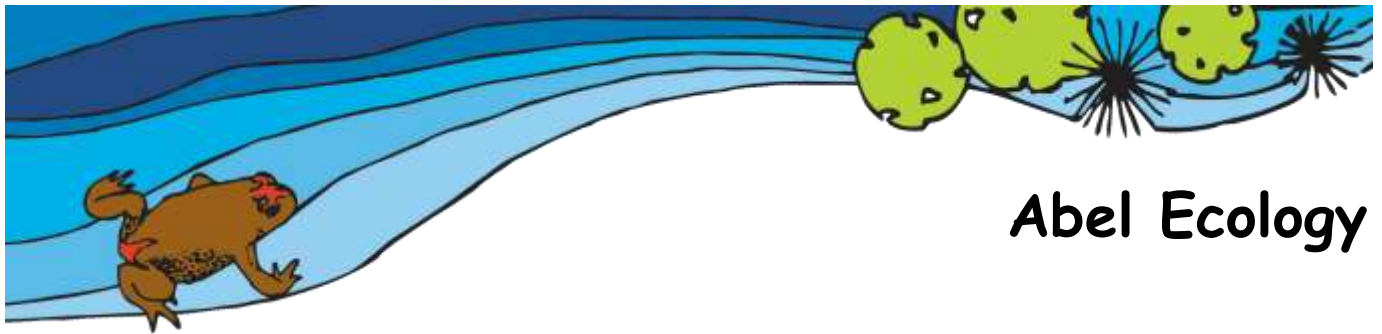




Abel Ecology

Spring 2014

Flora Monitoring and Annual Report

for

Bonnie Doon Golf Club

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Prepared for: Bonnie Doon Golf Club

Prepared by: Abel Ecology



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List of Abbreviations

ALG	African Love Grass
BDGC	Bonnie Doon Golf Club
EEC	Endangered Ecological Community
LGA	Local Government Area
NP	National Park
ROTAP	Rare or Threatened Australian Plant
ESBS	Eastern Suburbs Banksia Scrub
ALG	African Love Grass
EMP	Environmental Management Plan

Note regarding maps in this report

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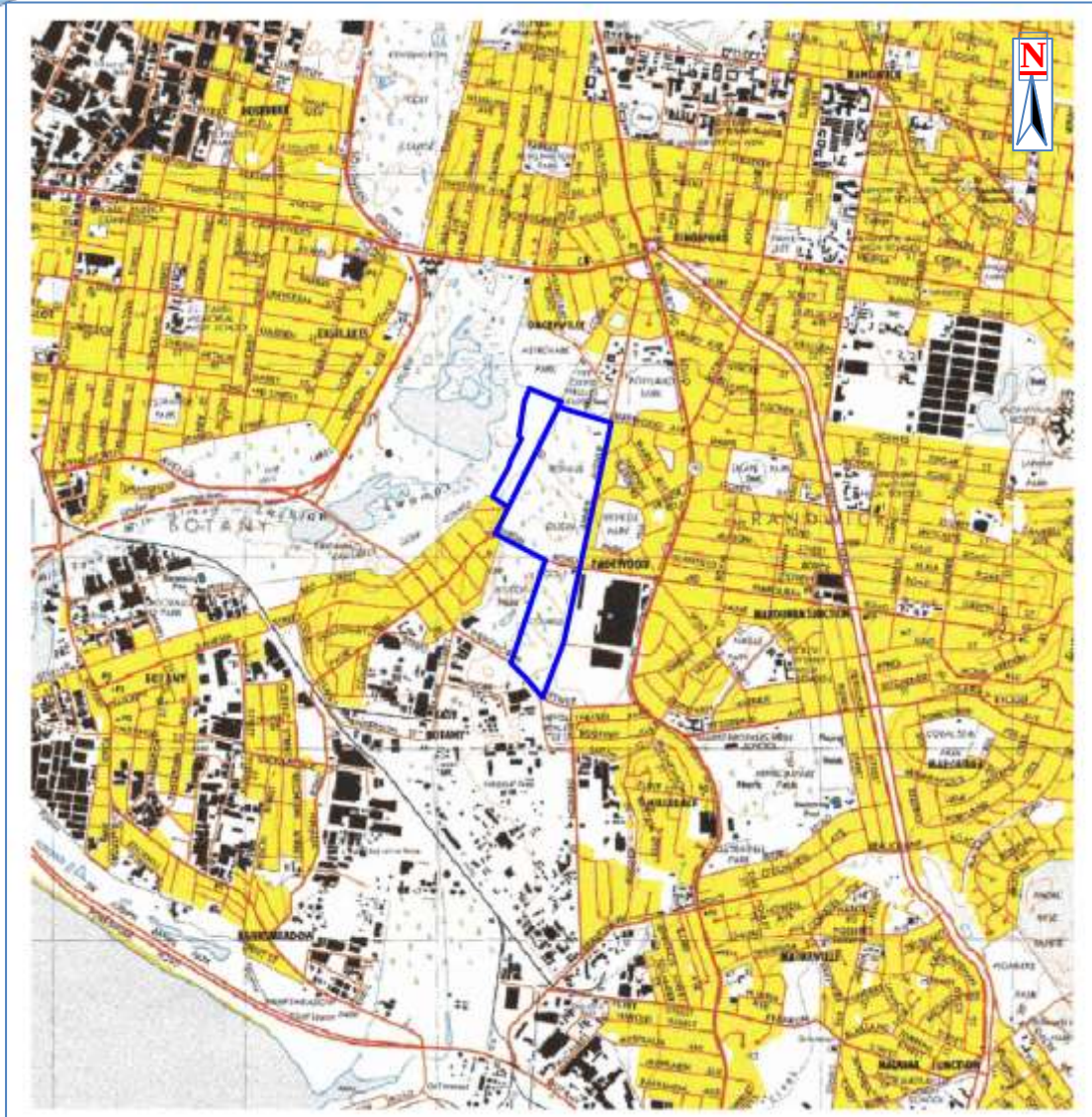


Figure 1. Locality map for Bonnie Doon Golf Course

 Site Locality

Scale: grid spacing = 1 km

Topographic maps used with permission; © Land and Property Information NSW (Combining the Land Information Centre, Land Titles Office and Valuer General's Office). Botany Bay 9130-3S, Third edition

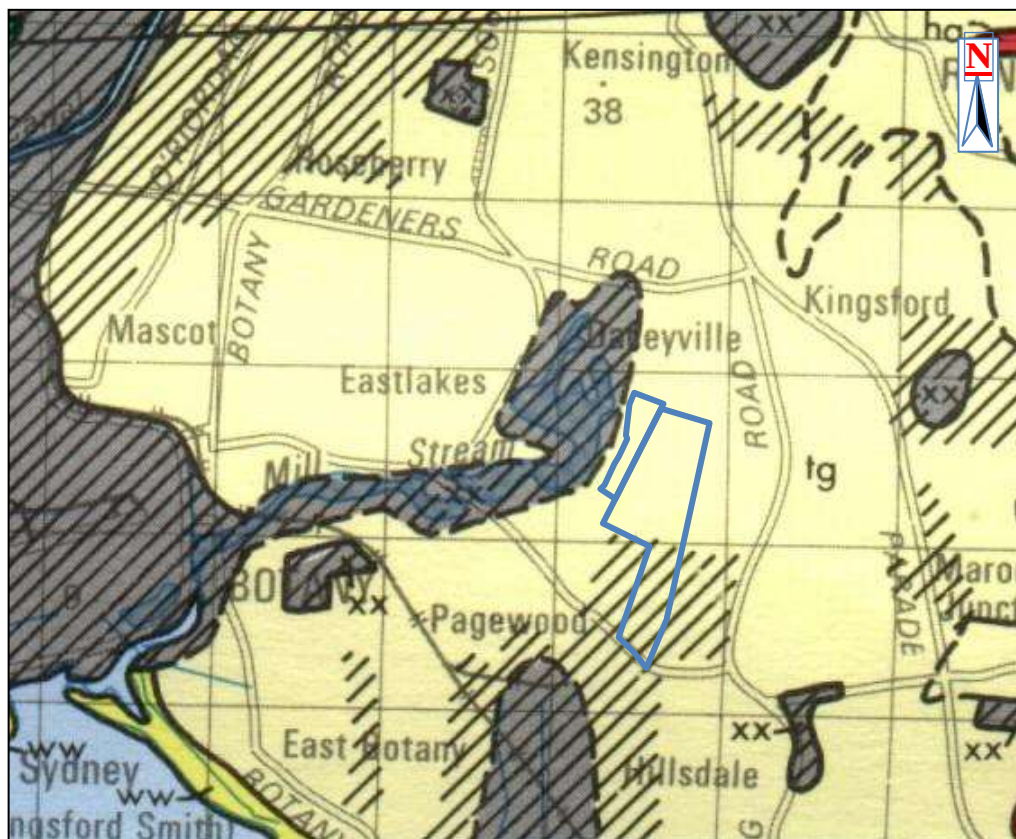


Figure 2. Soil map for site and surrounding area

 Site locality

Scale: grid square = 1 km

KEY

AEOLIAN

tg (Tuggerah) – Landscape – gently undulating to rolling coastal dunefields. Soils – deep on dunes and Podzol/Humus Podzol intergrades on swales.

COLLUVIAL

ha (Hawkesbury) – Landscape – rugged, rolling to very steep hills on Hawkesbury Sandstone. Soils – shallow, discontinuous Lithosols/Siliceous Sands associated with rock outcrop; Earthy Sands, Yellow Earths and some Yellow Podzolic Soils on inside of benches and along joints and fractures; localised Yellow and Red Podzolic Soils associated with shale lenses; Siliceous Sands and secondary Yellow Earths along drainage lines.

MARINE

ww (Woy Woy) – Landscape – level to gently undulating non-tidal beach ridges on marine sands. Soils – deep Siliceous Sands and occasional Podzols on sandy rises, Humus Podzols in poorly drained areas, Calcareous Sands near beaches.

DISTURBED

xx Cleared

Source: Soil Conservation Service of NSW Soil landscape series sheet 9130, Sydney, 1983.



Figure 3. Air photo of the site and local area



Site boundary

© Land and Property Information NSW. Spatial Information eXchange (SIX) website 2011.



Figure 4. 1943 Air photo of the site and local area

 Site locality

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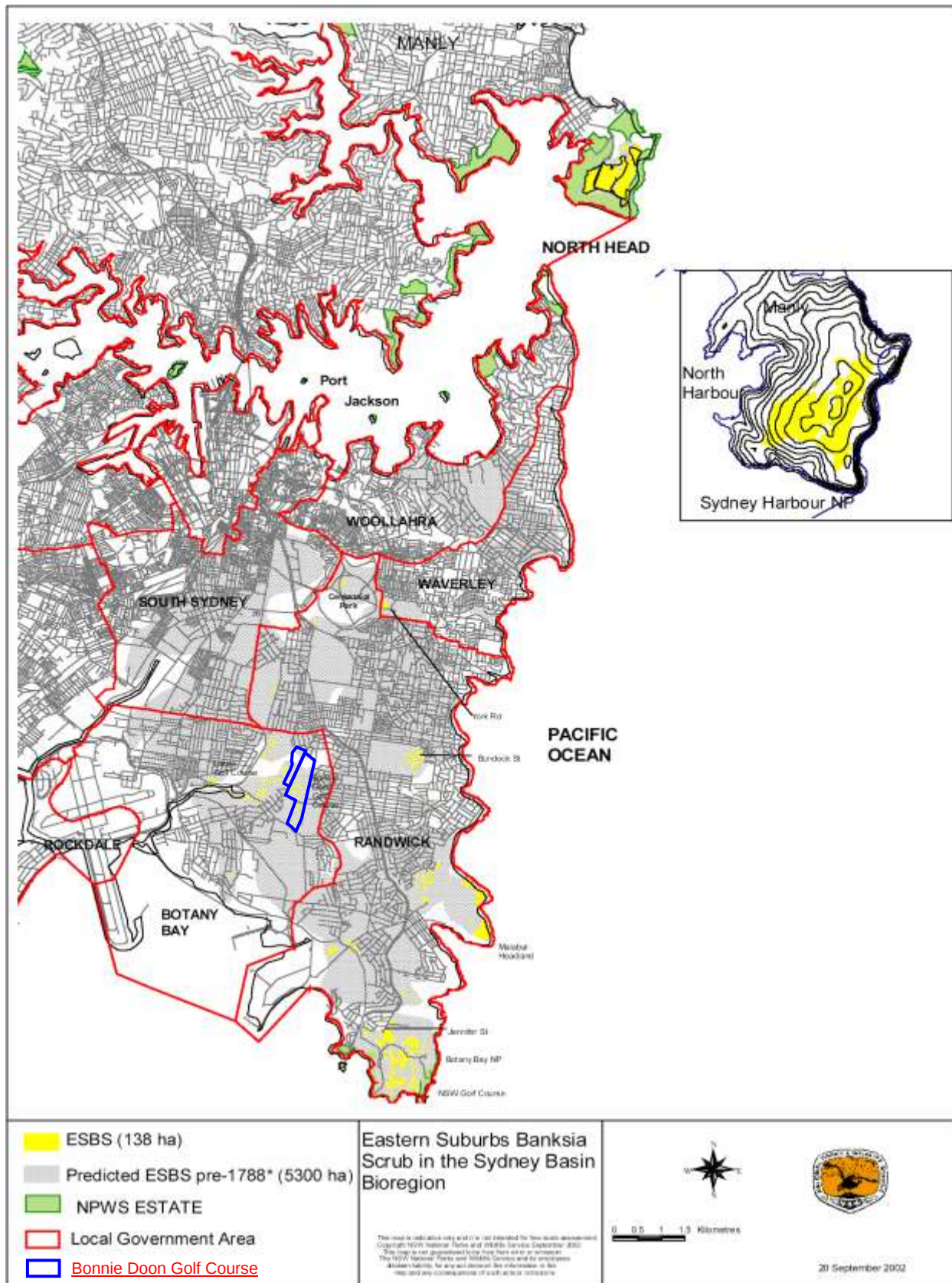


Figure 5. The extent of ESBS in the Sydney Basin Bioregion



Figure 6. North Course – north section and additional 6.5 ha extension



Figure 7. North course – south section



Figure 8. Site vegetation and flora and fauna methodology – South Course



Executive Summary

This is the monitoring report required under terms of the lease, for the year 2014. In 2004 a flora and fauna baseline survey was carried out at Bonnie Doon Golf Course (BDGC) to determine the fauna and vegetation present on the site, and the vegetation community condition under the then current management regime.

Follow-up surveys were performed each subsequent year from 2005 to 2014 to assess any changes to the flora and fauna communities on the site. The results of the surveys can be used to assess whether the intended outcomes of a revised management regime are being achieved. In particular ongoing monitoring will be used to show what effect management is having on the Endangered Ecological Community, Eastern Suburbs Banksia Scrub (ESBS). In 2013 the Club, in consultation with Daniel Cunningham of Sydney Water, decided to conduct fauna surveys on alternate years but continue with annual vegetation surveys.

The site is a golf course located at Pagewood in the eastern suburbs of Sydney. The present survey confirmed the presence of turfed areas (greens, tees, fairways and practice area), areas of weed invasion and landscape plantings, and Eastern Suburbs Banksia Scrub (ESBS). With the exception of B19, ESBS was present in all previously mapped remnants as fragments of variable condition (Class 1/2/2R/3), with the weed African Love Grass (ALG) *Eragrostis curvula* generally present as a significant component of the biomass in some remnants. ALG has been removed from some areas within particular ESBS, either by the volunteer members bush regeneration group, and/or a bush regeneration company, and/or by greenkeeping staff maintaining regular brushcutting and mowing of ALG along remnant margins and spraying of regrowth with herbicide.

In the last five years, site renovations have included clearing 6.5ha of dense weed cover on the north-west for extension of the course **Figure 7**, a new 'practice area', renovation of other parts of the existing course, and landscaping with various native species including those in ESBS.

Regeneration has been carried out primarily through substantial removal of ALG from B1, B2, B3, B5, B6, B7, B8, B11, B12, B14 and B18. There has been a significant improvement in control of ALG in many of the remnants over the past three years. In particularly good example can be seen in the northern part of B2.

Success of indigenous landscape plantings within the 6.5 ha extension to the course has been variable. Plantings of Wallaby Grass *Rytidosperma tenuius* (*Austrodanthonia tenuior*); abundant flowering in 2013 presumably set seed which will hopefully colonise adjoining bare areas over time. Several plantings on the south end of this area, including many Coast Rosemary *Westringia fruticosa*, are generally healthy and will form a dense local shrub layer over time.



The original baseline survey also revealed the presence of at least 11 species of reptile, one frog, four mammals and 32 birds. During the 2012 survey, seven species of reptile and 34 bird species were recorded. The site provides habitat for insectivorous, granivorous and generalist birds as well as small reptiles. Threatened fauna species were not detected on the site. Evidence of Fox presence was recorded on the north course. A Fox control program is in place and will need to be continued.

The identity of the small Sword Sedge *Lepidosperma* was unclear for a number of years. Scattered specimens were collected and Mrs Karen Wilson (Senior Research Scientist - Botanist – Royal Botanic Gardens Sydney) in July 2014 has now determined that the species on site is *Lepidosperma concavum* but is smaller than the typical form. Some species of *Lepidosperma* are currently being researched and this smaller form of *Lepidosperma concavum* may be named as a new species.

Table 1 Endangered ecological community found on the site

Species/ Communities	C'wealth listing EPBC Act '99	State listing TSC Act '95
Eastern Suburbs Banksia Scrub	Endangered	Schedule 1, Part 3, Endangered

Recommendations for the site

- a) Recommendations for remnant ESBS are shown in Table 5 of this Report.
- b) In particular, continue staged removal of African Love Grass (ALG in and around ESBS.
- c) Remove Spiny Rush *Juncus acutus* in a patch of Bulrush *Typha orientalis* on the western fence bordering Eastlake Golf Course to prevent further spread.
- d) Continuous control of Noxious weeds.
(Lantana in some remnants and Green Cestrum *Cestrum parquii* was observed in B2)
- e) The most appropriate location for the planting of indigenous species for landscaping must be considered and species matched for the most suitable microhabitat locations. We recommend that planting contractors be familiar with the preferred natural habitats of the indigenous species nominated for planting and use local ESBS species consistent with this plan and council consent conditions.
- f) For replanting areas cleared of ALG with appropriate ESBS species, seed collection of species on the site with low population numbers (< 20 individuals/patch) be undertaken (with permission) on the neighbouring golf courses, namely Eastlake and The Lakes,



and/or other golf courses with larger areas of ESBS. As a 'rule of thumb', it is recommended to collect seed from larger populations of > 50 individuals, to assist in returning genetic diversity. Sourcing seed on site is not recommended unless sourced from populations of > 50 individuals/patch. Prior to collecting seed it is worthwhile determining how readily seed of a species can be germinated. Details for collecting, drying, storing and germinating seed can be found in publications at the Florabank website: http://www.florabank.org.au/default.asp?V_DOC_ID=885

- g) As a general pattern, populations of species with low numbers will require assisted regeneration (manual replanting). A list of these is shown in Section 6.8.6. Other species with low number and/or low seed set include *Lambertia formosa*, *Acacia ulicifolia*, *A. suaveolens*, *Astroloma pinifolia*, *Persoonia lanceolata*, *Banksia paludosa*, and *Dichelachne*. While it will be difficult to source material of some of these (e.g. *Hibbertia*), others are more readily available (e.g. *Acacia* spp, *Banksia*) and can be used in the first instance. If undertaken correctly, planting improve long-term fecundity of these species. These species have consistently shown low or no recruitment in ESBS across the site.
- h) Guidelines for ESBS and landscape plantings are shown in Section 6.11. Regular monitoring of new/recent landscape plantings is critical for their establishment. As a general principle it is recommended that planting regimes be preferentially biased toward ESBS species where possible. There was a very high attrition rate of plantings on the new extension of the course **Figure 7**, including many *Banksia aemula*. Some of these have been replaced, although there are many plants of other species not occurring in ESBS on the site and therefore inappropriate for planting.
- i) The application to OEH for a controlled burn in B8 has not been finalised. In the event of a planned burn, follow up weed control will be important, especially for ALG, and Abel Ecology will need to monitor species recovery after the fire.
- j) Continue funding for professional control of foxes and rabbits. Evidence of fox predation (dens and tracks) has been recorded during several surveys. Feral fauna control is important for the survival of species such as Brown Quail and Eastern She-oak Skink *Cyclodomorphus michaeli*.

Fox control

During the survey fox scats were observed in remnant B3d (north course).



1. Introduction

A flora survey of Bonnie Doon Golf Course ('the site' – Figure 1) was undertaken during late December 2014. The main aim of the survey was to determine the floristic diversity and health, and to assess actions and potential impacts to Eastern Suburbs Banksia Scrub (referred to as ESBS in this Report) under current management regime.

The results of the survey indicate changes from previous years, allowing an assessment of plant health, population viability, and the relative needs for regeneration and planting.

2. Site overview

2.1 Site description

Bonnie Doon Golf Course (BDGC) is located approximately 9 km south of the Sydney CBD in the suburb of Pagewood. The course and associated amenities occupy an area of approximately 53 ha, of which approximately 2.5 ha is ESBS, comprising remnant areas and individual plants.

The site is surrounded by developed land and is bordered by roads and Mutch Park. No permanent water bodies occur on the site. Bore water is used for irrigation purposes. A golf course has existed at the present site since 1937 and the Bonnie Doon Golf Club took over the site during 1948-1952.

An estimated total of approximately 146 hectares of ESBS (of an original 5,300 Ha) has been recorded from the local government areas of Botany, Randwick, Waverley, and Manly. Of this, about 33Ha (0.6% of the original estimated distribution of the community) occurs within conservation areas. In 2004 there were 24 known sites with this community.

2.2 Critical habitat

Critical Habitat has not been declared under the TSC Act 1995 for ESBS.

A recommendation was made for its identification (inclusion) in a Draft document by Department of Environment and Conservation (DEC), NSW (2006), in which the preferred option was to declare all remaining patches Critical, together with "adjacent remnant vegetation that currently act as a protective buffer for ESBS".

According to the Draft document, "The area of critical habitat consists of 149 hectares of ESBS and 87 hectares of buffer area. The areas recommended for critical habitat are indicated on the maps contained in Appendix 1 of that document as "ESBS" and "Buffer



Zone". "Buffer Zone" areas have been included in the critical habitat to protect existing ESBS remnants. Remnants within golf courses have only a 1 to 2 m buffer where the surrounding land.

2.3 Geology

The geology on the site consists of Quaternary deposits of alluvium, gravel, sand, silt and clay (Bryan, 1966).

2.4 Soils

The soil consists of aeolian (wind blown) dune sand as part of the Tuggerah Group. The golf course is situated on an old sand dune, which, due to disturbance does not display the undulating terrain typical of vegetated sand dunes. Chapman *et al.* (1983) describes the soils of this type in the general locality as: the sediments are deep (>2 m), non-cohesive, highly wind erodible, highly permeable soils containing very low nutrients. Water tables are permanently high and localised flooding may occur (Figure 2).

2.5 Hydrology

The Course is within the Botany Wetlands catchment, which covers an area of approximately 20 km².

2.6 Vegetation

Approximately 90% of the site is covered by turf grass. Small areas of remnant ESBS (to 2.5 ha in total) are scattered across the site. Remnants are variable in quality and relative species dominance. The weed, African Love Grass (ALG) *Eragrostis curvula*, competes with the native understorey of many remnants. A small number of better quality remnants with varying amounts of ALG invasion occur on both the south and north courses, for example B2 on the north and B8 on the south.

The past three surveys have recorded significant regeneration works when comparing the survey to previous years. Various types of regeneration works from control of ALG to replanting were observed in Remnants B1, B2, B5, part of B3, B5, B6, B7, B8d, B9, B11b and B13. Control of ALG and other weeds will be ongoing as a standard part of course management. Recent bush regeneration activities have substantially improved the quality of some ESBS remnants, as noted in the Table 5 below; remnant B2 is particularly noteworthy in this regard.

A planned fire occurred mid-year 2011 in remnant B1. Recruitment of indigenous species from soil-stored seed is being monitored, with the response so far being poor.



2.7 Existing threats to the site

2.7.1 Fragmentation

Fragmentation is a significant threat to the viability of ESBS remnants. In many cases the remnants are separated by > 100m; e.g. from B3 complex to B1 complex is approximately 200m. Fragmentation and the low numbers of some species in the remnants leads to a reduction in the probability of successful pollination, seed set and later recruitment.

2.7.2 Low population numbers

The small number of individuals of some species, as well as reduced likelihood of successful pollination and seed production, is also likely to lead to genetic drift and inbreeding depression in those species that commonly cross-pollinate. The long-term result of these various factors is that populations of viable plants will decline and possibly disappear, and seed within the soil will also eventually die. This represents a serious long-term threat to the biodiversity of the site and particularly the viability of some of the fragments on the site. It will only be overcome by significant on-site recruitment or by the introduction of off-site plant material.

2.7.3 Feral fauna and weeds

Ongoing threats to the site include feral animals and weed invasion. Introduced rodents and dogs have all been observed on the site and cats are also expected. Foxes are known historically to frequent the site, and fox control programmes have been undertaken in previous years. Fox scats were recorded in the north course during the present survey, and the continuation of the fox control program is recommended.

Weeds remain a persistent problem in some areas, even though ongoing management is controlling invasion to ESBS remnants. ALG in particular remains as an ongoing threat to several remnants and the on-site weed seed bank is expected to persist. ALG has been eliminated from some golf courses in the eastern suburbs of Sydney, so long-term control is possible. In general, the abundance of ALG on the site is declining.

Soil compaction is restricted to turfed and developed areas and is not a threat to ESBS remnants.



3. Methodology

3.1 Literature review

Literature reviewed in order to assess possible issues relating to this site include:

Landscape and Environment Plan 1997-2007 for Bonnie Doon Golf Club, prepared by Kate Low and Associates & Daniel Ondinea, Designing for Wildlife.

Schedules to the TSC Act 1995

Schedules to the EPBC Act 1999

ROTAP lists Briggs & Leigh

NPWS Atlas of NSW Wildlife

Approved Recovery Plan for Eastern Suburbs Banksia Scrub (NPWS, March 2004).

Threatened Species Information and Environmental Assessment Guidelines Central Region
NSW NPWS 2000 AD.

Other flora and fauna survey reports in the local area or from similar sites, including:

White, A. (2004). *Frog and Reptile Survey of Botany Wetlands*. Sydney Water Corporation.

Wilson, K.A. (2004). *Botany Wetlands Bird Survey: April 2003 to February 2004*. Sydney Water Corporation.

Wotherspoon, D. (2005). *Environmental Management Plan for Bonnie Doon Golf Club*. Blue Mountain Wilderness Services Pty. Ltd. Falconbridge.

Wotherspoon, D. (2005). *Baseline Flora and Fauna Condition Report for Bonnie Doon Golf Club*. Banks Avenue, Pagewood. Blue Mountain Wilderness Services Pty. Ltd. Falconbridge.

Abel Ecology (2006) *Spring 2005 Flora and Fauna Condition Report for Bonnie Doon Golf Course*, Banks Avenue, Pagewood. Abel Ecology, Falconbridge.

Abel Ecology (2007) *Spring 2006 Flora and Fauna Condition Report for Bonnie Doon Golf Course*, Banks Avenue, Pagewood, Abel Ecology, Falconbridge.

Abel Ecology (2008) *Spring 2007 Flora and Fauna Condition Report for Bonnie Doon Golf Course*, Banks Avenue, Pagewood, Abel Ecology, Falconbridge.

Abel Ecology (2009) *Spring 2008 Flora and Fauna Condition Report for Bonnie Doon Golf Course*, Banks Avenue, Pagewood, Abel Ecology, Falconbridge.

Abel Ecology (2010) *Spring 2009 Flora and Fauna Condition Report for Bonnie Doon Golf Course* Banks Avenue, Pagewood, Abel Ecology, Falconbridge.

Abel Ecology (2011) *Spring 2010 Flora and Fauna Condition Report for Bonnie Doon Golf Course* Banks Avenue, Pagewood, Abel Ecology, Falconbridge.



Abel Ecology (2012) *Spring 2011 Flora and Fauna Condition Report for Bonnie Doon Golf Course Banks Avenue, Pagewood, Abel Ecology, Faulconbridge.*

Abel Ecology (2013) *Spring 2012 Flora and Fauna Condition Report for Bonnie Doon Golf Course Banks Avenue, Pagewood, Abel Ecology, Faulconbridge.*

Field work

Over the three days of fieldwork a total of 5.5 hours were spent undertaking survey work on the site and surrounding habitat areas.

Table 2. Survey dates and weather conditions

Date	Times	Weather (°C)	Task	Hours (hrs x no. people)
18 Dec 14	14:30 – 16:30	30-34 °C	Vegetation survey	(2 x 1) = 2
23 Dec 14	15:00 – 16:35	18-25 °C	Vegetation/quadrat survey	(1.5 x 1) = 1.5
24 Dec 14	13:45 – 15:45	22-28 °C	Vegetation/quadrat survey	(2x1) = 2
			Total	5.5 hours

Survey effort was concentrated within the site boundaries (**Figure 8**). The site has been assessed in the context of the larger study area, taking into account areas adjoining the site. Most adjoining areas are part of established urban development. Adjoining canopy habitat Extends west into Eastlakes course from the north-west corner of the southern course.

Habitat of the study area was ground-truthed by field survey. Data collected included species lists, photographs, and descriptions of each remnant condition. Habitat is described in terms of dominant plant species, vegetation height, density and disturbance. Structural names (e.g. Open Forest) given to the vegetation communities follow that of Specht (1970). Rare and Threatened Species were not observed. The survey was complemented by also listing species likely to occur on the site, but not actually detected during the survey.

The degree of habitat disturbance, weed invasions were noted. The presence of various other threats, such as feral animals and their likely impact, were recorded. Changes in disturbance compared with the baseline condition were also noted.



4. Survey methodology

4.1 Flora survey method

Each ESBS remnant was assessed to determine its current condition and to upgrade relevant recommendations where required. Comprehensive flora surveys have previously been carried out annually since the baseline survey in 2004. Changes in weed status, germination and losses of native species, landscape plantings, and the status of particular species or other observed changes in each remnant were also recorded. This methodology has been used in all previous years of surveying the site. All remnants are photographed as part of the ongoing record of this vegetation.

Class System for vegetation quality

Vegetation communities may be classified according to the grading system developed by Perkins for Cumberland Plain Woodland, and outlined by Berzins (1999). A grading system is used whereby three broad Classes are recognised. The Class system has been published for Cumberland Plain Woodland but has also been used as the basis for classification of other vegetation communities.

Three main classes of vegetation quality are recognised, together with cleared and previously cleared areas constituting a fourth class. There is variation within each class, and in addition the class boundaries are somewhat fluid where one grades into the other. Classes are as follows:

CLASS 1 - areas consist of remnant or regenerating areas with a range of indigenous species and are representative of the description for the specific vegetation unit involved, as described under the TSC Act 1995. Natural soils still dominate, and weed invasion is relatively minimal.

CLASS 2 - remnants and regenerating areas with a range of native canopy species, but with reduced native understorey and groundcover layers by comparison to Class 1.

CLASS 2R REGENERATING - similar to Class 2, but in the primary stages of regeneration after disturbance. Native understorey and groundcovers may be present, but assessment over time is needed, to determine the abundance or otherwise of these species.

CLASS 3 areas have a range of canopy species but lack any significant degree of understorey or groundcover species. Weeds may be present. Natural soils are either absent or have been intensively and/or repeatedly disturbed.

Application of Class system to ESBS at BDGC

This class system has been used as a basis to describe and assess the on-site vegetation. Modified class descriptors for ESBS remnants on the site are given below. Classes can be used



as an assessment tool for prioritising regeneration of ESBS on the site. Gradation will occur between the classes and regeneration strategies must take this into account. Not all remnants have experienced the various degrees and types of disturbance, such as clearing, disturbance by machinery access, slashing along margins, trampling, grazing by feral fauna (rabbits), weed invasion and weed removal.

Class 1 - High-quality vegetation (natural or near-natural composition and structure), minor weed invasion and soil disturbance.

Class 2 - Reduced native species diversity by comparison to Class 1. Soil disturbance and weed invasion at any/all structural levels; native understorey often replaced by ALG, occasional canopy invasion (e.g. by *Acacia saligna*, other non-local/exotic species).

Class 2R - Weeded areas, often planted out to ESBS species. Weed seed germination/minor weed invasion. Includes both recently planted areas on or adjacent to some existing remnants (e.g. B3d, B11b/c).

Class 3 - Native canopy or individual plants of any species occurring within the ESBS. Includes, for example, areas of continuous or fragmented canopy cover (*Angophora costata* and *Banksia aemula* as in B7).

5. Survey Results: Habitat

The site harbours small islands of native vegetation in an otherwise developed landscape. Similar vegetation is present on surrounding land including The Lakes Golf Course and Eastlake Golf Course. Other open areas such as Mutch Park, Astrolabe Park and David Phillips Sports Field occur nearby, although ESBS is not present on all of these sites.

The predominant vegetation cover on the course is maintained turf. When landscaped areas associated with course redevelopment are established, denser vegetation will provide native flora habitat for various fauna species.

No water bodies occur on the site, except for a small ornamental pond near the clubhouse. Off-site habitat consists of the water bodies associated with Botany Wetlands, extending through Eastlake Golf Course to the west.

5.1 Site habitat descriptions

5.1.1 Eastern Suburbs Banksia Scrub (ESBS)

ESBS remnants vary considerably in composition and areal extent, with disturbance history being a major factor. Some have low diversity (around 2-5 species), others much higher, some with substantial clearing and others with little disturbance in parts.



Recent bush regeneration works (2014) in several remnants has significantly reduced the presence of the weed ALG in several remnants. B2 (part), B3d, B3e, B3f, B6, B7, B8b, B8c, B8d, B11b, B11c, B12, B13, B14, and B18 have each had various levels of ALG reduction. In some cases there appears to be almost complete initial control of ALG (e.g. B1, B13) while others have some remaining areas of high-density ALG cover which is expected to be removed over time as part of work in progress.

Controlled burning was conducted in various sections of B1 in the north course. This has effectively removed most groundcover on the northern part of the remnant (south of Green 3), with the remaining remnant vegetation now restricted to the very north end of the remnant. See Table 5 for further details.

Smooth-barked Apple *Angophora costata* is the canopy dominant in B2 and B7, while in others the shrub layer forms canopy composed variously of Mountain Devil *Lambertia formosa*, *Banksia* spp., *Acacia* spp. and other 1-3m-high shrubs. In some remnants Grass Trees *Xanthorrhoea resinosa* generally dominate the community, e.g. B5 (north) and B8d (south) with scattered low emergents (e.g. *Monotoca*, *Banksia*) also present.

5.1.2 Open grass areas

Extensive areas of short turf (fairways, tees and greens) comprise most of the golf course.

Site habitat is described below. The distribution of vegetation/habitat types on the site and surrounding areas is shown in Error! Reference source not found..

5.1.3 Other vegetation types

The site also includes planted landscape areas with a mixture of indigenous and non-indigenous trees, shrubs and groundcovers. Canopy trees separate most of the fairways.

5.2 Specific habitat features

Important habitat features of significance for fauna occupation are provided in Table 3. These include both natural features and those resulting from disturbance.

Table 3 Important habitat features on BDGC

Type	Description
Vegetation layers	Open areas: Short-cut dense turf or long-cut turf, with occasional canopy plantings. ESBS: Canopy, understorey and groundcover Trees: mature plantings by greens, tees, and separating fairways.
Density of cover	Variable. Turfed areas 100%; ESBS 100% in some remnants to 10% cover in the burnt/cleared area of B1; 5% in exposed areas to 90-100% in established areas; fence line plantings variable; landscaped areas variable.
Clearing	Most original ESBS has been replaced (> 97%) with turf/landscaping.
Fire damage and regrowth status	Remnant B2 was burnt in November 2005 and has shown healthy recovery. Remnant B1 was burnt mid-2011. There is no evidence of recent or historical fires over the remaining course.



6. Survey Results: Flora

6.1 Species and communities of conservation concern

Most remnants of ESBS previously recorded (BMWS 2004/5 and AE 2006/7/8/9/10/11) were present during the survey. Compared with the 2013 survey, senescent and/or dead *Acacia longifolia* subsp. *sophorae* have been removed from the southern end of B1, following a controlled burn in 2011. Following the death of *Banksia aemula* in remnant B19 (recorded in 2012 and 2013) no seedling recruitment was observed during this survey.

Refer to Table 5 for details on conditions of the remnants.

Recruitment of some species is occurring at various locations. For example, *Acacia longifolia* subsp. *sophorae*, *Kunzea ambigua*, *Monotoca elliptica* and *Persoonia lanceolata*. However, even for these species, it may still be lower than that expected in an expansive natural area. *Leptospermum laevigatum* is spreading in some locations.

No other significant changes were recorded in remnants across the site.

No Threatened flora species or ROTAPs have been recorded on the site during any survey.

6.2 Vegetation description

Detailed descriptions of the course vegetation are contained in the previous Reports. Changes to the various vegetation 'types' are addressed below.

Alterations to some areas on the north end of the north course have been carried out as part of course redesign in conjunction with the construction of the new extension of course to its west **Figure 7**. Additionally, remnant B1 has been significantly altered by the controlled burn in 2011; all sections of B1 have been otherwise altered by the removal of ALG and in some areas by extensive plantings.

Appendix 1 shows the list of flora found on the site.

6.3 Overview

Vegetation includes remnants of ESBS, large-scale turfing with various exotic species, fairway plantings, screening/fence line plantings, landscaping around buildings, car parks and amenity areas, maintained lawns, and areas with dense tree/shrub/herb layer weed invasion.

Weed presence has been reduced during the last 12 months, with substantial control of ALG in several remnants. The construction of the new extensions of the course adjoining the north



course effectively removed the large weed threat formerly occupying most of that site **Figure 7**.

6.4 Flora name and nomenclature

Currently accepted names and old names of flora species on the site are given below **Table 4**

Table 4. Flora name changes

Current accepted botanical name	Old botanical name	Common Name
<i>Acacia longifolia</i> subsp. <i>sophorae</i>	<i>Acacia sophorae</i>	Coast Wattle
<i>Ficinia nodosa</i>	<i>Isolepis nodosa</i>	Knobby Club-rush
<i>Rytidosperma tenuius</i>	<i>Austrodanthonia tenuior</i> , <i>Danthonia tenuior</i>	Wallaby Grass
<i>Xanthorrhoea resinosa</i>	<i>Xanthorrhoea resinifera</i>	Grass Tree

6.5 Turf

Regular mowing/slashing of areas of ALG has allowed localised marginal extension of fairways and greens in some areas. Eventually these mown areas will be replaced by either turf or landscape plantings of indigenous species or other suitable less invasive grass species.

Several species of grass occur on the course and these are listed in Appendix 1 (Poaceae).

6.6 Plantings

6.6.1 General comments

In general, existing landscape plantings have been maintained throughout. Mixed plantings of native and exotic shrubs adjacent to main buildings and car parks are regularly maintained. An area of established landscape plantings by the access path between T7 and T17 (north course) has been removed.

In previous years, plantings near and adjacent to ESBS have included several non-local natives, and some of these remain (e.g. near B1, B3, B6). Some replanting schemes have not been of sufficient density for establishment of viable populations and these will need to be augmented over time. The use of local ESBS species in landscaping where possible will be advantageous for the long-term health of onsite ESBS.

Landscape plantings on the new course extension **Figure 7**, particularly replacement plantings on the south end, will continue to establish with regular monitoring and maintenance.



Recommended principles for landscape plantings are discussed further in Section 6.11. Details on replantings are also provided in comments for the relevant ESBS patch conditions.

6.6.2 Fairways

Golf course reconstruction on the northern course (both ends) has been carried out. Several mature non-local and exotic trees remain, including Pine (*Pinus radiata*, *P. pinaster*, other *Pinus* spp.), Lemon-scented Gum *Corymbia citriodora* (a safety hazard and a weed in the Sydney region), Sydney Peppermint (near B4), and semi-mature Swamp Mahogany *Eucalyptus robusta* with dieback (south course).

Planted native canopy species generally not occurring within ESBS include Sydney Peppermint *Eucalyptus piperita*, White Stringybark *E. globoidea*, Rusty Fig *Ficus rubiginosa*, Spotted Gum *Corymbia maculata*, River Peppermint *E. elata*, Tallowwood *E. microcorys*, Swamp Mahogany *E. robusta*, Paperbark *Melaleuca quinquenervia* and several other local and non-local Eucalypt species (e.g. *E. nicholii*, *E. cosmophylla*). Of these, *E. robusta* is known to occur in or adjoining off-site ESBS remnants closer to the coast. However, many *E. robusta* on the site are performing poorly, and it is recommended that this species not be used on the course in future. Site conditions appear to be unfavourable for this species in some areas, although healthy trees usually occur at lower elevations on fairways where drainage has allowed for a higher, localised soil moisture.

Local small tree / large shrub species include Coastal Tea-tree *Leptospermum laevigatum*, Honey Myrtle *Melaleuca armillaris* and Water Gum *Tristaniopsis laurina*. Some mature *Agonis flexuosa* (a native of Western Australia) were removed for the north course redevelopment.

6.6.3 Fence lines

The non-local native Lemon-scented Gum *Corymbia citriodora* and a large Norfolk Island Pine *Araucaria heterophylla* occur on the south-eastern corner of the north course, while mature Hoop Pine *Araucaria cunninghami* occur along the fence adjacent to remnant B6/Tee 10. *Araucaria* trees may be retained but Lemon-scented Gum *Corymbia citriodora* is a weed of the Sydney region and it is recommended that, in the long term, this species be removed from the site (two semi-mature plantings of the latter were removed from B2 sometime in 2010; they were apparently planted with *Casuarina glauca* and *E. capitellata*).

Older plantings of ESBS shrub species along the eastern fence of the north course have now established. Recent landscape plantings near the fence west of B4 are establishing.

Several planted Swamp Mahogany *Eucalyptus robusta* and Bangalay *E. botryoides* across the course have dieback in the smaller branches. These include several semi-mature trees along the eastern fence of the north course.



Trees suffering from dieback and/or other forms of stress will need to be replaced in time with local ESBS species, such as Smooth-barked Apple *Angophora costata* and Red Bloodwood *Corymbia gummifera*. In this regard we recommend that the use of exotics and of non-local Eucalypt or *Corymbia* species be avoided for new plantings (see Section 6.11 for recommendations).

6.6.4 Remnant B6

African Love Grass (ALG) has been cleared from parts of B6 on the eastern fence of the north course. The single *Banksia paludosa* here is still in good health and was flowering at the time of survey, although no fruit was observed. It is highly likely that this species does not self-fertilise. Goldingay and Whelan (1990) in experimental self-pollinations recorded that 80% of plants did not produce follicles but when cross-pollinated 100% of individuals produced follicles. It is recommended that, as part of the redevelopment of BDGC, additional individuals of this species be planted nearby to create a viable population.

Six seedlings of *Persoonia lanceolata* were recorded in this remnant for the 2010 annual report, 17 in the 2011 report, and 12 seedlings for the present report. Presumably some are from the previous two years seedlings but others may be new recruits. Two vigorous adults remain. ALG has been cleared from parts of this remnant, which will assist in reducing competition and facilitate establishment of *Persoonia* seedlings.

6.7 Weeds

African Love Grass (ALG) *Eragrostis curvula*

Slashing, particularly along fairway margins achieves ongoing control. However, this weed continues to be a significant problem on the site in some areas. It is usually associated with ESBS remnants and adjacent margins where it usually dominates the understorey, fairway margins and disused areas. There are also some areas where it was historically used for landscaping or as a feature, for example north of Remnant B8.

Presently, ALG control is undertaken by regular mowing of areas marginal to fairways and greens where it dominates. This is a successful ongoing strategy that is steadily decreasing the above-ground ALG biomass to prevent further flowering and seed set and to allow for gradual replacement by turf grass or suitable landscape plantings. On steeper slopes where mowing is not feasible, other control methods (e.g. brushcutting plus herbicide) and subsequent replanting have been very successful.

Replacement of small areas of ESBS understorey adjacent to margins of particular remnants is also being carried out as part of habitat replacement on the course. The propagation facilities on the site will continue to assist with the propagation of on-site native plants.



6.8 ESBS remnants

6.8.1 Assessment methodology

Remnants have been assessed in terms of a Class system (per Section 4.1) and by remnant composition, plant vitality and recruitment rates.

Most remnants are generally in good health. However, B1 has had significant cover loss since the recent fire. Signs of disease, insect predation, gall and dieback are present in most patches, as expected for natural vegetation, but these were usually restricted to relatively small numbers of plants within a remnant and noted where they occur. The assessment table details existing status and changes of patch health (Table 5).

6.8.2 Fire within remnants

Remnant B1

A planned fire occurred in remnant B1 in 2011. The fire was not very hot as, while the lower leaves of the Banksia within this area were scorched or burnt, leaves above approximately 1.5 m in height survived. Regrowth of new stems and leaves has been observed on the Banksia within this remnant. To date there has been poor germination/recruitment of indigenous species and ALG has re-grown from the base. ALG is not killed by fire and responds post-fire by actively regrowing from the base. Currently ALG has regrown vigorously in this remnant and will require control. Some landscape planting of ESBS species has been undertaken in this remnant.

Remnant B2

Vigorous regrowth and probably some regeneration have occurred in the burnt areas of B2 (accidental fire November 2005). Each year the shrub layer has increased in density, increasing the difficulty of walking within this remnant. *Lepidosperma viscidum*, *Bossiaea heterophylla*, *Eriostemon australasius* and *Acacia suaveolens* have again all produced abundant fruit. ALG, which had established since the fire, has been substantially controlled by slashing, spraying and hand removal.

Regeneration works appear to have been carried out during 2011, 2012, 2013 and 2014 within this area. The track through the middle of the remnant is now closed. Control of ALG and planting of indigenous species north of the track is proceeding positively. Over the past two years there has been a significant reduction in the amount of ALG in this northern section and the amount of ESBS species. It appears also that replanting with local ESBS species has also been undertaken in the section of B2.



6.8.3 Appropriate fire regimes for ESBS

Fire is considered an important factor in the ecology of ESBS. ESBS communities that experience fire too frequently (more than once every ten years) or too rarely (less than once every fifteen years) may result in a reduction in species diversity. The “Eastern Suburbs Banksia Scrub Endangered Ecological Community Recovery Plan” (February 2004) suggests the trialling of a variable fire regime as a research priority.

Quadrat in B2

It is difficult to gain permission for fires in urban areas. Analysis of observations from the quadrat in B2 where fire took place in 2005 does not provide sufficient evidence to conclude that observed seedlings germinated as a result of the fire. Confounding factors include disturbance due to ALG removal and the fact that seedlings of the same species have been observed in other remnants (e.g. *Monotoca*). By way of comparison example, several *Persoonia* seedlings in B6 have most probably appeared as a result of clearing ALG.

Planned burn for B8

Should this option be carried out, a controlled burn could provide useful information on germination of ESBS species and also be an effective ALG control measure if suitable post-fire follow-up measures are undertaken.

6.8.4 Permanent monitoring quadrats

There are three 400 m² quadrats in place in ESBS remnants and one located in the southern landscaped area of the new course extension **Figure 7**. Two quadrats were established in 2007, one in the southern portion of B2, the other in B11b. An additional quadrat was established in B8d in 2010. These permanent plots are monitored each year for changes in floristic structure including seedling recruitment, spread of ALG, presence of fruit/seed, plant death, and other factors (e.g. rubbish, signage), which feed recommendations for future regeneration actions.

Remnant B2 quadrat

This quadrat in the southern portion of B2 is within the fire-affected area; post-fire regeneration will therefore be monitored. In this high quality remnant (Class 1-2) the most obvious post-fire change is the increasing density of the shrub layer and leaf litter. The fire is anticipated to produce a positive effect in fruiting and seeding patterns here.

Remnant B11b

Since the previous survey, alterations to B11b (Class 2R-3) include substantial removal of ALG and the death of a senescent *Acacia longifolia* and an *Astroloma pinifolium* (one remaining beneath an *Acacia*). To the north-west of the quadrat seedlings of *Persoonia lanceolata* and *Acacia longifolia* subsp. *sophorae* were recorded. Elsewhere in the quadrat a small



number of seedlings of *Kunzea ambigua* and *Leptospermum laevigatum* were observed. The 1.3m *Lambertia formosa* near the northern quadrat edge (outside) remains healthy.

Mature Bracelet Honey-myrtle *Melaleuca armillaris* on the north remnant margin have reduced to two large shrubs (down from 5 original). Planted *Angophora costata* on the north-west side have increased in height since the last survey, although ALG remains an ongoing threat in this area. ALG here requires control to prevent flowering and seed set.

Remnant B8d

The proposed control burn has not yet occurred and will need to be pursued in the near future. Accumulated quadrat data so far will provide a basis for future management in terms of species composition and requirements for assisted plantings.

6.8.5 Vitality and fecundity

Although plant health is generally good across composition and remnants, some species continue to have poor quality/low numbers of fruit/seed set, despite profuse flowering. This appears to be a particular problem for Proteaceous species including *Banksia aemula*, *Banksia paludosa*, *Lambertia formosa* and *Persoonia lanceolata*. The single Brown Stringybark *E.capitellata* in B2 (not normally an ESBS component - probably planted together with Swamp Oak *Casuarina glauca* and two Spotted Gum *Corymbia maculata* several years ago) has set a small amount of fruit for the first time in 5 years.

The low fertility is most likely a result of both low numbers of individuals and the sparseness of species populations. The decrease in population size and density is the result of habitat loss and fragmentation. For example, Mountain Devil *Lambertia formosa* is likely to have been a common species across the site historically. Perhaps 1,000 or more individuals would have been present prior to clearing (historically) or more recently for the construction of the golf course. Flocks of honeyeaters such as Eastern Spinebill and New Holland Honeyeater would have been attracted to the large population during flowering as it provided an abundant food source (nectar). This species is treated in more detail in the following section.

The solution to this problem is to create larger and denser populations of these species on site. The best approach is to collect seed from the nearest large population (at least greater than 50, ideally greater than 200 individuals). An alternative is to buy plants as seedlings of suitable provenance. Populations of 20-50 can then be established around the existing plants.

Many individual plants of these species are presently in decline, many being of advanced age, and similar conditions apply for other species on the site. Positively, some cases have produced vigorous new growth and flowers during the present season, e.g. *Banksia aemula*.

Regular monitoring for seed collection from all species in large numbers on the site (> 50) is recommended. In particular, close attention will be required for those with dehiscent



fruit/seed so that seed collection can be undertaken prior to seed drop. Initially only collect seed from indigenous species that are easy to germinate, see Ralph (2003) for details.

6.8.6 Species with low numbers of fruit set

The low seed set in these four Proteaceae members, which has been observed for the past several years, possibly results from the limited number of plants within each remnant and across the site generally. Pollinators probably spend a very limited time foraging in these small remnants before moving onto other areas; pollination seems to be an outcome of a general paucity of pollinators and short visitation times.

Moreover, the limited number of plants in each remnant may be close relatives. In general, set seed from cross-pollination is much greater than seed set from self-pollination or pollination by close relatives in the Proteaceae (Goldingay and Carthew 1998). Comments under '*Lambertia formosa*' below apply to the other Proteaceous species referenced here.

Wallum *Banksia aemula*

Apart from plants in remnant B14, most plants on the site have produced very low seed set (formed follicles) over the last 12 months, consistent with previous years.

Banksia paludosa

This is a particular case of the only known plant of a species on the site. This plant has never produced fruit. Healthy new growth and flowering was observed in the present survey, although it is being crowded by an *Acacia* on its western side.

Mountain Devil *Lambertia formosa*

Mountain Devil *Lambertia formosa* is present in better quality remnants, e.g. B2, B3. Presently there are about 25 *Lambertia* plants spread over the site, and most commonly only one or two are present in a remnant and perhaps 10m apart. Additionally, these two plants may be 50-100 m away from other *Lambertia* plants on the site. While they flower abundantly each year, fruit are rarely formed. Interestingly, *Lambertia* in B3 were forming fruit during the present survey. Honeyeaters are still likely to feed on the plants but after feeding on one plant are likely to fly to the closest other plant in flower, rarely a *Lambertia*. Thus we arrive at the present situation.

Most of the plants would have been close to other individuals of the same species. It is easy to imagine a New Holland Honeyeater feeding on one *Lambertia* then flying to a neighbouring (within 10 m) *Lambertia* and so on. This species is self-incompatible and relies on pollen from other plants to outcross and set seed/fruit. Cross-pollination would have regularly occurred and hence seed/fruit set would have been high.



It must be noted that there is very little seed of *Lambertia formosa* on the site. An increase in genetic diversity will be gained by importing seed from elsewhere. While cuttings could be taken from onsite plants and propagated, but this would not improve genetic diversity and would not improve seed set in existing *Lambertia formosa* plants. The use of cuttings is not appropriate and is not recommended.

Geebung *Persoonia lanceolata*

Geebung in remnants has had a variable history over the last 5 years. Three mature plants were lost from B9 in the recent past, while up to a dozen seedlings have been recorded in B6, The apparent result of disturbance from ALG removal.

Stringybark *Eucalyptus capitellata*

A single plant of *Eucalyptus capitellata* exists within remnant B2. Fruit has been recorded on this tree for the first time in five years. We recommended that fruit not be collected for seed, as this species is not generally considered a defining component of ESBS. Hence, its status relative to onsite ESBS is presently in doubt until clarified from other field studies. Its close relative, *E.camfieldii* (with which it hybridises) has been recorded in other coastal remnants.

Other species

Some species on site are represented in small numbers or in some cases by only a single plant, including:

Astroloma pinifolium (< 3 ?)

Banksia paludosa (1 in B6)

Dillwynia glaberrima (< 3)

Diuris sulphurea (< 10 ?)

Ficinia nodosa (syn. *Isolepis nodosa*) (1 in B7)

Hibbertia fasciculata (1 in B3)

Hibbertia linearis (< 5 in B3)

Hypolaena fastigiata (< 5 patches ?)

Juncus continuus (1, formerly in B7)

Lomandra cylindrica (1 ?)

Microtis unifolia (1 small patch in B2)

(*Eucalyptus capitellata* (1) - most probably been planted)

With the exception of *Microtis*, these plants are all likely to require cross-pollination to produce good quality seed; any seed produced by self-pollination will probably be in lower numbers and will generally result in weaker progeny. Additionally the following genera are also generally difficult to germinate from seed without specialised facilities: *Astroloma*, *Diuris*, *Hibbertia* and *Hypolaena*.

No seedlings of *Hibbertia linearis* were observed in B3d.

Lomandra cylindrica is dioecious; the single clump in B2 is possibly up to three plants.



2 *Banksia paludosa* appears to be one plant with 3 stems; it has never produced mature fruit.

4 The populations of species with low numbers need to be boosted by supplementary planting where possible.

6

6.8.7 **Species with high numbers of fruit set**

8 **Grass Tree *Xanthorrhoea resinosa***

10 In previous years, mature plants were in flower and setting abundant seed during surveys. However, seed production was very poor this season. This species needs regular monitoring for seed collection.

12

6.8.8 **ESBS remnant quality survey**

14 Table 5 below includes patch assessment from the present survey.

16 Appendix 1 contains the flora list for the site.



Table 5. Summary of findings from the ESBS condition survey 2014

2

Remnant No.	Observations	Photos
B1 complex	Overall B1 is one of the poorer remnants at Bonnie Doon Golf Course. A planned ecological burn was undertaken in this remnant in early 2011. Northern end. <i>Acacia</i>, <i>Allocasuarina</i>, <i>Banksia</i>, <i>Monotoca</i>, <i>Hypolaena</i>. Large, mature <i>A.longifolia</i> subsp. <i>sophorae</i> (to 3.5m, all of which had severe galling – see photos in 2010 Report) and <i>Allocasuarina littoralis</i> (also with significant gall attack) have been removed. A sparse, patchy cover of ALG and other weeds, e.g. Panic Veldt Grass <i>Ehrharta calycina</i>, occurs in some areas, with the sandy surface being generally exposed throughout. Native understorey is now restricted to the northern end. There appears to have been some post-fire control of ALG, and there are plantings on the northern tip. Very little recruitment of indigenous species was evident. Seedlings of <i>Monotoca elliptica</i> and <i>Acacia longifolia</i> subsp. <i>sophorae</i> were observed in some areas. About 10 <i>Allocasuarina distyla</i> seedlings were scattered through the north end (now staked). Small patches (~0.25-0.5 m²) of <i>Hypolaena fastigiata</i> also occur. Dead mature plants included <i>Monotoca</i> (~1m) and <i>Allocasuarina distyla</i> near <i>Banksia aemula</i> on the north end; the latter had many burnt cones (unused seed source). Mature plantings of <i>Banksia serrata</i> are now to 5m tall. <i>Banksia aemula</i> plants had substantial new growth and were in good health (Photo below). Central section (north of and below T3, hilltop end). Formerly with several mature <i>Acacia longifolia</i> subsp. <i>sophorae</i>, <i>Bossia heterophylla</i>, <i>Leucopogon ericoides</i> and <i>Persoonia lanceolata</i>. This area has been significantly altered (photo below right), and many ESBS plants have been removed (presumably by fire). Many plantings installed. Natural ESBS in this area is now represented only by scattered plants.	 Part of B1 complex showing impacts from fire in 2011. <i>Allocasuarina littoralis</i> & <i>Acacia sophorae</i> removed. Very low recruitment from seed. (View N from N of the hilltop area of T3)  South slope of T3, above G2  Plantings through



Remnant No.	Observations	Photos
	Southern hilltop portion (T3). Large, senescent <i>Acacia longifolia</i> subsp. <i>sophorae</i> removed. Dense ALG slashed and controlled across both the southern and northern slopes of the hilltop (photo above right). Mature plantings include <i>Kunzea ambigua</i> and <i>Hibbertia scandens</i>. Mature non-local tree planting retained.  Recommendations a) Ongoing control of ALG and all other weeds. Maintain existing plantings. b) Additional plantings, particularly on the slopes of the T3 hilltop area (N of G2). Plantings are to be strictly of local provenance and be consistent with the local onsite composition of ESBS (<u>excludes</u> <i>Westringia fruticosa</i> and <i>Correa alba</i> – which are more characteristic for Coastal Heath), <i>Kunzea ambigua</i> (where ESBS occurs near Coastal heath), <i>Hibbertia scandens</i>, <i>Hakea teretifolia</i> and some other species used elsewhere on the course).  c) Additional signage; Ensure signage is secure (sometimes it has been removed). d) As a general rule, ensure that seed is collected prior to any controlled burns.	central area of B1 below (N of) hilltop T3; <i>Acacia</i>, <i>Bossiaea</i>, <i>Persoonia</i>, and <i>Leucopogon</i> removed.  Plantings across northern tip of north section. Signage through this remnant needs upgrading.



Remnant No.	Observations	Photos
B2	<i>Angophora</i>, <i>Monotoca</i>, <i>Banksia aemula</i>, <i>Leptospermum</i> spp., <i>Xanthorrhoea</i>, <i>Acacia</i> spp, <i>Eriostemon</i>, <i>Lambertia</i>, <i>Persoonia</i>, <i>Caustis</i>, <i>Brachyloma</i>, <i>Pomax</i>, <i>Lomandra</i> spp., <i>Austrostipa</i>, <i>Dichelachne</i>, <i>Lepidosperma</i>, <i>Bossiaea</i>, <i>Microtis</i>, <i>Eucalyptus capitellata</i> (mature planting). This is one of the better quality remnants on the site. The former east-west track (removed) which divided B2 is now overgrown with native understorey. There has been excellent weed control of the northern section of B2 and good recovery (by regrowth and possibly also by replanting ?), particularly in the centre-north. Apparently the Bradley Method has been used (working from better areas to invaded areas). Dense understorey includes <i>Acacia</i> spp., <i>Lambertia</i> and <i>Xanthorrhoea</i>. Seed pods were abundant on <i>A. longifolia</i> subsp. <i>sophorae</i>. <i>Lepidosperma</i> has successfully colonised where ALG has been removed, although dense ALG bordering the north and west here remains a threat and will need to be controlled. Advanced seedlings of <i>Acacia sophorae</i>, <i>A.suaveolens</i> and <i>Monotoca elliptica</i> don't appear to have resulted from regeneration disturbance, although this may yet occur. The southern portion of this remnant continues to be the best quality remnant on the golf course, with the greatest diversity of indigenous species and weed invasion generally restricted to marginal areas. Weed control by Bonnie Doon staff and the Bonnie Doon volunteer bush regeneration group has achieved very positive results. Control of ALG within this portion, particularly in the quadrat area, has been successful, and native groundcover has colonised several previously bare areas. The shrub layer has increased in density so that it is now difficult to walk through. Details of the vegetation quadrat were recorded within the central section of this remnant and are displayed in Appendix 2. Seedlings have been planted on the southern margin of the remnant, beside the track (after removal of ALG - photo above right). This is the only remnant with <i>Lomandra cylindrica</i> (patch at about 4m in from the south-west margin). The area has recovered well from the partial burn in November 2005,	 Healthy regen in the north area of B2, following ALG removal  B2 – South edge with plantings (cleared of ALG). View east from nr. W edge of remnant.  Dense leaf litter in the S section



Remnant No.	Observations	Photos
	and a dense layer of leaf litter (5-10cm depth) is now present (photo below right). Seed source Several species are good sources of seed in this remnant, including <i>Angophora</i>, <i>Eriostemon</i>, <i>Acacia</i> spp., <i>Xanthorrhoea</i>, <i>Bossiaea</i> and <i>Lepidosperma</i>. Fruit set on <i>Lambertia</i> remains very low (most flowers not pollinated) Recommendations The northern section will require continuing control of ALG and unless germination of ESBS species occurs, additional planting of some species is an important consideration, e.g. <i>Lambertia formosa</i> (to ~20-50 plants), preferably propagated from several different local sources (either onsite and nearby). Randwick Community Nursery can supply propagated material, but it is recommended that sources be as genetically diverse as possible.	 Coir logs as bank stabilisers, NW margin of B2  NW side of south portion of B2, with ALG controlled
B3 complex	<i>Angophora costata</i>, <i>Corymbia gummifera</i>, <i>Lambertia formosa</i>, <i>Leptospermum trinervium</i>, <i>Banksia aemula</i>, <i>Monotoca elliptica</i>, <i>Acacia sophorae</i>, <i>A. suaveolens</i>, <i>Allocasuarina distyla</i>, <i>Caustis pentandra</i>, <i>Xanthorrhoea resinosa</i>, <i>Brachyloma daphnoides</i>, <i>Bossiaea heterophylla</i>, <i>Hypolaena fastigiata</i>, <i>Leucopogon ericoides</i>, <i>Pomax umbellata</i>, <i>Lepidosperma concavum</i>, <i>Hibbertia linearis</i>, <i>Lomandra glauca</i>. This remnant consists of three sections: northern (B3a, B3b, B3e and smaller patches), central (B3d) and southern (B3f).	



Remnant No.	Observations	Photos
	B3a. Modified. A cleared track through dense ALG now divides the remnant into east & west areas. Several <i>Acacia longifolia</i> subsp. <i>sophorae</i> dominate the east with dense ALG understorey, although an area on the south-east side has recently been cleared of ALG. Mature plantings of <i>Hakea salicifolia</i>, <i>Melaleuca quinquenervia</i>, <i>Leptospermum laevigatum</i> and <i>Allocasuarina</i> remain. On the west, <i>Angophora costata</i>, <i>Kunzea ambigua</i> and <i>Xanthorrhoea resinosa</i> were recorded in this remnant. Dense ALG extends several metres north from both areas, with several small Eucalypt saplings (<i>E.robusta</i> ?) in ALG north of the western area. Otherwise, the condition of B3a appears to be similar to previous years, although <i>Acacia</i> shrubs are undergoing increased senescence. B3b. The memorial 'George Saharov' <i>Monotoca elliptica</i> is still present in the turfed area. B3c. Dead, previously removed B3d. <i>Monotoca</i>, <i>A.longifolia</i> subsp. <i>sophorae</i>, <i>Xanthorrhoea</i>, <i>Allocasuarina</i>, <i>Leucopogon</i> (flowering at time of survey).Seedlings In cleared areas included: <i>Allocasuarina distyla</i> (7), <i>Acacia</i> spp. (2), <i>Leucopogon ericoides</i> (10). ALG has been removed from the W side and regen plantings carried out (includes <i>Lepidosperma</i>); ALG persistent through remaining understorey. <i>Hibbertia linearis</i> was not recorded in this survey (present in previous years, and known only from this remnant) but may still be present. Supplementary plantings of <i>Hibbertia linearis</i> will therefore be a consideration. <i>Allocasuarina</i> in fruit. Evidence of foxes. B3e. <i>Xanthorrhoea resinosa</i>, <i>Banksia serrata</i> (planted). Original ESBS supplemented with plantings (<i>Correa alba</i>, <i>Hakea teretifolia</i>, <i>Banksia integrifolia</i>, <i>Westringia fruticosa</i>). South edge with several seedlings of <i>Leptospermum laevigatum</i> (not planted).	B3b = <i>Monotoca elliptica</i>  Eucalypt saplings, N of B3a  Corridor through centre of B3a  Regen area, NW side of B3d  <i>Ricinocarpos pinifolius</i> fruit; B3f



Remnant No.	Observations	Photos
	Rabbits are present. <i>Lantana camara</i> and ALG occur through the understorey. Significant growth of <i>Banksia</i> during last 2 years (flowering at time of survey). B3f. <i>Banksia</i>, <i>Monotoca</i>, <i>Allocasuarina</i>, <i>Persoonia</i>, <i>Acacia sophorae</i>, <i>A.suaveolens</i>, <i>Lambertia</i>, <i>Bossiaea heterophylla</i>, <i>Brachyloma</i>, <i>Hypolaena</i>, <i>Pomax</i>. <u>Planted species:</u> <i>Lomandra longifolia</i>, <i>Leptospermum laevigatum</i>, <i>Kunzea ambigua</i>, <i>Banksia serrata</i>. Note that these are <u>not to be used</u> in further onsite plantings in ESBS West side has been cleared of ALG and regeneration plantings carried out (includes <i>Lepidosperma</i>). Fruit on <i>Bossiaea heterophylla</i> (which made heavy fruit set in previous years); fruit forming on <i>Allocasuarina distyla</i> and <i>Lambertia formosa</i>. Seeds dropped from <i>A.suaveolens</i>. This remnant is a good seed source for onsite propagation. Recommendations a) Continue control of ALG throughout the remnant (all areas) and maintain all plantings. Remove <i>Lantana</i>. Replace <i>Leptospermum laevigatum</i> seedlings with another ESBS shrub species. This remnant is a high priority for assisted regeneration. Species for planting must include those occurring onsite (species such as <i>Westringia fruticosa</i>, <i>Hakea teretifolia</i>, <i>Kunzea ambigua</i>, <i>Hibbertia scandens</i>, <i>Banksia serrata</i>, <i>Leptospermum laevigatum</i>, etc, must <u>not</u> be used).	 <u>W side of B3f with plantings, following control of ALG</u>



Remnant No.	Observations	Photos
	b) In addition to <i>Hibbertia linearis</i>, this is also the only remnant where Wedding Bush <i>Ricinocarpus pinifolius</i> has been recorded on the site. As a longer-term strategy, consider establishing populations of at least 20 individuals of each within this remnant. Germination of seed from the single <i>Ricinocarpus</i> plant is not recommended (difficult to germinate, and very unlikely to have outcrossed). Plantings are to be supplemented from local external sources (via Randwick Nursery as one possibility). c) Seed collection in B3f, including <i>Bossiaea</i>, <i>Allocasuarina</i>, <i>Lambertia</i> and <i>Acacia</i> spp.	
B4	This remnant comprises two sections: B4 east and B4 west. [This numeration (labelling) is an historical anomaly from the original NPWS survey] B4 West. This patch lies between the western fence and the west edge of remnant B2. NOTE: Description of this portion was included under the subheading 'Western portion' of remnant B2 in the 2010 Report (Table 6, p.36). Several mature <i>Acacia saligna</i>, areas of dense weed invasion, and a mature <i>Angophora costata</i> have all been removed, and plantings installed. <i>Xanthorrhoea resinosa</i> retained. The path formerly dividing B4 west from B2 has been rationalised. B4 East. <i>Acacia longifolia</i> subsp. <i>sophorae</i>, <i>Monotoca elliptica</i>, <i>Persoonia lanceolata</i>, <i>Xanthorrhoea resinosa</i>, <i>Lomandra glauca</i>, <i>Lomandra longifolia</i>, <i>Lepidosperma concavum</i>, <i>Brachyloma daphnoides</i>, <i>Bossiaea heterophylla</i>; <i>Melaleuca nodosa</i>, <i>Leptospermum laevigatum</i>. Part of a planted area known as the 'Bird Sanctuary'. Fauna pitfall trap site. ALG dominates most of the understorey. <i>Lantana camara</i>	 B4 West – <i>Angophora costata</i> removed (plantings in place).  <i>Euc. Piperita</i> seedlings, B4 East (view north from south side)



Remnant No.	Observations	Photos
	on north side. Several Paperbark saplings (<i>Melaleuca quinquenervia</i>) remain in the seepage line. No significant compositional change from previous surveys; larger shrubs have significantly increased in size. Seed source in B4 East. Abundant fruit also on <i>Acacia longifolia</i> subsp. <i>sophorae</i>. Several <i>Lomandra longifolia</i> on the west margin of B4 East (near sand pit) were holding abundant seed at the time of survey, which could be used for (non ESBS) landscape plantings. Recommendations B4 East. Control of ALG (smothered most of the native groundcover, Lantana and Paperbark saplings in seepage line. Control of <i>Eucalyptus piperita</i> (Sydney Peppermint) seedlings nearby on the south side.	
B5	<i>Angophora costata</i> (sapling), <i>Acacia suaveolens</i>, <i>Monotoca elliptica</i> (seedlings), <i>Xanthorrhoea resinosa</i> (5 'clumps of 2-5 stems each), <i>Lomandra glauca</i>, <i>Haemodorum planifolium</i>, <i>Pomax umbellata</i>, <i>Lepidosperma concavum</i>, <i>Wahlenbergia gracilis</i>. Dense ALG present. Mature <i>Melaleuca quinquenervia</i> at north end of this remnant. No significant change otherwise. Recommendations Control of ALG and replacement of failed ESBS plantings as required. Remove adjacent Pine trees.	 B5 - Pine removed, ALG slashed, ESBS plantings installed (2010)
B6	<i>Banksia paludosa</i>, <i>Monotoca elliptica</i> (2 x trees + seedlings), <i>Leptospermum trinervium</i>, <i>Persoonia lanceolata</i> (2 mature + seedlings), <i>Lomandra glauca</i>, <i>Acacia longifolia</i> subsp. <i>sophorae</i> (6 + seedlings), <i>Acacia terminalis</i> (x 3); <i>Melaleuca nodosa</i>, <i>Acacia floribunda</i> nearby. Single multi-stem <i>Banksia paludosa</i> was healthy but no	 <i>Persoonia</i> seedlings,



Remnant No.	Observations	Photos
	follicles; now partially overshadowed by <i>Acacia</i>. <i>Monotoca</i> seedling beneath mature <i>Persoonia</i>. Recruitment of <i>Persoonia lanceolata</i> remains low in number. In the 2011 survey, 17 <i>Persoonia</i> seedlings were recorded, in the 2012; 11 <i>Persoonia</i> seedlings were counted and in this current survey 9 seedlings were counted. Relative to the previous surveys, the count is slowly decreasing. ALG is slowly encroaching again. Recommendations Continue control of ALG. Previous efforts have assisted survival of the <i>Persoonia lanceolata</i> seedlings; ongoing control will greatly assist regeneration of this remnant. Augmentary planting of several <i>Banksia paludosa</i> (say 10 plants), from suitably sourced material (old records from Centennial Park, Maroubra, La Perouse). Ensure that signage is secure.	B6, 2013  <i>Banksia paludosa</i>, B6
B7	North-west corner of S course. <i>Angophora costata</i>, <i>Xanthorrhoea resinosa</i> (dense clumps + individuals), <i>Banksia aemula</i>, <i>Ficinia nodosa</i>; + <i>Acacia saligna</i>. <i>Banksia aemula</i> on south end are healthy (new growth in Dec 2014 season), but low seed set. The single clump of <i>Ficinia nodosa</i> (syn. <i>Isolepis nodosa</i>) has been cleared of ALG and significant recovery has occurred (proliferating from about 5 stems to > 100 presently). Since partial clearing of ALG and <i>Nephrolepis cordifolia</i> (Fishbone Fern), germination of both native & weed species has occurred, including <i>Acacia longifolia</i> subsp. <i>sophorae</i>, <i>Microlaena stipoides</i>. Mature trees of <i>Acacia saligna</i> (Western Australian wattle) have not been removed, and several seedlings of it occur nearby, apparently resulting from regeneration activities. <i>Crassocephalum crepidioides</i> (Thickhead, an annual) was again recorded flowering. Some <i>Eucalypt</i> seedlings (possibly non-local species). Weed seed is dropped/blown	 B7 – Edge mowing of ALG and partial removal of <i>Nephrolepis cordifolia</i>, by the Green.



Remnant No.	Observations	Photos
	into this remnant from the adjoining Mutch Park. <i>Celtis</i> seedlings recorded as weeds in this remnant. Seed source <i>Angophora</i> in fruit; needs collecting before seed drop (mid-late summer). (<i>Banksia aemula</i> fruit has low seed set but is viable) Recommendations a) Continue removing ALG, Fishbone Fern, Thickhead and <i>Celtis</i> seedlings. Remove <i>Acacia Saligna</i> trees and seedlings. b) Continue mowing the remnant edge where ALG is dense adjacent to the northern fence line (note that some of this area is steep and will be difficult to mow). Once the ALG is adequately controlled along the top, consider planting locally indigenous species, such as Wallaby Grass <i>Rytidosperma tenuius</i>, Plume Grass <i>Dichelachne crinita</i>, Grass Tree <i>Xanthorrhoea resinosa</i> and the Rush <i>Juncus continuus</i>.) Maintain the cleared area around Knobby club-rush <i>Ficinia nodosa</i>. Consider planting additional plants of these species. c) Request Botany Bay City Council to remove Noxious and environmental weeds from areas of Mutch Park that adjoin Bonnie Doon Golf Club.	 <i>Ficinia nodosa</i> clump, beside mature tree, B7.
B8 complex North side – B8a/b/c South – B8d	<i>Xanthorrhoea resinosa</i>, <i>Banksia aemula</i>, <i>Acacia ulicifolia</i>, <i>Acacia suaveolens</i>, <i>Juncus usitatus</i>, <i>Pimelea longifolia</i>, <i>Lambertia formosa</i>, <i>Pomax umbellata</i>. B8a, B8b, B8c are upslope of the larger B8d. B8a. Substantial reduction of ALG (now patchy). 2m sapling of <i>Corymbia/Eucalyptus</i>. 4 x <i>Acacia longifolia</i> saplings (0.5m) + <i>A.suaveolens</i> + plantings. All old <i>Acacia</i> on E side (uphill) of the <i>Casuarina</i> are dead with 4 or 5 shrubs left. B8b. <i>Acacia</i>, <i>Xanthorrhoea</i>.	 Dense ALG with senescent <i>Acacia</i>, upper E side of B8a (view W)



Remnant No.	Observations	Photos
	Significant reduction of ALG. Several small <i>Acacia</i> seedlings (staked). Good regen potential. B8c. <i>Angophora</i>, <i>Banksia</i>, <i>Xanthorrhoea</i>, <i>Acacia suaveolens</i>. Significant reduction of ALG and <i>Nephrolepis cordifolia</i>. 2 x <i>Cyathea cooperi</i> to 1m high. Good regen potential. B8d. <i>Acacia</i>, <i>Angophora</i>, <i>Banksia</i>, <i>Lambertia</i>, <i>Xanthorrhoea</i>. ALG cleared through the NW quarter, and also on the S side of the new central (E-W) track, but remaining through N, E & S areas. 3 x roof tiles (fauna refuge and survey – nothing present). Several seedlings staked – <i>Acacia longifolia</i>, <i>A.suaveolens</i>, <i>Monotoca elliptica</i>. Small patches of <i>Caustis pentandra</i> also exposed by ALG clearing. The orchid <i>Microtis</i> has been previously recorded here. Seed source <i>Xanthorrhoea</i> has had substantial seed in previous years. Recommendations a) Continue control of ALG and <i>Nephrolepis</i>. Ensure plant stakes are secure. b) When available, collect and propagate seed of <i>Xanthorrhoea resinosa</i>.	 ALG cleared from <i>Xanthorrhoea resinosa</i>, NW side of B8d (view S)  <u>N side of B8c, showing ALG controlled (view S)</u>



Remnant No.	Observations	Photos
B9	Staff at Bonnie Doon recall that <i>Acacias</i>, <i>Correa</i>, <i>Kunzea</i>, <i>Allocasuarina distyla</i> and Swamp Mahogany trees were planted as part of landscape works when mounds were installed and turfed at this location, many years ago. The majority of planting was <i>Acacia longifolia</i> subsp. <i>sophorae</i>. The location had previously included, but has since lost 3 x mature <i>Persoonia lanceolata</i>. Note that the area mapped in the Recovery Plan as B9 is now under mounds of soil and turf, installed as part of previous earthworks. Recommendations a) Ongoing ALG control. Current control of ALG is good. b) Regard B9 as no longer being present	 B9 – <i>Acacia longifolia</i> subsp. <i>sophorae</i> dominates the area (view N from W side)  Old photo showing <i>Persoonia lanceolata</i> (view S from N side)
B10	This remnant was situated west of B11a and consisted of a single <i>Monotoca elliptica</i>. That plant no longer exists so the remnant is gone.	
B11 complex	<i>Leptospermum laevigatum</i>, <i>Melaleuca armillaris</i>, <i>Monotoca elliptica</i>, <i>Astroloma pinifolium</i>, <i>Persoonia lanceolata</i>, <i>Lambertia formosa</i>, <i>Allocasuarina distyla</i>. 11a. <i>Acacia longifolia</i> subsp. <i>sophorae</i>, <i>Allocasuarina distyla</i> + <i>Lomandra longifolia</i>, (+ <i>Lomandra longifolia</i>, <i>Hakea (sericea ?)</i> - planted. Dense ALG in understorey. The E-W track through centre is now cleared.	 B11a – cleared central corridor



Remnant No.	Observations	Photos
	11b. <i>Acacia sophorae</i>, <i>Allocasuarina distyla</i>, <i>Astroloma pinifolium</i>, <i>Brachyloma daphnoides</i>, <i>Kunzea ambigua</i>, <i>Lambertia formosa</i>, <i>Leptospermum laevigatum</i> (N edge), <i>Melaleuca nodosa</i>, <i>M. armillaris</i>, <i>Monotoca elliptica</i>, <i>Persoonia lanceolata</i>, <i>Lepidosperma concavum</i>. Seedlings of <i>Acacia</i>, <i>Kunzea</i>, <i>Leptospermum</i>, <i>Monotoca</i> and <i>Persoonia</i> (2). This patch is proposed to be relocated east of the existing B11b. Remnant area = approx. 1225 m² and the proposed relocation area is also approximately 1225 m². ALG substantially controlled. <i>Melaleuca armillaris</i> now reduced to two large shrubs on N side. <i>Astroloma pinifolium</i> previously recorded; one now being overgrown by an <i>Acacia longifolia</i>. Little regeneration in areas where ALG has been controlled (small number seedlings). Permanent quadrat location. Recommendation for B11b Ongoing control of exotic grasses including ALG and <i>Ehrharta calycina</i> (Panic Veldt Grass). 11c. <i>Monotoca</i>, <i>Allocasuarina</i>, <i>Acacia</i>, <i>Brachyloma</i>, <i>Lepidosperma concavum</i>. <i>Glochidion</i>, <i>Brachyloma</i>, <i>Kunzea</i>, 3 x <i>Monotoca</i> seedlings. Weeds include <i>Lantana</i>, <i>Ochra</i>. <i>Allocasuarina</i> with large galls. Dense ALG particularly along downslope edge. <i>Pomax</i> in cleared sections.	 B11b – View S to B11c in the distance  B11c – Dense ALG on lower eastern slopes



Remnant No.	Observations	Photos
B12	<i>Xanthorrhoea resinosa</i>. <i>Lambertia formosa</i>, <i>Allocasuarina distyla</i>. West & north areas with remnant ESBS; central east side with dense weed cover (photo). Planted <i>Hakea teretifolia</i> not suitable for ESBS. ALG and other weeds on hilltop (beneath canopy) almost controlled (photo below). <i>Xanthorrhoea</i> in fruit (seed source) Fauna: NH honeyeater, Australian Raven, Pee wee. Recommend control of ALG and weeds in lower central area. Remove <i>Leptospermum laevigatum</i> seedlings and plant with local provenance ESBS, including <i>Acacia longifolia</i> subsp. <i>sophorae</i>.	 B12 – View S from NE margin  <u>Lower central-east slope with dense weed cover (view W)</u>



Remnant No.	Observations	Photos
B13	<i>Allocasuarina distyla</i>. Class 2 condition. Three female <i>Allocasuarina distyla</i> plants, no males. Two senescent, three seedlings. Most of the groundcover layer covered with mulch, very small areas of ALG; significant improvement from previous years, good regeneration potential. 3x <i>Allocasuarina distyla</i> + seedlings x 3, <i>Themeda Dianella</i>, <i>Lepidosperma</i>, <i>Acacia longifolia</i> subsp. <i>sophorae</i>, <i>Microlaena</i>, <i>Dichelachne</i>, <i>Acacia suaveolens</i> (seedlings?), <i>Kunzea</i>. Recommendations Continue removal and control of ALG. Replant with ESBS species from this and nearby remnants using local material.  Insect attack on <i>Acacia longifolia</i> subsp. <i>sophorae</i>	 B13 – View E from W side, Showing reduction of ALG.  B14 – View S through centre; ALG significantly controlled  B14 – View E from
B14	<i>Banksia aemula</i>, <i>Leptospermum laevigatum</i>, <i>Xanthorrhoea resinosa</i>, <i>Acacia longifolia</i> subsp. <i>sophorae</i>, <i>Corymbia gummiifera</i>, <i>Glochidian ferdinandii</i>. Class 2R condition. 6 x mature <i>Banksia aemula</i> with many flower spikes on all sides of most plants. ALG has been removed from a substantial portion of the understorey (photo at right); most <i>Xanthorrhoea resinosa</i> are now clear of this weed but followup is required. The single senescent <i>Lambertia formosa</i> has no fruit. Seedlings of <i>leptospermum laevigatum</i> are most probably from mature plantings. Recommendations a) Continue control of ALG.	 B14 – View S through centre; ALG significantly controlled  B14 – View E from



Remnant No.	Observations	Photos
	b) Plant with ESBS through the exposed central area and on sides to expand ESBS along the fence. Replanting will establish ESBS (include <i>Lambertia</i>) and buffer against ALG re-invasion. c) Remove mature <i>Leptospermum laevigatum</i> (presently shading <i>Banksia aemula</i> at the northern end of this remnant) and its seedlings. Seed source for propagation of <i>Banksia aemula</i>.	B11c
B15	Remnant located in Mutch Park – adjacent to BDGC.	
B16	Remnant located in Mutch Park – adjacent to BDGC.	
B17	No remnant plants remain in the expected location of this remnant	
B18	<i>Banksia aemula</i>, <i>Lambertia formosa</i>, <i>Leucopogon ericoides</i>, <i>Brachyloma daphnoides</i>, <i>Monotoca elliptica</i>, <i>Bossiaea heterophylla</i>, <i>Acacia suaveolens</i>, <i>Leptospermum trinervium</i>, <i>Persoonia lanceolata</i>, <i>Acacia longifolia</i> subsp. <i>sophorae</i>, <i>Lepidosperma (concavum)</i>, <i>Eriostemon australasius</i>, <i>Dichelachne crinite</i>, <i>Xanthorrhoea resinosa</i>. <i>Bossiae heterophylla</i> (seedlings) in cleared areas around <i>Lepidosperma</i>. No fruit on <i>Lambertia formosa</i>. Senescent <i>Persoonia lanceolata</i>. ESBS is generally in good health. Mature <i>Banksia aemula</i> and <i>Leptospermum trinervium</i> in flower. <i>Persoonia lanceolata</i> now exposed. <i>Stenotaphrum secundatum</i> (Buffalo grass) occurs as dense local cover beneath one <i>Leptospermum trinervium</i>. ALG significantly controlled through the centre and along the northern margin by the course (photos at right). West end now planted with several seedlings (photo below).	 B18 – View W along N margin, showing ALG controlled back into ESBS remnant  View W along N margin from lower



Remnant No.	Observations	Photos
	Recommendations a) Continue control of ALG – target existing control areas first and then expand into invaded areas. b) Continue control of <i>Casuarina glauca</i> in the depression on the eastern end. c) Control <i>Stenotaphrum</i>. d) Maintain low grass cover through planted area, and create a grass-free zone around plantings (20-30cm) as a control measure so that plantings will not be compromised. a) (see photo at right)	down the hill
B19	<i>Banksia aemula</i> and <i>Xanthorrhoea resinosa</i> dead, About 6 <i>Acacia longifolia</i> subsp. <i>sophorae</i>, <i>Monotoca elliptica</i> dead (north side). Single <i>Monotoca elliptica</i> present on the southern side of the patch, adjacent to the fence. ALG regrowth has been slashed but the site needs weed control and regeneration plantings. Smaller ESBS plants are generally in depauperate condition. This remnant has been substantially reduced compositionally and areally from its status even five years ago.	 <u>Plantings into turf,</u> NW side of B18  B19 – View NW in 2010 (4 years previously) showing the <i>Banksia aemula</i> which died.



Remnant No.	Observations	Photos
	Recommendations a)  Removal and control of all weeds including ALG b) Plantings of ESBS (assisted regeneration) to retain the areal extent of this remnant and to assist in the control of ALG. Existing remnant B19, showing absence of <i>Banksia</i>, <i>Acacia</i> formerly present. This area now needs assisted regeneration from plantings.	



6.9 Survey observations of the new extensions to the north course

The north course area has been separated into the following four zones for ease of discussion.

North-east corner

Good growth recorded from most landscape plantings, including *Baeckea*, *Dichelachne*, *Hibbertia*, *Darwinia*, *Bauera*, *Rytidosperma*, *Banksia* and *Wahlenbergia*. Weed control has generally been effective although exotic grasses need regular control.

View of N end from B1



North-west corner

Landscape plantings include *Rytidosperma*.

On the fenceline, a patch of Bulrush *Typha orientalis* occurs together with the weed Spiny Rush *Juncus acutus*. While not listed as Noxious in this LGA, Spiny Rush *Juncus acutus* is a troublesome weed in other LGAs of the Sydney region and NSW. It is recommended that it be controlled to prevent flowering and seeding. The hard pungent tips of this Rush render it 'user unfriendly' and care needs to be taken with its treatment.

Juncus acutus



Central section

This section was in general similar to the north-west corner. Generally undulating with some slightly elevated 'hill' areas, sand bunkers and maintained turf. A low-lying wet area contains the native Woolly Frogmouth *Philydrum lanuginosum* (possibly naturalised) together with some poorly established *Juncus* sp., and the weed *Juncus cognatus*. Other native species recorded were *Leptospermum*, *Baeckea*, *Dichelachne* sp. and *Wahlenbergia*.

Southern end

The turfed area with sand bunkers appears to be well maintained. Adjoining plantings include *Banksia aemula*, *Actinotus* and *Austrodanthonia*. *Rytidosperma* has died off in patches and needs replacement.

Exotic grasses, including Kikuyu *Pennisetum clandestinum*, Crab Grass *Eleusine indica* and Rat's Tail Fescue *Vulpia myuros* need control in some landscape areas, particularly in the vicinity (to 40m from) the drainage channel. The channel and nearby low-lying area, on the western side towards the fence, have small patches of *Typha* sp., sometimes together with *Juncus* sp. *Typha* appears to occur only here and in the NW corner. Survey details of Quadrat 4 provide further details of this area.



Plantings near south end, adjacent to quadrat. Most are establishing. View E.



Plantings on low bank at south end. *Banksia aemula*, *Actinotus*. View N.



Typha at southern end, near drainage channel (quadrat). View S.



Track at southern end with logs and *Typha* stand. View S.

6.10 Disturbance and weeds

Noxious Weeds

Lantana camara was recorded in B3e, B4 and B11. Targetted control of this weed in these remnants is recommended.

Green Cestrum *Cestrum parqui*, Class 3 Noxious, was recorded in 2013 near remnant B1. Other Noxious weeds previously recorded include Castor Oil Plant *Ricinus communis*, Prickly Pear *Opuntia stricta* and Pellitory *Parietaria judaica*. Early removal of these weeds is recommended if observed on the site.

All weeds declared Noxious under both classifications are to be systematically and continually suppressed from the site. Noxious weeds in the Sydney Region and their required control measures are tabulated in Appendix 1.



6.5 Ha extensionExtension to the north course

Construction of the 6.5 ha extension to the north course has generally controlled most of the former weed problem, with at least 90% (estimated) of the original weed cover now replaced by turf, sand bunkers and landscaping. However, new weeds not previously recorded here now occur in landscaped areas and these will need ongoing weed control to ensure they do not become a significant problem, particularly in terms of establishing plantings.

Exotic grasses - including Panic Veldt Grass *Ehrharta calycina*, *E. erecta*, Crab Grass *Eleusine indica*, African Love Grass *Eragrostis curvula*, Fescue *Festuca* sp. and Pigeon Grass *Setaria* spp. – will readily seed and propagate, the early control of which will significantly reduce maintenance requirements. Kikuyu *Pennisetum clandestinum*, which generally propagates vegetatively, also requires early control. Whereas Couch *Cynodon dactylon* is regarded as a native (Royal Botanic Gardens

<http://plantnet.rbgsvd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Cynodon~dactylon>)

it is usually invasive and needs controlling. Many of these grasses occur on the southern end in areas of landscape planting.

Early control of Sharp Rush *Juncus acutus*, in a small area in the north-west of the practice range, is recommended. More information about this plant is available at:

http://www.environment.gov.au/cgi-bin/biodiversity/invasive/weeds/weeddetails.pl?taxon_id=67600

Weeds across the site

Mature *Acacia saligna* on the south-west fenceline of the southern course, and in B7 continues to be a threat on the site. This weed is also likely to be present in the soil seedbank in B4 (western remnant near B2 in the north course) and will require control.

Other weeds commonly recorded in various remnants include Panic Veldt Grass *Ehrharta calycina*, Fireweed *Senecio madagascariensis*, White Clover *Trifolium repens*, *Juncus cognatus*, Umbrella Sedge *Cyperus eragrostis*, *Gnaphalium* spp., Lamb's Tongue *Plantago lanceolata*, Farmers Friend *Bidens pilosa*, Catsear *Hypochaeris radicata*, Peppergrass *Lepidium africanum* and *Cyperus* sp. (*C.reflexus* ?). Many of these can be treated manually or with a careful, targetted spraying regime carried out prior to flowering and seeding.

Other significant weeds

Whereas targetted regeneration effort has significantly reduced ALG within several ESBS remnants, this weed remains a threat to the site, occurring as dense swards in some remnants and adjoining areas. The status of this weed is addressed in more detail in the 'Discussion of results' below.



6.11 Recommended species for ESBS landscaping and planting

Recommendations for planting are made on the basis of previous plantings, landscaping, and the composition of ESBS remnants. Note that, in previous years, some plantings in both landscaped areas and ESBS were inappropriate and/or unsuitable. As a basic principle all ESBS plantings are to be consistent with those species on the site and nearby local remnants, with exclusions for some species that are more coastal in their natural habitat.

6.11.1 Recommendations for ESBS plantings

Suitable Choices

- Include those presently naturally occurring in remnants as per the ESBS flora list for the site,
- minimise/avoid use of some ESBS species that can become aggressive colonisers on the course including *Kunzea ambigua* and *Leptospermum laevigatum* (the latter already colonising in B3e and B14),
- prefer *Banksia aemula* over *B. integrifolia* and *B. serrata* (this will reflect the natural *Banksia* species occurrence in site remnants),
- *Melaleuca nodosa*, may be used in B3f, B4, B6, B11b and nearby remnants, avoid particular native species from coastal ESBS, heath, forest including
- Avoid use of some ESBS species that can become aggressive colonisers on the course including *Kunzea ambigua* and *Leptospermum laevigatum* (the latter already colonising in B3e and B14),
- Avoid the canopy species (these have been used on fairways – their status relative to the site is uncertain),
- avoid any non-ESBS species
- Avoid *Banksia integrifolia* and *B. serrata*

Avoid

Avoid particular native species from coastal ESBS, heath and forest including:

- *Allocasuarina littoralis*,
- *Correa alba*,
- *Hakea teretifolia*,
- *Hibbertia scandens*,
- *Melaleuca armillaris*, *Westringia fruticosa*,

and the canopy species that have been planted on fairways:

- *Eucalyptus capitellata*,
- *E.piperita*,
- *E.robusta* and
- *E.globoidea*



6.11.2 Recommended landscape plantings

Suitable Choices

Use ESBS species in landscaping when possible, consistent with the above principles;

- Prefer local ESBS canopy species - *Angophora costata* and *Corymbia gummifera*, ;
- Other known ESBS canopy such as *Eucalyptus botryoides*, *E.globoidea*, *E.robusta*, *E.camfieldii* and *Angophora hispida* may be used (but maximise distance from ESBS),);
- avoid *Eucalyptus piperita* (recorded in ESBS, but this is colonising close to B4), *Melaleuca quinquenervia* (colonising in B4), and any non-local non-ESBS canopy, use
- Use ESBS species such as *Banksia aemula*, *Caustis pentandra*, *Ficinia nodosa*, *Persoonia lanceolata*, and *Xanthorrhoea resinosa* where possible, as attractive feature plants;
- Non-local native species may also be used but preferably keeping a maximum distance from remnants.

Avoid

- Avoid *Eucalyptus piperita* (recorded in ESBS, but this is colonising close to B4);
- Avoid *Melaleuca quinquenervia* (colonising in B4), and any non-local non-ESBS canopy;
- Avoid any species with known weed potential (e.g *Acacia saligna*).

7. Discussion of results

7.1 Seed source and provenance

BDGC has been the subject of a long disturbance history. Small remnants of ESBS in nearby areas, such as Mutch Park and Eastlakes, are also the result of similar disturbance histories. There remains the ongoing need to use offsite remnants for sourcing seed for the site. Where external sources (e.g. Randwick Nursery) are used for propagated plants, it is recommended that provenances be from beyond known ESBS remnants, to avoid the risk of inbreeding depression.

7.2 Ferals

Introduced predators, particularly foxes and also domestic cats, continue to reduce native fauna on the site. Rabbits are also a continuing problem, as evidence for example by diggings and droppings on the southern slope of B3e (by staked *Leptospermum* seedlings).



7.3 Native fauna

A survey of the nearby Botany Wetlands shows the diversity of birds, reptiles and frogs present. Although not directly connected to BDGC some of the fauna present in or around the wetlands also use the site, such as Eastern Water Dragon, recorded near sand stockpiles in December 2007, and Marsh Snake recorded in October 2008 and 2011.

It is important to note that BDGC lacks permanent surface water so frogs and wetland birds are unlikely to be common. Local golfers have observed snakes including Red-Bellied Black Snake and Eastern Brown Snake. These populations would rely on lizards and rodents found on BDGC.

7.4 Herpetofauna

Opportunistic observations recorded herpetofauna in B11, for example. In previous years, most remnants contained a diversity of skinks and/or Jacky Dragon, with individuals occurring much more frequently than successful trapping or capturing.

A range of reptile species occurs, indicating that a range of ecological requirements is present on the site. Blind Snakes are ecological specialists that are largely subterranean and feed on ants or termites. Given their cryptic habit, it is not surprising there is only one record of a Blind Snake for the site. Eastern Blue-tongued Skink feeds on vegetation and snails and is more often observed than trapped (a mature Skink, > 40 cm length, was previously trapped in remnant B3d).

7.5 Herpetofauna habitat and connectivity

Jacky Dragons have been observed crossing fairways, which indicates that they will also move between remnants. It is expected that, as plantings become established, a greater diversity of reptiles, or at least larger populations of the existing species, may be found in these areas due to slowly increasing connectivity between remnants and landscape plantings and the local increase in micro-habitat diversity.

In particular, landscape plantings in the new extension **Figure 7** to the course (especially the southern end) are anticipated to form valuable connective fauna habitat, the success of which will depend on regular monitoring to control weeds and maintain plantings. Weed removal together with bush regeneration and plantings will, in the long-term, generally increase the habitat values of the site for local fauna populations.

Connectivity between ESBS remnants is either limited (e.g. B3d - B3e) but is more generally absent, as most remnants are fragmented by roads, paths and maintained turf (fairways, etc.). We therefore expect the mortality of animals using corridors between remnants to be high due to predation (raptors are often sighted over the course). A shift to native vegetation by removal of ALG is expected to result in an improvement in fauna populations.



A recommendation is that any controlled burns be conducted on smaller patches to ensure sufficient fauna refuge to other habitat nearby. A smaller burn also enables easier control of post-burn re-emergent ALG. These impacts are likely to be temporary and restricted to fauna occurring within the locality; given time, the populations will recover. An accidental burn occurred in 2005 in remnant B8 on the south side of the course which has since recovered, and a number of reptile species have since been recorded within the patch, including Jacky Dragon and She-oak Skink.

The creation of connecting corridors between ESBS remnants would help to reduce these mortality risks while promoting exchange of genetic material between remnants. Corridors would also allow species to re-colonise areas where they have become locally extinct. Increasing connectivity between remnants would increase the availability of habitat on the site and offset some of the negative impacts of fragmentation (e.g. predation, edge effects and small patch size).

7.6 Log piles

Log piles have been used in conjunction with plantings to promote connectivity between remnants. While it is still early days there is some evidence that these constructed corridors are effective. During the 2004/2005 surveys in these constructed corridors a few species of reptiles (small skinks *Lampropholis delicata* and *L. guichenoti* were detected and juvenile Jacky Dragon *Amphibolurus muricatus* were found sheltering under constructed log piles). All of the species found in constructed corridors are relatively common and disturbance tolerant. As the quality of the corridor habitat improves, disturbance-sensitive species are likely to move in.

7.7 Pollination

Pollination rates are extremely low in some remnants for particular species, e.g. Mountain Devil *Lambertia formosa*. This problem is treated in more detail in section 7.2 'Floristic diversity' below (in 'pollination and diversity').

Insects and birds are the most common pollinators for many species, with small mammals (e.g. rodents) also playing a part when present. Ants were found to be common in several remnants and would provide food for small reptiles. They aerate the soil and play important functions as seed vectors (distributors) and pollinators for some plant species. At least 5-6 species of ants will be present on the site. Insects are also prey for birds.

7.7.1 Canopy plantings

Several plant species, known to occur in off-site remnants of ESBS, do not occur in remnants on the site, although they may have been present. Some of these have been planted in several places on the course as landscape trees, often for separating fairways.



However, there is a question around some planted canopy species used in landscaping which have also been recorded in some offsite remnants. Bangalay *Eucalyptus botryoides*, White Stringybark *E. globoidea*, Sydney Peppermint *E. piperita* and Swamp Mahogany *E. robusta* all occur in other sites. Although it cannot be readily determined from the composition and distribution of on-site remnants whether these species formerly occurred on the site, they are not recommended for planting into any of the remnants.

According to the Recovery Plan (2004) for ESBS, a total of four Eucalypt species have been recorded in six (of 24 known) locations, as follows.

- Sydney Peppermint: 1 remnant – Wassell Street (Matraville);
- Swamp Mahogany: 2 remnants – Botany Bay NP, La Perouse (NSW Golf Club);
- Bangalay: 4 remnants - Malabar Headland 'west', La Perouse (NSW Golf Club), Little Bay (St.Michaels Golf Course), York Road (Bondi Junction);
- White Stringybark: 2 remnants – La Perouse (NSW Golf Club), Little Bay (St.Michaels Golf Course).

Of these, Swamp Mahogany occurs in 'wet' sites, which do not occur at Bonnie Doon. Sydney Peppermint seedlings are now colonising exposed sand adjacent to B4.

On the basis of the infrequent occurrence of these canopy species in other remnant sites, it is recommended that a cautious approach to planting be adopted: only Red Bloodwood *Corymbia gummifera* and Smooth Barked Apple *Angophora costata* appear to be suitable for canopy planting within ESBS on the site.

7.7.2 African Love Grass *Eragrostis curvula* (ALG)

ALG, the most significant weed on the site, is still quite abundant and continues to replace native understorey in some ESBS remnants. This weed has re-invaded some areas where it was removed, for example in B11. Failure to control re-invasion will make former removal efforts somewhat redundant and require additional weed control measures beyond what would otherwise be required.

Efforts by BDGC staff and the bush regeneration group have successfully controlled ALG in some locations. Once there is reasonable control of ALG in an area it is important to commence revegetation with indigenous ESBS species, particularly if there is little germination of indigenous seed. This will reduce the likelihood of re-invasion by ALG. Control of turf grasses to prevent invasion of ESBS remnants is ongoing. B2, B8, B11, B14, B18 are good examples where ALG has been substantially reduced from within and adjacent to the remnant.

The dense tussock habit of ALG is similar to the foliage habit of mature Grass Tree and provides habitat for native fauna on the site, particularly Jacky Dragon *Amphibolurus muricatus*. Progressive removal of ALG where it co-occurs with Grass Tree will promote



reestablishment of the native habitat over time, of which the remnants B8 'complex' and B14 will hopefully be good examples. Grass Tree seed can be collected, propagated and planted en masse as part of a revegetation strategy.

7.7.3 Soil-stored seed

For several species - e.g. *Acacia* spp., *Monotoca*, *Bossia* and *Pomax* - a seed store will be present in some locations and would be stimulated by weed removal. Native seedlings will require protection and nurture through the combination of ongoing weeding, restorative and ameliorative measures. Note that seed of some species – e.g. *Xanthorrhoea resinosa* – needs to be collected from the plant, fumigated and stored immediately to prolong viability; this is important before any control burn (especially for *Xanthorrhoea*). Others such as *Acacia* spp. need to be carefully monitored to collect ripened pods before they open and seed drops.

7.7.4 Fire and controlled burns

Impacts from fire seem to have mixed results, depending on the initial quality and diversity of the vegetation. An accidental fire (cool) in the high-quality remnant B2 has resulted in high-density litter and debris and (in some cases) increased foliage density and vigour. By contrast, a controlled burn in nearby B1 to its north appears to have resulted in very low germination rates, although this complex was of generally lower floristic and structural diversity. Controlled burns will take account of composition, disturbance history and post-fire weed control.

[For a detailed study on fire/smoke effects on soil-stored seed in Sydney region see: "Fire-related germination cues for soil-stored seedbanks of fire-prone habitats in the Sydney region, Australia", Doctoral thesis, UTS, 2003; available at: <https://opus.lib.uts.edu.au/research/handle/10453/21845>]

7.7.5 Pollination and diversity

In addition to insect pollination, visitation by nectivorous birds is important for plant pollination in order to maintain the viability of ESBS on the site. This could be encouraged by planting a range of endemic ESBS plants with overlapping flowering periods to maintain year-round food resources.

The population numbers of some plant species on site are rather low, resulting in low on-site genetic diversity within species which in turn can have an effect on plant population fecundity. Some species, e.g. *Lambertia formosa*, have shown a consistently low pollination rate in most plants for several years (B3f is an exception), even in remnants of high quality and floristic diversity, e.g. B2. Although remnant visitation patterns by avifauna have not been studied, different contributing factors to low pollination may include: location of particular plants inside a remnant and low nectar production/availability.



Planting could be undertaken within and adjacent to existing ESBS and in non-playing areas to increase the local frequency of particular species to encourage pollinators. Restraint from chemical (insecticide) use in and near ESBS will also help to provide insects for birds.

8. Management recommendations

This Report provides key recommendations reflecting alterations to course structure and management during the previous 12 months.

The results of the baseline survey in 2004 were used to initially develop detailed management recommendations for the site, provided in the Club's Environmental Management Plan 2005 (EMP).

The revised EMP will include the detailed management recommendations. that are made here:

- Recommendations for remnant ESBS patches are shown in Table 5 of this Report.
- Continue staged removal of African Love Grass (ALG) in and around ESBS.
- Remove Spiny Rush *Juncus acutus* in a patch of Bulrush *Typha orientalis* on the western fence bordering Eastlake Golf Course to prevent further spread.
- Continuous control of Noxious weeds.
- The most appropriate location for the planting of indigenous species for landscaping must be considered and species matched for the most suitable microhabitat locations. We recommend that planting contractors be familiar with the preferred natural habitats of the indigenous species nominated for planting and use only local ESBS species.
- For replanting areas cleared of ALG with appropriate ESBS species, seed collection of species on the site with low population numbers (< 20 individuals/patch) be undertaken (with permission) on areas with larger populations of those species such as National Parks further up and down the coast. As a 'rule of thumb', it is recommended to collect seed from larger populations of > 50 individuals, to assist in returning genetic diversity to the site. Sourcing seed on site is not recommended unless sourced from populations of > 50 individuals/patch. Prior to collecting seed it is worthwhile determining how readily seed of a species can be germinated. Details for collecting, drying, storing and germinating seed can be found in publications at the Florabank website: http://www.florabank.org.au/default.asp?V_DOC_ID=885
- As a general pattern, populations of species with low numbers will require assisted regeneration (manual replanting). A list of these is shown in Section 6.8.6. Other species with low number and/or low seed set include *Lambertia formosa*, *Acacia ulicifolia*, *A. suaveolens*, *Astroloma pinifolia*, *Persoonia lanceolata*, *Banksia paludosa*,



and *Dichelachne*. While it will be difficult to source material of some of these (e.g. *Hibbertia*), others are more readily available (e.g. *Acacia* spp, *Banksia*) and can be used in the first instance. If undertaken correctly, planting improve long-term fecundity of these species. These species have consistently shown low or no recruitment in ESBS across the site.

- Guidelines for ESBS and landscape plantings are shown in Section 6.11. Regular monitoring of new/recent landscape plantings is critical for their establishment. As a general principle it is recommended that planting regimes only use ESBS species. There was a very high attrition rate of plantings on the south end of the new extension to the course, including many *Banksia aemula*. Some of these have been replaced, although there are many plants of particular species not occurring in ESBS on the site.
- The application to OEH for a controlled burn in B8 has not been finalised, but needs to be pursued in the near future. In the event of a planned burn, follow up weed control will be important, especially for ALG, and Abel Ecology will need to monitor species recovery after the fire.
- Continue funding for professional control of foxes and rabbits. Evidence of fox predation (dens and tracks) has been recorded during several surveys. Feral fauna control is important for the survival of species such as Brown Quail and Eastern She-oak Skink *Cyclodomorphus michaeli*.

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Appendix 1. Flora species list

Approximate grid co-ordinates for the site are as follows. Co-ordinates are in AMG 66 and rounded to the nearest 5 metres.

North course

Main entrance (north course, Banks Avenue):	335 880 E, 6243 615 N
South-west corner (corner of Heffron Road & Page Street):	335 330 E, 6243 125 N
South-east corner (corner of Heffron Road & Banks Ave.):	335 735 E, 6242 965 N

South course

Office (off Heffron Road entrance):	335 685 E, 6242 925 N
North-west corner (corner of Heffron Road & Banks Ave.):	335 560 E, 6242 975 N
South-west corner (Wentworth Ave.):	335 390 E, 6242 460 N
South-east corner (corner of Banks & Wentworth Ave's):	335 550 E, 6242 300 N

Note: the list is not exhaustive. Not all weed species have been recorded, and some planted Eucalypts (possibly from western Australia) were not identified to species level. Several exotic shrubs planted as part of ongoing landscaping have not been recorded.

Fifty-eight (58) ESBS species were recorded as naturally occurring within remnants. *Acacia longifolia subsp. sophorae* and *A. longifolia* were counted as separate species).

Class	Family	Species	Comments
CONIFEROPSIDA	ARAUCARIACEAE	#% <i>Araucaria heterophylla</i>	
	PINACEAE	*# <i>Pinus radiata</i>	
		*# <i>Pinus nigra</i>	
		*# <i>Pinus pinaster</i>	
		*# <i>Pinus (elliottii?)</i>	
FILICOPSIDA	DAVALLIACEAE	* <i>Nephrolepis cordifolia</i>	
	DENNSTAEDTIACEAE	<i>Pteridium esculentum</i>	
	SCHIZAEACEAE	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	
MAGNOLIOPSIDA			
DICOTYLEDONS	APIACEAE	* <i>Cyclospermum leptophyllum</i>	
		* <i>Foeniculum vulgare</i>	
		<i>Pomax umbellata</i>	
	ASTERACEAE	* <i>Acanthospermum australe</i>	
		* <i>Conyza canadensis</i>	
		* <i>Conyza sumatrensis</i>	
		* <i>Cotula australis</i>	
		* <i>Galinsoga parviflora</i>	
		* <i>Gnaphalium americanum</i>	



Class	Family	Species	Comments
		* <i>Hypochoeris microcephala</i> <i>alba</i>	
		* <i>Hypochoeris radicata</i>	
		* <i>Senecio madagascariensis</i>	
		* <i>Sonchus oleraceus</i>	
	BRASSICACEAE	* <i>Capsella bursa pastoris</i>	
		* <i>Hirschfeldia incana</i>	
		* <i>Lepidium</i> sp.	
	CACTACEAE	* <i>Opuntia (stricta)</i>	Noxious C4
	CAMPANULACEAE	<i>Wahlenbergia gracilis</i>	
	CARYOPHYLLACEAE	* <i>Polycarpon tetraphyllum</i>	
	CASUARINACEAE	<i>Allocasuarina distyla</i>	
	CHENOPODIACEAE	* <i>Chenopodium album</i>	
	CONVOLVULACEAE	* <i>Ipomoea (cairica?)</i>	
	DILLENIACEAE	<i>Hibbertia fasciculata</i>	
		<i>Hibbertia linearis</i>	
		#+ <i>Hibbertia scandens</i>	
	ERICACEAE	<i>Astroloma pinifolium</i>	
		<i>Brachyloma daphnoides</i>	
		<i>Leucopogon ericoides</i>	
		<i>Monotoca elliptica</i>	
		<i>Monotoca scoparia</i>	
	EUPHORBIACEAE	<i>Amperea xiphoclada</i> var. <i>Xiphoclada</i>	
		<i>Ricinocarpos pinifolius</i>	
		* <i>Ricinus communis</i>	Noxious C4
	FABACEAE	<i>Bossiaea heterophylla</i>	
		<i>Dillwynia glaberrima</i>	
		#* <i>Erythrina x sykesii</i>	
		<i>Gompholobium glabratum</i>	
		?#+ <i>Hardenbergia violacea</i>	
		?#+ <i>Kennedia rubicunda</i>	
		* <i>Melilotus indicus</i>	
		* <i>Robinia pseudoacacia</i>	
		* <i>Trifolium repens</i>	
	GENTIANACEAE	* <i>Centaurium erythraea</i>	
	LAMIACEAE	#+ <i>Westringia fruticosa</i>	
	MELIACEAE	# <i>Melia azedarach</i>	
	MIMOSACEAE	# <i>Acacia binervia</i>	
		# <i>Acacia myrtifolia</i>	
		%* <i>Acacia saligna</i>	



Class	Family	Species	Comments
		<i>Acacia longifolia</i>	
		<i>Acacia longifolia</i> subsp. <i>sophorae</i>	
		<i>Acacia suaveolens</i>	
		<i>Acacia terminalis</i>	
		<i>Acacia ulicifolia</i>	
	MYRTACEAE	<i>Angophora costata</i>	
		# 3 x <i>Callistemon</i> sp.	
		#+ <i>Calytrix tetragona</i>	
		<i>Corymbia gummifera</i>	
		# <i>Corymbia maculata</i>	
		<i>Darwinia fascicularis</i>	
		# <i>Eucalyptus capitellata</i>	
		# <i>Eucalyptus (camphora?)</i>	
		# <i>Eucalyptus elata</i>	
		#+ <i>Eucalyptus globoidea</i>	
		# <i>Eucalyptus microcorys</i>	
		# <i>Eucalyptus nicholii</i>	
		# <i>Eucalyptus (pilularis)</i>	
		#+ <i>Eucalyptus piperita</i>	
		#+ <i>Eucalyptus robusta</i>	
		#% <i>Eucalyptus</i> sp.	West Aust. sp.
		#% <i>Eucalyptus (polyanthemos?)</i>	
		#(%?) <i>Eucalyptus</i> sp.	a Red Gum
		#% <i>Eucalyptus</i> sp. (<i>mannifera?</i>)	
		#% <i>Eucalyptus scoparia</i>	
		<i>Kunzea ambigua</i>	
		#+ <i>Leptospermum juniperinum</i>	
		<i>Leptospermum laevigatum</i>	
		(#?) <i>Leptospermum polygalifolium</i>	
		#+ <i>Leptospermum squarrosum</i>	
		<i>Leptospermum trinervium</i>	
		<i>Melaleuca armillaris</i>	
		#% <i>Melaleuca bracteata</i>	
		#% <i>Melaleuca nesophila</i>	
		<i>Melaleuca nodosa</i>	
		# <i>Melaleuca quinquenervia</i>	



Class	Family	Species	Comments
		# <i>Melaleuca</i> sp. (squamea?)	
		# <i>Tristaniopsis laurina</i>	
	OCHNACEAE	* <i>Ochna serrulata</i>	
	OXALIDACEAE	* <i>Oxalis corniculata</i>	
	PASSIFLORACEAE	* <i>Passiflora caerulea</i>	
	POLYGONACEAE	* <i>Acetosella vulgaris</i>	
		* <i>Acetosa sagittata</i>	
	PORTULACEAE	<i>Portulaca oleracea</i>	
	PROTEACEAE	<i>Banksia aemula</i>	
		# <i>Banksia ericifolia</i>	
		#+ <i>Banksia integrifolia</i>	
		<i>Banksia paludosa</i>	
		# <i>Banksia robur</i>	
		<i>Banksia serrata</i>	
		#% <i>Grevillea whiteana</i>	
		# <i>Grevillea</i> 'Robyn Gordon'	
		# <i>Grevillea</i> ('Sandra Gordon'?)	
		#+ <i>Hakea gibbosa</i>	
		<i>Lambertia formosa</i>	
		<i>Persoonia lanceolata</i>	
	RUBIACEAE	<i>Opercularia aspera</i>	
		<i>Pomax umbellata</i>	
	RUTACEAE	<i>Eriostemon australasius</i>	
	SOLANACEAE	* <i>Cestrum parqui</i>	Noxious C3
		* <i>Salpichroa organifolia</i>	
		* <i>Solanum nigrum</i>	
	THYMELEACEAE	<i>Pimelea linifolia</i>	
	URTICACEAE	* <i>Parietaria judaica</i>	Noxious C4
	VERBENACEAE	* <i>Lantana camara</i>	Noxious C4
		* <i>Verbena bonariensis</i>	
MONOCOTYLEDONS	ARECACEAE	* <i>Phoenix dactylifera</i>	
	COMMELINACEAE	<i>Commelina cyanea</i>	
	CYPERACEAE	<i>Caustis pentandra</i>	
		* <i>Cyperus eragrostis</i>	
		<i>Ficinia nodosa</i> (syn. <i>Isolepis nodosa</i>)	
		<i>Lepidosperma laterale</i>	
		<i>Lepidosperma concavum</i>	
	HAEMODORACEAE	<i>Haemodorum planifolium</i>	
	JUNCACEAE	* <i>Juncus bufonius</i>	



Class	Family	Species	Comments
		* <i>Juncus cognatus</i>	
		<i>Juncus continuus</i>	
	LOMANDRACEAE	<i>Lomandra cylindrica</i>	
		<i>Lomandra glauca</i>	
		# <i>Lomandra longifolia</i>	
	ORCHIDACEAE	<i>Diuris sulphurea</i>	
		<i>Cryptostylis erecta</i>	
		<i>Microtis unifolia</i>	
		<i>Thelymitra</i> sp.	
	PHILYDRACEAE	<i>Philydrum lanuginosum</i>	
	POACEAE	<i>Austrostipa pubescens</i>	
		* <i>Bromus catharticus</i>	
		<i>Cynodon dactylon</i>	
		<i>Dichelachne crinita</i>	
		* <i>Ehrharta calycina</i>	
		* <i>Ehrharta erecta</i>	
		* <i>Ehrharta longiflora</i>	
		<i>Eragrostis brownii</i>	
		* <i>Eragrostis curvula</i>	2 forms
		* <i>Festuca arundinacea</i>	
		<i>Lachnagrostis filiformis</i>	
		* <i>Pennisetum clandestinum</i>	
		# <i>Poa labillardierei</i>	
		<i>Rytidosperma</i> (<i>Austrodanthonia</i>) <i>tenuius</i>	
		* <i>Setaria parviflora</i>	
		* <i>Sporobolus africanus</i>	
		* <i>Stenotaphrum secundatum</i>	
		<i>Tetrarrhena</i> sp.	
		<i>Themeda australis</i>	
		* <i>Vulpia myuros</i>	
	PHORMIACEAE	## <i>Dianella</i> sp.	
	RESTIONACEAE	<i>Hypolaena fastigiata</i>	
		<i>Lepyrodia scariosa</i>	
	TYPHACEAE	<i>Typha</i> sp.	Western extension to the course
	XANTHORRHOEACEAE	<i>Xanthorrhoea resinosa</i>	

NOTE: uncoded species are those naturally occurring in ESBS on the site.

* Weeds – includes exotic species and some native species.



Plantings: (note that ESBS species also naturally occurring on the site are not coded)

#* Planted exotic – weed on the site

Planted or naturalised local native but not naturally occurring in extant ESBS.

#+ Planted – local native occurring in (some) ESBS remnants but not previously recorded as occurring naturally on the site. Some of these, for example *Ficus rubiginosa*, occur in just one or two remnants elsewhere (off-site) and it cannot be determined whether they formed part of the original site vegetation; consequently they are not recommended for planting in/adjacent to ESBS remnants on this site, although they may be used in landscaping and fairways. Other species, for example *Hardenbergia violacea*, *Kennedia rubicunda*, are known to occur naturally in several remnants (off-site) and in the local area and are likely to have occurred on this site.

Although most of the planted native canopy species are not a threat on the site, trees removed (trees which are dead/dying/removed for safety or aesthetic reasons, etc.) should be replaced with ESBS canopy species.

Not all landscape plantings have been recorded.

Note also that plantings along fence lines and landscaped areas also contain several species occurring naturally within ESBS on the site – these have not been coded, (i.e. uncoded species are those naturally occurring in ESBS on the site).

In all cases, plantings into and near ESBS is to be consistent with existing species composition of those remnants.

#% Planted – non-local native. Some of these, for example, *Acacia saligna* are significant environmental weed in the parts of the Sydney region (also coded with a *).

The common *Lepidosperma* in remnants on the site has been identified by the Botanic Gardens as *L.concavum*, but is not typical of the species.



Appendix 2. Vegetation quadrats

Quadrat No: 1

Survey Details

Date of survey: 23 December 2014
Quadrat size: 20 m x 20 m

Location Details

Location description: BDGC, north course Remnant B2 - southern portion thereof
Map number: 9130-3S Map name: Botany Bay

Weather Details

Temperature (°C): ~25.0 °C Cloud cover: 5/8
Wind direction and speed: **Calm** / Light / Mod / Fresh / Strong
Rain: None / **Light drizzle** / Heavy drizzle / Heavy rain

Vegetation Description

Community: Eastern Suburbs Banksia Scrub

Notes

Quadrat located in southern 'half' of the remnant, south of an old central east-west track previously overgrown with dense ALG (now removed).

Dominant species: Brown Stringybark *Eucalyptus capitellata* (1 tree), Grass Tree *Xanthorrhoea resinosa* and Smooth-barked Apple *Angophora costata*.
Accidental fire in Nov 2005.

High levels of leaf litter following the fire in November 2005. Woody debris and logs.

Understorey is generally increasing in density since the fire (now difficult to navigate through). Similar ESBS vegetation surrounding the quadrat.

ALG (*Eragrostis curvula*) substantially controlled, especially on NW area of quadrat, extending up to the track. Debris from *Xanthorrhoea resinosa*. Density of *Pomax umbellata* in NW area now reducing from previous years.

Other observations

Effective control of ALG, including the southern and north-western marginal areas of the remnant (outside the actual quadrat boundary).

Potentially good seed source for *Xanthorrhoea*, *Eriostemon*, *Pomax* and *Bossiae* (in several previous years the latter has had abundant seed on plants on the western side).



The adjoining understorey extending northwards is increasing in density since track removal and control of ALG through the northern portion.

Several plantings along the southern remnant margin (adjacent to quad boundary).

Species name	CA	Comments
<i>Xanthorrhoea resinosa</i>	4	Several dense clumps
<i>Lomandra glauca</i>	2	
<i>Lepidosperma concavum</i>	4	Localised dense patches – potential seed source
<i>Pomax umbellata</i>	4	Now thinning out from previous years
<i>Caustis pentandra</i>	2	Small dense stands in approximate centre
<i>Eriostemon australasius</i>	3	Dense stand in quad centre (potential seed source)
<i>Brachyloma daphnoides</i>	2	
<i>Platysace ericoides</i>		
<i>Acacia suaveolens</i>	2	Seed already dropped
<i>Bossiaea heterophylla</i>	1	Seed now dropped – good seed source
<i>Angophora costata</i>	4	Seed forming – good seed source
<i>Leucopogon ericoides</i>	3	Several plants to 1.2m – potential seed source
<i>Haemodorum planifolium</i>	1	Several mature plants in flower
<i>Acacia longifolia</i> subsp. <i>sophorae</i>	3	Seed pods – seed source
<i>Leptospermum laevigatum</i>	1	Shrubs to 2m
<i>Leptospermum trinervium</i>	2	
<i>Monotoca elliptica</i>	3	Seedlings. New growth on saplings.
<i>Eucalyptus capitellata</i>	2	5 m tall x 5 m spread; N edge of plot (by old track)
<i>Lambertia formosa</i>	1	No fruit – all flowers aborted
<i>Microlaena stipoides</i>	2	
<i>Lomandra longifolia</i>	1	
<i>Ehrharta calycina</i>		Controlled in most areas
<i>Eragrostis curvula</i>	1	ALG. Mainly in quad centre; also in N portion of remnant.
<i>Aira</i> sp.		Possibly controlled (previously by the track)
<i>Banksia aemula</i>	1	Mature plants
<i>Woolsia pungens</i>	1	Scattered plants, small clumps
<i>Acacia ulicifolia</i>	1	Rare
<i>Eragrostis brownei</i>	1	Rare
<i>Dichelachne</i> sp.	1	Scattered mature grass plants – seed source



Quadrat No: 2

Survey Details

Name of surveyor: Mark Sherring Contact number: (02) 4751 9487
Number of surveyors: 1 Date of survey: 23 December 2014
Quadrat size: 15 m x 25 m

Location Details

Location description: BDGC, Eastern Suburbs Banksia Scrub Remnant B11
Map number: 9130-3S Map name: Botany Bay

Weather Details

Temperature (°C): ~20.0 °C Cloud cover: 6/8
Wind direction and speed: Calm / **Light** / Mod / Fresh / Strong
Rain: None / **Light drizzle** / Heavy drizzle / Heavy rain

Vegetation Description

Community: Eastern Suburbs Banksia Scrub

Description:

Small areas of bare sand, African Love Grass (ALG) *Eragrostis curvula* dominates ground cover layer. Dead *Acacia longifolia* subsp. *sophorae*. Remnant *Allocasuarina distyla* east end of plot. Few exposed sandy areas through the plot, of 2-5 m².

Since last survey, ALG has been controlled in the remnant centre (within the quadrat) and ALG that had reinvaded the previously cleared central strip but has also been controlled. This weed is still present east and west of the plot on the fairway edge and requires control to prevent reinvasion of the remnant.

Very little native species recruitment in the area previously cleared of ALG by National Trust many years ago. *Allocasuarina distyla* shrubs are present within the quadrat and next to the quadrat within this remnant. This quadrat contains a pitfall trap. The quadrat slopes towards the south-east corner.

Southern side of remnant is similar, with patches of bare sand, *Eragrostis curvula* and *Allocasuarina distyla*. There are a few *Allocasuarina distyla* on the southern border.

No evidence of fire.

ALG substantially removed from a small central area.

No *Persoonia lanceolata* seedlings or old adult. One adult to S of quadrat.



Species name	CA	Comments
* <i>Eragrostis curvula</i>	+	Patchy
<i>Acacia longifolia</i> subsp. <i>sophorae</i>	+	One dead in centre of remnant
* <i>Ehrharta calycina</i>	+	
<i>Allocasuarina distyla</i>	+	One dead plant, one living
<i>Leptospermum laevigatum</i>	+	Mature shrubs + seedlings
<i>Xanthorrhoea resinosa</i>	(+)	Outside quadrat
<i>Banksia serrata</i>	+	Planted, mature
<i>Cynodon dactylon</i>	+	
<i>Persoonia lanceolata</i>	+	Old adult
<i>Kunzea ambigua</i>	+	Mature shrubs
<i>Angophora costata</i>	+	Planted
<i>Astroloma pinifolia</i>	+	Shaded by <i>Acacia longifolia</i>
<i>Brachyloma daphnoides</i>	+	
<i>Lambertia formosa</i>	+	Just outside NE corner of quadrat; healthy.
<i>Monotoca elliptica</i>	+	Mature shrubs + seedlings
<i>Araujia seraciferasericifera</i>	(+)	Outside quadrat
<i>Vulpia myuros</i> sp.	+	Patchy, scattered
<i>Facelis retusa</i>	+	
<i>Bidens pilosa</i>	+	
<i>Solanum nigrum</i>	+	
<i>Cotula australis</i>	+	
<i>Hypochaeris radicata</i>	+	

NOTE

Cover abundances were not recorded for this quadrat during this survey.

+ = Present in quadrat

(+) = Adjacent to quadrat



Quadrat No: 3

Survey Details

Name of surveyor: Mark Sherring Contact number: (02) 4751 9487
Number of surveyors: 1 Date of survey: 23 December 2014
Quadrat size: 15 m x 25 m

Location Details

Location description: Eastern Suburbs Banksia Scrub Remnant B8d
Map number: 9130-3S Map name: Botany Bay

Weather Details

Temperature (°C): ~25.0 °C Cloud cover: 4/8
Wind direction and speed: Calm / Light / **Mod** / Fresh / Strong
Rain: **None** / Light drizzle / Heavy drizzle / Heavy rain

Vegetation Description

Community: Eastern Suburbs Banksia Scrub

Description:

Quadrat slopes to south. *Xanthorrhoea resinosa* is the (co)dominant canopy species with *Monotoca* and *Banksia* as short emergents.

Variable understorey: African Love Grass (ALG) *Eragrostis curvula* forms a dense layer on the east/south-east, while but has been cleared from a 5m x 6m oval-shaped area on the west/north-west.

Woody debris remains uncommon and scattered. One senescing *Banksia aemula*. A track divides this remnant into north and south portions. Habitat tiles present, but no evidence of use by fauna (beneath). Species of orchids previously recorded here (including *Microtis*) were not observed during this survey.

Similar vegetation adjoining quadrat. Remnant surrounded by golf greens and fairways.

Excellent seed source for *Xanthorrhoea resinosa*.

No evidence of fire (planned burn has not occurred).

Recent weed control works including Lantana removal needs followup.

ALG being controlled in the north-west.



Species name	CA	Comments
* <i>Eragrostis curvula</i>	6	Common cover; partially cleared in one area
<i>Acacia longifolia</i> subsp. <i>sophorae</i>	3	Seedlings where ALG has been cleared
<i>Caustis pentandra</i>	3	Now exposed after ALG removal
<i>Allocasuarina distyla</i>	2	
* <i>Conyza sumatrensis</i>	1	
<i>Brachyloma daphnoides</i>	2	
<i>Xanthorrhoea resinosa</i>	6	Common
<i>Banksia aemula</i>	1	
<i>Lepidosperma concavum</i>	3	
* <i>Gnaphalium</i> sp.		
<i>Haemodorum planifolium</i>	2	
<i>Microtis unifolia</i>	2	Not observed but recorded in a previous survey
<i>Thelymitra</i> sp.	2	Not observed but buds/fruit previously recorded
* <i>Solanum nigrum</i>	1	Rare
* <i>Cirsium vulgare</i>	1	
<i>Microlaena stipoides</i>	1	
* <i>Vulpia myuros</i>	1	
<i>Dichelachne crinita</i>	1	Rare
<i>Leptospermum trinervium</i>	2	Seedling + adults
* <i>Ehrharta calycina</i>	1	
<i>Acacia suaveolens</i>	3	Seedlings where ALG has been cleared
<i>Lomandra longifolia</i>	3	Now exposed after ALG removal
<i>Xanthorrhoea resinosa</i>	3	Common
<i>Pteris tremula</i>	1	Rare
<i>Pimelea linifolia</i>	1	Rare
<i>Hypolaena fastigiata</i>	1	
<i>Oxalis</i> sp.	1	
* <i>Taraxacum officinale</i>	1	
<i>Monotoca elliptica</i>	1	Seedling where ALG has been cleared
<i>Lomandra glauca</i>	1	Small patch where ALG has been cleared

* Weeds



Quadrat No: 4

Survey Details

Name of surveyor: Mark Sherring Contact number: (02) 4751 9487
Number of surveyors: 1 Date of survey: 23 December 2014
Quadrat size: 20 m x 20 m

Location Details

Location description: BDGC, north course Southwest corner of extension to the
course new practice area
Map number: 9130-3S Map name: Botany Bay

Weather Details

Temperature (°C): ~18.0 °C Cloud cover: 7/8
Wind direction and speed: Calm / Light / Mod / Fresh / **Strong**
Rain: **None** / Light drizzle / Heavy drizzle / Heavy rain

Vegetation Description

Community: ESBS landscape plantings

Southern end of 6.5ha course extension area.
Reconstructed veg/landscaping on site of formerly dense weed cover.
Several former plantings had failed and been replaced.
Landscaped (various stages in previous 2 years) with a large number of seedlings.
Turf; weeds also present, especially exotic grasses.
Almost no leaf litter/debris; large sandstone rocks, building rubble, concrete present.
A drainage line flows through the quadrat west to the fence.
A track runs through the quadrat near the NE corner and crosses the eastern boundary.
The surface elevation varies by about 30 cm.
There is a reptile pitfall trap near the SW corner.

Southern end of 6.5ha extension to the course **Figure 7**.

Reconstructed veg/landscaping
Small *Typha* patches occur only here and in the north-west corner of the practice range.



Species name	CA	Comments
<i>Banksia aemula</i>	1	Rare. Healthy new growth. (~ 22 in previous survey)
<i>Angophora costata</i>	1	4 in previous survey, approx 1.5 m high
* <i>Vulpia myuros</i>	3	
* <i>Polycarpon tetraphyllum</i>	1	
* <i>Conyza</i> sp.	3	
* <i>Bromus catharticus</i>	1	
* <i>Hypochaeris radicata</i>	1	
<i>Darwinia fascicularis</i>	2	
* <i>Festuca arundinacea</i>	1	
<i>Dichelachne crinita</i>	2	
<i>Rytidosperma tenuius</i>	4	
<i>Lachnagrostis filiformis</i>	1	
* <i>Pennisetum clandestinum</i>	2	
* <i>Centaurium erythraea</i>	1	
* <i>Juncus cognatus</i>	1	Many dense small clumps around Tee
* <i>Galinsoga parviflora</i>	1	
* <i>Sonchus oleracea</i>	1	
<i>Typha</i> sp.	1	Small patches, W side, low areas + channel
* <i>Verbena bonariensis</i>	1	
* <i>Melilotus indicus</i>	1	
<i>Hibbertia scandens</i>	1	
* <i>Sporobolus africanus</i>	1	
* <i>Cyperus eragrostis</i>	1	Small dense clumps with <i>Typha</i>
* <i>Chenopodium album</i>	1	
<i>Portulaca oleracea</i>	1	
* <i>Capsella bursa pastoris</i>	1	
* <i>Gnaphalium</i> sp.	2	
<i>Kennedia rubicunda</i>	1	Clumps on bank of channel with <i>Typha</i>
<i>Wahlenbergia gracilis</i>	1	Scattered, rare.
* <i>Hypochaeris microcephala alba</i>	1	
<i>Melia azedarach</i> (?)		(seedling previously recorded)
* <i>Setaria parviflora</i>	1	
<i>Acacia (ulicifolia?)</i>		(seedling previously recorded)
<i>Cynodon dactylon</i>	2	Around margin of Tee (by W fence)
<i>Acacia longifolia</i>	1	Small plants
* <i>Juncus bufonius</i>	1	
* <i>Senecio madagascariensis</i>	1	
* <i>Gamochaeta</i>		
* <i>Erhrarta erecta</i>		
* <i>Eragrostis curvula</i>		
* <i>Lepidium africanum</i>		
* <i>Bidens pilosa</i>		



Species name	CA	Comments
* <i>Eleusine indica</i>		
* <i>Trifolium</i> sp.		
* <i>Trifolium repens</i>	1	Localised small patches 1m x 1m
* <i>Cyperus</i> sp.	1	<i>C. reflexus</i> ? (not local native)
* <i>Cyperus difformis</i>	1	With <i>Typha</i>
* <i>Plantago lanceolata</i>		
* <i>Galinsoga parviflora</i>		
* <i>Paronychia brasilensis</i>		
* <i>Juncus</i> sp.	1	(specimen taken for ID)
<i>Epilobium</i> sp.		Not identified to species level (possibly native)

* Weeds

Cover abundance not recorded for some species (usually very small numbers/isolated plants)

Path along E boundary - **No CA recorded**



Appendix 3. Noxious Weeds for the City of Botany Bay LGA

Extracted from Weed Control Order No. 28, New South Wales Government Gazette No. 39/2011, dated 30 September 2011.

Note: It is the responsibility of Local Council, (Noxious Weeds Act 1993 (ss 10, 12-14, 35, 4) to issue a Weed Control Notice (Noxious Weeds Act 1993 (ss 18(1), (2) and 22(1)).

* = Aquatic Weeds - = not present on the site

Category	Species	Common Name	Status
Class 1	<i>Acacia karoo</i>	Karoo Thorn	-
	<i>Acacia nilotica</i>	Prickly Acacia	-
	<i>Annona glabra</i> *	Pond Apple	-
	<i>Asystasia gangetica</i> subsp. <i>micrantha</i>	Chinese Violet	-
	<i>Bassia scoparia</i> except <i>B.scoparia</i> subsp. <i>trichophylla</i>	Kochia	-
	<i>Centaurea stoebe</i> subsp. <i>micranthos</i>	Spotted Knapweed	-
	<i>Centaurea nigra</i>	Black Knapweed	-
	<i>Chromolaena odorata</i>	Siam Weed	-
	<i>Clidemia hirta</i>	Koster's Curse/Clidemia	-
	<i>Cryptostegia grandiflora</i>	Rubbervine	-
	<i>Eichhornia azurea</i> *	Anchored Water Hyacinth	-
	<i>Equisetum</i> spp.	Horsetail	-
	<i>Gymnocoronis spilanthoides</i> *	Senegal Tea Plant	-
	<i>Heteranthera reniformis</i>	Heteranthera/Kidneyleaf	-
		Mud Plantain	-
	<i>Hieracium</i> spp.	Hawkweed	-
	<i>Hydrocotyle ranunculoides</i> *	Hydrocotyl/Water Pennywort	-
	<i>Hymenachne amplexicaulis</i> and hybrids*	Hymenachne	-
	<i>Lagarosiphon major</i> *	Lagerosiphon	-
	<i>Limnocharis flava</i>	Yellow Burrhead	-
	<i>Miconia</i> spp.	Miconia	-
	<i>Mikania micrantha</i>	Mikania	-
	<i>Mimosa pigra</i> *	Mimosa	-
	<i>Myriophyllum spicatum</i> *	Eurasian Water Milfoil	-
	<i>Nassella tenuissima</i>	Mexican Feather Grass	-
	<i>Orobancha</i> spp. except <i>O. cernua</i> var. <i>australiana</i> and <i>O. minor</i>	Broomrapes	-
	<i>Parthenium hysterophorus</i>	Parthenium Weed	-



Category	Species	Common Name	Status
	<i>Pistia stratiotes</i> *	Water Lettuce	-
	<i>Stratiotes aloides</i>	Water Soldier	-
	<i>Striga</i> spp. except the native	Witchweed	-
	<i>S. parviflora</i>		
	<i>Trapa</i> spp.*	Water Caltrop	-
Class 2	<i>Chrysanthemoides monilifera</i> subsp. <i>monilifera</i>	Boneseed	-
	<i>Eichhornia crassipes</i> *	Water Hyacinth	-
	<i>Hygrophila costata</i>	Hygrophila	-
	<i>Salvinia molesta</i> *	Salvinia	-
	<i>Solanum viarum</i>	Tropical Soda	-
Class 3	<i>Alternanthera philoxeroides</i> *	Alligator Weed	-
	<i>Cestrum parqui</i>	Green Cestrum	Present
	<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>	Bitou Bush	-
	<i>Cortaderia</i> spp.	Pampas Grass	-
	<i>Ludwigia longifolia</i>	Long-leaf Willow Primrose	-
	<i>Ludwigia peruviana</i>	Ludwigia	-
	<i>Ulex europaeus</i>	Gorse	-
Class 4	<i>Asparagus asparagoides</i>	Bridal Creeper	-
	<i>Cylindropuntia</i> spp.	Prickly Pear	-
	<i>Egeria densa</i> *	Leafy Elodea Dense Waterweed	-
		Egeria	
	<i>Harrisia</i> spp.	Harrisia Cactus	-
	<i>Hygrophila polysperma</i>	East Indian Hygrophila/Hygro	-
	<i>Hypericum perforatum</i>	St. John's Wort	-
	<i>Lantana</i> spp.	Lantana	Present
	<i>Ligustrum lucidum</i>	Privet (Broad-leaf)	-
	<i>Ligustrum sinense</i>	Privet (Narrowleaf/Chinese)	-
	<i>Nassella neesiana</i>	Chilean Needle Grass	-
	<i>Nassella trichotoma</i>	Serrated Tussock	-
	<i>Opuntia</i> spp. except <i>O. ficus-indica</i>	Prickly Pear	-
	<i>Parietaria judaica</i>	Pellitory	-
	<i>Phyla canescens</i>	Lippia	-
	<i>Ricinus communis</i>	Castor Oil Plant	Present



Category	Species	Common Name	Status
	<i>Rubus fruticosus</i> agg. spp. except cultivars: <i>Black Satin, Chehalem, Chester Thornless, Dirksen Thornless, Loch Ness, Murrindindi, Silvan, Smoothstem, Thornfree</i>	Blackberry	-
	<i>Sagittaria montevidensis</i> *	Arrowhead	-
	<i>Toxicodendron succedaneum</i>	Rhus Tree	-
Class 5	<i>Amelichloa brachychaeta</i>	Espartillo	-
	<i>Amelichloa caudata</i>	Espartillo	-
	<i>Ambrosia artemisiifolia</i>	Annual Ragweed	-
	<i>Ambrosia confertiflora</i>	Burr Ragweed	-
	<i>Argemone mexicana</i>	Mexican Poppy	-
	<i>Brassica barrelieri</i> subsp. <i>oxyrrhina</i>	Smooth-stemmed Turnip	-
	<i>Cabomba</i> spp. except <i>C. furcata</i> *	Cabomba	-
	<i>Carthamus glaucus</i>	Glaucous Star Thistle	-
	<i>Cenchrus biflorus</i>	Gallon's Curse	-
	<i>Cenchrus brownii</i>	Fine-bristled Burr Grass	-
	<i>Cenchrus echinatus</i>	Mossman River Grass	-
	<i>Cucurbita</i> spp. except <i>C. australis</i> , <i>C. tasmanica</i> and <i>C. Victoriana</i>	Dodder	-
	<i>Cynara cardunculus</i>	Artichoke Thistle	-
	<i>Cyperus esculentus</i>	Yellow Nutgrass	-
	<i>Festuca gautieri</i>	Bear-skin Fescue	-
	<i>Gaura parviflora</i>	Clockweed	-
	<i>Helianthus ciliaris</i>	Texas Blueweed	-
	<i>Oryza rufipogon</i>	Red Rice	-
	<i>Pennisetum macrourum</i>	African Feather Grass	-
	<i>Pennisetum setaceum</i>	Fountain Grass	-
	<i>Picnemon acarna</i>	Soldier Thistle	-
	<i>Sagittaria platyphylla</i> *	Sagittaria	-
	<i>Salix</i> spp. except <i>S. babylonica</i> , <i>S. x reichardtii</i> , <i>S. x calodendron</i>	Willows	-
	<i>Scolymus hispanicus</i>	Golden Thistle	-
	<i>Sisymbrium runcinatum</i>	African Turnip Weed	-
	<i>Sisymbrium thellungii</i>	African Turnip Weed	-
	<i>Sonchus arvensis</i>	Corn Sowthistle	-
	<i>Stachytarpheta cayennensis</i>	Cayenne Snakeweed	-
	<i>Tamarix aphylla</i>	Athel Tree/Athel Pine	-



Weed Control Classes

- Class 1** - State Prohibited Weeds. *"The plant must be eradicated from the land and the land must be kept free of the plant."*
- Class 2** - Regionally Prohibited Weeds. *"The plant must be eradicated from the land and the land must be kept free of the plant."*
- Class 3** - Regionally Controlled Weeds. *"The plant must be fully and continuously suppressed and destroyed."*
- Class 4** - Locally Controlled Weeds. *"The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority."*
- Class 5** - Restricted Plants. *"The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with."*

Control objectives

The control objectives for each class is as follows:

- Class 1** is to prevent the introduction and establishment of those plants in NSW.
- Class 2** is to prevent the introduction and establishment of those plants in parts of NSW.
- Class 3** is to reduce the area and the impact of those plants in parts of NSW.
- Class 4** is to minimise the negative impact of those plants on the economy, community or environment of NSW.
- Class 5** is to prevent the introduction of those plants into NSW, the spread of those plants within NSW or from NSW to another jurisdiction.

Class 5 weeds are predominately weeds listed under the old Seeds Act, which has been repealed. There is no obligation to control Class 5 weeds. However Class 5 weeds are notifiable weeds. This means that the plant, or any animal or thing, which has the weed on it or in it, cannot be sold, purchased or offered for sale in NSW. It cannot be removed from any land to another place and it cannot be scattered on land or water.

'Sell' includes:

- (a) barter, offer or attempt to sell, receive for sale, have in possession for sale, expose for sale, send, forward or deliver for sale or cause or permit to be sold or offered for sale, or
- (b) sell for resale.



Appendix 4. Notes for seed collection and control

Harvesting

Harvesting of some species can be undertaken over a number of months. Other species are dehiscent and need to be regularly checked as the fruit/capsules mature, as they will quickly drop from the parent plant, for example *Bossiaea heterophylla* and *Acacia suaveolens*. These two species are likely to require hot water treatment of the seed for good germination.

Seed from such species drops readily and the opportunity window for collection is generally quite narrow. For example, seed of *Bossiaea heterophylla* has a dehiscent pod; a small gauze bag enclosing the fertilised flowers can effectively capture the seed, although this will also need to be treated and stored at low temperature to prevent predation by larvae that may hatch from any eggs present.

Seed Treatment for Insect Control

Seed is a food source for insects as well as other species. Harvested seed may contain insects that will continue to eat the seed and destroy it. A simple method for the control of insects in seed is provided below:

- a) Dry collected seed at room temperature for one to three days.
- b) Place seed in a labelled envelope in a plastic container.
- c) Place the plastic container with the seed in a domestic freezer (typical temperature -20°C) and leave for at least one week.
- d) The seed can remain in the freezer until it can be sown. Alternatively it can be stored on a shelf in a cool, dry room. If the seed is to be stored for a long period ensure that re-infestation of the seed by insects does not occur.

Failure to control insects in harvested seed may result in significant (even entire) seed loss by insects (larvae, small beetles, etc.).

Storage

Use appropriate storage (e.g. shelf, fridge or freezer) and germination methods for all collected material. Seed viability can be significantly extended by suitable storage conditions (e.g. low temperature, reduced moisture content).

Germination

The ease of germinating an individual species varies widely across different plant species. Seed viability can range from days to centuries. Similarly if one hundred seeds of a species are sown, some species may produce over 90 seedlings in a month while other species may only produce 10 seedlings after a decade or longer.



BDGC has an established propagation greenhouse. We recommend that seed first be collected from species that are relatively easy to germinate and these be used in revegetation and landscaping works. A guide to the germination of Australian native seed is **Ralph** (2003).



Appendix 5. Company Profile

Abel Ecology has been in the flora and fauna consulting business since 1991, starting in the Sydney Region, and progressively more state wide in New South Wales since 1998, and now also in Victoria. During this time extensive expertise has been gained with regard to Master Planning, Environmental Impact assessments including flora and fauna, bushfire reports, Vegetation Management Plans, Management of threatened species, Review of Environmental Factors, Species Impact Statements and as Expert Witness in the Land and Environment Court. We have done consultancy work for industrial and commercial developments, golf courses, civil engineering projects, tourist developments as well as residential and rural projects. This process has also generated many connections with relevant government departments and city councils in NSW. Our team consists of four scientists and two administrative staff, plus casual assistants as required.

Licences

NPWS s132C Scientific licence number is SL100780 expires 30 April 2014

NPWS GIS data licence number is CON95034

DG NSW Dept of Primary Industries Animal Care and Ethics Committee Approval expires 8 December 2015

DG NSW Dept of Primary Industries Animal Research Authority expires 8 December 2013

The Consultancy Team

Dr Danny Wotherspoon

Grad Dip Bushfire Protection (University of Western Sydney 2012)

PhD, researching Cumberland Plain vegetation and fauna habitat, at Centre for Integrated Catchment Management (University of Western Sydney, 2008)

MA (Macquarie University, 1991)

Dip Ed (University of New England, 1978)

BSc (University of New England - Triple Majors in Zoology, incl. Ecological Zoology, 1974)

Dr Daniel McDonald

Mark Sherring

BM, MAABR, Cert. Hort., Cert. Bush Regen., Cert. Rural Ops, White Card.

Mark is a member of the Australian Association of Bush Regenerators and has extensive knowledge and experience of plant species in New South Wales. Mark holds a Bachelor of Maths degree, majoring in statistics, a Certificate of Horticulture, Certificate of Bush Regeneration and a Certificate of Rural Operations. He has built up his expert knowledge on NSW native plant species over the many years that he has practised as a Botanist. He is regularly asked to contribute to the extensive (ongoing) flora surveys of the Sydney Basin and Blue Mountains carried out by the Royal Botanic Gardens, Sydney. Mark has extensive field survey experience, having worked for over ten years in various plant-related roles. His role in Abel Earthcare is to provide expert advice on flora and on the full range of flora



management issues encountered and in the design and management of environmental monitoring projects.

PhD (The University of Sydney 2006)

M. Agr (The University of Sydney 1996)

B. Ag Sc. (The University of Sydney 1991)