



Mary's Mount Drainage Corridors Vegetation Management Plan

Report Prepared For
Goulburn City Council



Prepared by:

STORM Consulting Pty Ltd

November 2003

Commercial in Confidence

All intellectual property rights, including copyright, in designs developed and documents created by STORM Consulting Pty Ltd remain the property of that company. Any use made of any such design or document without the prior written approval of STORM Consulting Pty Ltd will constitute an infringement of the rights of that company which reserves all legal rights and remedies in respect of any such infringement.

The information, including the intellectual property, contained in this document is confidential and proprietary to STORM Consulting Pty Ltd. It may only be used by the person to whom it is provided for the stated purpose for which it is provided, and must not be imparted to any third person without the prior written approval of STORM Consulting. STORM Consulting reserves all legal rights and remedies in relation to any infringement of its rights in respect of its confidential information.

© 2003 STORM Consulting Pty Ltd



Job title	Mary's Mount Vegetation Management Plan	Job number	M288
-----------	---	------------	------

Document title	Mary's Mount Drainage Corridors Vegetation Management Plan
----------------	--

Revision	Date	Filename	X:\Marys Mount VMP M288\Reports\M288_VMPversion2copy.doc		
Draft 1	10/09/03	M288_VMPVersion 1	First draft (for review)		
			Prepared by	Checked by	Approved by
			Name	Emma Garraway	Matt Wierzbicki
		Signature			
Revision	Date	Filename	X:\Marys Mount VMP M288\Reports\M288_VMPversion2copy.doc		
Final	05/11/03	M288_VMPVersion2	Document revised to include amendments for DIPNR, Goulburn City Council and NSW Rural Fire Service.		
			Prepared by	Checked by	Approved by
			Name	Emma Garraway	Matt Wierzbicki
		Signature			

Issue Document Verification with Document



This report takes into account the particular instructions and requirements of our Client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.



ACKNOWLEDGMENTS

STORM Consulting wishes to thank all representing organisations who contributed to the production of this report, including:

Goulburn City Council	Joan Saunders Jack Miller Phil Hunter Brian Ohlback
DIPNR	Stephen Watts Gillian Young
Laterals Planning	Gina M ^c Donald
Rural Lands Protection Board	Mark M ^c Gaw



EXECUTIVE SUMMARY

The objective of this VMP is to provide a revegetation strategy for providing and managing riparian drainage corridors through the Mary's Mount subdivision. These drainage corridors are to provide highly vegetated, relatively narrow, low maintenance channels to convey flood flows.

This document is applicable to revegetation of drainage corridors only. For design of streams within the DCP area, the reader is referred to Mary's Mount Drainage Corridors - Stream Management Guidelines for Mary's Mount DCP (Storm 2003a).

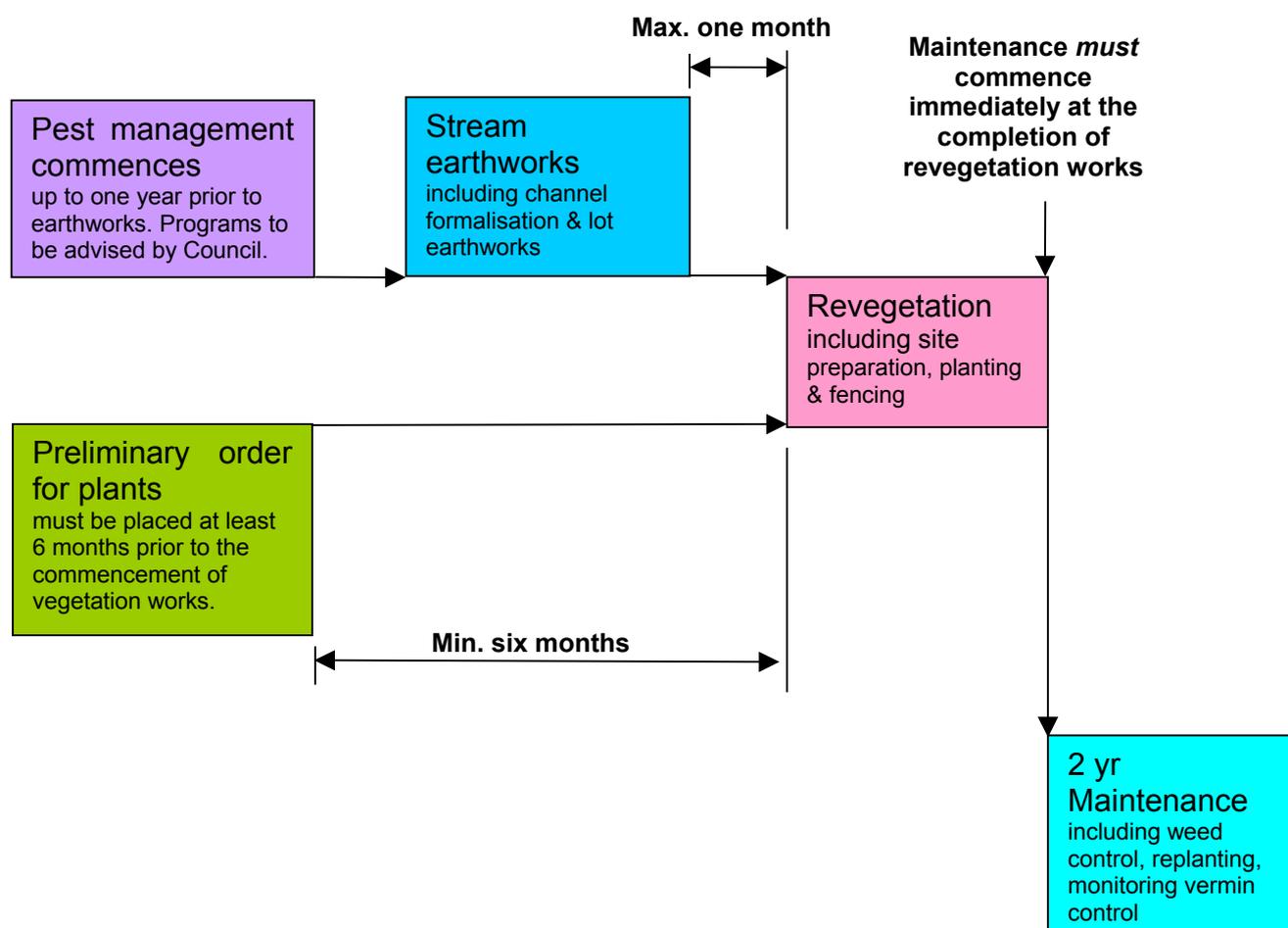




TABLE OF CONTENTS

1.0	INTRODUCTION	1
1.1.	Background	1
1.2.	Objectives.....	1
1.3.	Scope	1
2.0	LEGISLATION AND AUTHORITY JURISDICTION	3
2.1.	Council requirements.....	3
2.2.	Rivers and foreshores improvement act.....	3
2.3.	Other legislation	4
2.3.1.	Environment Protection and Biodiversity Conservation Act	4
2.3.2.	Other.....	5
3.0	SITE APPRAISAL	6
3.1.	Location.....	6
3.2.	Landform	6
3.3.	Fauna	6
3.3.1.	Endangered species	7
3.4.	Flora	7
3.4.1.	Vegetation communities.....	7
3.4.2.	Endangered species	8
3.5.	Soils.....	9
3.6.	Salinity.....	10
3.7.	Soil revegetation analysis.....	11
4.0	PROPOSED DEVELOPMENT.....	12
4.1.	Formalised stream – incised.....	12
4.2.	Formalised stream – filled	12
5.0	REVEGETATION	13
5.1.	Introduction.....	13
5.2.	Planting	13
5.2.1.	Riparian zonation	13
5.2.2.	Revegetation areas.....	13
5.3.	Site preparation	15
5.3.1.	Protection of vegetation to be retained	15
5.3.2.	Weed and pest eradication	15
5.3.3.	Site stripping	15
5.3.4.	Erosion protection	16
5.3.5.	Soil remediation	16
5.3.6.	Surface preparation	18
5.4.	Planting materials.....	18
5.4.1.	Imported topsoil	18
5.4.2.	Mulch	19
5.5.	Seed collection and propagation	19
5.5.1.	General	19
5.5.2.	Seed collection.....	20
5.5.3.	Viro tubes.....	20
5.5.4.	Tubestock	20



5.5.5.	Species planting lists	20
5.5.6.	Planting methods	21
5.5.7.	Staking and plant protection during establishment.....	21
5.6.	Site protection	22
5.7.	Clean up.....	22
6.0	WEED AND PEST MANAGEMENT	28
6.1.	Weed management	28
6.1.1.	Introduction	28
6.1.2.	Weed control and management.....	28
6.2.	Pest management	30
6.2.1.	Introduction	30
6.2.2.	Pest control.....	30
7.0	SOIL EROSION CONTROL.....	31
7.1.	Silt fences and straw bales.....	31
7.2.	Instream erosion control.....	31
8.0	FIRE HAZARDS AND CONSIDERATIONS	35
9.0	MAINTENANCE.....	36
9.1.	Maintenance regime	36
9.2.	Maintenance acceptance criteria.....	36
9.2.1.	Maintenance log book.....	36
9.2.2.	Maintenance report	37
10.0	MONITORING AND REVIEW	38
10.1.	Introduction.....	38
10.2.	Performance indicators.....	38
10.3.	Review procedures.....	39
11.0	PROGRAM OF WORKS.....	41
12.0	REFERENCES	42

APPENDICES

APPENDIX A.....	DRAWING M288/P01 VEGETATION MANAGEMENT PLAN
APPENDIX B.....	WEEDS INFORMATION
APPENDIX C.....	PLANT SUPPLIERS
APPENDIX D.....	SOIL REVEGETATION ANALYSIS



FIGURES

Figure 3.1	Mary's Mount DCP area	6
Figure 5.1	Planting zones within drainage corridors	14
Figure 5.2	Mulching and topsoil placement	19
Figure 6.1	Management recommendations for interface between creek restoration area and adjoining residential developments	30
Figure 7.1	Example of location of soil erosion control devices to be installed during drainage corridor revegetation works	34
Figure 11.1	Program of Works.....	41

STANDARD DRAWINGS

Standard Drawing 5.1	Erosion control blanket	17
Standard drawing 5.2	Protection works	23
Standard Drawing 7.1	Temporary erosion control.....	32
Standard Drawing 7.2	Temporary check dam.....	33

TABLES

Table 3.1	Typical soil profile in the Mary's Mount drainage corridors	10
Table 6.1	Noxious weeds likely to be problematic in the Mary's Mount DCP	28
Table 10.1	Performance indicators for revegetation works at Mary's Mount	39
Table 10.2	Bush regeneration performance measures	39



1.0 INTRODUCTION

1.1. BACKGROUND

Approximately 410 hectares of urban development is planned for Mary's Mount, Goulburn. This area is within the Goulburn Local Government Area and is part of the SCA drinking water catchments defined by SEPP 58.

The Mary's Mount DCP specifies that areas identified as drainage lines shall be set aside as drainage reserves, which are to be re-established as "natural" water courses through revegetation with native species. These drainage reserves shall serve to provide erosion control, stormwater conveyance and enhance ecological values and create an aesthetically more pleasing environment.

Goulburn City Council has a demonstrated commitment to sustainable development. The implementation of this vegetation management plan achieves in part, sustainable urban development within the city of Goulburn.

1.2. OBJECTIVES

The objective of this Vegetation Management Plan (VMP) is to satisfy Council and Department of Infrastructure, Planning and Natural Resources (DIPNR) requirements for:

- providing and managing riparian drainage corridors through the subdivision; and
- to provide highly vegetated, relatively narrow, low maintenance channels to convey flood flows.

It is important that riparian zones and drainage reserves are well managed for a number of reasons, including:

- to decrease erosion and mitigate corridor degradation;
- improve water quality;
- prevent vulnerability to flooding;
- provide healthy ecosystems; and
- provide wildlife habitat and corridors.

1.3. SCOPE

This document is applicable to revegetation of drainage corridors only. For design of streams within the DCP area, the reader is referred to the accompanying document *Mary's Mount Drainage Corridors Stream Management Guidelines* (Storm Consulting 2003a).

Other matters relating to vegetation such as preservation and linking of important particular vegetation communities including remnant vegetation, is outside the scope of this project.



Specifications provided in this plan provide details on soil fertility management, site preparation, planting lists and densities, typical soil and erosion control and necessary maintenance.

The VMP is a working document and should be subject to ongoing revision throughout the duration of the Mary's Mount development.



2.0 LEGISLATION AND AUTHORITY JURISDICTION

2.1. COUNCIL REQUIREMENTS

With the exception of an area adjacent to the Mulwaree River, all creek corridors and drainage lines will come under Goulburn City Council's jurisdiction and are within the Mary's Mount Development Control Plan (DCP) area (Goulburn City Council 2003). The Mary's Mount DCP specifies that areas identified as being a drainage line shall be set aside as a drainage reserves which are to be re-established as "natural" water courses through revegetation with native species. In accordance with water sensitive design principles outlined in the DCP, these natural creeks are to be used as trunk drainage corridors for stormwater.

Additional Council requirements include but are not limited to the following:

- Stream design for conveyance of stormwater must be designed in accordance with the accompanying Stream Management Guideline (Storm Consulting 2003a)
- Flood level assessment is required in order to ensure sufficient freeboard to floor levels. i.e. 500 mm

The DCP supports the provision of the *Goulburn Local Environmental Plan 1990* and has been prepared in accordance with the *Environmental Planning and Assessment Act 1979*. The provision of any planning instrument will apply to any inconsistencies between the DCP and planning instruments.

2.2. RIVERS AND FORESHORES IMPROVEMENT ACT

When any development is in or within 40m of the top of the bank or shores of protected waters or prescribed streams, a permit is required under Part 3A of the *Rivers and Foreshores Improvement Act 1948*. The Development Application will be referred by Council to the Department of Infrastructure, Planning and Natural Resources (DIPNR) who administer the Act.

The *Rivers and Foreshores Improvement Act (R&FI) 1948* applies to protected waters, and includes both natural and artificial water bodies. Part 3A of the R&FI Act also applies to the bank, shore or bed of these water bodies and adjacent land within 40m of the top of banks, which is known as protected land. Part 3A may also apply to land further than 40m from a water body, as determined by DIPNR.

The purpose of Part 3A of the R&FI Act is to control activities and development that that have the potential to cause adverse impacts. These impacts include detrimental effects such as increased erosion, bed lowering, stream diversion, obstructing stream flow, ecological deterioration and long term stability issues. A 3A permit is issued with conditions attached that are specific to the type of activity being undertaken. Part 3A gives DIPNR the authority to order remediation works if it considers an activity has or might damage or adversely affect protected land and waters (DLWC 2000b).

In relation to Mary's Mount DCP area, the R&FI Act applies to the stream system situated on the southern side of the Mary's Mount Road (see relevant hatching area on plan M288/P01, Appendix A). Developers must seek a 3A permit for works within these areas.



Drainage corridors outside the above-mentioned areas, generally in the north of the DCP area, are not subject to the R&FI Act. However, DIPNR (Goulburn Office) should be consulted with in regards to stream design and revegetation, in particular when landowner owners propose to formalise drainage corridors as this can lead to adverse impacts on the surrounding environment if not done correctly. It is recommended that stream designs be submitted to DIPNR for comment prior to commencement of any works.

2.3. OTHER LEGISLATION

Developers and landholders should be aware of other relevant legislation to enable them to fulfil their legal responsibilities and implement appropriate management decisions. These are explained briefly below.

2.3.1. Environment Protection and Biodiversity Conservation Act

The *Environment Protection and Biodiversity Conservation Act 1999* requires the developer or proponent to obtain Commonwealth approval if an activity is likely to have a significant impact on matters of national environmental significance. It is not the responsibility of the local government to refer an action, unless that local government itself proposes to take the action. Local, State and Commonwealth government approvals and permits are still required.

Six matters of national environmental significance are identified in the Act:

- World Heritage properties;
- Ramsar wetlands of international significance;
- Nationally listed threatened species and ecological communities;
- Listed migratory species;
- Commonwealth marine areas; and
- Nuclear actions.

For development within the Mary's Mount DCP, this Act is most likely to come into effect for any works that may be undertaken within areas identified as endangered remnant vegetation, or areas listed as containing nationally listed threatened species.

Under the EPBC Act, proponents are required to undertake and publish certain assessment documents which must be lodged at a relevant local authority or regional library, as well as being available from the proponent. Further information should be obtained through Environment Australia. For example, early contact with Environment Australia is recommended if an action is likely to impact on an ecological community.



2.3.2. Other

Other legislation that may need to be considered includes, but is not limited to, the following: -

- *Native Vegetation Conservation Act 1997* (removal of native or exotic vegetation)
- *Noxious Weeds Act 1993* (Control of noxious weeds)
- *Threatened Species Conservation Act 1995*
- *Rural Lands Protection Act 1998* (Poisoning of feral animals)
- *National Parks and Wildlife Act 1970* (protecting populations of threatened flora & fauna)
- Soil Conservation Act 1938 (works to mitigate soil erosion)
- Protection of the Environment Operations Act 1997

3.0 SITE APPRAISAL

3.1. LOCATION

This vegetation management plan applies to the drainage corridors within the Mary's Mount DCP area (Figure 3.1). These drainage corridors drain to the Wollondilly River, which is within the Wollondilly catchment. The Wollondilly catchment is a major water supply catchment for Sydney, and provides water to many small towns and cities for industry, irrigation and livestock.

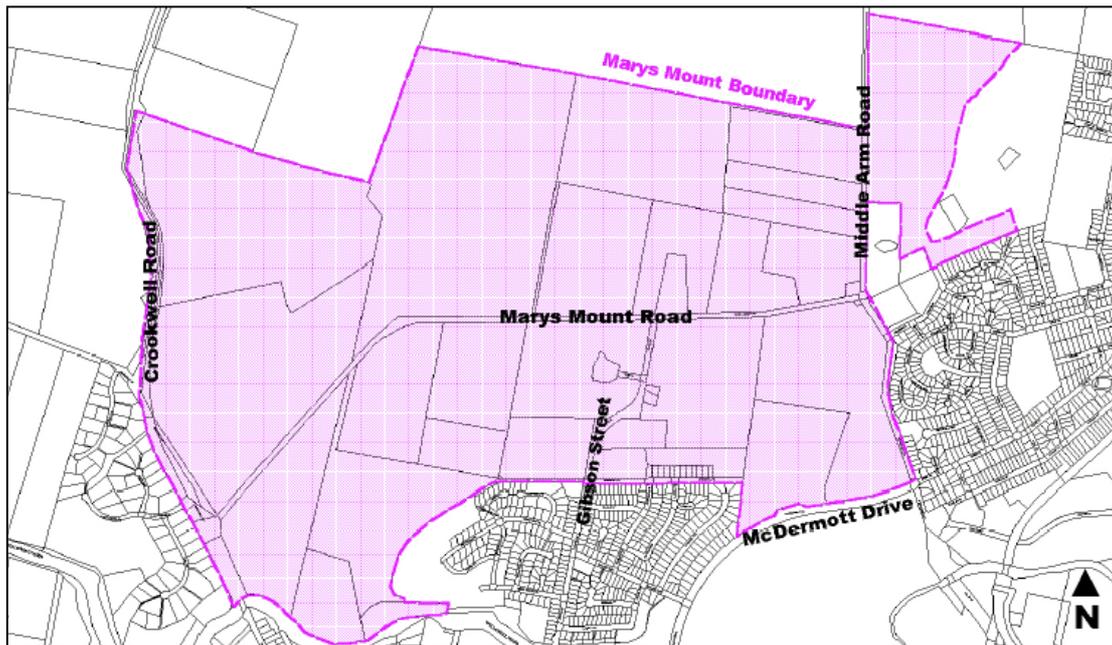


Figure 3.1 Mary's Mount DCP area

3.2. LANDFORM

The drainage corridors within the DCP area drain in a north to south direction into the Wollondilly River (Drawing M288/P01 Appendix A). The corridors are generally wide and flat at the northern end but become more incised and defined as the corridors confluence and enter the Wollondilly River. The site is gently sloping, and the main land use in the area has been grazing.

3.3. FAUNA

Within the city of Goulburn, various mammals are common, including the Brushtail and Ringtail Possum, Echidna, Common Wombat, Eastern Grey Kangaroo and Swamp Wallaby. Significant mammal species includes the Platypus, which is frequently sighted in the Wollondilly River. Other significant species, such as the Wallaroo, the Red Necked Wallaby and the Sugar Glider are thought to be found within the city of Goulburn.



Common small birds in Goulburn, which benefit from small shrubs and thickets, include the Eastern Spinebill, New Holland Honeyeater, Silvereye, Red Browed Firetail and Yellow Rumped Thornbill. The Pied Currawong, Grey Butcherbird, Red Wattlebird, Crimson Rosella and Sulphur Crested Cockatoo are common larger birds frequently sighted within the urban environment.

A number of reptiles are found in Goulburn's nature reserves, such as the Garden Skink, Copper Tailed Skink and Eastern Bluetongue Lizard. Other reptile species in Goulburn include the Eastern Snake-necked Turtle, Eastern Water Skink, Bouganville's Skink, Blotched Bluetongue Lizard, Shingleback and Common Tree Snake.

Amphibians commonly recorded near the Wollondilly River in Goulburn include the Common Eastern Froglet, Eastern Banjo Frog, Spotted Grass Frog and Verreaux' Tree Frog.

These native fauna are an important part of the ecosystem, and vegetation corridors provide habitat for these species, helping to retain and enhance native fauna of the Goulburn region.

3.3.1. Endangered species

A description of endangered and vulnerable species that may be found on the site is provided by Laterals Planning (Laterals Planning 2003) and reads:

Adjacent to the Wollondilly River Draft Vegetation Management Plan study area there was a particularly dense area of native grassland (dominated by Kangaroo Grass-Themeda australis) with numerous granite rocks of various sizes scattered throughout. It is possible that this area provides habitat for a variety of reptiles including the Striped Legless Lizard (Delma impar) which is a species identified as endangered, vulnerable and threatened with extinction on Schedule 1 of the Endangered Species Protection Act 1992. NSW National Parks and Wildlife Service should be contacted prior to any works concerning this area of land and further surveys may need to be carried out in this area to determine the presence of this species.

The Striped Legless Lizard has not been sighted in Goulburn, however it is recommended that a targeted search should be undertaken. It is also possible that the Pink-tailed legless lizard is also found in these granite outcrops with grassland. This species has previously been found unexpectedly in Goulburn.

Where development is proposed in an area where a threatened or endangered species is known to occur or possibly occur, an "8 Part Test" is required. It is the responsibility of the proponent to ensure that all necessary approvals are sought.

3.4. FLORA

3.4.1. Vegetation communities

A description of the existing vegetation on the site is provided by Laterals Planning (Laterals Planning 2003) and reads:



The Mary's Mount 400ha DCP area is currently comprised of three main vegetation types/communities – Improved Pasture, Native Grassland and Woodland areas and distinct riparian vegetation communities. Clearing, heavy grazing, weed invasion and the introduction of vigorous pasture species over time has resulted in almost complete removal of the native vegetation component of the site.

A mixture of exotic pasture and weed species (including grasses and forbs) dominate the understorey throughout much of the Mary's Mount area. These species included; *Phalaris* (*Phalaris aquatica*), Cocksfoot (*Dactylis glomerata*), *Paspalum* (*Paspalum dilatatum*), Paterson's Curse (*Echium plantagineum*), Sub Clover (*Trifolium subterraneum*), and several thistle species including large numbers of Scotch Thistle (*Onopordum acanthium*) and Spear Thistle (*Cirsium vulgare*), especially south of Mary's Mount Road. Serrated Tussock (*Nassella trichotoma*) was also common within the area surrounding the major drainage channels adjacent to the Wollondilly River.

This site visit also confirmed the presence of several major weed species within the proposed development area. These species can be removed and controlled with the use of appropriate herbicides in conjunction with hand removal methods, and as required by the Department of Infrastructure Planning and Natural Resources (DIPNR) and Goulburn City Council, as discussed in Section 6.0.

Throughout this area, drainage channels generally contained several species of rushes and sedges, dominated by Tall Sedge (*Carex appressa*), and scattered with weeds and pasture grasses such as *Phalaris* (*Phalaris aquatica*), Yorkshire Fog (*Holcus lanatus*), and Ryegrass (*Lolium* sp.). On the ridges and slopes throughout this area there were numerous mature eucalypts including Yellow Box (*Eucalyptus melliodora*), Blakeley's Red Gum (*Eucalyptus blakeleyi*), Apple Box (*Eucalyptus bridgesiana*) and Brittle Gum (*Eucalyptus mannifera*). Native grasses such as Wallaby Grass (*Danthonia* spp.) also occur throughout although in some areas they are quite sparse. Remaining native vegetation identified during this site visit included several areas of grassland dominated by Kangaroo Grass (*Themeda australis*), and with scattered forbs throughout including Many-flowered Mat-rush (*Lomandra multiflora*), Wattle Mat-rush (*Lomandra filiformis*) and Common Everlasting Daisy (*Chrysocephalum apiculatum*). Scrambled Eggs (*Goodenia pinnatifida*) were also scattered throughout several drainage areas south of Mary's Mount Road. Located directly in the drainage channels throughout this area, Common Reed (*Phragmites australis*) and Cumbungi (*Typha orientalis*) were also common.

3.4.2. Endangered species

White Box Yellow Box Blakely's Red Gum Woodland is listed as an Endangered Ecological Community under the *Threatened Species Conservation Act 1995*. This ecological community has been drastically reduced in area and highly fragmented because of clearing (Environment Australia 2003). It includes those woodlands where the characteristic tree species include one or more of the following species - *Eucalyptus albens* (White Box), *Eucalyptus melliodora* (Yellow Box) and *Eucalyptus blakelyi* (Blakely's Red Gum). The trees may occur as pure stands, mixtures of the three species, or in mixtures with other trees such as *E. bridgesiana* (Apple Box), *E. microcarpa* (Grey Box), *E. mannifera* (Brittle Gum), *E. rubida* (Candlebox), *E. cinerea* (Argyle Apple) and *E. macrorrhyncha* (Red Stringybark). The ground layer is characterised by grass and herbaceous species, although shrubs are generally sparse or absent. However, the understorey may be highly modified due to grazing and



disturbance. Disturbed remnants are still considered to be part of the community. The community is an important habitat for a diverse fauna. A number of fauna and flora species of conservation significance are found in some stands of White Box Yellow Box Blakely's Red Gum Woodland. Key threatening processes in this ecological community include clearing of native vegetation, predation by the European Fox *Vulpes vulpes* and predation by the Feral Cat *Felis catus* (NSW Scientific Committee 2002).

3.5. SOILS

According to Goulburn City Council's *Stormwater Management Plan* (Goulburn Council, 2000), Goulburn's soil profiles generally have poor drainage characteristics. Soil properties are described as having moderate permeability, moderate topsoil erodibility, low subsoil erodibility and moderate shrink-swell potential.

There are two soil landscape units within the Mary's Mount DCP area, the Sooley and Monastery Hill soil landscapes. The Sooley landscape unit covers the western portion of the DCP area, extending to the northern and southern boundaries of the DCP area from the bend in Mary's Mount Road. The remaining eastern portion classified as the Monastery Hill soil landscape unit.

The Sooley soil landscape is characterised as having localised poor drainage, water-logging, high water table and shrink swell subsoils (SCA and DLWC, 2002). This landscape is also characterised as having localised gully erosion, salinity and seepage scald hazards, which have occurred as a result of vegetation clearing over the years (Hird 1990).

The Monastery Hill soil landscape is characterised as having localised shallow soils and shrink swell subsoils where rock outcrops occur. Topsoil in this landscape is a sandy clay loam with high permeability, which is susceptible to structural decline, however the soils beneath the topsoil vary in permeability and acidity (Hird 1990).

Disturbance of either of the soil landscape surfaces will create significant short-term erosion problems, which is of particular significance due to Mary's Mount's close proximity to the Wollondilly River. It is important that appropriate soil and erosion control measures are incorporated into the works and revegetation is monitored and maintained in the drainage corridors to prevent gullying and sheet erosion.

A typical soil profile from within the Mary's Mount drainage corridors are shown in the table below (Table 3.1). This analysis, together with soil profile reports from the Soil Profile Attribute Data Environment (SPADE) (DLWC 2000a) can provide a typical soil profile from the Mary's Mount DCP area. SPADE is a tool that provides access to soil profile information from across NSW, which comes from the Soil and Land Information System, NSW's foundation land and soil database.



Table 3.1 Typical soil profile in the Mary's Mount drainage corridors

Approx Layer depth (mm)	Soil description [#]	Characteristics [#]
0 – 120	Topsoil	Silty to heavy clay, neutral to slightly acid, slight dispersion but slaking does not always occur. Generally deficient in phosphorus. Generally low salinity * however visual assessment revealed number of salinity affected areas (see Section 3.6)
120-400	Silty clay/ clay loam	Dark greyish brown with orange mottles, some organic matter, <i>in situ</i> weathered material, ironstone fragments observed, and medium to high plasticity. Slight slaking but no dispersion
400-900	Medium heavy clay	Orange mottles, slightly dispersive, moist, granular material.

[#] Derived from SPADE and site investigations undertaken by STORM

* 4 samples were taken across the site of which one indicated higher salinity whilst others were typical of soils in the area ranging from 0.06-0.12 dS/m (microseimans).

3.6. SALINITY

Two salt affected areas have been identified within the Mary's Mount drainage corridors, at the downstream confluence on the western drainage corridor close to the Wollondilly River, and within the grounds of the Mulwaree High School (see drawing M288/P01). These areas are approximately defined only and others may exist on the site that were either not recorded during initial site investigations or that may have emerged since.

Vegetation indicators of salinity include:

- "patchy" plant growth;
- reduced vigour or stunting of plant growth;
- yellowing of leaves and defoliation;
- presence of salt tolerant plant species;
- small bare areas and salt stains on (dry) soil surface in adverse conditions; small, bare areas are present.

Therefore, it is necessary to plant salt tolerant species that can withstand the saline environment to ensure that a desirable plant density is achieved.

Topsoil from within a saline area may exhibit the following properties:

- Moderately alkalinity;
- Salinity;
- Light clay texture;
- Moderate to high dispersivity; and
- High cation exchange capacity and exchangeable cations.

In general, the condition of soils within the Mary's Mount DCP can be improved for vegetation purposes by methods specified in Section 5.2.



3.7. SOIL REVEGETATION ANALYSIS

Soil samples from four representative locations in the Mary's Mount DCP area were analysed to assess the requirements for revegetation. The cation exchange capacity (CEC), a measure of the soil's ability to store exchangeable cations, was generally low to moderate. The CEC was quite high in the saline soil tested. Potassium (K) and phosphorus in soils were either limited or deficient, and results suggested that all samples would benefit from the application of K and P fertilisers.

Where soils exhibited slaking or dispersion, the application of organic matter is recommended to improve stability. These soil amelioration recommendations are further discussed in Section 5. The results of the soil revegetation analysis are included in Appendix D.



4.0 PROPOSED DEVELOPMENT

There are areas at Mary's Mount that are currently "unformed" drainage corridors. These areas will require formation as a "naturalised" drainage system (trunk drainage corridor). This formation work is to be undertaken by developers when they develop their respective landholdings.

Another option is to leave the channels as they are today, but revegetated for stability purposes. However, this scenario is not a viable option for the Mary's Mount subdivision as it is not consistent with the Mary's Mount DCP and the Water Sensitive Urban Design (WSUD) report prepared by STORM Consulting Pty Ltd. Not formalising the stream has the potential to cause nuisance flooding within the subdivision and the drainage corridor width is not likely to satisfy flood conveyance requirements.

In any instance, revegetation of the unformed drainage depressions will still be required to provide a water quality benefit and harmonise with the surrounding developments and character of the DCP area.

The developers will need to fill adjacent to the channels and or excavate the channels to ensure that the lots are constructed above the estimated 100-year ARI water levels and therefore it is envisaged that two scenarios for stream construction will occur as described below.

For more detailed information regarding stream development options and stream design guidelines, refer to the accompanying document *Mary's Mount Drainage Corridors Stream Management Guidelines (Storm, 2003a)*.

4.1. FORMALISED STREAM – INCISED

An incised stream will be appropriate when little or no earthworks are planned for the subdivision on condition that the site can be appropriately drained to the stream. Generally this form of construction is suitable when site contours are steeper and the proposed location of the drainage corridor is already situated in a relatively defined drainage channel.

In simple terms, the stream is formed by excavating to achieve the shape of the desired channel. However, where possible, it is recommended to retain existing in-stream vegetation and bed features, particularly in the lower reaches of the drainage corridor towards the Wollondilly River where there is bedrock and floaters and established vegetation.

4.2. FORMALISED STREAM – FILLED

In many cases it will be advantageous to construct the stream by filling the lots. It is likely that stream formalisation by filling will be done in conjunction with earthworks for the various subdivisions. This is recommended to ensure earthworks and integrity of fill is suitable.



5.0 REVEGETATION

5.1. INTRODUCTION

The objective of this VMP is to provide a strategy for providing and managing riparian drainage corridors through the Mary's Mount subdivision. These drainage corridors are to provide highly vegetated, relatively narrow, low maintenance channels to convey flood flows.

5.2. PLANTING

5.2.1. Riparian zonation

Along a body of water, different vegetation communities can be found in parallel bands of flow depth and soil type. For example, instream sections contain plants that can sustain being inundated, while vegetation on the top of banks prefer drier conditions.

Three riparian zones have been identified for drainage corridors within the DCP area, based on water level (or lack of) and stream profiles (Figure 5.1):

- Zone 1 - instream and channel bed vegetation;
- Zone 2 – channel bank and littoral vegetation;
- Zone 3 – top of bank and terrestrial vegetation.

5.2.2. Revegetation areas

Revegetation of drainage corridors within the Mary's Mount area have been classified into two categories depending on flow depth and location within the site (Drawing M288/P01 Appendix A). Two additional areas have also been identified; these being areas affected by salinity and areas identified as containing ecologically endangered species. These two areas are also shown in drawing M288/P01. Planting is to be adjusted to suit these conditions, as advised in the following section.

The four different areas identified in the Mary's Mount DCP area requiring specific planting details that have been included in this plan are:

- Revegetation Area 1 (little or no dry weather flows);
- Revegetation Area 2 (some or little base flow);
- Saline areas; and
- Endangered remnant vegetation area.

Different species have been selected for these areas, based on plant characteristics and flow regime. The planting lists also takes into account fuel loads for fire.

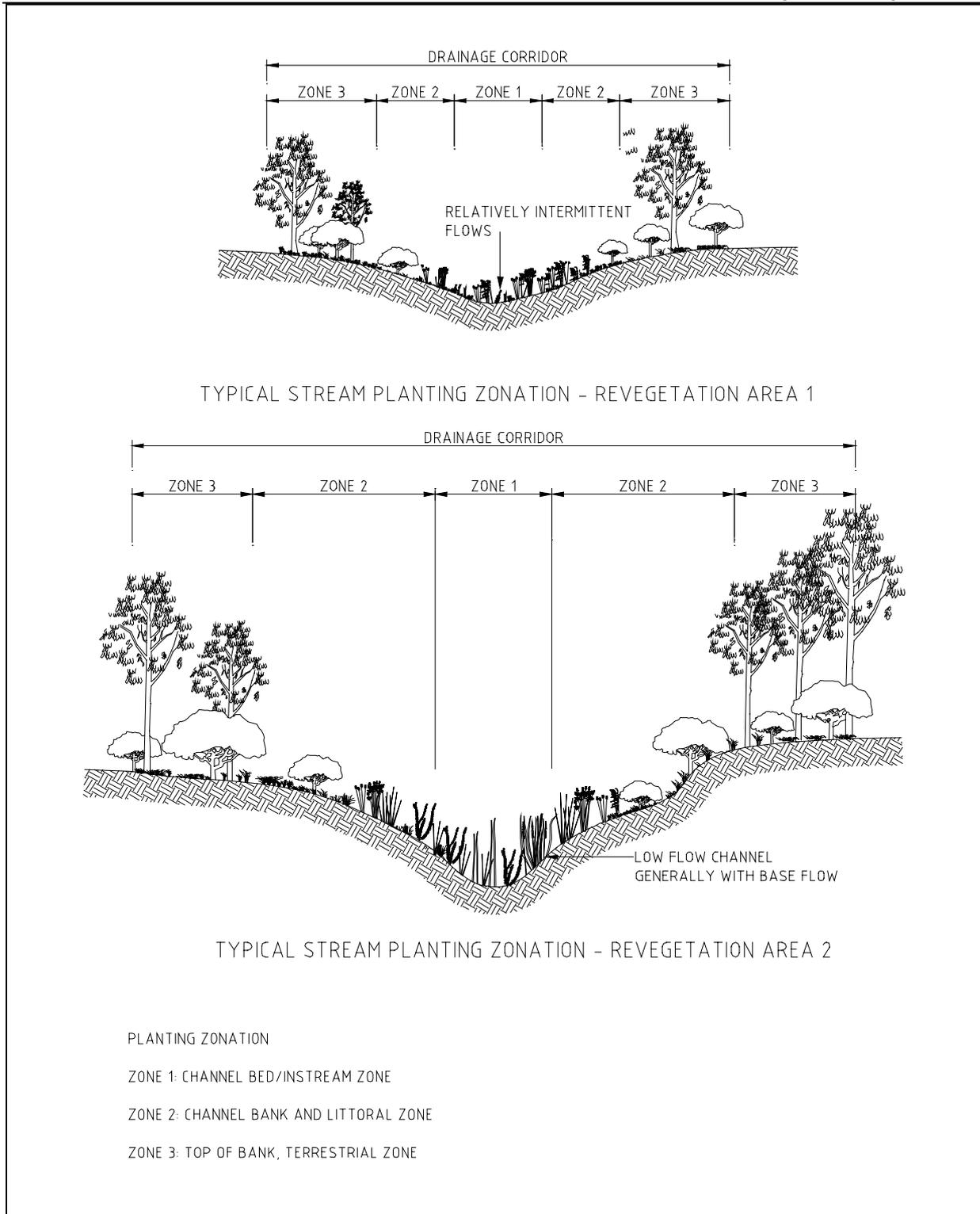


Figure 5.1 Planting zones within drainage corridors



5.3. SITE PREPARATION

The following site preparations are to be undertaken in conjunction with stream formalisation works (refer to *Mary's Mount Drainage Corridors Stream Management Guidelines*, STORM 2003a). Site preparation is critical to ensure success of vegetation established.

5.3.1. Protection of vegetation to be retained

Vegetation to be retained is to be clearly marked to prevent damage during channel formalisation and associated earthworks. Trees to be retained are to be protected by surrounding with plastic mesh webbing to a minimum 2.0m from trunk or at edge of drip line to avoid soil compaction to feeder roots and damage to trunk.

5.3.2. Weed and pest eradication

In many areas the formalisation of the drainage channels will cause significant site disturbance to streambeds and higher banks and slopes. In these areas, initial weed removal may not be necessary, as most ground cover will be lost during earthworks. However, where earthworks are not extensive, woody weeds such as Hawthorn (*Crataegus monogyna*) Blackberry (*Rubus* sp.) or African Box Thorn (*Lycium ferrocissimum*) will need to be removed either by machine or manually prior to any revegetation works. Also, Serrated Tussock (*Nassella trichotoma*) will need to be controlled and continually suppressed throughout this project (refer to Section 6.0 for further details).

It is expected that after the initial site disturbance there will be some re-growth of certain weed species, generally exotic forb and grass species. These weeds are to be controlled and where possible removed within the revegetation area before plantings are carried out. Ongoing maintenance will be needed until plantings are established. All weed control should be carried out as required by the Department of Infrastructure Planning and Natural Resources (DIPNR), and Goulburn City Council.

To reduce ongoing maintenance of planting at this site, laying suitable erosion control matting prior to planting operations within Zones 1 and Zone 2 is advised. The installation of erosion control matting will also reduce the impact of runoff and erosion on the site in the early stages of revegetation (refer to Standard Drawing 5.1 for specifications and installation instructions). Mulching of the top of bank areas will also assist in weed control.

Refer to Section 6.0 for further details on weed and pest control in the revegetation area.

5.3.3. Site stripping

Topsoil is to be removed prior to earthworks and stockpiled in a non-hazard area and protected from runoff by installation of silt fences (see Section 7.0). Stockpile heights must be less than two metres. Run-on flows from up slopes should be diverted around the stockpiles. Stockpiled topsoil should be reused within the drainage corridor or on the site. Ensure replaced topsoil contains organic matter, supports plant life, and is free from unwanted matter such as stones and weed material.



5.3.4. Erosion protection

To prevent erosion within the drainage corridor, suitable erosion and sediment control measures are to be implemented at the following stages:

1. During channel formalisation and associated earthworks;
2. During revegetation works; and
3. Until vegetation is sufficiently established.

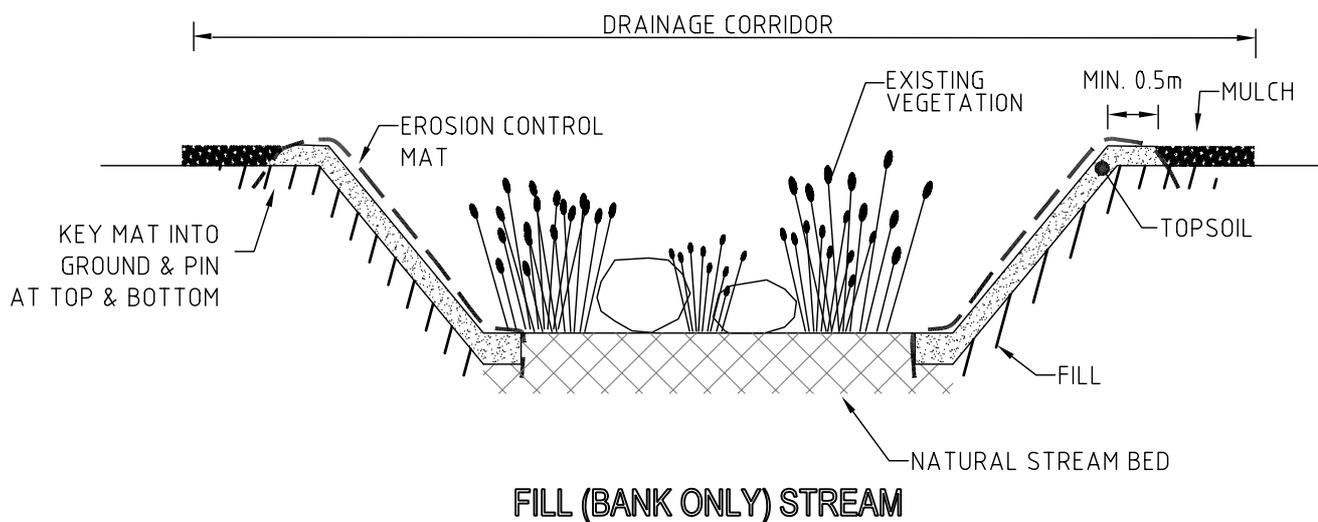
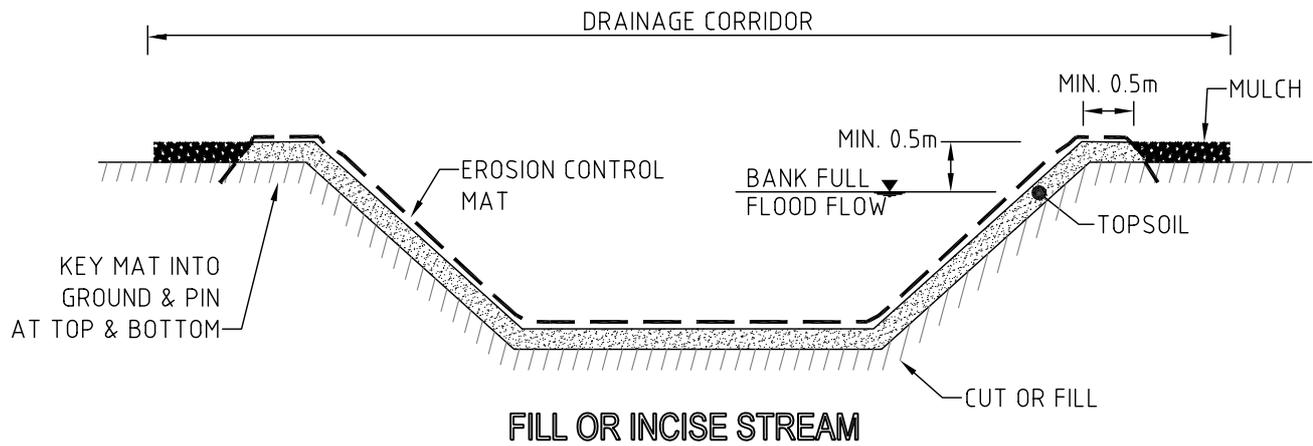
Erosion and sediment control measures include using biodegradable soil erosion mats to provide short-term erosion control on stream banks and beds (Standard Drawing 5.1).

Additional in-stream erosion control measures include check dams and silt fences. Refer to Section 7.0 for further detail.

5.3.5. Soil remediation

In general, the soils within Mary's Mount are low in available phosphorous and prone to slight dispersion. Testing undertaken on four samples indicate the soils will benefit from the following (Department of Lands 2003):

- Application of a high rate of P fertiliser (22-44 kg/ha P) e.g. 250 kg/ha of superphosphate;
- Application of nitrogen and potassium (N and K) to meet plant requirements (e.g. 15 kg/ha N and 30 kg/ha K) (refer to plant supplier for details);
- For areas identified as being affected by salinity, recommended that an application of 5-10 t/ha gypsum is recommended, and is incorporated into the soil to a minimum depth of 0.10 m. No by-products of gypsum are to be used, as the impurities will alter the application rate. Saline areas should also have an application of organic mulch; and
- Application of organic matter to improve soil stability. Organic matter will be added by an application of mulch on top of bank areas, and through using an erosion control mat for in-stream sections.



CONSTRUCTION NOTES FOR EROSION CONTROL BLANKET

EROSION CONTROL MAT SHALL BE EQUIVALENT TO MAXBIO 350 WITH MINIMUM MASS OF 350G/M² AND COMBINATION OF ORGANIC AND SYNTHETIC ELEMENTS, BUT FULLY DEGRADABLE. INSTALL EROSION CONTROL MAT AS INDICATED ON THE DRAWINGS AND ACCORDING TO MANUFACTURERS RECOMMENDATIONS INCLUDING:

1. ROLL BLANKET OVER THE PREPARED AREA FROM TOP OF BANK TO TOP OF BANK (IE. PERPENDICULAR TO FLOW, NOT ACROSS THE BATTER).
2. DIG TRENCH AT TOP (AND BOTTOM OF SLOPE AS REQUIRED) TO A MINIMUM 300MM DEPTH. LAY BLANKET EDGES IN TRENCH AND BURY, BACK FILLING WITH EXCAVATED MATERIAL. BLANKET EDGE AT TOP SHALL BE PINNED USING 500MM LONG PINS AT MINIMUM 150MM CENTRES OR AS DIRECTED.
3. OVERLAPS OF 150MM ARE REQUIRED, WITH OVERLAPS FOLLOWING THE FLOW LINE (IE. UPSTREAM MAT SECTION OVERLAPS ON TOP OF DOWNSTREAM MAT). OVERLAPS SHOULD BE PINNED AT 300MM INTERVALS.
4. PINS SHALL BE 300MM DEEP MINIMUM AND ANCHORED FIRMLY INTO COMPACTED GROUND. A MINIMUM OF THREE PINS PER SQUARE METRE SHALL BE USED.



Vegetation Management Plan EROSION CONTROL BLANKET



STORM CONSULTING
SUITE 3, 6 WEST STREET
PYMBLE NSW 2073
AUSTRALIA
PH: +61 2 9499 4333
FAX: +61 2 9499 4311
www.stormconsulting.com.au

Standard Drawing 5.1



5.3.6. Surface preparation

There are many advantages in ripping the soil in preparation for planting. However, ripping should be carried out with caution on highly erodible sites such as creek and riverbanks. It is also vital that rip lines do not run parallel to the watercourse, as this may concentrate flows and cause erosion.

The following notes are to be adhered to during surface preparation:

1. Rip using a single ripping tyne to a depth of between 450 to 600mm for zone 1 and a maximum of 400mm for zone 2 and 3. So that plants do not develop boxed or linear root systems, do not plant in single rip lines. Instead, for each plant row, rip at least a double line approximately 500mm apart and plant between the rip lines;
2. For blocks of trees, a grid system should be ripped and trees planted at the intersection of rip lines (Thomas & Stelling n.d);
3. Ripping should occur when the ground is moist enough to work but dry enough to shatter. Avoid ripping wet clay soils, which will leave a single knife cut without shattering the ground. Avoid working the ground for at least two to three (2-3) days after rain to allow free drainage;
4. Ripping is not to occur on streambeds or banks where natural vegetation and features are to be retained;
5. Laying of erosion control mat, planting and mulching should commence as soon as possible after ripping to prohibit the establishment of weeds on the site.

Before ripping, it is important that the following steps are followed:

- Consult DIPNR regarding the proposed work;
- Locate any underground cables and pipes before work commences (Dial 1100 for 'Dial before you Dig' to located underground cables).

Surface preparation also needs to consider pest eradication for rabbit control. In association with earthworks for channel formalisation and the above ripping procedure, developers will be responsible for locating rabbit burrows and fumigating. See Section 3.0 and 6.0 for further details.

5.4. PLANTING MATERIALS

5.4.1. Imported topsoil

Imported topsoil shall only be used when existing site topsoil is deemed unsuitable for growing plants or insufficient site supply is available to complete the works. It is preferable to modify and improve the existing soil wherever possible (using soil remediation recommendations made above).

Where it is necessary to use imported topsoil, it shall be a loam, sandy in nature, free from stone greater than 30mm, friable and completely suitable for the purpose and intentions described and implied in this management plan. It shall comprise not less than 85% of coarse and fine sands.



5.4.2. Mulch

Within Zone 3 areas (top of bank and where concentrated flows are unlikely), a thick layer (approximately 75mm) of suitable mulching material shall be laid following planting to control weeds and suppress any weed growth (Figure 5.2). Areas with existing native vegetation should not be mulched.

Mulch shall mean Native Leaf Chip, free from material derived from privet, Willow, Poplar, Plum, Ash, Hawthorne, Coral Trees or other noxious weeds. Mulch should be maintained until the vegetative cover can provide adequate cover against erosion and weed invasion.

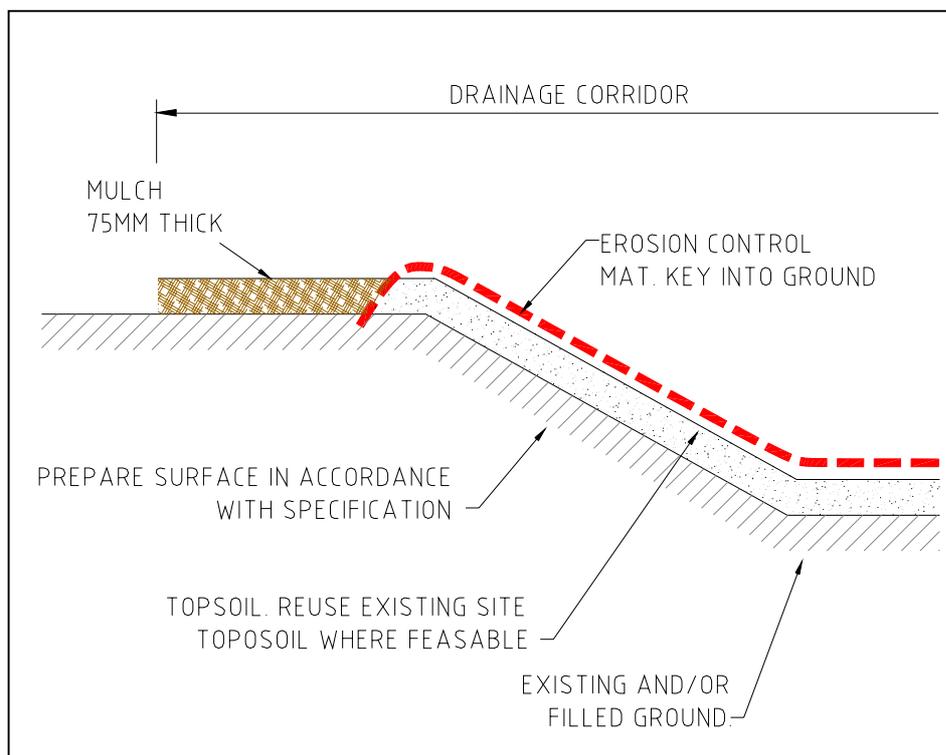


Figure 5.2 Mulching and topsoil placement

5.5. SEED COLLECTION AND PROPAGATION

5.5.1. General

It is required to use grasses as mature plants or from 'Viro-tubes', and trees and shrubs as tube-stock or from 'Viro-tubes'. Plants shall be vigorous, well established, hardened off, of good form consistent with species or variety, not soft or forced, free from disease or insect pests with large healthy root systems and no evidence of having been restricted or damaged. Immediately reject dried out, damaged or unhealthy plant material before planting. For a list of recommended suppliers, refer to Appendix C.



5.5.2. Seed collection

It is required that any seed collected for this project is sourced from the Goulburn area and grown locally to ensure plants are most suitably adapted to the environmental conditions of the planting site. In particular, all endemic *eucalypt* spp. specified in the planting list should be grown from locally collected seed.

For further details and information on seed collection contact Council's Landscape Planner.

5.5.3. Viro tubes

Native grasses, sedges and macrophytes as listed on the planting schedule are to be sourced from a recognized supplier to the landscape industry. These plants are to be grown in viro tubes (minimum 50mm x 50mm at the top and a minimum 90mm depth with a square profile from both top and bottom). If Viro Tubes are not used, a similar product may be used if approved by Goulburn City Council.

5.5.4. Tubestock

Tubestock or seedlings (minimum size tubes 200mm) are to be used for vegetation establishment. Seedlings can be grown from either cuttings or locally collected seeds. It is recommended that local native seed stock is use for the propagation of eucalypts. Tubestock has been selected over directed seeding to maximise plant establishment success. Tubestock is to be between 4 to 6 months old.

Tubestock that is to be planted into very wet or saline areas should be grown in large containers (minimum 250mm diameter) and be up to 10 months old (Berri Barmera Local Action Group, 2001).

5.5.5. Species planting lists

Determination of suitable species have been made based on species suitability for the planting areas identified, local occurrence of these species, and likelihood of availability at the time of planting.

Species occurring in the attached list have been allocated a category according to planting preference/necessity. These are as follows:

(Es) → Considered an **essential** species to have within the selected zone/revegetation area for planting to maximise bank stability and minimise the impacts of erosion at the site. These species are also considered essential to maintain/enhance local populations.

(De) → Considered **desirable** species to have within the planting zone/area identified but not essential in the control of erosion at the site. As many of these species as possible should be included when planting takes place.

(Op) → Considered an **optional** species for planting within the specified zone/revegetation area.



i) **Planting densities for species selected:**

It is intended that the **species be mixed throughout planting** and that where there is a planting density given for larger trees and shrubs, that other species will be planted out below them. It is also important to note that there will be inevitable mortalities, and species will compete with each other to form a community over time. Planting densities also give an indication of the approximate proportion of species throughout the planting area.

The species planting list for Revegetation Area 1 & 2 is enclosed at the end of this section (Section 5.0).

5.5.6. Planting methods

Prior to commencement of planting all plants and areas to be planted are to be thoroughly watered and shall be kept in a moist state throughout planting operations. No planting is to take place during extreme weather conditions (frost, heat, and drought). Following preparation of planting areas, plants are to be placed in densities as advised in the above section.

The following instructions should be adhered to for planting:

- To plant in erosion blanket, cut a slit 150-200mm long. Using a tree planter, planting drill or other suitable means, remove enough soil from under mat to plant the seedling in a hole twice the diameter and 1.5 times the depth of rootball. Ensure that all excess soil does not come into contact with the top surface of the matting to reduce weed seed germination. It is important to keep slits for planting as small as possible to reduce weed growth potential and maintain the strength of the matting. Do not stretch the material taut, as this will prevent it from contouring to the surface profile.
- Where there is no erosion mat, plants are to be planted in holes twice the diameter and 1.5 times the depth of the rootball and backfilled. The sides of the hole should be rough to promote new growth. Mulch around the plant to a radius of 500mm from the base of the plant, and to a depth of 75mm. Leave a gap of 3-5cm between the stem of the plant and the mulch
- Remove the seedlings from tubes/cells, being careful not to damage the plant or its root. Tease out the roots to loosen any compact roots and remove any that are coiled around or forming a dense mat at the base of the rootball.
- All plants (except virotubes) are to be marker staked to ensure plant failure can be identified and in particular to ensure all plant material is watered during initial plant establishment period.
- Back fill and stamp in soil by foot to compact the soil around the roots.
- Water plant thoroughly.

5.5.7. Staking and plant protection during establishment

All species planted as tube-stock (trees and shrubs) and grasses and forbs that come in 'Viro-Cells' are to be guarded and staked immediately after planting.



There are a variety of guards available. However, the use of Standard Plastic Sleeves secured with 3 bamboo stakes and ties are preferred. Plantings shall also be watered as necessary during the initial plant establishment period.

Taller plastic sleeves maybe required where pests are problematic, previous revegetation projects in the area have utilised 800mm high tree guards to prevent kangaroos and rabbits consuming young plantings.

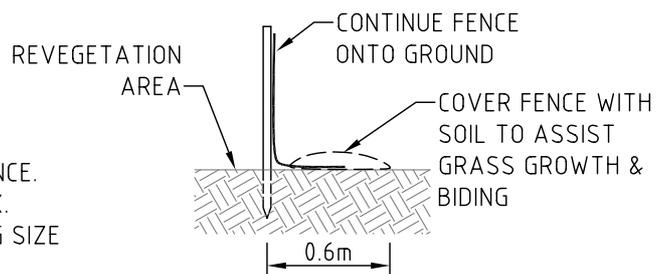
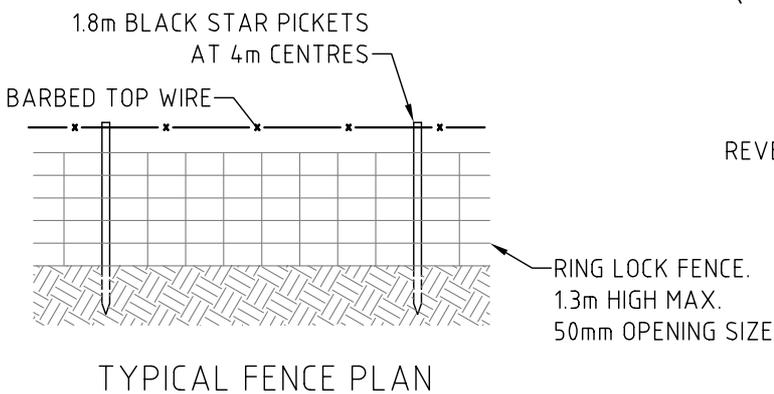
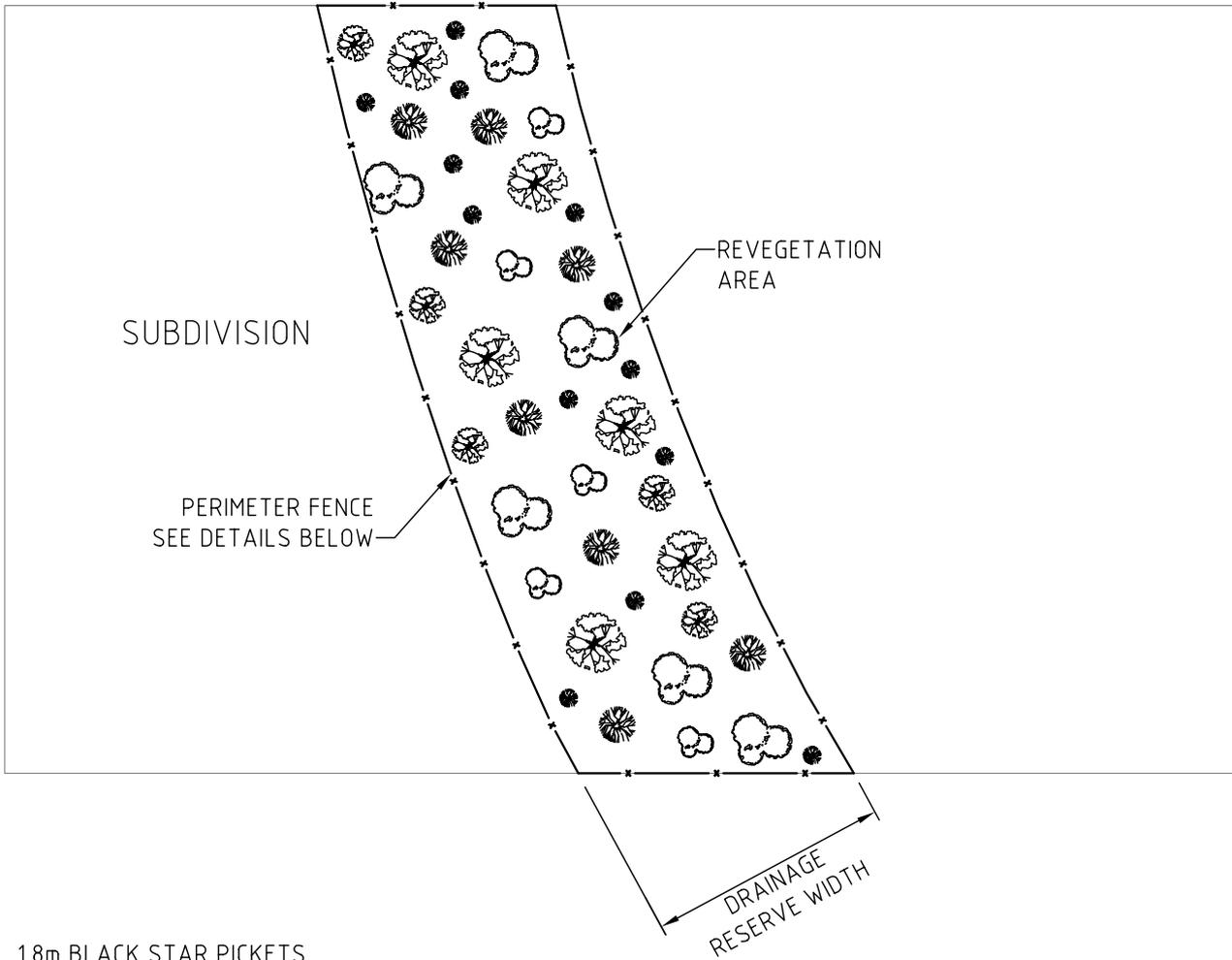
As the plantings mature, guards may need to be replaced with taller plastic sleeves or may need to be removed completely for grasses and forbs to allow maximum spread. Provide ongoing checks of the plantings to determine when taller guards are necessary and any guards that become damaged or blow off at any time shall be replaced as soon as possible.

5.6. SITE PROTECTION

Planting areas shall have fencing protection from farm animals, wildlife and vermin for the two-year period after planting. The fencing detail required is shown in Standard Drawing 5.2.

5.7. CLEAN UP

A general clean up and watering shall be implemented on completion of the project to the satisfaction of the Project Manager. Sweep pathway surfaces affected by the landscape construction and remove all waste material. Immediately prior to completion of the project, inspect all plants. Any plants not upright shall be tied loosely to marker stakes using appropriate ties secured to stakes. Carry out final watering and clear away all rubbish including disused plant containers. Remove any site compound establishment and make good all disturbed areas, including access tracks.



CONSTRUCTION NOTES FOR FENCING

1. FENCE TO BE ERECTED INSIDE PROPERTY AND DRAINAGE RESERVE PRIOR TO COMPLETION OF REVEGETATION WORKS
2. REMOVE FENCE UPON COMPLETION OF MAINTENANCE PERIOD (2YRS)



**Vegetation Management Plan
PROTECTION WORKS**



STORM CONSULTING
SUITE 3, 6 WEST STREET
PYMBLE NSW 2073
AUSTRALIA
PH: +61 2 9499 4333
FAX: +61 2 9499 4311
www.stormconsulting.com.au

Standard Drawing 5.2

Revegetation Area 1

Key to Importance of Species: (Es) Essential
(De) Desirable
(Op) Optional

Zone	Botanical Name	Common Name	Form & Size	Approximate Planting Densities for Zone Identified	Comments	
Zone 1 (channel bed/instream)	Grasses and groundcover					
	Carex appressa (Es) Cyprus spp (local spp only)	Native Sedge	Grass to 1m	8 mature plants/sq. m	Emergent on wet and damp ground	
	Lomandra longifolia (Es)	Spiny-headed Mat-rush	Grass to 1m	8 to 10 plants/sq. m	In channel and on lower banks	
	Microlaena stipoides (Es)	Weeping Grass	Grass < 1m	Seeded or 10 mature plants (tufts)/sq. m	Across narrow channel beds	
	Poa labillardieri (Es)	River Tussock	Grass to 1m	6 plants/sq. m	Good in drainage depressions and colder flats	
	Themeda australis (Es)	Kangaroo Grass	Grass to 2m	Seeded or 10 mature plants (tufts)/sq. m	Across narrow channel beds	
	Juncus subsecundus (De)	Native Common Subsecund Rush	Grass 1m	6 plants/sq. m	Emergent erect aquatic plant on damp ground; swampy ground	
	Persicaria decipiens (Op)	Slender Knotweed	Grass < 1m	4 plants/sq. m	Emergent on damp, muddy ground, wetter sites	
	Shrubs*					
	Callistemon sieberi (Es)	River Bottlebrush	Shrub 1 – 8m	4 plants/sq. m	Wet/moist rocky areas only	
Zone 2 (channel bank and littoral zone)	Grasses and groundcover					
	Carex appressa (Es)	Native Sedge	Grass to 1m	4 plants/sq. m	Anywhere in channel and on lower banks and slopes where moist	
	Lomandra longifolia (Es)	Spiny-mat Rush	Grass to 1m	6 to 8 plants/sq. m	Anywhere in moist channels to well drained banks	
	Microlaena stipoides (Es)	Weeping Grass	Grass < 1m	Seeded or 8 mature plants (tufts)/sq. m	Anywhere, lower slopes	
	Poa labillardieri (Es)	River Tussock	Grass to 1m	4 to 6 mature plants/sq. m	Around lower slopes and waters edge	
	Themeda australis (Es)	Kangaroo Grass	Grass to 2m	Seeded or 8 to 10 mature plants (tufts)/sq. m	Anywhere, particularly lower slopes and banks	
	Austrodanthonia richardsoni (De)	Richardson's Wallaby Grass	Grass < 1m	Seeded or 8 to 10 mature plants (tufts)/ sq. m	Anywhere, lower slopes	
	Austrodanthonia scabra (De)	Corkscrew	Grass	Seeded or 8 to 10 mature plants (tufts)/sq. m	Anywhere, disturbed bare sites	
	Austrostipa bigeniculata (De)	Tall Speargrass	Grass	Seeded or 8 to 10 mature plants (tufts)/sq. m	Anywhere	
	Amphibromus nervosus or pithogastrus (Op)	Swamp Wallaby Grass	Grass to 1m	Seeded or 10 mature plants (tufts)/sq. m area	Wet grasslands, swampy areas	
	Einadia nutans (Op)	Climbing saltbush	Forb		Slopes and valleys	
	Shrubs*					
	Callistemon sieberi (Es)	River Bottlebrush	Shrub 1-8m	2 to 4 plants/sq. m on suitable sites only	Rocky, moist areas only	
	Hakea microcarpa (Es)	Small Fruited Hakea	Shrub 1 to 2m	1 plant/2 sq. m	Edges of swamps and bogs and higher bank areas amongst grasses and other shrubs.	
	Pomaderris eriocephala (Es)	Pomaderris	Shrub 1 to 3m	1 plant/sq. m	Good in moist gullies and fragile slopes	
	Acacia genitifolia (De)	Spreading Wattle	Shrub 1 to 3m	1 plant/sq. m	Good on drier slopes and banks	
	Banksia spinulosa (De)	Hairpin Banksia	Shrub up to 4m	1 plant/ 2 sq. m area	Excellent small mammal and honey eater habitat	
	Bursaria lasiophylla (De)	Bursaria	Shrub to 1.5m	2 to 4 plants/sq. m	More open bank areas on moist but well drained sites.	
	Bursaria spinosa (De)	Blackthorn	Shrub up to 2m	1 to 2 plants/sq. m	Damp grassland areas and higher banks	
	Davesia latifolia (De)	Hop Bitter Pea	Shrub to 2m	1 to 2 plants/sq. m	Bank areas away from waters edge	
	Hakea dactyloides (De)	Finger Hakea	Shrub 1 to 3m +	1 plant/2 sq. m area	Banks and slopes in well drained areas	
	Leptospermum myrtifolium (De)	Shrub 2-4m	Shrub 2-4m	1 to 2 plants/sq. m	Good in swamps and bogs	
	Banksia marginata (Op)	Silver Banksia	Shrub/small tree to 7m	1 plant/ 5 to 10 sq. m area	Excellent small mammal and honey eater habitat	
	Einadia hastata (Op)	Saloop	Smaller shrub	4 to 6 plants/sq. m area	Alluvium valleys	
	Grevillea ramosissima (Op)	Fan Grevillea	Shrub to 1.5 m	1 to 2 plants/sq. m	Fragile slopes and banks	
	Trees#					
	Acacia decurrens (Es)	Early Black Wattle	Tree 2-10m	1 to 2 plants/10 sq. m area	Excellent habitat and fast growing	
	Acacia parramattensis (Es)	Parramatta Green Wattle	Tree 10m	1 plant/10 sq. m area	Excellent habitat	
	Eucalyptus amplifolia (Es)	Cabbage Gum	Tree up to 30m	1 plant/10 to 15 sq. m area	Good in poorly drained areas, fast growing	
	Eucalyptus mannifera (Es)	Red Spotted Gum	Tree 6 – 25m	1 or 2 plants/10 sq. m area	Anywhere not immediately in channel	
	Eucalyptus viminalis (Es)	Ribbon Gum	Tree up to 20m	1 to 2 plants/15-20 sq. m area	Dominant species upstream of Marulan. Very fast growing, excellent habitat, common. Space out plantings of this species. Good near rivers.	
	Acacia dealbata (De)	Silver Wattle	Shrub to small tree locally	1 to 2 plants/10 sq. m area	Alluvial soils with good drainage, frosty areas and it is fast growing, will sucker	
	Acacia mearnsii (De)	Furry Black Wattle	Tree 4-12m	1 plant/10 sq. m area	Frostier areas, creeks	
	Acacia melanoxylon (De)	Blackwood	Tree 4 to 10m locally	1 to 2 plants/10 sq. m area on favourable sites	Only in moist areas	
	Zone 3 (top of bank, terrestrial zone)	Grasses and groundcover				
		Joycea pallida (Es)	Red-anther Wallaby Grass	Grass to 1.5m	Seeded or 8 to 10 mature plants (tufts)/sq. m area	Higher bank areas on poorer soils, well drained sites
		Lomandra longifolia (Es)	Spiny-headed mat-rush	Grass < 1m	6 to 8 plants/sq. m	On banks in well drained soil
		Lomandra multiflora (De)	Many-flowered Mat-rush	Grass to < 1m	6 to 8 plants/sq. m area	On higher banks and slopes, open grassy areas
		Microlaena stipoides (Es)	Weeping Grass	Grass < 1m	Seeded or 10 mature plants (Tufts)/sq. m	Anywhere
		Themeda australis (Es)	Kangaroo Grass	Grass to 2m	Seeded or 8 to 10 mature plants (tufts)/sq. m area	Anywhere
Chrysocephalum apiculatum (De)		Common Everlasting Daisy	Forb	15 to 20 plants/sq. m	On higher dry areas of bank	
Poa labillardieri (De)		River Tussock	Grass 1m	4 to 6 mature plants/sq. m area	Dominates frosty alluvial areas	
Plantago gaudichaudiana (Op)		Gaudichaud's Planain	Graminoid	8 to 10 plants/sq. m	Lower slopes, valleys	
Plantago varia (Op)		Variable Plantain	Graminoid	8 to 10 plants/sq. m area	Lower slopes, valleys	
Puccinellia stricta (Op)		Saltmarsh Grass	Grass < 1m	Seeded or 8 to 10 mature plants/sq. m	Salt affected flats	
Shrubs*						
Bursaria lasiophylla (Es)		Bursaria	Shrub to 1.5m	2 to 4 plants/sq. m	Open areas in well drained to moist positions	
Bursaria spinosa (De)		Blackthorn	Shrub to 1.5m	2 to 4 plants/sq. m	Open areas in well drained to moist positions	
Leptospermum phyllicoides (Kunzea ericoides) (Op)		Tea-tree	Shrub 2-4m	4 plants/sq. m area	Poorly drained swamps and bogs	
Acacia paradoxa (De)		Kangaroo Thorn	Shrub to 2m	1 to 2 plants/sq. m area	Open areas in well drained positions	
Banksia spinulosa (De)		Hairpin Banksia	Shrub to 3m	1 plant/2 sq. m area	Excellent small mammal and honey eater habitat	
Brachyloma daphnoides (De)		Daphne Heath	Shrub < 1m	2 to 4 plants/sq. m area	Open areas in well drained positions	
Cryptandra amara (De)		Pretty Cryptandra	Shrub to 1m	2 to 4 plants/sq. m area	Open areas in well drained to moist positions	
Lissanthe strigosa (De)		Peach Heath	Shrub < 1m	2 to 4 plants/sq. m area	Open areas in well drained positions	
Banksia marginata (Op)		Silver Banksia	Shrub of 4m to tree 7m	1 to 2 plants/5 sq. m area	Excellent small mammal and honey eater habitat	
Leptospermum polygalifolium (Op)		River Tea-tree	Shrub 2-4m	1 plant/sq. m	Can form dense thickets	
Melaleuca ericifolia (Op) (dwarf)		Swamp Paperbark	Shrub 2-9m	1 plant/2 sq. m area	Can form closed scrub	
Trees#						
Acacia decurrens (Es)		Early Black Wattle	Tree 4-12m	1 to 2 plants/10 sq. m area	Excellent habitat and fast growing	
Eucalyptus amplifolia (Es)		Cabbage Gum	Tree up to 40m	1 plant/10 sq. m area	Good in poorly drained areas, fast growing	
Eucalyptus bridgesiana (Es)		Apple Box	Tree up to 30m	1 to 2 plants/10 sq. m area	Plain hills and risers	
Eucalyptus melliodora (Es)		Yellow Box	Tree up to 30m	1 to 2 plants/10 sq. m area	Rich loam's, common	
Eucalyptus pauciflora (Es)		Snow Gum	Tree up to 15m	1 to 2 plants/10 sq. m area	Well drained frosty terraces	
Acacia dealbata (De)		Silver Wattle	Tree 2-10m	1 to 2 plants/10 sq. m area	Alluvial soils with good drainage, frosty areas and it is fast growing. Will sucker.	
Eucalyptus blakelyi (De)		Blakely's Red Gum	Tree up to 40m	1 to 2 plants/10 sq. m area	Valleys and slopes	
Eucalyptus viminalis (De)		Ribbon/Manna Gum	Tree up to 20m	1 to 2 plants/15 to 20 sq. m area	Dominant species upstream of Marulan. Very fast growing, excellent habitat, common. Space out plantings of this species. Good near rivers.	
Allocasuarina luehmannii (Op)		Bull Oak	Tree > 10m	1 to 2 plants/sq. m	Only on rocky slopes with good drainage. Suckers.	
Eucalyptus cinerea (Op)		Argyle Apple	Tree 7-15m	1 plant/5 sq. m area	North of Goulburn	

* It is recommended that some shrubs are planted in dense isolated thickets to provide habitat for small birds
NSW Rural Fire Brigade advises that Eucalyptus plantings are acceptable so long as a continuous canopy is not formed

Revegetation Area 2

Key to Importance of Species: (Es) Essential
(De) Desirable
(Op) Optional

Zone	Botanical Name	Common Name	Form & Size	Planting Densities	Comments
Zone 1 (channel bed/instream)	Grasses and groundcover				
	Bulboschoenus fluviatilis (synonym Scirpus fluviatilis) (Es/De)	Marsh Clubrush	Grass to 2m	8 to 10 plants/sq. metre	Wet areas and moist lower banks. Similar to Cumbungi. Forms rush beds, dies down in winter.
	Carex appressa (Es)	Tussock Sedge	Grass < 2m	8 to 10 mature plants (tufts)/sq. metre	Good at stabilising drainage channels and damp stream beds. Creates very dense communities.
	Phragmites australis (Es)	Common reed	Grass < 4m	10 plants/sq. metre	Vigorous tall emergent plant on damp ground
	Poa labillardieri (Es)	River Tussock	Grass to 1m	4 to 6 mature plants/ q. metre	Good at stabilising stream channels and lower bank areas
	Typha orientalis (Es)	Cumbungi	Grass 4m	8 to 10 plants /sq. metre	Vigorous and emergent. Forms rush beds
	Eleocharis sphacelata (De)	Tall Spikerush	Grass up to 2m	10 plants/sq. metre	Vigorous, tall,, thicket forming emergent aquatic plant; swampy areas
	Juncus subsecundus (De)	Native Common Rush; Subsecund Rush	Grass 1m	8 to 10 plants/sq. metre	Emergent erect aquatic plant on damp ground
	Schoenoplectus validus (De)	River Clubrush	Grass up to 3m	10 plants/sq. metre	Emergent, forms dense thickets in wet areas
	Typha domingensis (De)	Cumbungi	Grass 4m	8 to 10 plants/ q. metre	Vigorous and emergent, Forms rush beds
	Plantago varia (Op)	Variable Plantain	Graminoid	10 plants/sq. metre	Lower slopes, valleys
	Shrubs*				
Callistemon sieberi (Es)	River Bottle Brush	Shrub 1 to 8m	4 to 6 plants in favourable sites	In rocky, gravelly areas of channel	
Zone 2 (channel bank and littoral zone)	Grasses and groundcover				
	Poa labillardieri (Es)	River Tussock	Grass 1m	4 to 6 mature plants/sq. metre	Dominates frosty alluvial areas
	Typha orientalis (Es)	Cumbungi	Grass 4m	8 to 10 plants/sq. metre	Vigorous and emergent. Forms rush beds
	Plantago gaudichaudiana (Op)	Plantain	Graminoid	8 to 10 plants/sq. metre	Lower slopes, valleys
	Plantago varia (Op)	Variable Plantain	Graminoid	8 to 10 plants/sq. metre	Lower slopes, valleys
	Shrubs*				
	Bursaria spinosa (Es)	Blackthorn	Shrub 1-8m	1 or 2 plants/sq. metre	Moist banks and slopes
	Callistemon sieberi (Es)	River Bottlebrush	Shrub 2m	2 to 4 plants/sq. metre	Moist lower banks and edges of channel where rocky
	Hakea microcarpa (Es)	Hakea	Shrub 2m	2 to 4 plants/sq. metre	Edge swamps and bogs, lower banks
	Leptospermum phyllicoides (Kunzea ericifolia) (Es)	Tea-tree	Shrub 2-4m	4 plants/sq. metre	Poor draining boggy flats
	Leptospermum myrrifolium (De)	Tea-tree	Shrub 2-4m	4 plants/sq. metre	Suitable in swamps and bogs
	Trees#				
	Acacia dealbata (Es)	Silver Wattle	Tree 2-10m	1 to 2 plants/10 sq. metre	Alluvial soils with good drainage, frost areas and it is fast growing, will sucker
	Acacia decurrens (Es)	Early Black Wattle	Tree 4-12m	1 to 2 plants/10 sq. metre	Excellent habitat and fast growing, dense canopy cover. Shorter lived than A. melanoxylon but a valuable species.
	Acacia parramattensis (Es)	Parramatta Green Wattle	Tree 10m	1 plant/10 sq. m	Excellent habitat
	Acacia melanoxylon (Es,De)	Blackwood	Tree 4-10m locally	1 plant/sq. metre on favourable sites.	Moist drainage depressions, slower growing but a valuable species once established
	Acacia paradoxa (Es,De)	Kangaroo Thorn	Shrub to 2m	1 to 2 plants/sq. metre	Well drained to moist areas on slopes and higher banks
	Eucalyptus amplifolia (De)	Cabbage Gum	Tree to 40m	1 plant/10 sq. metre	Good in poorly drained soils, fast growing.
Eucalyptus viminalis (De)	Ribbon Gum	Tree up to 15m	1 to 2 plants/10 to 15 sq. metre	Good near rivers	
Eucalyptus cinerea (Op)	Argyle Apple	Tree 7-15m	Space out plantings (1 to 2 plants/20 sq. metre area)	North of Goulburn in moist drainage depressions to lower slopes	
Zone 3 (top of bank and terrestrial zone)	Grasses and groundcover				
	Lomandra longifolia (Es)	Spiny-headed mat-rush	Grass < 1m	6 to 8 plants/sq. metre	On banks in well drained to moist positions
	Themeda australis (Es)	Kangaroo Grass	Grass	Seeded or 8 to 10 mature plants/sq. metre	Anywhere
	Poa labillardieri (Es,De)	River Tussock	Grass 1m	4 to 6 plants/sq. metre	Dominates frosty alluvial areas
	Plantago varia (De)	Variable Plantain	Graminoid	8 to 10 plants/sq. metre	Lower slopes, valleys
	Puccinellia stricta (Op)	Saltmarsh Grass	Grass		Salt affected flats
	Shrubs*				
	Bursaria spinosa (Es)	Blackthorn	Shrub 1-8m	1 to 2 plants/sq. metre area	Slopes and banks where moist but well drained
	Leptospermum phyllicoides (Kunzea ericoides) (Es)	Tea-tree	Shrub 2-4m	4 plants/sq. metre area	Poorly drained boggy areas
	Pomaderris eriocephala (Es, De)	Podaderris	Shrub 1 to 3m	1 plant/sq. metre	Good on lower slopes and moist but well drained banks.
	Banksia marginata (Op)	Silver Banksia	Shrub of 4m to tree 7m	1 to 2 plants/5 sq. m area	Excellent small mammal and honey eater habitat
	Banksia spinulosa (De)	Hairpin Banksia	Shrub up to 3m	1 plant/2 sq. metre area	Excellent small mammal and honey eater habitat
	Trees#				
	Acacia decurrens (Es)	Early Black Wattle	Tree 4-12m	1 to 2 plants/10 sq. metre area	Excellent habitat and fast growing
	Eucalyptus bridgesiana (Es)	Apple Box	Tree up to 30m	1 plant/15 sq. metre area	Plain hills and risers
	Eucalyptus melliodora (Es)	Yellow Box	Tree up to 30m	1 plant/10 to 15 sq. metre area	Good in valleys, lower slopes and banks. Rich loam's, common
	Eucalyptus pauciflora (Es)	Snow Gum	Tree up to 15m	1 to 2 plants/10 sq. metre area	Well drained frosty terraces
	Acacia dealbata (De)	Silver Wattle	Tree 2-10m	1 to 2 plants/10sq metre area	Alluvial soils with good drainage, frosty areas and it is fast growing. Suckers.
	Allocasuarina luehmanii (De,Op)	Bull Oak	Tree > 10m	1 to 2 plant/sq. metre	On rocky slopes and banks in well drained areas. Suckers.
	Eucalyptus amplifolia (De)	Cabbage Gum	Tree up to 40m	1 plant/10 to 15 sq. metre area	Good in poorly drained areas, fast growing
Eucalyptus blakelyi (De)	Blakely's Red Gum	Tree up to 40m	1 plant/15 sq. metre area	Valleys and slopes	
Eucalyptus viminalis (De,Op)	Ribbon/Manna Gum	Tree up to 30m	1 plant/10 to 15 sq. metre area	Dominant species upstream of Marulan. Very fast growing, excellent habitat, common. Good near rivers.	
Eucalyptus cinerea (Op)	Argyle Apple	Tree 7-15m	1 plant/10 sq. metre area	North of Goulburn	

* It is recommended that some shrubs are planted in dense isolated thickets to provide habitat for small birds

NSW Rural Fire Brigade advises that Eucalyptus plantings are acceptable so long as a continuous canopy is not formed

Endangered remnant vegetation zones¹

Botanical Name	Common Name	Form & Size	Planting Densities	Comments
Grasses and groundcover				
Aristida ramosa (Es)	Red Leg Grass	Grass	Seeded or 10 mature plants (tufts) sq. metre	Good on drier slopes and ridges and well drained flats
Themeda australis (Es)	Kangaroo Grass	Grass	Seeded or 10 mature plants (tufts)/ sq. metre	Good anywhere, especially as an open grassland species or an understorey species in woodland areas.
Trees				
Eucalyptus bridgesiana (Es)	Apple Box	Tree up to 30 m	1 to 2 plants/ 10 to 15 sq. metre area	Plain hills and risers, and lower slopes and banks
Eucalyptus mannifera (Es)	Brittle Gum	Tree	1 to 2 plants/ 10 to 15 sq. metre area	Anywhere on banks and slopes in well drained areas
Eucalyptus melliodora*(Es)	Yellow Box	Tree up to 30 m	1 to 2 plants/ 10 sq. metre area	Rich loam's, common on fertile, well drained areas
Eucalyptus blakelyi* (De)	Blakely's Red Gum	Tree up to 30 m	1 plant/ 15 sq. metre area	Good on lower slopes and banks
Eucalyptus cinerea (Op)	Argyle Apple	Tree 7-15 m	1 plant/ 10 to 15 sq. metre area	North of Goulburn, moist but well drained areas to drier flats and banks
¹ Shrubs generally sparse or absent (although may be locally common)				
² Characteristic tree species of White Box Yellow Box Blakely's Red Gum Woodland				

Saline Zones

Botanical Name	Common Name	Form & Size	Planting Densities	Comments
Grasses and groundcover				
Einadia nutans	Climbing saltbush	Forb	4 to 6 plants/ sq. metre	Slopes and valleys
Puccinellia stricta	Saltmarsh Grass	Grass	Seeded or 10 mature plants (tufts)/ sq. metre	Salt affected flats
Shrubs				
Einadia hastata	Saloop	Smaller shrub	4 to 6 plants/ sq. metre	Alluvium valleys
Melaleuca ericifolia	Swamp Paperbark	Shrub 2-9 m	4 plants/ sq. metre	Can form closed scrub
Melaleuca linarifolia	Flax-leaf paper bark	Small shrub/tree	4 plants/ sq. metre	
Melaleuca parvistraminea		Shrub 2-9 m	4 plants/ sq. metre	
Trees				
Eucalyptus camphora	Mountain swamp Gum	Tree 8-20 m	1 to 2 plants/ 10 to 15 sq. metre area	Good in frost pockets
Eucalyptus cinerea	Argyle Apple	Tree 7-15 m	1 plant/10 sq. metre area	North of Goulburn
Eucalyptus pauciflora	Snow Gum	Tree up to 15 m	1 to 2 plants/ 10 sq. metre area	Well drained frosty terraces
Melaleuca styphelioides	Prickly Paperbark	Tree 10 m	1 to 2 plants/ 10 to 15 sq. metre area	Not for severe frosts

**SPECIES PLANTING LISTS NOTES:**

- These lists have been developed with the aim of primarily reducing/controlling the effects of erosion and runoff and stabilising drainage channels within the proposed development area. Consideration has also been given to the fire hazard potential of species and vegetation communities created by these plantings.
- It is intended that these recommended **species be mixed throughout planting** and that where there is a planting density given for larger trees and shrubs, that other species will be planted out below them. It is also important to note that there will be inevitable **mortalities**, and species will compete with each other to form a reasonably stable community over time. Planting densities also give an indication of the approximate proportion of species throughout the planting area.
- A mosaic planting is recommended to provide greater structural diversity, which in the long term should correlate to greater biodiversity of faunal species. That is, regimented planting layout is to be avoided.
- It is preferable for native grasses to be planted as mature plants if these are available. Where they are not, seeding may have to occur and the area enhanced with mature plants of other native grass species as identified throughout this species list.



6.0 WEED AND PEST MANAGEMENT

6.1. WEED MANAGEMENT

6.1.1. Introduction

Drainage corridors are generally more fertile than surrounding land and are prone to weed infestation. Weed eradication should take place prior to revegetation and creek works, and weed management implemented to effectively control weed growth in the long term.

Numerous weeds occurring in the Goulburn City Council are declared noxious in NSW under Noxious Weeds Act 1993). Under the Noxious Weeds Act, nominated weeds must be fully and continuously suppressed and destroyed. For a full list of declared noxious weeds for Goulburn City Council see Appendix B.

The declared noxious weeds of most concern for the drainage corridors are those that are most likely to infest the area. These weeds are listed below in Table 6.1, and various descriptions of these weeds are listed in Appendix B.

Table 6.1 Noxious weeds likely to be problematic in the Mary's Mount DCP

Common name	Botanical Name
Serrated Tussock	<i>Nassella trichotoma</i>
Blackberry	<i>Rubus</i> spp
African Boxthorn	<i>Lycium ferocissimum</i>
Privet	<i>Ligustrum</i> spp
African Love Grass	<i>Eragrostis curvula</i>
Horehound	<i>Marrumium vulgare</i>
Patersons Curse	<i>Echium</i> spp
Sifton Bush	<i>Cassinia arcuata</i>
St Johns Wort	<i>Hypericum perforatum</i>
Sweet Briar	<i>Rose rubiginose</i>

6.1.2. Weed control and management

Prior to any contractors undertaking work, machinery to be used shall be thoroughly cleaned to reduce the spread of weeds. At completion of project on site, equipment shall be cleaned prior to exiting the property.

i) Serrated tussock

Excessive soil disturbance of areas infested with serrated tussock, for example by earthworks associated with channel formalisation, will encourage the establishment of serrated tussock seedlings. Revegetation works should commence as soon as possible after the completion of earthworks to prevent the establishment of weeds. A maximum lag of one month is recommended.



Long-term control of serrated tussock can be achieved by a program of over planting with competitive desirable species, as specified in this vegetation management plan. Dense vegetation establishment of native trees and shrub, as proposed for the drainage corridor, will assist in the control of serrated tussock in the long term, particularly when undertaken in conjunction with the application of fertilisers. Regular maintenance inspections (see Section 8.0) of the drainage corridors will be required to control isolated plants that may emerge from time to time which are to be manually removed by chipping.

ii) Other

Woody weeds such as blackberry, buckthorn, privet and gorse are to be removed mechanically or be treated by chemical means. Where it is possible, manually remove woody weeds by pulling them out by hand. Broad scale herbicide is not to be used.

If it is not possible to manually remove woody weeds, a brush controller such as CUT OUT[®] is recommended, plus surfactant such as Round-up Bio Active[®]. All products shall be used according to manufacturers specifications and at the manufacturers recommended rates. Contact Goulburn City Council, NSW Agriculture and EPA for further information regarding chemical use and to obtain appropriate permits. Application shall be by authorised personnel only.

Natural areas such as drainage corridors are often subjected to weed infestation from adjoining residential areas. The following management techniques are additionally recommended to reduce the impact of neighbouring residential properties:

- A native plant buffer reinforced by a maintenance edge is the preferred landscape treatment for residential properties fronting the natural area;
- Popular common commercial plants such as poplars and Evergreen Alders are to be avoided, particularly in areas adjacent to the Wollondilly River.
- A non-invasive turf grass (i.e. Couch) should be grown on residential properties in preference to Kikuyu, a highly invasive species. See Figure 6.1 below.

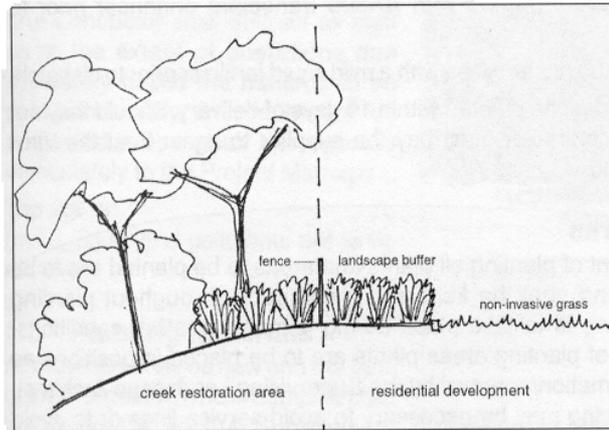


Figure 6.1 Management recommendations for interface between creek restoration area and adjoining residential developments

(Source: Environmental Partnership 2002).

6.2. PEST MANAGEMENT

6.2.1. Introduction

All land managers are legally required to control rabbits under the Rural Lands Protection Act 1989, which states that the occupier of any land must “fully and continually destroy all noxious animals on that land.”

Rabbits are the main priority for the Mary’s Mount area, as they are likely to cause the most damage to revegetation works. Vermin control should occur in the spring/summer prior to revegetation (Goulburn RLPB 2003).

6.2.2. Pest control

Systematic harbour destruction across the area will impact on rabbit numbers, by destroying rabbit habitats. A baiting program is to be implemented up to 12 months prior to any earthworks, followed by fumigating and ripping of burrows during construction works. Goulburn City Council will devise a suitable baiting program for the area. The Council will implement the baiting program across the DCP area as required while land owners will be responsible for addressing the issues a lot scale. Council’s Parks & Recreation Manager should be contacted to obtain further details.

When devising a baiting program, special consideration should be given to the selection of an appropriate bait that is suitable for use in an urban area, brands such as Pindone™ pose less risk to other animals than alternate poisons and a simple antidote is available (Vitamin K1).



7.0 SOIL EROSION CONTROL

Generally, the erosion and sediment control measures specified in this report are temporary in nature and comprise of measures to mitigate transport of sediment during earthworks/ construction phase and also combat the effects of channelised flow in streams and creeks. These are detailed below:

- 1) Areas disturbed by earthworks and formalised stream works must be protected to prevent the removal of topsoil and underlying soils.
- 2) Erosion control measures also are used to stabilise the drainage corridor and stream until vegetation is sufficiently established to protect the corridor from the erosive velocity of water.

For additional design of sediment and erosion control structures for both stream works and earthworks on lots the reader is referred to the Department of Housing Blue Book titled *Managing Urban Stormwater: Housing & Construction* (1998).

7.1. SILT FENCES AND STRAW BALES

Sediment traps such as silt fences and straw bales are temporary measures used to trap sediment and shall be used accordingly in the Mary's Mount site. An example of sediment traps with construction notes is shown in Standard Drawing 7.1.

Design of such devices should take into account the topography and fall of the site. Catchment areas shall be sufficiently small to constrain maximum flows at any one point to 40 Litres/ second per metre width of overland flow in the selected design storm event. Such structures shall be constructed as close as possible parallel to the contours of the site and generally located at the top of the stream bank or at the drainage reserve boundary to prevent sediment from lot earthworks entering the creek system.

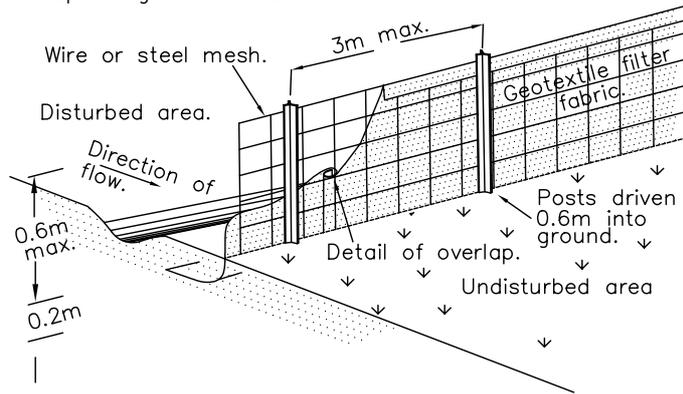
7.2. INSTREAM EROSION CONTROL

To assist in scour protection and combat erosive forces from channelised stream flows, the installation of check dams is recommended, as shown in Standard Drawing 7.2.

The aim is to provide temporary protection (<2 years) to ensure vegetation establishes and serves to naturally protect the drainage from scour and erosion.

Figure 7.1 gives an example of typical locations of silt traps, straw bales and check dams to be installed during drainage corridor revegetation works. Note that this is a typical example only and each site will have its own requirements in terms of erosion and soil control.

Drainage area 0.6ha. max. Slope gradient 1:2 max.
Slope length 60m max.



Sediment Fence

CONSTRUCTION NOTES FOR SEDIMENT FENCE

SEDIMENT FENCING TO BE USED IN CONTROLLING SILT MOVEMENT. WHERE USED, ENSURE CONSTRUCTION IS AS FOLLOWS:

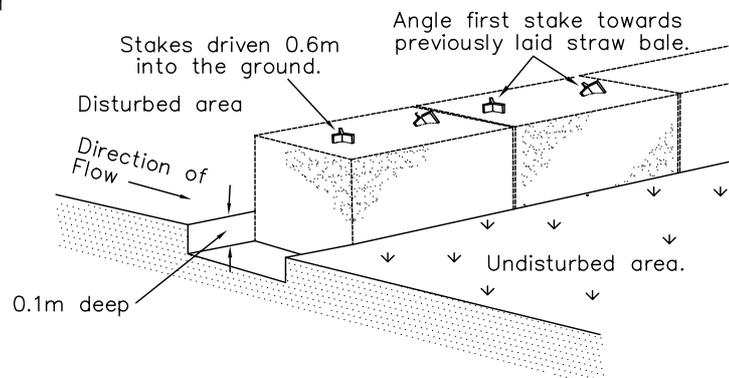
1. CONSTRUCT SEDIMENT FENCE AS CLOSE AS POSSIBLE PARALLEL TO THE CONTOURS OF THE SITE.
2. EXCAVATE A SMALL (150 TO 200MM DEEP) TRENCH ALONG THE LINE OF THE FENCE, ENSURING ANY LOOSE SPOIL IS DEPOSITED ON THE UPSLOPE SIDE.
3. INSTALL A PLAIN WIRE FENCE DOWNSLOPE OF THE TRENCH, WITH POSTS A MAXIMUM OF 3 METRES APART AND DRIVEN AT LEAST 500 TO 600MM INTO THE GROUND OR DELETE WIRE AND PLACE POSTS AT CLOSER CENTRES.
4. WHERE NECESSARY FOR ADDITIONAL FABRIC SUPPORT, STAPLE WIRE MESH TO THE FENCE.
5. ATTACH GEOFABRIC TO THE FENCE, ENSURING THE BASE IS BURIED AT LEAST 200MM IN THE GROUND ON THE UPSLOPE SIDE. THE HEIGHT OF GEOFABRIC ABOVE THE GROUND MUST BE LESS THAN 600MM.
6. ANY JOINTS OVERLAP A MINIMUM 300MM AND ARE EITHER SEWN OR SECURELY ATTACHED TO A POST, AND THE ENDS ARE SECURELY FASTENED TO A POST.

CONSTRUCTION NOTES FOR STRAW BALES

STRAW BALES TO BE USED IN TEMPORARY SITUATIONS TO MINIMISE EROSION AND DECELERATE WATER FLOW WHILST ESTABLISHING GRASS COVER. THEY WILL PROBABLY NEED REPLACEMENT AT INTERVALS OF LESS THAN FOUR MONTHS. WHERE USED, ENSURE CONSTRUCTION IS AS FOLLOWS:

1. CONSTRUCT STRAW BALES AS CLOSE AS POSSIBLE PARALLEL TO THE CONTOURS OF THE SITE OR AT THE TOE OF A SLOPE.
2. BALES ARE TO BE BOUND WITH WIRE OR PLASTIC RATHER THAN TWINE.
3. PLACE BALES LENGTHWISE IN ROWS, NUMBERS TO SUIT SITE CONDITIONS WITH STRAWS PARALLEL TO THE GROUND SURFACE.
4. BALES ARE TO BE EMBEDDED INTO THE SOIL TO A DEPTH UPSLOPE SIDE OF AT LEAST 0.1 METRE
5. ANCHOR BALES SECURELY TO THE GROUND BY TWO STAKES OR PICKETS DRIVEN THROUGH THE CENTRE (AS SHOWN ON SKETCH).

Sediment Fence

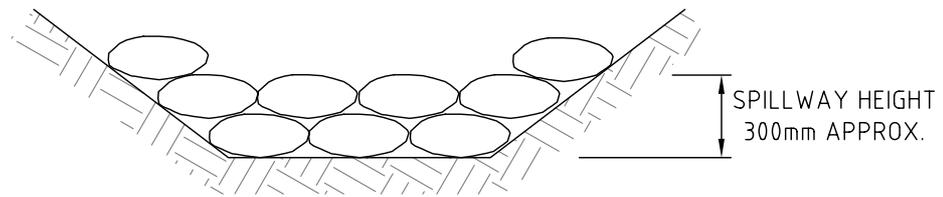


Vegetation Management Plan TEMPORARY EROSION CONTROL

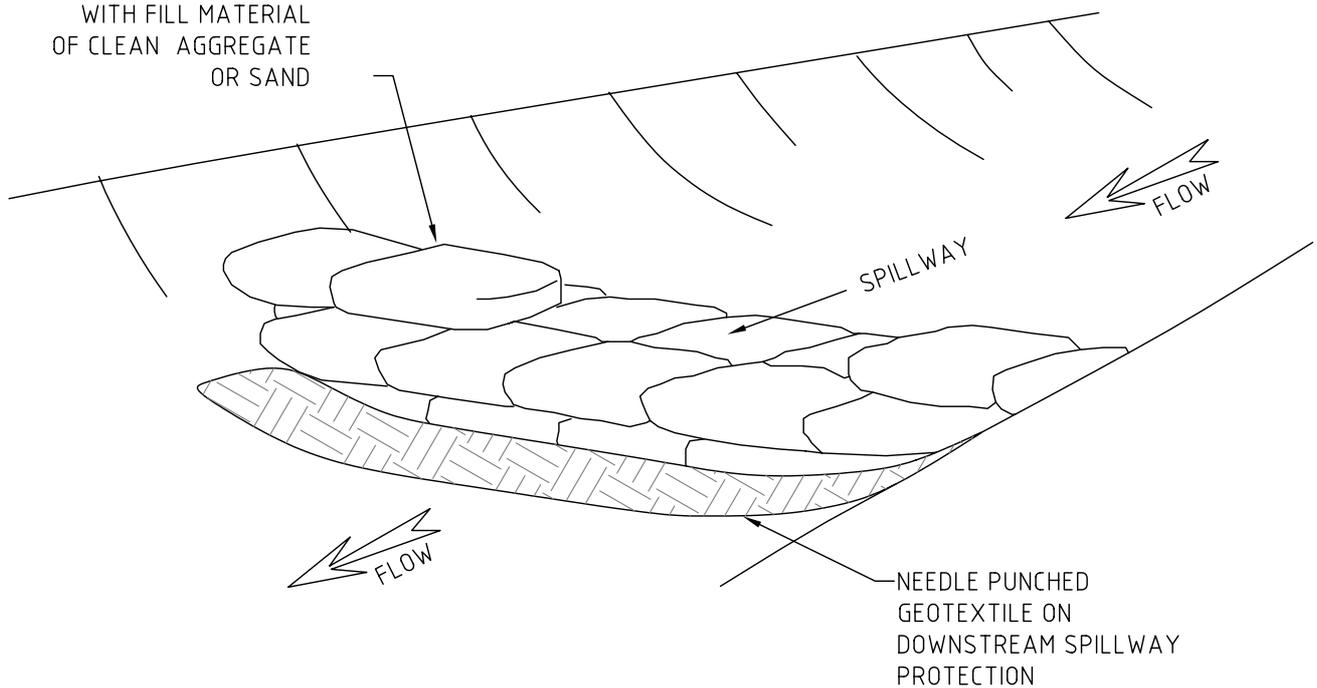


STORM CONSULTING
SUITE 3, 6 WEST STREET
PYMBLE NSW 2073
AUSTRALIA
PH: +61 2 9499 4333
FAX: +61 2 9499 4311
www.stormconsulting.com.au

Standard Drawing 7.1



BIODEGRADABLE HESSIAN BAG
WITH FILL MATERIAL
OF CLEAN AGGREGATE
OR SAND



CONSTRUCTION NOTES FOR TEMPORARY CHECK DAM

A CHECK DAM IS A SMALL TEMPORARY DAM BUILT ACROSS A CHANNEL OR WATERWAY TO REDUCE FLOW VELOCITY AND THE EROSION OF THE CHANNEL BED. IT CAN ALSO BE USED TO PROTECT A REVEGERATED CHANNEL DURING THE INITIAL ESTABLISHMENT OF THE VEGETATION. WHERE USED, ENSURE CONSTRUCTION IS AS FOLLOWS:

1. BAGS SHOULD BE PLACED TO ACHIEVE COMPLETE LOW FLOW CORRIDOR COVERAGE.
2. SPACING SHOULD BE APPROXIMATELY EVERY 30-40M OF CHANNEL (SLOPE < 2%). FOR STEEPER CHANNELS SPACING SHOULD BE REDUCED TO EVERY 20-30M.
3. TIGHTLY ABUT BAGS AND STACK ACCORDING TO DETAIL SHOWN.
4. MAXIMUM SPILLWAY HEIGHT SHOULD NOT EXCEED 300MM.
5. THE CENTRE SHOULD BE AT LEAST ONE BAG LOWER THAN THE OUTER EDGES.
6. UPSTREAM CATCHMENT AREA SHOULD BE LIMITED TO LESS THAN 1 HECTARE.
7. CHECK DAMS ARE ONLY TEMPORARY (<2 YEARS). BAGS MUST BE FILLED WITH CLEAN SAND OR AGGREGATE THAT IS FREE FROM CONTAMINATION AND SUITABLE FOR FUTURE DEPOSITION IN THE CHANNEL.
8. BAG MATERIAL MUST BE HESSIAN OR SIMILAR TO PERMIT BIODEGRADATION.



Vegetation Management Plan TEMPORARY CHECK DAM



STORM CONSULTING
SUITE 3, 6 WEST STREET
PYMBLE NSW 2073
AUSTRALIA
PH: +61 2 9499 4333
FAX: +61 2 9499 4311
www.stormconsulting.com.au

Standard Drawing 7.2

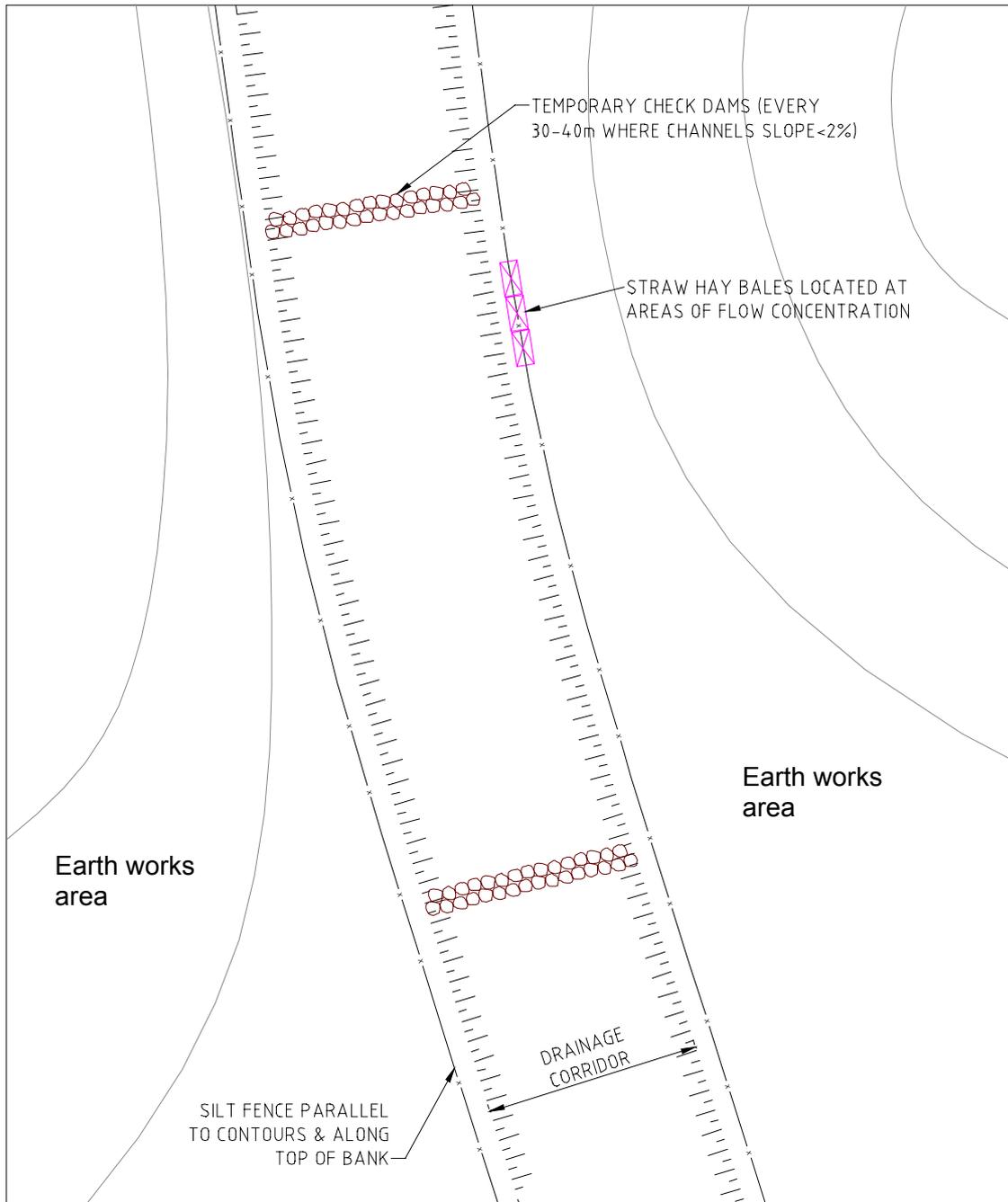


Figure 7.1 Example of location of soil erosion control devices to be installed during drainage corridor revegetation works



8.0 FIRE HAZARDS AND CONSIDERATIONS

The NSW Rural Fire Service provided advice regarding bush fire threat for the Mary Mount DCP area, see letter dated 13 November 2003. The Service advises that the proposed location of residential lots be considered in relation to the proposed revegetation areas, as well as the future provision of asset protection. As the revegetation areas are long thin strips (within the drainage corridors), the NSW Rural Fire Service has stated that these areas are not likely to pose a significant bushfire threat. However, larger areas may pose a higher threat. *Planning For Bushfire Protection – 2001* is referred to for specific advice regarding required asset protection zones for future residential subdivision.

Attention has also been given to the **fire hazard potential** of species and vegetation community created by revegetation of drainage corridors. Larger trees (mostly eucalypts) were generally avoided in the species planting list. However, in some areas (especially zone two and three) it is **essential** to have deep-rooted trees for the purpose of stabilising banks and as an important habitat and aesthetic component. The NSW Rural Fire Service has advised that larger eucalypt species not be excluded from the species planting list from a bush fire planning perspective, and recommends that these larger trees be positioned so that they do not form a continuous canopy throughout the corridor. In light of this comment, the species planting list has included larger eucalypt trees where necessary for stability and habitat purposes, with a note made to advise that continuous canopy is avoided and recommendations made for the spacing out of these trees/plantings.

Rough barked trees and trees producing large amounts of bark ribbons/fuel have generally been avoided but listed as an optional planting species. Smooth barked eucalypt species have been recommended because of their ability to reflect significant amounts of heat in event of a fire, and as the smooth trunks don't provide fuel for /or tend to contribute to spot fires.

All other species selected, (including many Acacias, and with the exception of several rush and grass species which die down in winter) remain green all year round, act as a good wind break species, and have a dense canopy cover reasonably resistant to fire events. These species would be particularly valuable in shielding homes from heat, wind and sparks should a fire event occur in this area.



9.0 MAINTENANCE

The contents of Section 9.0 - Maintenance and Section 10.0 - Monitoring and Review have been sourced from the vegetation management plan prepared by Environmental Partnerships titled *Lansdowne Creek Vegetation Management Plan* (Environmental Partnerships 2002). This is considered appropriate due to the close proximity of the site and prior review and acceptance by DIPNR.

9.1. MAINTENANCE REGIME

Maintenance for the drainage corridor revegetation works is to be undertaken on the following basis:

- Fortnightly for the first 13 weeks after completion of planting;
- Monthly thereafter for 91 weeks (to 24 months total); and
- On an as required basis thereafter sufficient to maintain the Maintenance Acceptance Criteria of this plan.

9.2. MAINTENANCE ACCEPTANCE CRITERIA

Maintenance effort shall meet the following Maintenance Acceptance Criteria:

- No more than 5% - 10% of plant material to be a weed species;
- Mulch to be replaced as bare ground becomes apparent for the first 12 months of the maintenance period;
- All failed plant material to be replaced on a monthly basis for the first 12 months;
- All marker stakes to be kept in place for the first 12 months and thereafter removed;
- Tree guards adjusted and re-planted as necessary; and
- Continue to ensure the general appearance and presentation of the drainage corridor.

9.2.1. Maintenance log book

The developer is to keep a Maintenance Log Book, recording for each occasion that maintenance is carried out for the following information:

- When the maintenance was undertaken;
- What maintenance activities were undertaken;
- What level of resources were committed to the work, e.g.:
 - how many people undertook the work,
 - over what time-frame,
 - what materials were used, and
 - what special requirements will be needed for the next maintenance visit.



- Whether the Maintenance Acceptance Criteria was met.

The Maintenance Log is to be made available for DIPNR and Council compliance audits.

9.2.2. Maintenance report

In relation to streams identified in R&FI Act, as shown in site plan Appendix A, a concise report will be provided to DIPNR every six months during the two (2) year maintenance period. The report shall provide:

- A summary of the progress of the revegetation works based on the performance indicators outlined in the above section;
- Any problems faced in implementing the VMP; and
- Measures developed to overcome these difficulties.



10.0 MONITORING AND REVIEW

10.1. INTRODUCTION

DIPNR identifies in their guidelines for VMP preparation that an ongoing process of monitoring and review of riparian revegetation is required after revegetation works. This process is to ensure that revegetation meets long-term objectives for environmental improvement and to identify and address specific problems at the site.

10.2. PERFORMANCE INDICATORS

Performance assessment is an important component of monitoring and review. For the revegetation works to be successful regular reviews are to be carried out to ensure that:

- Construction items meet design, program, and quality objectives;
- Developers and Council are meeting commitments for implementation, and establishment / maintenance responsibilities; and
- Recurrent maintenance is of acceptable standard and regularity.

Performance indicators include measures of input and output measures, and include but not limited to:

- Level of ongoing planting/replacement;
- Regular maintenance;
- Site monitoring and plant protection;
- Quality and diversity of revegetation establishment; and
- Number of fauna (bird) species seen in area.

Listed below in Table 10.1 are a series of performance indicators, which provide a basis for periodic reviews.



Table 10.1 Performance indicators for revegetation works at Mary's Mount

Revegetation component	Performance indicators
Environment and Landscape Character	Extension of healthy, natural tree canopy on site Improvements in water quality of stormwater throughout the Mary's Mount DCP Community awareness of revegetation areas
Vegetation Management	Incidence of weed and garden rubbish dumping decreases Decreasing percentage of weed cover in quadrants (<i>see table below</i>) Maintenance and expansion of existing site indigenous vegetation area Liaison with other bush regeneration teams working in the Local Government Area (LGA)
Soil and Water Management	No new scouring of streams No displacement of vegetation during high flows Reduction in nutrient levels of stormwater entering river system Reduction in litter entering drainage channel and riparian system
Management and Maintenance	Satisfaction of DIPNR in quality of recurrent maintenance Satisfaction of organised groups in carriage of responsibilities by other groups for detailed maintenance requirements.

Performance Measures for Bush Regeneration

Establish 5 x 5m quadrant in the revegetation area and work out the percentage of weed species. Assess the bush land by criteria shown in:

Table 10.2 Bush regeneration performance measures

Bush land Condition	Description Occurrence	Percentage weed cover
Good	Weed free	0 – 10 %
Fair	Moderate amount of weeds	10 – 40 %
Poor	Numerous weeds	40 - 70 %
Bad	Heavy weed infestation	70 – 100 %

10.3. REVIEW PROCEDURES

The implementation of this Vegetation Management Plan's recommendations is an ongoing process. Therefore, the outcomes of this VMP must be subject to review, to ensure its implementation programme remains relevant to the objectives and strategies that must be addressed.

The revegetation works should be subject to review within two (2) years of initial planting to ensure that recommended strategies remain viable, and have been implemented and maintained to the highest possible standard.



On an annual basis, the following reviews should be undertaken:

- Review establishment of plant species in liaison with Council's Parks Technical Adviser to confirm strategies for ongoing projects to Riparian and open space system.
- Review ongoing maintenance performance for weed management, vandalism, and erosion to determine one off or recurrent mitigation actions required.



11.0 PROGRAM OF WORKS

The following program of works (Figure 11.1) is indicative only. However, the timing of works is crucial to ensure success of revegetation works. A long lag time between earthworks and planting would allow weed establishment, and therefore a maximum period of one month is recommended.

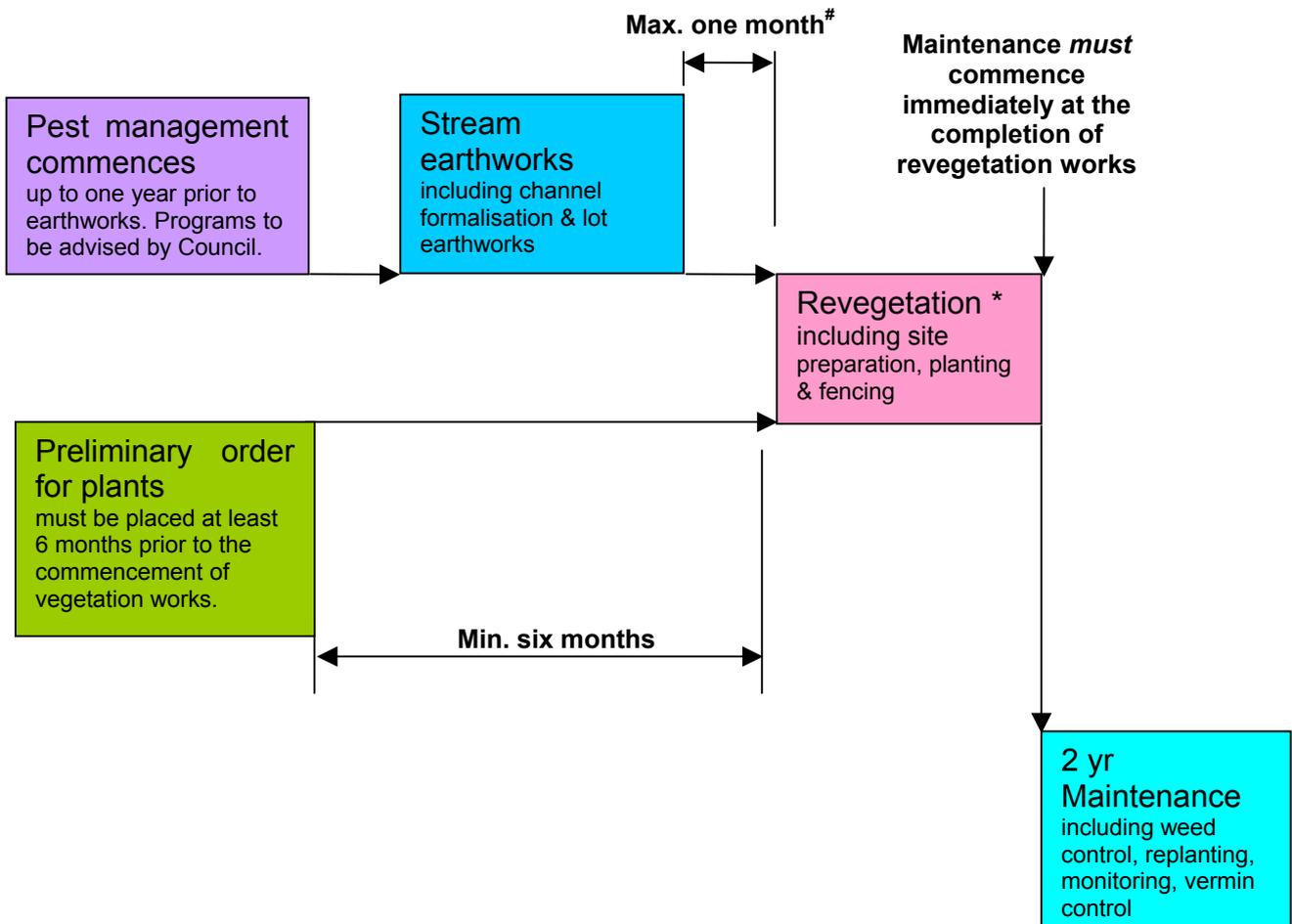


Figure 11.1 Program of Works

Note:

[#] Period between completion of earthworks and revegetation must be minimised to prevent weed infestation. Immediate commencement is encouraged.

* Recommended planting times are Sep – Oct and Mar – May. Planting outside these periods must be justified and warranted, as success rate is limited.



12.0 REFERENCES

Berri Barmera Local Action Planning 2001, ***Revegetation and Vegetation Guidelines***, Berri Barmera Local Action Planning Committee Inc.

Lewis, B. & Crawford, C. (2002), ***Riparian Management Guidelines for the Wollondilly and Wingecarribee Rivers***, Wollondilly Catchment Management Committee, Goulburn.

Department of Lands 2003, Analysis of four soil samples – Mary's Mount, 18 September 2003

DLWC 2000a, Soil Profile Attribute Data Environment.

DLWC 2000b. Guidelines for Rivers and Foreshores Improvement Act.

Environmental Partnership, 2002, ***Lansdowne Creek Vegetation Management Plan – Proposed subdivision and creek restoration***.

Goulburn City Council (2000), ***Stormwater Management Plan***.

Goulburn City Council (2003), ***Draft Goulburn Development Control Plan No.14 – Mary's Mount and Mary's Mount Contributions Plan***.

Hird, C. 1991. ***Soil Landscapes of the Goulburn 1:250 000 Sheet***. Soil Conservation Service of NSW, Sydney.

Laterals Planning (2003). Letter to Storm Consulting, dated 30/09/03, providing review and input for Mary's Mount vegetation management plan, including development of final species planting list.

NSW Scientific Committee 2002. Letter to Goulburn City Council from Dr Chris Dickman, Chairperson of the NSW Scientific Committee regarding the Final Determination to list the White Box Yellow Box Blakely's Red Gum Woodland as an ENDANGERED ECOLOGICAL COMMUNITY on Part 3 of Schedule 1 of the Act, 20 March 2002.

SCA and DLWC (2002), SCA Soil Landscapes as described by Michael Davey, printed 11/11/2002.

STORM Consulting Pty Ltd, 2003a. Mary's Mount Drainage Corridors – Stream Management Guidelines. October 2003.

STORM Consulting Pty Ltd, 2003b. Water Sensitive Urban Design - Mary's Mount Goulburn. August 2003.

Thomas, R. & Stelling F., 'Revegetation guide for the Goulburn Broken Catchment', chapter 7, ***Revegetation Guide for the Goulburn Broken Catchment***, ed, G. Earl, F. Stelling, M. Titcomb, S. Berwick, Department of Natural Resources and Environment.

Appendices



APPENDIX A DRAWING M288/P01 VEGETATION MANAGEMENT PLAN



APPENDIX B WEEDS INFORMATION

The following weeds are listed as noxious weeds for the Goulburn City Council.

Common Name	Botanical Name	Declared Categories
African Boxthorn	<i>Lycium ferocissimum</i>	W2 or W3
African Lovegrass	<i>Eragrostis curvula</i>	W2 or W3
Alligator Weed	<i>Alternanthera philoxeroides</i>	W1 or W2 or W3
Bathurst Burr	<i>Xanthium</i> spp.	W2 or W3
Blackberry	<i>Rubus fruticosus</i> (agg.)	W2 or W3
Californian Burr	<i>Xanthium</i> spp.	W2 or W3
Cockle Burr	<i>Xanthium</i> spp.	W2 or W3
Coco Leaf	<i>Erythroxylum coca</i>	W1
Dodder	<i>Cuscuta campestris</i>	W1 or W2
Fireweed	<i>Senecio madagascariensis</i>	W2 or W3
Gorse	<i>Ulex europaeus</i>	W2
Green Cestrum	<i>Cestrum parqui</i>	W2 or W3
Hemlock	<i>Conium maculatum</i>	W2 or W3
Horehound	<i>Marrubium vulgare</i>	W2 or W3
Horsetail	<i>Equisetum</i> spp.	W1
Indian Hemp	<i>Canabis sativa</i>	W1
Karoo Thorn	<i>Acacia karoo</i>	W1
Kochia (not Summer or Mock Cypress)	<i>Kochia scoparia</i> <i>Kochia scoparia</i> subsp. <i>Tricophylla</i>	W1
Largarosiphon	<i>Lagarosiphon major</i>	W1
Nodding Thistle	<i>Carduus nutans</i>	W2 or W3
Noogoora Burr	<i>Xanthium</i> spp	W2 or W3
Opium Poppy	<i>Papaver somniferum</i>	W2
Pampas Grass	<i>Cortaderia</i> spp.	W2
Parthenium Weed	<i>Parthenium hysterophorus</i>	W1
Paterson's Curse, Viper's and Italian Bugloss	<i>Echium</i> spp.	W2 or W3
Rhus Tree	<i>Toxicodendron succedaneum</i>	W2
Salvinia	<i>Salvinia molesta</i>	W1 or W2
Scotch/ English Broom	<i>Cytisus scoparius</i>	W2



Scotch/ Illyrian/ Stemless Thistle	<i>Onopordum</i> spp.	W2 or W3
Senegal Tea Plant	<i>Gymnocoronis spilanthoides</i>	W1
Serrated Tussock	<i>Nassella trichotoma</i>	W2 or W3
Siam Weed	<i>Chromolaena odorata</i>	W1
Sifton Bush	<i>Cassinia arcuata</i>	W2 or W3
St. John's Wort	<i>Hypericum perforatum</i>	W2 or W3
Sweet Briar	<i>Rosa rubiginosa</i>	W2 or W3
Water Hyacinth	<i>Eichhomia crissipes</i>	W1 or W2 or W3
Water Lettuce	<i>Pista stratiotes</i>	W1
Wild Radish	<i>Raphanus raphanistrum</i>	W2 or W3
Willows	<i>Salix</i> spp. except for <i>S. babylonica</i> , <i>S. x calodentron</i> , <i>S. x reichardtii</i>	W4g

The four categories for noxious weeds defined under the Noxious Weeds are:

- **W1** – the presence of the weed on the land must be notified to the LCA and the weed must be fully and continuously suppressed and destroyed;
- **W2** – the weed must be fully and continuously suppressed and destroyed;
- **W3** – the weed must be prevented from spreading and its numbers and distribution reduced; and
- **W4** – the action specified in the declaration must be taken in respect of the weed. The action specified in relation to a W4 weed may be more or less stringent, and more specific, than the action required to be taken under the other control categories. There are currently seven sub-categories (a-g) of W4 noxious weeds.

Below is a list of noxious weeds in order of priority for control as identified by Goulburn City Council.

- Serrated Tussock (W2)
- Blackberry (W2)
- African Lovegrass (W2)
- St Johns Wort (W2)
- Gorse (W2)
- Sifton Bush (W3)
- Willows (Wg3)
- African Boxthorn (w3)
- Paterson's Curse (W3)
- Horehound (W3)



Serrated tussock

Serrated tussock (*Nasella trichotoma*) is a category W2 noxious weed in the Goulburn area, which means that the weed must continuously be suppressed and destroyed. Originally a native of South Africa, serrated tussock is a perennial tussock forming grass up to 50cm in height. Its leaves are tightly inrolled with tips turning in colour. Serrated tussock usually flowers in spring, and one plant can produce up to 80, 000 seeds, which are easily dispersed by wind. It grows well on high producing and poor soils.

Serrated tussock is a particular problem in the Mary's Mount site area due to a lack of maintenance with little or no weed control. Poor weather conditions in recent times have reduced competition from other plants, which has enabled serrated tussock to spread unchecked. Effective long-term control of serrated tussock involves a program of planting out along open drainage corridors with competitive desirable species of dense vegetation of native trees and shrubs.



Blackberry

Blackberry (*Rubus* spp) is also classified as a W2 noxious weed. Blackberry needs to be controlled in the Mary's Mount area due to its ability to take over large areas of land. Additionally, blackberry acts as a harbour for rabbits and other vermin, and therefore removal and control of blackberry assists in managing vermin populations.

Hawthorn

Hawthorn (*Crataegus monogyna*) – An erect, prickly shrub to 6m in height, producing large quantities of small red fruit and seed during winter. Roots produce suckers when disturbed and are often difficult to remove from site. Efforts should be made to remove this species from site before revegetation works begin, and any regrowth of this species will need to be controlled/ removed, especially while newly planted vegetation is becoming established, but also after establishment to prevent spread to other areas.

Briar Rose

Briar Rose (*Rosa rubiginosa*) – An erect prickly shrub to approximately 3m in height, producing substantial quantities of fruit during winter. This species will also need to be removed from the site before revegetation works commence and follow up works may be necessary to completely remove this species from site.



Firethorn

Firethorn (*Pyracantha sp.*) – A dense prickly shrub to approximately 6m in height producing large quantities of orange berries during the winter months. Efforts should also be made to remove this species from site before revegetation works commence and any regrowth of this species will need to be controlled and removed even after vegetation has become established to prevent spread to other areas.

Scotch Thistle

Scotch Thistle (*Onopordum acanthium*) – An erect annual or biennial herb to 2m in height forming a broad spreading basal rosette that effectively competes with native plant species, and rapidly spreads by seed. Large numbers of this species were observed on a newly constructed dam wall and control of this species in this area is a particular priority. Following initial earthworks it is likely this species will be seen readily throughout areas disturbed. To prevent further spread, young rosettes should be spot sprayed with a suitable spray applied to manufacturers specifications. Where there are isolated individuals, hand removal (chipping) removing as much as possible of the plant is likely to prove successful while plants are young or prior to seed set.

Paterson's Curse

Paterson's Curse (*Echium plantagineum*) – An erect annual and occasionally biennial herb, reaching a height of approximately 1.5m, with a broadly spreading basal rosette that significantly restricts and can exclude the growth of surrounding plant species, particularly native grasses and forbs. There were large numbers of this species present within the lower reaches of revegetation zone 2. This species should be spot sprayed with a suitable herbicide to manufacturers specifications before plantings of native vegetation occur and follow up works will need to be carried out to control likely re-growth until vegetation is established on the disturbed sites.

African Box Thorn

African Box Thorn (*Lycium ferrocissimum*) – An erect, thorny shrub to approximately 5m high and often spreading 3 to 4m across, forming impenetrable barriers and producing large quantities of attractive red/orange fruit. This species should be removed from the planting area completely by manual means and any re-growth should be continually suppressed/removed, even after new vegetation is established.

An 'Environmental Weed' is any plant that invades the natural system, often at the expense of native vegetation communities. Environmental weeds can be an exotic plant species introduced from overseas or a species from outside the state or that has spread outside its original distribution. Large portions of environmental weeds are horticultural species that have escaped from cultivation. Weed infestation from adjoining residential areas is a significant threat to the drainage corridors in the Mary's Mount area.



Whilst Goulburn City Council does not have an environmental weed list, the following weeds have been identified.

Common name	Botanical name
Willow	<i>Salix</i> spp.
Silver Poplar	<i>Populus alba</i>
Tree of Heaven	<i>Ailanthus altissima</i>
Privet	<i>Ligustrum</i> spp.
Hawthorns	<i>Crataegus monogyna</i>
Sweet Briar	<i>Rosa rubiginosa</i>
Honeysuckle	<i>Lonicera japonica</i>
Gorse	<i>Ulex europaeus</i>
Buckthorn	<i>Rhamnus alaternus</i>
Sifton Bush	<i>Cassinia arcuata</i>



APPENDIX C PLANT SUPPLIERS

Note that orders need to be placed 6 to 12 months before intended planting time.

Nursery	Telephone	Special Interests & notes
ABULK	(02) 4577 5912 008 045 543	Suppliers of native grasses and sedges; viro cells and virotubes.
Danganelly Native Nursery	(02) 4829 8135	
Lyndfield Park Nursery (John Weatherston)	(02) 4845 1282	Native seed collection.
Ms Mary Bell	(02) 9388 2427	Native seed collector
Plantwize Nursery and Australian Aqua Flora Ecological Restoration Australia (ERA)	(03) 97173484	Wetland & riparian plant propagation and supply

APPENDIX D SOIL REVEGETATION ANALYSIS

SOIL AND WATER TESTING LABORATORY
Scone Research Service Centre

Report No.: SC003/245R1
Client Reference: Emma Garraway
Storm Consulting Pty Ltd
Suite 3, 6 West Street
Pymble 2073

Page 2 of 2

Lab. No.	Method Sample Id.	CIA/4 EC (dS/m)	C2A/3 pH	C5A/3 CEC & exchangeable cations (me/100g)							C8A/2 P (mg/kg)	p9B/2 EAT	Texture
				CEC	Na	K	Ca	Mg	Al				
1	TP#1 A 0-	0.06	6.0	10.4	0.6	0.2	3.7	1.5	nt	1	3(1)	Silty clay	
2	TP#2 A1 0-150	0.12	7.3	23.7	0.8	1.1	11.2	5.6	nt	1	8/3(1)	Light medium clay	
3	TP#3 A1 0-100	0.08	6.1	25.1	0.7	0.8	10.7	7.0	nt	1	8/3(1)	Heavy clay	
4	TP#4 A1 0-80	0.55	8.0	40.6	3.1	0.7	15.0	18.7	nt	12	2(1)	Light clay	

nt = not tested

END OF TEST REPORT

R. Pelting





Department of Lands

Land Administration & Management
Property & Spatial Information

Emma Garraway
Storm Consulting Pty Ltd
Suite 3, 6 West Street
Pymble 2073

Scone Research Service Centre
Gundy Road Scone NSW 2337
P O Box 283 Scone NSW 2337
Tel: (02) 6545 1666
Fax: (02) 6545 2520
www.lands.nsw.gov.au

18 September 2003

Lab. No.: SCO03/245

Dear Emma

Analysis of four soil samples – Mary's Mount

Four soil samples from Mary's Mount were analysed at the Scone Research Service Centre (Soil test report SCO03/245R1). As requested, these samples were analysed to assess the requirements for revegetation.

TP#1 A 0-

The TP#1 A 0- sample was a moderately acidic silty clay. The electrical conductivity (EC) indicates that this sample had low salinity. The available phosphorus (P) was very low and plant growth is likely to benefit from the application of phosphate fertilisers.

The cation exchange capacity (CEC) is a measure of the soil's ability to store exchangeable cations. The major exchangeable cations in soil are calcium (Ca), magnesium (Mg), potassium (K), sodium (Na) and aluminium (Al). Both the concentration and percentage of cations are important for plant growth. The CEC and the concentration of exchangeable K and Ca were all low and the concentration of exchangeable Na and Mg both moderate. With an exchangeable sodium percentage (ESP) of 10% this sample was sodic. However, the higher level of Mg may limit the availability of K and this sample is likely to benefit from the application of K fertilisers.

The Emerson aggregate test (EAT) was indicative of samples with slight dispersion. This sample dispersed when disturbed and was prone to slaking. The stability of this sample may be improved with the application of organic matter.

TP#2 A1 0-150

The TP#2 A1 0-150 sample was a light medium clay with a neutral pH, low salinity and low available P. This sample should also benefit from the application of P fertilisers. The CEC was moderate and the concentration of exchangeable cations were all high. This sample also had slight dispersion but was not prone to slaking and hence is considered to be generally stable.



**TP#3 A1 0-100**

The TP#3 A1 0-100 sample was slightly acidic heavy clay with low salinity and low available P, indicative of P deficiency. The CEC and concentration of exchangeable cations ranged from moderate to high but this sample may also benefit from the application of K fertilisers. This sample also had slight dispersion but was not prone to slaking and hence is considered to be generally stable.

TP#4 A1 0-80

This sample was a moderately alkaline and saline light clay with moderate to high dispersion such that the growth of some plant species may be affected. The concentration of available P was moderate. The CEC and exchangeable cations were all high or very high but the Ca:Mg and K:Mg ratios were low and the application of gypsum and K fertilisers would be beneficial.

Recommendations

The following recommendations are provided to improve soil conditions:

- 22-44 kg/ha P fertiliser (eg. 250-500 kg/ha of superphosphate)
- N and K to meet plant requirements (eg. 15 kg/ha N and 30 kg/ha K).

For the TP#4 A1 0-80 sample the application of 5-10 t/ha gypsum is recommended. The gypsum should be incorporated into the soil to a minimum depth of 0.1 m. If the gypsum is not incorporated, to this depth, then the rate should be decreased accordingly. If by-product gypsum is used then the impact of impurities should also be considered. The application of organic mulch to protect the soil surface from erosion may be beneficial.

This interpretation is based on the samples supplied being representative and literature guidelines. If you have any queries please contact me on (02) 65451666.

Yours faithfully

S.R. Young
Laboratory Manager
Scone Research Service Centre