

Preliminary Restoration Plan

Eviron Road Quarry and Landfill

May 2011

Version 2

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1 Introduction

Tweed Shire Council (TSC) is proposing to establish two new quarries and three landfills and a haul road in Eviron, in the far North Coast of NSW (Eviron Rd Q&L/the proposal).

The proposed Eviron Rd Q&L is designated a Part 3A Major Project under the *Environmental Planning and Assessment Act 1979* (EP&A Act), with TSC as the proponent. An environmental assessment prepared by GHD (2010) for the Eviron Rd Q&L Major Project Concept Plan application (08_0067) and Stage 1 project application (08_0068) was lodged with NSW Department of Planning (now Department of Planning and Infrastructure - DPI) on the 31 March 2008.

The DPI, in consultation with other state departments, assessed the adequacy of the environmental assessment accompanying the application. In assessing the adequacy of the assessment in relation to biodiversity, the Department of Environment, Climate Change and Water (now the Office of Environment and Heritage - OEH), identified the need for a preliminary restoration plan that provides sufficient information to assess the likely success of the corridor planting and enhancement proposed in the environmental assessment report.

The proposed restoration program is over a five year period. Beyond the five year period management of these restoration areas will be incorporated into general site management in accordance with a site-wide Environmental Management Plan (EMP).

The subject Preliminary Restoration Plan is intended to fulfil OEH's further information request and provide an ecologically sound, practical plan, to guide restoration works.

2 Project location

2.1 Site location

The Eviron Rd Q&L site is located at Eviron, within the Tweed Local Government Area, and comprises Lot 1 DP115352, Lot 602 DP1001049 and Lot 1 34555 (Figure 1).

The site occurs on the northern and easterly slopes of the Condong Range and the adjoining floodplain. The site is bound by Eviron Road in the south, the Pacific Highway to the east and sugar cane fields to the north and west. Stott's Creek Resource Recovery Centre adjoins the site to the northwest and Quirk's Quarry occurs in the eastern portion of the site.

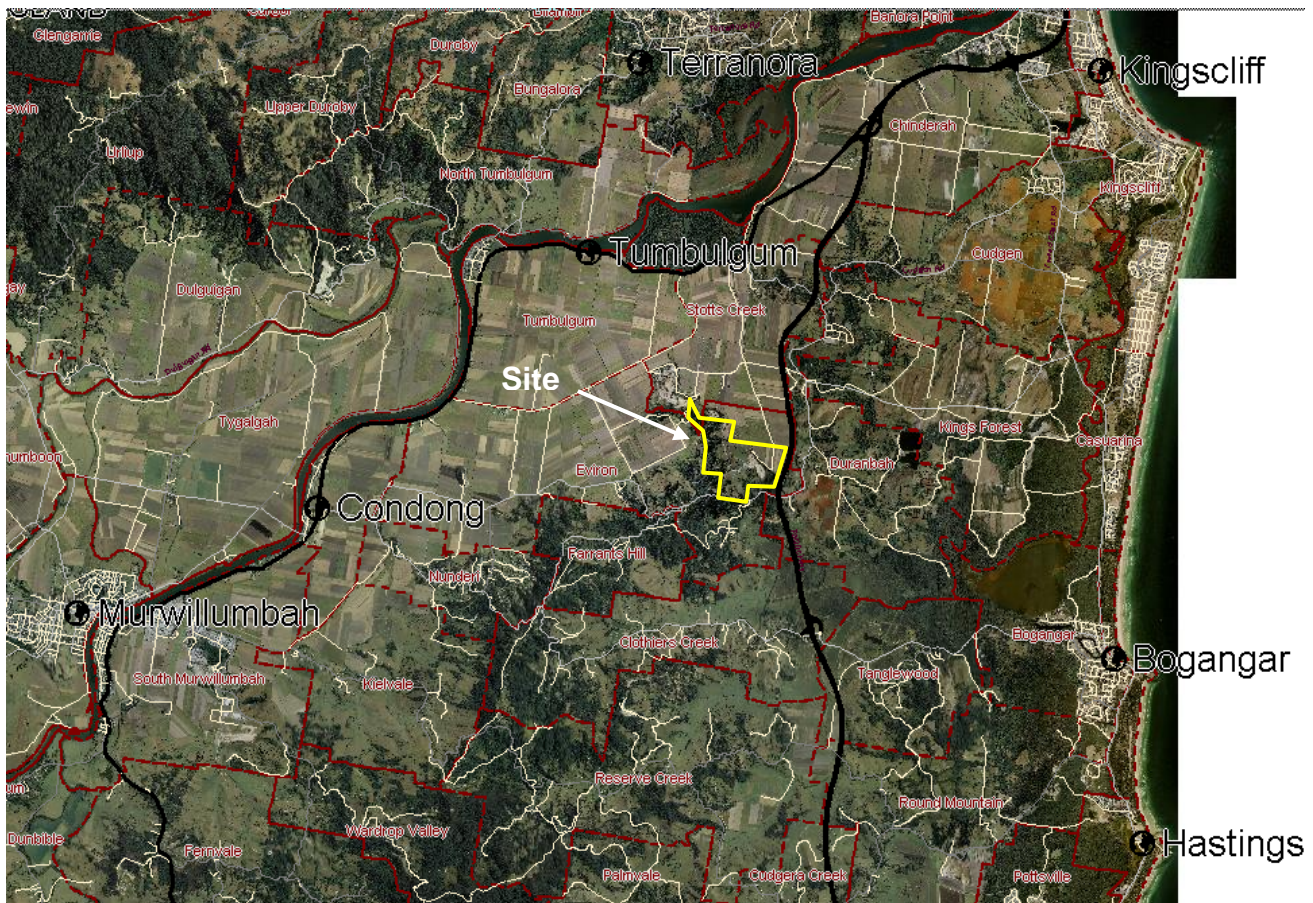


Figure 1: Site locality

2.2 Nominated restoration work areas

The ecological assessment prepared by GHD (2010) has proposed corridor planting and enhancement to provide wildlife corridors and facilitate wildlife movements across the site. Two suitable corridor alignments were nominated: Northern Riparian Corridor and Southern Ridgeline Corridor (refer to Figures 2-4).

2.2.1 Northern Riparian Corridor

The Northern Riparian Corridor is aligned along a heavily modified and degraded drainage line which flows in a north-westerly direction across the northern portion of the site. This drainage line discharges into Ledday's Creek approximately 1 km to the north-west of the site; Ledday's Creek discharges into the Tweed River at Stott's Island. The intent of the Northern Riparian Corridor is to reconstruct habitat and provide a lowland route across the site for native wildlife. This corridor will connect lowland areas to the Condong Range ridgeline and connect the patch of retained sclerophyll forest/camphor laurel forest east and south of Quirk's Quarry with the patch of retained sclerophyll forest in the central west of the site.

A small narrow strip of Broad-leaved Paperbark – Camphor Laurel Open Forest was recorded along this drainage line (GHD, 2010). This community was determined to be analogous with Endangered Ecological Community (EEC): Swamp Sclerophyll Forest on Coastal Floodplains (SSF) (GHD, 2010). The remainder of the drain is cleared and dominated by exotic groundcovers.

It is proposed that this corridor be planted out with swamp sclerophyll forest species, including koala feed tree species (eg. Swamp Mahogany – *Eucalyptus robusta*). The goal is to achieve a corridor width in the order of 20m. The length of the drainage line is approximately 956m, amounting to a total restoration area of approximately 1.9 ha.

Given the extent of the area requiring reconstruction, the restoration method proposed for this area comprises a combination of revegetation and assisted regeneration. Assisted regeneration is focussed around areas of existing native vegetation, where possible, and otherwise inter-dispersed amongst proposed revegetation clusters. In addition to numerous revegetation clusters a single row revegetation screen is proposed along the entire length of the corridor. This serves to introduce a seed source along the entire length of the corridor to promote natural regeneration, as well as providing visual screening of the site.

An existing access road occurs parallel to the drainage line. This road has been built up with fill which is not a suitable growing medium for bush restoration. Rather than remove the road fill, it is proposed that the vegetated corridor be established around the existing access track. The access track will provide good access for planting, maintenance and monitoring during the establishment phase of works. Given the close proximity of the track to the drainage line, the restoration area will be wider on one side of the bank than the other (generally wider on the southern and western side of the bank) in order to achieve the 20 m wide corridor.

An existing revegetation screen occurs on the north-eastern side of the access road. These plantings were previously established for the purpose of a visual screen and are currently 1-1.5m in height. These plantings will continue to serve the function of screening the site, both visually and from weed seed; however, will remain separate from the SSF plantings by the access road. The species selection used for the existing visual screen is characteristic of riparian rainforest rather than SSF.

An aerial photograph of the Northern Riparian Corridor is provided in Figure 2 and the nominated revegetation and assisted regeneration areas are depicted in Figure 3.

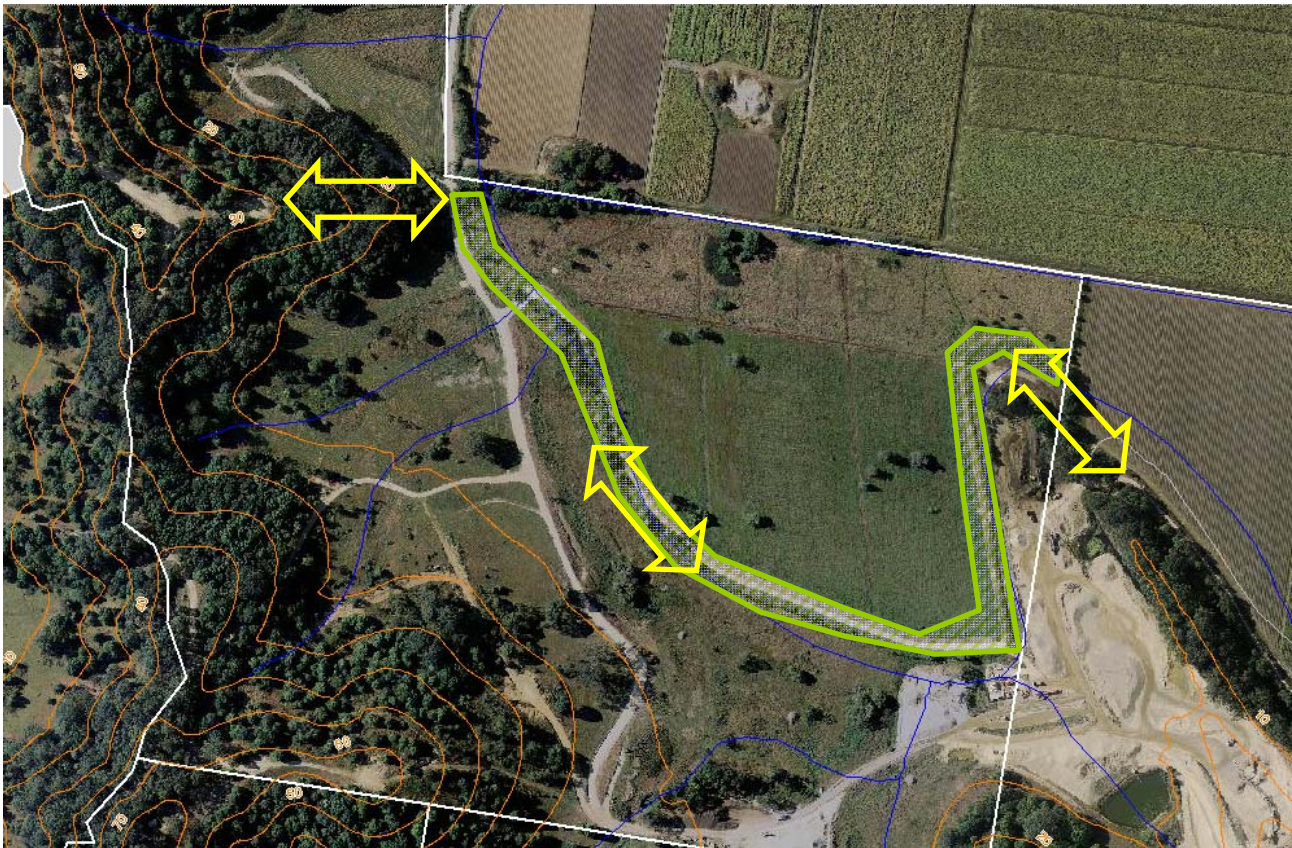


Figure 2: Northern Riparian Corridor restoration work area

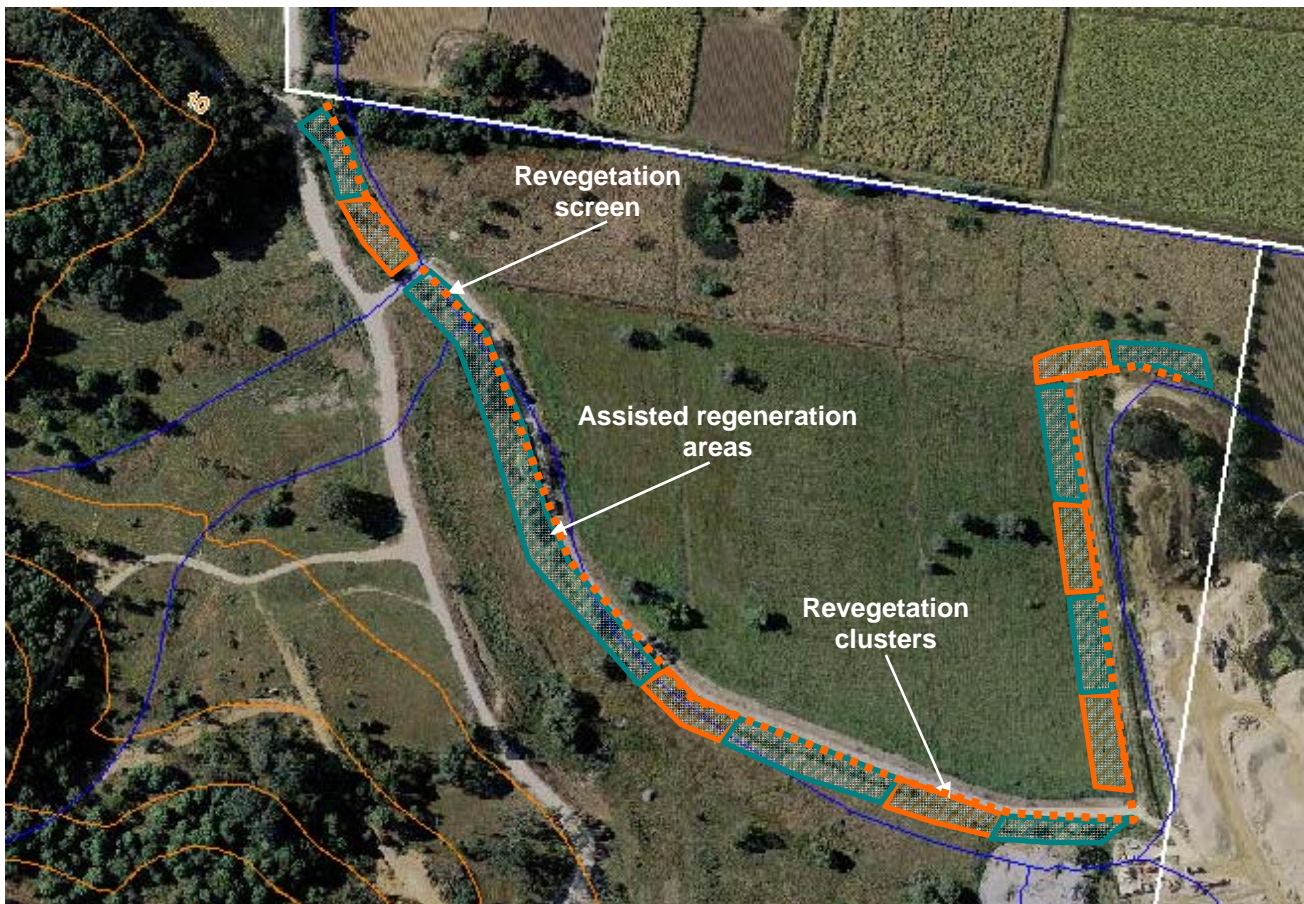


Figure 3: Northern Riparian Corridor nominated revegetation and assisted regeneration work areas

2.2.2 Southern Ridgeline Corridor

The Southern Ridgeline Corridor occurs along the ridge of the Condong Range in the southern portion of the site. It provides for upland east-west movement of native fauna and connects the patch of retained sclerophyll forest/camphor laurel forest east and south of Quirk's Quarry with the retained sclerophyll forest in the western portion of the site. The western portion of this corridor is vegetated with Blackbutt Wet Sclerophyll Open Forest and the eastern portion is vegetated with camphor laurel forest and, further east, sclerophyll forest. The central portion of this corridor, in the vicinity of the existing haul road and the residence of Lot 1 DP 34555, is largely cleared of native vegetation and represents a break in the linkage across the site. It is proposed that this area be planted to reconstruct wet sclerophyll habitat and in turn improve the connectivity of this east-west corridor. The revegetation area will be down slope of the existing residence of Lot 1 DP 34555, generally between the 60 and 70m contour for a length of approximately 220m. The proposed width of the Southern Ridgeline Corridor revegetation area is approximately 20m amounting to a restoration area of approximately 0.44ha.

An aerial photograph of the Southern Ridgeline Corridor is provided in Figure 4.

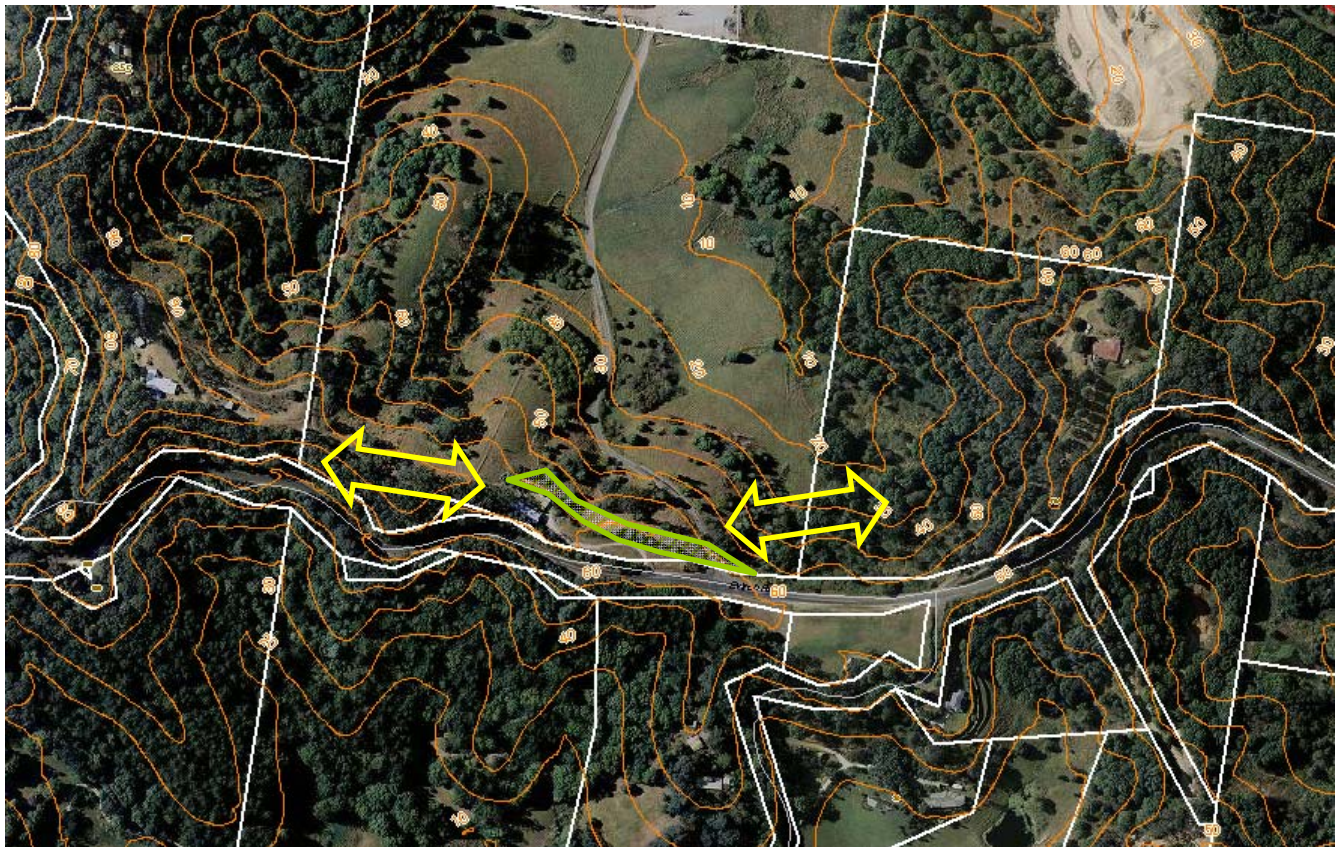


Figure 4: Southern Ridgeline Corridor restoration work area

Refer to section 5 for more information on proposed works.

3 Restoration objectives

The restoration objectives are as follows:

- To contribute to 'maintaining or improving biodiversity values' at the site and its locality.
- To reconstruct bushland habitat that connects areas of retained bushland on the site (and adjoining the site) to facilitate wildlife movement (and genetic transfer) throughout the site and wider locality.
- To provide a fauna refuge across the site to minimise the risk of fauna injuries and mortalities from quarry and landfill operations and natural disturbance events (eg. fire or storms).
- To reconstruct native vegetation communities consistent with that likely to have occurred prior to clearing, or where the existing environment is highly modified, reconstruct a suitable alternative native vegetation community.
- Along the Northern Riparian Corridor, the objective is to reconstruct a swamp sclerophyll forest that is commensurate with SSF EEC.
- Along the Southern Ridgeline Corridor, the objective is to reconstruct Blackbutt wet sclerophyll forest.
- To revegetate with species that provides significant habitat values as much as possible (eg. Koala and Glossy Black-cockatoo feed trees).
- To restore and improve the ecological integrity of degraded areas of existing vegetation along the corridors through assisted regeneration.
- It is not expected that mature swamp sclerophyll forest or Blackbutt wet sclerophyll forest communities will be achieved within the period of the five year program. However, at the completion of the five year period, it is expected that the revegetation areas will represent healthy self-sustaining regrowth communities with a floristic and structural diversity comparable to benchmark swamp sclerophyll/Blackbutt wet sclerophyll forest communities. The assisted regeneration areas are expected to have a significant cover of native vegetation.
- At the end of the five-year program it is expected that the presence of exotic species be significantly reduced.

Refer to Section 5.6 and Appendix C for detailed Key Performance Indicators (KPIs).

4 Biological and ecological considerations of target vegetation communities

4.1 Swamp sclerophyll forest EEC

The suitability of the proposed Northern Riparian Corridor restoration area, in terms of landform, elevation, inundation and soil type, for establishing SSF is discussed below.

4.1.1 Landform, elevation and inundation

Swamp sclerophyll forest generally occurs on alluvial flats and drainage lines associated with coastal floodplains on soils that are either waterlogged or subject to periodic flooding or inundation (DECC, 2007; Scientific Committee, 2004). This community is generally found below 20 m elevation (DECC, 2007).

Floodplains are level landform patterns on which there may be active erosion and deposition of sediment by flooding, where the average interval is 100 years or less (DECC, 2007). The Northern Riparian Corridor restoration area is flat (<8 degrees) and subject to flooding. Incorporating the BMT WBM Pty Ltd (2009) updated climate change predictions; the flood design level for the site is 4.0 m, which is 2-4 m above existing levels. As no filling is proposed within this area, the site will continue to be subject to flooding.

The landform, elevation and periodic flooding at the Northern Riparian Corridor restoration area are suitable for the re-establishment of SSF.

4.1.2 Soil type

Swamp sclerophyll forest is associated with humic clay loams and sandy loams (Scientific Committee, 2004). Soil investigations undertaken by Gilbert+Sutherland (2007) included three boreholes along the drainage line associated with the Northern Riparian Corridor restoration area and an additional two boreholes in close proximity (on the north-eastern side of the drainage line). The boreholes revealed the soil profile in the area consists of medium clay to a depth of 40 cm overlying heavy clay along the drainage line and clayey sand to loam (10 and 20 cm, respectively) overlying heavy clay on the north-eastern side of the drainage line. The borehole soil profile results are consistent with the 1:100,000 soil landscape mapping of the area which maps the entire site as occurring within the Tweed (tw) alluvial landscape (Morand, 1996). The Tweed soil landscape consists of deep Quaternary alluvium and estuarine sediments; the soils are described as deep (>200 cm), poorly drained Brown Alluvial Clays on levees and Humic Gleys on backplains (Morand, 1996).

The soils within the Northern Riparian Corridor restoration area are potentially a little heavier (higher in clay content) than what is typical host to SSF; however, the clayey sand and loam detected on the north-east side of the drainage line are more suitable soil types and restoration area is likely to harbour soils with varying clay:sand ratios. Given the occurrence of a small patch of regrowth SSF already exists within this area, it is considered suitable for this community type. It is expected that the heavier soils would allow for the incorporation of some rainforest species within the community structure.

4.2 Blackbutt wet sclerophyll forest

The suitability of the proposed Southern Ridgeline Corridor restoration area, in terms of landform, elevation, inundation and soil type, for establishing Blackbutt wet sclerophyll forest is discussed below.

Blackbutt wet sclerophyll forest was recorded along the ridgeline that occurs around the western and southern boundaries of the site, with another patch occurring on a spur east of Quirks Quarry. This community was found to be analogous with TVMS community 201: Blackbutt Open Forest Complex and Biometric vegetation type 24: Blackbutt - Tallowwood tall moist forest of the far north east of the North Coast.

4.2.1 Landform, elevation and inundation

The landscape position for Biometric vegetation type 24: Blackbutt - Tallowwood tall moist forest of the far north east of the North Coast is described as the eastern Mount Warning Shield. The TVMS community Blackbutt Open Forest Complex is described as occurring on ridges and hillslopes, with floristic composition varying with soil fertility and aspect (Kingston *et al*, 2004). The existing occurrence of this community on site is along the ridgeline and hillslopes associated with Condong Range, with elevation varying between approximately 10 – 60 AHD. This community occurs on elevated coastal hills and ridges where the soils are moderately well draining.

4.2.2 Soil type

This community is associated with the Burringbar (bu) soil landscape (Morand, 1996). Soil investigations undertaken by Gilbert+Sutherland (2007) included nine boreholes along the ridgeline. The results from the boreholes found the soil profile to comprise silty/sandy/gravelly clay, loam and clayey gravelly sand (to a depth of 90cm) overlying siltstone, silty sand, sandy gravel, silty medium clay and gravelly sandy light clay (Gilbert+Sutherland, 2007). The borehole investigations are generally consistent with Morand (1996) description which describes a typical profile of a shallow layer of crumbly clay loam overlying silty clay loam overlying quartite phyllite on the ridge top; a shallow layer of crumbly clay loam overlying silty clay loam overlying red plastic clay overlying siltstone/mudstone/shale on the upper slopes; and a shallow layer of crumbly clay loam overlying stony silty clay/yellow mottled clay and red crumbly clay overlying quartzite/phyllite on the lower slopes.

Blackbutt forest is known to occur on all of these variations of the Burringbar soil landscape. Accordingly, the soil within the southern ridgeline restoration area is considered suitable for this community.

5 Scope of works

The proposed scope of works is detailed in the following sections.

5.1 Seed collection and propagation

Seed is to be collected from native species within and adjoining the existing Swamp Sclerophyll Forest and Blackbutt wet sclerophyll forest communities of the Northern Riparian Corridor and southern ridgeline, respectively. Seed is to be collected from species listed in the revegetation species lists for each restoration area (Appendix A).

In accordance with the florabank Model Code of Practice, it is recommended that no more than 20% of fruit is removed from any one plant (in any one season).

Records will be kept for each sample of propagation material and maintained from the time of collection, to the raising of seed/cuttings, planting out of tubestock and maintenance and monitoring period. The following information will be collected for each sample:

- Sample id code (unique code to be created for each sample – eg. ‘EP_1’, which represents *Eucalyptus pilularis*, plant 1);
- Source plant location (GPS coordinates and description);
- Date of collection;
- Type of material collected (eg. seed, cutting);
- Amount of material collected;
- Seed treatment technique;
- Date of sowing;
- Date of germination;
- Date of out-planting;
- Location of out-planting (GPS coordinates and description);
- Monitoring results (refer to Section 5.6.2 for proposed monitoring method).

Each sample will be tagged with its Sample id code for the duration of its life cycle.

Collected seed is to be stored in accordance with the florabank *Guidelines for Native Seed Storage for Revegetation*.

Collected seed is to be delivered to TSC Nursery or contracted private nursery for propagation. Sample id codes are to be kept with the sample at all times on a label that is not going to deteriorate with water and sun exposure.

5.1.1 Seed provenance

Local seed is typically endorsed as the preferred source of stock for revegetation plantings, primarily because local seed is considered best adapted to local conditions and it is in the interest of conserving local variation in genetic material. However, it is noted that problems can arise from limiting revegetation stock to that which is locally sourced. Namely, by encouraging the establishment of populations that do not harbour sufficient evolutionary potential for future environmental change (Moritz, 1999). Or through the selection of inbred or genetically inferior stock (Lowe, 2009), particularly in highly degraded landscapes which are likely to have inherently high levels of inbreeding due to fragmentation and genetic isolation of populations. To simulate gene flow in highly fragmented landscapes, revegetation programs may employ 'composite provenancing' which involves sourcing a mixture of seed stock from varying distances from the nominated revegetation site (Lowe, 2009). This method utilises predominantly local seed but also incorporates proximate and eco-geographically matched sources, with a small proportion (~10-30%) being sourced from much further afield (Lowe, 2009) (refer to Figure 5). Composite provenancing theory is based on providing a variety of genes to an area to allow for the redistribution of preadapted genes and the evolution of new adaptive gene combinations. This creates an environment where natural selection can take place.

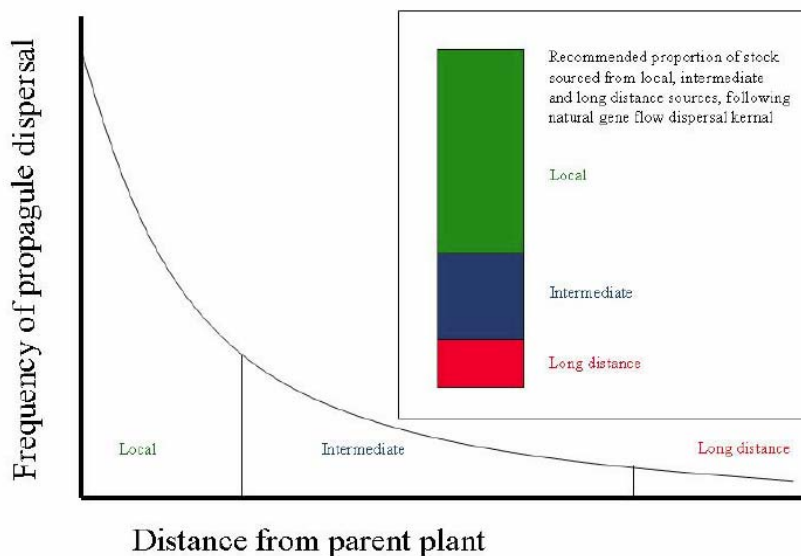


Figure 5: Recommended proportion of seed stock from varying distances from the subject site, based on composite provenancing theory (Source: Lowe, 2009).

The level of genetic diversity in the local seed stock is expected to be highly variable depending on the individual species, the abundance of that species in the locality and the connectivity between patches of similar vegetation types within the locality. Blackbutt forest is well represented and relatively well connected in the locality, so the genetic diversity of Blackbutt is expected to be considerably diverse. However, there is very little Swamp Mahogany dominated communities in the locality and as a result, obtaining local provenance Swamp Mahogany stock with high genetic diversity is likely to be difficult. Accordingly, sourcing the stock for this species will require an element of composite provenancing, where a variety of sources, likely from further afield, will be utilised.

For species that are poorly represented in the locality, the seed stock will be sourced from local, intermediate and long distances from the revegetation site in general accordance with Lowe (2009) recommendations, ie. ~60% sourced from local stock (on or adjoining the site), ~30% from an intermediate source and ~10% from a more removed site. For species well represented in the locality, all seed will be of local provenance.

5.2 Site preparation

5.2.1 Control of grazing

A cow was seen grazing throughout the Northern Riparian Corridor. Further, patches of flattened grasses/herbs we observed characteristic of a resting place of a cow within this area. The presence of cattle has the potential to significantly reduce restoration success through trampling and grazing of planted tubestock and natural regeneration. Access by cattle to the restoration area will need to be controlled, either through destocking or fencing. Temporary fencing, such as electric tape, could be employed around revegetation clusters; however, would require maintenance to remain effective.

There was no evidence of cattle grazing within the Southern Ridgeline Corridor; however, macropod scats were observed. The potential for macropod grazing on planted tubestock and natural regeneration exists. However, fencing is not considered necessary, at least initially. If herbivore grazing becomes a significant problem in this area, tree guards may be required.

5.2.2 Primary weed control

Refer to Section 5.4 for proposed primary weed control works.

5.3 Revegetation

5.3.1 Nominated revegetation areas

The areas to be revegetated include:

- Northern Riparian Corridor: a single row of trees along the entire length of the corridor (approximately 956m) with six additional revegetation clusters of approximately 50 x 20 m, focussed on open areas with minimal to no native canopy cover. This amounts to a total revegetation area of approximately 0.7ha of the total 1.9ha restoration area (the remainder will be treated with assisted regeneration).
- Southern Ridgeline Corridor: focussed on gap in existing ridgeline vegetation centred around the existing residence on Lot 1 on DP34555. A 220m x 20m strip (an estimated 0.44ha will be revegetated) (refer to Figure 4).

5.3.2 Revegetation species selection

The Northern Riparian Corridor is to be revegetated with species characteristic of SSF. The Southern Ridgeline Corridor is to be revegetated with species characteristic of Blackbutt wet sclerophyll forest. A species list for revegetation works is provided in Appendix A, it has been developed with consideration for the list of flora species recorded at site, characteristic species for each community, site conditions and suitable pioneer species. No threatened species are to be included in the plantings.

The species list included in Appendix A provides an indication of species abundance recorded at the site. This, along with the Key Performance Indicators (KPIs) relating to floristic and structural diversity (Appendix B), will be used to guide the planting composition. It is noted that the revegetation species composition will differ from a mature community composition in that there will be a higher proportion of pioneer species during the establishment phase of the community.

In the Northern Riparian Corridor, Swamp Oak (*Casuarina glauca*) saplings are prevalent, particularly near the existing patch of SSF. This species is successfully regenerating itself in this area and in the absence of establishing other SSF species, there is risk that Swamp Oak forest will dominate the area. Accordingly, plantings of Swamp Oak are not proposed; however, their establishment will be promoted through assisted regeneration.

5.3.3 Revegetation planting density and tubestock quantity

Within the Northern Riparian Corridor, the revegetation screen will be planted out with a single row of trees, spaced approximately 1m apart. The revegetation cluster areas will be planted out with tubestock at a density of 1 plant per 1m² with a ratio of 3 trees/shrubs to 1 groundcover.

The Southern Ridgeline Corridor will be planted out with tubestock at a density of 1 plant per 1m² with a ratio 4 trees/shrubs to 1 groundcover.

The tubestock quantities required, based on the above density and ratio, are presented in Table 5.1.

Table 5.1: Tubestock quantities required for revegetation.

	Ground covers	Trees / shrubs	Total
Northern Riparian Corridor			
Revegetation screen (956m @ 1 plant per linear m)	-	956	956
Revegetation clusters (6 clusters of 50 x 20m)	1 500	4 500	6 000
Southern Ridgeline Corridor	880	3 520	4 400
Total	2 380	8 976	11 356

At least a 90% survival rate of planted stock is expected throughout the duration of the program. Any plant losses experienced above this will be replaced through supplementary planting events.

Refer to Section 5.6 for maintenance and monitoring requirements.

5.3.4 Mulching

At the out-planting stage, revegetation areas are to be mulched to a depth of 75 - 100 mm. Mulch is beneficial for weed suppression, water retention and reducing soil erosion. It is recommended that either wood chip or cane mulch is used. Soybean mulch is not recommended as it generally contains viable soy seed which is likely to be introduced to the area. Care is to be taken in sourcing mulch to guard against introducing weed propagules to the area. Where possible mulch from native vegetation cleared on site will be used to maximise potential germination of local seed within the restoration areas. Use of Camphor Laurel mulch is acceptable as long as no foliage is mulched with the timber, as this is likely to contain camphor seed. Mulch is to be kept clear of the tubestock stems to minimise the risk of stem rot.

5.4 Weed control

5.4.1 Weed control target areas

Weed control is to take place throughout the restoration areas, in both the revegetation and assisted regeneration areas.

5.4.2 Primary and follow-up control events

A primary weed control event is required as part of site preparations for revegetation works. This is to remove any existing weeds to allow for out-planting and mulching.

Follow-up weed control works are to be undertaken as required to achieve the Key Performance Indicators (refer to Appendix C). Follow-up weed control would be undertaken as revegetation maintenance works (Section 5.6) and assisted regeneration works (Section 5.5).

5.4.3 Priority weed species

Weed species recorded within the restoration areas are listed in Appendix B, Table B.1.

The priority weed species to be targeted in control works are:

- Weeds of National Significance (WoNS)
- noxious weeds listed under the *Noxious Weeds Act 1993*
- weeds associated with a Key Threatening Process listed under the TSC Act
- environmental weeds which have been identified by NSW *North Coast Weed Advisory Committee* (NCWAC) as one of 187 species considered to have the greatest potential impact on native vegetation.

Refer to Appendix B, Table B.1 for designations of weeds recorded on site. A brief discussion on each of these categories is provided below.

WoNS

The Australian Weeds Committee (2009) has identified 20 WoNS. WoNS are species that have degraded large portions of Australia's natural and productive landscape and require action at a national level to reduce their impacts (AWC, 2009). There is a national strategy for each WoNS specifying actions to better manage the weed (AWC, 2009). One WoNS was recorded on site: Lantana (*Lantana camara*).

Noxious weeds

Within the site, six noxious weeds were recorded:

- Groundsel Bush (*Baccharis halimifolia*) - class 3
- Camphor Laurel (*Cinnamomum camphora*) - Class 4
- Lantana - Class 4.

Class 3 noxious weeds are plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area. The legal requirement for class 3 weeds is: 'the plant must be fully and continuously suppressed and destroyed'. Groundsel Bush is a class 3 weed known to occur on site., within the Northern Riparian Corridor.

Class 4 noxious weeds are plants that pose a threat to primary production, the environment or human health, are widely distributed in the area to which the order applies and are likely to spread in the area or to another area. The control objective for weed control class 4 is to minimise the negative impact of those plants on the economy, community or environment of NSW. The legal requirement for class 4 weeds is: 'the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority'. Class 4 weeds recorded on site include Camphor Laurel and Lantana. Management of the sites class 4 noxious weeds is to be in accordance with the NSW North Coast Weed Advisory Committee (NCWAC) Regional Management Plans for these species.

Weeds associated with a TSC Act Key Threatening Process listed under TSC Act

Key Threatening Processes (KTPs) listed under Schedule 3 of the TSC Act of relevance to the weeds species recorded on the site and the rehabilitation works on site include:

- Invasion and establishment of exotic vines and scramblers (ie. *Ipomoea cairica*).
- Invasion, establishment and spread of *Lantana camara*
- Invasion of native plant communities by exotic perennial grasses (ie. *Paspalum urvillei* and *Setaria sphacelata*).

Environmental weeds

The NSW NCWAC's Environmental Weed Taskforce, in consultation with organisations and individuals involved in weed control, identified 187 weeds as having, or with potential to have, a significant impact on native vegetation on the NSW North Coast (NCWAC, 2000). These weeds were weighted for their current major or minor impact and their potential for major or minor impact on North Coast native vegetation communities (NCWAC, 2000). They are ranked in order of potential impact, with 1 being the species with the greatest potential impact.

Of the NCWAC 187 environmental weed species (with greatest potential impact on native vegetation), nine were recorded on site (refer to Appendix B, Table B.1).

5.4.4 Best practice

Weed removal techniques and herbicide application is to be conducted according to current best practice methods in bushland restoration. Specifically, works are to be undertaken in accordance with the following guidelines:

- The Department of Industry and Investment (I&I) (2009) *Noxious and environmental weed control handbook a guide to weed control in non-crop, aquatic and bushland situations* and
- The Department of Environment and Conservation's *Guidelines for bush regeneration in threatened species habitat and endangered ecological communities*.

Best practice guidelines recommend an integrated approach to weed control spanning several years, with the final combination of control treatments being site-specific. Integrated weed management is the coordinated use of a range of suitable chemical and non-chemical control methods and reduces reliance upon herbicides (I&I, 2009).

Throughout herbicide application, weather conditions are to be assessed and monitored to reduce the risk of drift and subsequent off-target damage (I&I, 2009) as heavy rains following herbicide application can reduce the effectiveness of a treatment and may cause contamination through run-off (I&I, 2009).

5.4.5 Legislative considerations

All herbicide applications are to be undertaken in accordance with the requirements of the *Pesticides Act 1999*. Under this Act all pesticide users must:

- use only pesticides registered by the Australian Pesticides & Veterinary Medicines Authority (APVMA) that are approved for the intended situation of use
- read the registered label on the pesticide container (or have them read to the user) and strictly follow the label directions
- not risk injury to persons, property and non-target plants and animals through the use of the pesticide
- obtain an AVPMA permit if the user wishes to vary the label directions or use pattern
- make a record of pesticide applications
- be trained (WorkCover, 2006).

Under the *National Parks and Wildlife Act 1974*, bush regeneration contractors must hold a current S132C licence to undertake bush regeneration works in the vicinity of threatened species and within EECs in the Tweed LGA.

5.4.6 Pesticide use reporting and notification

The *Pesticides Regulation 2009* requires persons using pesticides, and acting for or on behalf of a public authority, takes a record of each use. For treatments undertaken by hand or by hand-held applicators, the supervisor of the herbicide application works is the person responsible for the record keeping.

It is also a requirement of the *Pesticides Regulation 2009* that any pesticide use in public places includes public notification in accordance with the *Tweed Shire Council Pesticide Use Notification Plan* (TSC, 2007).

Under the TSC Pesticide Use Notification Plan, publicly accessible landfill sites are considered low to moderate use areas. For control of weeds and grasses, both spot and directed applications of a non selective herbicide may be used. For this type of weed treatment, the TSC Pesticide Use Notification Plan requires a permanent sign at the entrance to the site. Stott's Creek Resource Recovery Centre fulfils this requirement; however, the restorations areas occur in areas of the proposed landfill site that won't be publicly accessible. The other pesticide requirements for landfill sites relate to insecticide (flies) and rodenticide applications which are not relevant to restoration works.

5.4.7 Fauna considerations

The habitat requirements of fauna species known, or likely, to occur on site are to be considered when controlling weeds. Herbicides without surfactants are to be used (i.e. Roundup Biactive® or Weedmaster® Duo) to minimise impacts to aquatic fauna.

5.5 Assisted regeneration

Assisted regeneration is to occur within nominated areas of the Northern Riparian Corridor as depicted in Figure 3. These areas are focussed around areas of existing native vegetation where native soil and canopy seed banks exist or are otherwise inter-dispersed between revegetation clusters and adjacent to the revegetation screen. The idea is to expand on areas of existing native vegetation and establish seed sources along the corridor (through revegetation works) which will promote natural regeneration.

The assisted regeneration is to primarily involve targeted weed control. The nominated areas are weed infested which is characteristic of cleared, highly disturbed, areas. The regeneration potential of these areas is considered high in the area surrounding the existing SSF because of the in-situ soil and canopy seed bank. The potential for assisted regeneration success in areas away from existing native vegetation is reduced due to a limited seed source. However, once the revegetation screen and clusters reach reproductive maturity, they are expected to contribute to the seed bank within the regeneration areas and improve regeneration success.

Weed control works within these areas is to employ targeted spot applications around regenerating natives growing amongst the weeds to reduce competition from weeds and promote the establishment of native recruits.

5.6 Maintenance, monitoring and adaptive management

The works are to be maintained and monitored over a five year period. To measure progress of the works programs, KPI's have been developed (Appendix C). The KPIs would be applied to each restoration area separately. The bush regeneration contractor will be required to undertake the level of maintenance and monitoring necessary to achieve the KPIs; however, the minimum requirements are described below.

5.6.1 Maintenance

The proposed maintenance program is outlined in Table 5.2.

Table 5.2: Proposed maintenance program

Task	Frequency and method
Watering	The plants would initially be watered in during out-planting. For the first three months post-planting, watering would be undertaken weekly. For the subsequent three months of the first year, watering would be undertaken monthly. Watering events may be skipped in the event of adequate rainfall.
Weed control	Primary weed control would be undertaken prior to out-planting as part of site preparations. For the duration of the five-year program, weed control would be undertaken once every second month. Regular weed control is considered important due to the significant assisted regeneration component of the program, which relies on targeted weed control.

5.6.2 Monitoring

The proposed monitoring schedule is bi-annual monitoring events for the duration of the five-year program.

5.6.3 Adaptive management

In line with the principles of adaptive management, the frequency of maintenance and monitoring is subject to change with achievement of the project objectives the primary requirement.

The KPIs are provided in Appendix C is in the form of an assessment checklist which is intended to be used and submitted by the bush regeneration contractor as part of the annual self-assessment and reporting requirement. The methodology for measuring the KPIs would be negotiated between TSC and the bush regeneration contractor.

An annual on-site meeting would be held with attendance of TSC Environmental Scientists and the bush regeneration contractor.

5.7 Hygiene and safety requirements

5.7.1 Handling and application of herbicides

Herbicides have potentially harmful effects on human health. By following label instructions and applying herbicides in the correct manner, using best practices and trained staff, adverse effects can be avoided (I&I, 2009).

Bush regenerators handling pesticides are to do so in accordance with the WorkCover NSW *Code of practice for the safe use of pesticides in non-agricultural workplaces* (2006). This code of practice provides guidance on the safe use of pesticides, to protect the health and safety of workers using pesticides and is intended to assist with achieving compliance with the *Occupational Health and Safety Act 2000* and *Occupational Health and Safety Regulation 2001*.

All personnel handling pesticides are to be familiar with the most current Material Safety Data Sheet (MSDS) available for the product.

5.7.2 Managing against the introduction of harmful pathogens

The bush regenerator should take precautions to avoid the introduction of pathogens into the site. In particular, the bush regeneration contractor should ensure no infected nursery stock is planted at the site.

5.8 Reporting

The bush regeneration contractor commissioned for the subject works will be required to provide annual progress reporting at the completion of each year of the five year program. The annual report will be a brief document (1-2 pages) including the following:

- a brief discussion of works completed to date, including an update on revegetation, weed control and assisted regeneration works. Indicative photos may be included were deemed appropriate
- a description of outstanding works planned for the subsequent year, highlighting priority tasks
- a self-assessment against the KPIs (provided in Appendix C)
- any recommendations for adapting works to suit changing conditions, shifting priorities (eg. new listing of noxious weed species, or outbreak of particular weed species at site)
- copies of Daily Work Sheets.

In addition to progress reports, an evaluation report is to be prepared at the end of the five year program. The evaluation report will summarise the monitoring data over the five year period, discuss findings and provide recommendations for future management of the restoration areas.

The reports will be submitted to the TSC Waste Management Coordinator.

6 Schedule of works

The schedule of works, based on the minimum requirements for maintenance and monitoring, is presented in Table 6.1. Additional maintenance and monitoring events may be required to achieve the annual KPIs and the overall project objectives by the end of the program. Adaptive management will be employed to adjust the maintenance and monitoring frequency, and KPI's if required, to best achieve the project objectives.

Table 6.1: Schedule of works based on minimum maintenance and monitoring requirements

Task	Prior to clearing	Year 1												Year 2												Year 3												Year 4												Year 5													
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D		
Seed collection & propagation	█																																																														
Site preparation		█																																																													
Out-planting			█																																																												
Watering			4	4	4																																																										
Weed control		█	█	█	█	█	█		█		█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█													
Monitoring					█					█																																																					
Reporting										█																																																					

Note: A coloured box indicates one event for the month; if more than one event is proposed, the number within the box indicates the total events proposed for the month.

7 Breakdown of tasks and delegation of responsibilities

The breakdown of tasks and delegation of responsibilities is presented in Table 7.1.

Table 7.1: Breakdown of tasks and delegation of responsibilities

Task	Responsible authority
Seed collection	TSC – environmental scientists/bush regeneration contractor
Propagation of seed and raising of seedlings	TSC – nursery staff/private nursery staff
Sourcing of tubestock	Bush regeneration contractor in consultation with TSC environmental scientists
Site preparation – control of grazing	TSC – Waste Coordinator in consultation with adjoining landholders (cattle/horse); bush regeneration contractor in consultation with TSC environmental scientists (tree guards)
Site preparation – primary weed control	Bush regeneration contractor
Revegetation – initial out-planting and supplementary planting as required	Bush regeneration contractor
Weed control – follow-up maintenance	Bush regeneration contractor
Contractor OHS	Bush regeneration contractor
Monitoring – self assessment	Bush regeneration contractor
Monitoring – on site meeting	Bush regeneration contractor and TSC environmental scientist
Annual reporting – submission	Bush regeneration contractor
Annual reporting – review	TSC environmental scientist
Adaptive management	Collaboration between bush regeneration contractor and TSC environmental scientists

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Appendix A: Revegetation species list

Table A.1: Revegetation species list for Northern Riparian Corridor

Family	Botanical name	Common name	Abundance recorded within vegetation community on site
Trees canopy species			
Myrtaceae	<i>Eucalyptus resinifera</i>	Red Mahogany	Not recorded
Myrtaceae	<i>Eucalyptus robusta</i>	Swamp Mahogany	Occasional
Myrtaceae	<i>Eucalyptus tereticornis</i>	Forest Red Gum	Not recorded
Myrtaceae	<i>Lophostemon suaveolens</i>	Swamp Box	Not recorded
Myrtaceae	<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark	Not recorded
Myrtaceae	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	Common
Rhamnaceae	<i>Alphitonia excelsa</i>	Red Ash	Not recorded
Rhamnaceae	<i>Alphitonia petriei</i>	White Ash	Not recorded
Small trees / shrubs			
Araliaceae	<i>Polyscias sambucifolia</i>	Elderberry Ash	Not recorded
Elaeocarpaceae	<i>Elaeocarpus obovatus</i>	Hard Quandong	Not recorded
Elaeocarpaceae	<i>Elaeocarpus reticulatus</i>	Blueberry Ash	Not recorded
Euphorbiaceae	<i>Homalanthus populifolius</i>	Bleeding Heart	Not recorded
Euphorbiaceae	<i>Macaranga tanarius</i>	Macaranga	Uncommon
Euphorbiaceae	<i>Mallotus philippensis</i>	Red Kamala	Not recorded
Fabaceae - Mimosoideae	<i>Acacia melanoxylon</i>	Blackwood	Common
Malvaceae	<i>Hibiscus diversifolius</i>	Swamp Hibiscus	Common
Moraceae	<i>Ficus coronata</i>	Sandpaper Fig	Not recorded
Myrsinaceae	<i>Myrsine variabilis</i>	Muttonwood	Not recorded
Myrtaceae	<i>Acmena smithii</i>	Creek Lilly Pilly	Uncommon (planted)
Myrtaceae	<i>Callistemon salignus</i>	Willow Bottlebrush	Not recorded
Myrtaceae	<i>Melaleuca alternifolia</i>	Tea Tree	Not recorded
Phyllanthaceae	<i>Glochidion ferdinandi</i>	Cheese Tree	Not recorded
Phyllanthaceae	<i>Glochidion sumatranum</i>	Umbrella Cheese Tree	Not recorded
Sapindaceae	<i>Cupaniopsis anacardioides</i>	Tuckeroo	Uncommon (planted)
Sapindaceae	<i>Jagera pseudorhus</i>	Foam Bark Tree	Not recorded
Groundcovers			
Cyperaceae	<i>Gahnia clarkei</i>	Tall Saw-sedge	Not recorded
Cyperaceae	<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge	Not recorded
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	Not recorded
Phormiaceae	<i>Dianella caerulea</i>	Blue Flax Lily	Not recorded

Table A.2: Revegetation species list for Southern Ridgeline Corridor

Family	Botanical name	Common name	Abundance recorded within vegetation community on site
Trees canopy species			
Myrtaceae	<i>Corymbia intermedia</i>	Pink Bloodwood	Occasional
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaf Ironbark	Occasional
Myrtaceae	<i>Eucalyptus pilularis</i>	Blackbutt	Dominant
Myrtaceae	<i>Eucalyptus propinqua</i>	Small-fruited Grey Gum	Occasional
Myrtaceae	<i>Eucalyptus siderophloia</i>	Grey Ironbark	Common
Myrtaceae	<i>Lophostemon confertus</i>	Brush Box	Common
Rhamnaceae	<i>Alphitonia excelsa</i>	Red Ash	Not recorded
Small trees / shrubs			
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black She-oak	Not recorded
Casuarinaceae	<i>Allocasuarina torulosa</i>	Forest Oak	Not recorded
Euphorbiaceae	<i>Homalanthus populifolius</i>	Bleeding Heart	Not recorded
Euphorbiaceae	<i>Macaranga tanarius</i>	Macaranga	Occasional
Euphorbiaceae	<i>Mallotus philippensis</i>	Red Kamala	Common
Lauraceae	<i>Neolitsea dealbata</i>	Hairy-leaved Bolly Gum	Common
Meliaceae	<i>Synoum glandulosum</i>	Scentless Rosewood	Common
Sapindaceae	<i>Jagera pseudorhus</i>	Foam Bark Tree	Not recorded
Sterculiaceae	<i>Commersonia bartramia</i>	Brown Kurrajong	Not recorded
Ulmaceae	<i>Trema tomentosa</i> var. <i>aspera</i>	Poison Peach	Not recorded
Groundcovers			
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	Not recorded
Lomandraceae	<i>Lomandra multiflora</i>	Many-flowered Mat-rush	Common
Phormiaceae	<i>Dianella caerulea</i>	Blue Flax Lily	Not recorded

Appendix B: Weed species recorded at the site

Table B.1: Weed species recorded at the site

Family	Botanical name	Common Name	Status*	Restoration area recorded and abundance#
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Balloon Cotton Bush	Environmental weed	NRC – common; SRC – common
Asteraceae	<i>Ageratum houstonianum</i>	Blue Billygoat Weed	Environmental weed – ranked 56	NRC – uncommon
Asteraceae	<i>Aster subulatus</i>	Wild Aster	Environmental weed	NRC – occasional
Asteraceae	<i>Baccharis halimifolia</i>	Groundsel Bush	Class 3 noxious weed; environmental weed – ranked 26	NRC – uncommon
Asteraceae	<i>Bidens pilosa</i>	Farmers Friends	Environmental weed – ranked 131	NRC – occasional
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	Environmental weed	NRC – uncommon
Convolvulaceae	<i>Ipomoea cairica</i>	Five-leaved Morning Glory	Environmental weed – ranked 23; KTP	NRC – common
Fabaceae - Faboideae	<i>Desmodium uncinatum</i>	Silver-leaved Desmodium	Environmental weed – ranked 83	NRC – common
Fabaceae - Faboideae	<i>Neonotonia wightii</i>	Perennial Soybean	Environmental weed	NRC – common
Haloragaceae	<i>Myriophyllum aquaticum</i>	Parrots Feather	Environmental weed	NRC – common
Lauraceae	<i>Cinnamomum camphora</i>	Camphor Laurel	Class 4 noxious weed	NRC – common; SRC – common
Poaceae	<i>Paspalum mandiocanum</i>	Broad-leaved Paspalum	Environmental weed	NRC – dominant; SRC – common
Poaceae	<i>Paspalum urvillei</i>	Vasey Grass	Environmental weed – ranked 104; KTP	NRC – dominant

Poaceae	<i>Setaria sphacelata</i>	Setaria	Environmental weed – ranked 68; KTP	NRC – dominant; SRC – dominant
Rosaceae	<i>Rubus bellobatus</i>	Kittatinny Blackberry	Environmental weed	NRC - Common
Solanaceae	<i>Solanum capsicoides</i>	Devil's Apple	Environmental weed	NRC – uncommon
Solanaceae	<i>Solanum chrysotrichum</i>	Devil's Fig	Environmental weed	NRC – common; SRC – dominant
Solanaceae	<i>Solanum mauritianum</i>	Tobacco Bush	Environmental weed	NRC – common; SRC – common
Solanaceae	<i>Solanum nigrum</i>	Blackberry Nightshade	Environmental weed	NRC – occasional
Verbenaceae	<i>Lantana camara</i>	Lantana	WoNS; Class 4 noxious weed; environmental weed – ranked 10; KTP	NRC – occasional; SRC – common
Verbenaceae	<i>Verbena bonariensis</i>	Purpletop	Environmental weed – ranked 178	NRC – common

* WoNS are Weeds of National Significance.

Noxious weeds are those listed under the NSW *Noxious Weeds Act 1993*.

Key Threatening Process (KTP) listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act).

Environmental weeds are exotic invasive species, those with a ranking have been identified by NSW North Coast Weed Advisory Committee as one of 187 species considered to have the greatest potential impact on native vegetation.

NRC – Northern Riparian Corridor

SRC – Southern Ridgeline Corridor

Appendix C: Key Performance Indicators Assessment Proforma

Table C.1: Key Performance Indicators Assessment Proforma

KPI	Description	Target	Annual performance achieved
Revegetation			
Tubestock survival	Proportion of planted tubestock survived	90%	
Floristic diversity and species composition	Number of surviving future tree canopy species	>5	
	Number of surviving future small trees/shrubs species	>5	
	Number of surviving future groundcover species	>2	
Structural diversity	Proportion of surviving species which are future tree species (emergent and canopy species)	=/>50%	
	Proportion of surviving species which are future shrub species	=/>30%	
	Proportion of surviving species which are future ground cover species (concentrated along verge of drainage line)	=/>10%	
Weed control			
Representation of WoNS/Noxious weeds	% cover of WoNS/Noxious weeds in tree stratum	<1%	
	% cover of WoNS/Noxious weeds in shrub stratum	<5%	
	% cover of WoNS/Noxious weeds in ground stratum	<5%	
Representation of environmental weeds	% cover of environmental weeds in tree stratum	<1%	
	% cover of environmental weeds in shrub stratum	<5%	
	% cover of environmental weeds in ground stratum	<10%	
Assisted regeneration			
Recruitment of native species	Number of stems of native species within nominated assisted regeneration areas	Greater than previous year	



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