KIRRAWEE FORMER BRICK PIT SITE

Biodiversity Management Plan
Revised November 2011

For:

KIRRAWEE CENTRE PTY LTD

November 2011

Final Report

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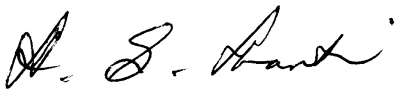
Report No. 10070RP2

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

Approved by: Alison Martin for David Robertson

Position: Project Manager for Director

Signed: 

Date: *2 November, 2011*

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Chapter 1

Introduction

1.1 Background

This Biodiversity Management Plan (BMP) has been prepared in support of an application for Concept Plan approval under Part 3A of the Environmental Planning and Assessment Act at 566-594 Princes Highway Kirrawee, otherwise known as the former Kirrawee Brick Pit (Reference MP 10_0076). This BMP represents an updated version of the previously submitted BMP prepared for the project. The application seeks approval for a mixed use development comprising residential, retail and commercial uses and building envelopes of between 5 and 14 storeys,. The proposal also involves basement car parking, landscaping, services and the provision of a major new public park. Specifically, this report addresses issue number 2 as detailed in the Director General's Requirements (DGR's) issued by the Department of Planning on 24 August 2010 and subsequent submissions made to the Department of Planning (DoP) by Council, DECCW and the general public on the proposal. This document also address matters raised by the DoP in their "issues letter" dated 14 April 2011. The purpose of this report is to provide a Habitat Management Plan for the Grey-headed Flying-fox and a Vegetation Management Plan for the Sydney Turpentine Ironbark Forest (STIF) community and the Grey-headed Flying-fox and consideration of appropriate offsets to compensate for unavoidable impacts.

The subject site, being a former brickworks quarry, consists of largely disturbed areas of exotic grassland vegetation and grassland in the northern sector with some small areas of remnant native vegetation in the southern and southwestern sector. The remnant native vegetation surrounds the former quarry pit, concentrated along the western and southern edges. This vegetation has previously been identified as Sydney Turpentine Ironbark Forest, which is listed as an Endangered Ecological Community under the NSW Threatened Species Conservation Act 1997, and as Critically Endangered under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (under the name Turpentine-Ironbark Forest of the Sydney Basin Bioregion).

The previous quarry pit holds a large body of freshwater, occupying approximately 1.4 ha of the total 4.254 ha site and dominating the southern portion of the site,. The location of the subject land is shown in **Figure 1.1.** The flooded pit is significantly depressed within the local topography, with steep embankments of up to 15m above the current water line.

As part of the previous Development Application (DA) documentation for the project, Environmental Resources Management Australia (ERM) prepared a *Flora and Fauna Assessment* [1] which described the existing flora and fauna species and plant communities on the land, and assessed the presence or likely occurrence of Threatened species, populations and ecological communities listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act). This report classified the vegetation along the southern boundary (Flora St) as not constituting STIF, due to a degraded understorey containing insufficient native species. This classification contradicts a previous report by URS which classified the vegetation as constituting STIF. A contention relating to the original DA was made by Sutherland Shire Council on the basis that the vegetation along the southern boundary had been incorrectly identified by ERM. Cumberland Ecology was engaged by Kirrawee Centre Pty Ltd as a secondary party to carry out an independent assessment of the vegetation community in question. This assessment found the vegetation to constitute STIF.

The ERM survey also reported the occurrence of two threatened mammal species within the subject land, The Grey-headed Flying Fox (*Pteropus poliocephalus*) and the Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*). These species were associated with the water body (the quarry), with the Grey-headed flying Fox observed drinking from the pit. A Contention to the DA by Sutherland Shire Council was also made on the basis that the proposal made insufficient provisions for these species.

Cumberland Ecology has subsequently prepared an *Ecological Impact Assessment (*EIA) (Cumberland Ecology 2008[6]) and an updated Flora and Fauna Assessment (Cumberland Ecology 2010[7]), the latter report based on the revised Concept Plan for the Part 3A application and provided as supplementary documentation to that application. The Flora and Fauna Assessment and subsequent reports have been prepared to assess the impact of the proposed action, recommend appropriate compensatory actions, and guide the management of existing bushland and the proposed re-vegetation on the subject site.

The preparation of this BMP follows on from the mitigation measures and recommendations provided in the latest EIA and applies to all vegetation stands to be retained within the land, and to areas to be replanted as STIF within proposed on-site and off-site offset areas. The proposed off-site offset areas are to be provided on Council land within the locality, subject to Council and the Applicant entering a Voluntary Planning Agreement (VPA). The purpose of the offset measures is to provide compensation for the STIF vegetation proposed to be removed, as part of the planned development. This vegetation is to be removed primarily from the southern boundary, from a small section from the northern edge along Oak Rd and from the western embankment of the water-filled pit. This BMP also applies to a freshwater pond to be constructed within, the western sector, as a compensatory water source for the Grey-headed Flying Fox (GHFF) and Eastern Bentwing Bat (EBWB), and to a temporary pond to provide a water source during the final water feature construction period.

1.2 Project Description

The proposed development of the subject land has been revised and if approved, will result in the construction of a mix of residential, commercial and retail developments, occupying the majority of the 4.254 ha site. Further revisions have been made to the scheme, specifically in response to submissions made to the Department of Planning (DoP) by Council, DECCW and the general public. These revisions also address matters raised by the DoP in their "issues letter" dated 14 April 2011 specifically;

- *"The PPR is to confirm the total area of STIF located on the site and the total area of STIF to be removed from the site. The PPR should also provide specific details of the area and location of the replacement STIF."*

- *"The PPR shall demonstrate how the proposed ponds are of sufficient size (area and length) to be effectively used by the threatened bat species, including during the construction phase of the proposal"*

The revised Concept Plan site layout for the lower ground floor level of the site is shown in **Figure 1.2.** The south-western corner of the site has been proposed as public open-space that is to contain the permanent compensatory water body and any on-site STIF replanting. As part of the Concept Plan, the existing water body will be drained, partially re-filled and re-structured. This area also includes the majority of the STIF vegetation located on the site, concentrated along the western boundary adjacent to Oak Rd. Portions of this vegetation have regenerated on the quarry pit western embankment. Additional areas of STIF have been identified along the southern boundary. The vegetation in this southern sector is inconsistent in composition, with some areas supporting a predominantly exotic understorey, or no remnant canopy of STIF characteristic trees. Such vegetation is considered as only a marginal representation of the historical STIF vegetation community.

Agreement between the Applicant and Council at a concept level has been reached on all aspects of the design and delivery of the public open space/public park. The negotiation and collaboration between the Applicant and the Council have produced a set of "VPA documents" that cover all aspects of the proposed public open space and will form the basis of the VPA. The Council's Environment and Planning Committee on 26 September 2011 made recommendations to the Council including;

"*That the concept plan for a public park attached as Appendix 1 and 2 be endorsed by Council as the basis for the preparation of a draft Voluntary Planning Agreement."*

The Committee Recommendations were adopted in full by Council on 10 October 2011. It is agreed that the VPA will be finalised and executed only after Concept Plan approval and before the first Project Application.

Numerous design issues are addressed in the documents adopted by Council, including the required amount of compensatory STIF planting resulting from the development. Council has nominated a number of existing parkland reserves and has agreed to make these reserves available for the required compensatory STIF planting and also expressed the desire to replant some of the compensatory STIF on-site in the park adjoining the retained

STIF. The majority of the STIF vegetation occurring on original soils in the western sector is to be retained as part of the agreed landscape plan for the project (refer to **Figure 1.3**), except for a small portion to be removed in the northern sector for vehicle access to parking facilities. The agreed landscape plan forms part of the VPA documents agreed to by Council and will be the basis for the public open space landscape design. Some STIF vegetation, primarily comprising regenerating STIF on the quarry walls, is to be removed to allow for the construction of the public park and new permanent water body. The majority of the vegetation along the southern boundary will be removed as part of the proposed development, except for the western end. The total area of STIF to be removed, based on the agreed landscape plan (Figure 1.3), as part of the proposed action and as agreed by Council, is 0.28 ha (2,792 m^2) and the total area to be retained is 0.20 ha (1,973 $m^{2)}$. Further details on the specific areas of STIF to be removed and retained are provided in **Table 1.1** and illustrated in **Figure 1.4**.

Table 1.1 Summary Of Proposed Extent Of Alteration Of Stif Community On The Kirrawee Brick Pit Site And Required Offset Based On VPA With Council

Vegetation Category	Current Extent (m2)	Extent to be Cleared (m2)	Extent to be Retained (m2)	Extent of Offset Required (2:1 ratio) (m2)
1 - STIF on original soil	3010.81	1038..01	1972.80	
2 - STIF regenerating on quarry walls	1264.74	1264.74	0	
3 - STIF trees with exotic dominated understorey	489.97	489.97	0	
4 - Exotic shrubs and understorey	427.08	304.17	122.92	
Totals	**5192.61**	**3096.89**	**2095.72**	
Total STIF	**4765.52**	**2792.72**	**1972.80**	**5585.45**

Compensation for the areas of STIF to be removed will be provided, by enhancing the STIF to be retained on site and by replanting additional offset areas with the aim for the vegetation in the long term to develop into a functional STIF community. The majority of the offset area is proposed to be located on Council land within the locality with the balance to be planted adjoining the STIF retained on-site. The locations for offsite planting have been nominated by Council in the VPA documents and are provided in **Table 1.2.** Total area proposed to be replanted has been determined on the basis of the area of STIF to be removed and is a minimum of 2:1 (offset replanting: vegetation to be removed). As indicated in **Table 1.1,** the total area of offset required is approximately 5585 sq m.

Table 1.2 Potential Locations For Compensatory Off-Site STIF Replacement/Rehabilitation

Location	Approx Area	Works
Willow Pl, Kirrawee (adj No1.)	300m2	Mulching, tree planting, understorey planting
184 Oak Rd, Kirrawee (Bilga St)	500m2	Mulching, tree planting, understorey planting
32 Kirrawee Ave, Kirrawee (Erang Ave)	1,500m2	Some tree planting, mainly mulching and understorey planting
2R Hotham Road (Bowie Park)	400m2	Remove Erythrina sp, mulching, tree planting, understorey planting
459R President Ave, Kirrawee (Fauna Pl)	600m2	Mulching, understorey planting
99R Acacia Rd, Sutherland	800m2	Weed control, mulching, some tree planting, understorey planting
131 Acacia Rd & 96R Glencoe St, Sutherland	200 + 200 = 400m2	Remove Erythrina & Jacaranda sp, mulching, tree planting, understorey planting
10R Laurel Grove, Menai	800m2	Mainly mulching, understorey planting
Total	**5,300m2**	

If the VPA is for some reason not executed prior to the Project Application and the park ownership is retained by the Applicant, it is proposed that an appropriate offset area be available on-site, since off-site Council locations could not be assured. In this case, the extent of STIF to be removed would be 1,293 sq m, as indicated in **Table 1.3** and illustrated in **Figure 1.5.** Conforming to the required 2:1 ratio for offsets, it has been demonstrated that sufficient area is available on-site to accommodate the required extent of offset (2,856 sq m), as indicated in the revised Concept Plan site layout for the lower ground floor level of the site in **Figure 1.2.** .

Table 1.3 Summary Of Proposed Extent Of Alteration Of STIF Community On The Kirrawee Brick Pit Site And Required Offset Based On No VPA

Vegetation Category	Current Extent (m2)	Extent to be Cleared (m2)	Extent to be Retained (m2)	Extent of Offset Required (2:1 ratio) (m2)
1 - STIF on original soil	3010.81	1038..01	1972.80	
2 - STIF regenerating on quarry walls	1264.74	0	1264.74	
3 - STIF trees with exotic dominated understorey	489.97	255.06	234.92	
4 - Exotic shrubs and understorey	427.08	304.17	122.92	
Totals	**5192.61**	**1597.24**	**3595.38**	
Total STIF	**4765.52**	**1293.07**	**3472.46**	**2586.13**

Any offset areas will be retained and/or recreated and maintained in perpetuity, both on and off the subject site and these obligations will be formalised via legal covenant on title or other such appropriate legal instrument as agreed in the VPA documents. If the VPA is not entered into, the Applicant will enter into similar agreements to preserve the retained and compensatory STIF on the site. The BMP specifies the management of these areas during construction and after occupation of the subject site and for off-site locations.

Agreement has also been reached on the concept design of the compensatory water body (layouts, dimensions etc) and importantly the water quality standards suitable for threatened bat species that will utilise the water body, as well as the proposed methods to supply and maintain water quality and quantities at the required levels. Documentation reflecting the agreed designs and specifications have been finalised and are included in the VPA documents. The VPA documents also outline the agreed legal instruments that cover maintenance and provision of water quality and quantity at the agreed levels.

The brick pit water body is occasionally used as habitat (as a fresh water source) by the Grey-headed Flying-fox (GHFF) and Eastern Bentwing Bat (EBWB). As a compensatory measure for the drainage of the pit, a permanent pond will be constructed in the western sector of the subject lands. The agreed concept design for this compensatory water source is shown in **Figure .1.3.** A temporary pond, to be available during the reconstruction period for the water body, will also be provided in the northwestern sector of the site and is clearly indicated on the architectural staging plans submitted with the Concept Plan application.

Site specific water quality guidelines have been determined via a study of relevant local data, namely analysis of water quality data from water resources around the Sydney area known to be utilised by GHFF. This approach is nominated by the ANZECC Guidelines as preferable to simply applying the default approach previously applied, that calls for generic guidelines such as the *ANZECC Stock Water Guidelines* or the *ANZECC Water Quality*

Guidelines for Freshwater Lakes and Resevoirs. It is also considered that the EBWB and the GHFF would have similar water quality requirements.

The water quality data study has been conducted by Equatica[8] and the detailed report forms part of the Council agreed VPA documentation and the Concept Plan application. The report, in addition to formulating appropriate water quality guidelines also outlines the methods of treatment to maintain the water quality to the specified levels via recirculating wetland. Council officers have agreed that the proposed site specific water quality guidelines and treatment methods are appropriate and will in their view satisfy the ecological objective of providing a compensatory water resource for the threatened species of bats in question.

Some stags (dead hollow-bearing trees) within the remnant STIF vegetation along the western boundary adjacent to Oak Rd will be removed, due to concerns for the safety of the public and property. Details of these trees are shown in the ERM report[1]. This loss of habitat will be compensated for by the instalment of nest boxes at a ratio of 2:1 for all hollows removed.

The proposed development estate and associated conservation areas are referred to as the "subject site".

1.3 Aims and Objectives

The general aims of the BMP are as follows:

- To provide a working document for the long-term protection and rehabilitation of the vegetation to be retained within the site in perpetuity;
- To outline the methods needed for the rehabilitation of the compensatory areas of STIF;
- To provide habitat management procedures to ensure the ongoing protection and maintenance of an appropriate water source for the GHFF; and
- To provide protection and maintenance of potential roosting and foraging habitat for the GHFF and other threatened fauna potentially utilising the subject site.
- More specifically, the objectives of the BMP are to:
- Assess the vegetation management issues relating to the site and the proposal, including existing flora and fauna, physical characteristics, hydrology and adjoining and proposed land uses;
- Outline the actions required for the re-planting and rehabilitation of compensatory areas of STIF;
- Specify construction and maintenance requirements for the permanent and temporary freshwater ponds;

- Specify appropriate vegetation management measures;
- Identify the appropriate timing of vegetation management activities and provide a schedule of works;
- Assign responsibilities for management actions; and
- Ensure the works comply with Council requirements and policies;

The BMP also considers the general standards and requirements set out in the document *How to Prepare a Vegetation Management Plan*[2].

1.4 Scope

The BMP applies to areas of bushland to be retained and enhanced within the western sector of the subject site (refer to **Figure 1.4**); areas to be replanted as STIF within on-site and off-site offset areas and the permanent and temporary pond to be created as habitat for the GHFF and EBWB. The general locations of the proposed permanent features are shown in **Figure 1.2**.

The BMP does not apply to hard landscaping areas within the proposed development area or in the immediate surrounds of built up areas, such as car parks, pathways, etc except for the council managed public access way to the west on the western boundary.

The BMP has been prepared by qualified ecologists (Dr David Robertson, Cumberland Ecology and Alison Martin, Greenloaning Biostudies) and the BMP Management Actions are to be implemented by a qualified bushland regeneration contractor ('BR Contractor').

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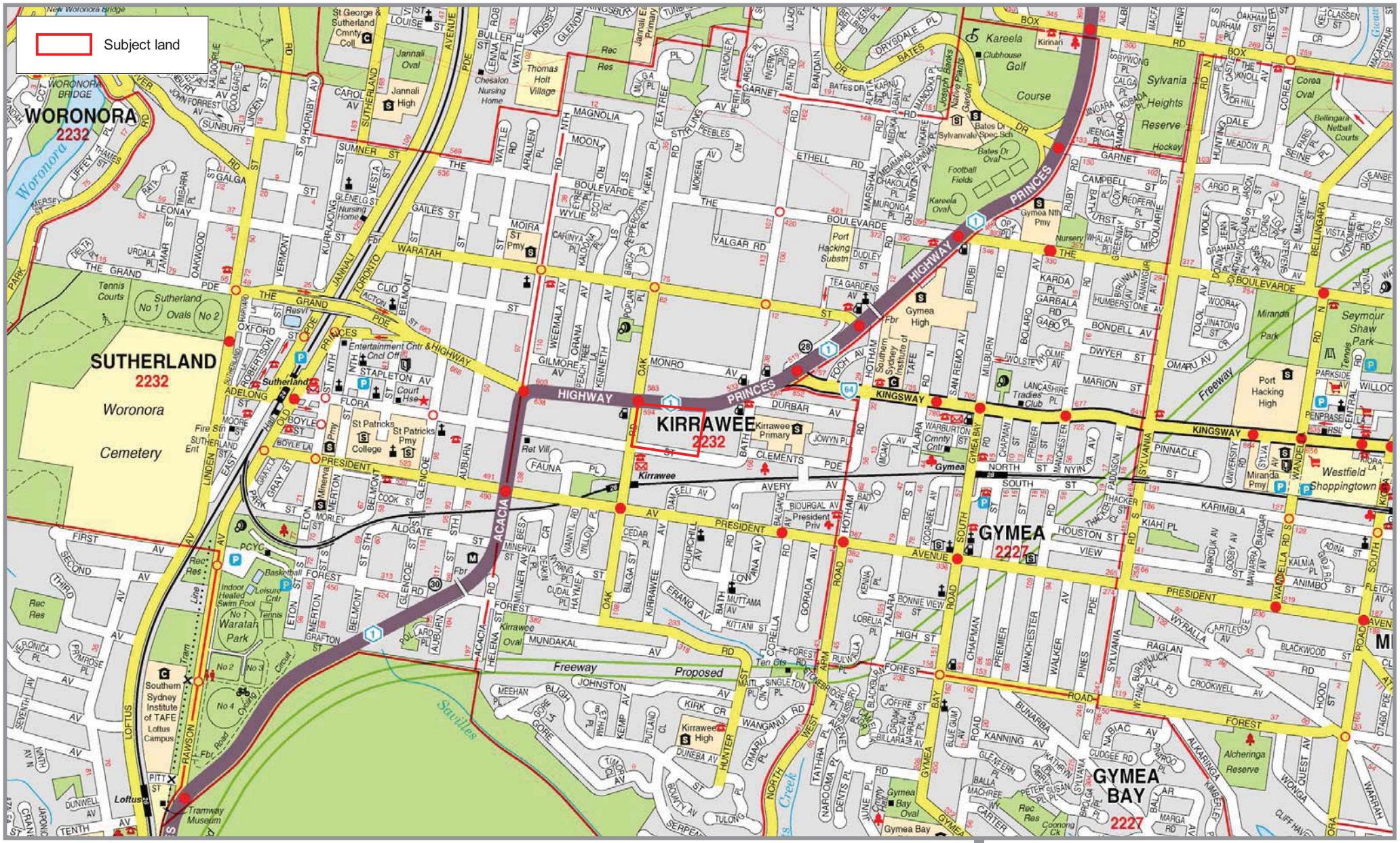
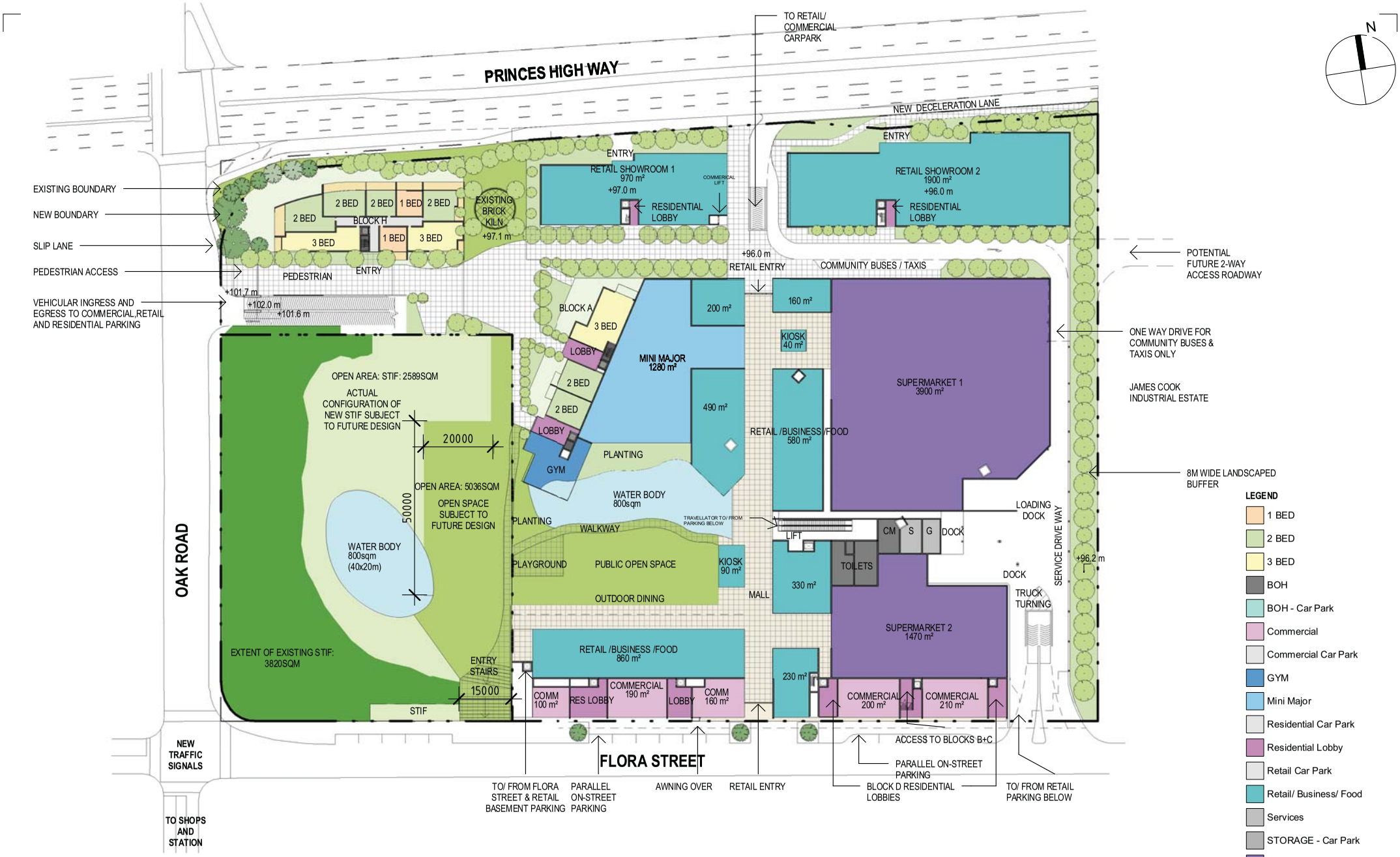


Figure 1.1 Location of the Subject Land



1 RL 96.00_ LOWER GROUND FLOOR PLAN_PLOT
1 : 1000

NSW Registered & Nominated Architects: Geoffrey Lee 4223, Phillip Bowen 4527

Australia
Asia
Europe

Client
Henroth Investments Pty Limited
46-56 Kippax Street
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Figure 1.2 - Lower Ground Floor Concept Plan

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woodhead™

DRAWING TITLE: LOWER GROUND FLOOR PLAN				
PROJECT NAME: KIRRAWEE BRICK PIT			CLIENT NAME: HENROTH INVESTMENTS PTY LIMITED	
PROJECT NUMBER: 09211902	SCALE: 1:1000	DRAWING NUMBER: 0130	DATE: 25/08/11	REVISION NUMBER: B

Figure 1.3 - Conceptual Landscape Plan Showing General Layout of Permanant Water Body and Vegetated/Revegetated Areas

Coordinate System: MGA Zone 56 (GDA 94)

Grid North

Legend

Site Boundary

Vegetation Community

- Retained STIF on original soil
- Impacted STIF on original soil
- Impacted STIF regenerating on quarry walls
- Impacted STIF characteristic trees with predominantly exotic understorey
- Retained Exotic shrubs and understorey
- Impacted Exotic shrubs and understorey

CUMBERLAND ECOLOGY

25 0 25 50 75 100 m

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Figure 1.4. Cleared and Retained Vegetation Communities (with VPA)

Coordinate System: MGA Zone 56 (GDA 94)

Grid North

Legend

Site Boundary

Vegetation Community

- Retained STIF on original soil
- Cleared STIF on original soil
- Retained STIF regenerating on quarry walls
- Cleared STIF regenerating on quarry walls
- Retained STIF characteristic trees with predominantly exotic understorey
- Cleared STIF characteristic trees with predominantly exotic understorey
- Retained Exotic shrubs and understorey
- Cleared Exotic shrubs and understorey

CUMBERLAND ECOLOGY

25 0 25 50 75 100 m

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Figure 1.5. Cleared and Retained Vegetation Communities (No VPA)

Chapter 2

Methods

Detailed assessments of the study site were conducted as part of the EIA by Cumberland Ecology, and previous reports by ERM[1] and URS[3]. Activities specifically related to the preparation of this BMP include:

- An assessment of the general condition and extent of each protection zone, including weed species present, levels of weed infestation, levels of disturbance, access and drainage;
- Identification of current factors threatening the ecological function and survival of the bushland; and
- Determination of appropriate rehabilitation and bush regeneration techniques for the bushland.

Details of the flora and fauna field survey methods are provided in the updated Cumberland Ecology EIA that forms part of the supplementary documentation to the Part 3A Application.

Chapter 3

Site Assessment

3.1 Site Description

The Kirrawee former Brick Pit site consists of a 4.254 ha block located adjacent to the Princes Highway in Kirrawee, between Oak Road and Flora Street, within the Sutherland Shire LGA. Within this block lies the former brick pit previously used for the quarrying of clay for the construction of bricks. Following the cessation of activities on site, the quarry has progressively filled with storm water since the early 1980s. The land is not currently used for any purpose, although a small, disused brick electricity sub-station still remains on the northern boundary. Steep slopes surround the pit, being highest at around 15m along the western edge and lowest around 2m along the eastern edge.

Along the western and southern edge of the quarry lies remnant vegetation of *Sydney Turpentine Ironbark Forest* (STIF), an Endangered Ecological Community (EEC) under the NSW *Threatened Species Conservation Act 1995*, (TSC Act) and as Critically Endangered under the Commonwealth *Environmental Protection and Biodiversity Act 1999* (EPBC Act) (under the name *Turpentine-Ironbark Forest of the Sydney Basin Bioregio*n). Along the western slope of the quarry, significant regeneration of STIF vegetation has occurred on this slope, with an associated canopy of STIF characteristic trees. To the north and east of the pit, vegetation is dominated by exotic species.

Surrounding the subject site is a mix of residential, retail and commercial land uses. The current retail centre of Kirrawee is located along Oak Road, beginning at the south-west corner of the subject site and continuing to the Kirrawee train station to the south.

3.2 Soils

The soils of the subject site and surrounding areas are derived from Hawkesbury sandstone comprising shale lenses, siltstone, and claystone, with additional outcropping mudstone characteristic of the area. This combination produces clays and sandy clays suitable for brick making. The construction of the quarry has produced a cross-section of the soil profile, which has allowed some erosion.

The regeneration of native vegetation along this quarry wall, with few of the exotic species prevalent in other parts of the site, indicates the lack of nutrients in the soil, these nutrients normally being concentrated within the topsoil layer. Areas to be replanted as part of the

BMP will be located within areas of altered soil profiles, as the original slopes will be graded to reduce risk to public safety.

3.3 Topography and Aspect

The site is characterised by a moderate eastern facing slope. Surface levels rise from around 93mAHD at the eastern boundary to the peak of the ridgeline at 105mAHD. The current water level of the quarry is approximately 91mAHD. The water level is around 8m at its deepest, with the pit bottom at approximately 83mAHD. The slopes of the quarry walls range from 0 ^{o} (sheer drop) to 20^{o}.

3.4 Vegetation

3.4.1 General

The vegetation of the site is described in detail in the updated EIA (Cumberland Ecology 2010), and is summarised below.

The site contains a mixture of Sydney Turpentine Ironbark Forest vegetation, and exotic dominated vegetation. The condition of the remnant STIF varies, with some areas heavily invaded by exotic species such as Asparagus Fern (*Protasparagus aethiopicus*), whereas other areas are relatively weed-free and support a good diversity of native understorey species. The various occurrences of this community on the subject lands, although highly modified and degraded to a large extent, conform to the definition of *Sydney Turpentine Ironbark Forest* under the TSC Act.. The extent of Sydney Turpentine Ironbark Forest is too small however, to conform to the definition of the *Turpentine-Ironbark Forest of the Sydney Basin Bioregion* under the (EPBC Act).

The north and east of the subject site are dominated by exotic species, such as Large-leafed Privet (*Ligustrum lucidum*) and Coral Tree (*Erythrina sp.*), and the exotic grass Kikuyu (*Pennisetum clandestinum*). These areas will be removed as part of the proposed development. As these areas do not constitute native vegetation, they will not be dealt within this BMP.

As a result of the three flora surveys carried out on site, 109 species were recorded within the western and southern areas of vegetation on the subject site. These species comprised 36 exotic and 73 native species (see Appendix A). Of these species, two are considered significant within the Sutherland Shire LGA (*Acacia stricta* and *Leucopogon juniperinus*). Four species are listed as noxious weeds in the Sutherland Shire LGA and. additional (mostly exotic) species were found within the eastern and northern areas of the site which are not included in the total species count referred to above.

3.4.2 Plant Community

One plant community was identified on the site: *Sydney Turpentine Ironbark Forest* (STIF). STIF is listed as an EEC under the TSC Act This community fails to qualify as constituting the analogous Turpentine-Ironbark Forest of the Sydney Basin Bioregion, classed as Critically Endangered under the EPBC Act, as the total area is less than 1 hectare. The remaining vegetation has been identified as exotic. The floristics and structure of the STIF community is described in detail in the Environmental Impact Assessment and have been summarised below. The distribution and condition of the STIF plant community within the site is shown in **Figure 1.3**.

i. Sydney Turpentine Ironbark Forest

Sydney Turpentine Ironbark Forest is described as containing an overstorey dominated by Turpentine (*Syncarpia glomulifera*), White Stringybark (*Eucalypts globoidea*) Red Mahogony (*Eucalyptus resinifera*), Grey Ironbark (*Eucalyptus paniculata*), Smooth-barked Apple (*Angophora costata*) or Rough-barked Apple (*Angophora floribunda*). Understorey and ground-layer species are variable between sites dependent on local topography, fire history, etc, however a suite of species are considered characteristic of this vegetation community. The most recent flora survey (described in the EIA) found a total of 53 native species within the Western and Southern Zones of vegetation on the subject site. Of these, 32 are characteristic species of the STIF community.

Within the subject site, STIF vegetation is concentrated within the area between the western edge of the brick pit, and the western boundary of the study site along Oak Rd (the "Western Zone"). An additional strip of remnant STIF vegetation is located along the southern boundary of the subject site along Flora St (the "Southern Zone"), and significant regrowth of STIF vegetation has occurred on the western wall of the brick pit ("Regenerating STIF on Quarry Walls", **Figure 1.4**).

Within the Western Zone of STIF, the dominant tree species are *Angophora costata* and *Eucalyptus globoidea*, with a significant stand of *Allocasuarina littoralis*. Vegetation in this portion varies in condition from poor to good. Along the fence of the western boundary invasion by Asparagus Fern (*Protasparagus aethiopicus*) and Lantana (*Lantana camara*) has occurred. This area also contains a significant amount of rubbish which has been thrown over the fence. Some central areas of this portion are relatively weed-free, and contain a good diversity of native shrubs, such as *Pultenaea villosa*, *Ozothamnus diosmifolius*, *Davesia genistifolia, Pittosporum undulatum, Dodonea triquetra, Bursaria spinosa, Notolea longifolia* and *Acacia implexa*, a ground-layer of herbs such as *Dianella caerulea, Glycine clandestina, Leucopogon juniperinus, Lomandra multiflora* and grasses *Aristida ramosa, Microlaena stipoides* and *Entolasia marginata*.

Within the Southern Zone of the community the canopy is dominated by *Eucalyptus paniculata*, *Angophora paniculata* and *Eucalyptus globoidea*, with condition varying from poor to moderate (see **Figure 1.4**). Due to the general shape of this portion, a long, thin strip of average width approximately 5m, this vegetation has been highly disturbed by edge effects and the adjacent street. Some areas have been heavily invaded by Asparagus Fern

(*Protasparagus aethiopicus*), Large-leafed Privet (*Ligustrum lucidum*), Lantana (*Lantana camara*) with little or no native understorey remaining. In one section, no native canopy remains. Other sections of the Southern Zone support a reasonable diversity of understorey and ground-layer species, with only moderate levels of weed invasion.

Vegetation on the quarry wall has regenerated largely from seed stock derived from the Western Zone, located above. The soil present is poor due to the altered soil profile associated with the construction of the quarry. Despite this, some large canopy trees and a reasonable diversity of native species occur, mostly concentrated within the southern end of the portion where slope is most moderate. Weed invasion in this area is minimal, again concentrated towards the southern end. The remaining area on the western slope (**Figure 1.4**) supports very few exotic species, probably due to the low nutrient levels and steep slope.

3.4.3 Threatened Plant Species

No threatened plant species were recorded during the field surveys, or during previous surveys of the site carried out by ERM or URS.

3.5 Resilience Assessment

The resilience of the vegetation within each protection zone is described below.

3.5.1 Western Zone - STIF on Original Soil Profile

This zone is located between Oak Rd and the western edge of the brick pit. Generally the resilience of the Western Zone is moderate to high. The soil profiles are largely unaltered in this zone although some dumping of rubbish over the fence has occurred. The extent of this dumping is limited to a narrow strip along the fence line along Oak Rd. Asparagus fern (*Protasparagus aethiopicus*) is most prevalent in the south-western corner of the subject site, at the corner of Flora St and Oak Rd (**Photograph 3.1**). Other areas remain relatively weed-free, especially where the canopy is intact (**Photograph 3.2**).

Photograph 3.1 Invasion of STIF vegetation by Asparagus Fern

Photograph 3.2 STIF vegetation with intact native understorey

3.5.2 Quarry Walls – Regenerating STIF on Altered Soil Profile

Resilience of the Quarry Walls is low to moderate. The significant alteration of the soil profile, amounting to the removal of the historical topsoil and deep excavation of the brick pit, has removed the historical seedbank. However, the adjacent remnant STIF in the Western Zone has since rejuvenated the seedbank through direct seed fall. The diversity of native

species within this zone is not as high as for the Western Zone, although it is substantial and likely to improve in the future as further seed fall and nutrients increase. This vegetation is shown in **Photograph 3.3**.

Conversely however, this reduction in soil nutrients creates an environment which is not conducive to the growth of exotic species. The northern and central area of the quarry wall thus supports little to no exotic cover.

This sector will be cleared as part of the site development, with some subsequent replanting.

Photograph 3.3 STIF vegetation regenerating on quarry wall

3.5.3 Southern Zone – Characteristic STIF Trees with Predominantly Exotic Understorey

This zone (see **Figure 1.4**) is currently dominated by exotic species. The resilience of the area, in terms of the native soil seedbank, is low. The exact level depends on the historical vegetation and the timing of weed invasion. It is likely that some of the historical seed bank remains, though probably reduced in diversity of species with short persistence periods (the amount of time seeds can remain dormant and viable in the seedbank). The current, exotic vegetation is shown in **Photograph 3.4**.

This zone will be cleared as part of the proposed development.

Photograph 3.4 Exotic vegetation to be cleared and replanted as STIF

3.5.4 Northern Zone– Replanted STIF

This zone is of a similar composition to the south-eastern boundary of the western sector of the subject site. The understorey and mid-storey of this zone is dominated by exotics such as Large-leaved Privet (*Ligustrum lucidum*), with little ground-layer vegetation. Within this zone, however, exists a number of canopy trees of *Angophora costata*. These specimens are located on the altered soil profile caused by the excavation of the quarry, although they are of substantial size and are likely to represent a previous, more native-dominated vegetation community. As such this zone may have some, albeit limited, resilience.

This zone will be graded to reduce the risk for public safety.

3.5.5 Proposed Off-site Compensatory Planting

Compensatory planting of STIF vegetation is proposed be carried out primarily off-site, that is, in parks or reserves close to the proposed development of similar geology likely to support STIF vegetation, subject to final approval by Council. Areas which may be suitable include:

- Willow Place;
- Bilga Street;
- Along Erang Avenue;
- Bowie Park (near Hotham Street);
- President Ave, Kirrawee (Fauna Pl);
- Acacia Rd, Sutherland;
- Acacia Rd/ Glencoe St, Sutherland; and
- Laurel Grove, Menai

Further details on these areas are provided in **Table 1.2**. Total area to be replanted (including both on-site and off-site) has been determined based on the amount of STIF to be cleared on-site, this comprising 0.28 ha (2,792 m^2), based on the agreed landscape plan (**Figure 1.3**) and will be no less than at a ratio of 2:1 (replanted:cleared).

If the VPA is for some reason not executed prior to the Project Application and the park ownership is retained by the Applicant, It is proposed that an appropriate offset area to be available on-site, since off-site Council locations could not be assured. In this case, the extent of STIF to be removed would be 1,293 sq m, as illustrated in **Figure 1.5**. Conforming to the required 2:1 ratio for offsets, it has been demonstrated that sufficient area is available on-site to accommodate the required extent of offset (2,856 sq m), as indicated in the revised Concept Plan site layout for the lower ground floor level of the site in **Figure 1.2.**

Any offset areas will be retained and/or recreated and maintained in perpetuity, both on and off the subject site and these obligations will be formalised via legal covenant on title or other such appropriate legal instrument as agreed in the VPA documents. If the VPA is not entered into, the Applicant will enter into similar agreements to preserve the retained and compensatory STIF on the site. The BMP specifies the management of these areas during construction and after occupation of the subject site and for off-site locations.

Methodologies for both off-site re-planting and on-site replanting will follow the same procedures for habitat enhancement as detailed in **Chapter 5**.

3.6 Fauna

3.6.1 Fauna Species

Over 50 vertebrate fauna species were recorded during the field surveys carried out by URS[3] and ERM[1]. Of these, over 30 were birds, with seven mammal species, six reptile species, three frogs and two fish.

Many of the species recorded are associated with the freshwater body created by the former brick pit. Of these associated species, two are listed as Threatened under the *NSW Threatened Species Conservation Act 1997*, the Grey-headed Flying Fox (GHFF) and the Eastern Bent-wing Bat (EBWB).

3.6.2 Fauna Habitats

Three broad habitat types were identified on the site during the current field surveys:

- STIF Vegetation;
- Weedy Vegetation;
- Tree Hollows; and
- Water.

These habitat types and the fauna they support are described below. Further details are provided in the reports by URS[3] and ERM[1].

i. STIF Vegetation

The STIF vegetation of the subject site contains a number of possible resources to be utilized by fauna species. The resources of potential value to locally occurring fauna within the open forest habitats include flowering and fruiting eucalypts, shrubs and small trees that provide foraging resources for birds and arboreal mammals. Species such as the Brushtail Possum and Grey-headed Flying Fox feed on fruits, nectar and blossom of native and introduced plant species at various times of the year according to seasonal availability. These flowering plants would also provide nectar and fruits for a limited range of urban-tolerant avifauna, including small passerine birds, such as fairy-wrens and thornbills.

ii. Weedy Vegetation

Weedy vegetation may also provide foraging habitat and shelter for vertebrate fauna. Fruits from exotic species such as Lantana (*Lantana camara*), Large-leaved Privet (*Ligustrum lucidum*), Small-leaved Privet (*Ligustrum sinense*) and Ochna (*Ochna serrulata*) provide a food source for birds. This relatively dense vegetation may also provide ideal nesting habitat and protection from predators.

iii. Tree Hollows

Tree Hollows exist particularly in the larger, more mature eucalypts located in the Western Zone. These hollows could provide nesting opportunities for small birds (eg Rainbow Lorikeet), or tree-dwelling micro-bats.

As part of the proposed development, two stags (dead trees bearing hollows) will be removed from the Western Zone due to concerns for public safety and property (see tree report 4). This loss of habitat will be compensated for by the instalment of artificial nest boxes at a ration of 2:1 for all suitable hollows removed, and replanting of STIF canopy species trees in the space of the removed trees (see **5.7**).

No hollow-bearing trees were found within the Southern Zone during the ERM1 survey.

iv. Water

Much of the vertebrate fauna detected on site in the two surveys was associated with the water body occupying the disused quarry. The water-body itself provides essential habitat for water birds such as the Dusky Moorhen (Gallinula tenebrosa), Eurasian Coot (Fulica atra), various Cormorant species (Phalacrocorax sp.), etc, as well as reptiles such as the Eastern Snake-necked Turtle (Chelodena longicollis).

The water body may also provide a source of drinking water for mammal species. Among these are the Grey-headed Flying Fox (GHFF) and Eastern Bent-wing Bat, both listed as threatened under the TSC Act.

The proposed compensatory water body will provide sufficient habitat for all species currently utilizing the water-filled former brick pit.

3.6.3 Threatened Species

Two threatened species have been recorded in the two fauna surveys carried out by URS3 and ERM1.

i. Grey Headed Flying Fox

This species has been observed roosting in trees within the Western Zone of the remnant STIF vegetation. Individuals have also been observed drinking from the freshwater-filled former quarry. The use of the site by this species is likely to be occasional due to the large foraging range the species can occupy, and the lack of any further observation of the species during site visits by Cumberland Ecology in October, 2008. The EIA by Cumberland Ecology and the previous report by ERM[1]both recommend the provision of some permanent drinking water on-site for this species.

Due to the use of the quarry water by the GHFF, the proposed development involves the construction of a pond within the western sector of the site. This provision will limit the effect of the proposed development on the potential habitat of this species. This BMP applies to the construction and maintenance of the compensatory water body, as well as to the

temporary pond to be constructed for use as a water resource during the reconstruction period of the permanent water body.

ii. Eastern Bentwing Bat

The Eastern Bent-wing Bat was recorded during the survey by ERM[1]. This species hunts in forest, where it collects moths and other flying insects. Roosting and breeding occurs in caves, and although no suitable caves exist on site, temporary or permanent crevices in the quarry wall may provide some habitat for the species. This is particularly relevant, as the species prefers roosting sites near water.

Chapter 4

Risk Assessment

The site has been highly modified from its pre-European condition, with most of the original vegetation removed as part of the excavation of the quarry and associated clearing to the north. The original soils and ground surface have been highly disturbed in places by filling and earthworks associated with the quarry.

Overall, a portion of the site has a high conservation value due to the presence of an Endangered Ecological Community (STIF) along the western and southern edges of the quarry. The proposed development will involve the removal of some areas of the STIF plant community located along the southern boundary of the site, along the quarry walls and on the northern extremity of the western sector. Based on the agreed landscape plan (**Figure 1.3**) as agreed with Council, the total area of remnant STIF vegetation to be retained on site is approximately 0.20 ha (1,973 m2.

The potential also exists for indirect impacts on retained STIF vegetation during construction. Processes such as inadvertent construction impacts (e.g. clearing and materials storage outside of the construction zone), erosion and sedimentation and weed invasion, can be caused or exacerbated by construction activities. However, appropriate environmental management of the development, including the measures set out in this BMP, should ensure that such impacts are avoided or minimised. With the correct implementation of the measures contained in Chapter 5 of this BMP, the proposal is not likely to have any significant or adverse effects on local biodiversity.

Areas of STIF to be removed are located along the southern boundary of the site, an area surrounding the current extent of the water-filled pit to the level RL 94, and a small section to the north of the Western Zone. These areas are shown in **Figure 1.4**. The total area of STIF to be removed based on the agreed landscape design in **Figure 1.3**, is 0.28 ha (2,792 m2), with the total current area of STIF on the subject site being 0.48 ha (4,765m2). On this basis,,the areas of STIF to be removed mostly represent parts of the remnant currently regenerating, as on the quarry walls, or highly affected by edge effects, such as the strip to be removed adjacent to Oak Rd, currently infested by weeds and holding a considerable amount of rubbish thrown over the fence.

Areas of STIF vegetation retained in the Western Zone will be subject to enhancement procedures to compensate for the removal of STIF vegetation as described above and shown in **Figure 1.4**. The main offset planting of STIF is proposed for an off-site location and an area of approximately 5,300 sq m has been nominated for this purpose by Council. The final extent of offset compensatory planting/revegetation to be undertaken will be no

less than.2:1 for all remnant STIF vegetation removed as part of the proposed action. The compensatory areas will be re-planted with species characteristic of STIF vegetation, grown from seed stock collected on-site and in the local region. These areas will also be maintained using bush regeneration principles, including the removal of weeds. Additionally, the remnant STIF within the Western Zone, to be retained, will be rehabilitated in conjunction with the BMP.

The potential environmental risks associated with the project and corresponding project objectives are listed in **Table 4.1**. Provided the environmental management measures outlined in this BMP are implemented, construction of the proposed development is not considered likely to place the environment at risk of serious or significant pollution or degradation.

Table 4.1 Summary Of Environmental Risks And Associated Project Objectives For Kirrawee Brick Pit

Issue	Environmental risk	Project objectives
General	No high level or significant risk to the local or regional environment is likely as a result of construction and operation of the proposal Minor loss of landscape amenity from vegetation removal	Conduct all work in compliance with the principles of ecologically sustainable development and environmental due diligence Prevent significant adverse effects on the natural environment Achieve best practice environmental management Standard environmental protection measures are necessary to ensure risks are controlled or avoided
Soil and Water	Erosion from construction area Sedimentation of bushland Discharge of construction wastes, fuel or other polluting substances during construction activities into lake and/or on to land Leaching of toxic substances buried in fill material (if present) into lake	Install appropriate erosion controls for duration of construction. Comply with Dept of Housing standards for erosion control on development sites[5] Minimise potential risk of sediment and contaminants entering lake Comply with standard EPA and DWE requirements for stormwater runoff quality Minimise soil disturbance and soil erosion during construction

Table 4.1 Summary Of Environmental Risks And Associated Project Objectives For Kirrawee Brick Pit

Issue	Environmental risk	Project objectives
Flora and fauna	Disturbance to aquatic fauna and aquatic habitats during rehabilitation activities Introduction of additional weed propagules and dispersal of propagules downstream Exacerbation of existing weed problems Disturbance to native flora and fauna habitats during construction and rehabilitation activities Damage to native trees to be retained	Establish an ecologically functional bushland system, approaching a 'natural' terrestrial ecosystem Prevent new infestations of weed species using appropriate weed prevention protocols; Control existing weed problems using suitable means, eg hand removal in-stream, mechanical removal Minimise clearing of native vegetation and trees (excluding exotic or weed species) Carry out appropriate rehabilitation and revegetation on areas disturbed by construction works Ensure tree protection measures properly installed, maintained and monitored Conduct site inductions for bush regeneration crews and site workers
Noise and vibration	Temporary reduction in habitat quality for native fauna residing on site as a result of construction noise and vibration Increased noise and light following commissioning and occupation of dwellings	Keep construction noise levels within EPA guidelines Ensure construction equipment has adequate noise prevention safeguards and is maintained in good working condition Direct external lighting away from vegetation protection zones

Chapter 5

Bush Regeneration/Restoration Strategy

5.1 Introduction

This chapter outlines the major activities to be undertaken as part of the BMP. They include the following:

- Phase 1: Pre Construction (section 5.2);
- Phase 2: Site Establishment (section 5.3);
- Phase 3: Fauna Protection Measures (section 5.4);
- Phase 4: Primary Weeding (section 5.5);
- Phase 5: Secondary (section 5.6);
- Phase 6: Planting (section 5.7);
- Phase 7: Maintenance Weeding (Year 2) (section 5.8);
- Phase 8: Construction Period (section 5.9);
- Phase 9: Drainage and Compensatory Water Body (section 5.10)
- Maintenance (section 5.11);
- Disease and Feral Animal Control (section 5.12);
- Fire (section 5.13);
- Occupational Health and Safety (OH&S) (section 5.14); and
- Community Involvement (section 5.15)

There is also provision for:

- Monitoring and Reporting (section 5.16);
- Roles and Responsibilities (section 5.17); and

- Schedule of Activities (section 5.18).

5.2 Phase 1: Pre Construction

Submission of BMP:	Sutherland Shire Council to review.
Surveying:	The site boundaries and construction zone and revegetation zones should be surveyed and pegged.
Contract documentation:	A paper copy of the survey should be included in the bushland regeneration tender/quote documents.
Action codes:	The action codes that form the BMP schedule of works should be included in the tender/quote.
Pre tender/quote meeting:	Required to clarify the scope of on ground works.
Tender/quote submission:	As required.
Tender/quote assessment:	As required.
Insurance documentation:	The accepted contractors Public Liability and Workers Compensation certificates of currency submitted to principal.
Proof of qualification:	Contractor to submit company profile showing staff details.
Proof of experience:	Contractor to submit company profile showing staff details.
Contract signing:	On agreed date.

5.3 Phase 2: Site Establishment

Submission of BMP:	Sutherland Shire Council to review.
Surveying:	The site boundaries and construction zone and regeneration zones should be surveyed and pegged.
Contract documentation:	A paper copy of the survey should be included in the bushland regeneration tender/quote documents.
Action codes:	The action codes that form the BMP schedule of works should be included in the tender/quote.
Pre tender/quote meeting:	Required to clarify the scope of on ground works.
Tender/quote submission:	As required.
Tender/quote assessment:	As required.

Insurance documentation:	The accepted contractors Public Liability and Workers Compensation certificates of currency submitted to principal.
Proof of qualification:	Contractor to submit company profile showing staff details.
Proof of experience:	Contractor to submit company profile showing staff details.
Contract signing:	On agreed date.

5.4 Phase 3: Fauna Protection Measures

The construction process may potentially alter the habitat for two Threatened species, the Grey-headed Flying Fox and Eastern Bent-wing Bat. Measures to reduce the extent of this disturbance to habitat will be taken.

During the construction process the quarry will be drained prior to the establishment of the compensatory pond. This means that the water source for the Grey-headed Flying Fox and Eastern Bent-wing Bat will be temporarily unavailable. As a measure to ensure the continual availability of fresh water on the site, a temporary pond will be constructed during the drainage of the quarry (see Phase 9, 5.10).

5.5 Phase 4: Primary Weeding

A reconnaissance will be conducted for additional species of weeds in the subject site to check for any additional species that may have germinated since the previous survey. Then, based upon the full, known array of weeds present, the following measures will be taken:

i. Western Zone

Weed densities and diversity in this part of the site are moderate, and concentrated along the western edge along Oak Rd. Due to the high conservation status of the Western Zone, primary weeding will:

- Be carried out at the commencement of the contract; and

Target the species tabulated below.

Table 5.1 Western Remnant STIF: Weed Species To Be Targeted And Treatment Method

Weed Species	Treatment Method				
	Handweed	Cut & Paint	Scrape & Paint	Spot Spray	Comment
Protasparagus aethiopicus	✓				Noxious
Lantana camara	✓	✓			Noxious
Ligustrum lucidum	✓	✓			
Ochna serrulata	✓		✓		
Freesia hybrid	✓			✓	

Note: Additional weed species may occur in this area that will emerge in relation to season and these will be treated using standard methods.

Weeding will be carried out with proper respect to the safety procedures outlined in the OH&S section, below.

5.6 Phase 5: Secondary Weeding

i. Western Zone

The priority areas and methodologies for these areas shall be as for the Primary weeding works.

Secondary weeding should be carried out at least 4 weeks after significant rains have fallen and before any weeds have set new season seed.

5.7 Phase 6: Planting

i. Western Zone

- Replanting of canopy species will be carried out to compensate for the removal of trees due to concerns for public safety and property. Plantings will be carried out at a ratio of 2:1 for the number of mature trees removed, and will be of Grey Ironbark (Eucalyptus paniculata), Smooth-barked Apple (Angophora costata), Stringybark (Eucalyptus haemostoma) and White Stringybark (Eucalyptus globoidea), as required to replace mature trees of these species removed;

- Replanting of additional canopy species will be carried out in areas where the remnant canopy is relatively open; and

- Replanting of herbs and grasses will be performed where the understorey is sparse, or in areas where significant

Planting will take place once the development works on the site likely to interfere with these actions, i.e. works within the Western Zone, are complete. Planting prior to completion of development may compromise the reinstatement objective for these species even if plant protection measures are in place. Appendix C provides a list of species suitable for planting in each of the Replanting Zones.

ii. Southern Zone - Characteristic STIF Trees with Predominantly Exotic Understorey

Under the current concept plan there is no proposal to regenerate any sector of the Southern Zone.

iii. Northern Replanting Zone.

Under the current concept plan there is no proposal to regenerate any sector of the Northern Zone.

iv. Off-site and On-site Compensatory Replanting

The offset areas will be restored as STIF vegetation by re-planting on the current soil profile wherever possible. Following any earthworks that may be required, if deemed appropriate the area should be capped with clean bushland topsoil (translocated from the area of STIF vegetation to be removed as part of the proposed action (if practical). This work will be completed under the supervision of the bush regeneration contractor as soon as possible following excavation. The following procedures, incorporating methods outlined in the earlier version of this BMP (Cumberland Ecology 2010) and recent Council specifications, will then be undertaken as appropriate

- This translocated soil will be weeded as required and replanted;
- Provenance seed and propagation material will be collected from remnant STIFF vegetation within a 1km radius;
- Additional plants might be salvaged from the development site and planted in the fill;
- Provenance specific tubestock should be used and the site brush matted;
- Tubestock (forestry size tubes) of canopy tree, shrub and groundcover species or salvaged plants are to be planted at the densities specified by Council, i.e. trees are to be planted at an average rate of 1 plant per 5m2; shrubs are to be planted at an average rate of 1 plant per m2.
- Planting densities for groundcovers shall be 5 grow cells/m2 (Not Viro Cells) and native leaf mulch applied to revegetation areas to a depth of 75mm;

- Planting design will reflect natural informal community structure;
- Slope stabilisation prior to planting will be carried out on any slopes where necessary as determined by the bush regeneration contractor. Biodegradable erosion control mat such as CoirMesh™ or equivalent will be laid over the soil surface in accordance with manufacturer's recommendations in any areas where grades are 1:3 or greater ;
- Areas where the existing ground level is to be re-profiled site soils or VENM, of similar structure and texture to the existing soils, is to be used as a sub grade. Re-profiled areas are to be topped with a native garden growing media to a depth of 300mm. The native garden media is to be lightly ripped or cultivated into the sub-grade material to prevent stratification of the soil profile.
- Plantings should be watered on installation, daily for the next week and then weekly for four weeks;
- Replanting on slopes will be carried out with proper respect given to the safety procedures outlined in the OH&S section of the BMP; and
- Planting will take place at the commencement of the development works for the proposal wherever such planting is practically achievable, such that it will not be affected by other required works.

5.8 Phase 7: Maintenance Weeding (Year 2)

Maintenance weeding will be carried out for two years following the completion of planting, as seasonal conditions and site response dictates. All zones must be inspected for weed regrowth on every visit to the site and hand weeded and spot sprayed where required.

All plantings must be watered if required.

Dead plants must be replaced on the subsequent visit.

5.9 Phase 8: Construction Period

These activities will be undertaken concurrently with other phases and will include the following actions:

- Once the site has been surveyed all weed trees and exotic vegetation will be removed from site;
- All native vegetation to be retained will be protected by installing a temporary fence around the areas, at a distance of five meters from the nearest trunk;
- Trees retained adjacent to buildings will be protected with fence palings and Hessian bags wrapped around their trunks;

- The roots of any trees that are to be retained will be trimmed and protected if disturbed during excavation works;
- All native trees should be felled and their seed collected by a propagation nursery or the regeneration contractor;
- 50m3 of native tree refuse should be chipped and stockpiled for reuse in the regeneration program;
- All topsoil found on site that has weeds currently growing in it should be removed from site. These areas are to be defined by the bush regeneration contractor; and
- All top soil situated in areas that is to be excavated and that is currently supporting weed free bushland shall be sieved for large rocks and then stockpiled for reuse in bushland rehabilitation and landscaping on site; and

All excess tree chip, stumps, rock and topsoil must then be offered to bush regeneration volunteer programs in the Sutherland Shire and transported to those sites.

5.10 Phase 9: Drainage and Compensatory Water Body

To compensate for the loss of the water body during the construction period, the time between the draining of the brick pit and the completion of the compensatory water body, a temporary water body will be placed on-site. This temporary water body must:

- Be of an area of at least 800m2;
- Have the level checked regularly to ensure that water is available permanently;
- Contain water obtained from natural sources, without additives and meet the site specific water quality guidelines as outlined by Equatica (September 2011) and agreed with Council,
- Be located as close as is reasonably possible to potential roost sites.

To provide a suitable water source for bats throughout the construction period, a staged plan will be carried out as indicated in the staging plan for the concept plan application. This plan will involve the:

- Construction of the temporary pond;
- Drainage of the existing pit; and
- Filling of the pit, and construction of the permanent pond within the southwestern sector of the subject land.

The timeline for this work is likely to be determined at a later date, and will be dependent upon external factors. Each stage however, must be completed prior to the commencement of the following stage.

i. Construction of the temporary pond

- The requirements for this pond are to serve only as a drinking source for the GHFF and EBWB. To fulfil this requirement, the temporary pond specification will generally conform to the specifications for the permanent water body as provided in Section 5.10.3, and cover a total area of approximately 800m2.

ii. Drainage of the existing pit

The drainage process may reveal aquatic or semi-aquatic fauna species currently occupying the brick pit. The extent of use by native species is unknown, however the lack of natural water sources nearby and the recent filling indicates that this will be limited. A detailed sub-plan for the translocation of native species will be prepared subject to expert advice, and the determination of suitable permanent or temporary habitat.

iii. Filling of the pit, and construction of the permanent pond within the Southwestern Sector

The filling of the pit will be carried out, followed by the construction of the permanent pond. Construction on the pond will be carried out at the earliest possible time to reduce the time period between drainage of the brick pit and the construction of the permanent pond. The GHFF is known to drink water from these bodies by skimming over the top of the water body. To provide adequate quantities of clean freshwater for the GHFF and EBWB, the pond must:

- Be of a total area of approximately 800m2;
- Be of an elongated shape, in order to accommodate the 'skimming' drinking behaviour of the GHFF;
- Be located adjacent to suitable roosting habitat for the GHFF;
- Have methods in place to maintain water level, quality and clarity to meet the site specific water quality guidelines as outlined by Equatica8 and Northrop9 and as agreed with Council.
- Be constructed generally in accordance with the VPA documents as agreed with Council.

The Council agreed landscape plan provided in **Figure 1.3** and the alternate ground floor plan of the development provided in **Figure 1.2** indicate the conceptual layout of an appropriately designed permanent pond. The final detailed design will also ensure the required specifications are met.

5.11 Maintenance

Maintenance of the Western Zone, or compensatory off-site planting, will be required for five years from the date of final plantings and primary weeding activities. Maintenance activities will include:

- Maintenance weeding, as described above;
- Replacement of plant stock. The Bushland Management Consultant will ensure that a minimum of 80% of the original plant stock is maintained for the contract period;
- Supplementary mulching to maintain sufficient depth and quality of the mulch layer to suppress weed growth and assist native plant growth; and
- Disease and feral animal control, as required.

5.12 Disease and Feral Animal Control

Specific measures for disease and feral animal are not recommended in this BMP, as they are not likely to be effective on a site of such small area, and could endanger local pets (i.e. cats and dogs).

5.13 Fire

The use of controlled burning, as a regeneration tool is not appropriate for the site, given existing and planned future residential areas that will lie in proximity to the bushland.

5.14 Occupational Health and Safety (OH&S)

The appointed BR Contractor will have a formal Occupational Health and Safety Program (OH&S Program), set up in accordance with the NSW Occupational Health & Safety Act 2000 (OH&S Act) and the NSW Occupational Health & Safety Regulation 2001, incorporating:

- Workplace principles and policies relating to QA;
- Reporting systems;
- Project management system;
- Training and education;
- Workplace inspections, evaluations and audits; and
- Staff manuals.

The appointed BR Contractor will ensure that the following OH&S issues are addressed:

- A hazard assessment is conducted for the site prior to commencement of works;
- Preparation of a Safe Work Method Statement covering all vegetation management actions for the contract and all areas of the site;
- Site induction for bush regeneration crews, identifying all relevant safety issues and environmental risks, noting particularly the steep slope;
- Where necessary, planting and/or weeding along steep slopes will be carried out with the use of ropes/climbing equipment. Necessity will be determined by the BR Contractor;
- Ongoing reviews of safe work methods and hazards; and
- Self-auditing of OH&S procedures.

5.15 Community Involvement

Input and ongoing assistance from the future tenants or residents of the proposed development will be encouraged to ensure the long-term success of the bush regeneration program outlined in this BMP.

The vegetation management consultant and BR Contractor will co-ordinate with land owners and with Sutherland Council's Bushland Management Officer in this regard and determine appropriate arrangements for supervision of residents/volunteers following occupation of the residential estate and completion of the contract. For example, volunteer planting or weeding days organised by the body corporate, supervised by the BR Contractor, will be encouraged. The involvement of local schools in the implementation of the bush regeneration program will be sought, and will promote community awareness of conservation values for students, teachers and parents.

No plants known to be invasive or which become invasive should be allowed on private lots and material consistent with the local gene pool should be seen as convenient, being affordable and readily available. Plants used in the landscaping associated with built-areas within the subject site will be consistent with the local vegetation community.

5.16 Monitoring and Reporting

The BMP will be an adaptive plan of management that is updated as required to take account of the rate of progress of the aforementioned measures within the plan and also the success of vegetation management measures.

Changes may be made to the plan in the event that problems are detected in the management of the bushland on site.

5.16.1 Monitoring

Qualified bushland management consultants will carry out a program of regular monitoring and inspection work required for the BMP. The consultant will be responsible for ensuring the measures outlined in this BMP are implemented and that performance criteria are satisfied. The monitoring program will commence prior to the commencement of site preparation works and will continue until completion of the maintenance period. Monitoring activities are set out in **Table 5.2**.

General observations of the nature and condition of the bushland will be taken during monitoring surveys, including:

- Estimates of the success rate of plantings and assessment of plant replacement requirements;
- Evidence of erosion and sedimentation and the correct function of erosion control devices;
- Depth and condition of mulch; and
- Recommendations for corrective measures and/or vegetation management.

A weed density map will be prepared at the commencement of the monitoring program and will be updated on a biannual basis in conjunction with the preparation of progress reports. The vegetation management consultant will ensure that the map is prepared on a suitable base plan, which will remain as the base plan for the duration of the monitoring period.

5.16.2 Reporting

The DWE GTAs typically require a "brief and concise report" to be submitted every six months for the duration of the maintenance period. Accordingly, a total of four (4) biannual progress reports will be prepared by the vegetation management consultant and forwarded to Sutherland Council and Department of Water and Energy (DWE) during the two year maintenance period. The report will:

- State the findings of the monitoring activities;
- Address the performance criteria set out in Table 5.2;
- Discuss any problems encountered in implementing the BMP; and
- Comment on the stability of and condition of any associated stream works.

Additionally, the appointed vegetation management consultant must certify in the first biannual progress report (to DWE) that plants used in revegetation works have been propagated from seed collected in the local "botanical provenance" of the site. DWE must also be notified of the person responsible for seed propagation prior to the commencement of propagation.

5.17 Roles and Responsibilities

The roles and responsibilities of all project staff of relevance to the BMP are listed in **Table 5.1**. The vegetation management consultant will be primarily responsible for the implementation of this BMP, and will have appropriate qualifications in botany, biology and/or bushland management. The consultant will supervise the vegetation management works and ensure that the BR Contractor has complied with the requirements of this BMP and any additional requirements of the Part 3A Permit issued by DWE. The consultant will act as a communication link between the BR Contractor, Council and DWE.

Table 5.2 Project Staff And Responsibilities

Role	Responsibilities
Construction Project Manager	Project management of site, including all civil works, landscaping, etc
Civil Contractor	Implementation civil works Bushland exclusion fencing Stormwater infrastructure Erosion and sedimentation controls
BR Contractor	Vegetation/bushland management within protection zones Erosion control within protection zones Bush regeneration works Implementation of BMP
Bushland Management Consultant	Supervision and monitoring of bush regeneration works Ensuring compliance with BMP Progress Reports (to DWE) Certification

5.18 Schedule of Activities

The initial vegetation management contract is estimated to extend for approximately 30 months (two and half years), allowing six months for site preparation, primary and secondary weeding and planting, and a further two years for maintenance, as required by DWE.

Table 5.3 Proposed Vegetation Management Actions

Action	Responsibility	Performance Criteria	Timing
Phase 1 Site Preparation			
OH&S. Hazard & risk assessment for bush regeneration crews. Prepare Safe Work Method Statement. Conduct civil contractor induction. Conduct internal safety and environmental induction.	BR Contractor/Civil Contractor	Safe Work Method Statement submitted and approved	Prior to commencement
Prepare weed density map for all retained STIF vegetation on site. Submit to vegetation management consultant for review and sign-off.	BR Contractor/Vegetation Management Consultant	Weed map submitted and approved	Prior to any weeding activity
Install silt fences around fill mounds; Install silt fences along upslope margins of development area	BR Contractor (for protection zones); Civil Contactor (for development area)	Controls must conform to NSW Department of Housing (1998) guidelines[5].	During site preparation
Topsoil for restoration/landscaping works to be weed-free imported soil. Imported fill (if required) shall not contain weeds or other organic material. Dispose of any topsoil contaminated by construction wastes (eg cement, oil, and phytotoxic material) to an approved facility and replace with clean imported topsoil.	BR Contractor	Topsoil to be used for revegetation is certified to be free of weed propagules and contaminants	Throughout site preparation
Erect temporary chain mesh exclusion fencing along boundary of construction zone. Construction activities to be excluded entirely from protection zones. No construction plant or equipment will be parked within any zone. No construction materials (or waste products) are to be stockpiled within any zones.	Civil Contractor	Construction vehicles and plant excluded from protection zones for duration of construction period	Full construction period
Fell and tub-grind trees identified for removal. Chipped/mulched vegetation to be stockpiled on flat ground on geotextile fabric, for later use as mulch in revegetation works.	BR Contactor	Woodchips stockpiled as stated. Invasive exotic trees (eg Privet) not to be chipped	Following tree felling

Table 5.3 Proposed Vegetation Management Actions

Action	Responsibility	Performance Criteria	Timing
Carry out primary weeding.	BR Contractor	Main weed infestations and targeted or noxious weeds removed	Following site preparation, preferably in winter
Ensure compliance with Noxious Weeds Act 1993; ie organise on-site destruction or removal from site of noxious weed propagules and biomass, as per specific action control categories for each species.	BR Contractor	Noxious weeds controlled as per NW Act provisions	Duration of bush regeneration program
Carry out secondary weeding.	BR Contractor	Weed regrowth following primary weeding removed	3 to 6 months following primary weeding, depending on observed levels of weed regrowth
Ensure use of herbicides that are suitable for use near waterways and environmentally sensitive areas.	BR Contractor	BR Contractor has appropriate qualifications for herbicide use; Roundup Bi-Active (or equivalent) is used.	Duration of bush regeneration program
Weed biomass to be either composted on-site or disposed of at an approved waste management centre, as appropriate for each weed species.	BR Contractor	Evidence of receipts for disposal fees Weed biomass	Duration of maintenance period
Machinery will be cleaned prior to entering the site and when leaving a weed-infested area.	Civil Contractor/BR Contractor	Machinery and truck tyres within site are clean and weed free when entering or leaving site	Duration of contract

Table 5.3 Proposed Vegetation Management Actions

Action	Responsibility	Performance Criteria	Timing
Phase 2 - Revegetation			
Collect provenance seed and propagation material from remnant STIFF vegetation within a 1km radius. Salvage plant material from site if practical	BR Contractor;	Sufficient appropriate seed stock/plant material collected	Prior to planting at appropriate collection time for suitable seed/plant material; prior to vegetation removal onsite
Import topsoil for replanting area, from areas of STIF to be removed along the southern boundary of the subject site. Import clean topsoil if necessary.	BR Contractor; or: Civil Contractor supervised by BR Contractor	Topsoil at design levels and ready for planting	Following site preparation works
Any planting areas requiring re-profiling are to be topped with a native garden growing media to a depth of 300mm. The native garden media is to be lightly ripped or cultivated into the sub-grade material to prevent stratification of the soil profile.	BR Contractor; or: Civil Contractor supervised by BR Contractor	Areas appropriately prepared	Prior to planting
Slope stabilisation prior to planting will be carried out on any slopes where necessary. Biodegradable erosion control mat such as CoirMesh™ or equivalent will be laid over the soil surface in accordance with manufacturer's recommendations in any areas where grades are 1:3 or greater	BR Contractor; or: Civil Contractor supervised by BR Contractor	Suitable grades are achieved	Prior to planting
Weed topsoil if required. Apply mulch at minimum depth 100mm to bare or disturbed ground within protection zones. Use chipped	BR Contactor	Mulch applied where required to minimum 100mm depth.	Prior to planting

Table 5.3 Proposed Vegetation Management Actions

Action	Responsibility	Performance Criteria	Timing
trees felled within the site as a priority; supplement with purchased mulch.. Brush mat areas to be planted.			
Mass plant areas identified for revegetation. Plant forestry sized tubestock of tree and shrub species at mean density of 1 stem per $5m^{2f}$ for trees, 1 stem per $5m^{2f}$ for shrubs and groundcovers at 5 stems per m^2	BR Contractor	Plantings are at required mean densities	Following mulching
Only locally indigenous plant stock to be planted within protection zones.	BR Contactor	Tubestock and cellstock comprise locally indigenous species, as listed in Appendix C. Evidence of purchase order and provenance of plant stock	Following mulching
Phase 3 - Maintenance			
Water plantings	BR Contractor	Plants adequately hydrated with good survival rate	On installation, daily for the next week and then weekly for four weeks
Carry out maintenance weeding throughout the remnant, and replanted vegetation zones.	BR Contractor	Existing weed growth minimised or controlled; Regrowth following secondary weeding controlled No new weed species or infestations	Four times per year, for five(5) years from date of final planting. Three maintenance visits to occur between September and March.

Table 5.3 Proposed Vegetation Management Actions

Action	Responsibility	Performance Criteria	Timing
Carry out replacement of plant stock[1]. Maintain mulch layer, as required.	BR Contractor	Minimum 80% original plant stock maintained No dead plant stock left in ground Mulch layer intact and minimum depth of 100mm	Four times per year, for two (2) years from date of final planting. Three maintenance visits to occur between September and March.
Monitoring and auditing			
Regular inspections of bushland to check levels of weed regrowth following primary weeding.	BR Contractor	Levels of weed regrowth reported to Vegetation Management Consultant	Monthly following completion of primary weeding
Certify plant stock is locally indigenous[2] Certify required planting densities have been achieved.	Bushland Management Consultant	Certification forwarded to DWE	Date of final planting
Certify plant stock has been maintained at minimum 80% of original quantity of plantings.	Bushland Management Consultant	Certification forwarded to DWE	One year from date of final planting
Monitor health of any retained trees on-site, particularly those directly affected by construction works. Project Arborist to advise on appropriate remedial treatments, if necessary.	Project Arborist/ Vegetation Management Consultant	Tree health monitored regularly throughout construction	As required, during construction and rehabilitation

1 Replacement must achieve a minimum of 80% of the original quantity of plant stock one year from the date of final planting.

2 Provide certification to DIPNR that plant stock has been propagated from locally collected seed and is indigenous to the botanical provenance of the site.

Table 5.3 Proposed Vegetation Management Actions

Action	Responsibility	Performance Criteria	Timing
			maintenance period
Notify DWE of person responsible for seed propagation.	Bushland Management Consultant	DWE notified of person responsible for seed propagation prior to commencement of seed collection	Prior to commencement of seed collection
Inspect erosion and sediment controls, including sediment basins, sediment fences and stormwater drains.	Site Superintendent/BR Contractor	Erosion control devices are regularly cleaned and fully functional	Weekly during construction, and following rainfall events
Site inspections.	Bushland Management Consultant	Inspection checklist completed and included in Progress Reports	At Site Establishment, then quarterly for duration of contract
Monitoring Progress Report (submit to DWE).	Bushland Management Consultant	Progress Reports completed and submitted to satisfaction of DWE (4 reports in total)	Biannually during 2-year maintenance period
Final Inspection of Works.	Bushland Management Consultant	Final Inspection carried out at completion of contract	Prior to Occupation Certificate

Chapter 6

References

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3. URS (2002) **Flora and Fauna Survey and Assessment, Kirrawee Brickpit** Prepared for Planning NSW

4. Treescan (2008) **Tree Report Kirrawee Brick Pit Princes Hwy Kirrawee** for Kirrawee Centre Pty Ltd

5. Department of Housing (1998) **Managing Urban Stormwater: Soils and Construction**

6. Cumberland Ecology (2008) **Ecological Impact Assessment for Mixed Use Development of Kirrawee Brick Pit Development** Prepared for Henroth Investments Pty Ltd

7. Cumberland Ecology (2010) **Flora and Fauna Assessment Kirrawee Brick Pit Development** Prepared for Henroth Investments Pty Ltd

8. Equatica (2011) **Kirrawee Brick Pit Grey Headed Flying Fox Water Quality Requirements**, Final, Prepared for Henroth Investments Pty Ltd

9. Northrop (2011) **Concept Description: Water supply Scheme Using Treated Rainfall Runoff and General Management of Site Runoff.** Proposed Development – Former Kirrawee Brick Pit compensatory Habitat Water Body

Appendix A

A. FLORA SPECIES INVENTORY

Flora Species Inventory

Table A.1 Flora Species Inventory For Kirrawee Brick Pit

Family	Scientific Name	Common Name	URS Survey (2002)	ERM Survey (2008)	Cumberland Survey (2008)
Ferns					
Dennstaedtiaceae	*Pteridium esculentum*	Bracken		*	*
Dicots					
Asclepiadaceae	*Araujia sericifera**	Moth Vine			
Asteraceae	*Bidens pilosa**	Cobblers Peg		*	*
	*Chrysanthemoides monilifera subsp. Monilifera**	Boneseed		*	
	*Conzya sp.**	A Fleabane		*	*
	*Coreopsis lanceolata**	Common Tick-seed	*		
	*Hypochaeris radicata**	Cats Ears		*	
	Ozothamnus diosmifolius	Common Everlasting	*	*	*
	*Senecio madagascariensis**	Fireweed		*	*
	*Sonchus oleraceus**	Sow Thistle			
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine		*	*
Cactaceae	*Opuntia sp.**	Prickly Pear		*	*
Campanulaceae	*Wahlenbergia violacea*			*	
Cassythaceae	*Cassytha glabella*	Slender Devils Twine		*	*
	Cassytha pubescens		*		
Casuarinaceae	*Allocasuarina distyla*	Scrub She-Oak	*	*	*

Table A.1 Flora Species Inventory For Kirrawee Brick Pit

Family	Scientific Name	Common Name	URS Survey (2002)	ERM Survey (2008)	Cumberland Survey (2008)
	Allocasuarina littoralis	Black She-Oak	*	*	*
Clusiaceae	*Hypericum graminium*	Native St John's Wart			*
Dilleniaceae	*Hibbertia aspera*				*
	Hibbertia scandens	Golden Guinea flower		*	
Eleocarpaceae	*Eleocarpus reticulatus*	Blueberry Ash	*		
Epacridaceae	*Leucopogon juniperinus*		*	*	*
Euphorbiaceae	*Omalanthus nutans*				*
Fabaceae: Faboideae	*Davesia genistifolia*		*	*	*
	*Dipogon lignosus**				*
	Desmodium varians			*	*
	*Erythrina sp.**	Coral Tree	*		
	Glycine clandestina				*
	Glycine microphylla			*	*
	Gompholobium sp.				*
	Hardenbergia violacea			*	*
	Pultanea villosa		*		*
	*Vicia sativa**	Vetch			*
Fabaceae: Mimosoideae	*Acacia implexa*	Hickory		*	*
	Acacia longifolia var. longifolia	Sydney Golden Wattle		*	*

Table A.1 Flora Species Inventory For Kirrawee Brick Pit

Family	Scientific Name	Common Name	URS Survey (2002)	ERM Survey (2008)	Cumberland Survey (2008)
	Acacia falcata			*	*
	Acacia parramattensis			*	*
	Acacia stricta			*	*
	Acacia suaveolens	Sweet-scented Wattle	*		
	Paraserianthes lophantha	Cape Wattle	*		
Lobeliaceae	*Pratia purpurescens*	White Root		*	*
Malvaceae	*Sida corrugata*				*
	*Sida rhombifolia**	Paddys Lucerne		*	*
Moraceae	*Ficus obliqua**		*	*	
Myrtaceae	*Angophora costata*	Smooth-barked Apple	*	*	*
	Eucalyptus eugenoides	White Stringybark		*	*
	Eucalyptus eugenoides x globoidea		*	*	*
	Eucalyptus haemostoma	Scribbly Gum	*	*	*
	Eucalyptus paniculata	Grey Ironbark	*	*	*
	Eucalyptus resinifera	Red Mahogany	*	*	*
	Melaleuca sp.				*
Ochnaceae	*Ochna serrulata**	Mickey Mouse Bush		*	*
Oleaceae	*Ligustrum lucidum**	Large-leaved Privet		*	*
	*Ligustrum sinense**	Small-leaved Privet	*	*	*

Table A.1 Flora Species Inventory For Kirrawee Brick Pit

Family	Scientific Name	Common Name	URS Survey (2002)	ERM Survey (2008)	Cumberland Survey (2008)
	*Olea europaea var africana**	African Olive		*	*
	Notolaea longifolia forma longifolia	Native Olive	*	*	*
Pittosporaceae	*Billardieria scandens*		*	*	*
	Bursaria spinosa	Blackthorn	*	*	*
	Pittosporum revolutum			*	*
	Pittosporum undulatum	Sweet Pittosporum		*	*
Plantaginaceae	*Plantago lanceolata**	Plantain		*	*
Proteaceae	*Persoonia levis*	Smooth Geebung			*
Rosaceae	*Rosa sp.**	A Rose			*
	*Rubis fruticosus**	Blackberry	*	*	*
Rubiaceae	*Pomax umbellata*	Pomax			*
Rutaceae	*Zieria sp.*			*	
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart	*	*	*
Sapindaceae	*Dodonaea triquetra*	Hop Bush	*	*	*
Verbenaceae	*Lantana camara**	Lantana	*	*	*
Monocots					
Lilaceae: Asparagaceae	*Asparagus asparagoides**	Bridal Veil Creeper		*	*
	*Asparagus officinalis**	Garden Asparagus		*	*

Table A.1 Flora Species Inventory For Kirrawee Brick Pit

Family	Scientific Name	Common Name	URS Survey (2002)	ERM Survey (2008)	Cumberland Survey (2008)
	*Protsparagus aethiopicus**	Asparagus Fern	*	*	*
Lilaceae: Antheriaceae	*Chlorophytum comosum**	Spider Plant			*
Lilaceae: Phormiaceae	*Dianella caerulea var producta*	Blue Flax Lily		*	*
	Dianella caerulea var caerulea			*	*
	Dianella revoluta		*		*
Cyperaceae	*Elaeocharis sphacelata*			*	
	Gahnia radula				*
	Lepidosperma laterale	Sword Sedge	*	*	*
Lomandraceae	*Lomandra filiformis subsp. filiformis*			*	*
	Lomandra longifolia	Mat Rush	*	*	*
	Lomandra multiflora		*	*	*
	Lomandra obliqua	Fish Bones		*	*
Poaceae	*Agrostis avenaceae*	Brown Grass	*		
	Aristida ramosa			*	*
	Austrodanthonia sp.			*	*
	Austrostipa rudis ssp. rudis	Spear Grass	*		
	*Axonopus affinis**				*
	*Briza maxima**				*
	*Cynodon dactylon**	Common Couch	*	*	*

Table A.1 Flora Species Inventory For Kirrawee Brick Pit

Family	Scientific Name	Common Name	URS Survey (2002)	ERM Survey (2008)	Cumberland Survey (2008)
	Dichelachne crinita		*		
	Dichelachne rara				*
	Digitaria sp.			*	
	Echinopogon caespitosus			*	*
	Entolasia marginata	Bordered Panic	*	*	*
	Entolasia stricta var stricta	Wiry Panic	*		*
	*Eragrostis curvula**	African Love Grass		*	*
	*Erharta erecta**			*	*
	Imperata cylindrica var major	Blady Grass			*
	Microlaena stipoides var stipoides	Meadow Rice Grass		*	*
	Notodanthonia semiannularis	Wallaby Grass	*		
	Panicum simile	Two-colour Panic		*	
	*Paspalum dilatatum**				
	*Pennisetum clandestinum**	Kikuyu		*	*
	Poa labillardieri		*		*
	*Setaria gracilis**	Slender Pidgeon Grass		*	*
	Sporobolus sp.			*	*
	*Stenotaphrum secundatum**	Buffalo Grass			*
	Themeda australis	Kangaroo Grass	*		

Table A.1 Flora Species Inventory For Kirrawee Brick Pit

Family	Scientific Name	Common Name	URS Survey (2002)	ERM Survey (2008)	Cumberland Survey (2008)
Iridaceae	*Fresia* hybrid*				*

* Exotic species

Appendix B

B. FAUNA SPECIES INVENTORY

Fauna Species Inventory

Table B.1 Fauna Species Inventory For Kirrawee Brick Pit

Family	Scientific Name	Common Name	URS Survey (2002)	ERM Survey (2008)
Birds				
Anatidae	*Anas superciliosa*	Pacific Black Duck	*	*
	Chenonetta jubata	Australian Wood Duck	*	
Artamidae	*Gymnorhina tibicen*	Australian Magpie	*	*
	Strepera graculina	Pied Currawong	*	*
Aslecledinidae	*Dacelo naxaeguineae*	Laughing Kookaburra	*	
Cactuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	*	*
Charadriidae	*Vanellus miles*	Masked Lapwing	*	*
Columbridae	*Ocyphaps lophotes*	Crested Pidgeon		*
	*Streptophelia chinensis**	Spotted Turtle Dove	*	
Corvidae	*Corvus coronoides*	Australian Raven	*	*
Dicruridae	*Grallina cyanoleuca*	Magpie Lark	*	
	Rhipidura leucophrys	Willie Wagtail	*	
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	*	*
Maluridae	*Malurus cyaneus*	Superb Fairy Wren	*	*
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	*	
	Anthochaera chrysoptera	Brush Wattlebird	*	
	Anthochaera chrysoptera	Little Wattlebird		*

Table B.1 Fauna Species Inventory For Kirrawee Brick Pit

Family	Scientific Name	Common Name	URS Survey (2002)	ERM Survey (2008)
	Lichenostromus pencillatus	White-plumed Honeyeater	*	*
	Manorina melanocephala	Noisy Minor	*	*
Pardalotidae	*Acanthiza lineata*	Striated Thornbill	*	
	Acanthiza pusilla	Brown Thornbill	*	
	Pardalotus punctatus	Spotted Pardalote		*
Passeridae	*Passer domesticus**	House Sparrow	*	
Phaethontidae	*Phalacrocorax melanoleucos*	Little Pied Cormorant	*	
	Phalacrocorax sulcirostris	Little Black Cormorant	*	
	Phalacrocorax varius	Pied Cormorant	*	
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe	*	*
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	*	*
Pycnonotidae	*Pyconotus josocus**	Red-whiskered Bulbul	*	
Rallidae	*Fulica atra*	Eurasian Coot		*
	Gallinula tenebrosa	Dusky Moorhen	*	*
	Porphyrio porphyrio	Purple Swamphen	*	*
Sturnidae	*Acridotheres tristis**	Common Myna	*	*
Zosteropidae	*Zosterops laterals*	Silvereye	*	*
Mammals				
Leporidae	*Oryctolagus cuniculus**	Rabbit	*	

Table B.1 Fauna Species Inventory For Kirrawee Brick Pit

Family	Scientific Name	Common Name	URS Survey (2002)	ERM Survey (2008)
Molossidae	*Mormopterus sp. 2*	Eastern Freetail Bat		*
	Tadarida australia	White-striped Mastiff Bat		*
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	*	*
Pteropidae	*Pteropus poliocephalus#*	Grey-headed Flying Fox	*	*
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat		*
	Miniopterus shreibersii oceanensis#	Eastern Bent-wing Bat		*
Reptiles				
Chelidae	*Chelodina longicollis*	Eastern Snakenecked Turtle	*	
Elapidae	*Demansia psammophis*	Yellow-faced Whip Snake	*	
Scincidae	*Eulamprus quoyii*	Eastern Water Skink	*	
	Lampropholis delicata	Grass Skink	*	
	Lampropholis guichenoti	Garden Skink	*	*
	Teliqua scincoides	Blue Tongue Lizard		*
Amphibians				
Hylidae	*Litoria fallax*	Eastern Dwarf Tree Frog	*	*
	Litoria peronii	Peron's Tree Frog	*	
Myobatrachidae	*Limnodynastes peronii*	Striped Marsh Frog	*	*

Table B.1 Fauna Species Inventory For Kirrawee Brick Pit

Family	Scientific Name	Common Name	URS Survey (2002)	ERM Survey (2008)
Fish				
Eleotridae	*Hypseleotris galii*	Firetail Gudgeon		*
Cyprinidae	*Carasssius auratus**	Goldfish		*
* Exotic species				
# Threatened species				

Appendix C

C. PLANTING LIST FOR REGENERATION WORKS

Planting List for Regeneration Works

Table C.1 Planting List For Regeneration Works

Scientific Name	Common Name	Density (stems/m^2)	
		Western Zone - Remnant STIF: 2/m2	Offsite Offset
Dicots			
Asteraceae			
Ozothamnus diosmifolius	Common Everlasting	✓	✓
Bignoniaceae			
Pandorea pandorana	Wonga Wonga Vine	✓	✓
Casuarinaceae			
Allocasuarina distyla	Scrub She-Oak	✓	✓
Allocasuarina littoralis	Black She-Oak	✓	✓
Dilleniaceae			
Hibbertia aspera		✓	✓
Hibbertia scandens	Golden Guinea flower	✓	✓
Eleocarpaceae			
Eleocarpus reticulatus	Blueberry Ash	✓	✓
Epacridaceae			
Leucopogon juniperinum		✓	✓
Euphorbiaceae			
Omalanthus nutans	Bleeding Heart	✓	✓
Fabaceae: Faboideae			
Davesia genistifolia		✓	✓
Desmodium varians		✓	✓
Glycine clandestina		✓	✓

Table C.1 Planting List For Regeneration Works

Scientific Name	Common Name	Density (stems/m^2)	
		Western Zone - Remnant STIF: 2/m2	Offsite Offset
Glycine microphylla		✓	✓
Gompholobium sp.		✓	✓
Hardenbergia violacea		✓	✓
Pultanea villosa		✓	✓
Fabaceae: Mimosoideae			
Acacia implexa	Hickory	✓	✓
Acacia falcata		✓	✓
Acacia longifolia	Sydney Golden Wattle	✓	✓
Acacia parramattensis		✓	✓
Acacia stricta		✓	✓
Acacia suaveolens	Sweet-scented Wattle	✓	✓
Lobeliaceae			
Pratia purpurescens	White Root	✓	✓
Myrtaceae			
Angophora costata	Smooth Barked Apple	✓	✓
Eucalyptus haemostoma		✓	✓
Eucalyptus paniculata		✓	✓
Eucalyptus resinifera		✓	✓
Eucalyptus globoidea	White Stringybark	✓	✓
Oleaceae			

Table C.1 Planting List For Regeneration Works

Scientific Name	Common Name	Density (stems/m^2)	
		Western Zone - Remnant STIF: 2/m2	Offsite Offset
Notolaea longifolia forma longifolia	Native Olive	✓	✓
Pittosporaceae			
Billardiera scandens var scandens	Apple Dumplings	✓	✓
Pittosporum undulatum	Sweet Pittosporum	✓	✓
Bursaria spinosa	Blackthorn	✓	✓
Proteaceae			
Persoonia levis	Smooth Geebung	✓	✓
Rhamnaceae			
Pomaderris elliptica		✓	✓
Rubiaceae			
Pomax umbellata	Pomax	✓	✓
Santalaceae			
Exocarpos cupressiformis	Cherry Ballart	✓	✓
Sapindaceae			
Dodonaea triquetra	Hop Bush	✓	✓
Monocots			
Cyperaceae			
Lepidosperma laterale	Sword Sedge	✓	✓
Elaeocharis sphacelata		✓	✓
Gahnia radula		✓	✓
Lomandraceae			

Table C.1 Planting List For Regeneration Works

Scientific Name	Common Name	Density (stems/m^2)	
		Western Zone - Remnant STIF: 2/m2	Offsite Offset
Lomandra filiformis subsp. filiformis		✓	✓
Lomandra longifolia	Mat Rush	✓	✓
Lomandra multiflora		✓	✓
Lomandra obliqua	Fish Bones	✓	✓
Phormiaceae			
Dianella caerulea var producta	Blue Flax Lily	✓	✓
Dianella caerulea var caerulea		✓	✓
Dianella revoluta		✓	✓
Poaceae			
Agrostis avenacea	Blown Grass	✓	✓
Aristida ramosa	Three-Awn Speargrass	✓	✓
Austrostipa rudis ssp. rudis	Spear Grass	✓	✓
Dichelachne crinita	Longhair Plume Grass	✓	✓
Echinopogon caespitosus	Hedgehog Grass	✓	✓
Entolasia marginata	Bordered Panic	✓	✓
Entolasia stricta var stricta	Wiry Panic	✓	✓
Imperata cylindrica var major	Blady Grass	✓	
Microlaena stipoides var stipoides	Meadow Rice Grass	✓	✓
Poa labillardieri		✓	✓

Table C.1 Planting List For Regeneration Works

Scientific Name	Common Name	Density (stems/m^2)	
		Western Zone - Remnant STIF: 2/m2	Offsite Offset
Themeda australis	Kangaroo Grass	✓	✓