1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
5Mins	73.2	95.7	126	145	171	207	237
6Mins	68.1	89.2	117	135	159	193	220
10Mins	55.6	72.7	95.3	110	130	157	179
20Mins	40.8	53.3	69.5	80.0	94.2	114	130
30Mins	33.1	43.2	56.3	64.7	76.1	91.9	105
1Hr	22.0	28.7	37.4	43.0	50.6	61.1	69.6
2Hrs	13.8	18.1	23.7	27.3	32.2	39.1	44.6
3Hrs	10.4	13.6	17.9	20.7	24.5	29.8	34.0
6Hrs	6.27	8.24	11.0	12.8	15.2	18.6	21.3
12Hrs	3.83	5.05	6.77	7.91	9.44	11.6	13.4
24Hrs	2.38	3.14	4.21	4.91	5.87	7.20	8.29
48Hrs	1.46	1.92	2.56	2.98	3.55	4.34	4.98
72Hrs	1.05	1.38	1.84	2.15	2.55	3.12	3.59

(Raw data: 29.69, 5.16, 1.41, 57.86, 10.86, 2.92, skew=0.31, F2=4.32, F50=15.92)

Appendix 4 Applicable Standard Drawings extracted from the Blue Book and IECA Guideline

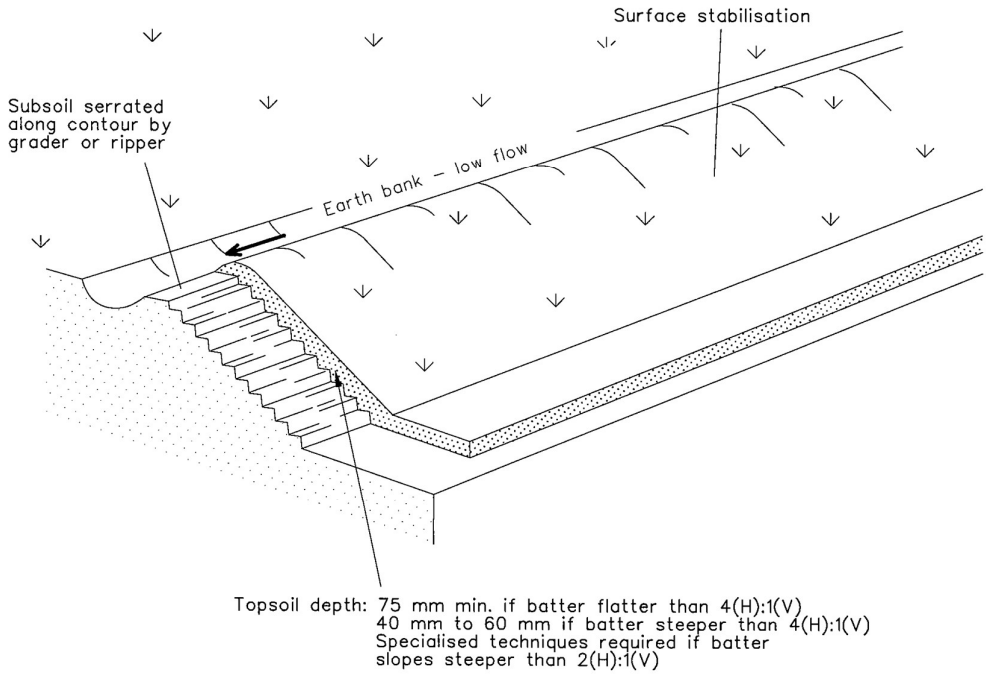


Construction Notes

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**

Blue Book Volume 1 (Landcom, 2004)

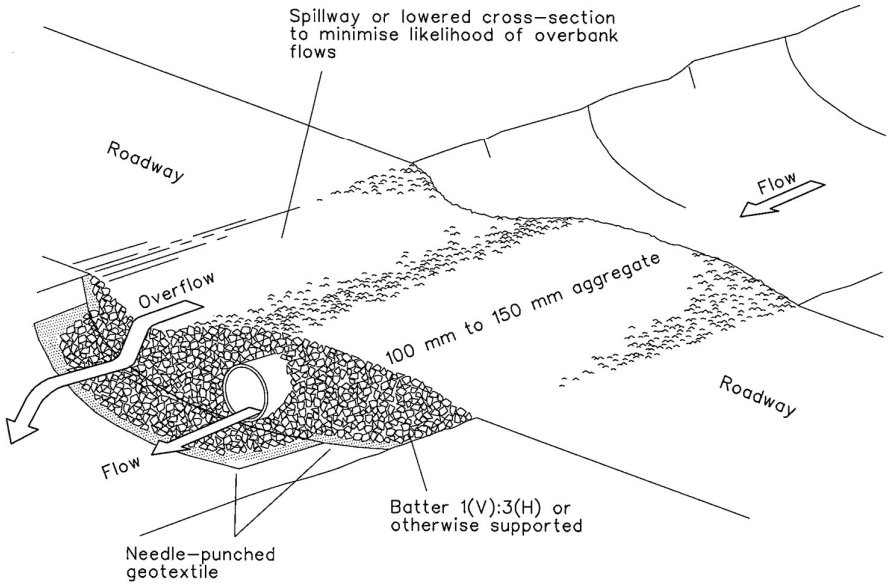


Construction Notes

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**

Blue Book Volume 1 (Landcom, 2004)

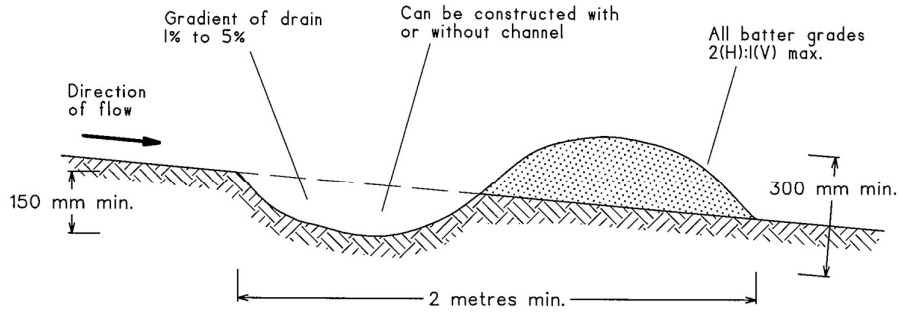


Construction Notes

1. Prohibit all traffic until the access way is constructed.
2. Strip any topsoil and place a needle-punched textile over the base of the crossing.
3. Place clean, rigid, non polluting aggregate or gravel in the 100 mm to 150 mm size class over the fabric to a minimum depth of 200 mm.
4. Provide a 3-metre wide carriageway with sufficient length of culvert pipe to allow less than a 3(H): 1 (V) slope on side batters.
5. Install a lower section to act as an emergency spillway in greater than design storm events.
6. Ensure that culvert outlets extend beyond the toe of fill embankments.

TEMPORARY WATERWAY CROSSING **SD 5-1**

Blue Book Volume 1 (Landcom, 2004)



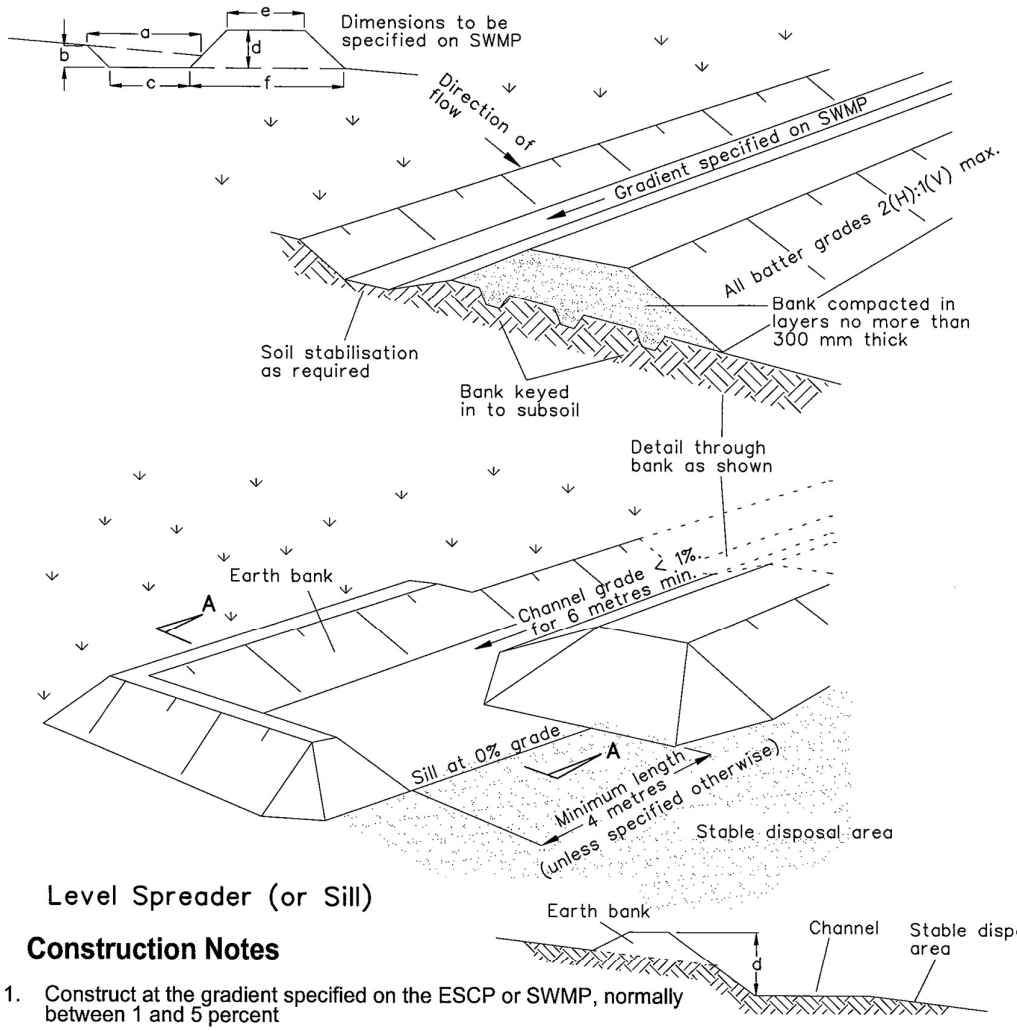
NOTE: Only to be used as temporary bank where maximum upslope length is 80 metres.

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**

Blue Book Volume 1 (Landcom, 2004)

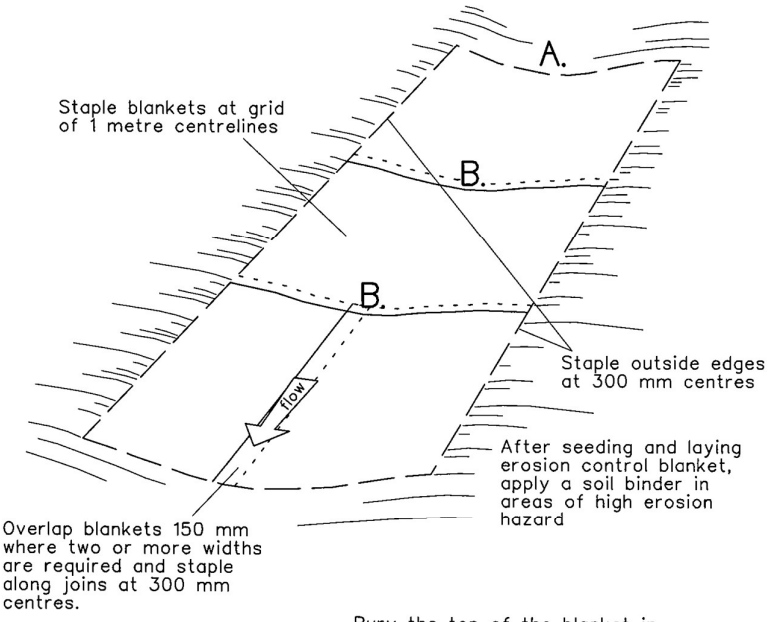


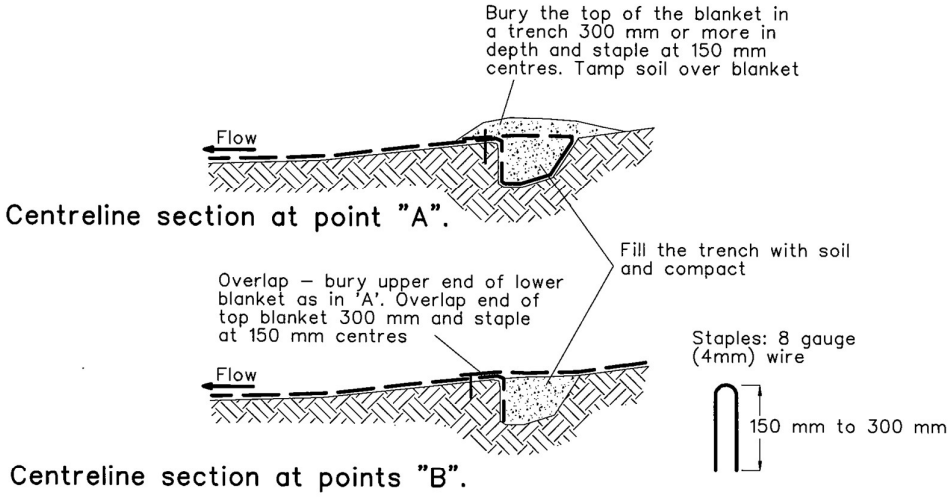
Construction Notes

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**

Blue Book Volume 1 (Landcom, 2004)



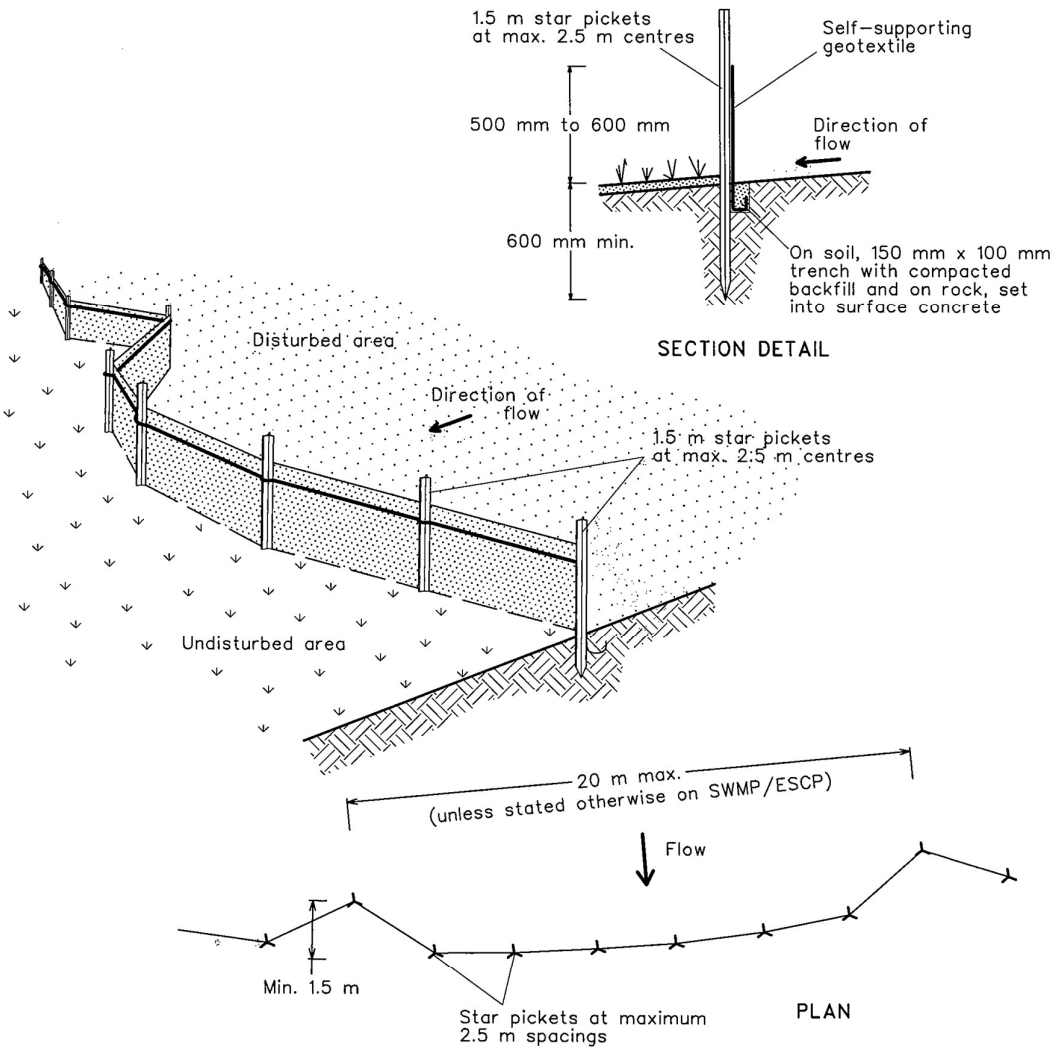


Construction Notes

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**

Blue Book Volume 1 (Landcom, 2004)

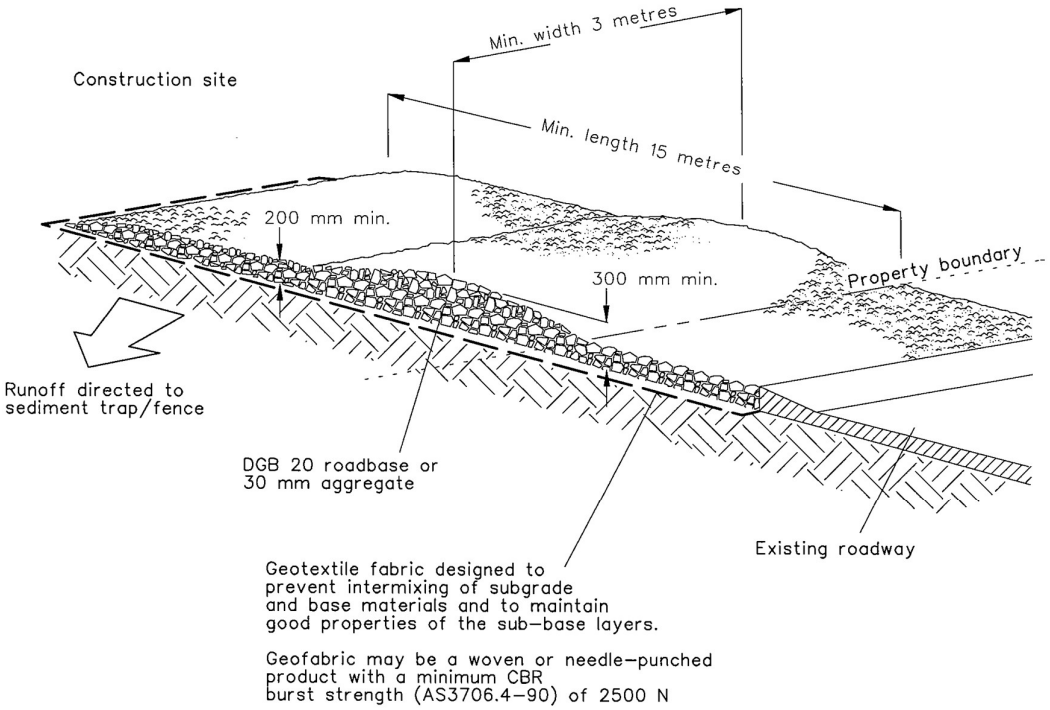


Construction Notes

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**

Blue Book Volume 1 (Landcom, 2004)

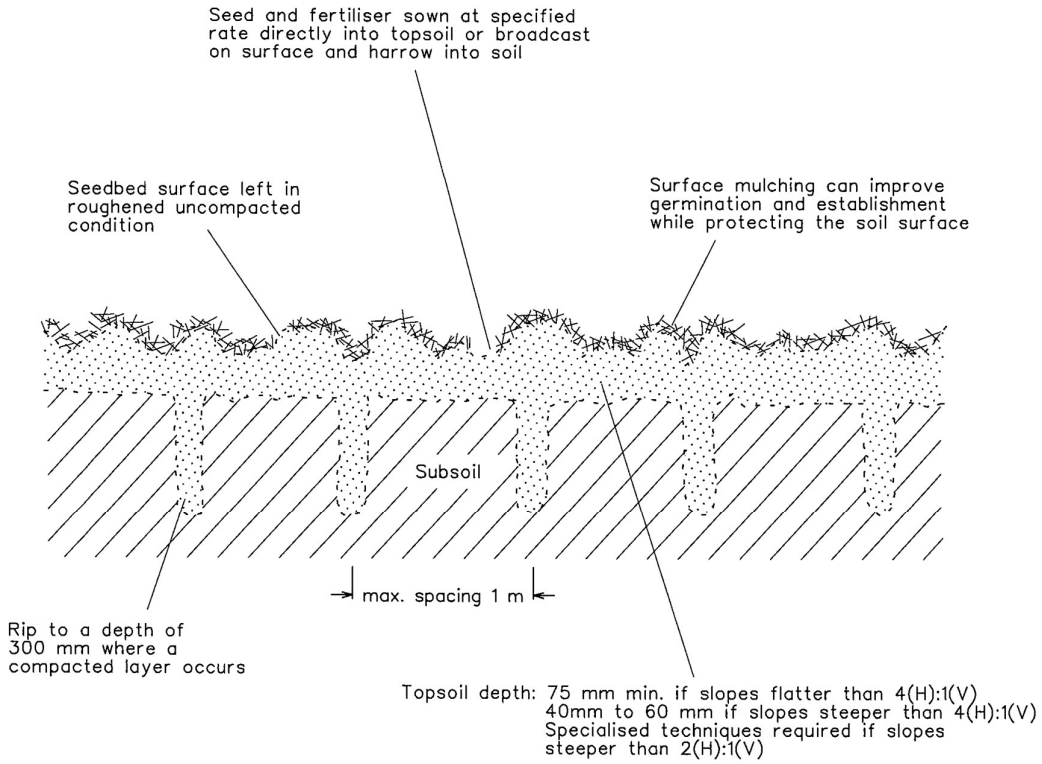


Construction Notes

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**

Blue Book Volume 1 (Landcom, 2004)



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**

Blue Book Volume 1 (Landcom, 2004)

CONSTRUCTION

1. REFER TO APPROVED PLANS FOR LOCATION AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE FOUNDATION AREA OF THE OUTLET STRUCTURE (IF ANY), AND INSTALL AS PER SEPARATE INSTRUCTIONS.

3. EXCAVATE THE SETTLING POND IN ACCORDANCE WITH THE APPROVED PLANS. UNLESS OTHERWISE SPECIFIED, THE EXCAVATED PIT SHOULD HAVE A SIDE SLOPE OF 2:1(H:V) OR FLATTER.

4. APPROPRIATELY STABILISE ANY BANK SUBJECT TO DIRECT INFLOW.

5. ESTABLISH ALL NECESSARY UP-SLOPE DRAINAGE CONTROL MEASURES TO ENSURE THAT SEDIMENT-LADEN RUNOFF IS APPROPRIATELY DIRECTED INTO THE SEDIMENT TRAP.

6. TAKE ALL NECESSARY MEASURE TO MINIMISE THE SAFETY RISK CAUSED BY THE STRUCTURE.

MAINTENANCE

1. CHECK EXCAVATED SEDIMENT TRAPS AFTER EACH RUNOFF EVENT AND MAKE REPAIRS IMMEDIATELY.

2. INSPECT THE BANKS FOR SLUMPING OR EXCESSIVE SCOUR.

3. IF FLOW THROUGH THE STRUCTURE IS REDUCED TO AN UNACCEPTABLE LEVEL DUE TO BLOCKAGE OF THE OUTLET STRUCTURE (IF ANY), THEN MAKE ALL NECESSARY REPAIRS AND MAINTENANCE TO RESTORE THE DESIRED FLOW CONDITIONS.

4. CHECK THE STRUCTURE AND SURROUNDING CHANNEL BANKS FOR DAMAGE FROM OVERTOPPING FLOWS AND MAKE REPAIRS AS NECESSARY.

5. REMOVE SEDIMENT AND RESTORE ORIGINAL SEDIMENT STORAGE VOLUME WHEN COLLECTED SEDIMENT EXCEEDS 30% OF THE PIT VOLUME.

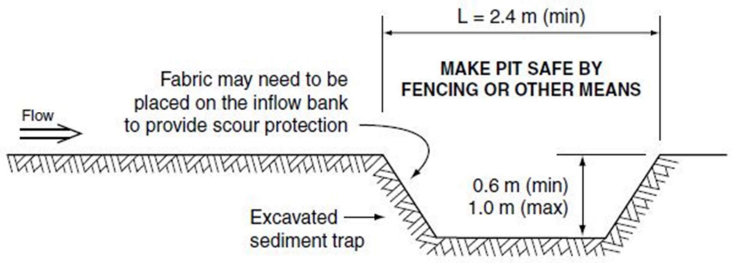
6. DISPOSE OF SEDIMENT AND DEBRIS IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

REMOVAL

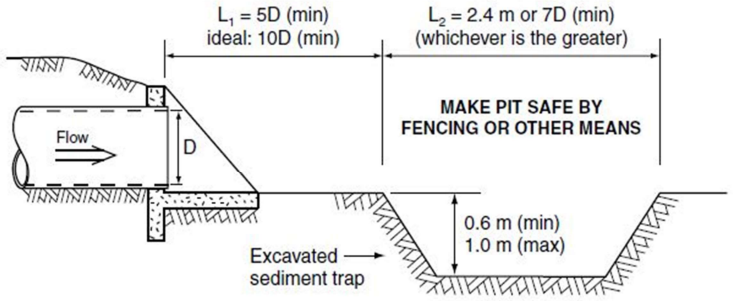
1. WHEN THE UP-SLOPE DRAINAGE AREA HAS BEEN STABILISED, REMOVE ALL MATERIALS INCLUDED DEPOSITED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

2. ALL WATER AND SEDIMENT SHOULD BE REMOVED FROM THE BASIN PRIOR TO THE DAM'S REMOVAL. DISPOSE OF SEDIMENT AND WATER IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

3. BRING THE DISTURBED AREA TO A PROPER GRADE, THEN SMOOTH, COMPACT AND STABILISE AND/OR REVEGETATE AS REQUIRED.



(a) Excavated sediment trap located within a minor drainage path



Where space is not available, make optimum use of the available space

(b) Excavated sediment trap located downstream of a stormwater outlet

Drawn:	Date:		
GMW	Apr-10	Excavated Sediment Trap	EST-01

Catchments & Creeks Pty Ltd

IECA Best Practice Erosion and Sediment Control Guideline (IECA, 2008)

MATERIALS

(i) MULCH MUST COMPLY WITH THE REQUIREMENTS OF AS4454.

(ii) MAXIMUM SOLUBLE SALT CONCENTRATION OF 5dS/m.

(iii) MOISTURE CONTENT OF 30 TO 50% PRIOR TO APPLICATION.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND EXTENT. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, MATERIAL TYPE, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. WHEN SELECTING THE LOCATION OF A MULCH FILTER BERM, TO THE MAXIMUM DEGREE PRACTICAL, ENSURE THE BERM IS LOCATED:

(i) TOTALLY WITHIN THE PROPERTY BOUNDARIES;

(ii) ALONG A LINE OF CONSTANT ELEVATION (PREFERRED, BUT NOT ALWAYS PRACTICAL);

(iii) AT LEAST 1m, IDEALLY 3m, FROM THE TOE OF A FILL EMBANKMENT;

(iv) AWAY FROM AREAS OF CONCENTRATED FLOW.

3. ENSURE THE BERM IS INSTALLED IN A MANNER THAT AVOIDS THE CONCENTRATION OF FLOW ALONG THE BERM, OR THE UNDESIRABLE DISCHARGE OF WATER AROUND THE END OF THE BERM.

4. ENSURE THE BERM HAS BEEN PLACED SUCH THAT PONDING UP-SLOPE OF THE BERM IS MAXIMISED.

5. ENSURE BOTH ENDS OF THE BERM ARE ADEQUATELY TURNED UP THE SLOPE TO PREVENT FLOW BYPASSING PRIOR TO WATER PASSING OVER THE BERM.

6. ENSURE 100% CONTACT WITH THE SOIL SURFACE.

7. WHERE SPECIFIED, TAKE APPROPRIATE STEPS TO VEGETATE THE BERM.

MAINTENANCE

1. DURING THE CONSTRUCTION PERIOD, INSPECT ALL BERMS AT LEAST WEEKLY AND AFTER ANY SIGNIFICANT RAIN. MAKE NECESSARY REPAIRS IMMEDIATELY.

2. REPAIR OR REPLACE ANY DAMAGED SECTIONS.

3. WHEN MAKING REPAIRS, ALWAYS RESTORE THE SYSTEM TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED OR SPECIFIED.

4. REMOVE ACCUMULATED SEDIMENT IF THE SEDIMENT DEPOSIT EXCEEDS A DEPTH OF 100mm OR 1/3 THE HEIGHT OF THE BERM.

5. DISPOSE OF SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

REMOVAL (IF REQUIRED)

1. WHEN DISTURBED AREAS UP-SLOPE OF THE BERM ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE BERM MAYBE REMOVED.

2. REMOVE ANY COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. REHABILITATE/REVEGETATE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.

Recommended maximum berm spacing

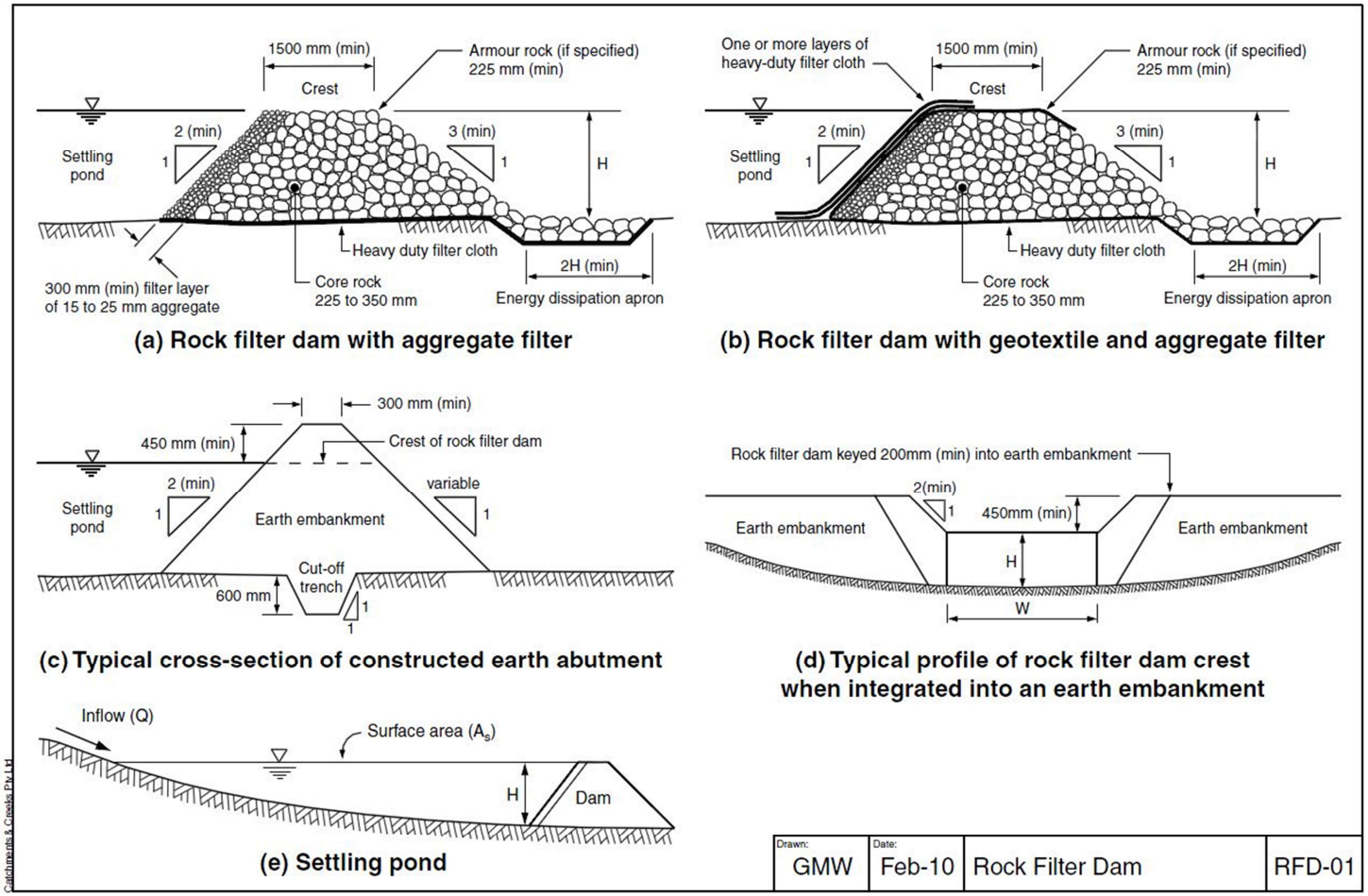
Land slope	Max spacing
< 2%	30 m
5%	25 m
10%	15 m
20%	8 m

Figure 1 - Typical placement of mulch filter berm

Drawn:	Date:		
GMW	Apr-10	Mulch Filter Berms	MB-01

Catchments & Creeks Pty Ltd

IECA Best Practice Erosion and Sediment Control Guideline (IECA, 2008)



IECA Best Practice Erosion and Sediment Control Guideline (IECA, 2008)

MATERIALS

PRIMARY CORE ROCK: WELL GRADED, HARD, ANGULAR, EROSION RESISTANT ROCK, WITH MEAN SIZE AS SPECIFIED IN THE APPROVED PLAN, BUT NOT LESS THAN 225mm, OR GREATER THAN 350mm.

ARMOUR ROCK: WELL GRADED, HARD, ANGULAR, EROSION RESISTANT ROCK, WITH MEAN SIZE AS SPECIFIED IN THE APPROVED PLAN, BUT NOT LESS THAN 225mm.

AGGREGATE FILTER: 15 TO 25mm CLEAN AGGREGATE.

GEOTEXTILE FILTER FABRIC: HEAVY-DUTY NON-WOVEN, NEEDLE-PUNCHED FILTER FABRIC, MINIMUM 'BIDIM' A34 OR EQUIVALENT.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE FOUNDATION AREA OF THE ROCK FILTER DAM OF WOODY VEGETATION AND ORGANIC MATTER. DELAY CLEARING THE UP-SLOPE POND AREA UNTIL THE DAM IS FORMED AND IS ABLE TO ACT AS A SUITABLE SEDIMENT TRAP, OTHERWISE AN ALTERNATIVE TEMPORARY DOWNSTREAM SEDIMENT TRAP MAY BE REQUIRED DURING CONSTRUCTION OF THE ROCK FILTER DAM.

3. IF SPECIFIED ON THE PLANS, EXCAVATE A CUT-OFF TRENCH ALONG THE CENTRE-LINE OF THE DAM AND EARTH ABUTMENTS (IF ANY).

4. COVER THE FOUNDATION AREA AND CUT-OFF TRENCH WITH HEAVY-DUTY FILTER FABRIC BEFORE BACKFILLING WITH THE CORE ROCK. OVERLAP ADJOINING FABRIC SHEETS A MINIMUM OF 600mm.

5. CONSTRUCT THE ASSOCIATED EARTH ABUTMENT (IF ANY). ALL CUT AND FILL SLOPES SHOULD BE 2:1(H:V) OR FLATTER. THE DOWNSTREAM FACE OF EARTH ABUTMENTS SHOULD BE 3:1(H:V) OR FLATTER. EARTH ABUTMENTS SHOULD BE CONSTRUCTED OF WELL-COMPACTED, EROSION RESISTANT SOIL THAT IS FREE OF VEGETATION AND ROOTS. OVERFILL EARTH ABUTMENTS 150mm TO ALLOW FOR SETTLEMENT.

6. PLACE THE CORE ROCK FOR THE ROCK FILTER DAM. ENSURE THE UPSTREAM FACE IS 2:1(H:V) OR FLATTER, AND THE DOWNSTREAM FACE IS 3:1(H:V) OR FLATTER.

7. ENSURE THE ROCK IS MACHINE PLACED WITH THE SMALLER ROCKS WORKED INTO THE VOIDS OF THE LARGER ROCKS.

8. IF SPECIFIED, CONSTRUCT THE SPILLWAY SECTION USING THE SPECIFIED ARMOUR ROCK. THE SPILLWAY SHOULD HAVE A MINIMUM PROFILE DEPTH OF 300mm. THE SPILLWAY WEIR CREST MUST BE LEVEL ACROSS ITS FULL WIDTH. THE MAXIMUM LONGITUDINAL SLOPE OF THE ROCK SPILLWAY SHOULD BE 3:1(H:V). THE MINIMUM THICKNESS OF ARMOUR ROCK PROTECTION SHOULD BE 500mm, OR TWICE THE NOMINAL ROCK SIZE, WHICHEVER IS THE GREATER.

9. ENSURE THE SPILLWAY OUTLET SECTION EXTENDS DOWNSTREAM PAST THE TOE OF THE FORMED EMBANKMENT UNTIL STABLE CONDITIONS ARE REACHED, OR A DISTANCE EQUAL TO THE HEIGHT OF THE DAM, WHICHEVER IS THE GREATER. THE EDGES OF THE SPILLWAY SHOULD BE LEFT FLUSH WITH THE SURROUNDING GROUND.

10. INSTALL THE SPECIFIED FILTER (AGGREGATE AND/OR FILTER CLOTH) ON THE UPSTREAM FACE OF THE ROCK FILTER DAM.

11. IF FILTER CLOTH IS USED, THEN:
(i) EXTEND THE FABRIC OVER THE CREST OF THE ROCK FILTER DAM INTO THE SPILLWAY CHUTE;
(ii) CONSIDER THE PLACEMENT OF SEVERAL LAYERS OF OVERLAPPING FABRIC, THUS ALLOWING EACH LAYER TO BE REMOVED INDIVIDUALLY ONCE THE FABRIC BECOMES BLOCKED WITH SEDIMENT.

12. CLEAR THE SETTLING POND AREA OF WOODY VEGETATION AND ORGANIC MATTER TO THE DIMENSIONS SPECIFIED WITHIN THE PLANS.

13. WHERE NECESSARY, EXCAVATE THE UPSTREAM SETTLING POND AND/OR SEDIMENT STORAGE PIT IN ACCORDANCE WITH THE APPROVED PLANS. EXCAVATED PITS TYPICALLY HAVE SIDE SLOPES OF 2:1(H:V) OR FLATTER UNLESS STEEPER SLOPES ARE KNOWN TO BE STABLE.

14. STABILISE ANY ASSOCIATED EARTH EMBANKMENTS IMMEDIATELY AFTER CONSTRUCTION THROUGH APPROPRIATE COMPACTION, VEGETATION AND/OR EROSION CONTROL MATTING.

15. ESTABLISH ALL NECESSARY UP-SLOPE DRAINAGE CONTROL MEASURES TO ENSURE THAT SEDIMENT-LADEN RUNOFF IS APPROPRIATELY DIRECTED INTO THE SEDIMENT TRAP.

16. TAKE ALL NECESSARY MEASURE TO MINIMISE THE SAFETY RISK CAUSED BY THE STRUCTURE.

MAINTENANCE

1. CHECK ALL ROCK FILTER DAMS AFTER EACH RUNOFF EVENT AND MAKE REPAIRS IMMEDIATELY.

2. INSPECT ALL ROCK AND EARTH EMBANKMENTS FOR UNDERCUTTING OR UNDESIRABLE SEEPAGE FLOWS.

3. IDEALLY, ROCK FILTER DAMS SHOULD DISCHARGE (FROM FULL) OVER NO LESS THAN 8 HOURS. IF DRAINAGE IS TOO RAPID, THEN ADDITIONAL FILTER AGGREGATE MAYBE REQUIRED TO ACHIEVE OPTIMUM HYDRAULIC PERFORMANCE.

4. IF FLOW THROUGH THE STRUCTURE IS REDUCED TO AN UNACCEPTABLE LEVEL, THE UPSTREAM FILTER MEDIUM (AGGREGATE OR FILTER CLOTH) SHOULD BE REMOVED AND REPLACED.

5. IF A GREATER DEGREE OF WATER TREATMENT (FILTRATION) IS REQUIRED, EXTRA GEOTEXTILE FILTER FABRIC SHOULD BE PLACED OVER THE UPSTREAM FACE OF THE STRUCTURE.

6. CHECK THE STRUCTURE AND DOWNSTREAM CHANNEL BANKS FOR DAMAGE FROM OVERTOPPING FLOWS. MAKE REPAIRS AS NECESSARY.

7. IMMEDIATELY REPLACE ANY ROCK DISPLACED FROM THE SPILLWAY.

8. REMOVE SEDIMENT AND RESTORE ORIGINAL SEDIMENT STORAGE VOLUME WHEN COLLECTED SEDIMENT EXCEEDS 10% OF THE SPECIFIED STORAGE VOLUME.

9. DISPOSE OF SEDIMENT AND DEBRIS IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. WHEN THE UP-SLOPE DRAINAGE AREA HAS BEEN STABILISED, REMOVE ALL MATERIALS INCLUDED DEPOSITED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

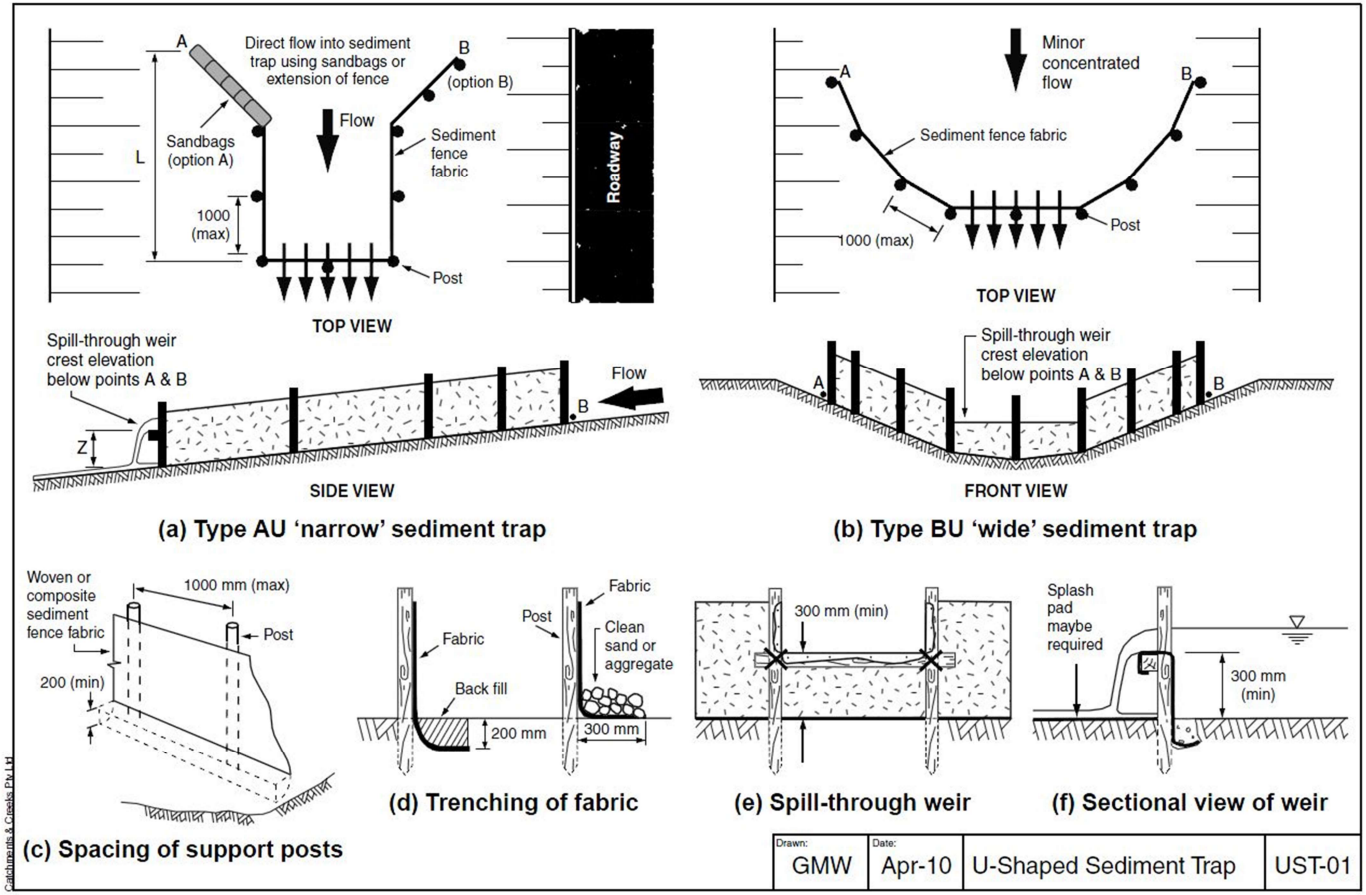
2. ALL WATER AND SEDIMENT SHOULD BE REMOVED FROM THE SETTLING POND PRIOR TO THE DAM'S REMOVAL. DISPOSE OF SEDIMENT AND WATER IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

3. BRING THE DISTURBED AREA TO A PROPER GRADE, THEN SMOOTH, COMPACT AND STABILISE AND/OR REVEGETATE AS REQUIRED TO MINIMISE THE EROSION HAZARD.

Drawn:	Date:		
GMW	Apr-10	Rock Filter Dam	RFD-02

Catchments & Creeks Pty Ltd

IECA Best Practice Erosion and Sediment Control Guideline (IECA, 2008)



IECA Best Practice Erosion and Sediment Control Guideline (IECA, 2008)

MATERIALS

FABRIC: POLYPROPYLENE, POLYAMIDE, NYLON, POLYESTER, OR POLYETHYLENE WOVEN OR NON-WOVEN FABRIC, AT LEAST 700mm IN WIDTH AND A MINIMUM UNIT WEIGHT OF 140g/m^2. ALL FABRICS TO CONTAIN ULTRAVIOLET INHIBITORS AND STABILISERS TO PROVIDE A MINIMUM OF 6 MONTHS OF USEABLE CONSTRUCTION LIFE (ULTRAVIOLET STABILITY EXCEEDING 70%).

FABRIC REINFORCEMENT: (IF USED) WIRE OR STEEL MESH MINIMUM 14-GAUGE WITH A MAXIMUM MESH SPACING OF 200mm.

SUPPORT POSTS/STAKES: 1500mm^2 (MIN) HARDWOOD, 2500mm^2 (MIN) SOFTWOOD, OR 1.5kg/m (MIN) STEEL STAR PICKETS SUITABLE FOR ATTACHING FABRIC.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND REQUIRED TYPE OF FABRIC (IF SPECIFIED). IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, FABRIC TYPE, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. INSTALL THE FABRIC IN A U-SHAPE, EXTENDING THE WING WALLS EITHER UP THE SIDE SLOPES AND/OR UP THE CHANNEL INVERT (AS DIRECTED) TO A POINT WHERE THE GROUND LEVEL IS AT LEAST 100mm HIGHER THAN THE CREST OF THE SPILL-THROUGH WEIR.

3. ENSURE THAT THE EXPECTED CHANNEL FLOW WILL ENTER THE SEDIMENT TRAP, EITHER BY EXTENDING THE WING WALLS UP THE BANK SLOPE, OR CONSTRUCTING SANDBAG FLOW DIVERSION BANKS.

4. UNLESS DIRECTED BY THE SITE SUPERVISOR, EXCAVATE A 200mm WIDE BY 200mm DEEP TRENCH ALONG THE ALIGNMENT OF THE SPILL-THROUGH WEIR AND WING WALLS.

5. ALONG THE LOWER SIDE OF THE TRENCH, APPROPRIATELY SECURE THE STAKES INTO THE GROUND SPACED NO GREATER THAN 1m.

6. CONSTRUCT THE SEDIMENT TRAP FROM A CONTINUOUS ROLL OF FABRIC.

7. SECURELY ATTACH THE FABRIC TO THE SUPPORT POSTS/STAKES USING 25mm STAPLES OR TIE WIRE AT MAXIMUM 150mm SPACING WITH THE FABRIC EXTENDED AT LEAST 200mm INTO THE TRENCH.

8. INSTALL A SPILL-THOUGH WEIR AT THE LOWEST POINT IN THE FENCE. THE WEIR MUST BE AT LEAST 300mm ABOVE ADJACENT GROUND LEVEL, AND BELOW THE LOWEST GROUND LEVEL AT THE ENDS OF THE WING WALLS.

9. SECURELY TIE A HORIZONTAL CROSS MEMBER (WEIR) TO THE ADJACENT SUPPORT POSTS. CUT THE FABRIC DOWN THE SIDE OF THE POSTS AND FOLD THE FABRIC OVER THE CROSS MEMBER AND APPROPRIATELY SECURE THE FABRIC.

10. IF DIRECTED, INSTALL A SUITABLE SPLASH PAD IMMEDIATELY DOWN-SLOPE OF THE SPILL-THROUGH WEIR TO CONTROL SOIL EROSION DOWNSTREAM OF THE SEDIMENT TRAP.

11. BACKFILL THE TRENCH AND TAMP THE FILL TO FIRMLY ANCHOR THE BOTTOM OF THE FABRIC AND MESH TO PREVENT WATER FROM FLOWING UNDER THE FENCE.

MAINTENANCE

1. INSPECT THE SEDIMENT TRAP AT LEAST WEEKLY AND AFTER ANY SIGNIFICANT RAIN. MAKE NECESSARY REPAIRS IMMEDIATELY.

2. REPAIR ANY TORN SECTIONS WITH A CONTINUOUS PIECE OF FABRIC FROM POST TO POST.

3. WHEN MAKING REPAIRS, ALWAYS RESTORE THE SYSTEM TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED OR SPECIFIED.
4. IF THE FABRIC IS SAGGING BETWEEN STAKES, INSTALL ADDITIONAL SUPPORT POSTS/STAKES.

5. REMOVE ACCUMULATED SEDIMENT IF THE SEDIMENT DEPOSIT EXCEEDS A DEPTH OF 150mm.

6. DISPOSE OF SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

7. REPLACE THE FABRIC IF THE SERVICE LIFE OF THE EXISTING FABRIC EXCEEDS SIX MONTHS.

REMOVAL

1. WHEN DISTURBED AREAS UP-SLOPE OF THE SEDIMENT TRAP ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE SEDIMENT TRAP MUST BE REMOVED.

2. REMOVE MATERIALS AND COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

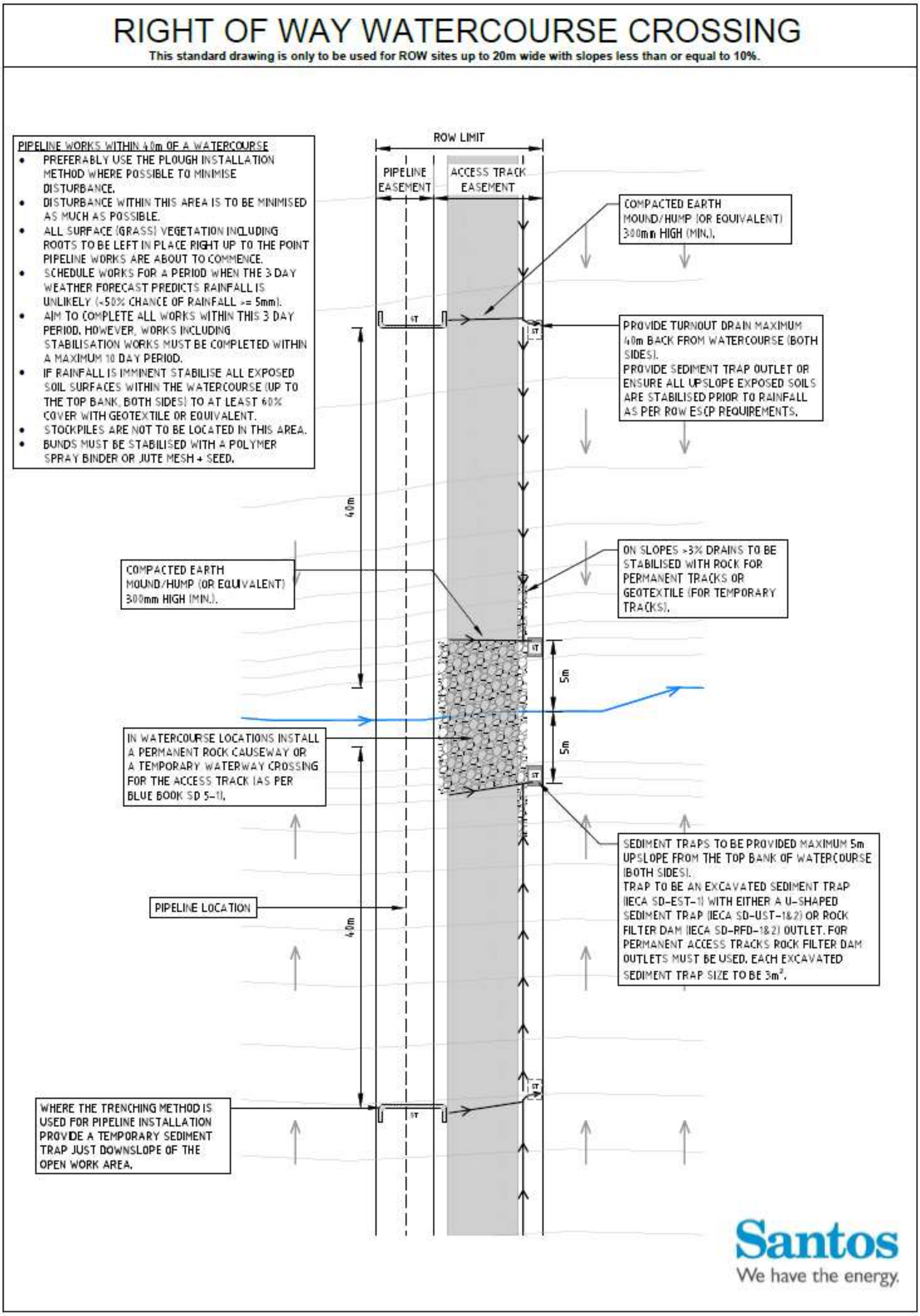
3. REHABILITATE/REVEGETATE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.

Drawn:	Date:		
GMW	Apr-10	U-Shaped Sediment Trap	UST-02

Catchments & Creeks Pty Ltd

IECA Best Practice Erosion and Sediment Control Guideline (IECA, 2008)

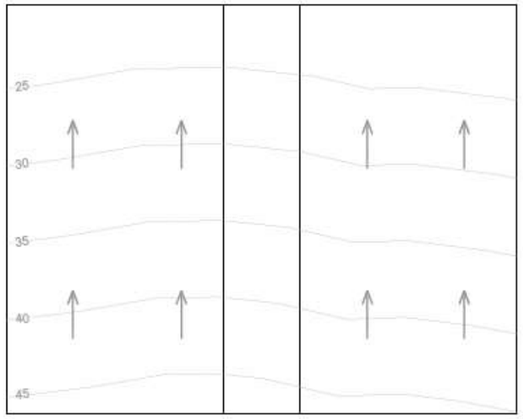
Appendix 5 ROW Watercourse Crossing Standard Drawing

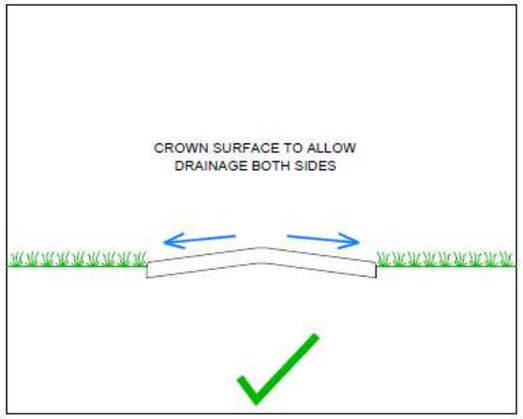


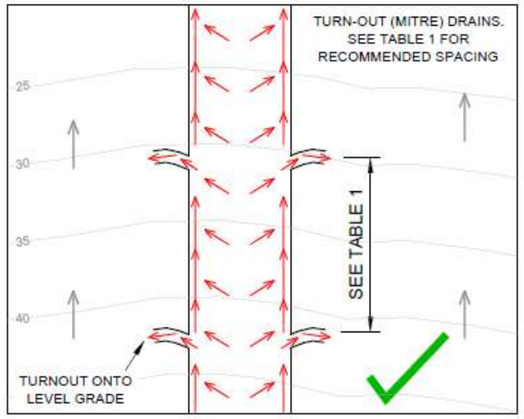
Appendix 6 Access Track Standard Drawings for Unsealed Tracks

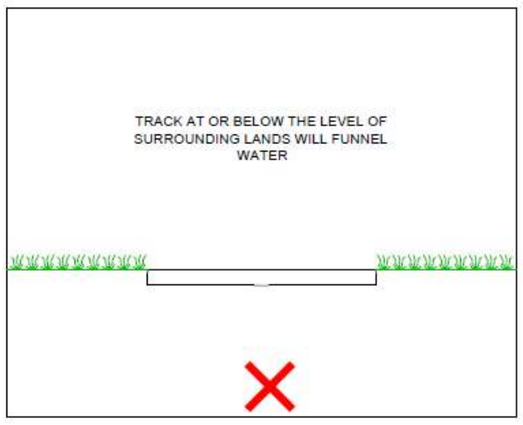
ACCESS TRACK - STANDARD DRAWING 1

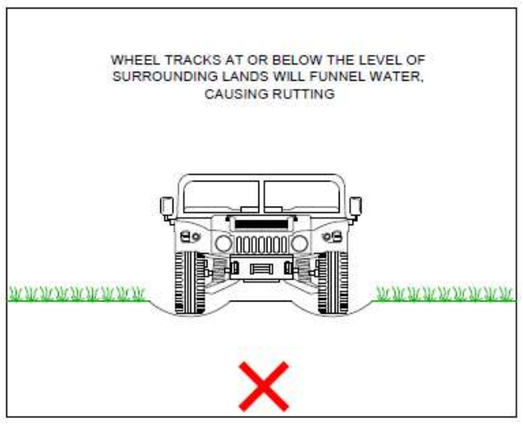
FOR ACCESS TRACKS RUNNING UP OR DOWN (i.e. PERPENDICULAR TO) THE NATURAL SLOPE











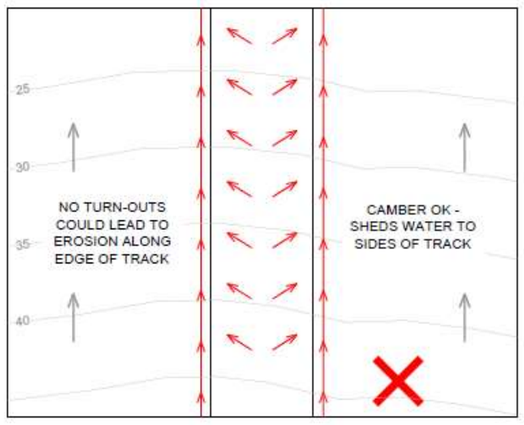


TABLE 1	
GRADE	MAX. SPACING OF TURN-OUT (MITRE) DRAINS
0 to 2%	120m
2+ to 4%	60m
4+ to 8%	30m
>8%	15m

UNSEALED ROADS AND TRACKS DO NOT HAVE A PROTECTIVE HARD SEAL AND, AS SUCH, ARE HIGHLY PRONE TO EROSION AND DAMAGE. THE KEY TECHNIQUES TO MINIMISE EROSION AND DAMAGE TO UNSEALED ROADS AND TRACKS ARE:

- GOOD SHAPING (CAMBER, SUPER-ELEVATION ETC)
- GOOD DRAINAGE.

GOOD DRAINAGE IS PARTICULARLY IMPORTANT ON UNSEALED ROADS AND TRACKS, EVEN MORE SO THAN FOR A SEALED ROAD

TRACK AT OR BELOW THE LEVEL OF SURROUNDING LANDS

USE OF TURN-OUT (MITRE) DRAINS TO MOVE WATER AWAY FROM TRACK

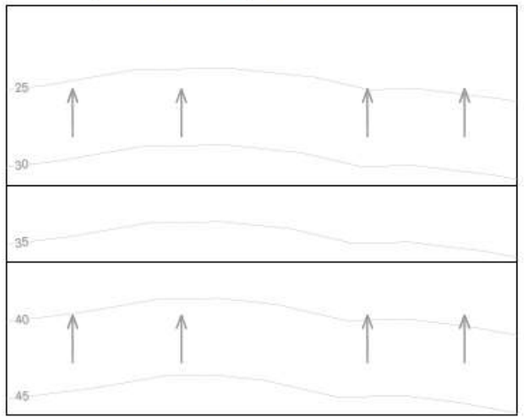
TURN-OUTS TO BE AT LEAST 5m LONG (WHERE POSSIBLE) AND AT 0% GRADE.

SEDIMENT FENCES SHOULD NOT BE REQUIRED IN TURN-OUT DRAINS IF THEY ARE CONSTRUCTED PROPERLY

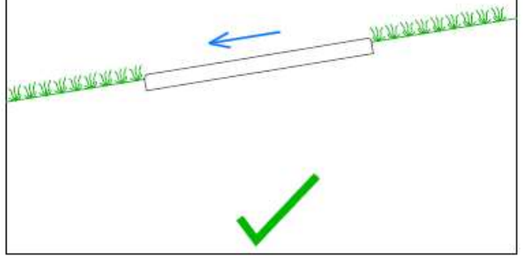
Santos
We have the energy.

ACCESS TRACK - STANDARD DRAWING 2

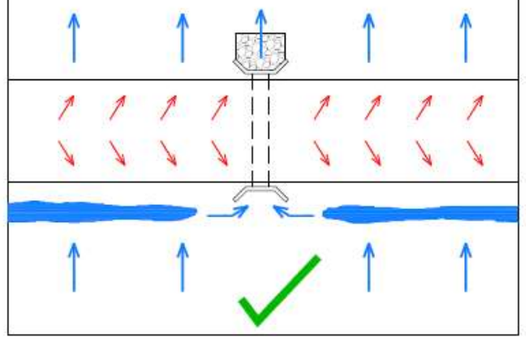
FOR ACCESS TRACKS RUNNING ACROSS
(i.e. PARALLEL TO) THE NATURAL SLOPE



ON GENTLE SIDE SLOPES,
ROAD SURFACE CAN MIMIC
SURROUNDING LANDS.

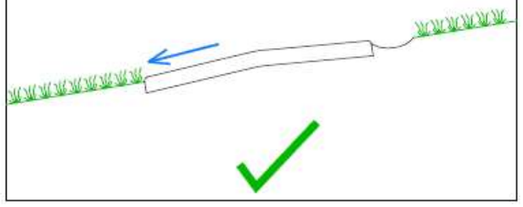


REGULAR CROSSING POINTS
FOR WATER TO DRAIN

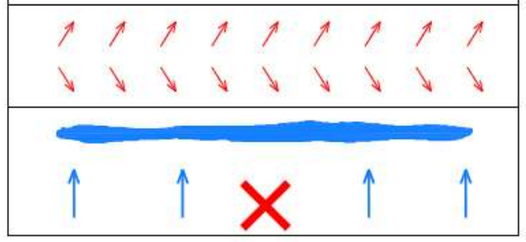


UNCONTROLLED DRAINAGE.
WATER SPILLS ACROSS TRACK AT
LOW POINTS, CAUSING EROSION

DRAIN ON HIGH SIDE OF ROAD
REQUIRES REGULAR MITRE
DRAINS, PIPES OR CAUSEWAY
CROSSING POINTS.

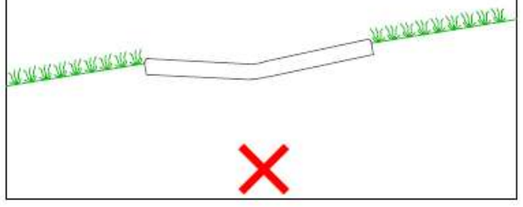


LACK OF CROSSING POINTS. WATER
POOLS ON HIGH SIDE AND DAMAGES
TRACK WHERE IT SPILLS OVER



WHEEL RUTS FUNNEL WATER
ALONG TRACK, CAUSING EROSION

WATER WILL FLOW ALONG ROAD
SURFACE, CAUSING EROSION



UNSEALED ROADS AND TRACKS DO NOT HAVE A PROTECTIVE HARD SEAL AND, AS SUCH, ARE HIGHLY PRONE TO EROSION AND DAMAGE. THE KEY TECHNIQUES TO MINIMISE EROSION AND DAMAGE TO UNSEALED ROADS AND TRACKS ARE:

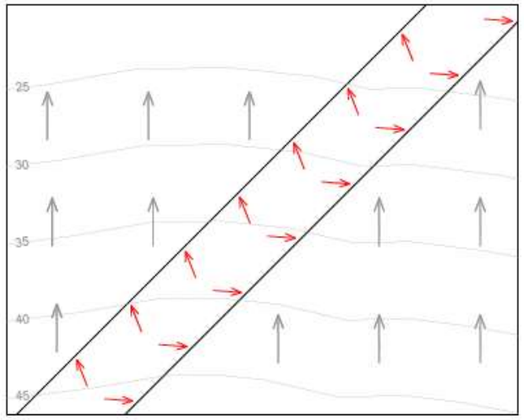
- GOOD SHAPING (CAMBER, SUPER-ELEVATION ETC)
- GOOD DRAINAGE.

GOOD DRAINAGE IS PARTICULARLY IMPORTANT ON UNSEALED ROADS AND TRACKS, EVEN MORE SO THAN FOR A SEALED ROAD

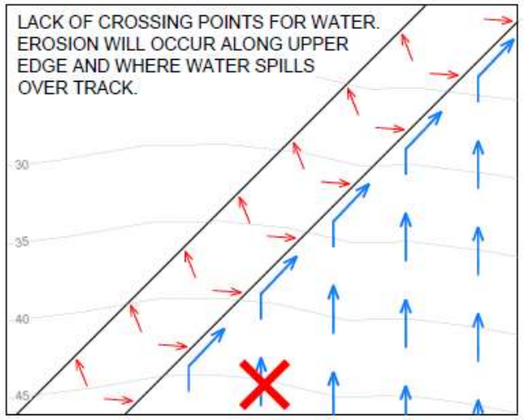
Santos
We have the energy.

ACCESS TRACK - STANDARD DRAWING 3

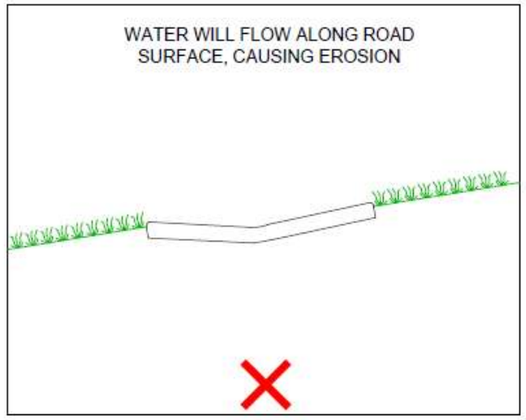
FOR ACCESS TRACKS RUNNING DIAGONAL TO THE NATURAL SLOPE



LACK OF CROSSING POINTS FOR WATER. EROSION WILL OCCUR ALONG UPPER EDGE AND WHERE WATER SPILLS OVER TRACK.

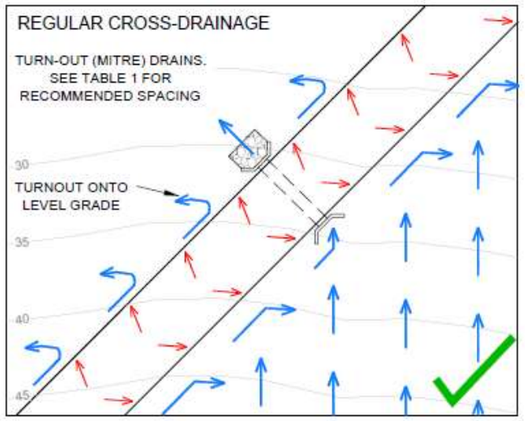


WATER WILL FLOW ALONG ROAD SURFACE, CAUSING EROSION

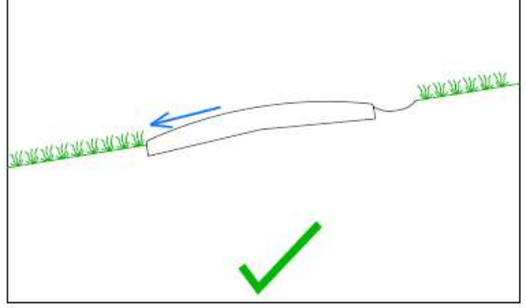


REGULAR CROSS-DRAINAGE

TURN-OUT (MITRE) DRAINS. SEE TABLE 1 FOR RECOMMENDED SPACING



GOOD SURFACE CROWN PLUS ADEQUATE UPSLOPE DRAINAGE. REQUIRES REGULAR MITRE DRAINS OR CULVERTS



UNSEALED ROADS AND TRACKS DO NOT HAVE A PROTECTIVE HARD SEAL AND, AS SUCH, ARE HIGHLY PRONE TO EROSION AND DAMAGE. THE KEY TECHNIQUES TO MINIMISE EROSION AND DAMAGE TO UNSEALED ROADS AND TRACKS ARE:

- GOOD SHAPING (CAMBER, SUPER-ELEVATION ETC)
- GOOD DRAINAGE.

GOOD DRAINAGE IS PARTICULARLY IMPORTANT ON UNSEALED ROADS AND TRACKS, EVEN MORE SO THAN FOR A SEALED ROAD

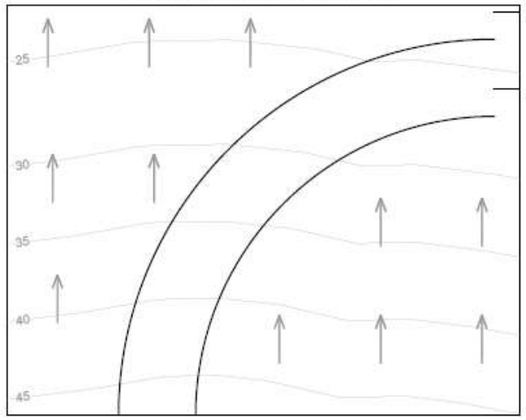
LACK OF DRAINAGE AT EDGE OF TRACK. WATER FLOWS ALONG THE TRACK AS A RESULT, CAUSING EROSION

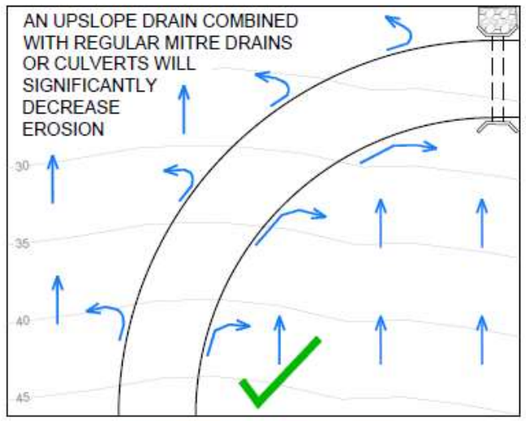
NOTE THAT THE TRACK AVOIDS EXISTING VEGETATION AND IS WELL BUILT-UP, ALTHOUGH REQUIRES ADEQUATE DRAINAGE TO MINIMISE THE RISK OF EROSION ON THE UPSLOPE EDGE.

Santos
We have the energy.

ACCESS TRACK - STANDARD DRAWING 4

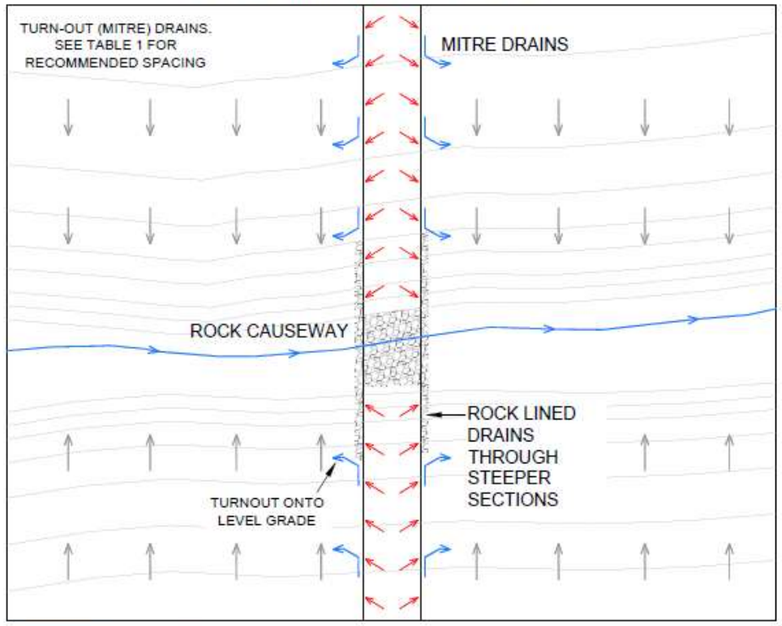
FOR ACCESS TRACKS WRAPPING AROUND THE NATURAL SLOPE





LACK OF STABLE DRAINAGE ON A STEEP SECTION OF TRACK

FOR WATERCOURSE AND GULLY CROSSINGS



THIS WILL ERODE WHENEVER THERE IS GULLY FLOW, RESULTING IN ONGOING MAINTENANCE COSTS.
IN ADDITION, THE SIDES OF THE TRACK WILL SCOUR DUE TO THE LACK OF STABLE DRAINAGE.

POOR STABILISATION OF WATERCOURSE CROSSINGS MEANS ADDITIONAL ONGOING COSTS FOR MAINTENANCE AND REPAIR.

UNSEALED ROADS AND TRACKS DO NOT HAVE A PROTECTIVE HARD SEAL AND, AS SUCH, ARE HIGHLY PRONE TO EROSION AND DAMAGE. THE KEY TECHNIQUES TO MINIMISE EROSION AND DAMAGE TO UNSEALED ROADS AND TRACKS ARE:

- GOOD SHAPING (CAMBER, SUPER-ELEVATION ETC)
- GOOD DRAINAGE.

GOOD DRAINAGE IS PARTICULARLY IMPORTANT ON UNSEALED ROADS AND TRACKS, EVEN MORE SO THAN FOR A SEALED ROAD

Santos
We have the energy.