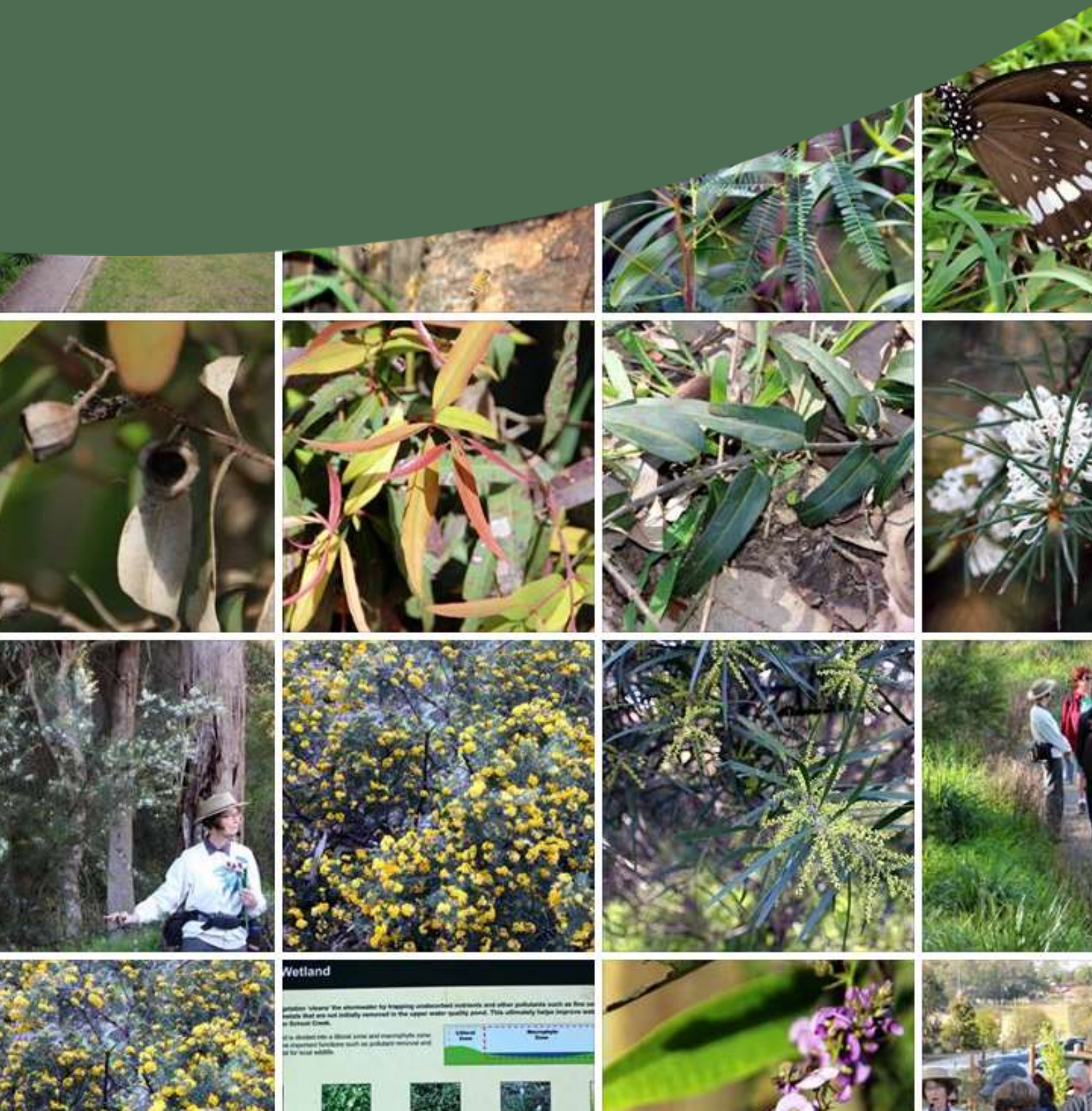
Bushland Management Strategy for Fairfield Indigenous Flora Park

Fairfield City Council

By Ecological Consultants Australia Pty Ltd

October 2015 updated January 2016



About this document

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Statement of Authorship

This study and report was undertaken by Ecological Consultants Australia for the City of Sydney. The authors of the report are Geraldene Dalby-Ball whose qualifications are BSc. majoring in Ecology and Botany with over 20 years' experience in this field, Anthea Whitlam BSc Master in Ecology and *Julian Reyes BSc and Cert IV in Natural Area Restoration.*

Limitations Statement

Information presented in this report is based on an objective study undertaken in response to the brief provided by the client and available resources. We note that the funding budget for this project was $5000 for all work. *We greatly appreciate the volunteering of time and expertise from Teresa James in relation to this project.*

Acknowledgement

Information in this report is a combination of the authors experience and those from many others in ecology. Particular acknowledgement to Teresa James – Botany expert and author of *Rare and Threatened Flora of Fairfield LGA* (July 2015). Special appreciation to those with long-term care of the reserve especially Frances Martin and Bob Ward - long term volunteers for sharing their passion and local and seasonal information as well as Daniel Smart – previous Fairfield nursery manager – for sharing his knowledge on-site. We give appreciation to all who have shared information. In particular we acknowledge the Original People of this Land who continue to share the wisdom of this lands plants and animals, seasons and cycles.

Document Control Sheet	
Title:	Bushland Management Strategy for Fairfield Indigenous Flora Park
Version:	Final
Author:	Mia Dalby-Ball and Anthea Whitlam
Date:	21/10/15 updated 28/1/2016 and 16th June 2016
File location:	E:\ ECA 4 Prod\2 ECA Projects \Fairfield
Distribution:	tjohnson@fairfieldcity.nsw.gov.au Fairfield City Council Tim Johnson and Helen Pollard

Signed: Mia Dalby-Ball – Director of Ecological Consultants Australia

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1. Executive Summary

Reserve description: Fairfield Indigenous Flora Park (FIFP) is a small remnant (2.570 ha) of level bushland on Orphan School Creek.

Fairfield Indigenous Flora Park is Cumberland Plain Woodland (CPW) EEC. With less than 9% of the original vegetation remaining in the Cumberland Plain Woodland (CPW) the park is of high importance not only for conservation but also for social connection and as a seed source for future re-vegetation projects.

Vegetation variants of CPW within the park are:
Spotted Gum Grey-box Woodland/Forest (on the Shale Plains Woodland) and
Alluvial Woodland in the riparian zone (on the Alluvial Woodland).
Slight changes in topography the Park also holds temporary pools of water and different species live in these wetter areas.

PCTs are: PCT ID: 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion and
PCT ID: 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion

Management objectives: The Park is managed by the Fairfield Indigenous Flora Park Group – a voluntary group of local residents – with the support of Fairfield City Council. The land is classified, under the Local Government Act, as Community Land and categorised as Natural Area – Bushland and Natural Area – Waterway and zoned as 6(a) public recreation. Thus management objectives are focused on the retention and care of the ecological values of the Park.

Updated species list based on the 2015 survey is included and has 113 native species.
Flora includes species listed on the state and federal list as threatened as well as rare and uncommon species. Propagation from the plants here and neighboring areas, such as the Showground, will increasingly be important as seed is needed for rehabilitation projects throughout Western Sydney.

A fire management regime has been developed that complies with the flora community classification and legal requirements. Burns are proposed for as soon as possible in some areas and others can be burnt in a mosaic way with at least 12-15 years between any one area being burnt. The current fire risk rating is low to moderate. Fine fuels are present throughout the reserve, generally less that 100mm deep.

Management strategies for pest species both flora and fauna have been provided. For Flora the management is via fire and bush regeneration. The key fauna pests are foxes and Noisy Minors. Psyllids are a potential problem for the Grey Box. Recommendations have been made in the report and summary action table.

Data has been obtained from quadrats and transects using Bio-banking methodology. Data was used to update the species list, determine changes is vegetation composition, or not, across the 5 quadrat locations. Surveys enables a focused assessment of ground fuels and logs.

Management strategies have been prioritised in the action table and a timeframe has been nominated. The summary table includes actions over the next 15 years. Most actions here are for the period 1-4 years however some are longer-term and other are on-going.

Maps have been included throughout the report showing plant communities, condition mapping, significant flora areas, proposed burn locations etc.

2. Introduction and Overview

2.1 Purpose of this Bushland Management Strategy

This Bushland Management Strategy (BMS) for the Fairfield Indigenous Flora Park in Prairiewood provides an overview of the Parks current values, condition and recommendations for future management, whilst providing a brief history of the park in relation to management.

Grant funding from Greater Sydney's Local Land Services has been provided to produce this Bushland Management Strategy and perform on ground works within Fairfield Indigenous Flora Park.

This Bushland Management Strategy's recommendations reflect the long term management of the site and legislative requirements. The Action Plan assists in determining and prioritising on-ground works. Actions focus on the Park however it is acknowledged that effective on-site outcomes are facilitated through effective catchment management. Recommendations focus on actions to be undertaken in 1-4 years and provide guidance for a 4-20 year timeframe.

The Specific Scope of this BMS is to provide:

- An overview of the existing environment and reserve description
- Management objectives
- Updated species list
- Development of a fire management regime to implement a strategy that complies with the flora community classification and legal requirements, including the current fire risk rating
- Management strategies for the local flora and fauna's pest species.
- Guideline for the placement of quadrats and transects using Bio-banking methodology
- Priorities for management strategies
- Maps showing plant communities, weeds, significant flora and fauna areas etc.
- Time frames for the implementation of this strategy

2.2 Indigenous Peoples

Fairfield Indigenous Flora Park is within the homelands of the Deerubbin of the Darug Peoples and close to the Gandangara – as per the mapping of the Aboriginal River Keeper Team – LALC Area (Figure 1).

The First Nations people are acknowledged as the traditional custodians of land with the Fairfield City local government area. Council pays its respect to the Elders both past and present. As part of this Bushland Management Strategy (BMS) we value the information and guidance from the First Peoples. It acknowledges their very long history of living with and knowing the local ecology, plants, animals and influences from seasons and cycles intimately.

Information in this BMS will be updated with information from First Nations People including through the Aboriginal advisory committee and Des Smith (9725 0132)

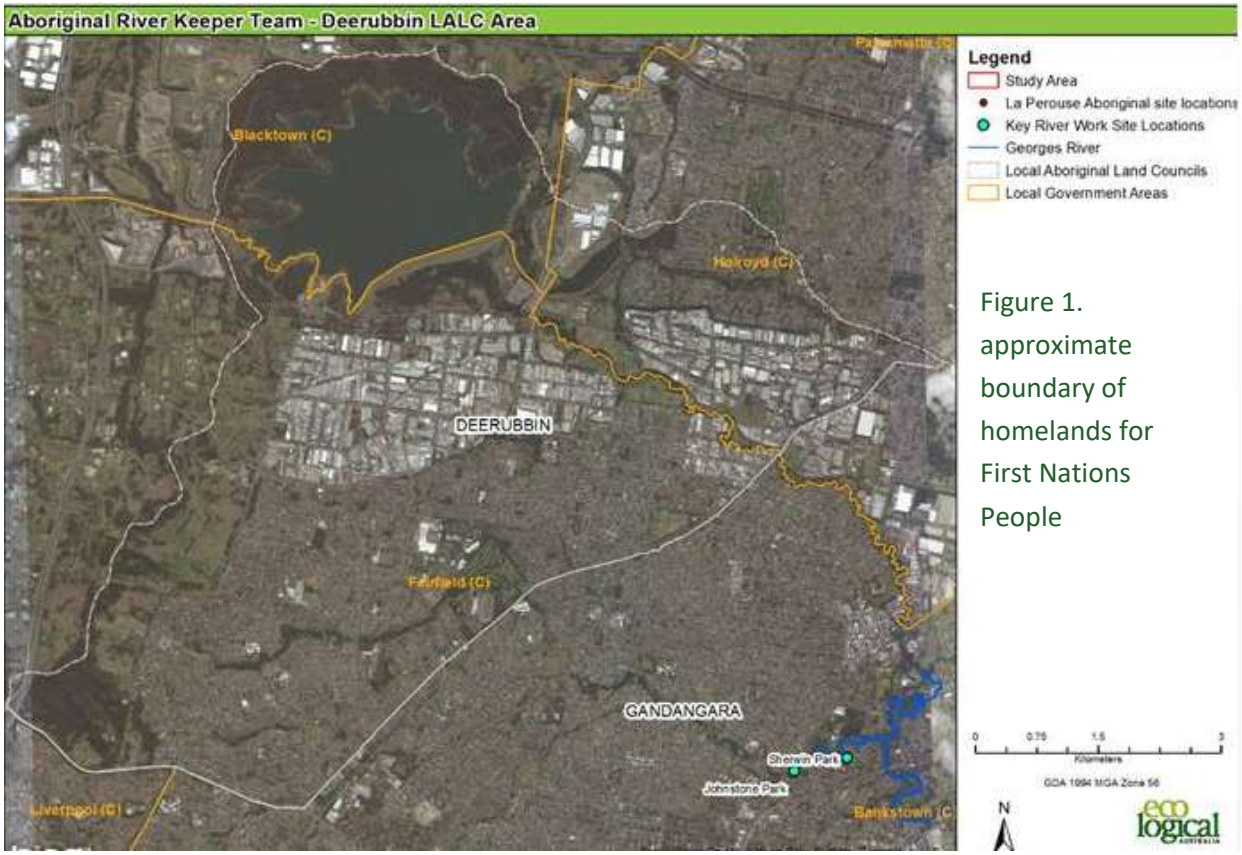


Figure 1. approximate boundary of homelands for First Nations People

Plate 1. Bush foods

Plate 2. Plant Medicines

2.3 Fairfield Councils City Plan 2012-2022

Fairfield Councils City Plan 2012-2022 states**:**

Our City values its natural environment, especially its biodiversity and its waterways

The theme *Environmental Sustainability* has as its first goal *Protecting and Improving our Natural Environment* and includes five outcomes with the first 3 directly relevant to Fairfield Indigenous Flora Park and this BMS. These are listed below and have been addressed in the Action Table and throughout this Strategy.

1.1 Rehabilitate waterways and riparian zones

1.2 Improved water quality in our waterways

1.3 Significant habitats, biodiversity and native vegetation are protected

2.4 When and how it became a Park

Conservation Value

A small remnant (2.570 ha) of level bushland along Orphan School Creek that was once a much larger area of bushland. With less than 9% of the original Cumberland Plain Woodland (CPW) vegetation remaining, this park is of high importance, not only for conservation, but also for social connection and a seed source for future re-vegetation projects. This later point will become increasingly important as much of the remaining bushland is threatened by residential expansion in the north and south west sectors of Sydney.

When it became a Park

Part of an area known as the Bossley Bush, the Park was bequeathed by Tarburton Bossley (1846-1932) to the people of Fairfield for public recreation.

A group of local residents concerned at the depreciation of bushland in the area had the idea of creating this Indigenous Flora Park. A proposal to convert this park into a car-parking area for the hospital, increased to conserve the Park. Fairfield Indigenous Flora Park was opened in September of 1991 as a living museum of indigenous plants. The aim of this park was to help protect the threatened species whilst also providing a workshop area and field studies centre for schools and other interested persons. This Flora Park would also contain all the indigenous plants of the Fairfield region (George, 1991).

When the park opened it contained 101 native plant species including 4 native orchid species (George, 1991). In 2012, 112 species of indigenous plants and 25 bird species had been identified within the Flora Park.

Park Management

The Park is managed by the Fairfield Indigenous Flora Park Committee – a voluntary group of local residents – with the support of Fairfield City Council. Activities of the committee includes bush regeneration, construction of walking trails providing guided tours for schools and other interested groups. Council also holds educational events to engage local residents where native bee workshops, tree planting days are provided.

Location and Access

The Flora Park located in Prairiewood Fairfield, along Orphan School Creek. It is a gated park, open on the third Sunday of every month, and at other times by arrangement (signage to this effect is provided at the entrance to the reserve.) Access is via the entrance gate on Christie Street.

Actions in this Bushland Management Strategy focus on the area shown highlighted in Figure 1. Bushland the west is also public reserve and includes part of Orphan School Creek. This area is not fenced and can be accessed at any time.

Figure 2a. Subject site (Source: Grant application GSLLS 2015)

Figure 2b. Subject site (Source: Google Maps 2015) showing close up of study area

2.5 Land Categorisation

The categorisation and classification of land, under the Fairfield LEP and DCP, provides the requirements for managing the land according to its classification. Fairfield Indigenous Flora Park is classified as *E2 Environmental Conservation* in the LEP and the DCP describes how to manage land in an E2 zone.

Appendix I shows the land categorisation and lists the objectives for managing areas of Natural Area – Bushland and Waterway. The 2001 Plan of Management for the Park is the most recent published document describing site values and proposed works.

Land surrounding Fairfield Indigenous Flora Park is mostly residential and has been developed over the past 30 years. Key areas of native vegetation are found in Western Sydney Parklands (WSP) to the west of the Park, Prospect Nature Reserve to the north-west and Landsdowne Park in the south east. Figure 3 shows these key areas relative to the site and the land zoning with extensive residential areas (light pink). Figure 4 shows the aerial of the built up areas.

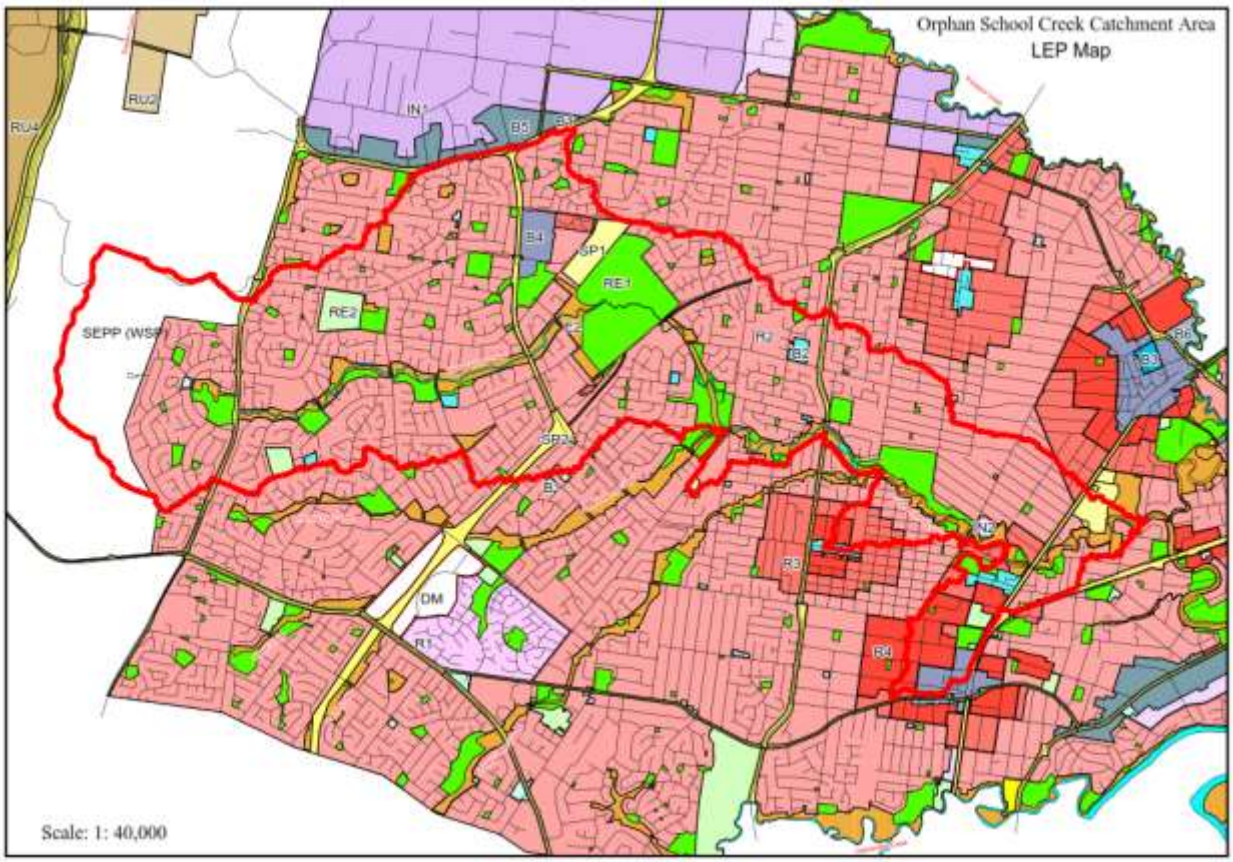


Figure 3 The land zoning with extensive residential areas (light pink).

Figure 4 Aerial view of the Local Government Area

Riparian zones (along waterways) are the key linkages between areas of remaining bushland. Orphan School Creek links WSP through Landsdowne Park to the Georges River and Botany Bay. The Park is one of the widest areas of native vegetation along this creek (Figure 5). Figure 6 shows the proximity of the park to the showground and other native vegetation. It is noted the vegetation at the showground includes rare species not yet identified in the Park.

Figure 5. Bushland and areas of native vegetation near the Park (Source: Aerial - Google Map 2015)

Figure 6. A close up of the Park showing the native vegetation along the creek and near the Fairfield Showground (Source: Aerial - Google Map 2015). Yellow indicates the park and adjoining riparian bushland.

2.5.1 Soils

Soils have a large influence on vegetation. This places resides in an area of Quaternary Alluvium. The soil

mapping scale is coarse, relative to the size of the park. On-site surveys have indicated that the soil has a high clay influence. Mapping shows soils are mostly derived from Wianamatta Shales (Blacktown, Luddenham and Picton soil landscapes) and the floodplains and valley flats from Quaternary alluvium (South Creek and Richmond soil landscapes).

On-site surveys indicate the obvious clay presence and influence with water-holding in depressions for at least 7 days after rain.

Figure 7 shows the soil landscapes with dark and light green being shale derived soils.

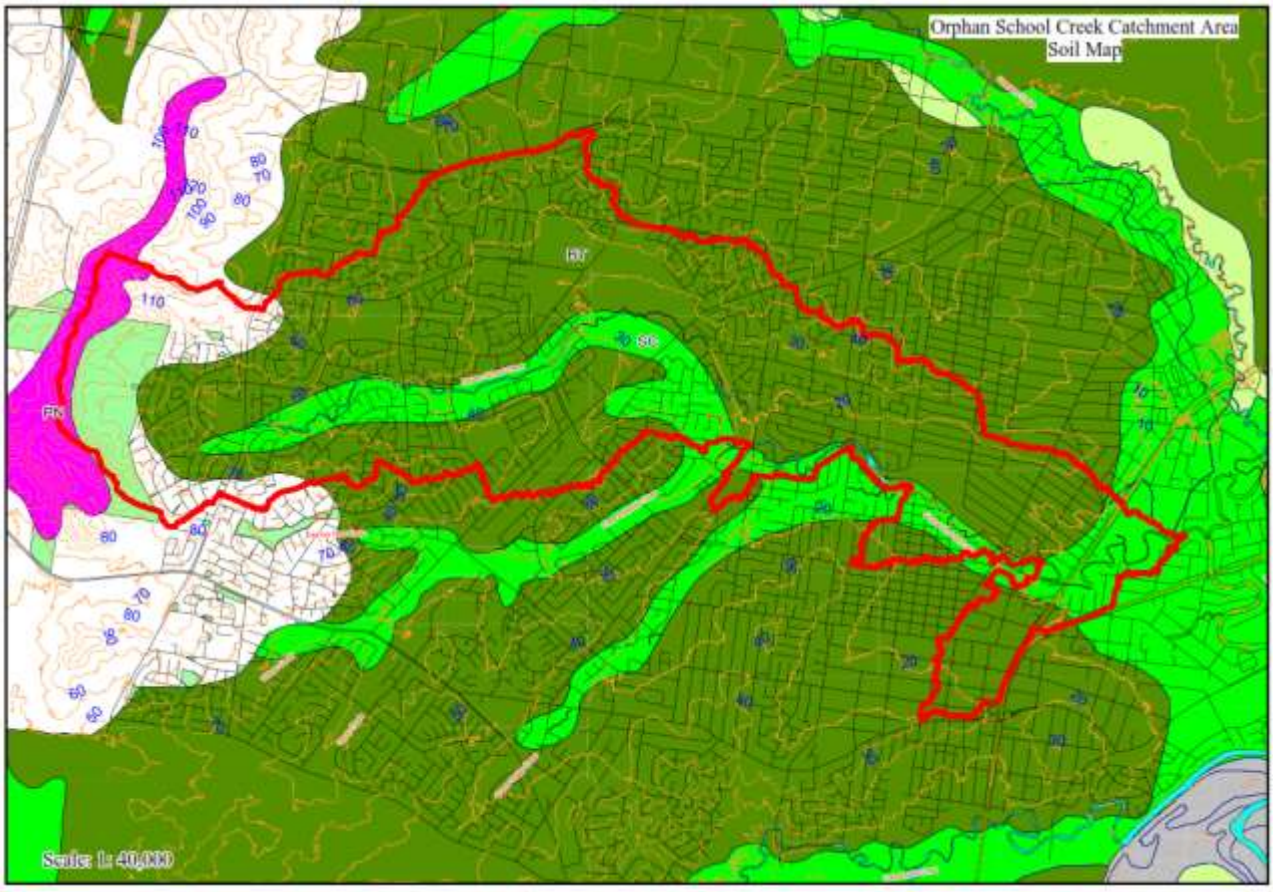
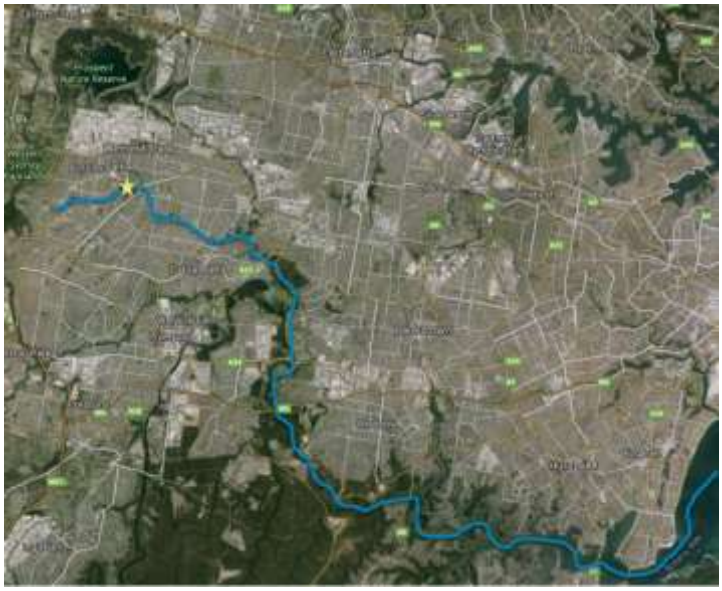


Figure 7. Soil Landscapes in Fairfield (Source: Fairfield City Council and Chapman *et al* (2009) Soil Landscapes of the Sydney 1:100,000 Sheet)

2.5.2 Water-flows, Run-off and Ephemeral Pools

Surrounding land use is urban largely consisting of residential properties and associated infrastructure such as roads. Extensive areas of non-porous (hard) surfaces in the catchment has resulted in water flows during and after rain being fast flowing with minimal opportunities to pool and recharge aquifers. Figure 8 shows the extensive urbanisation as well as the connectivity between Orphan School Creek and Botany Bay.

Figure 9 shows the stormwater system and how it links into the original water-ways.



=the approximate location of the Park.

Figure 8 Aerial showing the extensive urbanization and linkage between Orphan Schools Creek and Botany Bay in the lower RH corner (Source: Aerial Google maps 2015)

The urban nature of the catchment has implications for the Park including rapid water flows into the creek increasing erosion, channelisation and reduced natural flooding (banks over-topped and flooding onto surrounding land (including the Park). Fast run-off can also contribute to general decreased soil moisture in as there are fewer opportunities for water to pool and sink into soils - hence a drier environment overall.

Trees and ground plants in some area of the park, such as the clumps of White-Feathered Honey-Myrtle, *Melaleuca decora,* and the ground plant Nardoo, *Marsilea hirsuta,* indicate extended periods of surface water and / or saturated soils. See Plates 3 and 4 for examples of these species.

Plate 3. **White-Feathered Honey-Myrtle, *Melaleuca decora***

Plate 4. **Nardoo, *Marsilea hirsuta,***

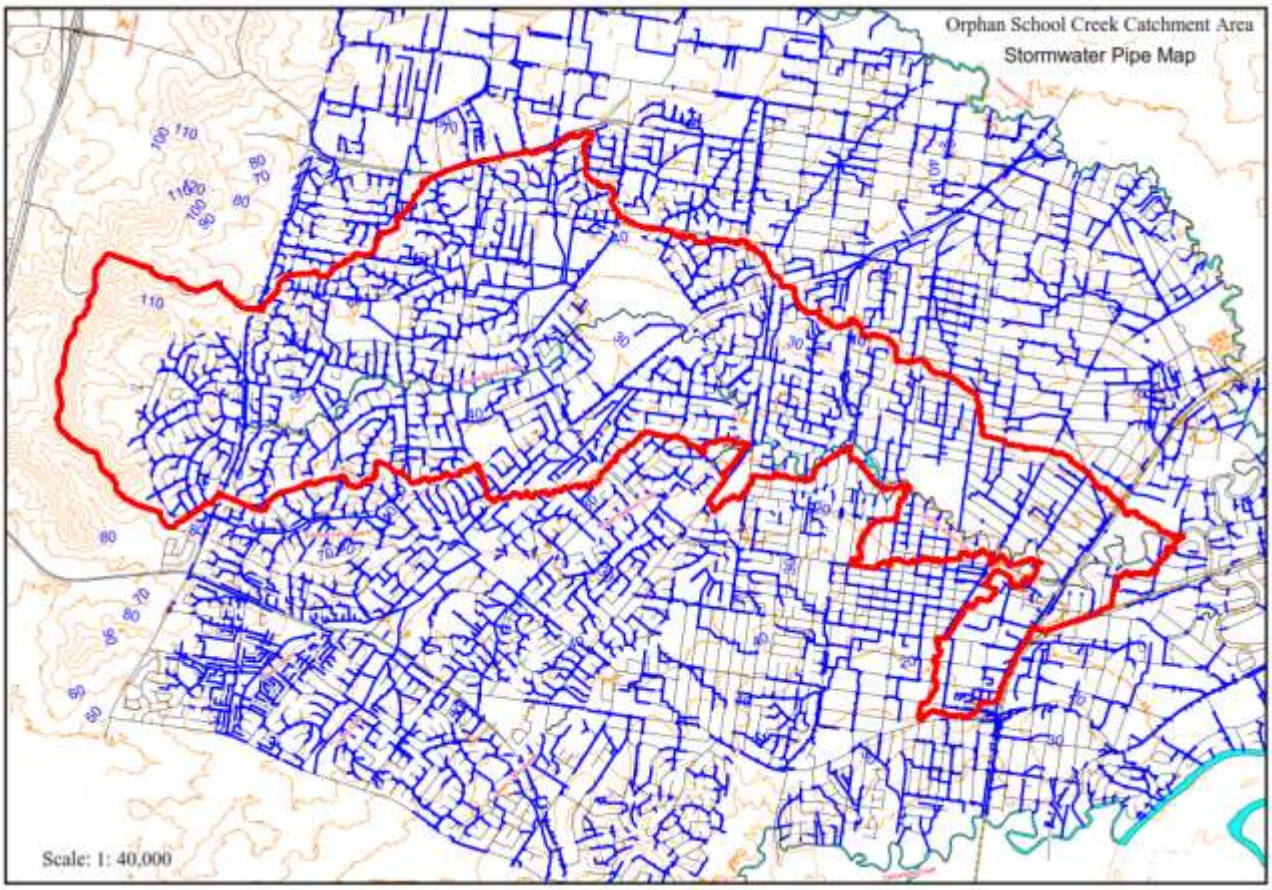


Figure 9. Orphan School Creek catchment and the stormwater system and how the pipes and pits connect into the original water-ways (Source: Fairfield City Council 2016).

3. Survey Method

Methods were designed to fulfill the agreed scope of works for this BMS with the scope including:

- An overview of the existing environment and reserve description
- Management objectives
- Updated species list
- Development of a fire management regime to implement a strategy that complies with the flora community classification and legal requirements, including the current fire risk rating
- Management strategies for pest species both flora and fauna
- Quadrats and transects using Bio-banking methodology
- Priorities for the management strategies
- Appropriate maps showing plant communities, weeds, significant flora and fauna areas etc.
- Appropriate time frame for implementation of the strategy

On-site surveys and on-site meetings with local experts and council were the key methods used. Quadrats and transects methods were based on the Bio-banking method. Methods have been provided in more detail below. Literature review and discussion with experts in different fields was also undertaken.

3.1 Field Work

On-site surveys were conducted in August, September, October and November, 2015. A total of seven visits were made. Weather variance we noted and included surveys undertaken immediately after rain and 5 days after rain as well as dry weather. The purpose of going during and after rain was to observe conditions in the reserve and Orphan School Creek. Site visit times varied from 7am through to sun-set and 3 hours after dark (for Anabat and nocturnal fauna observations). A total of 94 on-site survey hours were undertaken by the authors for this BMS.

Surveys included walking through all areas of the Park and noting species present, soils, topography, weeds, management issues such as erosion, holes in fencing, signage or access track issues, as well as the inspection of nest boxes. Only nest boxes 3m from the ground were inspected. Other were observed using Binoculars for signs of active use.

Survey methods for quadrats and transects methods were based upon the approved Bio-banking method (Appendix 1) and included basic habitat characteristics including hollows and logs.

Survey data from site-wide inspections, quadrats and transects were used to update the flora species list.

Fauna was recorded at anytime that they were observed. Birds seen or heard within a 30m radius from 3 points in the reserve were recorded. Each bird survey lasted 20mins and was conducted by 1 person. At all times whilst on-site, birds seen or heard were recorded including their approximate location inside or outside the park. On-site surveying included 2 events of 3 hours after dark (for Anabat and nocturnal fauna observations). Fauna observations included taking photos of large invertebrates such as butterflies and spiders.

Fire Regime: The size and depth of fuel was recorded at 35 locations within the Park and this data was used in determining the current fire risk rating. On-site data on fuel was combined with information on vegetation communities and vegetation condition, as well as the locations of threatened species was used to development the fire management regimes recommended in this BMS.

3.2 Consultation

On-site meetings and site inspections were held with Council and the community with the objective of gaining a deeper understanding of the parks history, management needs and desired future actions. On-site meetings were held with:

i) Council Biodiversity representatives Tim Johnson and Botanist, Hellen Pollard

ii) Community members Frances Martin, Bob Ward and Daniel Smart

iii) Des Smith (9725 0132)

Discussions were also held with Flora Consultant and Botanist Teresa James, author of RARE AND THREATENED FLORA OF FAIRFIELD LOCAL GOVERNMENT AREA, prepared for Fairfield City Council in July 2015. Species specific issues were discussed as well as overall park management with a specific focus on the long-term sustainability of native plant species diversity.

3.3 Mapping

Mapping was undertaken on-site using a hand-held GPS. The majority of maps were created using, Arc View. Simple maps depicting recommendations have been created in MS Word.

3.4 Flora Survey Biobanking Method

The site has been categorised into zones of similar condition containing the same Plant Community Type (PCT). Plot and transect locations were established randomly within each vegetation zone by marking points randomly on the site map. Data was recorded in the field in accordance with approved Bio-banking methods as shown in Appendix 1 and summarised below.

Figures 10 and 11 show the vegetation communities and locations of the transects and plots.

Vegetation types have been provided as per OEH mapping, mapping and names used in (James 2015) and the PCT as per biobanking.

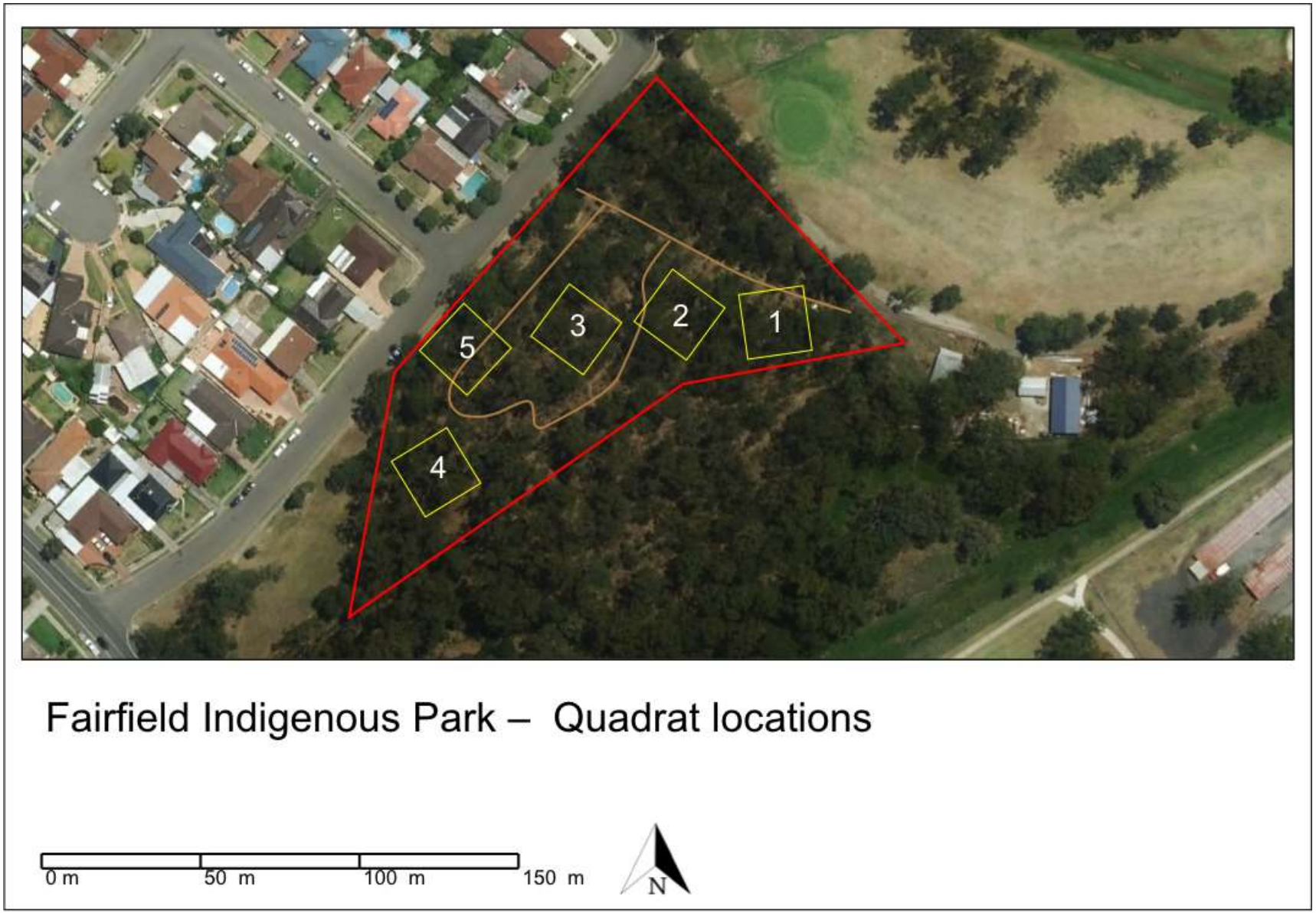


Figure 10. The official pathways within the park and locations of both transects and plots.

Figure 11. Plant Communities in Fairfield Indigenous Park (Source: the Native Vegetation of Sydney Metropolitan Area OEH 2013).

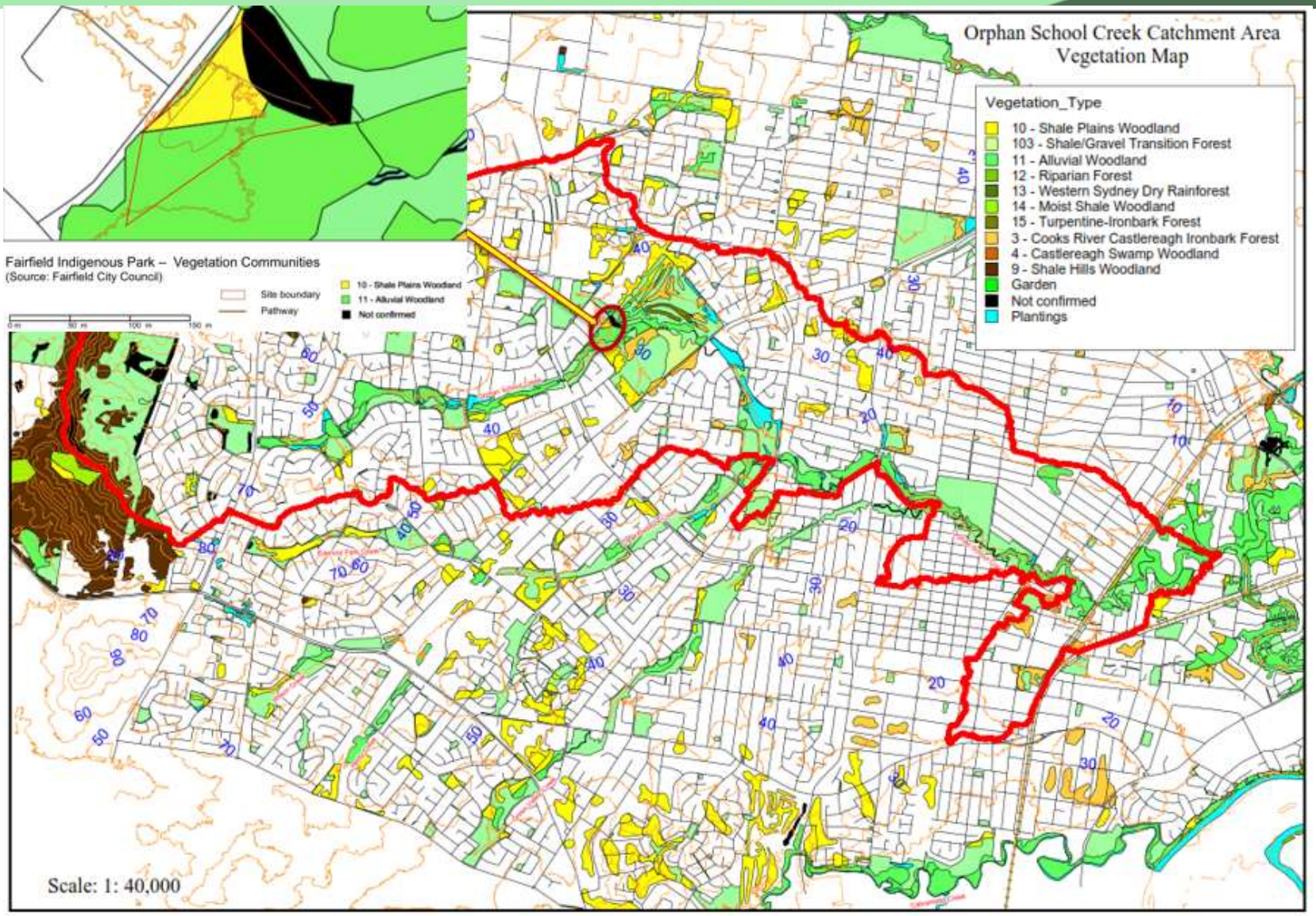


Figure 12 Vegetation Mapping Orphan School Creek Catchment Area (Source: Fairfield Council – based on Native Vegetation of Sydney Metropolitan Area OEH 2013). Showing Shale Plains Woodland (Yellow), Alluvial Woodland (Green) and vegetation type not confirmed (Black)

3.5 Additional Flora Surveying

Assessment included counting dead trees and logs in plots (20 x 40). Full results are including in Appendix IV. Assessment also included an assessment of fuel loading at 30 points within the reserve. The points include 4 points within each 20x40m plot as well as 14 points outside of the plots in randomly selected area within the reserve. The creek-line (area outside the fencing) was not included however this area has a very log to no fuel load and is dominated by mesophilic weeds particularly Tradescantia.

The following is summary of the methods from Bio-banking that were used in the vegetation surveying. Five areas were sampled – see Figure 10.

3.5.1 Native plant species richness

- One plot (20 x 20 m) was placed in each vegetation zone.
- The boundaries of the 20 x 20 m plot were marked using rope.
- Botanists systematically walked the plot until all vascular plant species located within the plot were identified.
- The following attributes were recorded for each species

Attribute	**Survey requirement**
Stratum (& layer)	Stratum & layer in which each species occurs
Growth form	Growth form for each recorded species
Species name	Scientific name and common name
Cover	A measure or estimate of the appropriate cover measure for each recorded species; recorded from 1–5% and then to the nearest 5%.
Abundance rating	A relative measure of the number of individuals or shoots of a species. The following intervals were used (numbers above about 20 are estimates only): 1,2,3,4,5,6,7,8,9,10,20,50,100,500,1000 or specify a number greater than 1000 if required

(Source: OEH BioBanking Assessment Method 2014)

3.5.2 Native over-story cover

- One 50m transect was placed in each vegetation zone.
- The transect was marked using a tape measure.
- The over-storey is defined as the native tree layer. The measure of cover is an estimate of the percentage value of foliage cover.
- This measure was taken at 5 m intervals along the transect, 10 measurements in total.
- The average of the 10 measurements was then recorded.

3.5.3 Native mid-story cover

- The mid-storey is defined as the native vegetation above 1 m and below the over-storey stratum. This includes tall shrubs, under-storey trees and tree regeneration.
- The mid-storey cover was recorded on the same transect and using the same method as the over-storey cover.

3.5.4 Native ground-cover (grasses)

- Native ground-cover (grasses) is defined as the native vegetation under 1 m in height belonging to the family Poaceae.
- At 1 m intervals along the transect, the presence or absence of native grasses was recorded
- The total number native grasses present that intersected the transect. This number was then divided by the total number of intervals (i.e. 50).

3.5.5 Native ground-cover (shrubs)

- Native ground-covers (shrubs) are defined as the woody native vegetation under 1 m in height that is woody.
- This was measured using the same method as for native ground-cover (grasses).

3.5.6 Native ground-cover (other)

- Native ground-cover (other) is defined as all native vegetation below 1 m in height which is non-woody and not in the family Poaceae. For example herbs, ferns, lilies, rushes and sedges .
- This was measured using the same method as for native ground-cover (grasses) and Native ground-cover (shrubs)

3.5.7 Exotic plant cover

- Exotic plant cover was measured

3.5.8 Number of trees with hollows

- A plot (50 m x 20 m) was randomly placed within each vegetation zone.
- The number of trees (living or dead) within the plot containing at least one hollow were recorded.
- Observers systematically scanned each tree within the plot, from the ground to the canopy, for hollows. It was ensured that the trees were observed from all angles.
- A hollow was recorded if all the following parameters were true: (a) the entrance is visible; (b) the minimum entrance width was at least 5 cm across; (c) the hollow appeared to have depth; (d) the hollow was at least 1 m above the ground; and the centre of the tree containing the hollow is within the plot.

3.5.9 Total length of fallen logs

- The same plot (50 m x 20 m) used for surveying the number of trees with hollow was used to measure the total length of fallen logs.
- Fallen logs must be at least 10 cm in diameter and at least 0.5 m long to be recorded.
- The plot was systematically walked and logs were measured for diameter (placing tape measure horizontally, directly above log) and length (placing tape measure along log)
- Only those parts of the log located within the plot were recorded.

3.5.10 Additional fallen log data and fuel loading

- This assessment included counting dead trees and logs in plots (20 x 40; Full results are including in Appendix IV).
- Fuel loading was measured at 30 points within the reserve. The points included 4 points within each 20x40m plot as well as 14 points outside of the plots in randomly selected areas within the reserve.
- The creek-line (area outside the fencing) was not included however this area has a very low fuel load as it was dominated by mesophilic weeds particularly Tradescantia.

3.6 Fauna Surveys

Fauna surveys were not the focus of this survey, hence all data collected was incidental with the exception of specific searches for snails and two evenings of micro-bat detecting using an Anabat. The presence of birds and frogs was recorded during each visit on site and species and abundance recorded. Butterflies, moths, spiders and ants were noted as present however they were not identified to beyond Class.

3.7 Community and Technical Expert Input

On-site discussions were held with Daniel Smart (21/10/15). Daniel was the previous Nalawala Community Nursery manager and is very familiar with the park, the rare and threatened species, the management history as well as having ideas on plant propagation and keeping local communities of plants sustainable.

Frances Martin and Bob Ward, long term volunteers (since 1990), were met on-site on 4/11/15 and shared their in depth local knowledge and provided suggestions for this strategy.

Thirty seven recommendations/questions to consider arose from the meetings and have been included in the Action Table and relevant sections of this report.

Team members conducting bush regeneration in the area (Toolijooa) were also asked about management matters for input to the Strategy. Julian Reyes, Natural Area Specialist (Dragonfly Environmental) conducted a site visit with the purpose of determining the priorities for bush regeneration. These priorities have been included in the recommendations and Action Table.

Recommendations are also being discussed with Teresa James.

4. Results

Overflow from the creek into the Park is expected to be infrequent. It is expected that prior to major catchment changes, the Park would have experienced inundation during large flow events.

Rain was observed to form standing water which persisted for at least 8 days during the survey period. Clay soils have a high capacity for holding water. Plates 5 and 6 show the water pooling. Plate 5 shows the Nardoo and Plates 8 and 9 show other plants *Alternanthera denticulata* and *Persicaria decipiens* that live in areas of occasional prolonged inundation. Water snails were also observed see Plate 7.

Plate 5. Nardo - forground

Plate 6. Nardoo close up

Plate 7. Water snail

Plate 8. Alternanthera denticulata

Plate 9. Water holding area under the Casuarina glauca

Plate 10. Pooling water

4.1.1 Soil

Soil within the park appears to be stable and no obvious signs of erosion. Soil within the creek is mobile and the banks are undercut in sections. Recommendations for the creek bed and bank stabilisation are not covered in this report. No testing of sub-soil moisture levels was conducted, but is recommended to gain a better understanding of the park. See Figure 7 for soil landscapes map.

4.1.2 Fungi

During the general and plot surveys the presence of fungi was recorded. No specific surveys were undertaken to detect Mycorrhizal fungi. As part of a full assessment it is recommend the fungi are identified, particularly mycorrhizal species which are known to have inter-dependencies with many native plants including orchids. Monitoring fungi could provide early warning signals of decline, or improvement in ecosystem functions. Fungi observed on site are shown in plates 11 and 12.

Plate 11. Bracket fungi on falled log – common in the park

Plate 12. Earth Star Puff Ball

4.1.3 Fire

Fire is a key component of ecosystem health for the vegetation communities within Fairfield Indigenous Flora Park. Threatened species such as *Acacia pubescens* rely on fire for seedling germination. A separate section about fire recommendations for the reserve is provided for in this plan.

4.1.4 Pollinators and Biotic Dispersal Agents

An essential component of long-term viability of vegetation communities, particularly small patches, is how effectively the plants can be pollinated and how well they can disperse mature propagules.

In the Park key natural pollinators include insects, micro-bats and birds. Additional research is required in this area to determine:

- which pollinators are needed,
- which are present and
- what conditions do they need to survive.

This Bushland Management Strategy does not have the data to provide definitive recommendations however recommendations are provided to facilitate the on-going survival of pollinators in general.

Inter-species associations can be complex such as in the case of many orchid species. Orchid species previously seen on-site are the Sydney Plains Greenhood Orchid, *Pterostylis saxicola* and *P. curtea* which was surveyed around 2014 (pers comm. Fairfield Council). It was not observed during this study or recorded over the past year, however it could be present underground.

Plate 13. Tiger Moth

Plate 14. Native Bee 'hotel'

Plate 15. Leaf Hopper on Spotted Gum

Plate 16. Syllid

Plate 17. Beetle

Plate 18. Leaf Hopper

Plate 19. Moth

Plate 20. Cross Spider

Plate 21. Spider

Genetic Diversity

Another aspect of long-term viability is linked to genetics. While some species naturally have low genetic diversity within populations other have high diversity – hence generalisations cannot be made about the level of 'appropriate variation'.

Further data is required on the locations of remnant plants in the area. Once locations of remnant plants are known and their natural pollinators identified the likelihood of cross pollination is required and whether actions such as assisted pollination or infill planting are necessary. See the recommendations section for recommended planting areas.

4.1.5 Logs, Dead Trees and Leaf Litter including fuel loading

Logs

Logs are present throughout the site. Most are between 100-250mm in diameter and over 3m long. Some are over 5m long. Logs in general are trunks of trees that have died and fallen they have few features such as hollows. Decay and impact of burrowing invertebrates has hollowed out sections of some logs and bracket fungi are common. Log pile-ups are uncommon. Logs are used as natural edge marking along tracks.

Ground-litter

Ground litter varies across the site the deepest in areas are around Spotted Gums that are shedding their bark. As this is a seasonal occurrence the variations in ground litter is expected to change seasonally. Some areas within the Park have over 50% ground cover which is either dominated by grasses or herbaceous plants of a mix of both. In general the south eastern corner and shaded areas along the fence closest to the creek had the highest percentage of ground cover by herbaceous plants. The western area of the reserve has a high proportion of grasses in the ground layer. Exposed areas such as along the fence line in the north and west have areas with no ground vegetation and a layer of leaves and fine twigs (in Box areas) and leaves, twigs and bark (in Spotted Gum areas).

Ground cover and logs are also discussed in the Fire Management Strategy section.

Plate 22. Eucalypt leaves and shed bark in Spotted Gum Community <5cm deep

Plate 23. Herbacious plants and grasses as ground cover

Plate 24. Fine sticks and leaves in Box Community < 5cm deep

Plate 25. Along Christie street - herbacious & grass understory (LHS) and unvegetated area of fine sticks, leaves and bark (RHS).

Plate 26. Log - habitat

Plate 27. Logs as boarder for pathway network

Plate 28. Ground cover of "Wet-Weeds" in the creekline

Plate 29. Trad under Spotted Gums in the riparian zone outside the fenced area of the park.

4.2 Flora

4.2.1 Vegetation Communities

Vegetation within the Park's Cumberland Plain Woodland (CPW). Cumberland Plain Woodland is composed of a number of communities or complexes (James 2013). Figure 12, 13 and 14 depict the distribution of the vegetation communities present on-site. Complexes reflect changes in topography, variability in depth of shale, decreasing rainfall westward and disturbance history (James 2013). Plates 32-40 depict the vegetation communities and variants.

Plant Community Types (PCT) were determined based on bio banking criteria and have been included in Table 1a. See also http://www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm for PCT types and calculation methods. Determination was via the PCT ID tool.

PCT ID: 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion. Note in this occurrrance of PCT ID 849 the dominant species is Corymbia maculata

and

PCT ID: 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion

These are the same PCTs that are mapped in Figure 11 of this report.

Figure 13 Vegetation Communities in Fairfield Indigenous Park - Source: on-site mapping as part of this study 2015

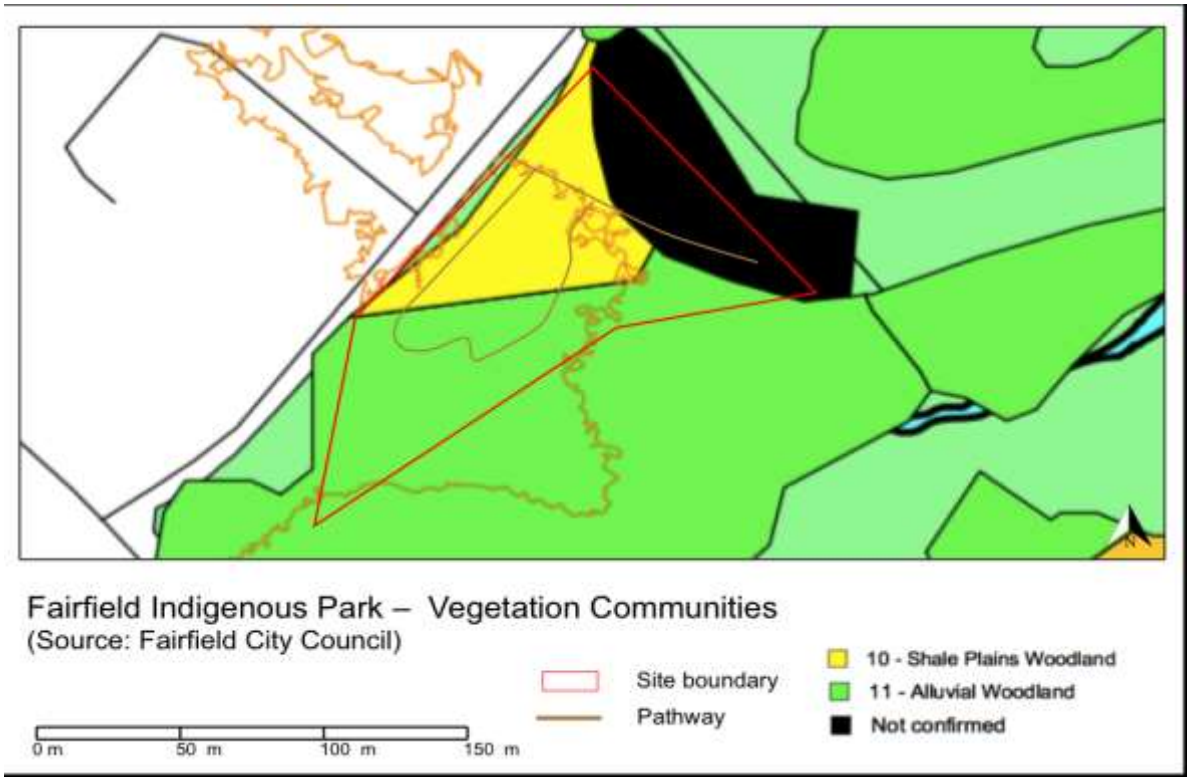


Figure 14 CPW vegetation communities. Source (extract from mapping supplied by Fairfield Council – see also Figure 12)

4.2.1.1 Spotted Gum - Grey Box Woodland/Forest

Shale Plains Woodlands is a complex of the Cumberland Plain Woodland commonly referred to as the variant **Spotted Gum - Grey Box Woodland/Forest** (SGGB) (James 2013).

Spotted Gum - Grey Box Woodland/Forest occurs at moderate to higher elevations (mostly >50m about sea level) in higher rainfall areas. The main occurrence of SGGB is in the CPW with Fairfield, Liverpool and Campbelltown LGA (James 2013) being key areas.

In the Park Spotted Gums are the dominant canopy tree, Grey Box occurs as small groups of trees throughout the Park. In general the Grey Box have a girth twice as wide as the Spotted Gums while they are of similar height. Plate 30 shows a large Grey Box on the RHS of the image and Spotted Gums in the background and through the foreground. In the mid-ground the shrub layer is denser and there is a mid-canopy of *Melaleuca decora* in locations where water pools.

Plate 30. Spotted Gum – Grey Box Woodland

4.2.1.2 River-flat Eucalypt Forest

Along the creek the vegetation grades into **River-flat Eucalypt Forest** (RFEF) also referred to as Alluvial Woodland. River-flat Eucalypt Forest is listed as an Endangered Ecological Community (EEC). Characteristic canopy species include Grey Box (*Eucalyptus moluccana)* and River Red-Gum (*E. tereticornis).* Riparian vegetation adjoining the Park has a diverse mix of canopy species including Spotted Gums, Forest Red Gum, Iron Barks, Swamp Oaks (*Casuarina glauca*) and Cabbage Gum (*Eucalyptus amplifolia).* Trees in this area are taller and generally larger than those in the Park off the alluvial soils.

Plate 31. ***Alluvial Woodland -*** *River-flat Eucalypt Forest* looking north from the playing field towards the creek

Mapping (provided by Fairfield Council) shows the vegetation community as Shale Plains Woodland and the waterway as Alluvial Woodland (see Figure 13). Land around the showground and Cooks River is classified as Castlereagh Iron Bark Forest and another patch of Shale Plains Woodland.

The area mapped is not confirmed, but thought to be Shale Plains Woodland in the northern portion grading to Alluvial Woodland in the south east. Plates 32 to 35 are examples of Shale Plains Woodland. Plate 36 is an example of Alluvial Woodland (marked as 'not confirmed' in Figure 14) and Plates 39 + 40 show the vegetation in the riparian zone along the creek and outside the fenced area. This area is clearly within the soil and vegetation type of Alluvial Woodland and into forest.

Plates 37 and 38 show Christie Street reserve, which is a seed orchard for the community nursery planting area. This seed is a supply for various sites in the local community. It is also a botanic garden educational centre that inspires residents to use locally native species in landscaping.

Additional plantings occur regularly at community events such as the annual national tree planting day. On-going maintenance is required (contract and /or community).

The following images from the site show the local variations across this small area. All photos were taken between August and December 2015.

Plate 32. Spotted Gum Community with Acacia pubescens. In Shale Plains Woodland.

Plate 33. Spotted Gum Community grasses in the understorey. In Shale Plains Woodland.

Plate 34. Grey Box In Shale Plains Woodland.

Plate 35. Spotted Gum with grassy understorey. Shale Plains Woodland area

Plate 36. Young Grey Box and Spotted Gum with grassy understorey. Alluvial Woodland Area

Plate 37. Christie Street Reserve outside the fenced area with plantings of locally native flora species

Plate 38. Plantings of native grasses in Christie Street Reserve

Plate 39. Riparian Zone – Spotted Gums on the bank - Alluvial Forest

Plate 40. Riparian Zone – Alluvial Forest - creekline with Casuarinas in background

Other canopy or sub-canopy trees growing in the Park include she oaks, iron barks and paper barks (41-43).

Plate 41. Casuarina patch – some suggest these were planted

Plate 42. Iron Bark – occasional presence in the Park more common in the Alluvial Woodland

Plate 43. Melaleuca decora

4.2.1 Vulnerable and Endangered Communities

Cumberland Plain Woodland is listed as a critically endangered community under state legislation (Threatened Species Conservation Act 1995), and federal legislation (Environment protection Biodiversity Conservation Act 1999). Based on aerial photography flown in November 1998, Tozer (2003) estimated the total extent of woody vegetation referred to as Cumberland Plain Woodland was 11 054 (±1 564) ha (upper and lower plausible bounds, sensu Keith et al. 2009), representing 8.8 (±1.2)% of the pre-European distribution. Fairfield Flora Park contains 2ha of Cumberland Plain Woodland in good condition.

Fairfield Flora Park and the nearby showground are in the area of four Threatened Communities, the first two being present in the Park. Following are their names under TSC act and the PCT as per biobanking classification.

Table 1a Plant Community Types (PCT) (see also Figure 11)

Vegetation Community TSC Act (1999)	PCT as per biobanking classification	As per T. James (2015)
Cumberland Plain Woodland, Shale	849- Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Spotted Gum – Grey Box Woodland / Forest
River-flat Eucalypt Forest	835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Alluvial Woodland

River-flat Eucalypt Forest (RFEF) is Endangered at both state & national levels. It is estimated that 10% of the original extent remains within western Sydney.

River-flat Eucalypt Forest includes two main forms - Riparian Woodland restricted to wettest areas along creek-lines and adjacent swampy areas dominated by Swamp Oak and Cabbage Gum. Groundcover with moist-loving and wetland herbs, sedges & grasses.

Alluvial Woodland occurs in a drier habitat with Cabbage Gum (*Eucalyptus amplifolia*), Forest Red Gum *(E. tereticorni),* Rough-barked Apple *(Angophora floribunda)* & the Broad-leaved Apple (*A. subvelutina)*. Exclusice to Fairfield, the Blue Box (*Eucalyptus baueriana*) is common. Smaller trees include *Melaleuca* species & the Parramatta Wattle (*Acacia parramattensis*). Understorey species include native Blackthorn (*Bursaria spinosa*) with a grassy ground layer of Microlaena (*Microlaena stipoides), Juncus usitatus, Oplismenus aemulus, Entolasia marginata & Echinopogon ovatus*. Ground flora also includes herbs such as *Plectranthus parviflorus, Alternanthera denticulata, Persicaria* spp., and *Pratia purpurascens*. Throughout the community vines and climbers can be present with common species being *Glycine* species and *Clematis glycinoides*.

Data on the extent of the vegetation community on-site relative to what is left of these variants, and how much of each variant is in protected areas is not yet known. This data should be obtained and used to complete the following table. See Plates 32-40 for examples of these EECs.

Table 1b Relative extent of the vegetation community on-site to that remaining – Data Needed

Community - variant	Ha remaining	Ha protected	Ha in FIFP
Spotted Gum – Grey Box Woodland / Forest	Research needed to complete this table and this is recommended as part of future studies.		
Alluvial Woodland also called Riverflat Eucalypt Forest Community			

A Recovery Plan has been prepared for the CPW. The Recovery Plan Actions are directly relevant to the Park and are presented in the Recommendations Section. For additional detail on communities of the CPW and RFEF see:

- New South Wales National Parks and Wildlife Service (2002) Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain, Western Sydney, Final Edition NSW NPWS, Hurstville, and the corresponding maps.
- Commonwealth Government (2010) Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest. A guide to identifying and protecting the nationally threatened ecological community Environment Protection and Biodiversity Conservation Act 1999. Policy Statement 3.31,
- Department of Environment, Climate Change and Water (NSW) (2010) Cumberland Plain Recovery Plan, Department of Environment, Climate Change and Water (NSW), Sydney.

4.2.2 Species List updated 2015

Total count

A total of 113 species of native plants were recorded in the Park in the 2015 surveys undertaken by Fairfield City Council and volunteers. A full species list has been included in Appendix III. Previous studies recorded 110 native species (ref) and 112 (ref 2012).

Non-local native species

Native species such as *Eucalyptus microcorys* (Tallow Wood) and not locally endemic Casuarina *glauca* could be thinned out to allow native ground covers to come through in some areas. The recommendation section provides advice on the proposed removals.

Young Ironbark and established Spotted Gum trees have been considered by some to be not indigenous to the site and considered for removal to allow for more groundcover.

The recommendation section provides advice on the proposed removals.

4.2.3 Threatened Plant Species

An effective BMS has actions designed to assist the over-all sustainability of a site as well as aiming to increase the likelihood of long-term survival of threatened and rare species, community, populations. Following is a summary of species growing or having the potential to grow in the Park or the RFEF adjoining. Figure 15 shows the location of significant species.

Nine species are listed on the TSC Act and / the EPBC as Vulnerable or Endangered. Of these, two are known to grow in Cumberland Plain Woodland and were observed during the 2015 surveys. Table 2 summarises these species. See Plates 44-47 for examples.

Figure 15. The location of significant species on-site (Source 2015 flora surveys).

Plate 44. Acacia pubescens - FIFP

Plate 45. Acacia pubescens in Spotted Gum Community - FIFP

Table 2 Summary of threatened plant species

Species Name	Common Name	Status - NSW	Status - Comm	Veg Comm.	Presence in Park
Acacia pubescens	**Downy Wattle**	**Vulnerable**	**Vulnerable**	**CPW**	**Growing in the Park with about 40 stems NB: colonial in nature**
Cynanchum elegans		Endangered	Endangered	RFEF	Potential to occur along creek
Hibbertia puberula subsp. glabrescens		Critically Endangered		CPW	Potential to occur
Marsdenia viridiflora subsp. *viridiflora*	Native Pear	Endangered Population		various	Fairfield Showground at one site. This site yet to be added to the End Population listing.
Pimelea spicata	Spiked Riceflower	Endangered	Endangered	CPW	Potential to occur
Pomaderris prunifolia	Plum-leaf Pomaderris	Endangered Population		various	Fairfield Showground at one site. This site yet to be added to the Endangered Population listing.
Pultenaea pedunculata	Matted Bush-pea	Endangered		CCIF	Potential to occur

4.2.4 Rare Plant Species

An effective BMS has actions designed to assist the over-all sustainability of a site as well as aiming to increase the likelihood of long-term survival of threatened and rare species, community, populations. The plants listed in Table 3 are not listed legislatively as threatened, however are seen as rare to the locality and urban areas of Sydney in general. Actions could be taken to maximize cross-pollination of rare species in Fairfield Indigenous Park. Facilitated seed collection, germination and planting in appropriate areas along with maximising opportunities for natural regeneration to lead to successful establishment.

Table 3 Rare Plants in Fairfield Indigenous Flora Park (FIFP)

Species Name	Common Name/Image	Veg Comm.	Conservn Status	Considerations
Boronia polygalifolia	 Milk Wort Photo from site (MDB).	CPW	Locally rare	Growing on-site ~ 2 plants seen. Only known occurrence in Fairfield.
Leucopogon juniperinus	 Spiny Leucopogon. Photo from site (MDB).	CPW	Locally rare	Growing on-site. Four plants sighted. Significant in the area.
Marsilea hirsute	 Nardoo Photo from site (MDB).	CPW	Locally rare	Growing on site in damp patch ~ 10 x 4 m – many plants. NB colonial in nature
Parsonsia straminea		CPW	Locally rare	Growing on site. Another known location is Bossley Park Fairfield. This plant was poisoned by contractors at one point, but recovered. Pers Comms. Community Volunteers

Species Name	Common Name/Image	Veg Comm.	Conservn Status	Considerations
Persoonia linearis	 Geebung. Photo from site (MDB).	CPW	Locally rare	Growing on site – 1 plant seen. Significant in the area. Possibly only one in the area.
Drosera sp	Sun Dew 	CPW	Locally rare	Sighted ~2013 by community volunteers near the dip where the Nardoo grows.
Eucalyptus baueriana	Blue Box	RFEF	Rare	Growing in Fairfield Park and the lower parts of Prospect Creek
Eucalyptus bosistoana	Bosisto's Box	RFEF	Rare	Growing in Fairfield Park usual habitat creek flats and floodplains.
Hybanthus stellarioides	Spade Flower 	CPW	Rare	Growing in Powers road reserve just on the other side of the golf course, in open grassland (pers Comms Helen Pollard) near FIFP.
Senna barronfieldii Synonym: *Senna odorata.* 	 Photo: Lyne, A	RFEF	Rare	Growing in the Showgrounds. It's a Sprawling shrub to 2.5 m high.

Species Name	Common Name/Image	Veg Comm.	Conservn Status	Considerations
Pandorea pandorana	Snake Vine 	CPW and RFEF	Locally Rare	One vine – rare in Fairfield (only 2 others locations in the LGA)
Allocasuarina littoralis	Black She-Oak  Photo from site (MDB).	various	Common in Sydney Locally rare	One specimen on-site (female). Scarce in Fairfield council.
Pomax umbellata	Pomax  Photo from site (MDB).	various	Common in Sydney Locally rare Locally rare	Uncommon in the Fairfield area.

4.3 Vegetation Condition

Bushland condition varies from excellent to poor within the park. The Fairfield Indigenous Park remnant has all strata present with canopy trees, mid-canopy, shrub layer and understory vegetation of both grasses and herbaceous species.

Weed species are most common along the edges with the greatest weed incursions being along the creek and to a lesser extent along the boundary with the Golf Club property to the east. Weeds consist of exotic grasses, particularly *Ehrharta erecta* and annual weeds.

Condition categorisation used is as per the National Trust guidelines. The CPW Recovery Plan (2010) also has definitions for condition and under this plan the condition in the park is good and along the creek poor. See Figure 16 for the distribution of condition.

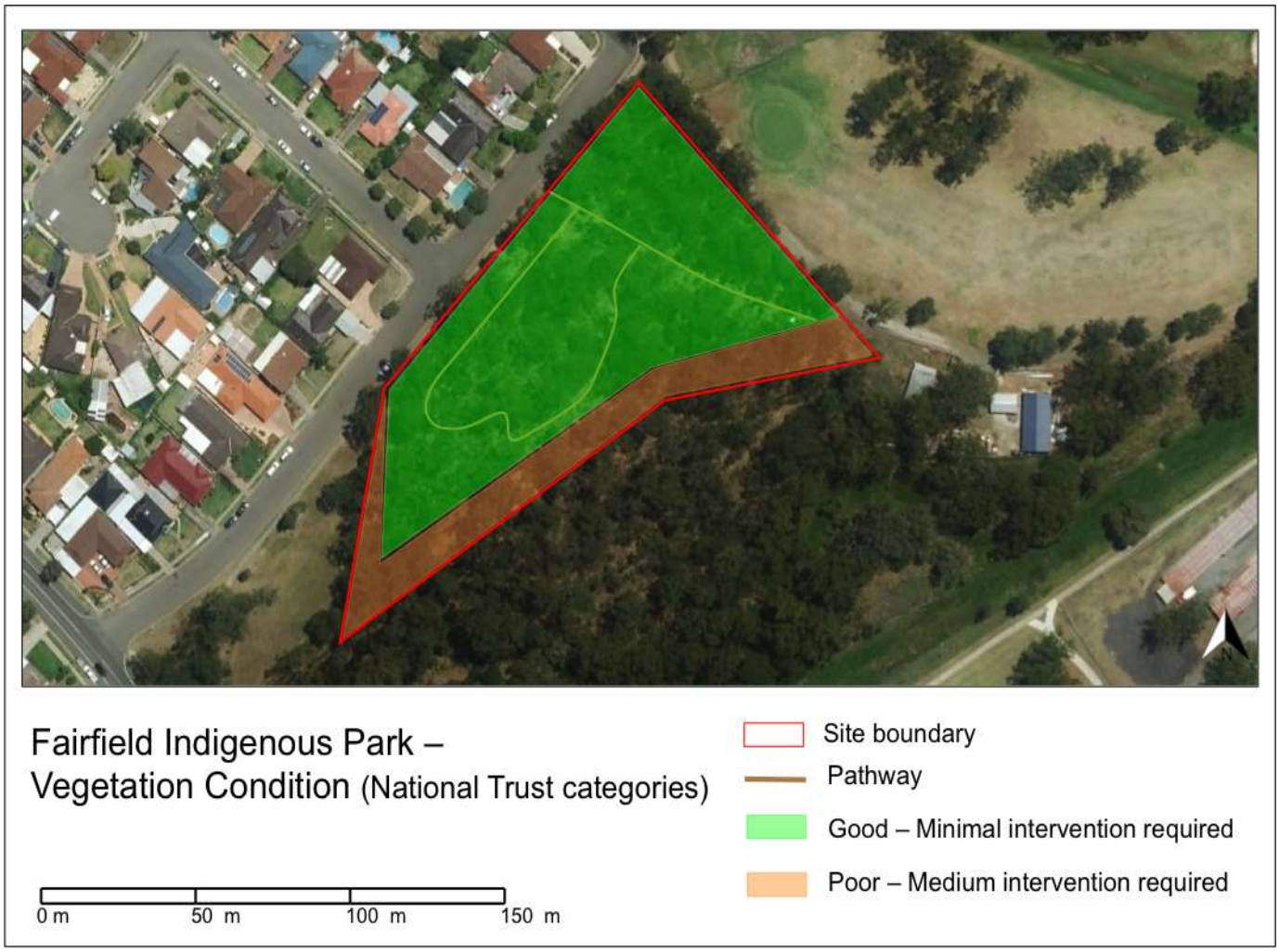


Figure 16 Vegetation condition mapping the park – based on October 2015 survey

4.4 Fauna and Habitat

Much is written about the decline in native fauna in CPW and associated EECs. Results of surveys are provided below.

Native Mammals –There were no signs of ground or arboreal mammals. It is possible that Brush-tail possums could utilise parts of the park. With an increase in mid-story and low canopy habitat the park could become more suitable for Ring-tail possums. No native ground mammals were observed. While habitat is present the potential impacts from foxes and cats greatly reduces the habitat quality. No mammals were observed in the habitat boxes inspected (x4) – other boxes in the higher canopy were not inspected.

Flying mammals: Micro-bats and Flying Foxes were observed on-site. Over 85 individual calls were recorded over two evening events each of 40min duration. Species identified are provided below. Micro-bats were most abundant flying along the forest edge in open sky next to trees at a height just below the tree canopy.

Grey-headed Flying Foxes were observed flying over the site. None were recorded in the site. Spotted Gums are a known food source for GGFF. When Spotted Gums are flowering GHFF are likely to feed on their nectar and pollen, however no flowering event occurred during the survey period.

2015/2016 Mixed locations			
Bat Species	17/11/2015	18/11/2015	04/12/2015
	No Bat Calls		
Chalinolobus gouldi (Goulds Wattle Bat)			Def
Chalinolobus morio (Chocolate Wattle Bat)			Pos
Cahlinolobus gouldi or Mormopterus species (Free-tail Bat)		Either (2)	Either
Nyctophilus geoffroyi or N. gouldi (long-eared bats)			Pos
Total Files	1	50	114

(Analysed by Narawan Williams)

Key : **Def**= definite **Prob** = Probable (over 60%) **Pos**= Possible (between 20 and 60%) **#,*,@,&** = used to highlight species with similar calls

It appeared micro-bats were most abundant flying along the forest edge in open sky next to trees at a height just below the tree canopy.

Three Grey-headed Flying Foxes were observed flying over the site. None were recorded in the site. Spotted Gums can be a major food tree for GGFF. When Spotted Gums are flowering GHFF are likely to feed from the flowering nectar.

Native Birds: A bird list is included in Appendix 5. A previous survey carried out by the local bushcare group (2012) recorded 25 species of native birds. This survey has not been seen so no comparisons were made to types of species. In the survey Noisy Minors dominated the avifauna. In addition to the Minors large birds were seen on-site including: Sulfur Crested Cockatoos, Currawongs, Kookaburras and a Butcher Bird. No wrens were observed however Superb Fairy Wrens were heard in along the creek adjoining the Park.

A Tawny Frogmouth was reportedly seen in the Park in 2015.

Habitat is present for woodland birds and wrens however the presence of Noisy Minors reduces the opportunities for these birds to live in the Park (per comm speakers and the 2016 Australia Bird Annual Conference).

Bird dynamics (species and abundance) are important for vegetation management as birds are involved with pollination and seed dispersal as well as influencing the dynamics of invertebrates that can damage trees. Psyllids, sap-sucking insects, can damage trees and contribute to die-back. Grey Box has been greatly damaged by psyllids in other parts of Western Sydney. While some birds eat the Psyllids others just eat their waxy or sugary casing. Minor Birds, particularly Bell Minors, eat the casing and not the insect. These species also exclude other birds that would eat the insect.

Reptiles: Skinks are abundant in the park. The most common is the Common Garden Skink while there are also Water Skinks. Snakes are expected to be on-site although none were seen. Community groups have reported seeing Long-necked Tortoises in the park and the creek-line. None reported in the past 4 years.

Frogs: Two species of frogs were heard during the 2015 survey. Striped Marsh Frog and Common Eastern Froglet. Approximately 20 Marsh Frogs and 10 Common Eastern Toadlets were heard during and after light rain. Around 5 Marsh Frogs were heard at other times along the creek-line. Bushcare groups report having seen tadpoles in the pools with the Park after rain.

Invertebrates: Invertebrates were recorded if seen. Records were made to the level of Class such as spiders, butterflies and moths, ants etc.

Specific searches were made for **snails,** both native and exotic. None were observed. The threatened **Cumberland Plain Land Snail has been previously recorded** in the park and is likely to remain in areas near clumping grasses and damp ground debris.

Four different butterfly species, that were not identified, were observed on-site. They were commonly on flowering native shrubs. Some invertebrates observed are in Plates 13 to 21.

5. Pest, Pathogens and Diseases

Small and fragmented remnants have reduced resilience to changes in environmental conditions an effects from pathogens and predatory or parasitic fauna.

5.1 Plant Pathogens

Plant pathogens include the Myrtle Rust and Phytophthora (a fungus). It is crucial that equipment and foot wear is adequately treated prior to entering the reserve. This is of extra high importance from bush regenerators who are likely to work in a variety of sites throughout Sydney including these known to have these pathogens. The currently system of spraying shoes with methylated spirits stored on-site is a good practice that must be continually supported.

5.2 Problem Fauna

The term problem fauna is used to loosely cover fauna that can reduce the resilience, diversity and or health of the vegetation community and its associated ecological functions. As such problem fauna can be native or introduced. While this BMS provides a brief note on the problem fauna and includes recommendations in the Action Table more information is available in other literature. Studies include those on birds of CPW including the impacts of Bell Minors and Noisy Minors on Woodland Birds and the corresponding declining vegetation health with the absence of certain Woodland Birds.

5.2.1 Native Fauna

Native fauna that can reduce vegetation resilience, diversity and abundance include:

- Noisy Minor Birds
- Bell Minors
- Others - “Butchers and Bully Birds”
- Lerps - Psyllids

Of these only Noisy Minor Birds were obvious on-site. Should Bell Minors set up colony they should be immediately removed

5.2.2 Non-Native

Non-native fauna that impact the reserve are cats and foxes. With these species present there will not be sustainable ground mammal or bird populations. It is recommended that the fencing be strengthened and gaps filled. Following this foxes and cats should be removed from the Park. Most native animals requiring access through the fence can still move through fox and cat proof materials.

Rats eat bird eggs and young birds and should be removed and excluded from the park. Vigilance is required for possible future fauna pests such as Fire Ants.

6. Fire Management Strategy

A fire management strategy has been developed for the Park. It is based upon:

- the reported recommended fire intervals and other conditions for vegetation communities recorded on-site. Additionally, the recommended fire intervals for individual species such as Downy Wattle and Juniper-leaved Grevillea are identified.
- the recommendations relating to burning in the CPW Recovery Plan
- the on-site assessments of fuels and
- known fauna on-site and their habitat requirements.
- Also the unsuccessful burn approximately 11 years ago (pers comms Fairfield Council)

Plate 46. Spotted Gums shedding bark

6.1 Known Fire Requirements of Specific Vegetation Communities and Species

Table 6 summarises the key species being managed in relation to fire. While careful consideration has been written for these species the recommended approach of a small area and mosaic burn is expected to be of advantage of a range of native species both rare and common.

6.1.1 Cumberland Plain Woodland

Fire alters the species composition and structure of Cumberland Plain Woodland (Benson & Howell 2002).

'High frequency fire resulting in disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is also listed as one of the Key Threatening Processes affecting Cumberland Plain Woodland under the Threatened Species Conservation Act 1995. High frequency fire regimes (1-2 years) in Cumberland Plain Woodland have been shown to cause a gradual decline in shrub species (Thomas, 1994).

It has also been shown that if the interval between fires is too long, the species diversity will also decrease. Low frequency fires can lead to increased dominance of shrubs such as Bursaria spinosa and declines in the diversity in the ground layer of grasses and herbs (Watson 2005)

The Cumberland Plain Recovery Plan written by the Department of Environment, Climate Change and Water (NSW) recommends that Cumberland Plain Woodland have a minimum fire interval of 5 years and a maximum fire interval of 12 years. The fire intensity and season of burn between each interval should be varied to ensure the greatest species diversity post fire (DECCW 2010).

6.1.1.1 Trees and Fire

Fire intensity has been shown to both aid in the development of hollows in trees as well as damage trees, particularly the older larger ones with many hollows. Older trees may become too brittle and as such they fall. Trees with and diameter under 20mm and over 80cm will have the built up fine fuels scrapes back from the trunk to a distance of approximately 1m. This will protect the trees at both stages of the life cycle (small and large).

6.1.2 The Downy Wattle (*Acacia pubescens*)

Inappropriate fire regimes are one of the threats facing threatened species and communities in western Sydney. 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is one of the Key Threatening Processes listed for *Acacia pubescens* in the New South Wales Threatened Species Conservation Act 1995.

The frequency of fire is an important factor to consider. If fires are too frequent an adequate seed bank for the species will not have time to develop, this may lead to declines in populations (NSW NPWS 2003).

Late summer and autumn are the preferable times for fire as seedlings are most likely to be able to gain the soil moisture they need to develop (Auld 1996). Seeds are released from October to December and so a fire in the late summer or autumn would also foster the germination and growth of this fresh seed crop (NSW NPWS 2003).

Fire intensity also affects the germination of many Australian plant species. For example, fire of sufficient intensity is required to stimulate the germination of Acacia seeds in the seed bank (Auld 1996). Conversely, a high intensity fire can kill young plants and result in the population requiring a longer fire interval in order to recover (NSW NPWS 2003).

Research has not been conducted on the optimal fire intensity for *Acacia pubescens* however it has been researched for similar species. For *Acacia suaveolons* the optimal fire temperature is between 60°C and 80°C for any duration and up to 100°C for durations less than one hour (Auld 1986). A fire-free period between 5-7 years is recommended for this species to replenish the soil seed bank (Thomas 1994).

6.1.3 *Fire and uncommon plants - Leucopogon juniperinus*.

Fire frequency, intensity and season influence what seeds germinate and the long-term success of germination (Dr Mark Ooi UNSW per comms June 2016 and research papers (Ooi 2007). Burn planning needs to take into account not only listed species but other rare species. Following are notes on *Leucopogon juniperinus,* such information should be sought for each rare species and used in determining a site wide burn plan over 20 years.

When this species is killed by fire, its population regenerates solely from soil-stored seed. Fire leads to a sudden increase in the recruitment of seedlings. Germination experiments show that germination rates are improved by exposure to both smoke and heat. The frequency of fire an important factor. If fires are too frequent there is insufficient time to build up seed in the soil to replace plants killed in the fire.

Physical disturbance of the soil appears to result in an increase in seedling recruitment. The recommended fire interval for this species is every 10-15 yrs. It is noted that fire season (summer, winter etc) can play a key role in:

i) when seedlings germinate and

ii) the success of seedlings over coming years

For more information see current research by Dr Mark Ooi and others whoes seed ecology studies are focused on figuring out how dormancy and germination drive plant dynamics and how this is interwoven with the themes of disturbance regimes (fire) and global change biology. Please refer to www.markooi.com for full publication list.

6.2 Fauna and Fire

6.2.1 Cumberland Plain Land Snail (*Meridolum corneovirens*)

High fire frequency is listed as a key threatening process for the Cumberland Plain Land Snail under the New South Wales Threatened Species Conservation Act 1995. If too frequent, fire can result in lifecycle disruption of flora/fauna as well as the loss of vegetation structure and composition.

The Cumberland Plain Land snail lives on the ground under leaf litter and bark and amongst loose soil. Fires at inappropriate times, or too frequently, will destroy the species habitat, and can kill individuals directly by burning the groundcover in which they may be sheltering.

Fine-scale mosaic burns can be used to reduce the loss of individuals in a burn and the amount of cover lost (OEH 2015). A fire of low intensity will also reduce the damage done to large woody debris, a common habitat for the snail.

Burns should be conducted no more than every 5 years in the same location and should be conducted in the dry season, as snails may be laying dormant underground and this increases their chance of survival (OEH 2015).

6.2.2 Micro-bats

Protection from fire for tree and bark roosting species will be created by have exclusion zones around large trees, particularly those with hollows and large sections of flakey bark.

Table 6. A summary of the key species being managed in relation to fire

Species Name	Common Name	Status - NSW	In Broad Burn area	In Thermal Weed area	Exclusion Zone	Presence in Park	Fire Management
FLORA							
Acacia pubescens	Downy Wattle	Vulnerable	possibly	yes	At least ½ patch to be excluded 4m	Growing in the Park with about 40 stems NB: colonial in nature	See species specific information
Allocasuarina littoralis	Black She-Oak		possibly	no	4m exclusion		
Boronia polygalifolia			no	no	4m exclusion	Growing on-site ~ 2 plants seen	
Cynanchum elegans		Endangered	no	yes		Potential to occur along creek	
Eucalyptus baueriana	Blue Box	Rare	no	no	no	Grows along creek	
Eucalyptus bosistoana	Bosisto's Box	Rare	no	no	no	Along creek lines	
Hibbertia puberula subsp. glabrescens		Critically Endangered	unknown	unknown	4m exclusion	Potential to occur. Only found in Bankstown to date on sandy tertiary	If present do not burn – seek advice. No written info. On fire tolerance.

Species Name	Common Name	Status - NSW	In Broad Burn area	In Thermal Weed area	Exclusion Zone	Presence in Park	Fire Management
						alluvium with high silt content.	
Hybanthus stellarioides	Spade Flower	Rare	unknown	unknown	4m exclusion	Potential to occur	Response of adult plants is to resprouter from the basal area (Williams 2005). Recommendation to use fire in moderation.
Leucopogon juniperinus		Uncommon	One in and others out	yes	1m exclusion	Growing on site 4 plants sighted	Killed by fire regenerates from soil-stored seed. Germination experiments show that germination rates are improved by exposure to both smoke and heat. Need to know optimum season to burn. Likely to be in the hotter months.
Marsilea hirsute	Nardoo	Uncommon	possibly	no	4m exclusion from top of the bank of the 'dip' ponding area	Potential to occur	Exclude from burns with exclusion area of fine fuel removal. If thermal weeding then avid area.
Parsonsia straminea		Uncommon	possibly	no	4m	Growing on site	Exclude from burns. Make exclusion area by removing fine fuels. If thermal

Species Name	Common Name	Status - NSW	In Broad Burn area	In Thermal Weed area	Exclusion Zone	Presence in Park	Fire Management
							weeding then keep back at least 3m.
Persoonia linearis	Gee Bung	Uncommon	no	no	4m exclusion	Growing on site – 1 plant seen	Fire can stimulate seed germination. Do not burn when flowering.
Pimelea spicata	Spiked Riceflower	Endangered	unknown	unknown	1m exclusion.	Potential to occur	Fire can stimulate seed germination. Do not burn when flowering.
Pomaderris prunifolia	Plum-leaf Pomaderris	Endangered Population	unknown	unknown	unknown	No	Fairfield Showground at one site. This site yet to be added to the End Population listing.
Pterostylis saxicola	Sydney Plains Greenhood		no	yes	1m exclusion.	Possibly in the south east portion of the site.	Fire can stimulate regeneration. Do not burn flowering orchids – burn before or after flowering.
Pultenaea pedunculata	Matted Bush-pea	Endangered	unknown	unknown	4m exclusion	Potential to occur	
Mosses and Fungi							
Mosses			no	yes	2m exclusion	Yes.	Keep fire from directly burning the small concentrated clumps of moss. Moss provides habitat fungi which have important ecosystem roles.
Fungi			yes	yes	no	Yes	Burns to be mixed temperature so as

Species Name	Common Name	Status - NSW	In Broad Burn area	In Thermal Weed area	Exclusion Zone	Presence in Park	Fire Management
							not to kill large areas of fungal hyphae
FAUNA							
Meridolum corneovirens	*Cumberland Plain Land Snail*	Endangered	unknown	unknown	4m exclusion	Potential to occur	See species specific information including burning the drier times and excluding refuge habitat like ligs.
	Southern Carnivorous Snail	Rare	unknown	unknown	4m exclusion	Potential to occur	As for *M. corneovirens*
	Micro-bats general	Common to Threatened	unknown	unknown	4m exclusion	Seemingly from trees along the creek.	Create exclusion area around trees possibly used by mico-bats for roosting.
	Fogs – various species	Common	unlikely	unknown	unknown	Along creek-line and riparian zone	Thermal weeding along the creek-line will be in frog habitat. Care to be taken to disturb area and 'move frogs on' prior to works plus work slowly towards the water so frogs can escape to water and cover.
	Skinks	Common	yes	yes	no	Skinks common	Work slowly towards areas not to be burnt so skinks can move out of flame areas.

7. Recommendations

The recommendation section should be read in conjunction with the Action Summary Table and Map which follow this section.

Recommendations in this BMS are consistent with categorisation of the land and the recommendations in the CPW recovery plan (2010).

Recommendations were built on the 2001 Plan of Management for the Indigenous Flora Park that states*:*

"The Indigenous Flora Park will continue to be used as an area set aside as a bushland reserve. Future opportunities that have been identified include but are not limited to:

- *Improvements to the paths and fencing (in particular to the aesthetics)*
- *Enhanced interpretation, signage and promotion for the reserve.*
- *Improved linkages with other areas of open space.*
- *Improved facilities for Christie Street Reserve (possibly including litter bins)."*

Each of these points has been included in the recommendations.

7.1 Community Engagement

The local community plays an important role in protecting and enhancing these areas through active involvement with local environmental groups including the Fairfield Indigenous Flora Park bushcare group, Fairfield Creeks and Wetlands Group and Fairfield Community Nursery Volunteers.

Fairfield City Council's Natural Resources Program aims to ensure the cities natural areas can be enjoyed by present and future generations.

7.2 Ecological Management

Long-term sustainability of the vegetation is directly linked with healthy functioning of the ecosystem. This includes the interactions and interrelations of the following:

- Water: Slight depressions topography of the park can also hold temporary pools of water. These pools are essential for the lifecycle completion of many different species. Ensure these depressions are maintained (not filled).
- Soil: On-site surveys have indicated that the soil has a high clay influence. Mapping shows soils are mostly derived from Wianamatta Shales (Blacktown, Luddenham and Picton soil landscapes) and the floodplains and valley flats from Quaternary alluvium. If vegetation is cleared, this soil is easily erodible. Therefore, it is recommended that additional plants be carried out in areas where deep rooted vegetation is absent.
- Fire: A fire strategy has been developed for the park according the types found on site. This plan should be followed to ensure the vegetation doesn't decline in quality.
- Pollinators and dispersal agents: Planting should be carried out outside of park with a focus on pollinators. This will allow pollinators to go through their whole lifecycle. Flying fox populations

should be encouraged in the park as they are a major long distance pollinator that could allow for the maintenance of genetic diversity of plants in the reserve

- Dead Trees: Dead trees should remain in the reserve as they are important habitat for a variety of fauna species. If a standing dead tree with hollows is in an area in which it is not a hazard to the public, its limbs can be trimmed and left to serve as a nesting area.
- Pest, Pathogens and Diseases
    - Myrtle Rust and Phytophthora: If entering highly vegetated areas of the park, methylated spirits should be sprayed on the underside of shoes. Observational examination of park should be carried out regularly to detect these pathogens in their early stages
    - Cats, Foxes: Maintain fox and feral cat removal programs within the local area.

7.3 Limiting Weed Incursions

The main weeds present in the park are grasses and vines. Weeds primarily occur along the boundary of the Golf Course dwelling and land and Orphan School Creek.

Recommendations for minimizing weeds in the reserve:

- Silt Fence
- Thermal Weeding
- Planting
- Frequent sweeps for bird-spread weeds in the Park particularly: African Olive, Lantana, and Asparagus Fern species.

Golf Course and Creek-line: Installation of a silt fence and shade cloth along the boundary with golf course dwelling and along the fence parallel to Orphan School Creek is recommended. Silt fencing could minimise propagule invasion/establishment and is low enough to inhibit roots growing under it. Silt fencing near the creek should have gaps to enable frogs and possibly tortoises, to move in and out of the park. See Figure 15 for proposed installation of silt and shade cloth.

Thermal weeding is recommended within the golf course, at least 4 m from the fence adjoining the Park. Once flame weeded, this area should be monitored for the regeneration of locally native plant species. If no native regeneration occurs, the installation of garden edging and the silt fence is recommended. A dense row of Lomandra (or an equivalent locally native species) one metre back from the fence, on both sides. Use the 1m clearing on each side to routinely manage either with thermal weeder or with herbicide. This dense row of Lomandra will act as a buffer against weed propagule invasion.

This technique can be applied along the boundary of the creek as well.

Wide scale planting is not recommended for the Fairfield Indigenous Flora Park. It has a relatively high level of resilience and therefore, by removing threats, the condition of the site is expected to improve on its own. The only planting recommended is the buffer planting on the edges of the reserve. For example: planting along the northern boundary fence to provide shading and protection to the park edge.

Possible re-introductions or 'human aided' pollination should be considered for the following species that have limited numbers in the Park.

- *Persoonia linearis* – (one known specimen). Significant in the area. Possibly only one in the area.
- *Leucopogon juniperinus* (one known specimen) – rare in Fairfield local area.
- *Boronia polygalifolia* – only known occurrence in Fairfield.
- *Pomax umbellata* – uncommon in the Fairfield area.
- *Allocasuarina littoralis* (one known specimen) – scarce in Fairfield council. Only one on the site. Female plant.
- *Pandorea pandorana (one known vine)* –uncommon in Fairfield – two known locations.
- *Drosera* sp. has been sighted in around 2013.
- *Parsonsia straminea* – rare in area.
- *Marsilea hirsuta* located in the sink.
- *Acacia pubescens* hybridizes readily with Cootamundra wattle, *A. parramatensis* and *Acacia decurrens.*

7.4 Fauna

Recommendations for specific fauna management are brief as the focus in on retaining and improving habitat and therefore benefiting fauna. Recommendations have been included in the Summary Table for specific species. General recommendations for problem species are summarised below.

7.4.1 Fauna Pest Management Strategies

- Community engagement and education to reduce the prevalence of cats
- Improved fencing can be used to exclude pest fauna from the site
- Habitat modifications to reduce Minor (Noisy and Bell) suitability
- Participate in regional Fox management / monitoring. Gassing of dens within the site has not been found to be effective as dens are re-colonised by foxes living up and down the creekline reserves. More regionally inclusive gassing program needed.
- Potential for inclusion of rat control in the management of Cumberland Land Snail.

7.5 Community and Social

- Work with Durag people to provide respect for the connection to place and gain a better understanding of answers to management questions around die-back, flooding, orchids, food plants etc based on longer histories of observation. Create opportunities for First Peoples to share their stories.
- Consider furthering the access track for disabled individuals.

7.6 Christies Reserve

- A botanical style garden has been created in Christie Street Reserve. This area is currently used as a seed garden for the community nursery. There are further opportunities for this area to enhance the populations of rare plants in Fairfield and act as a possible cross-pollination site for the Indigenous Flora Park.

7.7 Fire

Areas to burn, burn season and intensity have been based upon the vegetation type and specific species present. While it is impractical to have well controlled small fires in a mosaic in this small area it is possible to use a combination of techniques to actual burn or simulate a burn. These include: actual burns, patch burns with thermal weeder and simulated burn with mechanical disturbance and smoke water.

The flame-weeder can be used in rainy (low-fire hazard) conditions during summer. Hence small burns can be conducted in the hotter months. Devices for measuring soil heat (fire-buttons) can be placed in the soil at varying depths before small patch burns with the thermal weeder. Soil temperature can be recorded and compared with germination and establishment success. Adaptive management can then occur with future burns (with the thermal weeder) being hotter or cooler.

Areas listed below and plants species considered were also suggested through long-term park users/carers:

- Front, road-side, open area is a possible burn site. There has previously been *Acacia falcata* and *Indegophora australis*, which could grow. A burn could assist in the germination of *Brunoniella* sp.
- Possible burn in the orchid area – need to be in the right season (hotter months). See map for Orchid location.
- Possibly burn in some of the more weedy area towards the fence where there is *Tradescantia* amongst a good diversity of ground cover. This would encourage *Pseuderanthemum variabile* and *Arthropodium milliflorum*.

7.7.1 Broad Area Burn

Figure 17 shows areas suitable for a broad area burn as well areas for thermal burning (red). The broad acre burn should occur as soon as possible. Three areas are proposed and these could be conducted simultaneously or at different times during the year.

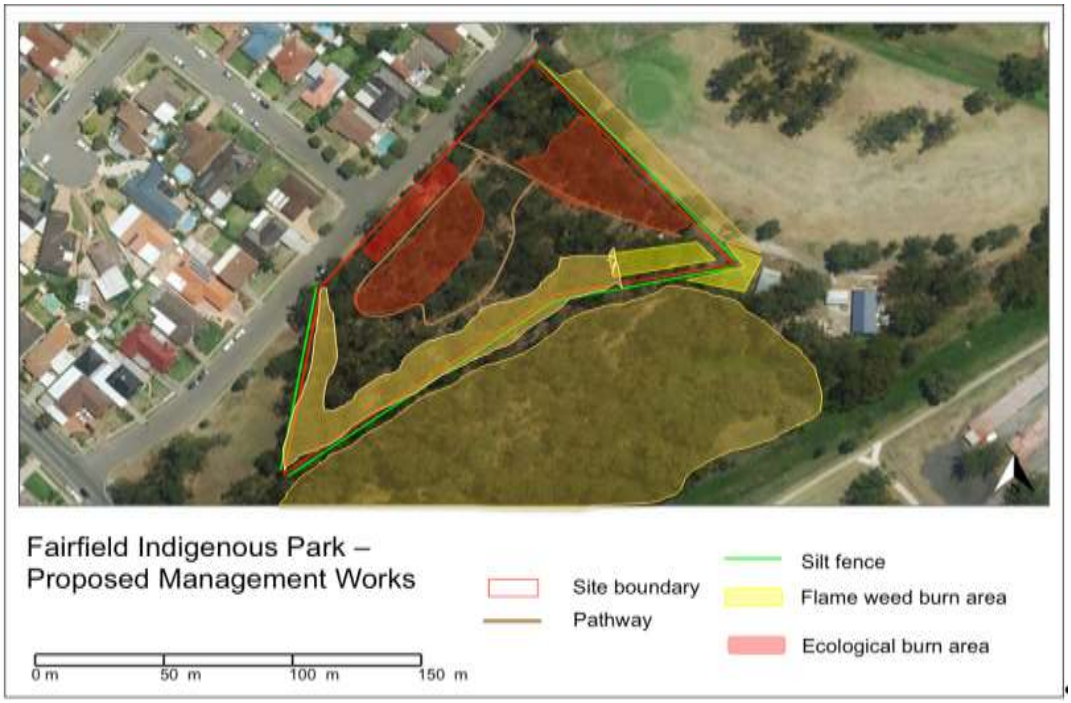


Figure 17. The areas recommended for burning within the park.

A broad area burn would be carried out by Fire Brigades Unit after ecological experts / Bushregenerators have prepared the site and put in the exclusion areas around plants and habitats as per the recommendations set in Table 7 and recommendations for specific species.

A broad area burn should be hot and fast in most areas and with low-intensity burns around larger logs (snail habitat).

7.7.2 Thermal Weeder Ecological Burns

Flame weeding has been shown to stimulate the germination of seeds form plants that have not been seen in some areas of Western Sydney for 10 year before the thermal weeding occurred. Thermal weeders can be used to provide low or high intensity burns based on the duration the heat is held at the location. This altering of fire intensity is recommended as different species respond differently to different fire intensity and durations.

Thermal weeding burns can be carried out in small areas with a practical burn area being 5m x 10m to 20m x 20m. Figure 17 shows areas recommended for thermal weeding (yellow). While large areas are shown, the aim would be to undertake thermal weeding in a mosaic way with not more than 20% of the yellow area being burnt in any one event and for the gaps between events being long enough for vegetation in the burnt to have grown back prior to burning another 20% of the yellow area.

The highest priority area for thermal weeding is along the eastern fencing line shared with the golf superintendent's property. The area on the golf course land could be burnt with high intensity, killing the exotic grass and annual weed plants and seeds. Following this, the area on the inside of the fence can be burnt and then the sediment fence and shade cloth can be erected along this boundary to minimise future weed entering form the golf course property.

Thermal weeding is recommended for areas with plants that require exclusion zones. Thermal weeding can be stopped at the desired exclusion zone edge. Appendix VI shows examples of the ecological uses of the thermal (flame) weeder.

8. Monitoring

Adaptive management will be required to effectively manage the FIFP. The following areas are recommended for monitoring:

- The response of flora and fauna to the fire (broad area and thermal weeder burns). Outcomes will influence future burns particularly those around listed species.
- Monitoring can include native plants and weed cover and diversity, particularly in areas that are currently dominated by weeds such as the adjoining creek. This will allow for the observation of the difference post burns and follow up bush regeneration.
- Monitor for the presence of pollinators such as native bees.
- Monitor for the presence of fungi and note species. Monitor fungi hyphae in soil (as discussed in this plan)
- Monitor invertebrate responses to burns (broad and thermal weeding) through leaf little sampling and possibly pit-fall traps.
- Monitor the seed set and germination of uncommon plants and assist with plant establishment as required to assist population become viable. Work with groups already undertaking this e.g. Dr Mark Ooi (see reference list for contact details).
- Continue to provide support for public care groups caring for and managing the park.
- Conduct bird surveys and remove, where possible, Bell Miner birds should they establish in the reserve.
- Monitor the effectiveness of bush regeneration and continue to improved bush regeneration outcomes.

9. Summary Action Map – Master Plan

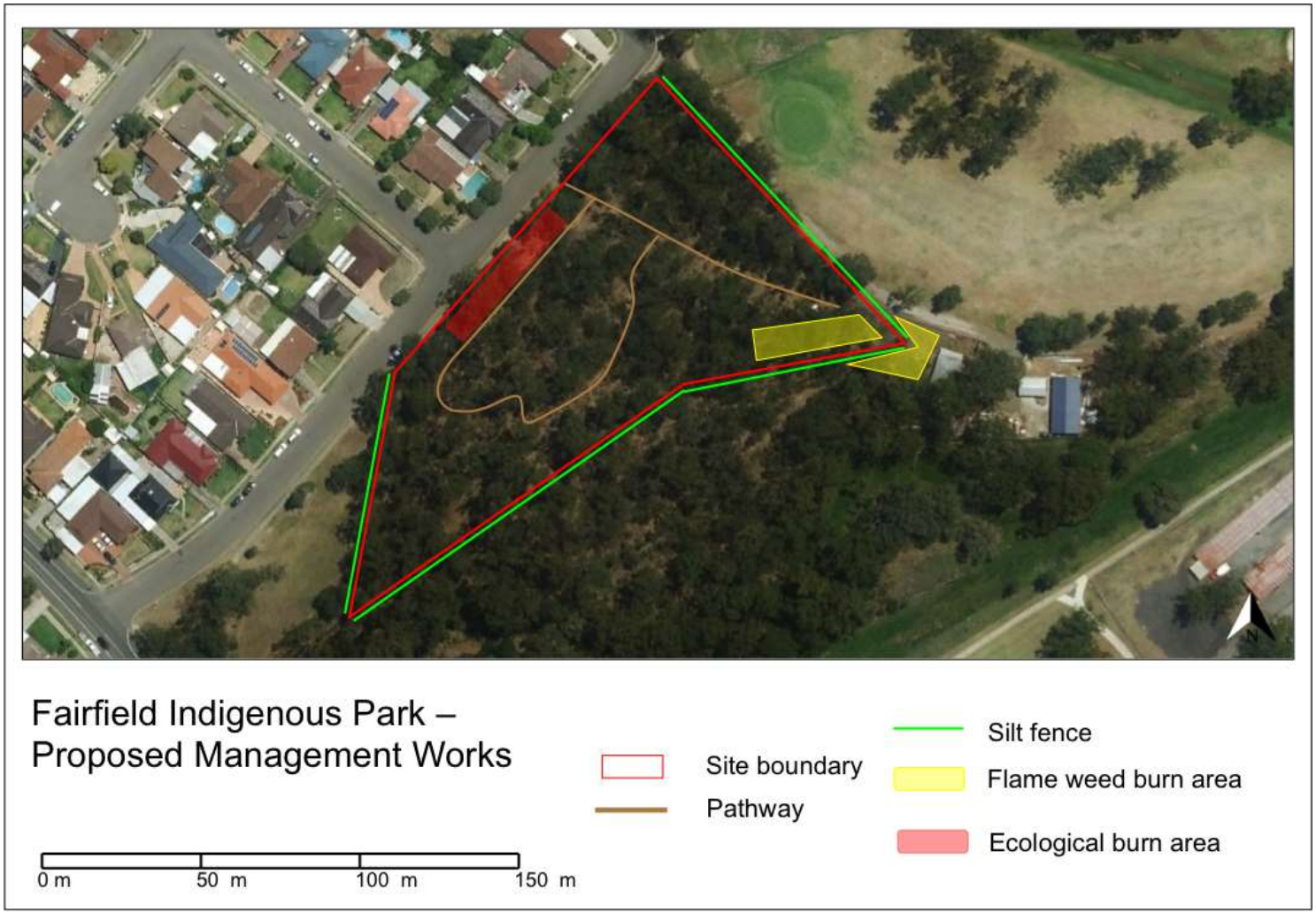


Figure 18 Proposed Management Works within the park.

Figure 18 shows the proposed physical works within the park.

See Figure 17 for detail fire proposal.

Figure 18 shows minimum amount of area to be burnt. This should be carried out as soon as practical.

It also shows:

- Silt fencing (green)
- Thermal (flame) weeding (yellow)
- Ecological burns – broad area (red)
- Fixing fencing to be fox proof (red)
- Collect and propagate seed of uncommon species (throughout).

10. Summary Action Table

The summary table includes actions over the next 15 years. Priority 1 is the highest priority then 2 and 3. Timing most actions here are for the period 1-4 years however some are longer-term and other are on-going. The 'Time' column indicates when the action should be taken that is in the first 4 years or 5-10 or 10-15yrs. It is noted that earlier action for most actions is desirable however some are on-going or repeat.

#	Action	Priority	Time*	Responsibility	Reference
	General Park Ecological Management				
1	Install silt fencing and shade cloth along the boundaries of the golf course and Creek.	1	1	FCC Community	Map area 1 and 2 and Report
2	Maintain fencing to make the Park cat and fox proof. Allow Lizards, Frogs, Birds and invertebrates passage through the fencing.	3	1	FCC	
3	Maintain necessary (NPWS) permit for working in and burning in EECs and with Threatened Species particularly *A. pubescens.*	1	1	FCC	Report
	Fire Strategy				
4	Trial, monitor and continue Thermal (flame) Weeding / small area ecological burns	1	2	FCC, Community	Figure 17 Report 7.7
5	Obtain necessary permits and schedule ecological burn, small broad-area, in location shown on Figure 17.	1	1	FCC	Figure 17 Report 7.7
6	Conduct ecological burn in area show on Figure 17	1	2 and on-	FCC	Figure 17 Report 7.7

#	Action	Priority	Time*	Responsibility	Reference
			going		
7	Monitor plant communities and species post-burns and use data to improve and create a tailored burning regime. Work with academics in the area of fire and seed /plant responses to continuing gaining understanding of how best to manage the park to retain species diversity and retain and increase numbers of rare species.	1	1-15	FCC, Expert Community / Ecologists	Section 6.1 and 7.7 Seed/fire experts Dr Ooi et al
	Community				
8	Pathways – retain existing pathways. Consider pathway along boundary with creek to provide access for weed management and a buffer between riparian zone weeds and fenced park.	3	2-4	FCC, Community	Existing pathways shown on plan in report
9	Signage-standard signage and have species names in correct locations – update and GPS. Create and install pictorial based signage about the EECs and programs to link this park vegetation with other areas through the parks and gardens. Provide signage on snails, native bees and microbats and pollination of plants.	2	2-4	FCC, Community	
10	Training – provide addition plant ID training by way of laminated book of species with photos. Provide training on best practice for placement of debris removed from pathways.	2	2-4	FCC, Community	
11	Publicity – increase Sydney-wide knowledge of the park. Have a case study of works on Australian Association of Bush regenerators (AABR) and in TAFEs.	3	2-15	FCC, Community	
12	Recognition - Get recognition or long-term park care people via Council of local media.	3	anytime	FCC, Comm.	

#	Action	Priority	Time*	Responsibility	Reference
13	Area Specific Master-Plans covering both bushcare and contractor projects. Create maps that have no more than ¼ of the Park on an A3 page to enable sufficient detail for management	1	2	FCC, Community	Section 5 and 6
14	Continue regular workshops with the Bushcare group and wider audience.	1	1	FCC, Comm.	Section 7.1
	Fungi				
16	Research species and abundance of fungi, particularly mycorrhizal spp. Develop recommendations based on findings. Involve the Sydney Mycology groups.	3	4	FCC, Comm. Mycologists	Section 4.1.2
17	**Vegetation Communities**				
18	Add updated mapping to Councils database and send to OEH	2	3	FCC	Section 4
19	Plan and conduct program of seed collection and propagation of all locally native plant in park and adjoining corridor.	1	1-4	FCC, Community	Section 7
20	Increase connectivity between native vegetation patches - plant trees to link canopies. Use locally native trees in streetscape planting. Provide free trees to residents who want them. Increase planting around playing ovals.	1	4-on-going	FCC, Community	Section 7
21	Contract a Bush Regeneration experts to undertake a program of weed management and to work with ecologists to implement on-site actions to increase sustainability of rare and threatened plant species and ecosystems functions	1	4-on-going	FCC, Comm., Contractors, Ecologists	Section 4, 6, 7
22	Develop and implement a 10 year plan to remove weeds and replace with native vegetation along Orphan School Creek – staring upstream of the Park near WSPL, working towards the junction with Georges River.	1	2-5	FCC, Community	Section 8

#	Action	Priority	Time*	Responsibility	Reference
23	Obtain funding, and community support, to manage weeds along Orphan School Creek – staring upstream of the Park near WSPL and work towards and past the Park towards the junction with Georges River.	2	2-15	FCC, Community, LLS	
	Specific Species of Plants				
24	Collect seed of local providence from large, healthy populations. Propagate the seeds and plant when sufficiently mature. Priority should be given to rare plant species.	1	1-4 and on-going	FCC, Community	Report section
25	Create a list of locally uncommon species, their pollinators and dispersal methods. Providing the habitats for pollinators and dispersers will ensure their long term survival in the Fairfield area	3	5-10	FCC, Community	Report section
	Weed Management				
26	Silt fencing along golf course and creek (after thermal weeding)	2	1		Section 7
27	Thermal weeding 10 x 10m patches, record areas, monitoring, vary fire intensity and duration in a replicated experimental way to gain better information on optimal burning regimes.	2	1-20 mosaic	FCC, Contractor	Section 6, 7.7 and 9
28	Contract bush regeneration with the reserve to maintain sweeps throughout to reduce bird spread weeds and exotic grasses with wind borne seeds.	2	1-20 on-going	FCC, Contractor	

#	Action	Priority	Time*	Responsibility	Reference
	Fauna				
29	Snails and fire. Understand the possible impacts of fire on snails and modify burning times and areas to reduce impact on native snails. Shells of the garden snail have been found with chew marks – consider monitoring and managing rats, should they be present.	1	Pre burn	Council, advising ecologists.	Research needed
30	Understand Micro-bats species diversity and population dynamics through further anabat recordings and other microbat sampling methods. Using this data, take appropriate action to ensure long-term habitat and resource availability for microbats.	3	Pre burn	FCC and Bat Specialist	Research needed
31	Assess the effectiveness of nest-boxes and replacement of existing broken units. Note: random use of nest boxes can be more detrimental that useful if it supports the proliferation of pests/ common species at the expense or rarer ones.	2	2	Community advising ecologists.	Research needed
32	Reduce the area of isolated trees in the surrounding parkland by under-planting isolated trees, in turn reducing habitat for Noisy Miners. See recommendations in Birds Australia (Holly Parsons) with regards to reducing Noisy Miner habitat (http://www.birdsaustralia.com.au/australian-birdlife).	2	2	Council, advising ecologists.	Research needed
33	Monitor for Bell Miners and seek permission to remove them should they establish in the park.			LLS, FCC, OEH	Research needed
34	Encourage research on ants and spiders in the reserve. Add to existing research occurring in the Cumberland Plain.	4	5	LLS, FCC, Science.	Research needed
35	Hover flies are abundant in the reserve conduct research to determine if they have a	3	4	FCC,	Research needed

#	Action	Priority	Time*	Responsibility	Reference
	role in pollinating native flora.			Community, Scientists.	
36	No native bees were observed during the survey. Additional planting of bee food plants outside the park is recommended to ensure adequate feed for bees. Additional trees can be planting in areas of public open space near the park. Tetragonia bees may use created habitat providing it is well located (stable, warm and out of the full westerly sun).	2	5-10	FCC	Research needed
37	Reptiles recorded in the park and creek include Blue Tongue Lizards, Eastern Water Skinks and Red-belly Black Snakes (pers comms community volunteers). Habitat for reptiles must be retained e.g. piles of logs especially in or near damp areas within 2m of the water are not to be burnt or removed.	2	1	FCC, Community	
38	Pollinators of the Orchid species should be identified and ecological works should ensure habitat for them is present.	3	4	FCC, Community, Scientists.	Research needed
	Legal Requirements				
39	Care for EECs and Threatened Species. See other actions recommended – such as optimising burn regime and conducting weed mgt.	1	1-5 ongoing	Council	Section 7
40	Risk management of dead trees. Add hazard signage at the entrance (e.g. caution trees and limbs may fall). If removing dead trees for risk management keep pieces on-site and check for fauna before felling.	1	1-5 ongoing	Council	

#	Action	Priority	Time*	Responsibility	Reference
	Problem Animals				
41	Manage Feral Animals – regional Fox Management as well as making the Park Fox and Cat Free.	1	1-5 ongoing	FCC	Pest Animals
42	Install cameras – and use those existing cameras – to monitor fox and cat presence in the reserve – take action in accordance with legalities.	2	2-5	FCC & Community	Pest Animals
43	Designate the Park as a Wildlife Protection Zone – and implement education and follow up cat trapping in the reserve with warnings and or fines to owners.	2	2-5	FCC, Community support	Pest Animals
44	Rats – kill non-native species as far as practical. This is for a number of reasons including their predation on CPLS and nesting birds.	2	2-5	FCC, Community	Pest Animals
45	Problem native animals – Noisy and Bell Minors and overabundance of predatory birds (eg. Currawongs, Butcher Birds)	12	2-5 +	FCC, Community	Pest Animals
	Plant Pathogens				
46	Phytophthora, Myrtle Rust – continue using the mentholated spirits and have easy access to spray at the entrance to the reserve. Install signage (at least laminated) with the information re: what to do with the cleaning of shoes and equipment and why).	2	2-5	Community, FCC support	Pests

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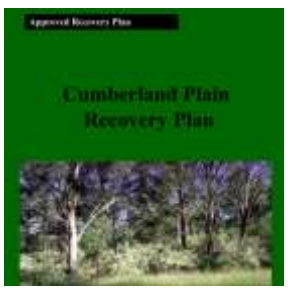
Links to documents for Cumberland Plain Woodland Protection and Management



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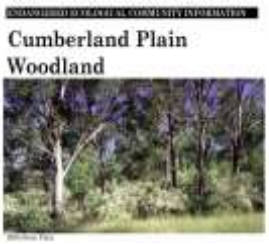
http://www.environment.nsw.gov.au/resources/nature/RecoveringCumberlandPlain.pdf

Federal Government information:

Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community.

http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=112&status=Critically+Endangered



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Source: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/112-conservation-advice.pdf

12. Qualifications of Authors and Researchers

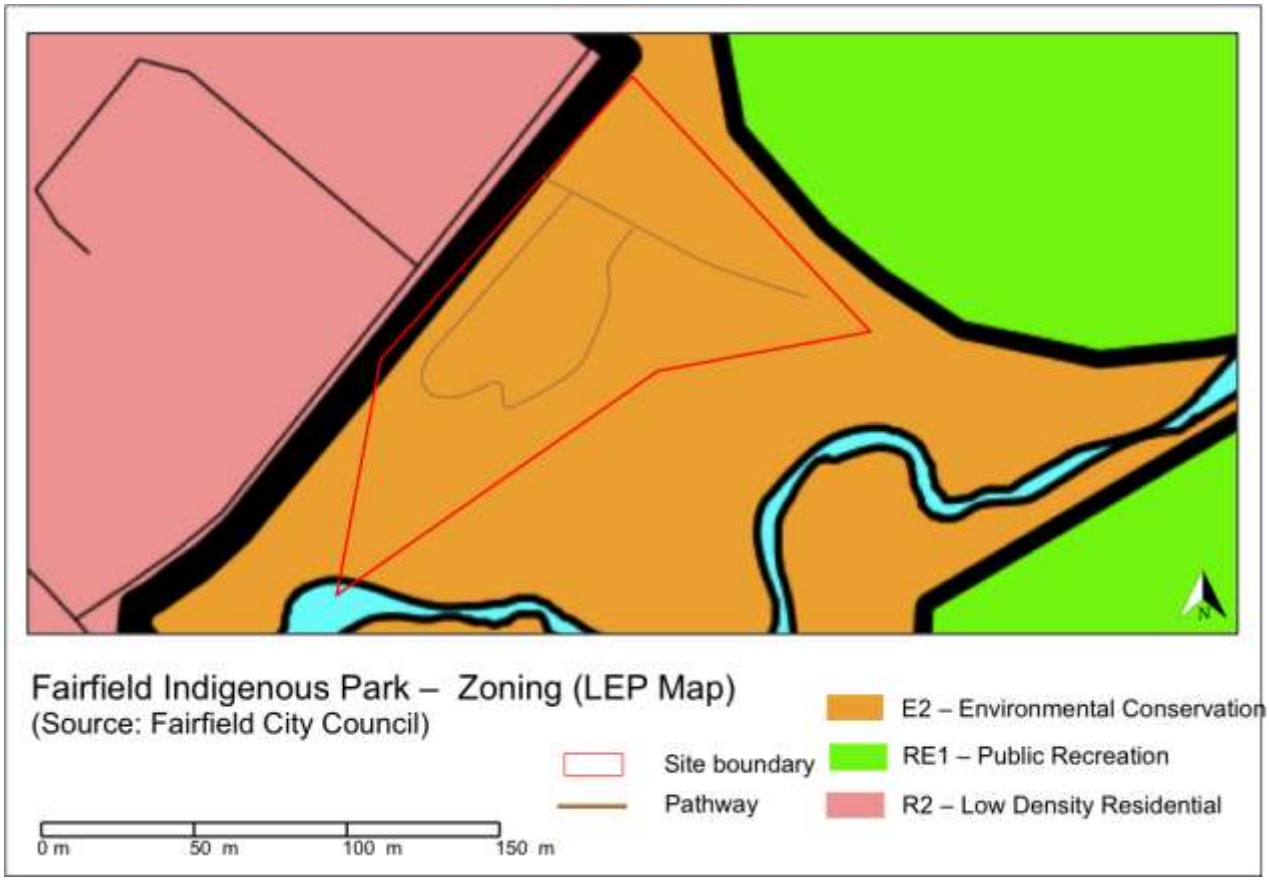
Mia Dalby-Ball: Ecology and fauna habitat. Bachelor of Science (Hons I), Sydney University, Majoring in Zoology, Ecology and Botany 1995 Current Director and Ecologist - Ecological Consultants Australia

Anthea Whitlam: Flora and GPS – see CV.

Julian Reyes - Acting Project Manager Dragonfly Environmental (now working with ECA) Ecological Restoration – See CV.

Expert input volunteered from Terresa James – See CV.

13. Appendix I – Land Use Mapping and Objectives of Management.



OBJECTIVES FOR MANAGEMENT

The following core objectives for managing community land are prescribed by the Local Government Act, 1993 for land categorised as **Natural Area:**

1. Conserve biodiversity and maintain ecosystems function in respect of the land, or the feature or habitat in respect of which the land is categorised as a natural area.

2. Maintain the land, or that feature or habitat, in its natural state and setting.

3. Provide for the restoration and regeneration of the land.

4. Provide for community use of and access to the land in such a manner as will minimise and mitigate any disturbance caused by human intrusion.

5. Assist in and facilitate the implementation of any provisions restricting the use and management of the land that are set out in a recovery plan or threat abatement plan prepared under the Threatened Species Conservation Act 1995 or the Fisheries Management Act 1994.

The core objectives for managing community land categorised as **Bushland** are to:

6. Ensure the ongoing ecological viability of the land by protecting biodiversity and habitat values, the flora and fauna and other ecological values of the land.

7. Protect the aesthetic, heritage, recreational, educational and scientific values.

8. Promote the management of the land in a manner that protects and enhances the values of the land and facilitates public enjoyment of the land, and to implement measures directed to minimising disturbance caused by human intrusion.

9. Restore degraded bushland.

10. Protect existing landforms such as natural drainage lines and watercourses.

11. Retain bushland in parcels of a size and configuration that will enable the existing plant and animal communities to survive in the long term.

12. Protect bushland as a natural stabiliser of the soil surface.

The core objectives for managing community land categorised as **Watercourse** are:

13. Manage watercourses so as to protect the biodiversity and ecological values of the instream environment, particularly in relation to water quality and water flows.

14. Manage watercourses so as to protect the riparian environment, particularly in relation to riparian vegetation and habitats and bank stability.

15. Restore degraded watercourses.

16. Promote community education and community access to and use of the watercourse, without compromising the other core objectives of the category.

The core objectives for managing community land categorised as a **Park** are to:

17. Encourage, promote and facilitate recreational, cultural, social and educational pastimes and activities.

18. Provide for passive recreational activities or pastimes and for the casual playing of games.

19. Improve the land in such a way as to promote and facilitate its use to achieve the other core objectives for its management.

14. Appendix II - Data from Bio-bank assessment plot and transect data 2015

Data from Bio-bank assessment Plot and transect Data

15. Appendix III Full Species List – native species

FAMILY	Scientific Name	Common Name	March 2012	Sep, Oct, Nov 2015	
Canopy					
MYRTACEAE	*Cormbia maculata*	Spotted Gum	X	X	
MYRTACEAE	*Eucalyptus moluccana*	Grey Box	X	X	
MYRTACEAE	*Angophora floribunda*	Rough-Barked Apple	X	X	
MYRTACEAE	*Eucalyptus eugeniodes*	Thin-leaved Stringy-Bark	X	X	
MYRTACEAE	*Eucalyptus tereticornis*	Forest Red Gum	X	X	
CASUARINACEAE	*Casuarina glauca*	Swamp Oak	X	X	
Shrub layer					
MIMOSACEAE	*Acacia parramattensis*	Parramatta Green Wattle	X	X	
MIMOSACEAE	*Acacia pubescens*	Downy Wattle	X	X	
MIMOSACEAE	*Acacia falcata*	Sickle Wattle	X	X	
MIMOSACEAE	*Acacia decurrens*	Sydney Green Wattle	X	X	
MIMOSACEAE	*Acacia binervia*	Coast Myall	X	X	
MIMOSACEAE	*Acacia fimbriata*	Fringed Wattle	X	X	
MIMOSACEAE	*Acacia floribunda*	White Sallow Wattle	X	X	
ASTERACEAE	*Olearia microphylla*	Bridial Daisy Bush	X	X	
ASTERACEAE	*Ozothamnus diosmifolium*	Everlasting Paper Daisy	X	X	
SAPINACEAE	*Dodonaea viscosa ssp cuneata*	Wedge Leaf Hop Bush	X	X	
SAPINACEAE	*Dodonaea viscosa ssp spaculata*	Hop Bush	X	X	
SAPINACEAE	*Dodonaea triquetra*	Hop Bush	X	X	
FABACEAE	*Daviesia ulicifolia*	Grose Bitter Pea	X	X	
FABACEAE	*Daviesia ulicifolia ssp ulicifolia*	Grose Bitter Pea	X	X	
FABACEAE	*Daviesia genistifolia*	Grose Bitter Pea	X	X	
FABACEAE	*Dillwynia sieberi*	Prickly Parrot Pea	X	X	
MELIACEAE	*Melia azedarach*	White Cedar	X	X	
MYRSINACEAE	*Myrsine variabilis*	Mutton Wood	X	X	
PITTOSPORACEAE	*Bursaria spinosa*	Blackthorn	X	X	
PITTOSPORACEAE	*Pittosporum revolutum*	Pittosporum	X	X	
VERBENACEAE	*Clerodendrum*	Hairy Clerodendrum	X	X	

FAMILY	Scientific Name	Common Name	March 2012	Sep, Oct, Nov 2015	
	tomentosum				
PROTEACEAE	*Persoonia linearis*	Narrow-Leaved Geebung	X	X	
EPACRIDACEAE	*Leucopogon juniperinus*	Bearded Heath	X	X	
OLEACEAE	*Notelaea longifolia*	Mock Olive	X	X	
SANTALACEAE	*Exocarpus cupressiformis*	Cherry Ballart	X	X	
CELASTRACEAE	*Maytenus silvestris*	Narrow-Leaved Orange-Bark	X	X	
CASUARINACEAE	*Allocasuarina littoralis*	Forest She Oak	X	X	
MYRTACEAE	*Melaleuca decora*	White-Feathered Honey-Myrtle	X	X	
EUPHORBIACEAE	*Breynia oblongifolia*	Coffee Bush	X	X	
EUPHORBIACEAE	*Phyllanthus gunnii*	Spurge	X	X	
Herb layer					
ACANTHACEAE	*Brunoniella australis*	Blue Trumpet	X	X	
ACANTHACEAE	*Brunoniella pumilio*	Dwarf Trumpet	X	X	
ACANTHACEAE	*Pseuderanthemum variabile*	Pastel Flower	X	X	
ASTERACEAE	*Brachycombe angustifolia*	Brachycombe	X	X	
ASTERACEAE	*Calotis dentex*	Burr Daisy	X	X	
ASTERACEAE	*Euchiton sp*	Cudweed	X	X	
ASTERACEAE	*Vittadinia pustulata*	Fuzz Weed	X	X	
ASTERACEAE	*Vernonia cinearia var cinearia*	Vernonia	X	X	
CAMPANULACEAE	*Walenbergia gracilis*	Blue Bell	X	X	
CHENOPODIACEAE	*Einadia hastata*	Saloop Bush	X	X	
CHENOPODIACEAE	*Einadia trigonos*	Saloop Bush	**X**	**X**	
CHENOPODIACEAE	*Einadia nutans*	Saloop Bush	X	X	
CYPERACEAE	*Cyperus gracilis*	Cyperus	X	X	
CYPERACEAE	*Gahnia aspera*	Saw Sedge	X	X	
CYPERACEAE	*Fimbristylis dichotoma*	Common Finge Rush	X	X	
CYPERACEAE	*Lepidosperma laterale*	Sword Sedge	X	X	
JUNCACEAE	*Juncus usitatus*	Common Rush	X	X	
GOODENIACEAE	*Goodenia hederacea*	Violet-Leaved Goodenia	X	X	

FAMILY	Scientific Name	Common Name	March 2012	Sep, Oct, Nov 2015	
	var hederacea				
LAMIACEAE	*Plectranthus parviflorus*	Cock Spur	X	X	
MYOPORACEAE	*Eremophila debilis*	Winter Apple	X	X	
PLANTAGINACEAE	*Plantago*	Plantago	X	X	
RUBIACEAE	*Asperula conferta*	Common Woodruff	X	X	
RUBIACEAE	*Opercularia diphylla*	Stink Weed	X	X	
RUBIACEAE	*Opercularia aspera*	Stink Weed	X	X	
RUBIACEAE	*Pomax umbellata*	Pomax	X	X	
MARSILEACEAE	*Marsilea hirsuta*	Nardoo	X	X	
SCROPHULARIACEAE	*Veronica plebeia*	Speed Wheel	X	X	
SOLANACEAE	*Solanum prinophyllum*	Forest Night Shade	X	X	
STACKHOUSIACEAE	*Stackhousia viminea*	Stackhousia	X	X	
COMMELINACEAE	*Commelina cyanea*	Scurvy Weed	X	X	
LILIACEAE	*Arthropodium milliflorum*	Vanilla Lily	X	X	
LILIACEAE	*Caesia parviflora*	Pale Grass Lily	X	X	
LILIACEAE	*Dianella longifolia*	Flax Lily	X	X	
LILIACEAE	*Dianella revoluta*	Flax Lily	X	X	
LILIACEAE	*Laxmania gracilis*	Wire Lily	X	X	
LILIACEAE	*Tricoryne elatior*	Yellow Rush Lily	X	X	
LILIACEAE	*Hypoxis hygrometrica var hygrometrica*	Yellow Stars	X	X	
ORCHIDACEAE	*Pterostylis curta*	Blunt Greenhood	X	X	
EUPHORBIACEAE	*Phyllanthus virgatus*	Spurge	X	X	
RUTACEAE	*Boronia polygalifolia*	Milk Wort Boronia	X	X	
LOBELIACEAE	*Pratia purpurascens*	White Root	X	X	
ADIANTACEAE	*Cheilanthes sieberi ssp sieberi*	Mulga Fern	X	X	
SCIZAEACEAE	*Adiantum aethiopicum*	Common Maidenhair Fern	X	X	
AMARANTHACEAE	*Alternanthera denticulata*	Lesser Joyweed	X	X	
XANTHORRHOEACEAE	*Lomandra longifolia*	Mat Rush	X	X	
XANTHORRHOEACEAE	*Lomandra multiflora*	Lomandra	X	X	
XANTHORRHOEACEAE	*Lomandra filiformis ssp coriacea*	Lomandra	X	X	

FAMILY	Scientific Name	Common Name	March 2012	Sep, Oct, Nov 2015	
XANTHORRHOEACEAE	*Lomandra filiformis ssp filiformis*	Lomandra	X	X	
CONVOLVULACEAE	*Dichondra repens*	Kidney Weed	X	X	
DILLENIACEAE	*Hibbertia diffusa*	Guinea Flower	X	X	
VIOLACEAE	Hybanthus stellarioides	Orange Spade Flower		X	
Vines/ Climbers					
FABACEAE	*Demodium varians*	Demodium	X	X	
FABACEAE	*Demodium brachypodum*	Demodium	X	X	
FABACEAE	*Hardenbergia vioacea*	Hardenbergia	X	X	
FABACEAE	*Glycine clandestina*	Love Creeper	X	X	
FABACEAE	*Glycine microphylla*	Love Creeper	X	X	
FABACEAE	*Glycine tabacina*	Love Creeper	X	X	
APOCYNACEAE	*Parsonsia straminea*	Monkey Rope	X	X	
ASCLEPIACEAE	*Tylophora barbata*	Tylophora	X	X	
BIGNONIACEAE	*Pandorea pandorana*	Wonga Wonga Vine	X	X	
CONVOLVULACEAE	*Convolvulus erubescens*	Bindweed	X	X	
CONVOLVULACEAE	*Polymeria calycina*	Swamp Bindweed	X	X	
MENISPERMACEAE	*Sarcopetulum harveyanum*	Pearl Vine	X	X	
PITTOSPORACEAE	*Billardiera scandens*	Appleberry Dumplings	X	X	
RANUNCULACEAE	*Clematis aristata*	Traveller's Joy/ Old Man's Beard	X	X	
ROSACEAE	*Rubus parvifolius*	Native Raspberry	X	X	
VITACEAE	*Cayratia clematidea*	Slender Grape	X	X	
PHILESIACEAE	*Eustrephus latifolius*	Wombat Berry	X	X	
PHILESIACEAE	*Geitonoplsium cymosum*	Scrambling Lily	X	X	
Grasses					
POACEAE	*Cymbopogon refractus*	Barb-wire Grass	X	X	
POACEAE	*Microlaena stipoides*	Weeping Meadow Grass	X	X	
POACEAE	*Themeda australis*	Kangaroo Grass	X	X	
POACEAE	*Austrostipa pubescens*	Stipa	X	X	

FAMILY	Scientific Name	Common Name	March 2012	Sep, Oct, Nov 2015	
POACEAE	*Oplismenus imbecilis*	Basket Grass	X	X	
POACEAE	*Oplismenus aemulus*	Basket Grass	X	X	
POACEAE	*Entolasia marginata*	Spreading Panic	X	X	
POACEAE	*Digitaria parviflora*	Native Summer Grass	X	X	
POACEAE	*Austrodanthonia racemosa*	Wallaby Grass	X	X	
POACEAE	*Austrodanthonia pilosa*	Wallaby Grass	X	X	
POACEAE	*Eriochloa pseudoacrotricha*	Early Spring Grass	X	X	
POACEAE	*Chloris truncata*	Windmill Grass	X	X	
POACEAE	*Chloris ventricosa*	Tall Chloris	X	X	
POACEAE	*Eragrostis benthmii*	Bentham's Lovegrass	X	X	
POACEAE	*Paspalidium simle*	Two Colour Panic Grass	X	X	
POACEAE	*Aristida vagans*	Three-awn Spear Grass	X	X	
POACEAE	*Dichelachne micrantha*	Shorthair Plume Grass	X	X	
POACEAE	*Echinopogon ovatus*	Hedge-hog Grass	X	X	

16. Appendix IV Bird list 2015 Spring and Summer Survey

17. Appendix V Case Studies with Thermal Weeder and ecological benefits.

FLAME WEEDER

Case Study:
Mother of Millions

Private land in Warringah

Recent inspection shows that four months on Mother of Millions has not regrown or germinated

FLAME WEEDER

Case Study: Herbicide and flame-weeder.
Timbertop Reserve
Blacktown

Area 1 sprayed.

Outcome: little natural regen and regrowth of Mother of Millions

Area 2 sprayed then thermal weeded.

Outcome: extensive native regeneration and minimal Mother of Millions

Final Report – Blacktown Council – Timbertop Reserve
Bushland Rehabilitation Project April 2013 – May 2014

by *Pratia purparescens* and minimal regrowth of the Mother of millions. The area where it was only sprayed and not thermal weeded, had little to no native regeneration and lots of regrowth of Mother of millions. It is recommended that further areas be thermal weeded, because it produces such excellent results (see photographs below).

The Trial area that was sprayed and not thermal weeded - little to no native regeneration and lots of regrowth of Mother of millions

The Trial area where Mother of millions was thermal weeded after being sprayed with brush off - extensive native regeneration, with dense growth and cover by Pratia purparescens and minimal regrowth of Mother of millions

FLAME WEEDER – AQUATIC WEEDS

Case Study:

Alligator Weed Narrabeen Creek Pittwater.

Also good on *Sagittaria* sp. (whole plant) and *Ludwigia* spp. seedlings.

Also for burning submerged weeds (post draining)

FLAME WEEDER – ECO BURN

Case Study: Weed Mgt and Eco-burn

Glenorie in the Hills Shire Council

FLAME WEEDER – SITE MANAGEMENT

Burning the weed seeds and newly germinated weeds.

Great for *Bidens* sp., Turkey Rhubarb, weed grasses and annuals.

Manual removal then flame weeding follow up.

Trials to do:

Themeda grasslands – edges between exotic grasses and natives.

Eastern Suburbs Banksia Scrub – where eco-burns can't be done.