Rainbow Beach, Bonny Hills

Open Space Management Strategy

Job Number 7135-01

Prepared for St Vincents Foundation Pty Ltd

17 June 2010

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Document Control

Version	Date	Author		Reviewer	
1	31 October 2008	M. Campbell	MC	J. Delaney	JD
2	7 April 2010	K. Griffin	KG	M. Campbell	MC
3	17 June 2010	K. Griffin	KAG	M. Campbell	MC

RAINBOW BEACH, BONNY HILLS

Open Space Management Strategy

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1 INTRODUCTION

This Open Space Management Strategy (OSMS) has been prepared by Cardno (QLD) Pty Ltd on behalf of the St Vincents Foundation Pty Ltd ("Land Owner") in relation to an integrated development of land situated at Ocean Drive, Rainbow Beach, Bonny Hills ("the site"). The site encompasses four parcels of land formerly described as Part Lot 123 on DP1106943 and Lot 5 on DP25886, with a total area of approximately 178 ha. The conceptual plan of development proposed for the Rainbow Beach site, as illustrated in Figure 1, makes provision for the integration of the following land uses:

- a residential subdivision consisting of approximately 930 lots;
- a business/retail centre;
- district sporting fields;
- two school sites;
- an Ecotourism site; and
- an Open Space Corridor that encompasses a constructed wetland area.

This OSMS provides the framework within which the Open Space Corridor is to be managed by the Land Owner as part of the Rainbow Beach development. Details are also provided concerning the strategies that have been developed and which are to be implemented by the Land Owner to ensure that the construction and occupation of the adjoining urban development, forming part of the Rainbow Beach development, does not adversely affect the values of the Open Space Corridor.

This OSMS also provides management guidelines for implementation by Port Macquarie-Hastings Council (PMHC) subsequent to PMHC assuming responsibility for the ongoing management of the Open Space Corridor.

This document draws upon material relating to the site's vegetative and broader ecological values and functions that is presented within the:

- *Area 14 KPoM – Figure 2 Vegetation Communities* prepared by Biolink Pty Ltd (20th October 2006);
- *Aquatic Flora and Fauna Survey – Rainbow Beach, Bonny Hills* report prepared by The Ecology Lab Pty Ltd (April 2008); and
- EPBCA – MNES 1999, Seven Part Tests, SEPP 44 – Koala Habitat Assessments of Proposed Constructed Wetland and Filling on Part Lot 92 DP1078055, Ocean Drive, Lake Cathie report prepared by Darkheart Eco-Consultancy (2008).

Site inspections were also completed by Cardno staff on 10-11 December 2007 and 27 October 2009 as part of the process of preparing this OSMS.

2 OPEN SPACE MANAGEMENT STRATEGY

The Open Space Corridor encompasses approximately 80.9ha (or 46% of the site) and includes the following existing and proposed features:

- approximately 7.7 ha dedicated to district sporting fields;
- existing lagoons, waterbodies and wetlands (approx. 6.3 ha);
- a large, proposed constructed wetland (approx. 10.5 ha);
- smaller constructed wetlands (approx. 3.6 ha);
- approximately 47.5 ha of open space;
- a pocket woodland (approx. 2.1 ha); and
- an eastern creek line and former nursery area (approx. 3.2 ha)

The locations and extent of the various elements of the Open Space Corridor are illustrated in Figure 1.

With reference to the above, the management of the proposed district sporting fields will not be included within the context of this OSMS.

2.1 Management Objectives

This OSMS seeks to provide management specifications that will protect and enhance the ecological values and functions of the Open Space Corridor whilst facilitating public access and use of designated recreational areas.

The aims of this OSMS are to:

- enrich the biodiversity of existing vegetation within the Open Space Corridor;
- enhance the existing corridor values of vegetation along Duchess Gully;
- create better movement opportunities in an east-west direction for native wildlife;
- reduce the extent of existing weed infestations within the Open Space Corridor;
- protect and enhance aquatic habitat values within existing and to be constructed waterbodies within the Open Space Corridor;
- provide an appropriate interface between native vegetation and wildlife habitats within the Open Space Corridor and adjacent areas of urban development; and
- provide a balance between public use and controlled public access within the Open Space Corridor.

2.2 Management Issues

The Land Owner is committed to retaining and enhancing the original and natural environment within the Open Space Corridor to promote this area's unique environmental values. As part of this commitment the Land Owner will undertake various actions that are designed to provide a firm foundation for the long-term management of the Open Space Corridor when it is transferred to PMHC.

Key management issues that are to be addressed by the Land Owner within this OSMS are detailed below.

1. Terrestrial Vegetation Management and Rehabilitation, in respect of providing management actions that will:

- ensure the preservation of native flora species and vegetation communities within the Open Space Corridor during both the construction and occupational phases of the Rainbow Beach development;
- rehabilitate and enhance the ecological values and functions of degraded native vegetation communities within the Open Space Corridor;
- provide for a reduction in the prevalence of weed species within the Open Space Corridor;
- provide passive recreational opportunities and facilities for future residents; and
- rehabilitate the Open Space Corridor in a manner that protects human health and property in the event of a bushfire occurring within and/or adjacent to the site.

2. Terrestrial Fauna and Corridor Linkage Management, in respect of providing management actions that will:
   - ensure the preservation of native fauna species and their associated habitats that currently exist within the Open Space Corridor during both the construction and occupational phases of the Rainbow Beach development;
   - enhance vegetated corridors and linkages to improve movement opportunities for native fauna residing within or dispersing through the Open Space Corridor; and
   - minimise the potential for mortality and/or harm to be inflicted on native fauna as a consequence of domestic pets and vehicular traffic associated with the residential development.
3. Aquatic Habitat Management, in respect of providing management strategies that will:
   - ensure the preservation of the ecological values of the existing lagoon;
   - ensure the proposed constructed wetland provides habitat that is favourable to native aquatic flora and fauna species; and
   - minimise the risk of aquatic weeds establishing in existing lagoon and proposed constructed wetland.
4. Weed Management, in respect of providing:
   - appropriate control mechanisms for the treatment of existing and any future weed infestations; and
   - monitoring programs to minimise the risk of weed infestations becoming established in the future.
5. Access and Public Safety Management, in respect of providing:
   - appropriate mechanisms to restrict unauthorised and inappropriate forms of access into the Open Space Corridor by contractors involved in the construction phase of the Rainbow Beach development;
   - appropriate infrastructure to facilitate controlled public access to and within the Open Space Corridor for passive recreational pursuits compatible with the area's environmental values; and
   - appropriate infrastructure to facilitate PMHC access to and within the Open Space Corridor for environmental management purposes.

The following sections provide details of the aforementioned management issues and summaries of the specific actions that are to be taken by the Land Owner, and other stakeholders, to address the various management issues that have been identified.

3 TERRESTRIAL VEGETATION MANAGEMENT AND REHABILITATION

The majority of the site supports pasture and pastoral woodland that has been subject to broad-scale vegetation clearance and is currently used for livestock grazing. As such, the most of the vegetation within the site is in a disturbed and degraded state and supports a variety of weed species common to agricultural landscapes. A number of wooded vegetation remnants have also been identified within the site (refer Biolink 2006; Darkheart 2008) including a variety of eucalypt woodlands and forests, Swamp oak swamp forest, disturbed/regrowth swamp forest and dry shrubland. The majority of these vegetation communities will be retained and protected within the Open Space Corridor. Whilst no threatened flora species have been identified within the site, two vegetation communities are considered to constitute Endangered Ecological Communities (EEC) recognised by the Threatened Species Conservation Act 1995 (refer Biolink 2006;Darkheart 2008). More specifically Biolink (2006) have identified:

- remnants of Paperbark, Swamp Mahogany and Swamp oak forest as 'Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast Bioregion' EEC; and
- areas of Swamp oak forest as 'Swamp Oak Floodplain Forest on Coastal Floodplains of the NSW North Coast Bioregion' EEC.

With regard to the above, the Swamp Sclerophyll Forest EEC and the majority of the disturbed Swamp Oak Floodplain Forest EEC will be retained and protected within the Open Space Corridor. The extensive rehabilitation and revegetation works that will be undertaken within the Open Space Corridor will offset the minor loss of degraded vegetation and fauna habitat elsewhere on the site.

3.1 Vegetation Management

Whilst the principal function of the Open Space Corridor is to preserve and enhance the site's existing environmental values, it will also be necessary to establish some essential infrastructure within this area. More specifically, the establishment of essential infrastructure will necessitate:

- the clearance of some Swamp oak forest and pasture land in the western portion of the Open Space Corridor for the purposes of establishing the proposed district sporting fields;
- some disturbance of pasture land within the central and north-eastern portion of the Open Space Corridor for the establishment of the proposed constructed wetlands and stormwater bioretention swales; and
- some disturbance to pasture land and disturbed Swamp oak forest for the purposes of establishing a network of pathways throughout the Open Space Corridor.

All vegetation clearance and construction works within the Open Space Corridor will be conducted in accordance with current best practice methodologies to minimise any potential impacts on the surrounding environment.

3.2 Asset Protection

A 'Bushfire Protection Assessment' (BPA) has been prepared for the site by Australian Bushfire Protection Planners Pty Ltd and identifies the need for the Open Space Corridor to provide appropriate buffers between residential development and adjacent areas of retained or regenerated bushland within the Open Space Corridor. The salient points of the BPA in how it related to vegetation management within the Open Space Corridor are:

- the required 15 m wide Asset Protection Zone (APZ) between new residential development and revegetated areas within the Open Space Corridor is provided by the perimeter road and building setbacks, i.e. no new APZ within the proposed Open Space Corridor;
- a requirement for a minimum 30 m wide Asset Protection Zone between the Open Space Corridor and the existing "Seawind Chase" residential development to the south;
- an urban edge or management (managed parkland) regime needs to be maintained on existing public lands adjoining the existing Rainbow Beach subdivision;
- any swale system that extends into the residential area will need to be managed in a manner that does not create a connection to bushfire prone vegetation in the Open Space Corridor. Swales required by future urban development will be detailed in future applications; and
- as per PMHC's request and in general, any new urban development will provide for APZ requirements within the urban area and will not rely upon APZ space within the Open Space Corridor.

3.3 Ecosystem Rehabilitation

The Open Space Corridor encompasses a mosaic of intact native vegetation, degraded habitats and cleared land. The intent for the majority of the Open Space Corridor is to protect existing native vegetation and enrich the ecological values and functions of the Open Space Corridor through extensive rehabilitation works. This objective will be achieved through:

- protection of existing intact native vegetation communities;
- encouraging regrowth and regeneration of native vegetation;
- removal of weed species; and
- active revegetation with appropriate native plant species where required.

However, as discussed in Section 3.2, there is a need for parts of the Open Space Corridor that adjoin existing residential interfaces to be managed in manner that contribute to asset protection from a bushfire perspective.

In this regard, an Environmental Land Use Management Plan (ELUMP) (refer Plan Nos 713501-ELUMP-01 and 713501-ELUMP-02) has been prepared for the Open Space Corridor. With reference to the ELUMP, vegetation within the Open Space Corridor has been classified into one of several Environmental Land Use Categories (ELUCs). The location and extent of these ELUCs is illustrated in Plan No. 713501-ELUMP-01, and the characteristics and intent of each ELUC described below.

1. Biodiversity Protection ELUCs, which encompass areas that:
   a) support native vegetation types that are relatively intact in terms of their structural and floristic elements;
   b) contribute to fauna movement corridors; and
   c) support habitat that is suitable to threatened native fauna species.

Within Biodiversity Protection ELUCs the primary objective is to protect the vegetation's existing biodiversity values by removing degrading processes (i.e. livestock grazing and weed invasion) and preventing any physical works from occurring within the subject areas. It should be noted that the Land Owner has instigated the removal of livestock from the Open Space Corridor such that cattle can no longer have a direct adverse impact on the vegetation communities within the Open Space Corridor. Some weed management (i.e. removal of Lantana [*Lantana camara*]) has already been conducted by qualified personnel of Wild Things Native Gardens Pty Ltd within some areas identified as Biodiversity Protection ELUCs.

2. Biodiversity Enrichment ELUCs, which encompass areas of the Open Space Corridor that:
   a) support degraded native vegetation;
   b) have the potential to contribute to wildlife corridors and linkages throughout the Open Space Corridor and wider locality; and
   c) adjoin areas of vegetation identified as providing habitat to significant wildlife species.

   Within the Biodiversity Enrichment ELUCs the primary objective is to enhance the biodiversity values of the vegetation via the implementation of appropriate weed control, encouragement of natural regrowth and regeneration, and supplementary planting works where required.
3. Urban Edge ELUCs, which encompass areas within the Open Space Corridor that:
   a) currently support cleared grasslands with scattered trees;
   b) have the potential to provide useable public open space without extensive clearance of native vegetation;
   c) directly adjoin existing residential development interfaces and therefore have the potential to:
      i. contribute to prescribed Asset Protection Zones; and
      ii. act as buffers between potentially conflicting land uses (i.e. residential areas and Biodiversity Protection and Biodiversity Enrichment ELUCs).

3.4 Rehabilitation Objectives and Methodologies

3.4.1 Biodiversity Protection ELUCs

Rehabilitation of native vegetation communities within Biodiversity Protection ELUCs will be achieved in the first instance through encouraging natural regrowth and regeneration of native species.

Encouraging the natural regeneration of pre-existing vegetation is the most beneficial form of site restoration as:

- a source of seeds and propagules exists within the seed bank;
- species of local provenance are better adapted to the environmental conditions in the area;
- re-establishment of the community will follow natural patterns of re-colonisation and succession; and
- soil fauna, fungal and microbial populations that are essential to a healthy plant growing environment are already present.

Removal of degrading processes is the first step in encouraging natural regrowth within native vegetation communities. In this regard, the Land Owner and Wild Things Native Gardens Pty Ltd have:

- removed cattle from Open Space Corridor and established appropriate fencing;
- implemented weed management and control programs within some areas of the Open Space Corridor; and
- identified areas where natural regrowth of vegetation is occurring with minimal intervention.

A supplementary planting program may be necessary in order to embellish areas where natural regeneration and regrowth isn't occurring readily. Key indicators to trigger the commencement of supplementary planting include:

- expanses of exposed ground resulting from weed removal treatments;
- stochastic disturbance events (i.e. windthrow, flood) that have induced high levels of plant mortality; and
- gaps created by limitations in natural recruitment (i.e. absence of germination cues such as fire).

The species planted and densities required will be dependent on the composition and structural elements of the existing vegetation. A recommended species list for each of the Biodiversity Protection ELUCs is provided within Appendix A.

3.4.2 Biodiversity Enrichment ELUCs

Biodiversity Enrichment ELUCs encompass vegetation that is currently in a degraded state and as such, it is more likely that a supplementary planting program will need to be undertaken in order to achieve the rehabilitation objectives for these communities. However, some of these communities are displaying a degree of resilience and are currently in the process of successfully regeneration. In this regard, a supplementary planting program will only be undertaken within areas where benchmark vegetation structure and composition are not achieved. Vegetation Benchmarks for Biodiversity Enrichment ELUCs are discussed in Section 3.4.2.1 below.

3.4.2.1 Vegetation Benchmarks

In order to determine whether a supplementary planting program needs to be instigated within a Biodiversity Enrichment ELUC, Vegetation Benchmarks have been developed in accordance with the methodologies and information provided within Gibbons *et al* 2005[1]. These vegetation benchmarks are provided in Table 1 below and should be used in conjunction with the monitoring program described in Section 3.7.2.1 to determine when a supplementary planting program should be implemented.

Table 1: Vegetation Benchmarks for Biodiversity Enrichment ELUCs

ELUC	Description	Minimum Native Plant Cover %		
		Overstorey	Midstorey	Groundstorey
BE 8	Cleared Pasture/Pastoral Woodland adjoining Swamp oak	10	5	5
BE 9	Cleared Pasture/Pastoral Woodland adjoining Dry Blackbutt Open Forest	10	10	10
BE 10	Cleared Pasture/Pastoral Woodland Disturbed/Regrowth Paperbark – Swamp Mahogany – Swamp She Oak	10	10	10

[1] Gibbons, P., Ayers, D., Seddon, J., Doyle, S. and Briggs, S (2005) ***Biometric*** Version 1.8 - *A Terrestrial Biodiversity Assessment Tool for the NSW Property Vegetation Plan Developer – Operational Manual*. NSW Department of Environment and Climate Change.

When vegetation within a Biodiversity Enrichment ELUC is identified as failing to achieve one or more of these Vegetation Benchmarks, a supplementary planting shall be implemented in accordance with the specifications provided herein and within Plan No. 713501-ELUMP-02.

3.4.3 Urban Edge ELUCs

The purpose of the Urban Edge ELUC is to provide an appropriate interface between residential development and the Open Space Corridor. These areas will be green firebreaks supporting mostly low-growing shrubs with areas of maintained grassland with passive recreation opportunities for future residents. In this regard, Urban Edge ELUCs will:

- be subject to weed removal and management;
- be revegetated with low-growing shrubs with low flammability;
- be grassed with species which are generally non-invasive and easy to manage;
- support plantings of appropriate shade trees; and
- include signage indicating that dogs are to be kept on leads at all times.

Any trees and shrubs planted in Urban Edge ELUCs must be endemic to the local area and be planted in a manner that maintains views of the proposed constructed wetland whilst providing fauna movement opportunities (refer Section 4.1 - Fauna Management). Recommended tree species for use within Urban Edge ELUCs are provided in Plan No. 713501-ELUMP-02.

3.5 Supplementary Plantings

3.5.1 Sourcing of Plant Stock

As far as practicable, native plant species to be used in the planting program should be derived from seeds or propagules collected from individuals growing within intact communities on the site or within the locality. In this regard, it is noted that the Land Owner and Wild Things Native Gardens Pty Ltd have established an on-site nursery and have commenced propagating plant species from populations growing within the site. Where species are not able to be sourced from on-site populations, seedlings should be sourced from local native plant nurseries as far as practicable.

3.5.2 Mulching

The application of mulch assists in the control of weeds, encourages growth of planted natives and improves the retention of water by providing a layer of organic matter on the soil substrate.

Mulch can be sourced from areas to be cleared on the site by stockpiling the existing litter layer and topsoil. Stockpiling and reuse of topsoil provides an additional source of seeds and propagules to the supplementary plantings from the pre-existing seed bank. It also contributes to the re-establishment of soil fauna, fungal and microbial populations that are essential for a healthy plant growing environment.

Alternatively, mulch can be sourced from chipping or mulching of vegetative material on the site. In either case, topsoil or vegetative material for mulching should be collected only from areas that have a low weed density.

Mulch should be applied evenly and to a depth of approximately 100mm as excessively thick mulch may have an adverse impact by suppressing the recruitment of native seedlings.

Mulching is not to occur around the base of existing established tress, unless the soil surface is exposed. In such instances mulch is to be applied to a depth of 25mm beneath the canopy of trees. Mulch should not be placed directly against the trunk.

3.5.3 Fertilisers

At the time of planting, fertiliser will be applied to each plant in the form of an Agriform® tablet. During the first year of planting, fertiliser such as Dynamic Lifter® will be applied to the plants as required to maintain the health and growth rate of planted species. To avoid potential leaching of fertilisers, slow release nitrogenous (and low phosphate content) fertilisers will be used.

3.5.4 Watering

Watering of the supplementary planting works will be undertaken to ensure that an adequate survival and establishment rate is achieved. To assist in this process, water crystals will be used at the time of planting to ensure that the plantings have sufficient water to survive during the early establishment period.

The frequency of watering to achieve plant establishment will depend on the prevailing climatic conditions at the time of planting and thereafter. Watering will generally be carried out in the cooler hours of the day, namely morning or evening, and will be frequent enough to prevent wilting of plants.

The following watering program is recommended:

Week 1 – 2 3 visits/week **Week 3 – 6** 2 visits/week **Week 7 – 12** 1 visit/ week

The necessity for watering during the above program will be dependent upon rainfall. The frequency of watering will be gradually reduced as the plantings mature and it is anticipated that after a period of 4 – 6 months the planting will be sufficiently established such that supplementary watering will no longer be required.

3.5.5 Pest Control

Predation by native macropods and introduced herbivores (rabbits and hares) can have an adverse affect on the establishment of plantings by defoliating, damaging or removing young plants. To minimise the loss of plants through predation, new plantings will be protected using either:

- plastic tree guards, which would be reused on new plantings once the initial planted specimens mature; or
- temporary exclusion fencing of larger areas or where initial trials indicate that the efficacy of using individual tree guards is low.

3.6 Performance Indicators

3.6.1 Overall Performance Indicators

Establishment of the Open Space Corridor must achieve the following Performance Indicators:

- all practicable measures are taken to design and locate essential infrastructure in a manner that avoids or minimises disturbance to native vegetation within the Open Space Corridor;

- all Biodiversity Protection ELUCs are to be clearly demarcated on construction plans and in the field and will be classified as “no-go zones” during construction of any essential infrastructure within the Open Space Corridor;
- no clearance of vegetation is to occur outside of nominated disturbance zones, any vegetation cleared outside of these zones is to be rehabilitated in general accordance with the specifications provided herein and in Plan No 713501-ELUMP-01 and 02;
- any disturbance to native vegetation is carried out in accordance with the terms and conditions of relevant development consents and permits which would specifically authorise any such disturbance;
- construction works within the Open Space Corridor are undertaken in accordance with the provisions of a PMHC-approved Erosion and Sediment Control Plan; and
- Urban Edge ELUCs are to be revegetated and maintained in a manner that achieves a balance between recreation and asset protection requirements.

3.6.2 Performance Indicators for Biodiversity Protection ELUCs

Rehabilitation of native vegetation communities within Biodiversity Protection ELUCs will be achieved in the first instance through encouraging natural regrowth and regeneration of native species. Supplementary planting programs may be necessary in order to embellish areas where natural regeneration and regrowth isn’t occurring readily. Management of Biodiversity Protection ELUCs will be measured against the following Performance Indicators:

- natural regrowth and regeneration of native endemic vegetation is occurring to a satisfactory level;
- implemented weed management and control programs are resulting in an identifiable reduction in the prevalence of weed species;
- expanses of exposed ground resulting from weed removal treatments or limitations in natural recruitment have been appropriately revegetated generally in accordance with the specifications provide herein and on Plan No. 713501-ELUMP-02.

3.6.3 Performance Indicators for Biodiversity Enrichment ELUCs

Biodiversity Enrichment ELUCs will undergo supplementary planting programs where the Vegetation Benchmarks specified within Section 3.4.2.1 are not being achieved through natural regeneration and regrowth. As such, management of Biodiversity Enrichment ELUCs will be measured against the following Performance Indicators:

- natural regrowth and regeneration of native vegetation is occurring to a satisfactory level;
- supplementary planting programs have been implemented in areas where Vegetation Benchmarks are not being achieved;
- supplementary planting programs have been implemented generally in accordance with the specifications provide herein and on Plan No. 713501-ELUMP-02;
- planting densities and mixtures established in each community are appropriate for the production of vegetation structure which will achieve the applicable Vegetation Benchmark for that ELUC;
- implemented weed management and control programs are resulting in an identifiable reduction in the prevalence of weed species.

3.6.4 Performance Indicators for Supplementary Plantings

The implementation and maintenance of a supplementary planting program generally in accordance with the specifications provided herein and within Plan No. 713501-ELUMP-02, must achieve the following Performance Indicators:

- no inappropriate plant species (i.e. non-endemic, exotic or weed species) are to be used in the revegetation program;
- planting densities and mixtures established in each community are appropriate for the production of vegetation structure which will achieve the applicable Vegetation Benchmark for that ELUC;
- an 80% survival rate of plant stock is to be maintained within each ELUC for at least three (3) years from the date of planting;
- a minimum 90% native ground cover is to be maintained for the maintenance period; and
- revegetation plots are to be maintained for the for at least three (3) years from the date of planting such that:
    i. native species comprise at least 90% of the species composition within each plot; and
    ii. native species comprise at least 90% of the biomass and/or cover within each plot.

3.7 Monitoring and Maintenance

3.7.1 Monitoring of Biodiversity Protection ELUCs

Monitoring of Biodiversity Protection ELUCs is to be carried out on an annual basis within three (3) permanent 20m x 20m plots within each ELUC. An additional three (3) random monitoring sites (i.e. three 20m x 20m plots) will be established and assessed at each monitoring period.

During each census, key indicators that trigger the need for supplementary plantings will be identified (refer section 3.4.1 herein) and a supplementary planting program will be implemented and managed in accordance with the specifications provided herein and within Plan No. 713501-ELUMP-02.

Each of the three permanent 20m x 20m plots will also be used as photo monitoring sites where photos will be taken on each compass quarter at each monitoring period.

3.7.2 Monitoring of Biodiversity Enrichment ELUCs

Monitoring of Biodiversity Enrichment ELUCs is to be carried on an annual basis as specified in the Vegetation Monitoring Program detailed below. This monitoring program has been developed in accordance with the methodologies presented within Gibbons *et al* 2005 and provides the basis for assessing the success of natural regeneration in achieving the Vegetation Benchmarks specified in Section 3.4.2.1. Where Vegetation Benchmarks are not being achieved, supplementary planting programs shall be implemented in general accordance with the specifications provide herein and within Plan No 713501-ELUMP-02.

3.7.2.1 Vegetation Monitoring Program

Native overstorey cover

Native over-storey cover is the woody tallest stratum (including emergents) above 1m and includes all native species. Native overstorey cover will be estimated by:

1. At 10 points along a 50m transect (i.e. every 5m) visually estimating percentage foliage cover of native species directly overhead.
2. Dividing the total by the number of points (i.e. ten [10]) measured along each transect.

In areas where regrowth has not achieved a height where projective foliage cover can be measured, the cover of native overstorey species shall estimated using the methodology for estimating 'Regeneration' described below.

Native midstorey cover

The mid-storey contains all vegetation between the overstorey stratum and 1m in height and includes all native species. Native mid-storey cover will be estimated by:

1. At 10 points along a 50m transect (i.e. every 5m) visually estimating percentage foliage cover of native species in the mid-storey.
2. Dividing the total by the number of points (i.e. ten [10]) measured along each transect.

Native groundstorey

The ground stratum contains all native vegetation below 1m in height and includes all native species. Native ground cover will be estimated by:

1. Visually estimating the percentage foliage cover in a 20m x 20m plot.
2. The precision of the estimate can be improved if the assessment is conducted separately within each of the four 10m x 10m quarters that make up the 20m x 20m plot.

Regeneration

Regeneration is measured as the proportion of over-storey species present at the site that is regenerating (i.e. with dbh ≤ 5cm). The magnitude of natural regeneration occurring within retained vegetation will be estimated by:

1. Recording all individual over-storey species within a 20m plot.
2. Calculating the proportion of these individuals that have a dbh ≤ 5cm.

This methodology for assessing regeneration shall be used to estimate native overstorey cover in circumstances where regrowth has not achieved a height that enables assessment of projective foliage cover.

The monitoring program will include the establishment of three (3) permanent sites (i.e. three (3) 50m transects and three (3) 20m x 20m plots) within each Biodiversity Enrichment ELUC that will be subject to assessment each census period. An additional three (3) random monitoring sites (i.e. three (3) 50m transects and three (3) 20m x 20m plots) will be established within each Biodiversity Enrichment ELUC and assessed at each monitoring period.

Each of the three (3) permanent 20m x 20m plots will also be used as photo monitoring sites where photos will be taken on each compass quarter at each monitoring period.

If there is not sufficient area within a Biodiversity Enrichment ELUC to accommodate all of the above specified monitoring sites, a suitable number of sites will be established within the area available.

3.7.3 Monitoring of Supplementary Plantings

The most intensive period of maintenance is during the plant establishment period (i.e. the first three [3] years of plant growth) when weed removal and supplementary planting may be required. In this regard, supplementary plantings shall be inspected every two (2) months for the first six (6) months following planting and once every six (6) months thereafter for a duration of at least two and a half (2.5) years. Routine monitoring and maintenance activities during this time should include, but not be restricted to the following:

- identification and removal of any areas of obvious increased sedimentation, litter build-up and blockages;
- repair of damage to supplementary plantings resulting from scour, erosion or sediment build-up;
- regular watering of plantings during the establishment phase;
- removal and management of weed species; and
- replacement of plantings that have died with plants of equivalent size and species.

3.8 Summary of Management Issues and Actions

A summary of the identified terrestrial vegetation management and rehabilitation issues and the various actions that are to be taken as part of the Rainbow Beach development is provided in Table 2. For each of the specific management actions a schedule for implementation is provided and the responsible entity for taking the action is identified.

Table 2: Summary of Terrestrial Vegetation Management and Rehabilitation Issues and Actions

Issue	Action	Schedule	Responsible Entity
The establishment of essential infrastructure within the Open Space Corridor may require disturbance to existing native vegetation.	All practicable measures will be taken to design and locate essential infrastructure such that disturbance to native vegetation within the Open Space Corridor is avoided or, where this is not possible, minimised. All areas to be disturbed within the Open Space Corridor shall be identified on construction plans and in the field. In this regard, it is relevant to note that disturbance associated with the construction and establishment of pathways and stormwater treatment devices will: • primarily involve the removal of disturbed and degraded vegetation; and • carried out in manner that minimises damage to any adjoining areas of intact, native vegetation.	Prior to the commencement of any construction works within the Open Space Corridor.	Land Owner
	Any disturbance to native vegetation will be carried out in accordance with the terms and conditions of relevant development consents and permits which would specifically authorise any such disturbance.	At all times.	Land Owner
The potential exists for contractors to unintentionally clear vegetation outside of the nominated clearance zones.	The limits of the areas within the Open Space Corridor nominated for clearance or disturbance must be fenced or clearly marked with tape. Outside of these areas (i.e. in the balance of the Open Space Corridor) the following activities shall not be permitted: • storage and mixing of materials; • vehicle parking; • liquid disposal; • machinery repairs and/or refuelling; • construction site office or shed; • combustion of any material; • stockpiling of soil, rubble or debris; • any filling or excavation including trenchline, topsoil skimming and/or surface excavation, unless otherwise approved by the relevant authority; and • unauthorised pesticide, herbicide or chemical applications.	Prior to commencement of construction. For the duration of construction works.	Land Owner

Issue	Action	Schedule	Responsible Entity
Cleared vegetation must be disposed of in an appropriate and responsible manner.	Vegetation cleared from the site shall be disposed of in accordance with either of the two following methods or else as stipulated by PMHC. a. Off-Site Disposal • Clearing and loading of material for off-site disposal shall only be carried out during the hours of 8am-6pm Monday to Saturday. • Where possible, sawn logs should be disposed of as timber for value added use at sawmills, pulping plants and other recyclable products plants. • Cleared vegetation shall not be disposed of in PMHC controlled rubbish tips or transfer stations. Should a woodchipping plant be available at a PMHC tip or transfer station, the contractor may by prior arrangement deliver vegetation for woodchipping at the tip or transfer station. b. Disposal by Woodchipping • On-site woodchipping shall only be carried out during the hours of 8am-6pm Monday to Saturday. • The woodchipper shall be located such that nuisance or annoyance to occupants of dwellings in the vicinity of the site is generally avoided. • Wherever possible, the woodchip should be spread over the areas of the site from which vegetation has been removed to stabilise the topsoil and prevent erosion. • If there is excess woodchip, the contractor shall liaise with PMHC in regard to the disposal of the woodchip and whether it is suitable for the stockpile to become available to the public or PMHC. Large logs are to be salvaged from within the clearance zone and used as habitat features within appropriate areas of the Open Space Corridor.	Throughout construction works within the Open Space Corridor.	Land Owner
Disturbed areas are susceptible to topsoil erosion and sedimentation.	Construction works within the Open Space Corridor are to be undertaken in accordance with the provisions of a PMHC-approved Erosion and Sediment Control Plan. Exposed surfaces caused through the removal of vegetation are to be rehabilitated as per the specifications provided herein and within Plan No. 713501-ELUMP-01& 02, or else stabilised through the appropriate distribution of woodchips across these surfaces or via the application of native grass seeding. The Land Owner is to ensure that all erosion and sedimentation controls are implemented and maintained for the duration of development activities.	Throughout construction works within the Open Space Corridor.	Land Owner

Issue	Action	Schedule	Responsible Entity
The potential exists for contractors to ignore the fenced clearance areas.	No clearance of vegetation is to occur outside of nominated disturbance zones. Any contractors that disturb vegetation outside of these zones will be required to rehabilitate the damaged area and, at the discretion of the Land Owner may be banned from the site.	At all times during the construction phase.	Land Owner
Disturbed areas within the Open Space Corridor are to be appropriately rehabilitated with native plant species.	The rehabilitation of the Open Space Corridor is to be undertaken in general accordance with the specifications provided within Section 3 of the OSMS and Plan No. 713501-ELUMP-01 & 02. The Land Owner is to engage the services of an appropriately qualified, experienced and licensed landscape contractor and/or bush regenerator. Interim status reports documenting the status of implementation of the Environmental Land Use Management Plan is to be provided to PMHC at annual intervals from the date of commencement of this OSMS.	Throughout the construction phase.	Land Owner Contractor
Areas where natural regrowth is not occurring are to be identified and supplementary planting programs must be implemented	Biodiversity Protection and Biodiversity Enrichment ELUCs shall be monitored in general accordance with the specifications provided within Sections 3.6 and 3.7 of this OSMS. Where required supplementary plantings are required, they will be undertaken in general accordance with the specifications provided within Section 3 of the OSMS and Plan No. 713501-ELUMP-01 & 02.		
Supplementary plantings are to maintain an 80% survival rate for at least three years from the date of planting	Supplementary plantings are to be monitored and maintained in general accordance with the specifications provided within Section 3.6 & 3.7 of this OSMS. Where a survival rate of 80% is not achieved, threatening processes shall be identified and removed where practicable. Supplementary plantings shall be undertaken to compensate for plant mortality.	Throughout the establishment period	Contractor
Rehabilitation areas are to be managed for weed infestations	Rehabilitation areas are to be monitored for weed invasion and colonisation. Where monitoring of revegetation plots reveals an unacceptable level of weed incursion (i.e. more than 10% of the species composition or 10% of the biomass is non-native species) weed species are to removed and managed in general accordance with the specifications provided with Section 6 within this OSMS.	Throughout the establishment period	Contractor

4 TERRESTRIAL FAUNA AND HABITAT LINKAGE MANAGEMENT

The availability of habitat resources for native terrestrial fauna on the site has been reduced by a prolonged history of disturbance associated with vegetation clearance and livestock grazing. The relatively open nature and low floristic diversity of vegetation communities such as the pasture and pastoral woodland communities that constitute the majority of vegetation on the site is likely to restrict:

- cryptic and/or secretive species;
- species that are specialist foragers; and
- species that require a range of forage resources.

As such, these areas are more likely to be utilised by more cosmopolitan and highly mobile fauna such as macropods, birds and bats, that are more adapted to highly modified rural and urban environments.

By contrast, the intact, native vegetation communities encompassed by the Open Space Corridor provide a greater range of habitat resources for native terrestrial fauna and some communities are known to support threatened fauna species such as the Koala (*Phascolarctos cinereus*), Wallum froglet (*Crinia tinnula*), Eastern chestnut mouse (*Pseudomys gracilicaudatus*) and Common planigale (*Planigale maculata*) (refer Darkheart 2008).

4.1 Fauna Management

The Land Owner recognises that appropriate actions need to be taken as part of the urban development to ensure that impacts to native terrestrial fauna are minimised during both the construction and occupational phases of development.

There is solid commitment to retain existing fauna habitat values within the Open Space Corridor, as well as enrichment of its values through:

- the removal of degrading forces such as livestock grazing and slashing;
- extensive revegetation works;
- weed control;
- habitat enhancement (i.e. nest boxes, use of felled tree for logs and snags); and
- implementation of appropriate control measures to reduce the impact of domestic animals associated with residential development on native fauna inhabiting the Open Space Corridor.

With regard to the above, the Land Owner has already initiated the following actions within the Open Space Corridor:

- removal of livestock from the Open Space Corridor;
- control of Lantana (*Lantana camara*) infestations;
- trials of weed control methods; and
- establishment of an on-site nursery to source plants of local origin for extensive revegetation works.

4.2 Habitat Linkage Management

The Open Space Corridor has the potential to contribute to fauna movement corridors in both a north-south and an east-west direction, as shown on Plan 713501-ELUMP-01. At present the quality and integrity of the east-west corridor is compromised by the impacts of historic vegetation clearance and livestock grazing practices. The north-south corridor is narrow and fragmented in its northern extent.

Rehabilitation of Open Space Corridor, in general accordance with specifications provided in Section 3 herein and in Plan No. 713501-ELUMP-01 & 02, will enhance the integrity and capacity of fauna movement corridors in both a north-south and an east-west direction through:

- increasing vegetative cover and complexity;
- the provision of specific habitat resources for different fauna groups (i.e. logs on the ground, nest boxes in trees) and for individual threatened fauna species (i.e. Koala food trees); and
- reducing cleared areas that act as barriers to the movement of some native wildlife species.

It should also be noted that in areas where there may be a need to accommodate recreational structures or the retention of view lines of the lake system, corridor values can be maintained through the following measures:

- planting aggregates of trees spaced no more than 20m apart;
- providing sufficient cover for ground-dwelling and arboreal species between tree aggregates;
- using a mixture of species to provide tree aggregates with multi-species values (i.e. food resources such pollen, nectar, foliage, arthropods); and
- providing nest boxes or artificial hollows within tree aggregates for native animals to use as refuges if necessary.

4.3 Summary of Management Issues and Actions

A summary of the terrestrial fauna and habitat linkage management issues associated with the design, construction and occupational phases of development, and the associated actions that have been or that are to be taken to minimise potential adverse impacts on native fauna within the Open Space Corridor, is provided in Table 3.

Table 3: Summary of Terrestrial Fauna and Habitat Linkage Management Issues and Actions

Issue	Action	Schedule	Responsible Entity
Clearance of vegetation within the Open Space Corridor for the purpose of establishing essential infrastructure may have an adverse impact upon fauna habitat values.	The extent of vegetation clearance associated with the establishment of essential infrastructure is to be minimised and clearly defined.	At all times.	Land Owner
The potential exists for terrestrial fauna to be injured during the clearance of vegetation undertaken for the purpose of establishing essential infrastructure within the Open Space Corridor. In this regard, clearance works should be designed and carried out to avoid injury or harm to native fauna	Determination of the alignment and location of essential infrastructure within the Open Space Corridor is to minimise the loss of significant habitat trees. Habitat trees are defined as trees that provide suitable foraging, refuge and nesting resources for arboreal and avian fauna. These include hollow-bearing trees, trees with fissures, trees with food resources (e.g. pollen, nectar, foliage, arthropods). Larger, old growth trees are also considered to be habitat trees as they are likely provide greater amounts of foraging resources, cover, and a high number of potential hollows. Dead (stag) trees are also regarded as important habitat trees as they provide roosting and nesting resources. Where the loss of habitat trees to accommodate essential infrastructure is unavoidable, the habitat trees proposed for removal are to be identified and marked with highly visible flagging tape Prior to the commencement of vegetation clearance, any habitat trees within the development area are to be identified and marked with highly visible flagging tape. Following habitat tree identification, clearing will progress in a manner whereby smaller non-habitat trees are removed first and the larger remaining habitat trees are removed three to five days after the initial clearing. Clearing vegetation in this manner provides a disturbances stimulus and provides fauna with time to leave the site, thereby maximising the chances of fauna survival while reducing the need for human intervention for translocation or rescue purposes. An appropriately qualified spotter-catcher is to be present on site during the felling of all identified habitat trees. A spotter-catcher is a person who holds a tertiary qualification in biology or zoology, or who is demonstrably experienced in the identification and location of fauna in their natural habitat. Following the felling of each habitat tree, an inspection of the felled tree by the spotter-catcher will be completed for the purposes of capturing and relocating fauna disturbed by the clearing process or remaining within the felled timber. Any fauna recovered during vegetation clearance will, immediately upon capture, be inspected for any signs of physical injury. If the fauna appear to be injured, they would be immediately transported to a suitably qualified veterinary surgeon for appropriate treatment. Uninjured fauna will be placed inside a calico or similarly porous bag, which would be placed in a shaded and secure position away from the area where clearance works are being undertaken. The fauna will be relocated to suitable, habitat	All habitat trees within the site to be appropriately identified and marked prior to commencement of any clearance works. Non-habitat trees to be removed in first instance. Habitat trees to be removed three to five days after the initial clearing. Throughout clearance works during the felling of habitat trees. As required, throughout works. Throughout clearance works during the felling of habitat trees. Throughout clearance works during the felling of habitat trees.	Land Owner

Issue	Action	Schedule	Responsible Entity
	in the surrounding area (i.e. retained vegetation adjacent to the site or a Reserve within the locality) and released at an appropriate time of day (i.e. after nightfall if the animal is nocturnal, or during daylight hours if diurnal) in order reduce the risk of predation. Where possible, the actual felling of the habitat trees shall be conducted in manner that will maximize the chances of survival for any fauna remaining within the tree hollows. This will involve pushing rather than cutting and/or cushioning the tree fall with other felled timber and foliage.		
The potential exists for native fauna to suffer as a result of predation from domestic animals.	Appropriate signage is to be erected at all entry points to the walking track advising members of the public that domestic animals are to be restrained by a leash at all times within the Open Space Corridor, and their activity is to be restricted to the walking tracks at all times.	During the construction phase of the development	Land Owner

5 AQUATIC HABITAT MANAGEMENT AND REHABILITATION

5.1 Existing Aquatic Habitats

The Open Space Corridor currently supports a number of exiting aquatic habitats, namely:

- an existing lagoon system in the central portion (i.e. E2 and E3 on Figure 1);
- two small wetlands constructed for the purposes of receiving and treating stormwater from the residential development to the south (i.e. E 1on Figure 1);
- Duchess Gully which extends along the eastern boundary of the site; and
- constructed drainage channels in the western portion of the site.

A preliminary assessment of the biodiversity values of the existing lagoon has been completed (refer the Ecology Lab July 2008) and the results indicate that the lagoons are currently in a healthy condition as reflected by:

- the moderate diversity of native aquatic fauna;
- the presence of only one introduced fish species (i.e. Mosquito fish [*Gambusia hookeri*]);
- acceptable levels of water quality parameters;
- the diversity of native species in the macrophyte and submerged zones; and
- the diversity of waterbirds utilising the waterbodies.

The presence of fish species in the existing lagoons such as Sea mullet (*Mugil cephalus*), and Shortfin eels (*Anguilla australis*) indicate connectivity to the ocean via Duchess Gully as these species have a marine phase in their lifecycle. The presence of juvenile specimens of the Snake-necked tortoise (*Chelodina longicolis*) and Short-finned eels also demonstrates the existing lagoon system is providing breeding and/or nursery resources to a range of aquatic organisms.

The only significant management issues identified with the existing lagoon were the predominance of the introduced Torpedo grass (*Panicum repens*) infestations within the littoral/marginal zone and a low diversity of benthic fauna.

5.2 Proposed Constructed Wetland

As part of the Rainbow Beach Development, four constructed wetlands are proposed to be created within the Open Space Corridor. These constructed wetlands will form an integral part of the proposed stormwater “treatment train” that will service the development and re-instate the natural flow path of Duchess Gully through the central portion of the site. The existing and proposed aquatic features encompassed by the OSC are illustrated within Figure 1.

The largest proposed constructed wetland (i.e. W1 on Figure 1) will have a surface area of 10.5ha, an average bed level of RL 1.0m AHD and a normal top water level 3.0m AHD. The capacity of the lake at its normal top water level is approximately 142.5ML. The remaining three wetlands (i.e. W2, W3 and W4 on Figure 1) will be much smaller and are located at the interface between the proposed urban development and the Open Space Corridor. While the primary purpose of the constructed wetlands is the management of stormwater runoff generated by the proposed development, revegetation and rehabilitation of the wetlands will be aimed at producing high quality habitat for aquatic and terrestrial fauna whilst providing visual amenity and passive recreational pursuits for future residents.

5.3 Aquatic Habitat Management

The Land Owner recognises that appropriate actions need to be undertaken as part of the urban development to ensure that impacts to aquatic habitats within and adjacent to the site are minimised during both the construction and occupational phases of development. As such, the proposed development will include a stormwater "treatment train" that will incorporate the following measures to reduce the impact of runoff from the development on receiving environments:

- vegetated buffer strips for the removal of sediment and nutrients from impervious surfaces such as foot paths and driveways;
- grassed swales to convey storm flow and provide adequate flow detention prior to downstream devices such as wetlands and bioretention systems;
- establishment of bioretention systems (generally in the upper reaches of the catchment) for the removal of sediments and nutrients; and
- wetland systems in the downstream end of the catchment and immediately upstream of receiving lakes.

The various components of the proposed stormwater "treatment train" will minimise any adverse impacts of run off on the receiving environment given that they will:

- convey and/or contain water that meets adopted water quality objectives as required by PMHC;
- not have any significant impacts on the hydrology and groundwater levels of the Open Space Corridor and surrounding locality;
- not result in the exposure of high Potential Acid Sulfate Soils material to potential oxidation;
- be constructed in accordance with an approved Erosion and Sediment Control Plan and Acid Sulfate Soil Management Plan; and
- be revegetated in a manner that enhances the diversity and connectivity of terrestrial and aquatic habitats within and adjacent to the site.

5.4 Rehabilitation and Revegetation Specifications

An integral component of this OSMS is the rehabilitation and revegetation of the existing lagoon system and proposed constructed wetland such that self-sustaining, wetland vegetation communities are established that will provide the following ecological values and functions:

- sediment removal and erosion control;
- excess nutrient and metal removal;
- bank stability;
- moderation of water temperature and light penetration through shading; and
- provision of feeding, breeding and nursery habitat resources for aquatic fauna and other wildlife species.

With regard to the above, a Wetland Revegetation Plan (refer Plan Nos 713501-WRP-01 and 02) has been prepared for the rehabilitation and management of aquatic features encompassed by the Open Space Corridor.

There are differences between the intended uses for the existing lagoon system (i.e. E2 and E3) and proposed constructed wetlands (W1 – W4). Given that the bank profile of the existing lagoon is unknown there are concerns regarding public access and safety and as such it is intended that the existing lagoon system be inaccessible to the public. In contrast the large proposed constructed wetland (i.e. W1) will have a design depth and profile that satisfies public safety guidelines. The northern side of the large proposed constructed wetland (i.e. W1) will form part of the open recreational parkland area that coincides with the southern boundary of the development envelope. The large proposed constructed wetland will therefore be exposed to public access and as such will need to be revegetated in manner that provides a balance between habitat requirements of fauna species, and the recreational and visual amenity requirements of future residents.

The smaller constructed wetlands (i.e. W2, W3 and W4) will also have a profile that satisfies public safety guidelines and will not exceed a depth of approximately 1.5m. It is also intended for these wetlands to provide ecological functions and values in addition to stormwater management services.

The finer scale rehabilitation objectives for the existing lagoon and the proposed constructed wetlands are detailed below.

Existing Lagoon (E2 and E3)

Rehabilitation of the existing lagoon will be focussed on:

- enhancing and expanding existing populations of native macrophyte species;
- enhancing the diversity of native macrophyte species associated with the lagoon;
- reducing habitat suitable for the colonisation of Torpedo grass;
- creating a vegetative barrier to the water edge that excludes access by the public and dogs; and
- improving the visual amenity of vegetation associated with the lagoon.

Proposed Constructed Wetlands (W1 – W4)

Rehabilitation of the proposed constructed wetlands will be focused on:

- creating a self-sustaining macrophyte zone characterised by a diversity of native species;
- providing a range of habitats to encourage colonisation of the wetland by native aquatic fauna;
- limiting the availability of habitat to be colonised by weed species such as Torpedo grass;
- contributing to the visual amenity of the Open Space Corridor; and
- providing an effective balance between biodiversity conservation/enhancement and passive recreational pursuits associated with the Open Space Corridor.

5.4.1 Supplementary Planting Specifications

The main objective of the supplementary program is to create diverse and structurally complex wetland vegetation associated with both the existing lagoon and proposed constructed wetlands. The Wetland Revegetation Plan (Plan No 713501-WRP-01 and 02) addresses the manner in which both the existing lagoon and proposed constructed wetlands are to be revegetated to achieve the desired goals and objectives listed above.

5.4.2 Species Selection

The particular species to be used in the supplementary plating program will vary depending on the nature of the existing vegetation and the wetland vegetation zone (i.e. Submerged, Marginal and Terrestrial Fringe). As such, details concerning species selection and planting patterns have been provided within Plan No 713501-WRP-02. In the case of the existing lagoon system, recommended species and planting patterns have been based upon expanding the existing populations of native macrophyte species, especially in areas that have been subject to extensive Torpedo grass removal efforts.

5.4.3 Soil Surface Preparation

It will be necessary to prevent erosion and the introduction of weeds to exposed areas created by weed removal activities associated with the existing lagoon. Heavily woven jute mesh is an open weave erosion control mat suitable for short term erosion control in areas subject to light water flow (i.e. marginal zone and terrestrial fringe). As well as preventing erosion, jute mesh holds seeds and saplings in place, promotes plant growth by improving soil condition and moisture levels, reduces weeds and is easily planted through.

The revegetation zone associated with the existing lagoon should be free of weeds, large stones and other debris leaving an even surface that will allow the jute mesh to obtain maximum possible adhesion. The jute mesh shall be overlapped with adjacent rolls by 150mm and secured with fixing pins at approximately 1 pin/m^2. The edges where the jute mesh overlaps should be stapled at regular intervals to prevent weed invasion. The jute mesh will hold in position for a considerable period whilst stabilisation by vegetation takes place. The jute mesh eventually decomposes and is incorporated into the soil.

The installation of jute mesh around the existing lagoon system will need to be adjusted to accommodate existing and regenerating native vegetation.

5.4.4 Fertilisers

At the time of planting, fertiliser will be applied to each plant in the form of an Agriform® tablet. During the first year of planting, fertiliser such as Dynamic Lifter® will be applied to the plants as required to maintain the health and growth rate of planted species. To avoid potential leaching of fertilisers, slow release nitrogenous (and low phosphate content) fertilisers will be used.

5.4.5 Water Level Management

Controlling the water levels in areas of wetland subject to permanent or temporary inundation is an important component of the establishment phase of a wetland revegetation zone as it:

- facilitates seedling establishment;
- allows for supplementary planting to be carried out to compensate for mortality rates;
- allows access to planting in the deeper submerged wetland zone;
- can assist in controlling floating weed species; and
- facilitates the repair of erosion and structural problems that may arise in the revegetation zone.

As such, water level management activities in areas subject to permanent and/or temporary inundation have been recommended within Plan 713501-WRP-02.

5.4.6 Performance Indicators

Management of the existing lagoon and proposed constructed wetland must achieve the following Performance Indicators:

- water quality is to be of a standard that is not detrimental to the colonisation and survival of native aquatic fauna;
- no erosion, scouring or slumping banks is to occur during the maintenance period;
- an impenetrable vegetative barrier is to be established around the existing lagoon and proposed constructed wetland in order to impede public access.

The implementation of the revegetation program, generally in accordance with the above specifications, must achieve the following Performance Indicators:

- no inappropriate plant species (i.e. non-endemic, exotic or noxious weed species) are to be used in the revegetation program;
- planting densities and mixtures established in each Wetland Zone are to correspond to the specifications provided in Wetland Revegetation Plan (Plan No 713501-WRP-01 and 02);
- an 80% survival rate of planting stock is to be maintained within each Wetland Zone for a period of at least three (3) years from the date of planting; and
- wetland vegetation is to be maintained such that:
  i. native species comprise at least 90% of the species composition within each plot; and
  ii. native species comprise at least 90% of the biomass and/or cover within each plot.

5.4.7 Monitoring

The most intensive period of maintenance is during the plant establishment period (i.e. the first three [3] years of plant growth) when weed removal and supplementary planting may be required. In this regard, each Wetland Zone shall be inspected every two (2) months for the first six (6) months and once every six (6) months thereafter for at least two and a half (2.5) years.. Routine monitoring and maintenance activities during this time should include, but are not restricted to the following:

- identification of mortality and/or damage to revegetation areas;
- removal of litter and/or debris build up;
- removal and management of weed species;
- watering of plantings and seeded areas during the plant establishment phase in accordance with the watering program provided in Plan No 713501-WRP-02;
- replacement of plantings that have died with plants of equivalent size and species detailed in the planting schedule, unless plant failure is indicative that the species is not suited to the prevailing conditions at that planting site; and
- alternative monitoring requirements may be agreed to by the landowner and PMHC as part of discussions relating to the long term ownership, management and any voluntary planning agreement(s).

5.5 Aquatic Fauna Management

A main objective of the Wetland Rehabilitation Plan (refer Plan Nos 713501-WRP-01 and 02) is to create high quality habitat for aquatic and semi-aquatic/terrestrial organisms that utilise habitat resources within wetland environments. In order to achieve this objective, it is intended to increase the diversity of habitat available and to gauge the success of the rehabilitation program by monitoring the diversity or organisms occupying the existing lagoon and proposed constructed wetland.

5.5.1 Aquatic Habitat Enhancement

Habitat enhancement for aquatic organisms and other native wildlife utilising the existing lagoon and proposed constructed wetland will include:

- creation of diverse and structurally complex wetland vegetation;
- provision of rocks and/or logs (salvaged from the development footprint) as habitat features within and around the wetlands;
- establishment of screening vegetation to reduce disturbance to wildlife;
- ongoing removal and control of invasive plant species;
- restricting public access to aquatic habitat; and
- prohibition of domestic pets within and around the wetland system.

5.5.2 Monitoring of Biodiversity

To formally assess the colonisation of the proposed constructed wetland by aquatic organisms and to monitor any change in the biodiversity of the exiting lagoon a monitoring program will be undertaken in accordance with the methodology used by The Ecology Lab (April 2008) and will at a minimum include sampling of the following.

- Benthic fauna – sediment samples taken from at least four sites at a standardised depth. Samples will be processed to obtain information concerning the species composition, diversity and abundance of benthic fauna.
- Fish species –
    i. a minimum of three (3) baited traps set in four sample location close the shoreline and macrophyte vegetation;
    ii. sampling with a seine net (approximately 10m long x 1.5m deep and a mesh aperture or 2mm) in at least three (3) locations; and
    iii. sampling with gill nets (approximately 60m long and comprised of two 30m lengths of 100mm and 50mm monofilament mesh, approximately 1.5m deep) in at least three (3) locations in open water.
- Water birds – incidental sightings during sampling for benthic fauna and fish species.

Monitoring in accordance with the above should be undertaken at least twice within each season over a period of at least two (2) years. This monitoring will assist in detecting any changes in wetland fauna communities that are indicative of either improvements in or degradation of ecological conditions within the wetland systems.

5.6 Summary of Management Issues and Actions

A summary of the identified aquatic habitat management and rehabilitation issues and the various actions that are to be taken as part of the Rainbow Beach development is provided in Table 4. For

each of the specific management actions a schedule for implementation is provided and the responsible entity for taking the action is identified.

Table 4: Summary of Aquatic Habitat Management and Rehabilitation Issues and Actions

Issue	Action	Schedule	Responsible Entity
Clearance of vegetation within the Open Space Corridor for the purpose of establishing essential infrastructure may have an adverse impact upon aquatic habitat values.	All practicable measures will be taken to design and locate essential infrastructure such that disturbance to native vegetation associated with aquatic within the Open Space Corridor is avoided or, where this is not possible, minimised. All areas to be disturbed within the Open Space Corridor shall be identified on construction plans and in the field. Exiting aquatic features shall be identified as "no-go zones" on construction plans and in the field. In this regard, it is relevant to note that disturbance associated with the construction and establishment of pathways and stormwater treatment devices will: • primarily involve the removal of disturbed and degraded vegetation; and • be carried out in manner that minimises damage to any adjoining areas of intact, native vegetation. Any disturbance to native vegetation will be carried out in accordance with the terms and conditions of relevant development consents and permits which would specifically authorise any such disturbance. Any disturbance to native vegetation will be carried in accordance with approved Erosion and Sediment Control Plan and an approved Acid Sulfate Soils Management Plan	Prior to the commencement of any construction works within the Open Space Corridor. At all times.	Land Owner
The potential exists for contractors to unintentionally clear vegetation outside of the nominated clearance zones.	The limits of the areas within the Open Space Corridor nominated for clearance or disturbance must be fenced or clearly marked with tape. Outside of these areas (i.e. in the balance of the Open Space Corridor including exiting aquatic habitats) the following activities shall not be permitted: • storage and mixing of materials; • vehicle parking; • liquid disposal; • machinery repairs and/or refuelling; • construction site office or shed; • combustion of any material; • stockpiling of soil, rubble or debris; • any filling or excavation including trenchline, topsoil skimming and/or surface excavation, unless otherwise approved by the relevant authority; and • unauthorised pesticide, herbicide or chemical applications.	Prior to commencement of construction. For the duration of construction works.	Land Owner

Issue	Action	Schedule	Responsible Entity
Disturbed areas are susceptible to topsoil erosion and sedimentation, which impact upon water quality in existing aquatic habitats.	Construction works within the Open Space Corridor are to be undertaken in accordance with the provisions of a PMHC-approved Erosion and Sediment Control Plan. Exposed surfaces caused through the removal of vegetation are to be rehabilitated as per the specifications provided in Plan No. 713501-ELUMP-01& 02, or else stabilised through the appropriate distribution of woodchips across these surfaces or via the application of native grass seeding. Jute mesh is to be established on exposed surfaces subject to light water flow and/or inundation in general accordance with the specifications provided in Plan No 173501-WRP-02. The Land Owner is to ensure that all erosion and sedimentation controls are implemented and maintained for the duration of development activities.	Throughout construction works within the Open Space Corridor.	Land Owner
The potential exists for contractors to ignore the fenced clearance areas.	No clearance of vegetation is to occur outside of nominated disturbance zones. Any contractors that disturb vegetation outside of these zones will be required to rehabilitate the damaged area and, at the discretion of the Land Owner may be banned from the site.	At all times during the construction phase.	Land Owner
The existing lagoon and proposed constructed wetlands are to be appropriately rehabilitated with native plant species.	The rehabilitation and revegetation of the existing lagoon and proposed constructed wetlands are to be undertaken in general accordance with the specifications provided within Section 5.0 of this OSMS and Plan No. 713501-WRP-01 & 02. The Land Owner is to engage the services of an appropriately qualified, experienced and licensed landscape contractor and/or bush regenerator. Interim status reports documenting the status of implementation of the Environmental Land Use Management Plan is to be provided to PMHC at annual intervals from the date of commencement of this OSMS.	Throughout the construction phase.	Land Owner Contractor
Rehabilitation plantings are to maintain an 80% survival rate for at least three (3) years from the date of planting	Rehabilitation plantings are to be monitored and maintained in general accordance with the specifications provided within Section 5.4.6 of this OSMS. Where a survival rate of 80% is not being achieved, threatening processes shall be identified and mitigated as far as practicable. Supplementary plantings shall be undertaken to compensate for mortality.	Throughout the establishment period	Contractor
Weed infestations are to be appropriately managed within rehabilitation areas and must not constitute more than 20% of the biomass.	Rehabilitation areas are to be monitored for weed invasion and colonisation. Where weed colonisation of greater than 20% is identified, weed species are to removed and managed in general accordance with the specifications provided with Section 6 within this OSMS.	Throughout the establishment period	Contractor

Issue	Action	Schedule	Responsible Entity
The proposed constructed wetlands may not provide good quality fisheries habitat	Biodiversity within the proposed constructed wetland is to be monitored in general accordance with the specification provided in Section 5.5.2 herein for the maintenance period. Where a low diversity and abundance of native aquatic species is detected, or if an over abundance of exotic fauna are detected the following remedial actions must be undertaken: • identification of conditions unfavourable to survival of native species (i.e. high turbidity); • evaluation of current management practices (i.e. effectiveness of storm water treatment devices and water cycle management); • implementation of mitigation strategies; and • follow up monitoring.	Throughout the maintenance period	Contractor

6 WEED MANAGEMENT

The Land Owner is committed to initiating a management program for weed species that have a recognised potential to adversely affect the environmental values of the Open Space Corridor. In this respect the Land Owner, as part of the establishment of the Open Space Corridor will undertake a weed management program designed to treat existing infestations of recognised weed species that occur within the Open Space Corridor. The weed management program and associated works is to be undertaken by trained, experienced bush regenerators with suitable qualifications such as a TAFE Certificate in Bushland Regeneration. The general manner in which weed species are to be managed within the context of this OSMS are detailed below.

6.1 Terrestrial Weed Species

Infestations of Lantana (*Lantana camara*) have been identified in a number of areas of the Open Space Corridor. Lantana is currently recognised as a:

- Noxious Weed pursuant to the Noxious Weed Act 1993 ; and
- Weed of National Significance by the National Weeds Strategy.

Pursuant to the Noxious Weeds Act 1993, the Land Owner is obliged to control and manage infestations of Lantana that occur within the entire site in accordance with PMHC's Weed Control Management Plan. A copy of this plan is provided herewith as Appendix B.

A number of other terrestrial weed species have been identified as occurring within or adjacent to the site, namely:

- Fireweed (Senecio madagascariensis);
- Parramatta grass (*Sporbolus africanus*);
- Rhodes grass (*Chloris gayana*);
- Whisky grass (Andropogon virginicus); and
- White passionflower (*Passiflora subpeltata*).

6.1.1 Control Methods

Existing infestations of the above listed weeds species and any other Noxious Weeds identified within the Open Space Corridor, are to be the subject of control efforts using the methods detailed below. In this respect it is noted that the control methods for specific species will vary depending upon the location and size of the infestation.

6.1.1.1 Mechanical Control

In areas that support dense infestations of weed species that dominate the vegetation the use of mechanical control methods, such as the use of tractor slashers, bobcats and/or small excavators, is generally appropriate as an initial treatment subject to certain restrictions.

Other more selective forms of mechanical weed control, involving the use of motorised brush-cutters and chain saws, will also be used in areas or circumstances where the use of larger machinery is not appropriate. Within Biodiversity Protection ELUCs, the use of mechanical control methods should generally be restricted to small mechanical equipment, such as brush-cutters. Large machinery can only be used within Biodiversity Protection ELUCs if it can be demonstrated, via the conduct of an appropriately designed and supervised trial, that the equipment does not cause environmental harm and will substantially increase the efficiency of weed control works.

6.1.1.2 Manual Control

Small plants and seedlings can often be easily hand removed, especially in sandy soils. However, this method of removal can be time consuming and is only practical on a small scale or within areas of particular environmental sensitivity. It is useful where chemical spraying may damage adjacent native seedlings or plants. This method of control has applications in the selective removal of small scale weed regrowth within the Biodiversity Protection and Biodiversity Enrichment ELUCs.

6.1.1.3 Chemical Control

A Glyphosate based herbicide will be used as a component of the weed control strategy. The proposed methods for herbicide application are outlined below.

- Cut and Paint - To remove larger weed species, the cut and paint method of herbicide application will be implemented. Immediately after cutting the weed species close to the base, the stump surface and any damaged areas will be painted or sprayed with 100% glyphosate. For the control of vines, the stem will be scraped back on one side to reveal the light green inner plant tissue. Immediately after scraping the stem, 100% glyphosate will be painted on to the affected area. This process can be repeated in sections along the vine to ensure a sufficient adsorption of herbicide.
- Foliar/spot spraying - This method will be used in the maintenance program for spot-spraying any weed regrowth in areas with regenerating or planted native species. This will involve the use of either Knapsack, Quad-bike or Tractor mounted spray units, depending upon the density of vegetation. The recommended rate of herbicide is 1:200 with a surfactant such as LI700 at a rate of 5 mL per litre.

Chemical control agents are only to be used strictly in accordance with the manufacturer's specifications and only for purposes for which the control agent has appropriate registration.

6.1.2 Weed Regrowth Suppression Schedule

To ensure that an adequate level of weed control is achieved by the end of the maintenance period a regular program of weed regrowth suppression will be required following initial weed control works. In this respect weed regrowth suppression treatments within ELUCs will occur at the following frequencies.

Period following Initial Control Works	Minimum Weed Regrowth Suppression Treatment Frequency
0-6 months	Every month
6-18 months	Every 2 months

6.1.3 Performance Indicators

The implementation and maintenance of the weed control works, generally in accordance with the above specifications, must achieve the following Performance Indicators:

1. initial weed control works and subsequent weed regrowth suppression to be carried out at regular intervals as specified in Section 6.1.2;
2. weed control methods used within the Open Space Corridor are to be in accordance with Section 6.1.1; and
3. sustained reduction in the presence of Noxious weeds and other weed species to a level that will ensure weed species do not suppress or exclude rehabilitation plantings or the natural recruitment of native species; and

4. nil fruiting of the priority weed species after the initial weed control works.

6.2 Aquatic Weeds

Many recognised aquatic weed species have been bought into Australia for ornamental purposes (i.e. water features, aquariums etc) and have escaped into natural and constructed waterbodies as direct result of seed/propagule dispersal and/or irresponsible disposal of plants into storm water drains. In this regard, wetlands constructed to manage storm water runoff, such as the proposed constructed wetland, have the potential to support high levels of nutrients and hence can provide ideal conditions for the invasion of aquatic weed species.

In the first instance, consideration must be given to the fact that existing lagoon does not currently support any significant aquatic weed infestations even though:

- it has been receiving run-off from surrounding pastoral land for at least 20 years;
- storm-water run-off from residential development to the south has also been directed into the lagoon; and
- substantial numbers of water birds, which are important dispersal agents for aquatic plants, utilise the existing lagoon on a regular basis.

The above facts and circumstances suggest that:

- the existing lagoon does not support conditions that are favourable to the growth of many aquatic weeds;
- there are no source populations of aquatic weeds within dispersal distance of the existing lagoon; or
- residents in the locality have not been disposing of aquatic weed material in an inappropriate fashion.

6.2.1 Aquatic Weed Management Program

Four aquatic weeds species are considered to be “high risk” species in regard to colonisation of the existing lagoon and proposed constructed wetland given their prevalence in northern NSW and listing pursuant to the NSW Noxious Weeds Act 1993. These species are:

- Alligator weed (*Alternanthera philoxeroides*) – Class 2 Noxious Weed;
- Salvinia (*Salvinia molesta*) – Class 3 Noxious Weed;
- Water lettuce (*Pistia stratiotes*) – Class 1 Noxious Weed;
- Water hyacinth (*Eichhornia crassipes*) – Class 3 Noxious Weed; and
- Senegal tea plant (*Gymnocoronis spilanthoides*) – Class 1 Noxious Weed.

Pursuant to the Noxious Weeds Act –

- Class 1 and Class 2 Noxious Weeds must be eradicated from the land and the land must be kept free of the plant; and
- Class 3 Noxious Weeds must be fully and continuously suppressed and destroyed.

Alligator weed and Salvinia are both recognised as Weeds of National Significance by the National Weeds Strategy.

6.2.1.1 Early Detection Monitoring Program

Early detection and response to aquatic weeds is the most important stage in any cost-effective weed management program. In this regard, regular monitoring of the existing lagoon, proposed constructed wetland and storm water treatment train will assist in the early detection of:

- aquatic weeds that have entered the existing lagoon and proposed constructed wetland through dispersal; and
- aquatic weed propagules and vegetative material that have entered the Open Space Corridor through the storm water treatment system.

With regard to the above, removal of aquatic weed material from bioretention basins and vegetated swales will reduce the likelihood of aquatic weeds colonising larger waterbodies.

The existing lagoon, proposed constructed water body, bioretention basins and vegetated swales shall be inspected for aquatic weeds:

- twice during the growing season of "high risk" aquatic weed species; and
- immediately after high rainfall events.

Any aquatic weed material that can be easily extracted from aquatic systems and the stormwater treatment devices will be disposed of at an appropriate land fill facility.

6.2.1.2 Recommended Control Techniques

The following control techniques are recommended for the removal and management of "high risk" aquatic weed species detected within the existing lagoon and proposed constructed wetland.

Table 5: Recommended Weed Control Techniques

Recommended Control Technique	Notes	Species
Manual/Physical Removal	• Smaller infestations are easiest to remove manually. Weed harvesters can improve the success of removing larger infestations. • Removed material should be left to dry and disposed of at a land fill site or burnt. • Manual removal of weed biomass has the advantage of removing nutrients from the water, in comparison to herbicide control where nutrients from dead weed material are released back into the water.	Salvinia Small infestations of Water hyacinth Isolated individuals of Senegal tea plant
Biological control	• Biological control can be effective in certain circumstances, but is generally slow acting and tends to only reduce the rate of spread of an infestation. • It is often effective in reducing the volume of weed to the point where chemical and/or physical removal can be considered cost-effective.	Salvinia Water hyacinth Alligator weed
Chemical control	• Can be more cost-effective than physical removal of large infestations. • Can be detrimental to health of waterways. • Can affect non-target plant species. • Can increase nutrification through decomposition of dead weed biomass.	Salvinia Water hyacinth Senegal tea plant Alligator weed

Chemical control agents are only to be used strictly in accordance with the manufacturer's specifications and only for purposes for which the control agent has appropriate registration.

The NSW Department of Primary Industries and CRC for Australian Weed Management strongly recommend contacting local weed management authorities prior to treating infestations of Senegal tea plant and Alligator weed.

Weed Management Guides for each "high risk" aquatic weed species produced by the CRC for Australian Weed Management are provided in Appendix C.

6.3 Torpedo grass

Dense infestations of Torpedo grass (*Panicum repens*) currently line the existing lagoon and the drainage lines in the western portion of the site. Torpedo grass has also spread out from the edges of waterbodies and is currently found throughout the majority of disturbed vegetation communities within the Open Space Corridor. In particular the existing lake system supports dense infestations of Torpedo grass throughout the macrophyte zone, upper banks and surrounding terrestrial areas.

6.3.1 Recommended Control Measures

The Land Owner and qualified staff from Wild Things Native Gardens Pty Ltd have commenced trials to determine the most effective means of removing and controlling Torpedo grass populations within the site. At present there a number of integrated management measures that have been identified as successful in controlling Torpedo grass within various habitats as detailed below.

6.3.1.1 Lake Macrophyte Zone

A combination of mechanical removal and chemical control has proven effective in reducing the net biomass of Torpedo grass currently infesting the macrophyte zone of the existing lake. Control of Torpedo grass in this area was most successful using the following combination of methods:

- staged mechanical removal of the bulk of Torpedo grass biomass with a large excavator; and
- application of regrowth with Roundup Bioactive® for at least 12 months.

Follow up plantings with native macrophyte species is predicted to reduce the regrowth and spread of Torpedo grass over time. Supplementary plantings should be undertaken in general accordance with the specifications provided herein and within Plan No. 713501-WRP-01 and 02.

6.3.1.2 Upper Banks

Control of Torpedo grass along the upper banks of the existing lake has been achieved through:

- reducing the water level within the lake;
- mechanical removal of Torpedo grass biomass with a brushcutter;
- raising the water levels within the lake to encourage Torpedo grass regrowth; and
- application of Roundup Bioactive® to regrowth.

6.3.1.3 Terrestrial Areas

Control of Torpedo grass that has invaded terrestrial areas surrounding the aquatic features has been most successful using foliar application of Roundup Bioactive® and/or Fusilade® with additives such as GOAL® and/or Li700®.

6.4 Summary of Weed Management Issues and Actions

A summary of the identified weed management issues and the various actions that are to be taken as part of the Rainbow Beach development is provided in Table 6. For each of the specific management actions a schedule for implementation is provided and the responsible entity for taking the action is identified.

Table 6: Summary of Weed Management Issues and Actions

Issue	Action	Schedule	Responsible Entity*
A reduction in the existing levels of weed infestations within the Open Space Corridor is required prior to hand over of the area to PMHC.	The Land Owner is to carry out a program of targeted weed control works within the Open Space Corridor.	Weed control works are to be completed prior to the transfer of the Open Space Corridor, or parts thereof, to PMHC.	Land Owner
The use of inappropriate weed control methods, including both physical and chemical control methods, have the potential to adversely affect the values of the Open Space Corridor.	The Land Owner is to carry out an initial program of weed control works using control methods specified within Section 6.1.1 and 6.2.1 herein and with reference to recommendations made by PMHC and the NSW Department of Primary Industry, which are presented as Appendix B and C. The use of machinery in the control of existing weed infestations will be avoided where practicable.	At all times.	Land Owner
Following the initial weed control works on-going maintenance of the treated areas will be required to control any regrowth of weed species and to facilitate regeneration of native plant communities.	The Land Owner is to implement a maintenance program in those areas subject to weed control efforts.	For the duration of the maintenance period	Land Owner
Adjacent urban development has the potential to act as a source of weed infestation within the reserved area.	The Land owner will establish informative signage around the boundary of the Open Space Corridor informing the residents of the status of the adjoining land and the fact that the following activities are prohibited: • deposition of waste, including garden clippings and aquatic plants; or • damage or disturbance to native flora and fauna.	At commencement of occupation of residential lots.	Land Owner
	PMHC is to ensure residents are not engaging in activities that promote the establishment and dispersal of weeds (i.e. dumping of garden waste etc.).	At commencement of occupation of residential lots.	PMHC Residents of the Rainbow Beach development

7 ACCESS AND PUBLIC SAFETY MANAGEMENT

7.1 Public Access

The Land Owner recognises that the establishment of an Open Space Corridor adjacent to urban development raises a number of issues related to the management of access to and within the Open Space Corridor.

This section of the OSMS provides management specifications in relation to the establishment of shared pathways (i.e. bicycle and pedestrian) within the Open space Corridor and, in particular, outlines strategies that would:

- maximise the use of areas within the Open Space Corridor that currently support cleared pastures, or that will be subject to disturbance associated with construction of the proposed constructed wetland for the location of passive recreational facilities;
- minimise the requirement for disturbance to other areas, whilst allowing for the establishment of shared pathway that provides access through the Open Space Corridor and linkages to external areas;
- restrict access to areas of high environmental sensitivity (e.g. the revegetated areas of the Open Space Corridor, Duchess Gully and the existing lagoon); and
- restrict access to areas that present public safety issues (i.e. the existing lagoon).

7.2 Public Safety

The safety of the existing lagoon and proposed constructed wetland is a major issue in regard to the management of the Open Space Corridor. As such, it is intended to address public safety issues associated with the waterbodies with a risk minimisation approach based on the principles of not inviting people to danger and ensuring risk is minimised through reasonable provision of safety measures. The measures outlined below have been designed in accordance with the Royal Life Saving Society Australia's Guidelines for Water safety in Urban Water Developments and the associated Constructed Wetland Systems Design Guidelines for Developers (2002) produced by Melbourne Water.

1. Vegetative barriers – the revegetation program has been specifically designed to create impenetrable vegetative barriers to most parts of the existing lagoon and proposed constructed wetland. The vegetative barrier will commence from the terrestrial fringe and extend into the submerged zone of the lagoon. The extent of the barrier has been specifically designed to prevent public access to the water from at least 2 -3 m back from the Normal Top Water Level (NTWL) mark to avoid confusion regarding the actual position of the NTWL. At designated locations no vegetative barrier will be established along the foreshore of the proposed constructed wetland to facilitate controlled public access to and enjoyment of the wetland. In these areas alternative safety measures, as specified below, will be adopted.
2. Physical Barriers – no formal access to either the existing lagoon or proposed constructed wetland will be provided unless there are appropriate barriers and/or safety benching installed. This will apply to areas where viewing platforms or shared cycle/pathways are situated along the edge of the existing lagoon or proposed constructed water body. Examples of barriers considered to provide an acceptable level of control over people unexpectedly entering waterbodies are provided as Appendix D.

3. Signage – Signage that complies with Australian Standards and is non-obtrusive and highly resistant to vandalism will be installed in appropriate locations around the existing lagoon and proposed constructed wetland. Signage will incorporate the following elements:
    - the purpose of the wetland (i.e. stormwater treatment and wildlife habitat);
    - significant environmental features (e.g. waterbird nesting habitat);
    - appropriate safety warnings; and
    - prohibition of domestic animals such as dogs within the wetland.

Examples of appropriate signage are provided within Appendix E.

7.3 Summary of Public Access and Safety Management Issues and Actions

A summary of the identified public access and safety issues and the various actions that are to be taken as part of the Rainbow Beach development is provided in Table 7. For each of the specific management actions a schedule for implementation is provided and the responsible entity for taking the action is identified.

Table 7: Summary of Access and Public Safety Management Issues and Actions

Issue	Action	Schedule	Responsible Entity*
During the construction phase of development there will be a need to use machinery adjacent to, and for limited specified purposes within, the Open Space Corridor. In the absence of appropriate controls, the operation of machinery has the potential to adversely impact on the values of the Open Space Corridor.	The Land Owner is to identify the location and extent of areas within the Open Space Corridor that will need to be accessed and disturbed for the purposes of establishing essential infrastructure (i.e. stormwater control devices, district sporting fields, constructed wetland, pathways etc.) as part of the orderly development of the site.	Detailed plans indicating the design and location of essential infrastructure within the Open Space Corridor must be prepared submitted to PMHC for approval prior to commencement of construction works.	Land Owner
	The land Owner is to physically mark the boundaries of areas where the operation of machinery is required for the purpose of constructing this essential infrastructure. The operation of machinery outside of these defined work areas is to be prohibited.	Prior to the commencement of construction works within the Open Space Corridor and to be maintained throughout the construction phase.	Land Owner
A network of formal shared pathways is to be established throughout the Open Space Corridor to allow for controlled public access to and within the Open Space Corridor. The walking track needs to be of a design that provides a reasonable level of access to the Open Space Corridor, whilst minimising impacts to the area's environmental values.	A network of formal walking paths is to be established within the Open Space Corridor which will provide pedestrian access throughout the central and western portions of the Open Space Corridor. In order to minimise the extent of vegetation clearance required to establish the formal walking tracks through the Open Space Corridor, Land Owner is, where possible, to locate the track: 1. within areas that currently support cleared vegetation; 2. within Urban Edge ELUCs to reduce ongoing management requirements. (*Note: Where pathways are located within firebreaks, they will be centrally located to allow one slasher width on either side*). The walking track is to have a gently meandering alignment and is will be designed to minimise any impacts to: • areas identified as Biodiversity protection and Biodiversity Enrichment ELUCs; • the existing and to be constructed waterbodies within the Open Space Corridor; and • where practicable, any existing native trees that occur along or adjacent to the proposed pathway alignment. The walking track corridor is to have a minimum formed width of approximately 3m, which is to consist of a 2.5m wide concrete track bordered on either side by a minimum 0.5m of slashed grassland regularly maintained to a height of 100mm. The width of the track corridor will enable pedestrian/cyclist access in either direction and will permit the occasional passage of maintenance vehicles. It is considered that the track corridor's width would limit the opportunities for any disturbance to adjacent existing or rehabilitated native vegetation within the balance of the Open Space Corridor as a consequence of either pedestrian or occasional maintenance vehicle movements.	Prior to the commencement of works within the Open Space Corridor	Land Owner
	The Land Owner will physically mark the alignment of the track prior to the commencement of any track construction or additional vegetation clearance.	To be completed as part of construction activities, prior to commencement of vegetation clearance	Land Owner

Issue	Action	Schedule	Responsible Entity*
	The Land Owner is to establish shared pathways generally in accordance with the relevant Australian Standard.	The shared pathway network is to be established as part of the Rainbow Beach, Bonny Hills development.	Land Owner
Public access to the Open Space corridor may have a negative impact upon the ecological values contained within the Open Space Corridor.	Appropriate signage is to be erected at the entry points of the shared pathways advising the public that: • any disturbance to flora and fauna within the Open Space Corridor is prohibited; and • domestic pets must be on a leash at all times whilst traversing the tracks within the Open Space Corridor; and • unauthorised activities in off-track areas of the Open Space Corridor are prohibited.	The signage would be erected during establishment of the walking track.	Land Owner
	Details relevant to the proposed signage are to be provided to PMHC. PMHC is to review the design of the signage and advise the Land Owner of any required modifications.	Following issue of Operational Works approval. In this respect, it may be appropriate for PMHC to require as a condition on a development approval, that details relevant to the proposed signage be submitted to PMHC for approval prior to the construction of the walking track.	Land Owner PMHC
The establishment of a walking track has the may represent a drain on PMHC resources if it is poorly constructed.	The Land Owner will maintain the shared pathways for a period of 24 months from the Work Acceptance meeting in accordance with any PMHC approved specifications.	For a period of 24 months from the Work Acceptance meeting.	Land Owner
	The Land Owner will commission a bi-monthly assessment of shared pathways to identify any maintenance or modification requirements.	Bi-monthly	Land Owner
	The Land Owner will carry out any required maintenance or modification works during the 24 months on-maintenance period.	As required.	Land Owner
	PMHC is to independently assess the condition of the shared pathway network on a bi-monthly basis during the 24 months on-maintenance period and is to advice the Land Owner of any additionally required maintenance or modification works.	Bi-annually.	PMHC
	In the event that any substantial maintenance or modifications works are required prior to the completion of the 24 months on-maintenance period, the Land Owner is to carry out these works which will be the subject of a further on-maintenance period of 24 months.	As required.	Land Owner
	Following completion of the on-maintenance period PMHC will maintain the shared pathway and associated signage.	As specified	PMHC
There are public safety issues with uncontrolled access to waterbodies	Appropriate risk-minimisation measures will be implemented within the Open Space Corridor. In particular no formal access to either the existing lagoon or proposed constructed wetland will be provided unless there are appropriate barriers and/or safety benching installed.	For the duration of the development	Land Owner

8 ADAPTIVE MANAGEMENT

An adaptive management approach is to be employed in respect of the works forming part of this OSMS. An adaptive management approach involves an integrated process of monitoring, reviewing and then responding to the observed results of management actions that have been previously taken or unforeseen circumstances that arise. This may require alterations or amendments to the specifications of this OSMS in circumstances where the specified performance criteria are not being achieved using the current specifications of this OSMS.

As noted in Sections 3.5 herein, the application rates for fertiliser and the watering schedule should be flexible in responding to the health and vigour of the plantings and changing climatic conditions. Monitoring the plantings will also allow for a review of the selected species to enable changes in the species composition of the supplementary planting if it is determined that a particular species or stock sourced from a certain location is not performing adequately. The supplementary planting species, planting densities and planting patterns nominated within this OSMS may be subject to change and review if certain species are unavailable or are performing inadequately.

The weed control works are also to be reviewed and appropriate changes implemented accordingly, if required. It is important to note that any changes should comply with the aims of this OSMS and any licensing or approval conditions issued by PMHC before implementation.

Performance criteria have also been nominated to determine the success of the planting schedule. To measure the growth performance, the plantings should be monitored periodically. At nominated intervals, the average height and ground cover of the plantings would be assessed. If particular areas or certain species do not meet the nominated performance criteria, action would be taken to provide and implement acceptable solutions to resolve these issues.

Where there is a recognised need for implementation of adaptive management, an issue specific adaptive management statement is to be prepared. Each Adaptive Management Statement is to contain the following details:

- the specific section(s) of this OSMS that is to be adapted;
- the nature of the adaptation, including any environmental controls;
- justification for the adaptation including a statement of the environmental benefits and risks associated with the adaptation, including the results of any small scale trials; and
- the duration of the adaptation (if relevant).

To take effect each amendment to this OSMS, as detailed in each Adaptive Management Statement, must be agreed to by, and contain the signatures of, delegated officers of Land Owner and PMHC.

9 MANAGEMENT ROLES AND RESPONSIBILITIES

9.1 The Land Owner

The land Owner and any successors in title to the Open Space Corridor, will assume responsibility for ensuring that the following elements of this OSMS are implemented.

1. Completion of selective vegetation clearance works.
2. Construction of structures specified in this OSMS.
3. Implementation of the supplementary planting program in a manner that achieves the specified Performance Indicators.
4. Maintenance of the supplementary planting program from the commencement of the supplementary planting works.
5. Control of existing infestations of priority weed species and suppression of weed species regrowth from the date of commencement of the supplementary planting works.

In discharge of its responsibilities the Land Owner will engage the services of an appropriately qualified, experienced and licensed landscape contractor who can provide the services of trained, experienced bush regenerators with suitable qualifications such as a TAFE Certificate in Bushland Regeneration.

The Land Owner is to provide to PMHC interim status reports documenting the status of implementation of this OSMS at annual intervals from the date of the commencement of implementation of this OSMS. The status reports are to provide a summary of:

1. the details of works carried out as part of the implementation of this OSMS in the preceding 12 month period;
2. the status of supplementary planting works and the degree of compliance with the specified Performance Indicators; and
3. the nature of any corrective or adaptive management actions that have been taken, or which are proposed, in respect of non-compliance with the specified performance criteria.

At the completion of the maintenance period, starting from the date of commencement of the supplementary planting program, the Land Owner is to provide a final status report to PMHC confirming that all the specified works have been carried out and relevant performance criteria have been achieved.

The interim status reports and final status report are to be prepared by an independent suitably qualified and experienced environmental scientist/ecologist.

The duration of construction, establishment and maintenance periods are the subject of separate discussions between PMHC and the landowner.

9.2 Port Macquarie-Hastings Council

PMHC will assume responsibility for the on-going management and maintenance of terrestrial and aquatic habitats and structures within the Open Space Corridor once the Land Owner has discharged its responsibilities in accordance with Section 9.1 of this OSMS, or alternatively in accordance with any voluntary planning agreement executed separately with PMHC and the landowner.

FIGURES

Figure 1 Concept Plan

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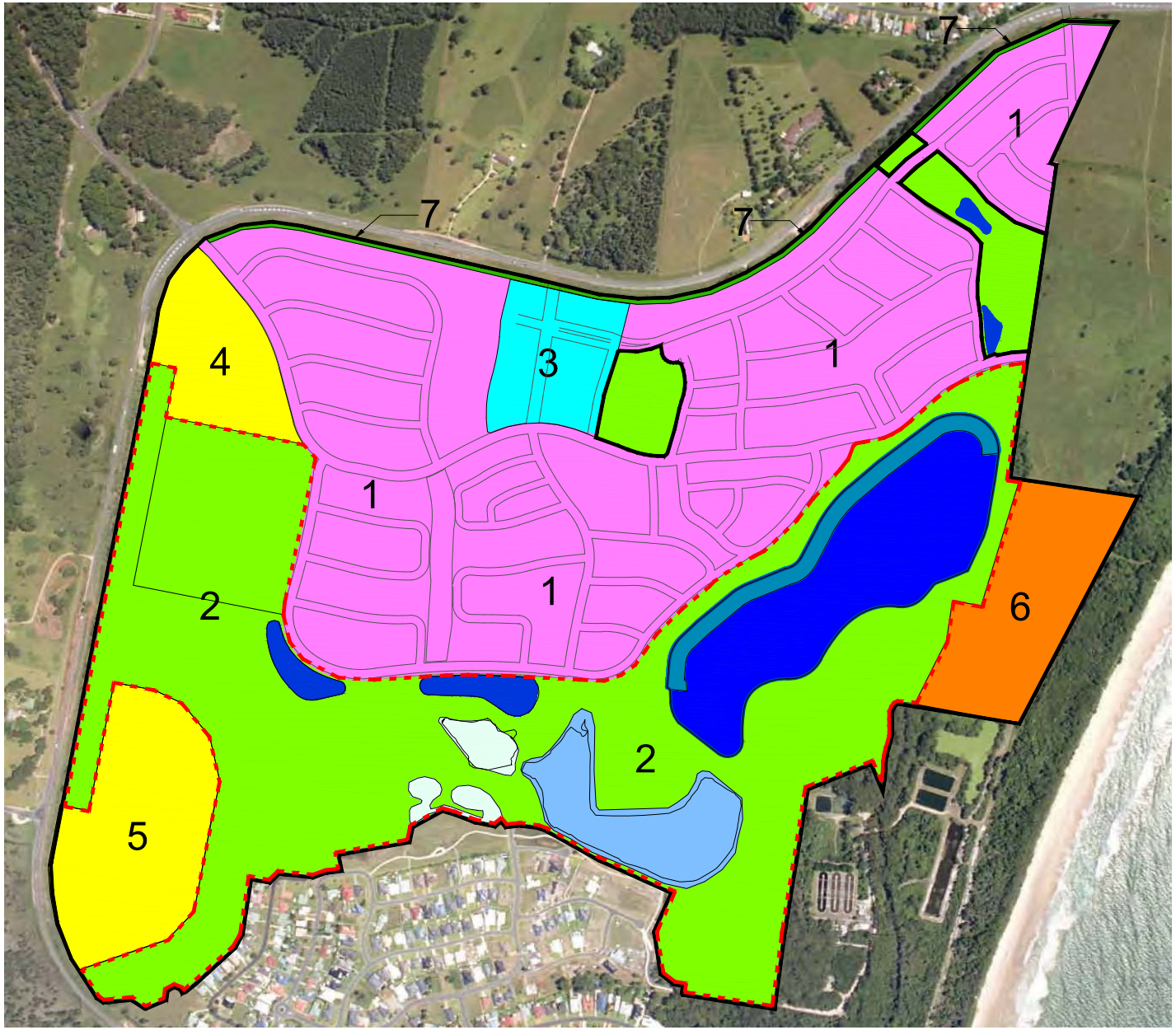

CONCEPT PLAN BREAKDOWN

1.	Residential Area	67.8
2.	Open Space, Drainage & Wildlife Habitat Corridor	80.9
3.	Village Centre	4.8
4.	Northern School Site	5.0
5.	Southern School Site	9.7
6.	Eco Tourist Site	7.6
7.	Ocean Drive Buffer (10m wide strip)	1.6
	TOTAL	**177.4**

Image sourced from Luke and Company Pty Ltd

Scale 1:7,5000 (A3)

FIGURE 1

CONCEPT PLAN DEVELOPMENT AREAS

Rev: 1 Date: 17 March 2010

Project No.: 713501/003

St. Vincents Foundation

CAD FILE: I:\7135-01\Acad\Central Corridor Management Costing Report\Figure 1 - Concept plan development areas.dwg
XREF's:

PRINT DATE: 17 March, 2010 - 2:01pm

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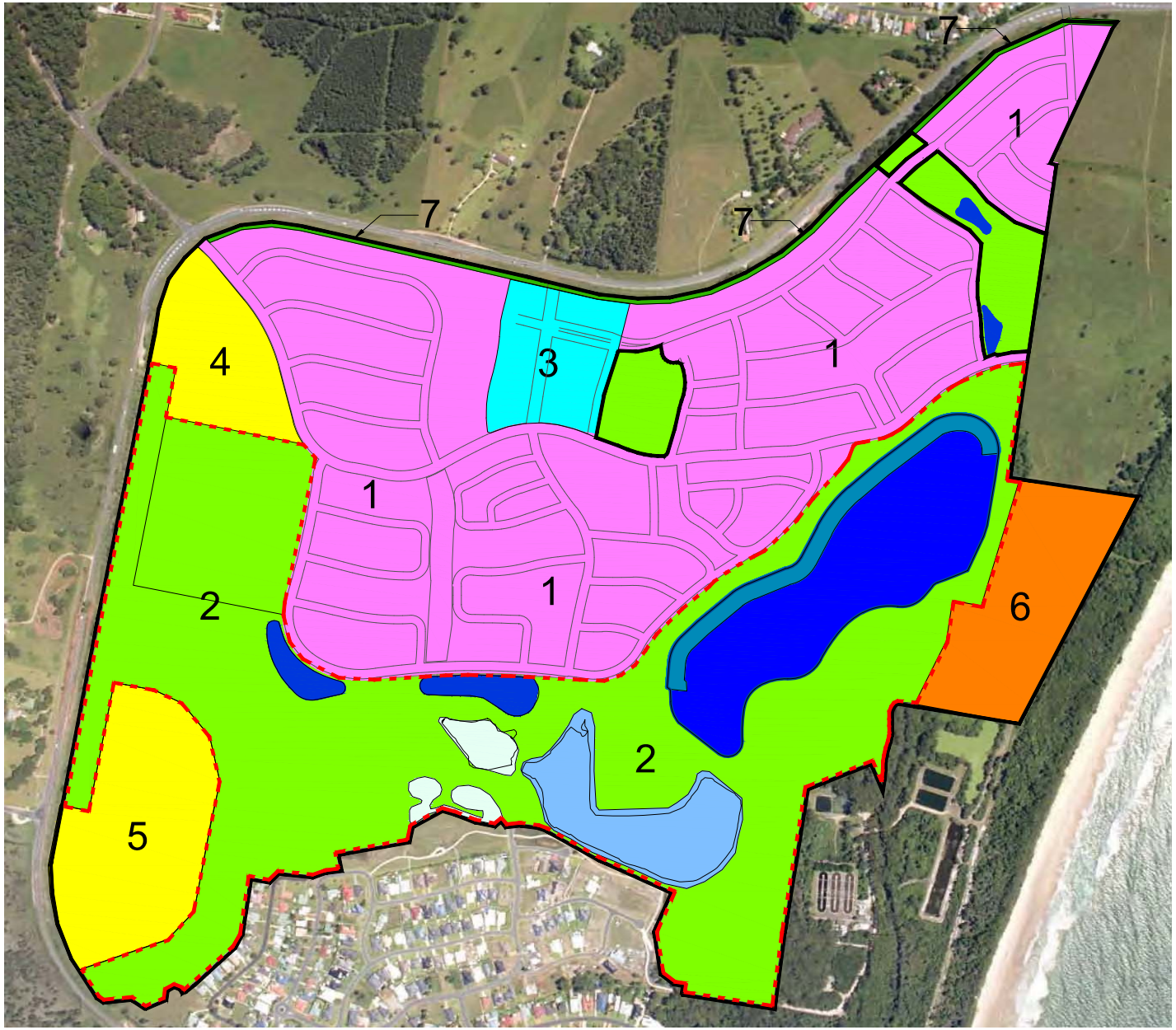

CONCEPT PLAN BREAKDOWN

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PLANS

Plan 1	713501-ELUMP-01
Plan 2	713501-ELUMP-02
Plan 3	713501-WRP-01
Plan 4	713501-WRP-02

Environmental Land Use Management Plan

The Land Owner is proposing an integrated urban development on approximately 178 ha of land situated at Rainbow Beach, Bonny Hills NSW ("the site"). As part of the proposal approximately 81 ha of land (or 46 % of the site) will form the Open Space Corridor located in the southern portion of the site. The Land Owner is cognisant of the natural assets that exist in the Rainbow Beach area, and as such proposes to rehabilitate the majority of the Open Space Corridor in a manner that enhances the ecological values and features of the site. This Environmental Land Use Management Plan (ELUMP) forms part of the broader Open Space Management Strategy prepared by Cardno (QLD) Pty Ltd and provides specific details concerning:

- the conceptual layout of the proposed development and the location of the Open Space Corridor;
- the location, extent and objectives of the Environmental Land Use Categories (ELUCs) defined within the Open Space Corridor; and
- the manner in which each ELUC is to be rehabilitated in order to achieve the specific management intents outlined herein and within the Open Space Management Strategy.

Environmental Land Use Category (ELUC)			Existing Vegetation Type (Darkheart 2008; Biolink 2006)		Rehabilitation objective	Vegetation Management Elements			
Type	No.	Area (ha)	Description	Ecological Values		Selective Vegetation Clearance	Structures	Supplementary Planting	Weed Control
Terrestrial Features									
Biodiversity Protection	1	1.2	Blackbutt – Tallowwood – Needlebark	• Regrowth with some mature trees • Some areas of dense weed infestation • Supports Koala food trees • Some corridor values	Preservation and enhancement of existing values	No	None	As required	Yes
	2	1.9	Dry Blackbutt	• Regrowth with some mature trees • Some areas of dense weed infestation • Supports Koala food trees • Some corridor values	Preservation and enhancement of existing values	No	None	As required	Yes
	3.1	1.7	Grey Ironbark – Grey Gum (near Southern School Site)	• Relatively intact canopy • Stepping-stone habitat only • Minor weed incursion • Supports Koala food trees	Preservation and enhancement of existing values	No	No	As required	Yes
	3.2	2.1	Grey Ironbark – Grey Gum (Pocket Woodland)	• Relatively intact canopy • Stepping-stone habitat only • Minor weed Incursion • Supports Koala food trees	Preservation and enhancement of existing values	No	No	As required	Yes
	4	8.8	Paperbark – Swamp Mahogany – Swamp She Oak	• Mostly regrowth, but contains elements of Swamp sclerophyll on coastal plains EEC* • Minor weed Incursion • Supports Koala food trees • Some corridor values	Preservation of existing values and enhancement of EEC elements	No	None	As required	Yes
	5.1	2.6	Swamp Oak (Eastern Creek)	• Mostly regrowth, but contains elements of Swamp Oak Floodplain Forest on Coastal Floodplains EEC • Minor weed Infestations • Some corridor values	Preservation and enhancement of existing Swamp oak swamp forest values	No	None	As required	Yes
	5.2	0.8	Swamp Oak (Central Corridor)	• Mostly regrowth, but contains elements of Swamp Oak Floodplain Forest on Coastal Floodplains EEC • Minor weed infestations • Some corridor values	Preservation and enhancement of existing Swamp oak swamp forest values	No	None	As required	Yes
	6	1.3	Wallum Froglet Habitat	• Subject to repeated slashing in the past • Minor weed Incursion • Supports Wallum froglet breeding habitat	Preservation and enhancement of existing habitat values	No	None	As required	Yes
	7	0.6	Disturbed Heathland	• Subject to repeated slashing in the past • Demonstrated resilience • Stepping-stone habitat • Minor weed Incursion	Preservation and enhancement of existing values	No	None	As required	Yes
Sub-Total Area		21							
Biodiversity Enrichment	8	0.6	Cleared Pasture / Pastoral Woodland adjoining Swamp Oak	• Highly disturbed and modified • Low corridor values • Moderate weed incursion	Enrichment of exiting values by reinstating Swamp Oak Floodplain Forest on Coastal Floodplains EEC elements	No	None	As required	Yes
	9	7.5	Cleared Pasture/ Pastoral Woodland adjoining Dry Blackbutt Open Forest	• Highly disturbed and modified • Low corridor values • Moderate weed incursion	Enrichment of existing values by reinstating Dry Blackbutt Open Forest elements	No	Pathway	As required	Yes
	10	17.8	Cleared Pasture/ Pastoral Woodland Disturbed/Regrowth Paperbark – Swamp Mahogany – Swamp She Oak	• Highly disturbed and modified • Some areas of degraded elements of Swamp sclerophyll on coastal plains EEC • Some demonstrated resilience • Minor-moderate weed Incursion • Low corridor values	Enrichment of existing values by reinstating elements of EEC and connectivity values	Limited – establishment pathways	Pathways	As required	Yes
Sub-Total Area		25.9							
Urban Edge	11	5.9	Cleared Pasture/ Pastoral Woodland	• Highly disturbed and modified • Low corridor values • Moderate weed Incursion	• Provision of recreation areas for future residents • Provision of buffer zones between residential development and BP and BE ELUCs	Limited – establishment of: • constructed wetland; • storm water detention basins and swales; and • pathways	• Storm water detention basins • Pathways • Drainage swales • Passive recreational facilities (e.g. benches, bbqs)	Limited	Yes
Sub-Total Area		5.9							
District Sporting Fields	12	7.7	Cleared Pasture/ Pastoral Woodland	• Highly disturbed and modified • Low corridor values • Moderate weed Incursion	Establishment of district sporting fields	Limited	No	No	Yes
Sub-Total Area		7.7							
Aquatic Features									
Macrophyte Treatment Zones	13.1	3.2	Cleared Pasture / Pastoral Woodland adjoining Swamp Oak (Central Corridor)	• Highly disturbed and modified • Low corridor values • Moderate weed incursion	Establishment of macrophyte vegetation for treatment of storm water runoff	Limited	Storm water detention basins	Yes	Yes
	13.2	0.4	Cleared Pasture / Pastoral Woodland adjoining Swamp Oak (Eastern Creek)	• Highly disturbed and modified • Low corridor values • Moderate weed incursion	Establishment of macrophyte vegetation for treatment of storm water runoff	Limited	Storm water detention basins	Yes	Yes
Constructed Wetland	14	10.5	Cleared Pasture/ Pastoral Woodland	• Highly disturbed and modified • Low corridor values • Moderate weed Incursion	Establishment of waterbodies for treatment and retention of stormwater	Limited	Safety fencing where required	As required	Yes
Existing Wetland	15	6.3	Waterbodies with aquatic vegetation	• Stepping stone habitat • Moderate levels of weed invasion on some banks • Good water quality	Retention and enhancement of existing values and functions	No	Safety fencing where required	As required	Yes
Sub-Total Area		20.4							
TOTAL AREA		80.9							

LEGEND

- Site Boundary
- Central Corridor Boundary
- Proposed Urban Development
- Eco Tourist Site (Not Included In this ELUC)

VEGETATION MANAGEMENT UNITS

- Vegetation Type Boundary
- 10 ELUC Number (refer Table)
- Biodiversity Protection (ELUC 1-7)
- Bioderversity Enrichment (ELUC 8-10)
- Urban Edge (ELUC 11)
- District Sporting Field (ELUC 12)

FAUNA MOVEMENT CORRIDORS

- East - West
- North - South

AQUATIC FEATURES

- Macrophyte Treatment Zone (ELUC 13)
- Constructed Wetlands (ELUC 14)
- Existing Wetlands (ELUC 15)

50 0 50 100 150 200 250m
SCALE @ A1 1:5000

* *EEC - Endangered Ecological Community* pursuant to the NSW *Threatened Species Act 1995.*

Rv.	DATE	REVISIONS	REC.	APPR.
3	18/06/10	Revision 3		
2	03/02/10	Revision 2		
1	22/02/08	Revision 1		

DESIGNED: KAG
DRAWN: NG
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Projection ******
A1
Vertical Datum A.H.D.

CAD FILE: I:\7135-01\Acad\Environmental Land Uses Management Plan\713501-ELUMP-01_v1.dwg
XREFs:

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Hervey Bay	(07) 4124 5455	(07) 4124 5155
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Philippines	(0011632) 910 5146	(0011632) 910 5146

ST VINCENT'S FOUNDATION
RAINBOW BEACH
BONNY HILLS
ENVIRONMENTAL LAND USE MANAGEMENT PLAN

DATE: 17/03/10
PLAN No: 713501-ELUMP-01
Rv. 3

DATE PLOTTED: 18 June, 2010 - 12:39pm

ELUMP Rehabilitation and Revegetation Specifications

These rehabilitation and revegetation specifications have been designed to re-establish native vegetation communities within the Open Space Corridor (OSC) as specified in Plan No. 713501-ELUMP-01 and within the Open Space Management Strategy.

Biodiversity Protection ELUCs

Rehabilitation of native vegetation communities within Biodiversity Protection ELUCs will be achieved in the first instance through encouraging natural regrowth and regeneration of native species.

Encouraging the natural regeneration of pre-existing vegetation is the most beneficial form of site restoration as:

- a source of seeds and propagules exist within the seed bank;
- species of local provenance are better adapted to the environmental conditions in the area;
- re-establishment of the community will follow natural patterns of re-colonisation; and
- soil fauna, fungal and microbial populations that are essential to a healthy plant growing environment are already present.

Removal of degrading processes is the first step in encouraging natural regrowth within native vegetation communities. In this regard, the Land Owner and Wild Things Native Gardens Pty Ltd have:

- removed cattle from OSC and established appropriate fencing;
- implemented weed management and control programs within some areas of the OSC; and
- identified areas where natural regrowth of vegetation is occurring with minimal intervention.

A supplementary planting program may be necessary in order to embellish areas where regrowth isn't occurring readily. Key indicators to trigger the commencement of supplementary planting include:

- expanses of exposed ground resulting from weed removal treatments;
- stochastic disturbance events (i.e. windthrow, flood) that have induced high levels of mortality; and
- gaps created by limitations in natural recruitment (i.e. absence of germination cues such as fire).

The species planted and densities required will be dependent on the composition and structural elements of the pre-existing vegetation. A recommended species list for each of the Biodiversity Protection ELUCs is provided within the Open Space Management Strategy.

Biodiversity Enrichment ELUCs

Biodiversity Enrichment ELUCs encompass vegetation that is currently in a degraded state and as such it is more likely that a supplementary planting program will need to be undertaken in order to achieve the rehabilitation objectives for these communities as described in the Open Space Management Strategy. However, some areas of these communities are displaying a degree of resilience and are in the process of succssfully regenerating. In this regard, a supplementary planting program will only be undertaken within areas where the Vegetation Benchmark. In this regard, a supplementary planting program will only be undertaken within areas where the Vegetation Benchmarks listed in Table 1 are not being achieved through natural regrowth and regeneration.

Table 1. Vegetation Benchmarks for Biodiversity Enrichment ELUCs

VMU	Description	Minimum Native Plant Cover %		
		Overstorey	Midstorey	Groundstorey
BE 9	Cleared Pasture/Pastoral Woodland adjoining Swamp oak	10	5	5
BE 10	Cleared Pasture/Pastoral Woodland adjoining Dry Blackbutt Open Forest	10	10	10
BE 11	Cleared Pasture/Pastoral Woodland Disturbed/Regrowth Paperbark – Swamp Mahogany – Swamp She Oak	10	10	10

*Benchmarks determined using data and methodologies presented within Gibbons *et al.* 2005.

To assess whether these Vegetation Benchmarks are being achieved, Biodiversity Enrichment ELUCs will be monitored on an annual basis in general accordance with the Vegetation Monitoring Program provided within the Open Space Management Strategy.

Where these Vegetation Benchmarks are not being achieved a supplementary planting program shall be implemented in order to establish community strata that will eventually support the minimum per cent cover of native vegetation specified in Table 1. A recommended species list for supplementary planting programs with Biodiversity Enrichment ELUCs is provided in Table 2 below.

Table 2. Recommended species for use in supplementary planting programs within Biodiversity Enrichment ELUCs

Scientific Name	Common Name	ELUC 8	ELUC 9	ELUC 10
OVERSTOREY				
Acacia implexa	Hickory wattle	P	-	
Casuarina glauca	Swamp oak	P	-	P
*Corymbia intermedia**	Pink bloodwood	A	A	A
*Eucalyptus grandis**	Flooded gum		-	
*Eucalyptus pilularis **	Blackbutt		P	
Eucalyptus planchoniana	Needlebark stringybark		P	
*Eucalyptus resinifera**	Red mahogany		A	
*Eucalyptus robusta**	Swamp mahogany	A	A	P
*Eucalyptus tereticornis**	Forest red gum	P	-	A
Ficus macrophylla	Moreton bay fig		-	
Glochidion ferdinandi	Cheese tree	A	-	
*Melaleuca quinquenervia**	Broad-leaved paperbark	P	A	P
UNDERSTOREY				
Acacia elongata var. dilatatum	Slender wattle		-	A
Acacia longifolia	Sydney golden wattle		P	
Acmena smithii	Lilly pilly	P	-	
Acronychia oblongifolia	Common acronychia	P	-	
Allocasuarina littoralis	Black she-oak	A	-	P
Babingtonia pluriflora	Tall baeckea		-	A
Banksia integrifolia	Coast banksia		P	-
Banksia serrata	Old man banksia		P	
Brachychiton populneus	Kurrajong		-	
Cissus antarctica	Kangaroo grape		-	
Cordyline stricta	Palm lily		-	
Eustrephus latifolius	Wombat berry		P	
Exocarpus cupressiformis	Cherry ballart		-	P
Glycine microphila	Small-leaf glycine		P	-
Leptospermum polygalifolium	Slender tea tree		-	P
Melaleuca linariifolia	Snow in summer		-	P
Melaleuca sieberi	Small-leaved paperbark		-	A
Melaleuca styphelioides	Prickly-leaved paperbark		-	P
Morinda jasminoides	Jasmine morinda	A	-	-
Parsonsia straminea	Monkey rope	P	-	-
Pultenaea retusa	Blunt bush pea		-	A
Pultenaeu villosa	Bronze bush pea		-	A
Smilax glyciphylla	Native sarsaparilla		A	-
Xanthorrhoea fulva	Swamp grass tree	P	-	A
GROUNDSTOREY				
Blechnum indicum	Bungwall fern		-	A
Calochaena dubia	False bracken fern		-	A
Carex appressa	Tall sedge	P	-	-
Doodia aspera	Prickly rasp fern		-	-
Eleocharis acuta	Common spike-rush		-	A
Histiopteris incisa	Bats-wing fern		P	-
Isachne globosa	Swamp millet		-	P
Ischaemum australe			-	P
Lomandra longifolia	Mat rush	P	P	A
Oplismenus aemulus	Basket grass	A	P	P
Restio tetraphyllus	Tallus rush		P	-

P, Preferred plant species; A, Alternative plant species; -, present in community.

* Koala food tree

Recommended planting densities to be used in the supplementary planting are provided in Table 3 below.

Table 3. Recommended planting densities to be used in supplementary planting programs within Biodiversity Enrichment ELUCs

Strata	Planting Densities	Notes
Overstorey	1 plant per 4 m^2	Any individual tree species is to constitute no more than 20% of plantings. At least 50% of plantings shall include Koala food trees
Midstorey	1 plant per 2 m^2	Any individual shrub species is to constitute no more than 20% of shrub plantings.
Groundstorey	1 plant per 1m^2	Any individual ground cover species is to constitute no more than 20% of plantings. Particular mix of ground covers in any given area is to be determined at the time of planting and is to take into account the nature of existing ground cover and overstorey vegetation.

Notes: planting densities are to be adjusted to account for the presence of native vegetation; and

Managed Parkland ELUCs

The purpose of Managed Parkland ELUCs is to provide an appropriate interface between residential development and the Open Space Corridor whilst providing additional asset protection from a bushfire perspective. These areas will be actively maintained as parkland with passive recreation opportunities for future residents. In this regard, Management Parkland ELUCs will:

- be subject to weed removal and management;
- be grassed with species which are generally non-invasive and easy to manage;
- support plantings of appropriate shade trees; and
- include signage indicating that dogs are to be kept on leads at all times.

Any trees planted in Managed Parkland ELUCs must be endemic to the area and be planted in a manner that maintains views of the proposed constructed wetland whilst providing fauna movement opportunities. Recommended tree species for use within Managed Parkland ELUCs are provided in Table 4.

Table 4. Recommended shade trees for use in Managed Parkland ELUCs

Scientific name	Common name
Angophora floribunda	Rough-barked apple
Angophora subvelutina	Broad-leaved apple
Acmena smithii	Lilly Pilly
Acronychia oblongifolia	Common acronychia
Alphitonia excela	Red ash
Brachychiton populnea	Kurrajong
*Corymbia intermedia**	Pink bloodwood
Cupaniopsis anarcardioides	Tuckeroo
*Eucalyptus grandis**	Flooded gum
*Eucalyptus robusta**	Swamp mahogany
*Eucalyptus tereticornis**	Forest red gum
Ficus macrophylla	Moreton bay fig
Glochidion fernandi	Cheese tree
Lophostemon confertus	Brush box

Supplementary Planting Management

Mulching

The application of mulch assists in the control of weeds, encourages growth of planted natives and improves the retention of water by providing a layer of organic matter on the soil substrate.

Mulch can be sourced from areas to be cleared on the site by stockpiling the existing litter layer and top soil. Stockpiling and reuse of topsoil provides an additional source of seeds and propagules to the supplementary plantings from the pre-existing seed bank. It also contributes to the reestablishment of soil fauna, fungal and microbial populations that are essential to for a healthy plant growing environment.

Alternatively, mulch can be sourced from chipping or mulching of vegetative material on the site. In either case, topsoil or vegetative material for mulching should be collected only from areas that have a low weed density.

Fertilisers

At the time of planting, fertiliser will be applied to each plant in the form of an [illegible] tablet. During the first year of planting, fertiliser such as Dynamic [illegible] will be applied to the plants as required to maintain the health and growth rate of planted species. To avoid potential leaching of fertilisers, slow release nitrogenous (and low phosphate content) fertilisers will be used.

Watering

Watering of the supplementary planting works will be undertaken to ensure that an adequate survival and establishment rate is achieved. To assist in this process, water crystals will be used at the time of planting to ensure that the plantings have sufficient water to survive during the early establishment period.

The frequency of watering to achieve plant establishment will depend on the prevailing climatic conditions at the time of planting and thereafter. Watering will generally be carried out in the cooler hours of the day, namely morning or evening, and will be frequent enough to prevent wilting of plants.

The following watering program is recommended,

Week 1 - 2: 3 visits/week **Week 3 - 6:** 2 visits/week **Week 7 - 12:** 1 visit/ week

The necessity for watering during the above program will be dependant upon rainfall. The frequency of watering will be gradually reduced as the plantings mature and it is anticipated that after a period of 4 - 6 months the planting will be sufficiently established such that supplementary watering will not be required.

Supplementary Planting Monitoring and Maintenance

Performance Requirements

The implementation of the supplementary planting programs, generally in accordance with the above specifications, must achieve the following performance requirements:

- no inappropriate plant species (i.e. non-endemic, exotic or weed species) are to be used in the revegetation program;
- planting densities and mixtures established in each community are appropriate for the production of vegetation structure which will achieve the applicable Vegetation Benchmark for that ELUC;
- an 80% survival rate of plant stock is to be maintained within each ELUC for a period of three years;
- a minimum 90% native ground cover is to be maintained for the three-year maintenance period; and
- revegetation plots are to be maintained for the three year period such that:
  - i) native species comprise at least 90% of the species composition within each plot; and
  - ii) native species comprise at least 90% of the biomass and/or cover within each plot.

Monitoring and Maintenance

The most intensive period of maintenance is during the plant establishment period (i.e. the first three years) when weed removal and supplementary planting may be required. In this regard, revegetation plots, bioretention basins and vegetated swales shall be inspected every two months for the first 6 months following construction and once every six months thereafter for the duration of the three year maintenance period. Routine monitoring and maintenance activities during this time should include, but not be restricted to the following:

- identification and removal of any areas of obvious increased sedimentation, litter build-up and blockages;
- repair of damage to supplementary plantings resulting from scour, erosion or sediment build-up;
- regular watering of plantings during the establishment phase;
- removal and management of weed species; and
- replacement of plantings that have died with plants of equivalent size and species.

Weed Management

All weeds are to be removed from areas to be revegetated prior to planting. All revegetated areas are to be managed for a minimum period of 6 months following the establishment of planted species, to ensure infestations of weed species do not become established in the OSC. All weeds are to be managed in general accordance with the specifications provided within the Open Space Management Strategy.

A summary of the weeds recorded within the site and their recommended control techniques are provided below in Table 5 below.

Table 5. Weed management techniques.

Scientific Name	Common Name	Control Methods	
		Physical	Herbicide
Lantana camara	Lantana	SR, SI, Gr	BB, CS, FS
Andropogon virginicus	Whisky grass	HW, SI	FS,
Chloris gayana	Rhodes grass	HW, SI	FS
Panicum repens	Torpedo grass	SI	FS
Passiflora subpeltata	White passionflower	HW	CS, SS
Senecio madagascariensis	Fireweed	HW	FS
Sporobolus africanus	Parramatta grass	HW	FS

*Recommended Control Methods (NSW Department of Primary Industries 2007): Physical methods. HW – Hand weeding, Gr- Grubbing SR – Stick raking, SI – Slashing; Herbicide application, BB – Basal bark, CS – Cut stump, FS – Foliar spray, SS- Spot Spray. Control Techniques for Torpedo grass, developed through on-site trials by Wild Things Native Gardens Pty Ltd.

DATE PLOTTED: 17 March, 2010 - 9:17am

Rv.	DATE	REVISIONS	REC.	APPR.

DESIGNED: KAG
DRAWN: NG
CHECKED: DMC
Horizontal Datum ******
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Vertical Datum A.H.D.
Projection ******

CAD FILE: L:\7135-01\Acad\Water Engineering & Env DGR Assessments\Vegetation Management Plans\7135-ELUMP-02.dwg
XREFs:

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ST VINCENT'S FOUNDATION

RAINBOW BEACH
BONNY HILLS
ENVIRONMENTAL LAND USE MANAGEMENT PLAN

DATE: 16/03/2010 Rv.
PLAN No:
713501-ELUMP-02 0

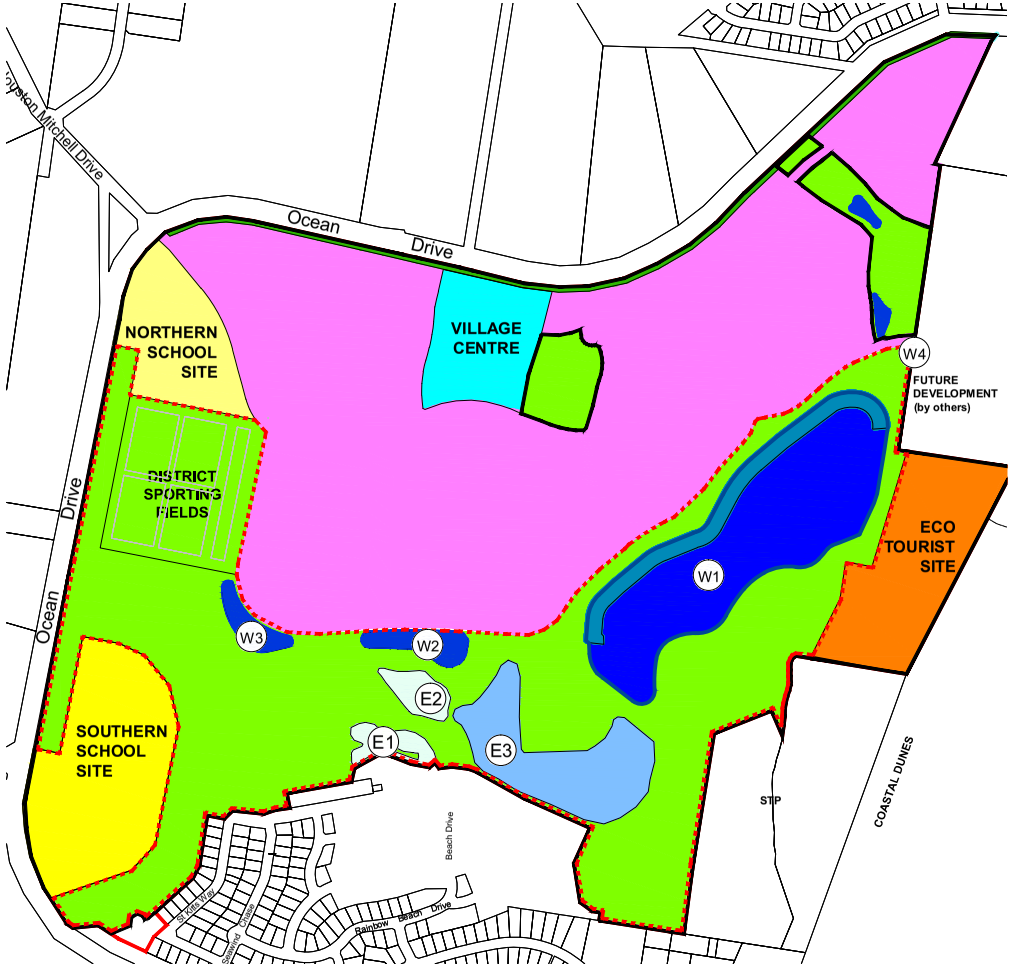
WETLAND REVEGETATION PLAN

approximately 81 ha (or 46% of the site) will be incorporated into an Open Space Corridor (OSC). This OSC will include an existing lagoon system in the central-southern portion of the site and the establishment of four (4) proposed constructed wetlands. This Wetland Rehabilitation Plan provides specific details concerning:

- the habitat values associated with the existing lagoon;
- the manner in which the existing lagoon and constructed wetlands are to be rehabilitated and/or revegetated in order to achieve specified desired outcomes; and
- recommendations and monitoring programs designed to assist the wetland revegetation program in creating high quality habitat for aquatic flora and fauna.

This WRP should be read in conjunction with the Opens Space Management Strategy and Environmental Land Use Management Plan (ELUMP) prepared for the site by Cardno (QLD) Pty Ltd.

CONCEPT PLAN



LEGEND

Site Boundary
Open Space Boundary
Residential
Village Centre
Schools
Eco Tourist Site
Open Space Corridor

E1 Prototype Wetlands for Stage 2 and 3
E2 Existing Wetland Lake
E3 Existing Eastern Lake
W1 Proposed Constructed Wetlands
W2 Wetlands Servicing Western Medium Density and Conventional Residential Area
W3 Constructed Wetlands(North School Site, Playing Fields and Western Residential Area)

EXISTING VALUES

The existing lagoon system (E2 and E3) was constructed at least 20 years ago and has since been receiving runoff from the surrounding grazing land to the north and more recently from residential development to the south. Vegetation within the macrophyte and littoral zone of the existing lagoon has been mapped by specialist personnel of 'Wild Things Native Gardens Pty Ltd' and an excerpt of this mapping is provided in the figure below. At present the existing lagoon supports a diversity of native macrophyte species and does not support any infestations of aquatic weeds. However, the littoral zone has been subject to heavy infestations of the introduced Torpedo grass (*Panicum repens*). The Land Owner and staff of 'Wild Things Native Gardens' have been actively trialling means of controlling this pest species and have successfully removed the majority of its biomass from the lagoon littoral zone. This has created an opportunity for the revegetation and rehabilitation of the existing lagoon to enhance its biodiversity values and inhibit regrowth of Torpedo grass.

In terms of aquatic habitat the existing lagoon is in a relatively healthy condition (refer Ecology Lab 2008) with only some minor concerns surrounding the low abundance and diversity of benthic fauna. A variety of aquatic organisms were found to inhabit the lagoon including Sea mullet (*Mugil cephalus*), Freshwater mullet (*Myxus petardi*), Snake-necked tortoise (*Chelodina longicollis*), Empire gudgeon (*Hypseleotris compressus*), Striped gudgeon (*Gobiomorphus australis*), Flathead gudgeon (*Philypnodon grandiceps*), and Shortfin eel (*Anguilla australis*). The only introduced species detected in the lagoon was the Mosquito fish (*Gambusia holbrooki*). A number of cosmopolitan waterbird species such as Chestnut teal (*Anas castanea*), Cormorants (*Phalacrocorax* spp), Pacific Black duck (*Anas superciliosa*) and Purple swamphen (*Porphyrio porphyrio*) utilise the existing lagoon for habitat resources on a regular basis.

No threatened flora or fauna species have been recorded within or adjacent to the lagoon system.

The existing stormwater treatment pond (i.e. E1) is also in a relatively healthy condition with no signs of aquatic weed establishment at present. The submerged and marginal zones of this pond have been actively planted out with native wetland species that complement the vegetation associated with the existing lagoon system. The treatment pond also supports a healthy population of Cape waterlilly (*Nymphaea caerulea*) as distinguished by the bright green signature in the aerial photograph below.

LEGEND

Extent of Wetland Revegetation
Jointed twig-rush (*Baumea articulata*)
Soft twig-rush (*Baumea rubiginosa*)
Sag (*Eleocharis equistina*)
Tall Spikerush (*Eleocharis spacelata*)
Sea Rush (*Juncus krausii*)

WETLANDS TO BE CONSTRUCTED

The Concept Plan provides for the establishment of four (4) constructed wetlands that will form part of the stormwater treatment train. The largest constructed wetland (i.e. W1) will have a surface

existing lagoon through the new constructed wetland (i.e. W1) by means of a new culvert connecting the two water bodies, hence re-establishing the natural flow path.

Three smaller wetlands (i.e. W2, W3 and W4) will also be constructed along the interface of the proposed urban development and OSC. These wetlands will assist in the management of stormwater being generated by the proposed development, but will also contribute to the ecological values and functions of the OSC.

DATE PLOTTED: 17 March, 2010 - 9:15am

Rv.	DATE	REVISIONS	REC.	APPR.
2	12/03/10	CHANGE TO CONCEPT PLAN		
1	07/10/09	CHANGE TO PROPOSED CONSTRUCTED WETLAND		

DESIGNED: KAG
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ST. VINCENTS FOUNDATION PTY LTD
RAINBOW BEACH
BONNY HILLS
WETLAND REVEGETATION PLAN

DATE: 16/03/2010
PLAN No: 713501-WRP-01
Rv. 3

REHABILITATION AND REVEGETATION GUIDELINES

OBJECTIVES

These guidelines provide specifications for the revegetation and rehabilitation of the existing lagoon system and the proposed constructed wetlands. The rehabilitation objective for the existing lagoon (E2 & E3) and proposed constructed wetlands (W1,W2, W3 & W4) is to establish self-sustaining wetland vegetation communities that will provide the following ecological values and functions:

- sediment removal and erosion control;
- excess nutrient and metal removal;
- bank stability;
- moderation of water temperature and light penetration through shading; and
- provision of feeding, breeding, nursery habitat resources for aquatic fauna and other wildlife species.

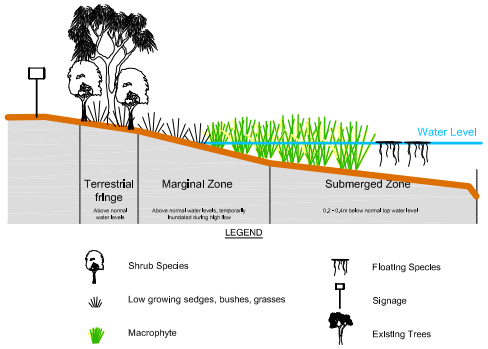
At a finer scale, there are some differences in the rehabilitation objectives between the existing lagoon and the proposed constructed wetlands, as detailed below.

Existing Lagoon (E2 & E3)

Rehabilitation of the existing lagoon will be focussed on:

- enhancing and expanding existing populations of native macrophyte species;
- enhancing habitat values for aquatic fauna and other wildlife species that utilise the lagoon;
- enhancing the diversity of native species in the Marginal Zone and Terrestrial Fringe of the lagoon;
- reducing habitat suitable for the colonisation of Torpedo grass;
- creating a vegetative barrier to the water edge that excludes access by the public and dogs; and
- improving the visual amenity of vegetation associated with the lagoon.

A conceptual diagram of the end profile of the existing lagoon is provided below.

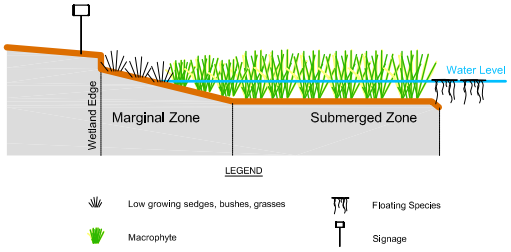


Proposed Constructed Wetlands (W1, W2, W3 & W4)

Rehabilitation of the proposed constructed wetlands will be focussed on:

- creating a self-sustaining vegetation communities characterised by a diversity of native species within the Marginal Zone and Submerged Zone;
- providing a range of habitats to encourage colonisation of the wetlands by native aquatic fauna;
- providing additional breeding habitat for the threatened Wallum froglet *(Crinia tinnula)* which is known to inhabit areas within the OSC;
- limiting the availability of habitat to be colonised by weed species such as Torpedo grass;
- contributing to the visual amenity of the OSC; and
- providing an effective balance between biodiversity conservation and passive recreational pursuits (i.e. bird watching) associated with the OSC.

A conceptual diagram of the end profile of the proposed constructed wetlands is provided below.



SPECIES SELECTION

The planting schedule and recommended planting densities shown herein have been specifically designed to achieve the rehabilitation objectives outlined for the existing lagoon and proposed constructed wetlands. Species included in the planting schedule have all been recorded within the existing lagoon or other waterway features on the site.

Table 1 Planting Schedule - Species to be used in the rehabilitation and revegetation of the existing lagoon and proposed constructed wetlands.

Scientific Name	Common Name	Submerged	Marginal	Terrestrial Fringe
Shrub Species				
Melaleuca linariifolia	Snow-in-summer	-	-	X
Callistemon linearis	Narrow-leaved bottlebrush	-	-	X
Leptospermum juniperinum	Prickly tea-tree	-	-	X
Groundstory Species				
Baumea rubiginosa	Soft twig-rush	X	-	-
Baumea articulata	Jointed twig-rush	X	-	-
Carex appressa	Tall sedge	-	-	X
Chorizandra sphaerocephala	Round-headed bristle rush	-	X	-
Cyperus polystachyos	-	-	-	-
Eleocharis equistina	Sag	X	-	-
Eleocharis sphacelata	Tall spike-rush	X	-	-
Fimbristylis dichotoma	Common fringe sedge	-	-	X
Fimbristylis tristachya	-	-	-	X
Juncus kraussii	Sea rush	-	X	X
Juncus usitatus	Common rush	-	X	X
Ludwigia peploides ssp montevidensis	-	X	-	-
Philidrum lanuginosum	Frogsmouth	-	X	-
Potamogeton javanicus	-	X	-	-
Ranunculus undosus	Swamp buttercup	-	X	-
Schoenus brevifolius	Zig-zag bog-rush	-	X	-
Schoenoplectus validus	River clubrush	-	X	X
Triglochin procera	Water ribbons	X	-	-
Themeda triandra	Kangaroo grass	-	-	X

Table 2 Planting Densities - Recommended planting densities for the rehabilitation and revegetation of the existing lagoon and proposed constructed wetland.

Wetland Zone	Understory (/m²)	Groundstorey (/m²)
Submerged	0	4
Marginal	0	10
Terrestrial Fringe	2	6

Notes:

- planting densities associated with the existing lagoon are to be adjusted to account for the presence of existing and/or regenerating vegetation;
- species selection around the existing lagoon should be focussed on expanding existing populations of native macrophytes;
- all plantings are to be carried out using standard tube stock;
- where practicable native species are to be sourced from the on-site nursery initiated and managed by Wild Things Native Gardens Pty Ltd;
- where species are not available from the on-site nursery, plants are to be sourced from a local native plant nursery; and
- to ensure local provenance, the planting stock should be derived from seed or propagules collected from individuals growing within the site and/or locality as far as practicable.

REVEGETATION MANAGEMENT

Soil Surface Preparation

Marginal Zone and Terrestrial Fringe

It will be necessary to prevent erosion and the introduction of weeds to exposed areas during construction of the proposed wetlands and weed removal activities associated with the existing lagoon. Heavily woven jute mesh is an open weave erosion control mat suitable for short term erosion control in areas subject to light water flow (i.e. marginal zone and terrestrial fringe). As well as preventing erosion, jute mesh holds seeds and saplings in place, promotes plant growth by improving soil condition and moisture levels, reduces weeds and is easily planted through.

The revegetation zone associated with the existing lagoon and proposed constructed wetlands should be free of weeds, large stones and other debris leaving an even surface that will allow the jute mesh to obtain maximum possible adhesion. The jute mesh shall be overlapped with adjacent rolls by 150mm and secured with fixing pins at approximately 1 pin/m2. The edges where the jute mesh overlaps should be stapled at regular intervals to prevent weed invasion. The jute mesh will hold in position for a considerable period whilst stabilisation by vegetation takes place. The jute mesh eventually decomposes into the soil.

The installation of jute mesh around the existing lagoon system will need to be adjusted to accommodate existing and regenerating native vegetation and ideally should only be used where weed removal (i.e. Torpedo grass) has left an area of exposed ground.

Fertilisers

At the time of planting, fertiliser will be applied to each plant in the form of an Agriform® tablet. During the first year of planting, fertiliser such as Dynamic Lifter® will be applied to the plants as required to maintain the health and growth rate of planted species. To avoid potential leaching of fertilisers, slow release nitrogenous (and low phosphate content) fertilisers will be used.

Water Level Management

Submerged and Marginal Zones

Controlling the water levels is an important component of the establishment phase of a wetland revegetation zone as it:

- facilitates seedling establishment;
- allows for supplementary planting to be carried out to compensate for mortality rates;
- allows access to planting in the deeper submerged wetland zone;
- can assist in controlling floating weed species; and
- facilitates the repair of erosion and structural problems that may arise in the revegetation zone.

The following water level management activities are recommended:

Table 3 Water Level Management. Recommended water level management activities during wetland revegetation establishment phase.

Time frame	
Initial months	Planting should be watered immediately and then the revegetation areas should remain drained completely for 2 - 4 weeks, ensuring there is always adequate sub-surface moisture available through occasional watering.
Year 1	Water depth should generally not exceed 200mm in the deepest planted section during the first year. The revegetation areas should be drained completely for a few weeks in summer, or longer, depending on rainfall
Year 2	During the second year of growth, water depths can range from 100-400mm, interspersed with weeks of shallower depths and few weeks of complete draining. Water levels can be maintained up to 400mm in the deeper planted parts. Water levels can be deeper for short periods when combined with a draining phase during the year.

Sourced from *The Constructed Wetlands Manual, Vol 2* (1998), Department of Land and Water Conservation, New South Wales.

These water management activities should be treated as a guide only and variations from these guidelines may be necessary depending on prevailing climatic conditions and logistical constraints associated with draining the existing lagoon and proposed constructed wetland.

Terrestrial Zone

If required, watering of the supplementary plantings will be undertaken to ensure that an adequate survival rate of transplants is achieved. The frequency of watering to achieve plant establishment will depend on the prevailing climatic conditions at the time of planting and thereafter. Watering will generally be carried out in the cooler hours of the day, namely morning and evening, and will be frequent enough to prevent the wilting of transplants.

The following watering program is recommended:

Week 1 - 2 3 visits/week **Week 3 - 6** 2 visits/week **Week 7 - 12** 1 visit/week

With regard to the above, the frequency of watering will be gradually reduced as the plantings mature and it is anticipated that after a period of 4 - 6 months the plantings will be sufficiently established that supplementary watering will no longer be required.

MONITORING AND MAINTENANCE

Performance requirements

The implementation of the revegetation program, generally in accordance with the above specifications, must achieve the following performance requirements:

- no inappropriate plant species (i.e. non-endemic, exotic or noxious weed species) are to be used in the revegetation program;
- planting densities and mixtures established in each Wetland Zone are to correspond to the specifications provided herein;
- an 80% survival rate of planting stock is to be maintained within each Wetland Zone for a period of three years; and
- areas included in the Marginal Zone and Terrestrial Fringe are to be maintained at a minimum of 90% weed free for a period of three years.

Monitoring

The most intensive period of maintenance is during the plant establishment period (i.e. the first three years) when weed removal and supplementary planting may be required. In this regard, each Wetland Zone shall be inspected every two months for the first six months and once every six months thereafter for the duration of the three-year maintenance period. Routine monitoring and maintenance activities during this time should include, but not be restricted to the following:

- identification of mortality and/or damage to Rehabilitation Zones;
- removal of litter and/or debris build up;
- removal and management of weed species;
- watering of plantings and seeded areas during the plant establishment phase in accordance with the watering program provided herein; and
- replacement of plantings that have died with plants of equivalent size and species detailed in the panting schedule.

Weed management

Several weed species exist within, and adjacent to the proposed development area. Species including Lantana (*Lantana camara*) and Torpedo grass (*Panicum repens*) have been recorded on site and are to be controlled in accordance with the specifications provided in the Open Space Management Strategy.

All weeds are to be removed from areas to be rehabilitated prior to planting or seeding. All Wetland Zones are to be managed for a minimum period of six months following the establishment of planted species, to ensure infestations of weed species do not become established.

Aquatic weed management is to be carried out in accordance with the specifications provided within the Open Space Management Strategy.

Fauna Management

Habitat Enhancement

Habitat enhancement for aquatic organisms and other native wildlife utilising the existing lagoon and proposed constructed wetland will include:

- creation of diverse and structurally complex wetland vegetation;
- provision of rocks and/or logs (salvaged from the development footprint) as habitat features within and around the wetlands;
- screening vegetation to reduce disturbance to wildlife;
- provision of fish friendly design into linkages between wetlands and Duchess Gully;
- ongoing removal and control of invasive plant species; and
- prohibition of domestic pets within and around the wetland system.

Monitoring of biodiversity

To formally assess the colonisation of the proposed constructed wetland by aquatic organisms and to monitor any change in the biodiversity of the exiting lagoon a monitoring program will be undertaken in accordance with the specifications provided within the Open Space Management Strategy. The monitoring program will be focussed on sampling the diversity of fauna species within the benthic sediments, fish and other free moving aquatic organisms and water bird species.

Signage

Advisory and interpretive signage will be established around the existing lagoon and proposed constructed wetland. Signage will comply with Australian Standards, will be non-intrusive and highly resistant to vandalism. Signage will incorporate the following elements:

- the purpose of the wetland;
- identification of any significant features (i.e. habitat for threatened wildlife species);
- appropriate safety warnings; and
- prohibition of dogs and other domestic animals.

References

Aquatic Flora and Fauna Survey - Rainbow Beach, Bonny Hills (April 2008). The Ecology Lab Pty Ltd.

Constructed Wetland Systems - Design Guidelines for Developers (2002) Melbourne Water®.

Plan No. P12 - Macrophyte Mapping in Waterbodies E2 & E3 Rev A, dated 25th February 2008. Wild Things Native Gardens and Luke & Company Pty Ltd.

The Constructed Wetlands Manual, Vols 1 and 2 , (1998) Department of Land and Water Conservation, New South Wales.

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WETLAND REVEGETATION PLAN
RAINBOW BEACH

DATE: 14/08/2008
PLAN No: 713501-WRP-02
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