

Appendix 4

2015 Pambalong Nature Reserve Monitoring Report*

(No. of pages including blank pages = 94)

*Note: A copy of this Appendix is available on the Project CD



This page has intentionally been left blank





2014 / 15 Annual Monitoring Report



Donaldson Coal Pty Ltd

Pambalong Nature Reserve
Abel Underground Coal Mine, Beresfield
NSW

April 2015



2014 / 15 Annual Monitoring Report

Pambalong Nature Reserve
Abel Underground Coal Mine, Beresfield NSW

Kleinfelder Report Number: WBA14R09204

Copyright 2014 Kleinfelder

All Rights Reserved

Prepared for:

DONALDSON COAL PTY LTD
1132 JOHN RENSHAW DRIVE
BLACK HILL NSW 2322

Only Donaldson Coal Pty Ltd, its designated representatives or relevant statutory authorities may use this document and only for the specific project for which this report was prepared. It should not be otherwise referenced without permission.

Document Control:

Version	Description	Date	Author	Technical Reviewer	Peer Reviewer
1.0	Draft for peer review	24/04/2015	Gilbert Whyte (flora)	Luke Foster	Colin Driscoll
3.0	Final	29/04/2015	Fred Rainsford (fauna)		

Kleinfelder Australia Pty Ltd

64 Medcalf Street
Warners Bay, NSW 2282
Phone: 1300 881 869
Fax: 1300 881 035

ABN: 23 146 082 500



EXECUTIVE SUMMARY

Donaldson Coal Pty Ltd commenced operations at Abel Underground Coalmine at Beresfield in the lower Hunter Valley, New South Wales in 2008. A Flora and Fauna Management Plan, prepared by Kleinfelder (ecobiological 2007) in accordance with consent conditions, identified the need for ecological monitoring at Pambalong Nature Reserve, a 34 ha freshwater wetland located between the eastern extent of the Abel coal mine lease and the M1 Pacific Motorway.

Pambalong Nature Reserve provides critical habitat for wader and water bird species and is part of a chain of protected wetlands in the lower Hunter floodplains and estuary. Hunter Wetlands National Park, which incorporates the previous Kooragang and Hexham Swamp Nature Reserves, the Stockton Sandspit and part of Ash Island protects many associated wetlands in the region. The wetland at Pambalong depends on freshwater from Blue Gum Creek to maintain and replenish aquatic and terrestrial habitats in the reserve. Consequently any changes to the quantity and quality of water delivered from the Blue Gum Creek catchment arising from mining activities or subsidence would compromise the ecological integrity of the wetland (ecobiological 2007).

A decline in the quantity of water could result in a reduction in the area of wetland and a subsequent loss of aquatic and terrestrial flora and fauna habitat. Increased sediment loads in Blue Gum Creek could affect macroinvertebrate numbers and change the depth of waterbodies within the wetland. Other related impacts to wetland could also occur such as weed and/or feral animal invasion (ecobiological 2007).

Underground mining has not yet reached the Blue Gum Creek catchment and monitoring to date has contributed to a robust dataset on baseline ecological conditions at the wetland. It is important that data is collected over as many years as possible to determine what constitutes normal variation and enable valid comparisons with post-mining conditions.

This document reports on results of the seventh annual baseline monitoring event at Pambalong Nature Reserve. Detected during this survey were 101 flora species and 106 fauna species comprising five frog, 17 mammal (12 bat), one reptile, and 84 bird species. Threatened species recorded included five microbats, the Grey-headed Flying-fox and one bird (Black-necked Stork). No new flora species were recorded and no significant changes to the spatial extent of vegetation communities were observed.



Table of Contents

EXECUTIVE SUMMARY	III
1. INTRODUCTION	1
1.1 LOCATION	2
2. METHODOLOGY	5
2.1 FLORA	5
2.2 FAUNA	6
2.2.1 Arboreal Mammals	8
2.2.2 Terrestrial Mammals	8
2.2.3 Bats	8
2.2.4 Birds	9
2.2.5 Amphibians	9
2.2.6 Introduced Fauna	10
3. RESULTS AND DISCUSSION	11
3.1 WEATHER CONDITIONS AND SURVEY ACTIVITIES	11
3.2 GENERAL ENVIRONMENTAL MONITORING	12
3.3 FLORA RESULTS	13
3.4 WEED SPECIES	21
3.5 VEGETATION COMMUNITIES	31
3.5.1 Coastal Foothills Spotted Gum – Ironbark Forest (Dry Sclerophyll Forest)	33
3.5.2 Paperbark Swamp Forest (Swamp Sclerophyll Forest)	33
3.5.3 Freshwater Wetland Complex (Freshwater Wetland)	34
3.5.4 Altered Vegetation - Swamp Oak Forest (planted)	35
3.5.5 Altered Vegetation - Disturbed/Kikuyu Grassland	35
3.5.6 Endangered Ecological Communities	35
3.6 FAUNA	37
3.6.1 Amphibians	39
3.6.2 Birds	39
3.6.3 Mammals	40
3.6.4 Reptiles	41
4. CONCLUSIONS AND RECOMMENDATIONS	42
5. REFERENCES	44



Tables

Table 1	Trapping statistics for the subject site	6
Table 2	Fauna survey effort for the subject site	6
Table 3	Weather conditions and survey activities undertaken during the sample period.....	11
Table 4	Monthly rainfall (mm) recorded at Maitland Visitors Centre weather station (long term mean includes East Maitland Bowling Club 1903 to 1994)	12
Table 5	Threatened fauna species recorded in 2014/15	38
Table 6	Fauna species (excluding birds) recorded from trapping and nocturnal survey activities by Kleinfelder 2008/09-2014/15 and White (2000)	53
Table 7	Bird species recorded in transect surveys by Kleinfelder 2008 to 2014	57
Table 8	Bird species recorded from the North Swamp by Kleinfelder 2008 to 2015	61
Table 9	Bird species recorded from the Main Swamp by Kleinfelder 2008 to 2015	66
Table 10	Bird species recorded from the South Swamp by Kleinfelder 2008 to 2015.....	70
Table 11	Roosting bird count results from the Main Swamp 2008 to 2014.....	75
Table 12	Bird species recorded by Huunter Valley Bird Observers July 2014.....	76

Figures

Figure 1	Locality Map.....	3
Figure 2	Pambalong Nature Reserve	4
Figure 3	Flora and Fauna Survey Effort.....	7
Figure 4	Monthly rainfall for 2014/15 survey period compared to historical monthly average (1903-2014/15).....	13
Figure 5	Flora species richness within Q1 from 2008 to 2014	15
Figure 6	Flora species richness within Q2 from 2008 to 2014	16
Figure 7	Flora species richness within Q3 from 2008 to 2014	18
Figure 8	Flora species richness within Q4 from 2008 to 2013	19
Figure 9	Flora species richness within T1 from 2008 to 2014.....	21
Figure 10	Weed Species Mapping	23
Figure 11	Vegetation Community Mapping	32
Figure 12	Fauna species richness recorded from 2008/09 to 2014/15	37
Figure 13	Fauna species richness by taxon from 2008/09 to 2014/15 (excluding birds).....	38
Figure 14	Bird species richness recorded at monitoring points from 2008 to 2015.....	39



Plates

Plate 1	Flora quadrat 1 (Q1) located in Coastal Foothills Spotted Gum - Ironbark Forest (Photograph taken in 2014)	14
Plate 2	Flora quadrat 2 (Q2) located in Freshwater Wetland Complex dominated by Typha (Photograph taken in 2014)	16
Plate 3	Flora quadrat 3 (Q3) located in Paperbark Swamp Forest (Photograph taken in 2014).....	17
Plate 4	Flora quadrat 4 located in Paperbark Swamp Forest (Photograph taken in 2014).....	19
Plate 5	Flora transect located in Freshwater Wetland Complex (Photograph taken in 2014)	20
Plate 6	Water Hyacinth at the Northern Swamp inlet in 2008.....	24
Plate 7	Water Hyacinth at the Northern Swamp inlet in 2009 showing the installation of a grate	24
Plate 8	Water Hyacinth at the Northern Swamp inlet in 2010.....	25
Plate 9	Water Hyacinth at the Northern Swamp inlet during the 2011 monitoring event	25
Plate 10	Water Hyacinth at the Northern Swamp inlet during the 2012 monitoring event	26
Plate 11:	Water Hyacinth at the Northern Swamp inlet during the 2013 monitoring event	26
Plate 12:	Water Hyacinth at the Northern Swamp inlet during the 2014 monitoring event	27
Plate 13:	<i>Pennisetum clandestinum</i> (Kikuyu) in the north-east corner of the reserve	28
Plate 14:	<i>Rubus fruticosus</i> (Blackberry) in the north-east and south-east corner of the reserve	29
Plate 15:	<i>Alternanthera philoxeroides</i> (Aligator weed) in the central portion of the reserve	30
Plate 16	Stitched photograph of South Swamp taken in November 2011.	77
Plate 17	Stitched photograph of South Swamp taken in March 2012.....	77
Plate 18	Stitched photograph of South Swamp taken in March 2014.....	77
Plate 19	Stitched photograph of South Swamp taken in March 2015.....	78
Plate 20	Stitched photograph of Main Swamp taken in November 2011.....	78
Plate 21	Stitched photograph of Main Swamp taken in March 2012.	79
Plate 22	Stitched photograph of Main Swamp taken in March 2014.	79
Plate 23	Stitched photograph of Main Swamp taken in March 2015.	80
Plate 24	Stitched photograph of North Swamp taken in November 2011.....	80
Plate 25	Stitched photograph of North Swamp taken in March 2012.	81
Plate 26	Stitched photograph of North Swamp taken in March 2014.	81
Plate 27	Stitched photograph of North Swamp taken in March 2015.	82



Appendices

- Appendix 1. Flora Species List
- Appendix 2. Fauna Species list
- Appendix 3. Water Body Photographs
- Appendix 4. Staff Contributions
- Appendix 5. Licensing

This page has intentionally been left blank



1. INTRODUCTION

Donaldson Coal Pty Ltd commenced mining in 2008 at the Abel Underground Coal Mine, located approximately 23 km north-west of Newcastle **Figure 1**. The mine will extract up to 4.5 million tonnes per year over 21 years using high productivity continuous miner based bord and pillar systems, and pillar extraction techniques.

Underground coal mining can cause land subsidence which may result in adverse environmental impacts such as loss of productive land, damage to underground pipelines and above-ground structures, decreased stability of slopes and escarpments, contamination of groundwater by acid drainage and dewatering of streams and groundwater supplies (Bell *et al.* 2000, Sidle *et al.* 2000). The main ecological concern arising from the Abel mine is the effect of subsidence on local and regional hydrology. Surface and sub-surface cracking associated with mining subsidence can alter and create preferential flow paths, causing dewatering and rerouting of surface water and groundwater (Sidle *et al.* 2000). Alterations in channel and drainage morphology may also affect channel erosion, sediment delivery, and routing in streams and riparian habitat.

Development approval for the Abel coal mine was granted with a number of conditions, including a requirement to prepare a Flora and Fauna Management Plan (F&FMP) (ecobiological 2007). The F&FMP is part of a comprehensive Environmental Management System (EMS) for Abel mine and sets out a strategy to monitor the effectiveness of the conservation measures identified in the Environmental Assessment (EA) Statement of Commitments. A Surface Ecological Monitoring Plan (SEMP) produced as part of the strategy focused monitoring effort on three discrete habitat areas:

1. Farm dams that form a belt across the mine site;
2. Subtropical rainforest areas of Long Gully Creek; and
3. Pambalong Nature Reserve.

Baseline and subsequent monitoring data are to be gathered in each of these areas to inform management and future change analysis. Results from the current period continue to contribute to a dataset that documents baseline ecological conditions at Pambalong Nature Reserve and contributes to the overall SEMF.



1.1 LOCATION

The Abel Underground Mine is located within Newcastle, Cessnock and Maitland Local Government Areas (LGAs). The majority of the underground mine and surface infrastructure area is within the Cessnock LGA. The seams to be mined are located under the Black Hill rural residential and adjoining forested areas. Mine access and associated surface infrastructure is located within the existing Donaldson Coal mine open cut void at Black Hill, with transfer of coal to the existing Bloomfield Coal Handling and Preparation Plant (CHPP) immediately to the north for coal washing and rail transport to the Port of Newcastle (Figure 1).

The Abel underground mine covers an area of approximately 2,750 ha that consists of low undulating forested hills with patches of cleared land supporting 110 rural/residential properties. A ridgeline associated with Black Hill runs east-west through the proposed underground mine area. Tributaries of Buttai Creek, Viney Creek, Weakley's Flat Creek and Four Mile Creek drain northwards from this ridgeline. A wide catchment containing Long Gully and Blue Gum Creek drains from the ridgeline providing water to the wet swamp at Pambalong Nature Reserve. Some cliff-lines and steeper gullies are located along sections of the Black Hill ridge.

The underground mine area is bounded on the eastern side by Pambalong Nature Reserve and the M1 Pacific Motorway; the western and southern sides by a tract of forest that extends south to the Central Coast and beyond to Hornsby, and the northern side by existing open cut coal mining activities within the Donaldson and Bloomfield mine leases (Figure 2).

Pambalong Nature Reserve consists of 34 ha of predominantly freshwater wetland on the western side of the M1 Pacific Motorway, approximately 20 km north-west of Newcastle (Figure 2). The reserve was gazetted in December 2000 over former farmland acquired by the Roads and Traffic Authority during construction of the M1 Pacific Motorway (former F3 Freeway) (DEC 2006).

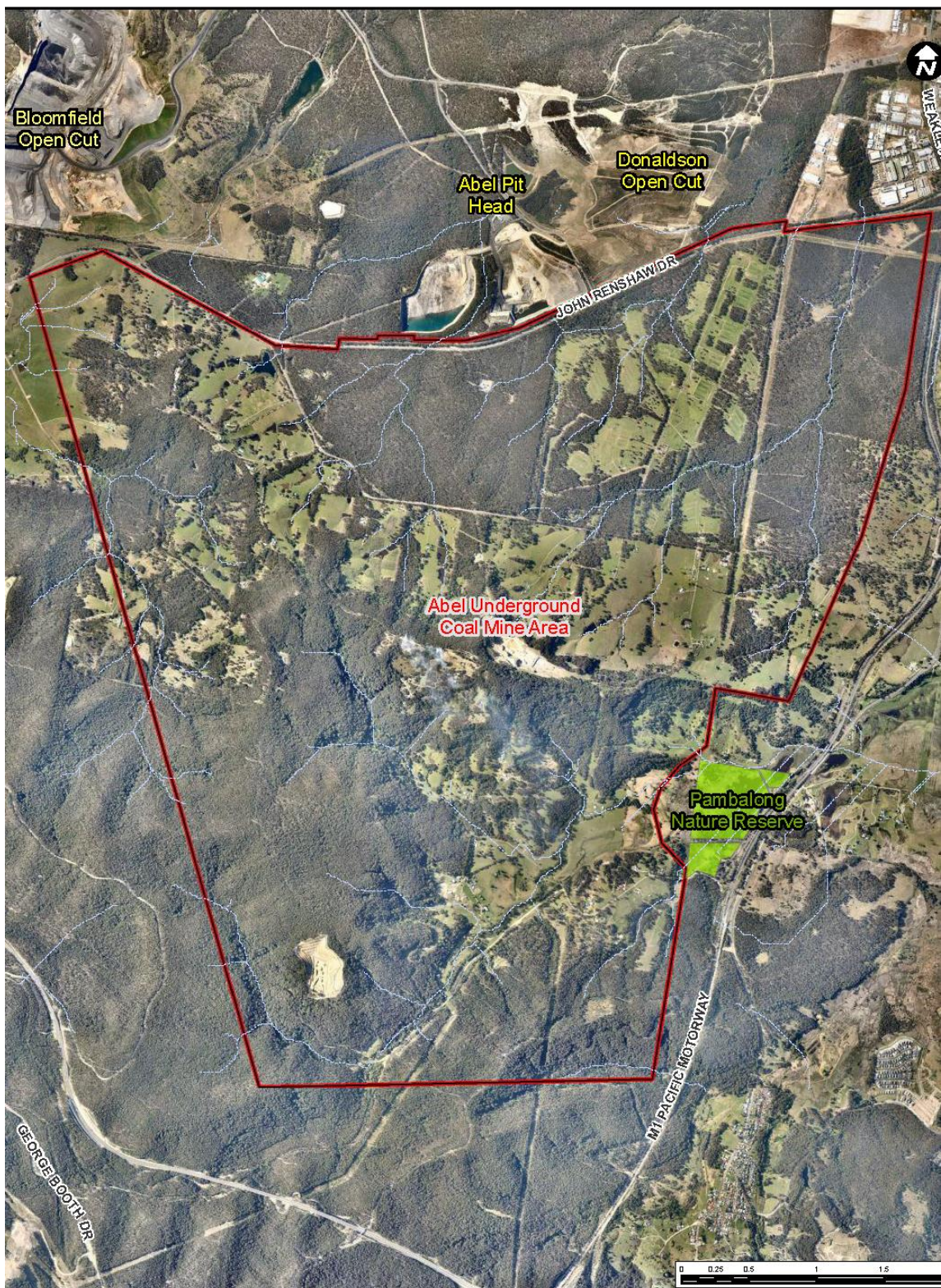





Figure 1 - Locality Map

Legend

-  Abel Underground Coalmine Boundary
-  Pambalong Nature Reserve
-  Waterways



Project Ref:	20153124
Plot Date:	1/12/2014 11:54
Revision:	001 (GJoyce)

Map Projection:

GDA 1994 MGA Zone 56

Data Sources:

LPI - 2011
OEH - 2012
Kleinfelder - 2014
Nearmap - 2014

Disclaimer: This is not an official or a legal map but is for informational use only. All data was compiled from the best source available. All boundaries, scale and geog points are approximate.

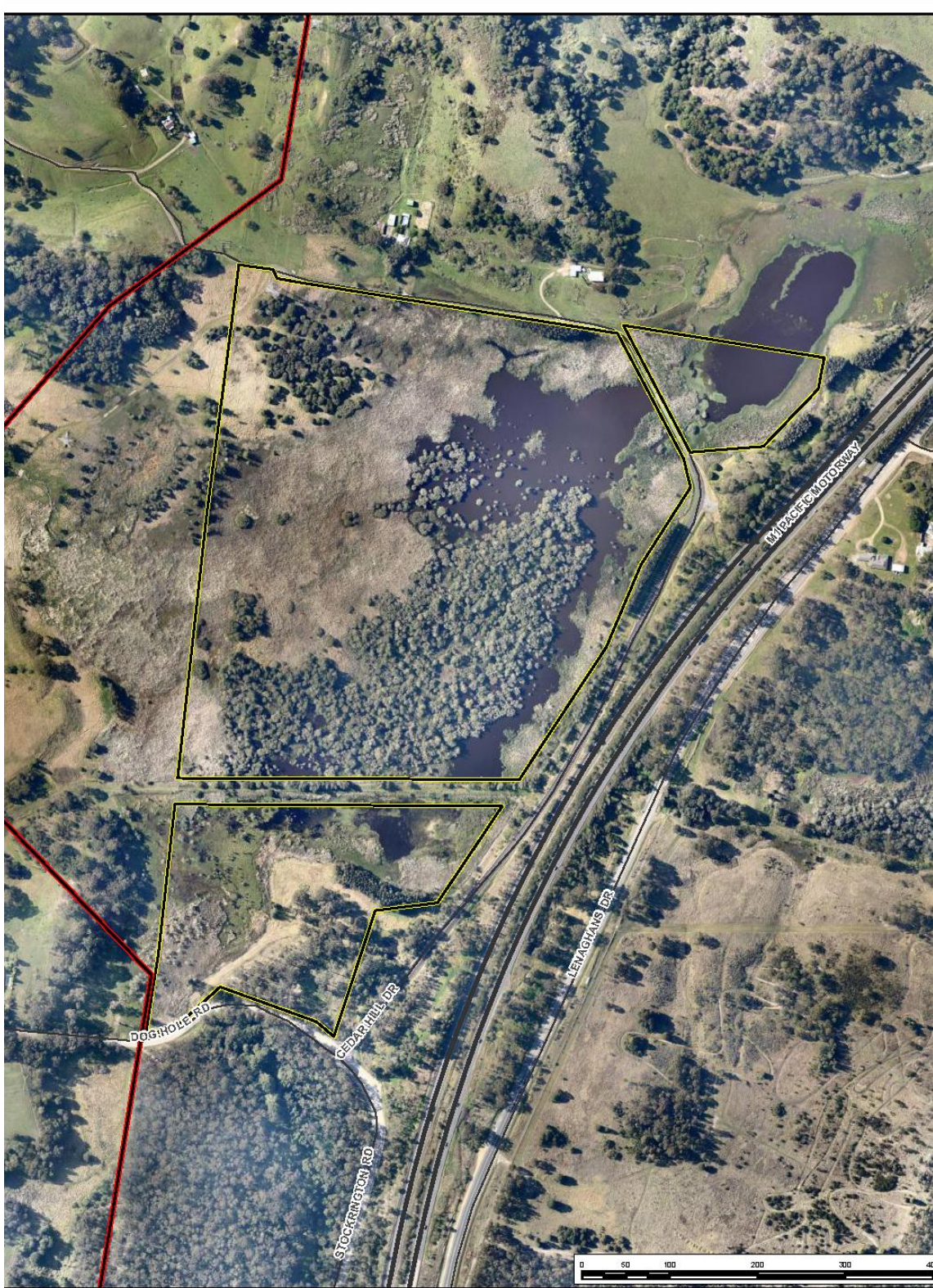



Figure 2: Pambalong Nature Reserve

Legend

- Abel Underground Coalmine Boundary
- Pambalong Nature Reserve
- Major roads
- Minor roads

		Map Projection: GDA 1994 MGA Zone 56
		Data Sources: LPI - 2011 CEH - 2012 Kleinfelder - 2014 Nearmap - 2014
Project Ref:	20153124	Disclaimer: This is not an official or a legal map but is for informational use only. All data was compiled from the best source available. All boundaries, scale and geog points are approximate.
Plot Date:	1/12/2014 12:01	
Revision:	001 (G.Joyce)	



2. METHODOLOGY

2.1 FLORA

Flora survey and vegetation mapping has been undertaken in accordance with the requirements of the F&FMP. The location of flora survey activities is shown in **Figure 3**.

A base vegetation map of the wetland was prepared for the 2008 annual monitoring report using a combination of aerial photograph interpretation and ground-truthing to delineate community boundaries. Communities were defined based on the type of habitat they formed as well as floristic content and structure. Vegetation community boundaries are monitored and mapped each year to identify any variation in extent.

Two standard 0.04 ha (20 m x 20 m) floristic quadrats (Q1 & Q3), two 0.1024 ha (32 m x 32 m) floristic quadrats (Q2 & Q4) and a 50 m transect were established in representative areas of identifiable vegetation structure. Data collected in these quadrats each year include total floristic content and the cover abundance index for each species in the plots using the Braun-Blanquet scale (Poore 1995).

Targeted searches for threatened flora species (*Tetratheca juncea*, *Maundia triglochinosoides*, *Persicaria elatior* and *Zannichellia palustris*) are also conducted each year in appropriate communities through random meandering. The location of any threatened flora species detected is recorded using a GPS.

Annual surveys also record the presence and distribution of weed species across the subject site. The dominant weed species, outbreak areas and recently treated areas are mapped.

Floristic identification and nomenclature is based on Harden (1992, 1993, 2000 and 2002) with subsequent revisions as published on PlantNet (<http://plantnet.rbgsyd.nsw.gov.au>). Plants listed under the ROTAP scheme (Briggs and Leigh 1995) were also considered in this assessment along with species and vegetation deemed to be of local conservation significance.



2.2 FAUNA

The position of observation points and transects has been recorded to ensure that sampling occurs at the same location each year. Systematic fauna monitoring is centred on two transects, one situated in the Spotted Gum – Ironbark open forest fringing the South Swamp and the other situated in the Melaleuca Swamp Forest fringing the Main Swamp.

Table 1 depicts trapping effort at transects, while Table 2 details of other fauna survey effort across the subject site. The location of fauna survey activities is shown in Figure 3.

Table 1 Trapping statistics for the subject site

Trap type	Traps	Nights	Trap nights
Elliott A	40	4	160
Elliott B Tree	3	4	12
Elliott B Ground	6	4	24
Cage Trap	4	4	16
Harp Trap	2	4	8
Hair Tubes	8	4	32

Table 2 Fauna survey effort for the subject site

Survey method	Days/nights	Locations
Anabat recording	2	4
Spotlighting	2	2
Owl call playback	2	3
Frog transect survey	2	3
Bird transect survey	2	2
Bird water body survey	8	3
Roosting bird abundance estimate	2	1
Opportunistic fauna observations	15	Across entire site

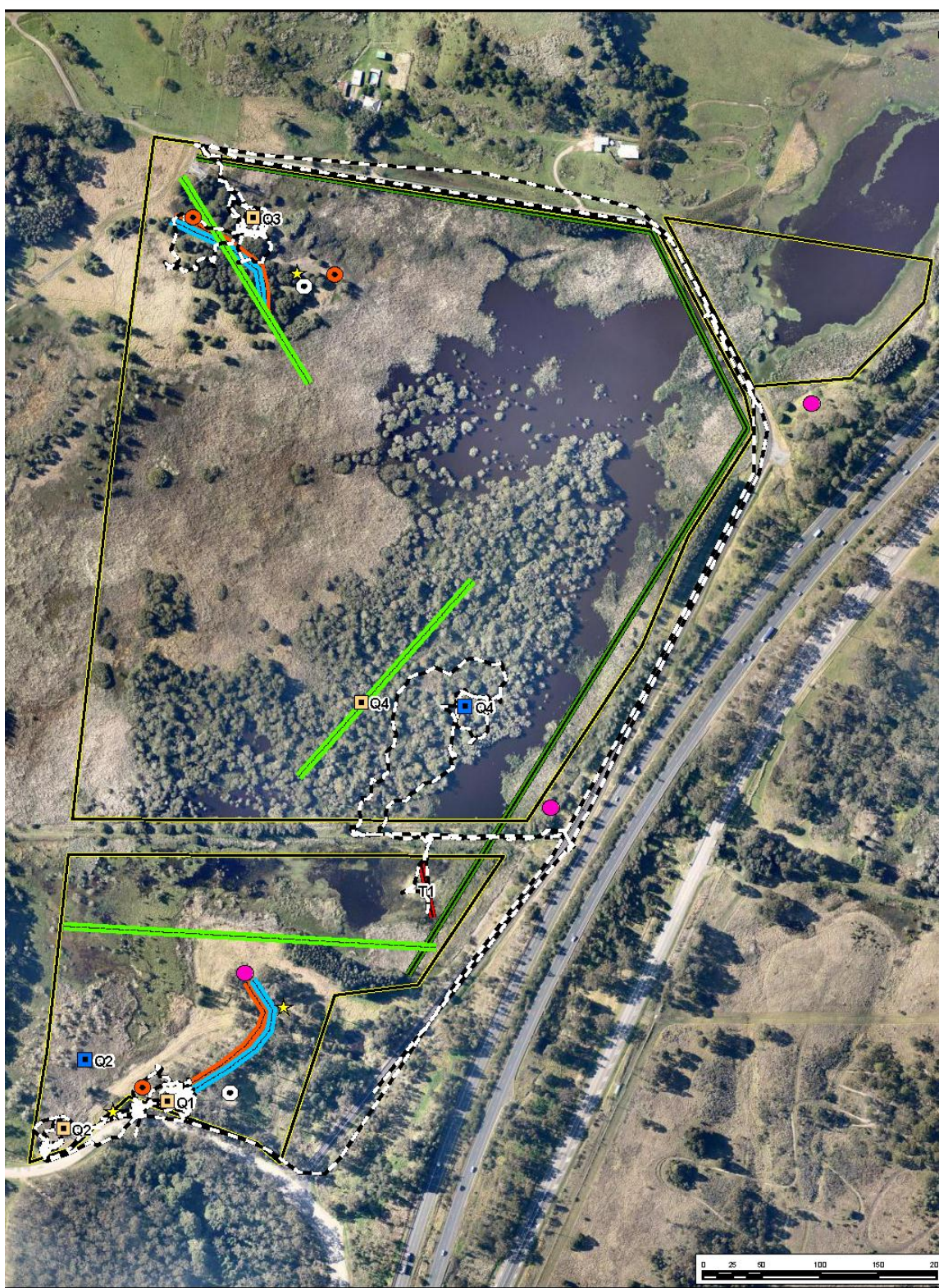


Figure 3: Flora & Fauna Survey Effort

Legend

- | | | |
|-----------------------------|-------------------------------|----------------------|
| Pambalong Nature Reserve | Hap Trap | Bird Survey Transect |
| Water Bird Survey Locations | Anabat | Trapping Transect |
| Flora Quadrats | Flora Meander - November 2014 | Frog Call Playback |
| Flora Quadrats 2008 | Amphibian Transect | Flora Transect 50m |
| Owl Call Playback | | |



Project Ref: 20153124
Plot Date: 1/12/2014 12:02
Revision: 001 (GJoyce)

Map Projection:

GDA 1994 MGA Zone 56

Data Sources:

LPI - 2011
OEH - 2012
Kleinfelder - 2014
Nearmap - 2014

Disclaimer: This is not an official or a legal map but is for informational use only. All data was compiled from the best data available. All boundaries, scale and geog points are approximate.



2.2.1 Arboreal Mammals

Three Elliott B traps and eight hair tubes are placed in trees at heights of 3 m or above, along transects and baited with a mixture of rolled oats, honey, peanut butter and treacle. The trunks of trees containing the traps are sprayed with a mixture of honey and water. Traps are checked daily for arboreal species. After 4 nights the sticky wafers from hair tubes are collected and checked for the presence of hair samples. Hair identification methods follow those of Brunner *et al.* (2002). If any hair sample was from a vulnerable or endangered species, the sample was sent to an expert in hair identification for confirmation. Spotlighting is undertaken along each transect for one hour per night on two separate nights.

2.2.2 Terrestrial Mammals

Forty Elliott A, six Elliott B and four cage traps are placed along two transects at regular intervals to capture terrestrial mammal species. Traps are baited with a mix of rolled oats, honey, peanut butter and treacle and set for four consecutive nights with checks for captures occurring each morning.

Opportunistic daytime observations of the signs of recent terrestrial mammal activity such as diggings, droppings or scratch marks were noted.

2.2.3 Bats

Two harp traps are erected on transects at South Swamp and Main Swamp. To increase the likelihood of captures traps are positioned in potential bat 'flyways' such as on tracks or in natural forest openings. Traps are set in position for four consecutive nights and checked each morning. Bats captured are identified in the field and placed in 'soft release' boxes tethered to nearby trees to enable the bats to shelter during the day and exit at nightfall.

Anabat™ II bat-call detectors are used passively to record the calls of passing Microchiropteran bats. Two units are set up at dusk and recording occurs for one hour on two separate nights (four hours total). Nocturnal searches of blossoming trees are also undertaken during spotlighting to detect Megachiropteran bats.



2.2.4 Birds

Surveys to detect birds are conducted at two transects in native vegetation fringing wetlands, and three permanent monitoring points overlooking North, South and Main waterbodies (Figure 3). Transect surveys record species richness only, whereas water body surveys make counts of the number of individuals of water bird species observed or when large estimate relative abundance.

Transects are surveyed for a period of 20 minutes on two separate days. Species are identified visually with the aid of binoculars or aurally from call identification. Bird surveys were conducted in the morning or late afternoon when bird activity is maximised (Bibby *et al.* 2000). After dark the calls of threatened owl species (Powerful, Masked, Sooty, Barking and Grass Owls) are broadcast over a megaphone at transects on two separate nights in an attempt to encourage a call back response.

Water bird surveys are conducted at permanent monitoring points in spring and autumn. During one season monitoring points are surveyed four times, at dawn and dusk in one week and again approximately 1 week later. All birds detected within a viewing arc overlooking open water bodies in a 20-minute period were recorded. Birds are identified by sight, with the aid of binoculars or a spotting scope, and by their calls.

At the completion of one of the dusk surveys, a count or abundance estimate of birds roosting in the Melaleuca Swamp Forest within the Main Swamp is undertaken. This method is repeated at approximately the same time (on nightfall) each year to enable comparison of the composition and abundance of bird species using the roost.

2.2.5 Amphibians

Amphibian surveys are carried out at each of the three main water bodies over four days and nights. Diurnal surveys involve dip netting and visual searches to detect tadpoles in water bodies. Nocturnal surveys involve aural detection of characteristic calls or visual detection of animals with a spotlight or head torch. Call playback for the endangered Green and Golden Bell Frog is carried out due to the species' historical occurrence at the site and the presence of suitable habitat.

Adult frogs encountered are identified by visual confirmation or by their distinct advertisement calls. Tadpoles are keyed out using diagnostic features including mouthparts (tooth rows, jaw



sheaths and papillae), pigmentation, body size, tail structure (musculature, fin depth, fin shape, tip shape), eye direction and spacing, pupil pigmentation, nare shape and spacing, spiracle height and direction, vent length and direction, and tadpole behaviour according to Anstis (2002).

2.2.6 Introduced Fauna

Introduced species previously recorded in the reserve include: Black Rat, Rabbit, Fox, Common Myna, Spotted Dove, House Sparrow, Red-whiskered Bulbul and Common Starling (Hunter Bird Observers Club records 1990 – 2008; Straw 2000; White 2000). The ecological condition of the reserve is negatively impacted by the presence of these species. Introduced species detected by annual field surveys are reported to the NSW National Parks and Wildlife Service to assist with management.



3.2 GENERAL ENVIRONMENTAL MONITORING

Changes in species composition, abundance or distribution within the wetland can result from a variety of external factors not associated with mining. Rainfall, bushfire and nearby development are examples of such factors (ecobiological 2007). During 2014/15 there was no significant bushfire event or development activity in the vicinity of the wetland that would impact water flow or quality.

Nearby Bureau of Meteorology (BoM) weather stations at East Maitland Bowling Club (1903 - 1994) and the Maitland Visitors Centre (1997 to 2014) provide historical rainfall data for a 112-year period (1903 – 2014). Historical mean monthly rainfall (mm) from 1902 – 2014 and monthly rainfall (mm) from 2008 – 2014 is presented for comparison in (Table 4). Error! Reference source not found. shows monthly rainfall (mm) from each year from 2008-2015 and compares it to long-term average.

Table 4 Monthly rainfall (mm) recorded at Maitland Visitors Centre weather station (long term mean includes East Maitland Bowling Club 1903 to 1994)

Year	J	F	M	A	M	J	J	A	S	O	N	D	Total
2008	182	174	45	224	7	123	42	22	183	76	89	74	1241
2009	12	267	53	125	73	75	24	2	24	67	44	58	824
2010	65	53	86	22	73	111	62	32	20	60	192	63	839
2011	36	37	47	140	91	162	86	57	75	104	141	67	1043
2012	84	174	102	79	12	125	45	14	22	7	46	45	753
2013	140	134	79	66	51	79	30	11	17	51	279	16	953
2014	21	113	66	81	30	45	22	111	31	50	22	164	756
2015	155	41	35										
Mean 1902-2014	84	99	96	82	69	84	55	49	54	61	67	82	880

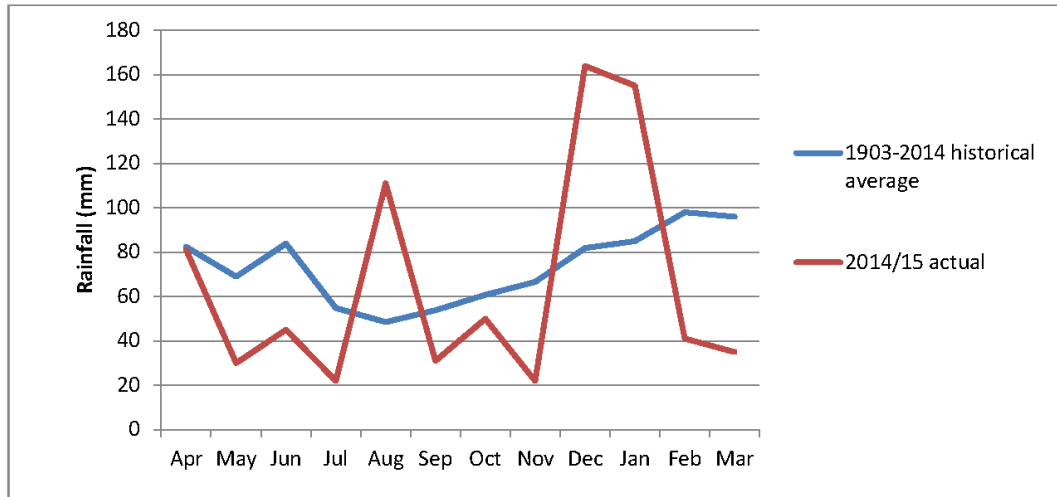


Figure 4 Monthly rainfall for 2014/15 survey period compared to historical monthly average (1903-2014/15)

Below average rainfall was recorded throughout most of the 2014/15 survey period compared with the historical average, with the exception of December 2014 and January 2015. In December there were five significant rainfall events with between 19 – 35 mm falling on the 4th, 6th, 11th, 12th and 26th. The rainfall in January was also above average with between 20 – 53 mm falling on the 12th, 20th and 28th. In February and March 41 and 35 mm fell respectively.

The water level within each of the waterbodies remained relatively high during most of the survey period including the amphibian and waterbird surveys.

3.3 FLORA RESULTS

Flora surveys for this report were conducted during November 2014. A total of 190 species have been identified on the site since monitoring surveys commenced in 2008 (**Appendix 1**).

No threatened flora species were recorded during the field surveys. Three species considered as regionally significant by Eco Logical (2003) were detected in the surveys, including *Cyperus odoratus*, *Melaleuca linariifolia* and *Enydra fluctuans*. All three species have been recorded in previous studies.



Coastal Foothills Spotted Gum - Ironbark Forest (Q1)

The Coastal Foothills Spotted Gum - Ironbark Forest quadrat (Q1) has previously been found to contain the highest species diversity of the flora plots surveyed in the Reserve (Plate 1).



Plate 1 Flora quadrat 1 (Q1) located in Coastal Foothills Spotted Gum - Ironbark Forest (Photograph taken in 2014)

Flora species richness in this quadrat has increased slightly since 2008 (Figure 5). The greatest number of species on record was identified during the 2014 survey. Two plant species were identified for the first time; *Lomandra filiformis* (Wattle Matt Rush) and *Veronica plebeia* (Trailing Speed weed). Both of these species commonly occur in dry forest.

Themeda australis (Kangaroo Grass) has increased in abundance within the plot. Other absent grass species which are usually detected in previous years may be being outcompeted by this competitive native species.

Historically the most significant weed species recorded in Q1 is *Lantana camara* (Lantana), however, only minor infestations were identified during the 2014 survey.

Overall, the vegetation community appears to be in a relatively good health with no obvious signs of decline.

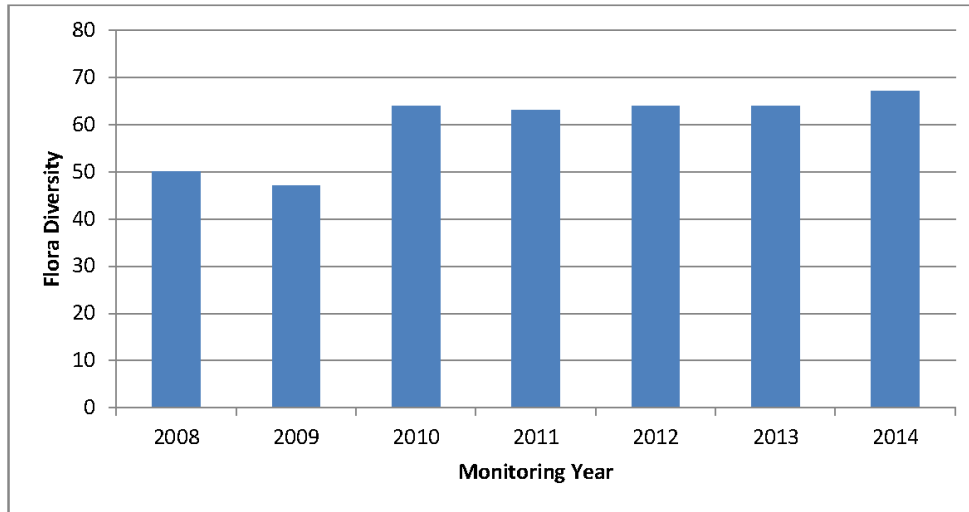


Figure 5 Flora species richness within Q1 from 2008 to 2014

Freshwater Wetland Complex (Q2)

The number of species recorded in the Freshwater Wetland Complex (Q2) since 2008 has doubled (Plate 2, Figure 6). This quadrat was relocated in 2009 following an OEH recommendation. It was thought that the new location would provide data more relevant to the scope of the survey.

Overall the wetland appears to be in good health with native species dominating the wettest areas (*Typha orientalis*, *Bolboschoenus caldwellii* and *Eleocharis equisetina*). Several exotic species are encroaching from the nearby roadside such as *Verbena bonariensis* (Purpletop) and *Pennisetum clandestinum* (Kikuyu), but it is unlikely that these species will spread into the actual wetland.



Plate 2 Flora quadrat 2 (Q2) located in Freshwater Wetland Complex dominated by Typha (Photograph taken in 2014)

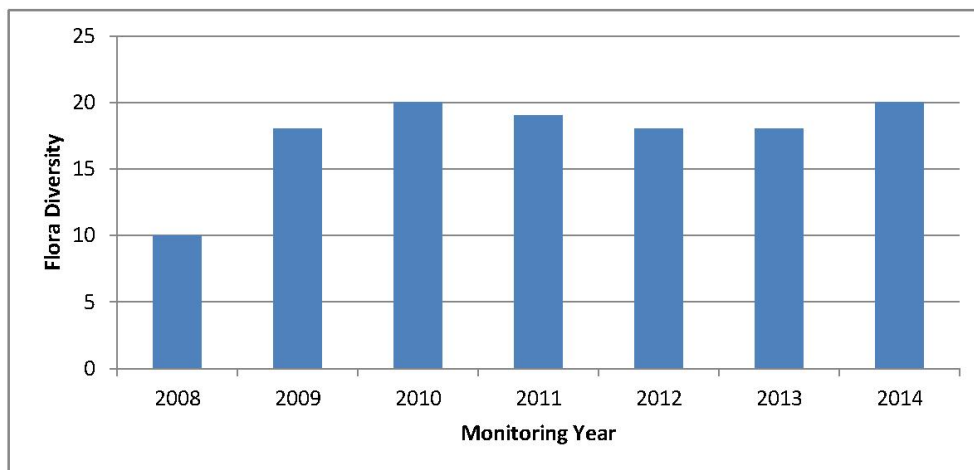


Figure 6 Flora species richness within Q2 from 2008 to 2014

Paperbark Swamp Forest (Q3)

Flora species richness in the Paperbark Swamp Forest (Q3) (Plate 3) increased from 2008 to 2010, then declined from 2011 to 2012 where it has remained relatively stable (Figure 7). This fluctuation is likely to be due to natural changes in the amount of standing water within the swamp.





Infestations of *Pennisetum clandestinum* (Kikuyu) and *Rubus fruticosus* (Blackberry) remain abundant outside Q3 in the north-east corner of the reserve.



Plate 3 **Flora quadrat 3 (Q3) located in Paperbark Swamp Forest (Photograph taken in 2014)**

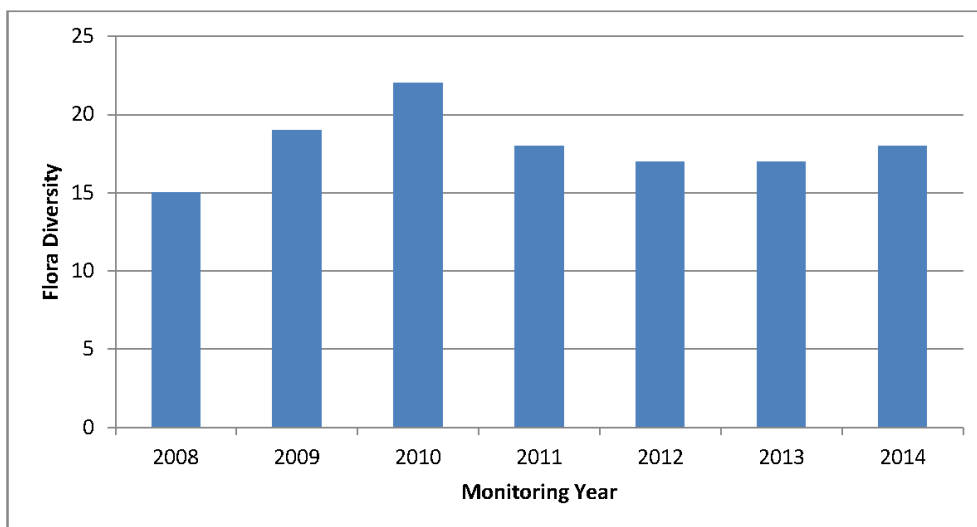


Figure 7 Flora species richness within Q3 from 2008 to 2014

Paperbark Swamp Forest (Q4)

A total of 12 species were recorded in the Paperbark Swamp Forest (Q4) in 2008 (Figure 8, Plate 4). This quadrat was relocated in 2009 in response to a request by OEH as the new location was thought likely to produce more informative seasonal data. There has been a gradual decrease in the number of flora species recorded from 2009 to 2012 with the number of species stable from 2012 to 2014 (Figure 8). This is likely to be due to natural variation.

Alternanthera philoxeroides (Alligator Weed) has been recorded in 2011, 2012, 2013 and 2014. The abundance of this noxious weed has increased slightly since it was first detected however at this stage it is causing only minor impacts as it does not appear to be out-competing native species.

Water Hyacinth (*Eichhornia crassipes*) continues to persist at the location in moderate to high densities. Densities of Water Hyacinth appear to be greater in 2014 since the previous year.



Plate 4 Flora quadrat 4 located in Paperbark Swamp Forest (Photograph taken in 2014)

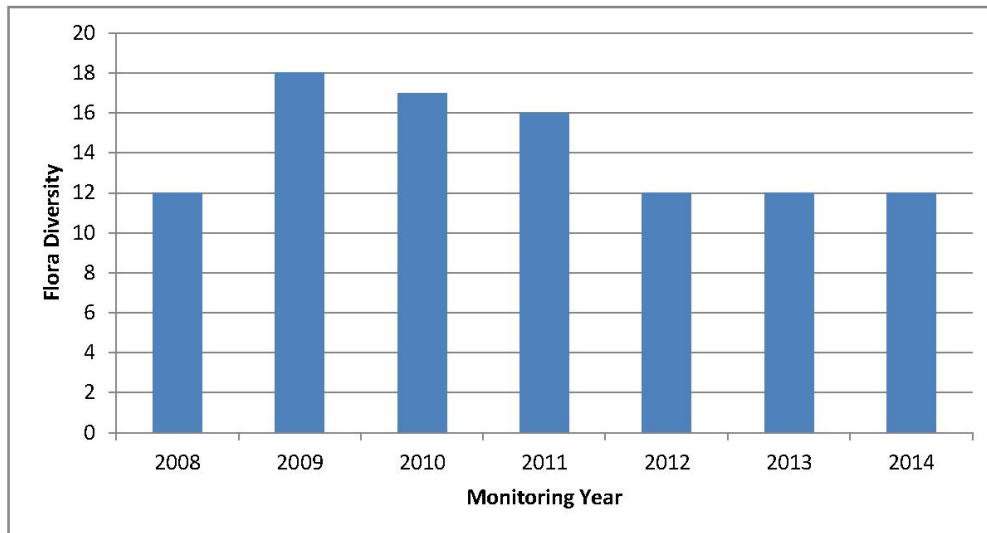


Figure 8 Flora species richness within Q4 from 2008 to 2013



Flora Transect

The flora transect samples a Freshwater Wetland Complex as can be seen in **Plate 5**. Flora species richness recorded on the transect has remained relatively stable since monitoring began (**Figure 9**). A lower number of species were recorded during the 2014 survey due to the absence of *Cyperus* species such as *Cyperus odoratus* and *Schoenoplectus validus*. Although these species were identified elsewhere in the reserve, their absence within the transect area may be due to natural seasonal variation.

Water Hyacinth (*Eichhornia crassipes*) was recorded at high densities from 2008 to 2011, with a reduction in 2012 following control efforts. Only small plants were observed in 2014.



Plate 5 Flora transect located in Freshwater Wetland Complex (Photograph taken in 2014)

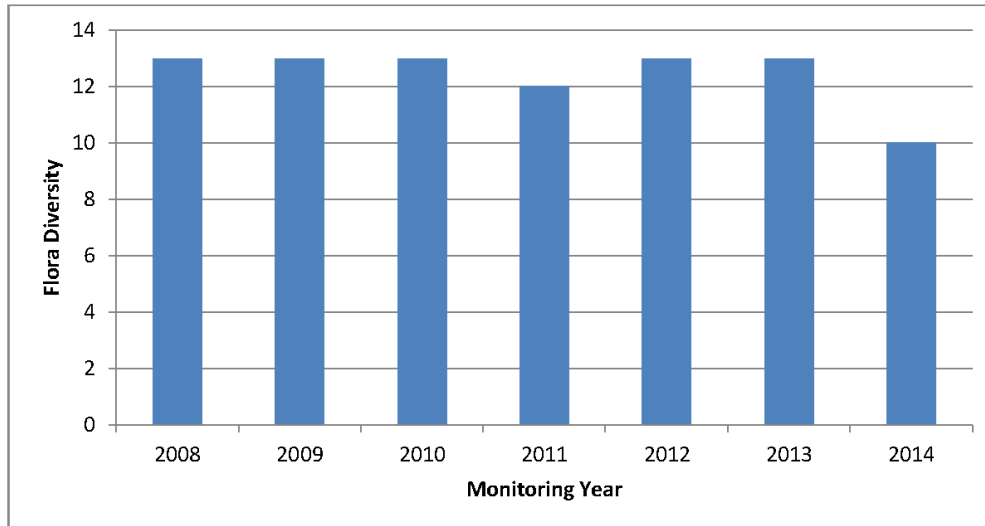


Figure 9 Flora species richness within T1 from 2008 to 2014

3.4 WEED SPECIES

The reserve has significant weed infestations across both disturbed areas and within the natural vegetation (Figure 10). The primary weeds at the time of survey were:

- ***Eichhornia crassipes* (Water Hyacinth)** – this species can survive for a long time and when conditions are favourable, can spread rapidly and cover large areas of open water. This rapid spread can choke out sunlight for natural inundated plant species and reduce open water access and usage for water birds. The life cycle of this plant means that it will continue to become established from both local and regional sources as it can float downstream and seeds can be delivered by itinerant birdlife.
 - This weed dominated the water outlet from the Main Swamp to the North Swamp during the first monitoring event in 2008 (Plate 6). Prior to the 2009 monitoring event, some Water Hyacinth had been extracted from the open water and a grate installed to prevent this weed blocking the under road culvert (Plate 7). Subsequent years can be observed in Plates 8, 9, 10 and 11 for years 2010, 2011, 2012 and 2013 respectively.
 - The 2014 monitoring event found that the coverage of *Eichhornia crassipes* has increased from the previous year (Plate 12). The abundance of the weed was decreased last year due to weed spraying by the Pambalong Nature Reserve



Enhancement Project. The spraying resulted in more open water present in the North Swamp (Plate 11).

- o Water Hyacinth is a declared Class 4 Noxious Weed in Newcastle, Cessnock and Maitland local government areas and the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority. Ongoing management would need to be coordinated through local government and stakeholders. The NPWS Hunter Region Pest Management Strategy (2002) has identified control of Water Hyacinth at Pambalong Nature Reserve as a "high priority" and an active program has been operating in the reserve since 2002.

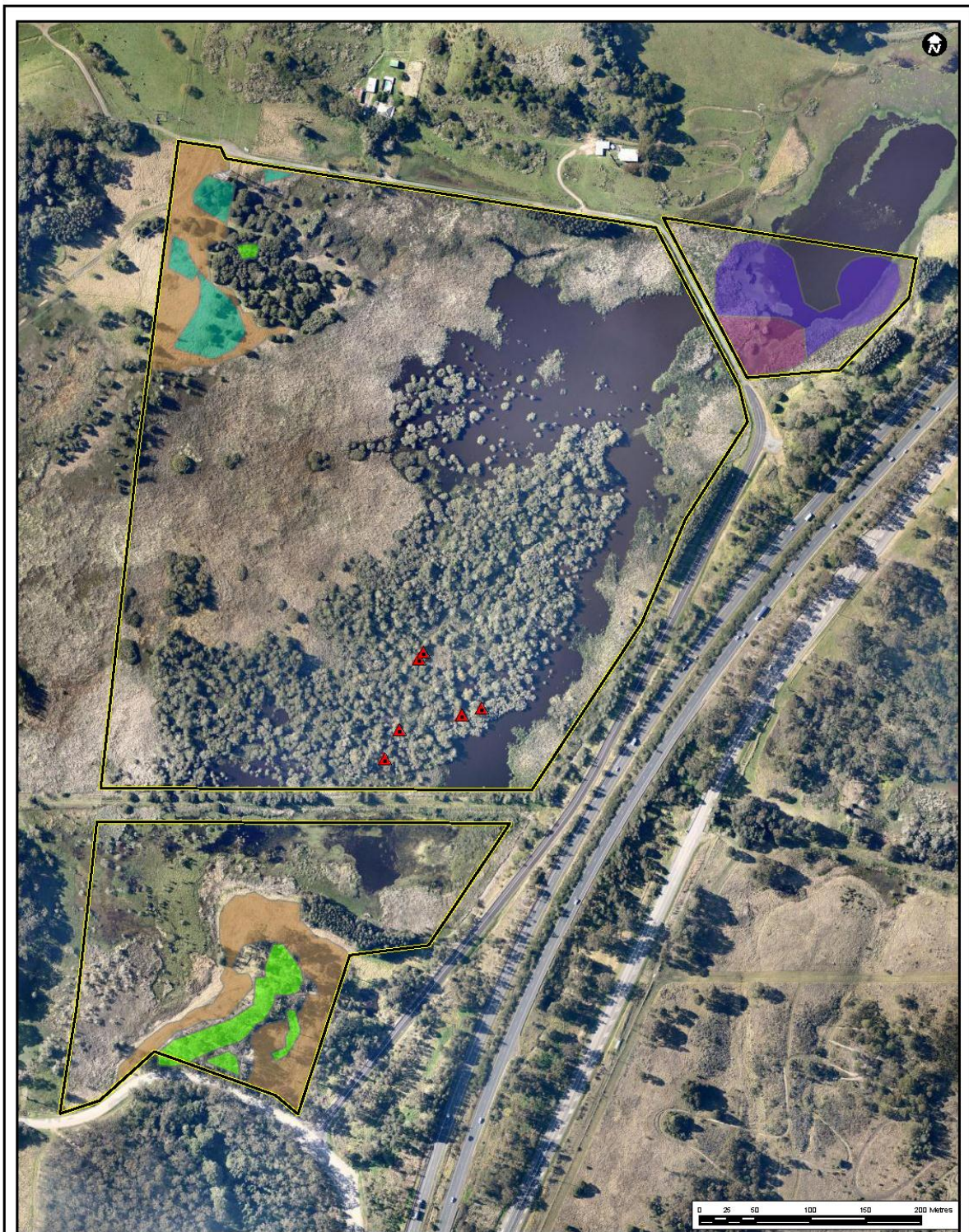


Figure 10: Weed Species Mapping

Legend

- Pambalong Nature Reserve
- ▲ Alligator Weed
- Blackberry (Treated 2009)
- Water Hyacinth (Treated 2009)
- Water Hyacinth
- Lantana
- Kikuyu and Various Weeds



Project Ref: 20153124
Plot Date: 1/12/2014 12:03
Revision: 001 (GJoyce)

Map Projection:
GDA 1994 MGA Zone 56

Data Sources:
LPI - 2011
OEH - 2012
Kleinfelder - 2014
Nearmap - 2014

Disclaimer: This is not an official or a legal map but is for information only. All data was compiled from the best sources available. All boundaries, scale and geographic points are approximate.

L:\GIS FOLDER\99 CLIENT FILES\101_AbelUndergroundCoalMine\2015\3124_Pambalong_2014\November\Mapping\2015\3124_Fig10_WeedSpeciesMapping.mxd



Plate 6 Water Hyacinth at the Northern Swamp inlet in 2008



Plate 7 Water Hyacinth at the Northern Swamp inlet in 2009 showing the installation of a grate



Plate 8 Water Hyacinth at the Northern Swamp inlet in 2010



Plate 9 Water Hyacinth at the Northern Swamp inlet in 2011



Plate 10 Water Hyacinth at the Northern Swamp inlet in 2012



Plate 11: Water Hyacinth at the Northern Swamp inlet in 2013



Plate 12: Water Hyacinth at the Northern Swamp inlet in 2014

- *Pennisetum clandestinum* (Kikuyu) forms dense, monoculture grassy thickets within disturbed areas of the subject site. The thickets are so dense in some areas that they are suppressing native vegetation regeneration.
 - Kikuyu is a species listed under the Key Threatening Process (KTP) 'Invasion of native vegetation communities by exotic perennial grasses'.
 - The boundary of Kikuyu dominance is restricted by the hydrological regime, generally adjacent to the high water mark, and the thickets are unlikely to spread into the wetland areas.
 - Kikuyu is particularly dense in the north-west and south-east corners of the subject site.



Plate 13: *Pennisetum clandestinum* (Kikuyu) in the north-east corner of the reserve

- *Rubus fruticosus* sp. agg. (Blackberry) is found in areas of previous disturbance within the reserve, and forms a dense thicket to 1 m high, suppressing natural regeneration. Blackberry thickets can restrict fauna access to the wetland areas and provide shelter for feral animals. Blackberry is a declared Class 4 Noxious Weed in Newcastle, Cessnock and Maitland local government areas and the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority (the plant may not be sold, propagated or knowingly distributed).
 - The NPWS Hunter Region Pest Management Strategy (2002) identifies Blackberry as a “high priority” weed. This species was initially treated by weed control efforts in 2008; however it was still recorded at low densities on Transect 1 in 2013. Ongoing treatment is required to eradicate/suppress this species and prevent re-establishment.



Plate 14: **Rubus fruticosus (Blackberry) in the north-east and south-east corner of the reserve**

- ***Lantana camara* (Lantana)** is a primary weed of the dry sclerophyll woodland at the southern portion of the subject site. This species can dominate the shrub and mid stratum, effectively out-competing native species and can provide refuge for feral animals.
 - The 'Invasion, establishment and spread of *Lantana camara*' is listed as a Key Threatening Process (KTP) under the NSW TSC Act.
 - *Lantana* is a declared Class 4 Noxious Weed in Cessnock and Class 5 Noxious Weed in all of NSW. The NPWS Hunter Region Pest Management Strategy (2002) identifies *Lantana* as a "high priority" weed. Significant efforts were made to control this weed in the southern part of the reserve in 2013.
- ***Ageratina adenophora* (Crofton Weed)** is tolerant of wet soils and will extend into wetlands if unmanaged. This species is a Noxious Weed and control is required where the weed is found. The NPWS Hunter Region Pest Management Strategy (2002) identifies Crofton Weed as a "high priority" weed. There were no significant outbreaks of this species recorded in the 2013 surveys.



- o Crofton Weed is a declared Class 4 Noxious Weed in Newcastle, Cessnock and Maitland local government areas and the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.
- ***Alternanthera philoxeroides* (Alligator Weed)** may infest both terrestrial and aquatic environments. Although only a few small plants were identified, this species is known to have the potential to cause severe impacts and should continue to be closely monitored. The cover of this weed was observed to have increased slightly in 2013. Alligator Weed has the potential to infest waterways and invade adjoining land. Alligator Weed is easily spread and once established it is virtually impossible to eradicate. It is a declared noxious weed and eradication measures are required. The NPWS Hunter Region Pest Management Strategy (2002) identifies Alligator Weed as a “high priority” weed.



Plate 15: ***Alternanthera philoxeroides* (Alligator weed)** in the central portion of the reserve



Other weeds found at the subject site are general weeds of disturbed areas, confined to the fringes of the reserve, roadsides and the former rail line and are generally outside the natural vegetation areas.

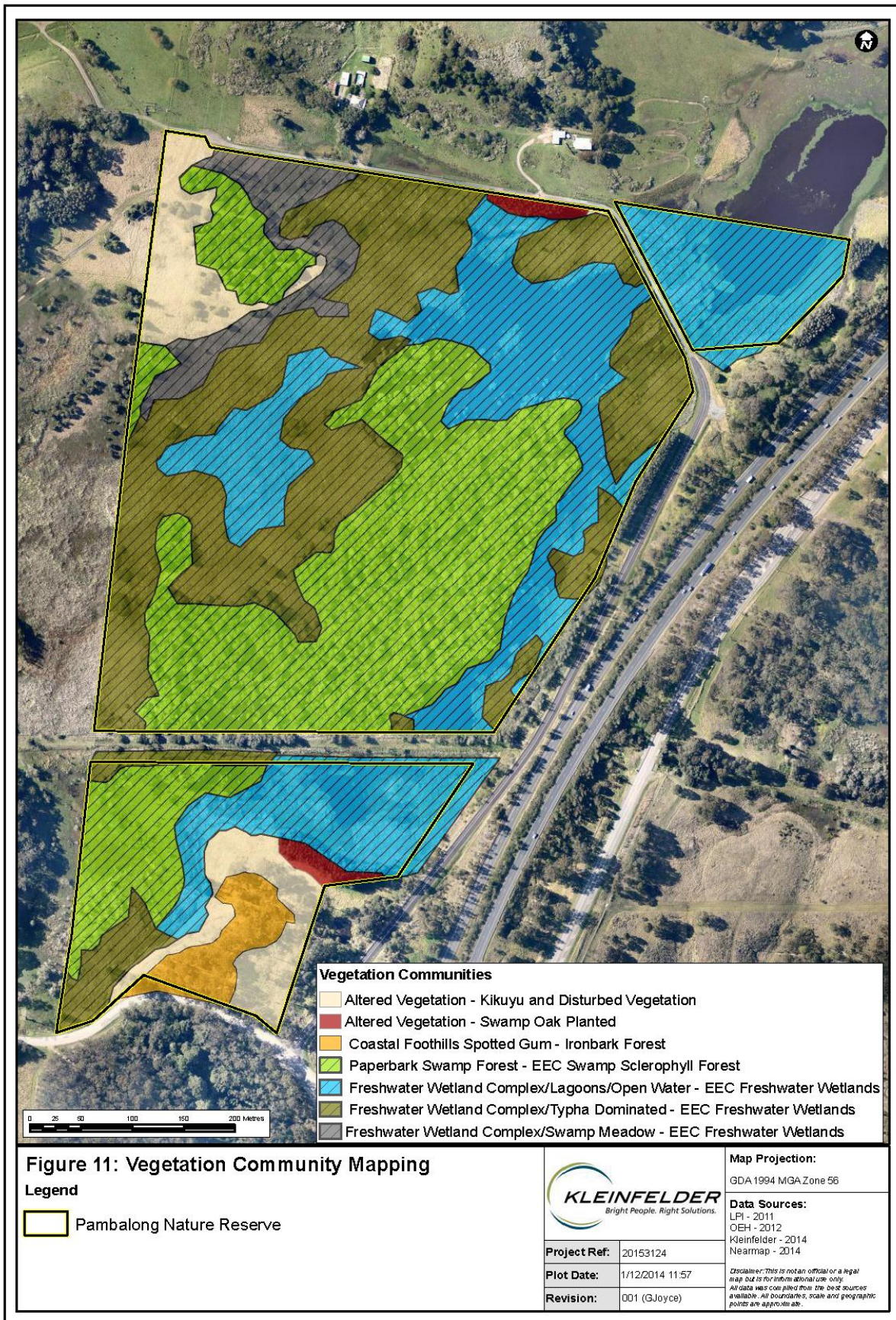
Weeds not detected during field surveys but with the potential to invade include:

- ***Xanthium occidentale* (Noogoora Burr)**. This species has been identified from previous studies. The NPWS Hunter Region Pest Management Strategy (2002) identifies Noogoora Burr as a “high priority” weed, although at this stage there are no specific control programs for this species in the reserve.

Some naturally occurring species may also present a problem if they become too abundant. *Typha orientalis* (Typha) and *Phragmites australis* (Phragmites) have the potential to spread into areas of open water, restricting the available habitat of open water bird species, such as pelicans, ducks and swans.

3.5 VEGETATION COMMUNITIES

Three natural vegetation communities and associated variations, and two altered vegetation types were mapped on the subject site in 2008 (Figure 11). The distribution of communities did not change in the 2014 surveys.



L:\GIS FOLDER\09 CLIENT FILES\101_AbelUndergroundCoalMine\20153124_Pambalong_2014\November\Wapping\20153124_Fig11_VegCommunity.mxd



3.5.1 Coastal Foothills Spotted Gum – Ironbark Forest (Dry Sclerophyll Forest)

This community occurs as an open forest on the knoll at the southern portion of the subject site. The overall community shows significant past disturbance and subsequent weed infestation.

The community is dominated by *Corymbia maculata* and *Eucalyptus siderophloia* with some *Eucalyptus acmenoides* scattered throughout. The mid stratum has a high abundance of *Lantana camara* and to a lesser extent, *Bursaria spinosa* and *Acacia maidenii*. The shrub layer is dominated by *Daviesia ulicifolia* and the ground cover is grassy with *Themeda australis*, *Dichelachne micrantha*, *Entolasia stricta*, *Echinopogon caespitosus* and *Aristida vagans* common.

This community is not dependent on the wetland and associated hydrology. *Coastal Foothills Spotted Gum – Ironbark Forest* is not listed as a Threatened Ecological Community.

3.5.2 Paperbark Swamp Forest (Swamp Sclerophyll Forest)

The Paperbark community is restricted to more elevated flats and areas bordering the freshwater wetland complex. Patches at the centre of the reserve are the most mature, and consists of a scattered *Casuarina glauca* canopy over dense *Melaleuca* sub-canopy. Flora quadrat 3 is located in the northern portion, adjacent to the Water Couch-Triglochin Swamp Meadow community and flora quadrat 4 is located centrally in the core forested area.

The species composition within Q3 is typically dominated by the canopy species *Melaleuca linariifolia* and *M. styphelioides*. One juvenile *Ficus macrophylla* is also located in the quadrat. The vine *Parsonsia straminea* is found within the quadrat, however, it is more common in mature vegetation. Some *Melaleuca ericifolia* is present within the quadrat indicating frequent inundation; however, this species is more common in permanent swamp areas at the ecotone between the Paperbark community and the freshwater wetlands. The mid stratum is sparse or absent. The ground cover within the quadrat comprises *Bolboschoenus caldwellii*, *Eleocharis acuta*, *Paspalum distichum*, *Persicaria hydropiper* and *Juncus usitatus*.

Within Q4, floristic structure is similar to Q3; however, with the more permanent inundation, several other species are also present. These include *Enydra fluctuans*, *Juncus pallidus*,



Ludwigia peploides subsp. *montevidensis*; *Typha orientalis* and *Casuarina glauca*. Two epiphytic orchid species, *Dendrobium linguiforme* (Tongue Orchid) and *D. teretifolium* (Rat's Tail Orchid), occur on several *Casuarina glauca* trees. The weed Water Hyacinth is present in low and scattered numbers in this community.

The Paperbark Swamp Forest and Paperbark Woodland forms part of the NSW TSC Act-listed *Swamp Sclerophyll Forest on Coastal Floodplains EEC*.

3.5.3 Freshwater Wetland Complex (Freshwater Wetland)

The Freshwater Wetland Complex occurs in deeper depressions having a permanent or periodical inundation of fresh water, such that the species composition is comprised of water tolerant species. At the subject site the Freshwater Wetland Complex consists of three variations: Typha Reedland; Rushland Swamp/Open Water; and Water Couch-Triglochin Swamp Meadow.

Specifically, these mapped freshwater wetland variations range from open water bodies, with tall reeds and sedges, to a mixed reedland, rushland or swamp meadow integrating with the Paperbark Swamp Forest community. The integration is likely to be a dynamic and moving boundary, at the present time directed by seasonal and climatic conditions.

The Freshwater Wetland Complex forms part of the NSW TSC Act-listed *Freshwater Wetlands on Coastal Floodplains EEC*.

3.5.3.1 Typha Reedland

The Typha Reedland dominates deeper permanently inundated areas within the reserve. The Typha Reedland generally borders the lagoon areas. The extent of Typha relates to the seasons and water levels. Q2 is located within this community variant. The dominant species are *Typha orientalis* (Broadleaf Cumbungi), *Schoenoplectus validus*, *Paspalum distichum* (Water Couch) *Eleocharis equisetina* and *Bolboschoenus caldwellii*.

3.5.3.2 Rushland Swamp/Open Water

The Rushland Swamp is located in shallow semi-permanent and permanent water bodies. Transect T1 is located in this community in the South Swamp and the species diversity within this community is relatively low. The water level varies from deeper water to boggy substrate in the survey transect. The community is dominated by *Bolboschoenus caldwellii*, *Eleocharis*



acuta and *Paspalum distichum*. *Ludwigia peploides* subsp. *montevidensis*, *Spirodela punctata* and *Triglochin procera*.

The open water areas occupy large portions of the Main Swamp and the North Swamp. This community is very variable due to seasonal and local climatic conditions and is related to the extent of the Typha Reedland and Rushland Swamp. The results of the 2013 surveys were not significantly different to the 2012 surveys.

3.5.3.3 Water Couch-Triglochin Swamp Meadow

The Water Couch-Triglochin Swamp Meadow is found at the northern end of the Main Swamp. The presence of old fence lines indicates the previous land use of the site for grazing purposes. The composition and structure of flora are indicative of some disturbance. This community is dominated by *Paspalum distichum*, *Triglochin* sp. and *Persicaria* sp. The Swamp Meadow is also fringed on the deeper inundations by Typha Reedland.

3.5.4 Altered Vegetation - Swamp Oak Forest (planted)

Two isolated sections of the subject site contain *Casuarina glauca* stands that have been physically planted. These communities are not natural and their composition does not adequately represent a natural community. *Casuarina glauca* is also found naturally throughout the Paperbark Swamp Forest.

3.5.5 Altered Vegetation - Disturbed/Kikuyu Grassland

The Kikuyu dominated grasslands and disturbed areas have a monoculture of Kikuyu or a weed dominated composition. Kikuyu Grass dominates large areas adjacent the south swamp and Coastal foothills Spotted Gum – Ironbark Forest community and north from the main swamp.

The rail line between the South Swamp and Main Swamp is infested by weeds; however, this is mainly restricted to the elevated area and is not impacting upon the swamp areas.

3.5.6 Endangered Ecological Communities

The vegetation mapping encompasses two Endangered Ecological Communities: *Freshwater Wetlands on Coastal Floodplains* EEC; and, *Swamp Sclerophyll Forest on*



Coastal Floodplains EEC. The EEC's occupy the majority of the reserve and their distribution is shown in Figure 11.

3.5.6.1 Freshwater Wetlands

Freshwater Wetlands are associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Soils are typically silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains (NSW Scientific Committee 2004).

The species composition of freshwater wetlands at the subject site is indicative of the EEC as they are dominated by herbaceous plants and have few woody species. The vegetation composition (grassland, open water or sedgeland vegetation) is known to vary both spatially and temporally depending on the water regime.

Hexham Swamp and Pambalong Nature Reserve are recognised as important reserves for freshwater wetlands.

3.5.6.2 Swamp Sclerophyll Forests

The Paperbark Swamp Forest is recognised as a Swamp Sclerophyll Forest EEC. The community is dominated by *Melaleuca linariifolia*, *M. ericifolia* and *M. styphelioides* (paperbarks) and scattered *Casuarina glauca*. This is indicative of a sclerophyllous community; however, it does lack a tree layer of eucalypts. The subject site was inundated at the time of surveying; however, previous reports indicate these areas become dry land during extended dry periods.

The groundcover was composed of abundant sedges, ferns, forbs, and grasses which were indicative of the EEC.

Within the Lower Hunter district, this community includes 'Swamp Mahogany-Paperbark Swamp Forest' (map unit 37), Riparian Melaleuca Swamp Woodland (map unit 42) and Melaleuca Scrub (map unit 42a) of NPWS (2000).



3.6 FAUNA

A total of 106 fauna species were recorded by monitoring surveys on the subject site in the 2014/15 monitoring period (**Appendix 2**). Total fauna species richness recorded in each monitoring year is shown in **Figure 12**. Species recorded in 2014 comprised five frogs, five scansorial mammals, 12 bat, one reptile and 84 bird species. Of these, seven species are listed as threatened (Vulnerable or Endangered) under the NSW TSC Act (**Table 5**).

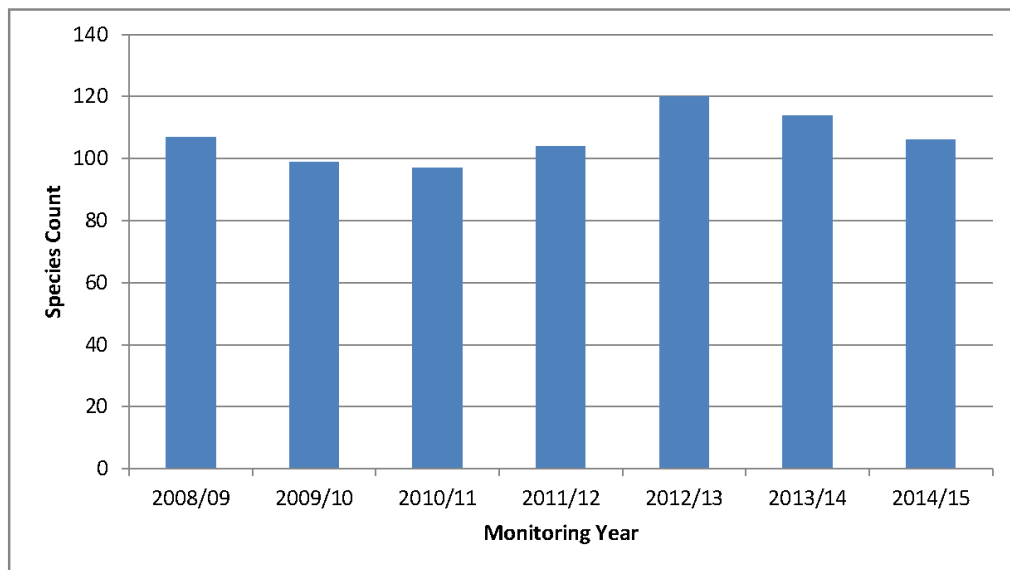


Figure 12 Fauna species richness recorded from 2008/09 to 2014/15



Table 5 Threatened fauna species recorded in 2014/15

Scientific Name	Common Name	Legal status	Survey Method
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E – TSC Act	Bird surveys / 2 birds at North Swamp
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V – TSC Act	Anabat recording (probable)
<i>Miniopterus australis</i>	Little Bentwing-bat	V – TSC Act	Trapped and Anabat recording (confident)
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V – TSC Act	Anabat recording (confident)
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V – TSC Act	Anabat recording (confident)
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V – TSC Act & EPBC Act	Spotlighting
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V – TSC Act	Anabat recording (probable)

NB: taxonomy for bats follows Churchill (2008)
 V = vulnerable; E = endangered

The number of amphibian, reptile, and mammal species detected in each monitoring year is shown in **Figure 13**. Total species richness has remained relatively stable with the exception of 2009/10 when total species richness was considerably lower and no reptiles were recorded.

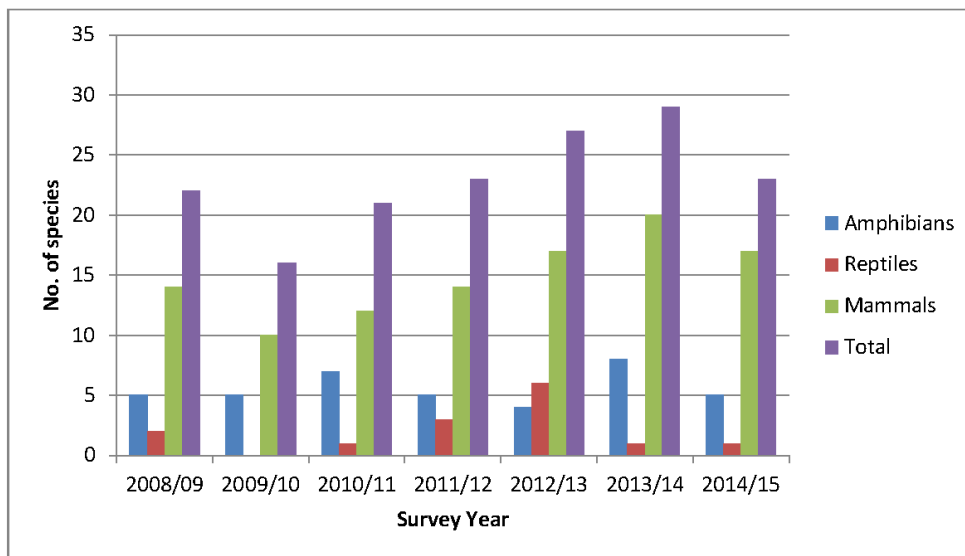


Figure 13 Fauna species richness by taxon from 2008/09 to 2014/15 (excluding birds)



3.6.1 Amphibians

Five species of amphibian were detected during the 2014/15 surveys. No threatened species of amphibian were detected. No new species or notable absences were detected in 2014/15.

Photographs of each water body surveyed for birds and amphibians are provided in **Appendix 3**. Photographs from the October 2011, March 2012, March 2014 and March 2015 survey period are provided to enable a visual comparison of the variability of water levels, areas of open water and aquatic vegetation occurring at each of the three water bodies.

3.6.2 Birds

Figure 14 shows changes in bird species richness at each of the five survey locations over time. A total of 84 bird species were recorded on site in 2014/15 compared with 85 species in 2013/14, 91 species in 2012/13, 81 species in 2011/12, 75 species in 2010/11, 83 species in 2009/10 and 84 species in 2008/09.

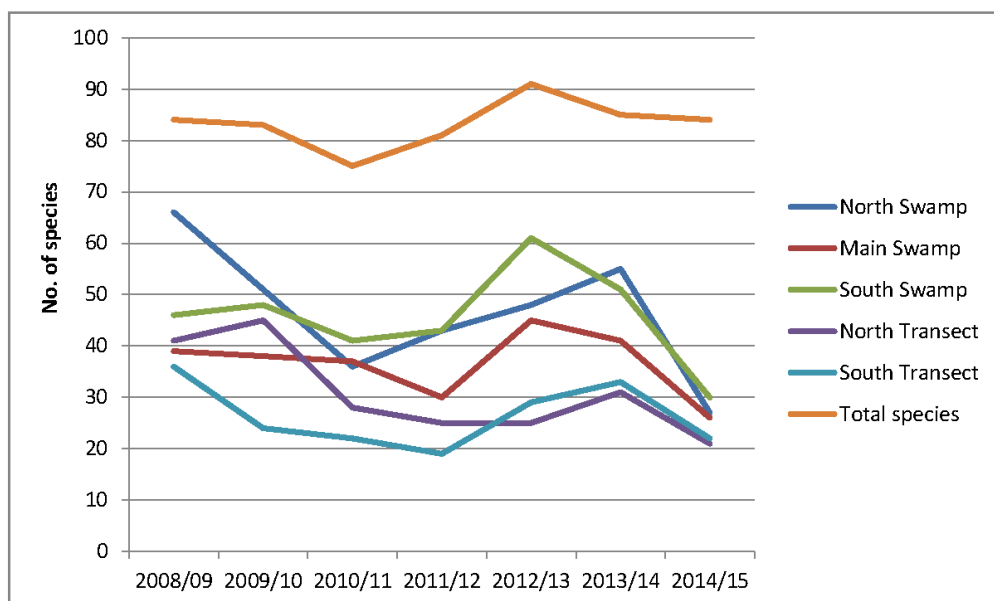


Figure 14 Bird species richness recorded at monitoring points from 2008 to 2015

Two species detected during the 2014/2015 surveys, the Southern Emu-wren (*Stipiturus malachurus*) and the Black-necked Stork (*Ephippiorhynchus asiaticus*), have not been detected during previous monitoring events.



Total bird species richness has remained relatively stable across all sites over the seven years of monitoring. While total species richness has been relatively constant, there was a decrease in species richness at each individual site from previous years, indicating variability in species composition between sites, most notably between the swamps and the transects. Species composition is quite variable between seasons and year-to-year. Surveys conducted in spring almost always detect more species than those conducted in autumn.

A higher number of roosting birds (598) was recorded during the 2014/15 surveys compared to previous survey events (**Appendix 2**).

Factors likely to affect bird species detection between years include seasonality issues (e.g. arrival times of migratory species), flowering times of foraging resources for nectarivorous species, climatic conditions and individual species ecology (eg. some species have a large home range and may be absent from the study area during surveys or have cryptic traits which make them more difficult to detect).

The Hunter Valley Bird Observers Club (HVBOC) was approached for bird survey data from the Pambalong Nature Reserve. A survey by members of the HVBOC in July 2014 recorded 24 bird species within the reserve (**Appendix 2**), one of which, the Little Wattlebird (*Anthochaera chrysoptera*) had not been previously recorded by Kleinfelder.

3.6.3 Mammals

One mammal species, Feathertail Glider (*Acrobates pygmaeus*), recorded from spotlight surveys in 2014, has not been recorded in previous years. Feathertail Gliders spend up to 87% of their time in trees at heights greater than 15 metres making them the most cryptic and rarely seen of all the glider species (Goldingay & Kavanagh 1995). An individual was observed in a tree along the southern dry forest transect.

A total of twelve bat species were recorded in 2014/15, which is considered a high diversity for the local area.

Introduced species such as the House Mouse and Black Rat and predators such as the Red Fox, Feral Cat and Dog have the potential to reduce native mammal populations. The Black Rat has been consistently recorded since 2008, except in 2011. This species is known to out-compete native rodent species. This could explain the intermittent detection of native



rodents, such as the Swamp Rat, which was only detected in 2013 and the Bush Rat, which was only detected in 2008.

Ongoing weed management targeting Lantana and Blackberry and ongoing management of illegal rubbish dumping is recommended.

3.6.4 Reptiles

One reptile species, Lace Monitor (*Varanus varius*), was detected during the 2014/15 surveys; this species has not been recorded in previous years.



4. CONCLUSIONS AND RECOMMENDATIONS

Monitoring of the Pambalong Nature Reserve has been undertaken in 2014/15 in accordance with the Flora and Fauna Management Plan for Abel Underground Coalmine (ecobiological 2007).

In total there were 101 flora species (within the flora survey quadrats and transect) and 106 fauna species comprising five frog, 17 mammal (12 bat), one reptile, and 84 bird species recorded at Pambalong Nature Reserve by monitoring surveys in 2014/15. The following threatened species were recorded during field surveys:

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Little Bentwing-bat (*Miniopterus australis*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*);
- Eastern Freetail-bat (*Mormopterus norfolkensis*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Eastern Cave Bat (*Vespadelus troughtoni*); and
- Black-necked Stork (*Ephippiorhynchus asiaticus*).

The 2014/15 survey recorded no new flora species. Flora species richness has remained relatively constant between the monitoring events in quadrats 1, 2 and 4 and the 50 m transect, with a steady increase occurring at Q3. No significant changes to the vegetation community extent were recorded in the 2013 surveys.

Kikuyu grass continues to cover significant areas and any treatment of these areas would require follow up regeneration and rehabilitation. All other significant weed species identified in Pambalong Nature Reserve should continue to be monitored and managed as necessary.

A recommendation made in previous years for water monitoring in the Main and South Swamps remains a high priority. Funding has recently been provided by the Donaldson Conservation Trust to The Tom Farrell Institute for the Environment to install a water quality



monitoring station at Pambalong that will record pH, electrical conductivity, temperature, dissolved oxygen, turbidity and water level within 15 minute intervals. The station is expected to be installed and operating by spring 2014. Data generated by this station will be immensely valuable in interpreting the results of future ecological monitoring. This will be followed-up for inclusion in the spring 2015 monitoring event to allow for a year of data to be collated for analysis.

Annual monitoring in 2014/15 has continued to contribute to a valuable long term data set on the composition, abundance and distribution of flora and fauna within Pambalong Nature Reserve. This information provides a sound basis for evaluating the potential ecological impacts of underground mining which may arise in the future and the development of appropriate management responses.



5. REFERENCES

Anstis M 2002, *Tadpoles of South-Eastern Australia: A Guide with Keys*, Reed New Holland, Sydney.

Bean AR 2007, 'A New System for Determining which Plants are Indigenous in Australia', *Australian Systematic Botany* 20(1), pp 1-43.

Bell FG, Stacey TR & Genske DD 2000 'Mining subsidence and its effect on the environment: some differing examples' *Environmental Geology* 40(1-2), pp 135-152.

Bibby CJ, Burgess ND & Hill DA 2000, *Bird Census Techniques*, Academic Press Limited, London.

Briggs JD & Leigh JH 1995, *Rare or Threatened Australian Plants*, CSIRO, Canberra.

Brunner H, Triggs B & Ecobyte Pty Ltd 2002, *Hair ID - An interactive tool for identifying Australia mammalian hair*, CSIRO Publishing, Collingwood.

Churchill S 2008, *Australian Bats 2nd Edition*, Allen & Unwin, Crows Nest.

Department of Environment and Conservation 2006, *Pambalong Nature Reserve Plan of Management*, DEC Hunter Region, May 2006.

ecobiological 2007, *Abel Underground Coalmine Flora and Fauna Management Plan*, prepared for Donaldson Coal Pty Ltd, October 2007.

Eco Logical Australia 2003, *An Investigation and Description of the Vegetation of the Pambalong Swamp (Pambalong Nature Reserve)*, NSW National Parks and Wildlife Service.

Goldingay, R.L., and Kavanagh, R.P. (1995). Foraging Behaviour and Habitat Use of the Feathertail Glider (*Acrobates pygmaeus*) at Waratah Creek. New South Wales, Wildlife Research 22: 457-470.

Harden GJ (ed) 1992, *Flora of New South Wales Volume 3*, NSW University Press, Sydney.



Harden GJ (ed) 1993, *Flora of New South Wales Volume 4*, NSW University Press, Sydney.

Harden GJ (ed) 2000 *Flora of New South Wales Volume 1*, NSW University Press, Sydney.

Harden GJ (ed) 2002 *Flora of New South Wales Volume 2*, NSW University Press, Sydney.

NPWS 2000, *Vegetation Survey, Classification and Mapping Lower Hunter and Central Coast Region Version 1.2*, A project undertaken for The Lower Hunter and Central Coast Regional Environment Management Strategy CRA Unit Sydney Zone, National Parks and Wildlife Service.

NPWS 2002, *Hunter Region Pest Management Strategy*, NSW National Parks and Wildlife Service, Shortland.

NSW Scientific Committee 2004, *Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions – Endangered Ecological Community Listing*, Office of Environment and Heritage Website, Updated 28 February 2011, Available:

<http://www.environment.nsw.gov.au/determinations/FreshwaterWetlandsEndSpListing.htm>

Poore MED 1955 'The use of phytosociological methods in ecological investigations: The Braun-Blanquet system', *Journal of Ecology*, 43(1), pp 226-244.

Sidle RC, Kamil I, Sharma A & Yamashita S 2000, 'Stream response to subsidence from underground coal mining in central Utah', *Environmental Geology* 39(3-4), pp 279-291.

Straw P 2000, *Birds of Pambalong Nature Reserve – Management Strategy Avifauna*, Avifauna studies for NSW National Parks and Wildlife Service.

Triggs B 1996, *Tracks, Scats and Other Traces: A Field Guide to Australian Mammals*, Oxford University Press.

White A 2000, *Frog, Reptile and Mammal Survey Minmi Swamp Biosphere*, Environmental Consultants for NSW National Parks and Wildlife Service.

This page has intentionally been left blank



APPENDIX 1. FLORA SPECIES LIST

Family	Scientific Name	Common Name	Q1	Q2	Q3	Q4	T1
Acanthaceae	<i>Brunoniella australis</i>	Blue Trumpet	1				
Adiantaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Mulga Fern	1				
Alismataceae	<i>Alisma plantago-aquatica</i>	Water Plantain					
Amaranthaceae	* <i>Alternanthera philoxeroides</i>	Alligator Weed				3	
Amaranthaceae	<i>Alternanthera denticulata</i>	Lesser Joyweed			3		
Anthericaceae	<i>Arthropodium milleflorum</i>	Pale Vanilla-lily					
Apiaceae	* <i>Foeniculum vulgare</i>	Fennel					
Apiaceae	* <i>Hydrocotyle bonariensis</i>	Pennywort					
Apiaceae	<i>Centella asiatica</i>	Indian Pennywort	2	1			
Apocynaceae	* <i>Araujia sericifera</i>	Moth Vine					
Apocynaceae	* <i>Gomphocarpus fruticosus</i>	Wild Cotton					
Apocynaceae	<i>Parsonsia straminea</i>	Monkey Rope			2		
Asparagaceae	* <i>Protasparagus aethiopicus</i>	Fern Asparagus					
Asteraceae	* <i>Ageratina adenophora</i>	Crofton Weed					
Asteraceae	* <i>Ambrosia tenuifolia</i>	Lacy Ragweed					1
Asteraceae	* <i>Aster subulatus</i>	Wild Aster	1				
Asteraceae	* <i>Bidens pilosa</i>	Cobblers peg	2				
Asteraceae	* <i>Cirsium vulgare</i>	Black Thistle					
Asteraceae	* <i>Conyza canadensis</i> var. <i>canadensis</i>	Canadian Fleabane					
Asteraceae	* <i>Conyza</i> sp.	Fleabane					
Asteraceae	* <i>Conyza sumatrensis</i>	Tall Fleabane					
Asteraceae	* <i>Crassocephalum crepidioides</i>	Thickhead					
Asteraceae	* <i>Euchiton</i> sp.	Cudweed					
Asteraceae	* <i>Hypochaeris radicata</i>	Catsear					
Asteraceae	* <i>Hypochaeris radicata</i>	Catsear					
Asteraceae	* <i>Senecio madagascariensis</i>	Fireweed	2		2		
Asteraceae	* <i>Sonchus oleraceus</i>	Milk Thistle		1			
Asteraceae	* <i>Tagetes minuta</i>	Stinking Roger					
Asteraceae	<i>Brachycome multifida</i> var. <i>dilatata</i>	Cut-leaf daisy	1				
Asteraceae	<i>Cotula coronopifolia</i>	Water Buttons					
Asteraceae	<i>Enydra fluctuans</i>						
Asteraceae	<i>Euchiton involucratus</i>	Star Cudweed					
Asteraceae	<i>Ozothamnus diosmifolius</i>	White dogwood	3				
Asteraceae	<i>Senecio pterophorus</i>						
Asteraceae	<i>Vernonia cinerea</i> var. <i>cinerea</i>		1				
Asteraceae	<i>Vittadinia cuneata</i> var. <i>cuneata</i>	Fuzzweed	1				



Family	Scientific Name	Common Name	Q1	Q2	Q3	Q4	T1
Azollaceae	<i>Azolla filiculoides</i>	Pacific Azolla					3
Bignoniaceae	<i>Pandorea pandorana</i> subsp. <i>pandorana</i>	Wonga Wonga Vine	3				
Campanulaceae	<i>Wahlenbergia gracilis</i>	Native Bluebell					
Caryophyllaceae	* <i>Stellaria media</i>	Chickweed					
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak		1		3	
Celastraceae	<i>Maytenus silvestris</i>	Orange Bark	1				
Ceratophyllaceae	<i>Ceratophyllum demersum</i>	Hornwort					
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush	1				
Chenopodiaceae	* <i>Atriplex prostrata</i>	Hastate Orache			4		
Commelinaceae	* <i>Tradescantia albiflora</i>	Wandering Jew	1				
Commelinaceae	<i>Commelina cyanea</i>	Scurvy Weed	1		3		
Convolvulaceae	* <i>Ipomoea purpurea</i>	Common Morning Glory					
Convolvulaceae	<i>Dichondra repens</i>	Kidney weed	2				
Cyperaceae	* <i>Cyperus difformis</i>						
Cyperaceae	<i>Bolboschoenus caldwellii</i>			3	5	2	
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge	1				
Cyperaceae	<i>Cyperus inversa</i>						
Cyperaceae	<i>Cyperus odoratus</i>						
Cyperaceae	<i>Eleocharis acuta</i>	Tall Spike-rush					
Cyperaceae	<i>Eleocharis equisetina</i>			2	3		2
Cyperaceae	<i>Eleocharis sphacelata</i>	Tall Spike-rush					2
Cyperaceae	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge					
Cyperaceae	<i>Schoenoplectus subulatus</i>			2			
Cyperaceae	<i>Schoenoplectus validus</i>			2			
Euphorbiaceae	* <i>Ricinus communis</i>	Castor Oil Plant					
Fabaceae - Caesalpinioideae	* <i>Senna pendula</i> subsp. <i>glabrata</i>	Cassia					
Fabaceae - Faboideae	* <i>Trifolium dubium</i>	Yellow Suckling Clover					
Fabaceae - Faboideae	* <i>Trifolium fragiferum</i>	Strawberry Clover					
Fabaceae - Faboideae	* <i>Trifolium repens</i>	White Clover					
Fabaceae - Faboideae	* <i>Vicia sativa</i>	Common Vetch		1			
Fabaceae - Faboideae	* <i>Vicia sativa</i>						
Fabaceae - Faboideae	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea	3				
Fabaceae - Faboideae	<i>Desmodium gunnii</i>	Slender Tick-trefoil					
Fabaceae - Faboideae	<i>Desmodium rhytidophyllum</i>	Tick-trefoil	2				
Fabaceae - Faboideae	<i>Desmodium varians</i>	Slender Tick-trefoil					
Fabaceae -	<i>Glycine clandestina</i>	Twining Glycine	2				



Family	Scientific Name	Common Name	Q1	Q2	Q3	Q4	T1
Faboideae							
Fabaceae - Faboideae	<i>Glycine tabacina</i>						
Fabaceae - Faboideae	<i>Hardenbergia violacea</i>	Purple Twining Pea	2				
Fabaceae - Faboideae	<i>Kennedia rubicunda</i>	Red Kennedy Pea					
Fabaceae - Faboideae	<i>Kennedia rubicunda</i>	Red Kennedy Pea					
Fabaceae - Mimosoideae	<i>Acacia falcata</i>	Sickle Wattle					
Fabaceae - Mimosoideae	<i>Acacia fimbriata</i>						
Fabaceae - Mimosoideae	<i>Acacia implexa</i>	Hickory					
Fabaceae - Mimosoideae	<i>Acacia irrorata subsp irrorata</i>						
Fabaceae - Mimosoideae	<i>Acacia maidenii</i>	Maidens Wattle	3				
Gentianaceae	* <i>Centaurium erythraea</i>	Common Centaury					
Goodeniaceae	<i>Goodenia heterophylla</i>		2				
Haloragaceae	<i>Myriophyllum variifolium</i>						
Iridaceae	* <i>Anomatheca laxa</i>		1				
Juncaceae	<i>Juncus continuus</i>			1	1		
Juncaceae	<i>Juncus pallidus</i>	Pale Rush					
Juncaceae	<i>Juncus usitatus</i>	Common Juncus	2				
Juncaginaceae	<i>Triglochin procerum</i>						6
Juncaginaceae	<i>Triglochin striata</i>	Streaked Arrowgrass		1		2	
Lamiaceae	<i>Plectranthus parviflorus</i>	Cockspur Flower	1				
Lemnaceae	<i>Lemna disperma</i>						2
Lemnaceae	<i>Spirodela punctata</i>	Duck Weed				3	2
Lobeliaceae	<i>Pratia purpurascens</i>	White root	3			1	
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Matt Rush	1				
Lomandraceae	<i>Lomandra glauca</i>	Pale Mat-rush	1				
Lomandraceae	<i>Lomandra multiflora subsp. multiflora</i>	Iron Grass	2				
Loranthaceae	<i>Dendrophthoe vitellina</i>	Mistletoe	1				
Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry	2				
Luzuriagaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily	1				
Malvaceae	* <i>Sida rhombifolia</i>	Paddy's Lucerne	3				
Menispermaceae	<i>Stephania japonica var. discolor</i>	Snake Vine	2				
Moraceae	<i>Ficus macrophylla</i>	Moreton Bay Fig			2		
Myoporaceae	<i>Eremophila debilis</i>	Winter Apple	1				
Myrsinaceae	<i>Myrsine variabilis</i>		2				
Myrtaceae	<i>Corymbia maculata</i>	Spotted Gum	4				
Myrtaceae	<i>Eucalyptus acmenoides</i>	White mahogany	2				



Family	Scientific Name	Common Name	Q1	Q2	Q3	Q4	T1
Myrtaceae	<i>Eucalyptus siderophloia</i>	Grey Ironbark	5				
Myrtaceae	<i>Eucalyptus tereticornis</i>	Forest Redgum					
Myrtaceae	<i>Melaleuca ericifolia</i>				4		
Myrtaceae	<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark		1	4	4	
Myrtaceae	<i>Melaleuca styphelioides</i>				4	4	
Oleaceae	<i>Notelaea longifolia</i>	Mock olive	3				
Onagraceae	* <i>Oenothera stricta</i>	Evening Primrose					
Onagraceae	<i>Epilobium billardierianum</i> subsp. <i>billardierianum</i>						
Onagraceae	<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>	Water Primrose					3
Orchidaceae	<i>Dendrobium linguiforme</i>	Tongue Orchid				2	
Orchidaceae	<i>Dendrobium teretifolium</i>	Rat's Tail Orchid				1	
Oxalidaceae	<i>Oxalis perennans</i>		1				
Passifloraceae	* <i>Passiflora edulis</i>	Common Passionfruit					
Phormiaceae	<i>Dianella caerulea</i>	Blue Flax-lily	3				
Phormiaceae	<i>Dianella revoluta</i> var. <i>revoluta</i>	Blueberry Lily	2				
Phyllanthaceae	<i>Breynia oblongifolia</i>	Coffee Bush	3				
Phyllanthaceae	<i>Phyllanthus hirtellus</i>	Thyme Spurge					
Pittosporaceae	<i>Bursaria spinosa</i>	Box Thorn	4				
Plantaginaceae	* <i>Plantago lanceolata</i>	Lambs Tongue	2	1			
Plantaginaceae	<i>Veronica plebeia</i>	Trailing Speedwell	1				
Poaceae	* <i>Andropogon virginicus</i>	Whisky Grass					
Poaceae	* <i>Axonopus fissifolius</i>	Narrow-leaved Carpet Grass			3		
Poaceae	* <i>Briza maxima</i>	Quaking Grass					
Poaceae	* <i>Bromus catharticus</i>	Prairie Grass					
Poaceae	* <i>Chloris gayana</i>	Rhodes Grass					
Poaceae	* <i>Cortaderia selloana</i>	Pampas Grass					
Poaceae	* <i>Ehrharta erecta</i>	Panic Veldtgrass	1				
Poaceae	* <i>Eragrostis curvula</i>	African Lovegrass					
Poaceae	* <i>Hyparrhenia hirta</i>	Coolatai Grass					
Poaceae	* <i>Lolium perenne</i>	Perennial Ryegrass					
Poaceae	* <i>Melinis repens</i>	Red Natal Grass					
Poaceae	* <i>Panicum maximum</i>	Guinea Grass					
Poaceae	* <i>Paspalum dilatatum</i>	Paspalum					
Poaceae	* <i>Paspalum urvillei</i>	Tall Paspalum					
Poaceae	* <i>Pennisetum clandestinum</i>	Kikuyu		2			
Poaceae	* <i>Polypogon monspeliensis</i>	Annual Beardgrass					
Poaceae	* <i>Setaria pumila</i>	Pale Pigeon Grass					
Poaceae	* <i>Setaria sphacelata</i>	South African Pigeon Grass					



Family	Scientific Name	Common Name	Q1	Q2	Q3	Q4	T1
Poaceae	* <i>Setaria verticillata</i>	Whorled Pigeon Grass					
Poaceae	* <i>Sporobolus africanus</i>	Parramatta Grass					
Poaceae	<i>Aristida ramosa</i>	Three-awned Spear Grass					
Poaceae	<i>Aristida vagans</i>	Three-awned Spear Grass	2				
Poaceae	<i>Austrostipa</i> sp.		1				
Poaceae	<i>Capillipedium parviflorum</i>	Scented-top Grass					
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass					
Poaceae	<i>Cynodon dactylon</i>	Couch		2	3		
Poaceae	<i>Dichelachne micrantha</i>	Shorthair Plumegrass	4				
Poaceae	<i>Digitaria ramularis</i>						
Poaceae	<i>Digitaria parviflora</i>	Small-flowered Finger Grass	1				
Poaceae	<i>Echinopogon caespitosus</i>	Tufted Hedgehog Grass					
Poaceae	<i>Entolasia stricta</i>	Wiry panic	4				
Poaceae	<i>Imperata cylindrica</i>	Bladey grass	4				
Poaceae	<i>Lachnagrostis filiformis</i>				3		
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass	1				
Poaceae	<i>Oplismenus aemulus</i>	Basket Grass	2				
Poaceae	<i>Panicum simile</i>	Two Colour Panic					
Poaceae	<i>Paspalidium distans</i>		2				
Poaceae	<i>Paspalum distichum</i>	Water Couch					
Poaceae	<i>Themeda australis</i>	Kangaroo grass	6				
Poaceae	<i>Austrodanthonia tenuior</i>	Wallaby Grass	5				
Polygonaceae	* <i>Polygonum arenastrum</i>	Wireweed					
Polygonaceae	* <i>Rumex conglomeratus</i>	Clustered Dock		3	3		
Polygonaceae	* <i>Rumex crispus</i>	Dock			1		
Polygonaceae	<i>Persicaria decipiens</i>	Slender Knotweed		3			
Polygonaceae	<i>Persicaria hydropiper</i>	Water Pepper		1			
Pontederiaceae	* <i>Eichhornia crassipes</i>	Water Hyacinth					2
Ranunculaceae	* <i>Ranunculus plebeius</i>	Creeping Buttercup		1		1	
Ranunculaceae	<i>Clematis glycinoides</i>	Old Mans Beard	1				
Ranunculaceae	<i>Ranunculus inundatus</i>	River Buttercup		1			
Rhamnaceae	<i>Alphitonia excelsa</i>	Red Ash	3				
Rhamnaceae	<i>Polyscias sambucifolia</i>	Elderberry Panax	1				
Rosaceae	* <i>Rubus fruticosus</i> sp.agg	Blackberry					
Rubiaceae	<i>Opercularia diphylla</i>		1				
Scrophulariaceae	<i>Bacopa monnieri</i>	Bacopa					
Solanaceae	* <i>Solanum mauritianum</i>	Wild Tobacco					
Solanaceae	* <i>Solanum nigrum</i>	Blackberry				1	



Family	Scientific Name	Common Name	Q1	Q2	Q3	Q4	T1
		Nightshade					
Solanaceae	<i>Solanum brownii</i>	Violet Nightshade	3				
Solanaceae	<i>Solanum prinophyllum</i>	Forest Nightshade					
Typhaceae	<i>Typha orientalis</i>	Broadleaf Cumbungi		6	3		2
Verbenaceae	* <i>Lantana camara</i>	Lantana	2				
Verbenaceae	* <i>Verbena bonariensis</i>	Purpletop					
Violaceae	<i>Viola hederacea</i>	Ivy-leaved Violet					
Vitaceae	<i>Cayratia clematidea</i>	Native Grape	1				

* denotes an introduced species



APPENDIX 2. FAUNA SPECIES LIST

Table 6 Fauna species (excluding birds) recorded from trapping and nocturnal survey activities by Kleinfelder 2008/09-2014/15 and White (2000)

Scientific Name	Common Name	Method	2008	2009	2010	2011	2012	2013	2014	White (2000)
Amphibians										
<i>Cirria signifera</i>	Common Eastern Froglet	Nocturnal amphibian survey	+		+	+	+	+	+	
<i>Limnodynastes peronii</i>	Striped Marsh Frog	Nocturnal amphibian survey	+	+	+	+	+	+		
<i>Limnodynastes tasmaniensis</i>	Spotted Marsh Frog	Nocturnal amphibian survey						+	+	
<i>Litoria fallax</i>	Eastern Dwarf Tree Frog	Nocturnal amphibian survey	+	+	+	+	+	+	+	
<i>Litoria freycineti</i>	Freycinet's Frog	Nocturnal and diurnal survey								+
<i>Litoria latopalmata</i>	Broad-palmed Frog	Nocturnal and diurnal survey			+			+		+
<i>Litoria peronii</i>	Peron's Tree Frog	Nocturnal amphibian survey	+	+	+	+		+	+	
<i>Litoria tyleri</i>	Southern Laughing Tree Frog	Nocturnal amphibian survey	+	+	+	+	+	+	+	
<i>Litoria verreauxii</i>	Verreaux's Tree Frog	Nocturnal amphibian survey		+				+		
<i>Uperoleia laevigata</i>	Smooth Toadlet	Nocturnal amphibian survey			+					
TOTALS			5	5	7	5	4	9	5	2



Scientific Name	Common Name	Method	2008	2009	2010	2011	2012	2013	2014	White (2000)
Reptiles										
<i>Amphibolurus muricatus</i>	Jacky Lizard	Diurnal reptile survey					+			+
<i>Chebodina longicollis</i>	Eastern Long-necked Turtle	Opportunistic sighting				+		+		+
<i>Ctenopus robustus</i>	Robust Ctenopus	Diurnal reptile survey								+
<i>Eulamprus quoyii</i>	Eastern Water Skink	Diurnal reptile survey								+
<i>Lampropholis delicata</i>	Garden Skink	Diurnal reptile survey					+			+
<i>Physignathus lesueurii lesueurii</i>	Eastern Water Dragon	Opportunistic sighting	+				+			
<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	Opportunistic sighting	+			+	+			+
<i>Pseudonaja textilis</i>	Eastern Brown Snake	Opportunistic sighting				+	+			
<i>Tiliqua scincoides</i>	Eastern Blue-tongued Lizard	Diurnal reptile survey					+			
<i>Varanus varius</i>	Lace Monitor	Opportunistic sighting							+	
TOTALS			2	0	1	3	6	1	1	6





Scientific Name	Common Name	Method	2008	2009	2010	2011	2012	2013	2014	White (2000)
Terrestrial/ Scansorial Mammals										
<i>Acrobates pygmaeus</i>	Feathertail Glider	Spotlighting							+	
<i>Antechinus stuartii</i>	Brown Antechinus	Trapping	+		+	+			+	+
<i>Canis lupus</i>	*Wild Dog	Spotlighting					+			
<i>Felis catus</i>	*House Cat	Spotlighting			+					
<i>Macropus sp.</i>	Wallaby sp.	Spotlighting					+			
<i>Mus domesticus</i>	*House Mouse	Trapping	+	+						
<i>Petaurus breviceps</i>	Sugar Glider	Spotlighting						+	+	+
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum	Spotlighting						+		
<i>Rattus fuscipes</i>	Bush Rat	Trapping	+							
<i>Rattus lutreolus</i>	Swamp Rat	Trapping						+		
<i>Rattus rattus</i>	*Black Rat	Trapping / spotlighting	+	+	+		+	+	+	+
<i>Trichosurus vulpecula</i>	Brush-tail Possum	Trapping / spotlighting					+	+	+	
<i>Vulpes vulpes</i>	*Red Fox	Opportunistic sighting /spotlighting				+	+	+	+	+
TOTALS			4	2	3	2	5	6	5	4



Scientific Name	Common Name	Method (2013)	2008	2009	2010	2011	2012	2013	2014	White (2000)
Bats										
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	Anabat analysis / trapping	+	+	+	+	+	+	+	+
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	Anabat analysis / trapping								
<i>Falsistrellus tasmaniensis</i>	# Eastern False Pipistrelle	Anabat analysis		+		+	+	+	+	
<i>Miniopterus australis</i>	# Little Bentwing-bat	Anabat analysis / trapping	+	+	+	+	+	+	+	
<i>Miniopterus oceanensis</i>	# Eastern Bentwing-bat	Anabat analysis	+	+			+	+	+	
<i>Mormopterus norfolkensis</i>	# East-coast Freetail-bat	Anabat analysis	+	+	+	+	+	+	+	
<i>Mormopterus sp.2</i>	Eastern Freetail-bat	Anabat analysis	+			+	+	+	+	
<i>Myotis macropus</i>	# Large-footed Myotis	Anabat analysis					+	+	+	
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	Trapping					+	+	+	
<i>Nyctophilus gouldii</i>	Gould's Long-eared Bat	Trapping								+
<i>Nyctophilus sp.</i>	Unidentified Long-eared Bat	Anabat analysis	+	+	+	+	+	+	+	
<i>Pteropus sp.</i>	Flying-fox	Spotlighting (heard call)						+		
<i>Pteropus poliocephalus</i>	# Grey-headed Flying-fox	Spotlighting (2008 & 2014) / dead animal observed in 2009	+	+					+	+
<i>Rhinolopus megaphyllus</i>	Eastern Horseshoe-bat	Anabat analysis				+				
<i>Saccolaimus flaviventris</i>	# Yellow-bellied Sheath-tail-bat	Anabat analysis			+					
<i>Scoteanax rueppellii</i>	# Greater Broad-nosed Bat	Anabat analysis	+					+		
<i>Scotorepens orion</i>	Eastern Broad-nosed Bat	Anabat analysis			+			+		
<i>Tadarida australis</i>	White-striped Mastiff-bat	Spotlighting (heard call)				+	+	+	+	+
<i>Vespardelus pumilus</i>	Eastern Forest Bat	Anabat analysis	+	+	+	+	+	+		
<i>Vespardelus troughtoni</i>	# Eastern Cave Bat	Anabat analysis				+	+		+	
<i>Vespardelus vulturinus</i>	Little Forest Bat	Anabat analysis / trapping	+	+	+	+	+	+	+	+
TOTALS			10	8	9	12	11	14	12	10

* denotes an introduced species

denotes a threatened species under the NSW TSC Act 1995

NB: Taxonomy for bats follows Churchill (2008).





Table 7 Bird species recorded in transect surveys by Kleinfelder 2008 to 2014

Family	Scientific Name	Common Name	Spring 2008		Spring 2009		Summer 2010		Spring 2011		Spring 2012		Spring/Summer 2013		Spring 2014	
			North	South	North	South	North	South	North	South	North	South	North	South	North	South
Acanthizidae	<i>Gerygone mouki</i>	Brown Gerygone	+		+		+		+		+				+	
Acanthizidae	<i>Acanthiza pusilla</i>	Brown Thornbill			+		+								+	
Acanthizidae	<i>Sericornis frontalis</i>	White-browed Scrubwren	+		+		+		+		+		+		+	
Acanthizidae	<i>Gerygone olivacea</i>	White-throated Gerygone	+		+		+				+		+			
Acanthizidae	<i>Acanthiza nana</i>	Yellow Thornbill			+		+								+	
Accipitridae	<i>Aviceda subristata</i>	Pacific Baza	+		+		+		+		+		+			
Accipitridae	<i>Circus approximans</i>	Swamp Harrier			+		+						+		+	
Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle	+												+	
Accipitridae	<i>Haliastur sphenurus</i>	Whistling Kite			+		+									
Acrocephalidae	<i>Acrocephalus australis</i>	Australian Reed-Warbler			+		+		+		+				+	
Anatidae	<i>Anas superciliosa</i>	Pacific Black Duck	+		+		+		+							
Apodidae	<i>Hirundapus caudacutus</i>	White-throated Needletail												+		
Ardeidae	<i>Ardea ibis</i>	Cattle Egret	+										+	+		
Ardeidae	<i>Egretta novae-hollandiae</i>	White-faced Heron	+													
Artamidae	<i>Cracticus tibicen</i>	Australian Magpie									+		+			
Artamidae	<i>Cracticus torquatus</i>	Grey Butcherbird	+		+		+		+		+		+		+	
Artamidae	<i>Cracticus nigrogularis</i>	Pied Butcherbird	+												+	
Artamidae	<i>Strepera graculina</i>	Pied Currawong	+		+		+		+		+		+			
Artamidae	<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	+		+		+		+		+		+			
Cacatuidae	<i>Eolophus roseicapillus</i>	Galah														
Cacatuidae	<i>Cacatua sanguinea</i>	Little Corella	+		+											
Cacatuidae	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo									+		+			
Campephagidae	<i>Coracina novae-hollandiae</i>	Black-faced Cuckoo-shrike	+		+		+		+		+		+		+	
Campephagidae	<i>Coracina tenuirostris</i>	Cicadabird	+		+		+		+		+		+			
Charadriidae	<i>Vanellus miles</i>	Masked Lapwing			+		+		+							





Family	Scientific Name	Common Name	Spring 2008		Spring 2009		Summer 2010		Spring 2011		Spring 2012		Spring/Summer 2013		Spring 2014	
			North	South	North	South	North	South	North	South	North	South	North	South	North	South
Cisticolidae	<i>Cisticola exilis</i>	Golden-headed Cisticola							+		+					+
Columbidae	<i>Geopelia humeralis</i>	Bar-shouldered Dove											+			
Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon														
Columbidae	<i>Leucosarcia picata</i>	Wonga Pigeon	+													
Coraciidae	<i>Eurystomus orientalis</i>	Dollarbird														+
Corvidae	<i>Corvus coronoides</i>	Australian Raven														+
Cuculidae	<i>Cacomantis variolosus</i>	Brush Cuckoo														
Cuculidae	<i>Scothrops novaehollandiae</i>	Channel-billed Cuckoo														
Cuculidae	<i>Eudynamis orientalis</i>	Eastern Koel														
Cuculidae	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo														
Cuculidae	<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo														
Cuculidae	<i>Centropus phasianinus</i>	Pheasant Coucal														
Cuculidae	<i>Chalcites lucidus</i>	Shining Bronze-Cuckoo														
Estrildidae	<i>Taeniopygia bichenovii</i>	Double-barred Finch														
Estrildidae	<i>Neochmia temporalis</i>	Red-browed Finch														
Eupetidae	<i>Psophodes olivaceus</i>	Eastern Whipbird														
Halcyonidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra														
Halcyonidae	<i>Todiramphus sanctus</i>	Sacred Kingfisher														
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow														
Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren														
Maluridae	<i>Malurus lamberti</i>	Variegated Fairy-wren														
Megaluridae	<i>Megalurus gramineus</i>	Little Grassbird														
Megaluridae	<i>Megalurus timorensis</i>	Tawny Grassbird														
Meiphagidae	<i>Manorina melanophrys</i>	Bell Miner														
Meiphagidae	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater														
Meiphagidae	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill														
Meiphagidae	<i>Meliphaga lewinii</i>	Lewin's Honeyeater														





Family	Scientific Name	Common Name	Spring 2008		Spring 2009		Summer 2010		Spring 2011		Spring 2012		Spring/Summer 2013		Spring 2014	
			North	South	North	South	North	South	North	South	North	South	North	South	North	South
Meliphagidae	<i>Philemon corniculatus</i>	Noisy Friarbird	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Meliphagidae	<i>Manorina melanocephala</i>	Noisy Miner	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Meliphagidae	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater														
Meliphagidae	<i>Plectorhyncha lanceolata</i>	Striped Honeyeater														
Meliphagidae	<i>Phylidonyris niger</i>	White-cheeked Honeyeater														
Meliphagidae	<i>Meliphreptus lunatus</i>	White-naped Honeyeater														
Meliphagidae	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	+													
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater		+												
Monarchidae	<i>Monarcha melanopsis</i>	Black-faced Monarch														
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistlebird														
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Oriolidae	<i>Sphenocortheres vieillotii</i>	Australasian Figbird	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Oriolidae	<i>Oriolus sagittatus</i>	Olive-backed Oriole	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pachycephalidae	<i>Pachycephala pectoralis</i>	Golden Whistler	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrike-thrush														
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler														
Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pardalotidae	<i>Acanthiza lineata</i>	Striated Thornbill														
Petroliidae	<i>Eopsaltria australis</i>	Eastern Yellow Robin	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Psittacidae	<i>Alisterus scapularis</i>	Australian King-Parrot														
Psittacidae	<i>Platyercus eximius</i>	Eastern Rosella	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Psittacidae	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ptilonorhynchidae	<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird														
Rallidae	<i>Porphyrrio porphyrio</i>	Purple Swamphen														
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Rhipiduridae	<i>Rhipidura rufifrons</i>	Rufous Fantail	+	+	+	+	+	+	+	+	+	+	+	+	+	+





Family	Scientific Name	Common Name	Spring 2008		Spring 2009		Summer 2010		Spring 2011		Spring/Summer 2012		Spring/Summer 2013		Spring 2014	
			North	South	North	South	North	South	North	South	North	South	North	South	North	South
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail														+
Sturnidae	<i>Sturnus tristis</i>	*Common Myna														
Sturnidae	<i>Sturnus vulgaris</i>	*Common Starling	+		+		+		+		+		+			
Threskiornithidae	<i>Threskiornis spinicollis</i>	Straw-necked Ibis														
Timaliidae	<i>Zosterops lateralis</i>	Silvereye				+			+	+						
TOTALS			41	36	47	25	45	24	38	31	28	22	31	33	21	22

The list follows the taxonomy of Christidis & Boles (2008).
* = introduced species



Table 8 Bird species recorded from the North Swamp by Kleinfelder 2008 to 2015

Family	Scientific Name	Common Name	Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Summer 2010	Autumn 2011	Spring 2011	Autumn 2012	Spring 2012	Autumn 2013	Spring 2013	Autumn 2014	Spring 2014	Autumn 2015
Pardalotidae	<i>Acanthiza lineata</i>	Striated Thornbill													+	
Acanthizidae	<i>Acanthiza pusilla</i>	Brown Thornbill								+				+		
Acanthizidae	<i>Sericornis frontalis</i>	White-browed Scrubwren		+	+	+	+	+	+	+	+	+	+	+		
Acanthizidae	<i>Acanthiza nana</i>	Yellow Thornbill	+						+	+	+	+	+	+		
Accipitridae	<i>Elanus axillaris</i>	Black-shouldered Kite														
Accipitridae	<i>Circus approximans</i>	Swamp Harrier	+			+			+	+						
Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle	+						+	+	+		+			
Accipitridae	<i>Haliaeetus spheerurus</i>	Whistling Kite	+										+			
Accipitridae	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle						+							+	
Acrocephalidae	<i>Acrocephalus australis</i>	Australian Reed-Warbler	+		+	+	+		+	+	+		+		+	
Alcedinidae	<i>Ceyx azureus</i>	Azure Kingfisher											+			
Anatidae	<i>Anas platyrhynchos</i>	*Northern Mallard	+													
Anatidae	<i>Anas rhynchotis</i>	Australasian Shoveler	+		+											
Anatidae	<i>Chenonetta jubata</i>	Australian Wood Duck	+									+				
Anatidae	<i>Cygnus atratus</i>	Black Swan	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Anatidae	<i>Anas castanea</i>	Chestnut Teal	+	+	+				+	+	+	+	+	+	+	+
Anatidae	<i>Anas gracilis</i>	Grey Teal	+	+	+							+			+	+
Anatidae	<i>Aythya australis</i>	Hardhead	+		+				+						+	+
Anatidae	<i>Anas superciliosa</i>	Pacific Black Duck	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Anatidae	<i>Dendrocygna arcuata</i>	Wandering Whistling Duck	+													
Anhingidae	<i>Anhinga melanogaster</i>	Australasian Darter	+	+						+			+			+





Family	Scientific Name	Common Name	Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Summer 2010	Autumn 2011	Spring 2011	Autumn 2012	Spring 2012	Autumn 2013	Spring 2013	Autumn 2014	Spring 2014	Autumn 2015
Anhinga	<i>Anhinga melanogaster</i>	Darter														
Ardeidae	<i>Ardea ibis</i>	Cattle Egret		+	+			+		+			+		+	
Ardeidae	<i>Ardea modesta</i>	Eastern Great Egret											+			
Ardeidae	<i>Ardea alba</i>	Great Egret									+					
Ardeidae	<i>Ardea intermedia</i>	Intermediate Egret			+						+		+			
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ardeidae	<i>Ardea pacifica</i>	White-necked Heron														
Artamidae	<i>Cracticus tibicen</i>	Australian Magpie				+	+	+			+					
Artamidae	<i>Cracticus torquatus</i>	Grey Butcherbird		+						+						
Artamidae	<i>Cracticus nigrogularis</i>	Pied Butcherbird	+		+	+	+			+						+
Artamidae	<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	+				+	+		+						
Cacatuidae	<i>Cacatua sanguinea</i>	Little Corella		+												
Cacatuidae	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo		+	+	+	+						+			
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	+	+	+	+	+		+	+	+	+	+	+	+	+
Charadriidae	<i>Vanellus miles</i>	Masked Lapwing	+	+	+	+	+	+								
Ciconiidae	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork														
Cisticolidae	<i>Cisticola exilis</i>	Golden-headed Cisticola			+	+	+			+	+					
Columbidae	<i>Streptopelia chinensis</i>	*Spotted Dove	+						+							
Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon	+			+				+						
Columbidae	<i>Leucosarcia picata</i>	Wonga Pigeon	+													
Coraciidae	<i>Eurystomus orientalis</i>	Dollarbird														
Corvidae	<i>Corvus coronoides</i>	Australian Raven	+	+	+	+	+	+				+				+



Family	Scientific Name	Common Name	Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Summer 2010	Autumn 2011	Spring 2011	Autumn 2012	Spring 2012	Autumn 2013	Spring 2013	Autumn 2014	Spring 2014	Autumn 2015
Cuculidae	<i>Cacomantis variolosus</i>	Brush Cuckoo	+													
Cuculidae	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo							+							
Cuculidae	<i>Eudynamis orientalis</i>	Eastern Koel	+		+											
Cuculidae	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	+					+		+						
Cuculidae	<i>Centropus phasianinus</i>	Pheasant Coucal			+											
Estrildidae	<i>Neochmia temporalis</i>	Red-browed Finch	+			+		+		+						
Eupetidae	<i>Psophodes olivaceus</i>	Eastern Whipbird	+		+	+				+						
Falconidae	<i>Falco longipennis</i>	Australian Hobby						+								
Halcyonidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra				+				+						
Halcyonidae	<i>Todiramphus sanctus</i>	Sacred Kingfisher	+		+											
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow	+			+		+		+						
Jacaniidae	<i>Irediparra gallinacea</i>	Comb-crested Jacana									+					
Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren	+		+	+		+		+						
Maluridae	<i>Malurus lamberti</i>	Variegated Fairy-wren				+										
Maluridae	<i>Stipiturus malachurus</i>	Southern Emu-wren														
Megaluridae	<i>Megaturus gramineus</i>	Little Grassbird			+	+				+						
Megaluridae	<i>Megaturus timorensis</i>	Tawny Grassbird														
Meliphagidae	<i>Manorina melanophrys</i>	Bell Miner			+	+										
Meliphagidae	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill									+					
Meliphagidae	<i>Meliphaga lewinii</i>	Lewin's Honeyeater				+					+					
Meliphagidae	<i>Philemon corniculatus</i>	Noisy Friarbird						+								
Meliphagidae	<i>Manorina melanocephala</i>	Noisy Miner														





Family	Scientific Name	Common Name	Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Summer 2010	Autumn 2011	Spring 2011	Autumn 2012	Spring 2012	Autumn 2013	Spring 2013	Autumn 2014	Spring 2014	Autumn 2015
Meliphagidae	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater					+			+					+	
Meliphagidae	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	+		+	+	+						+	+		
Monarchidae	<i>Gralina cyanoleuca</i>	Magpie-lark	+	+	+	+	+	+		+	+	+	+	+		+
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird					+			+						+
Pachycephalidae	<i>Pachycephala pectoralis</i>	Golden Whistler	+	+	+	+									+	
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler	+		+					+					+	
Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote		+												
Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian Pelican			+											
Petroicidae	<i>Eopsaltria australis</i>	Eastern Yellow Robin				+		+		+	+		+		+	
Phalacrocoracidae	<i>Phalacrocorax carbo</i>	Great Cormorant											+			
Phalacrocoracidae	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	+		+	+	+			+	+	+	+		+	
Phalacrocoracidae	<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	+	+	+					+		+	+			
Phalacrocoracidae	<i>Phalacrocorax varius</i>	Pied Cormorant	+	+						+		+				
Podicipedidae	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	+	+	+	+			+		+	+	+		+	+
Psittacidae	<i>Platycercus eximius</i>	Eastern Rosella	+		+	+					+					
Psittacidae	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet				+		+						+		
Rallidae	<i>Gallinula tenebrosa</i>	Dusky Moorhen	+	+								+	+		+	+
Rallidae	<i>Fulica atra</i>	Eurasian Coot										+	+		+	+
Rallidae	<i>Porphyrio porphyrio</i>	Purple Swamphen	+	+	+	+	+	+		+	+	+	+		+	+
Recurvirostridae	<i>Himantopus himantopus</i>	Black-winged Stilt									+		+			
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail	+	+	+	+	+	+	+	+	+	+	+		+	+
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail	+	+	+	+	+	+	+	+		+	+		+	+



Family	Scientific Name	Common Name	Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Summer 2010	Autumn 2011	Spring 2011	Autumn 2012	Spring 2012	Autumn 2013	Spring 2013	Autumn 2014	Spring 2014	Autumn 2015
Sturnidae	<i>Sturnus tristis</i>	*Common Myna	+				+									
Sturnidae	<i>Sturnus vulgaris</i>	*Common Starling	+	+	+	+										
Threskiornithidae	<i>Threskiornis molucca</i>	Australian White Ibis		+	+			+			+					
Threskiornithidae	<i>Platalea regis</i>	Royal Spoonbill	+								+					
Threskiornithidae	<i>Threskiornis spinicollis</i>	Straw-necked Ibis	+									+			+	
Threskiornithidae	<i>Platalea flavipes</i>	Yellow-billed Spoonbill			+											
Timaliidae	<i>Zosterops lateralis</i>	Silvereye	+	+	+	+	+		+	+	+		+	+	+	
TOTALS			50	35	42	39	31	25	27	34	39	27	39	37	37	27





Table 9 Bird species recorded from the Main Swamp by Kleinfelder 2008 to 2015

Family	Scientific Name	Common Name	Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Summer 2010	Autumn 2011	Spring 2011	Autumn 2012	Spring 2012	Autumn 2013	Spring 2013	Autumn 2014	Spring 2014	Autumn 2015
Acanthizidae	<i>Acanthiza pusilla</i>	Brown Thornbill														
Acanthizidae	<i>Sericornis frontalis</i>	White-browed Scrubwren														
Acanthizidae	<i>Acanthiza nana</i>	Yellow Thornbill														
Acanthizidae	<i>Gerygone olivacea</i>	White-throated gerygone														
Accipitridae	<i>Accipiter novaehollandiae</i>	Grey Goshawk														
Accipitridae	<i>Circus approximans</i>	Swamp Harrier														
Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle														
Accipitridae	<i>Haliaeetus sphenurus</i>	Whistling Kite														
Acrocephalidae	<i>Acrocephalus australis</i>	Australian Reed-Warbler														
Anatidae	<i>Chenonetta jubata</i>	Australian Wood Duck														
Anatidae	<i>Cygnus atratus</i>	Black Swan														
Anatidae	<i>Anas castanea</i>	Chestnut Teal														
Anatidae	<i>Anas gracilis</i>	Grey Teal														
Anatidae	<i>Aythya australis</i>	Hardhead														
Anatidae	<i>Anas superciliosa</i>	Pacific Black Duck														
Anhinga	<i>Anhinga melanogaster</i>	Australasian Darter														
Ardeidae	<i>Ardea ibis</i>	Cattle Egret														
Ardeidae	<i>Ardea modesta</i>	Eastern Great Egret														
Ardeidae	<i>Ardea alba</i>	Great Egret														
Ardeidae	<i>Mesophoyx intermedia</i>	Intermediate Egret														
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron														
Ardeidae	<i>Ardea pacifica</i>	White-necked Heron														





Family	Scientific Name	Common Name	Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Summer 2010	Autumn 2011	Spring 2011	Autumn 2012	Spring 2012	Autumn 2013	Spring 2013	Autumn 2014	Spring 2014	Autumn 2015
Artamidae	<i>Cracticus tibicen</i>	Australian Magpie				+	+					+				+
Artamidae	<i>Cracticus torquatus</i>	Grey Butcherbird	+	+	+		+					+		+		
Artamidae	<i>Cracticus nigrogularis</i>	Pied Butcherbird					+									+
Artamidae	<i>Strepera graculina</i>	Pied Currawong									+					
Artamidae	<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	+				+	+								+
Cacatuidae	<i>Eolophus roseicapilla</i>	Galah									+					
Cacatuidae	<i>Cacatua sanguinea</i>	Little Corella										+				
Cacatuidae	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	+						+				+			
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike			+										+	
Campephagidae	<i>Coracina tenuirostris</i>	Cicadabird														
Charadriidae	<i>Vanellus miles</i>	Masked Lapwing		+										+		
Cisticolidae	<i>Cisticola exilis</i>	Golden-headed Cisticola		+	+											
Climacteridae	<i>Cormobates leucophaea</i>	White-throated Treecreeper														+
Coraciidae	<i>Eurystomus orientalis</i>	Dollarbird											+			+
Corvidae	<i>Corvus coronoides</i>	Australian Raven	+	+	+						+	+	+			+
Cuculidae	<i>Cacomantis variolosus</i>	Brush Cuckoo	+													
Cuculidae	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo			+						+		+			
Cuculidae	<i>Platycercus eximius</i>	Eastern Rosella														
Cuculidae	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	+						+						+	
Cuculidae	<i>Chalcites lucidus</i>	Shining Bronze-Cuckoo	+													
Estrildidae	<i>Neochmia temporalis</i>	Red-browed Finch		+							+	+	+			+
Eupetidae	<i>Psophodes olivaceus</i>	Eastern Whipbird										+				
Halcyonidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra		+												





Family	Scientific Name	Common Name	Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Summer 2010	Autumn 2011	Spring 2011	Autumn 2012	Spring 2012	Autumn 2013	Spring 2013	Autumn 2014	Spring 2014	Autumn 2015
Halcyonidae	<i>Todiramphus sanctus</i>	Sacred Kingfisher	+		+		+									
Hirundinidae	<i>Petrochelidon ariel</i>	Fairy Martin	+		+		+									
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow	+		+		+	+	+	+	+	+	+	+	+	+
Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren	+		+		+	+	+	+	+	+	+	+	+	+
Maluridae	<i>Malurus lamberti</i>	Variegated Fairy-wren		+	+											
Megaluridae	<i>Megalurus gramineus</i>	Little Grassbird			+		+			+		+				
Megaluridae	<i>Megalurus timoriensis</i>	Tawny Grassbird			+											
Meliphagidae	<i>Manorina melanophrys</i>	Bell Miner	+	+	+	+										+
Meliphagidae	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill						+						+		
Meliphagidae	<i>Meliphaga lewinii</i>	Lewin's Honeyeater							+							
Meliphagidae	<i>Manorina melanocephala</i>	Noisy Miner	+			+										
Meliphagidae	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater					+	+	+	+	+				+	
Meliphagidae	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	+			+		+	+	+	+		+			
Monarchidae	<i>Myiagra rubecula</i>	Leaden Flycatcher	+													
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark	+	+	+	+	+					+	+	+	+	+
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird					+						+			
Oriolidae	<i>Oriolus sagittatus</i>	Olive-backed Oriole			+								+			
Pachycephalidae	<i>Pachycephala pectoralis</i>	Golden Whistler										+				
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler					+									
Petroicidae	<i>Eopsaltria australis</i>	Eastern Yellow Robin					+	+		+		+				+
Phalacrocoracidae	<i>Phalacrocorax carbo</i>	Great Cormorant					+					+	+			
Phalacrocoracidae	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant					+					+	+			
Phalacrocoracidae	<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	+						+			+	+			



Family	Scientific Name	Common Name	Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Summer 2010	Autumn 2011	Spring 2011	Autumn 2012	Spring 2012	Autumn 2013	Spring 2013	Autumn 2014	Spring 2014	Autumn 2015
Phalacrocoracidae	<i>Phalacrocorax varius</i>	Pied Cormorant										+				
Podicipedidae	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	+						+							
Psittacidae	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet			+	+										+
Rallidae	<i>Gallinula tenebrosa</i>	Dusky Moorhen	+	+	+	+	+		+	+	+		+		+	+
Rallidae	<i>Fulica atra</i>	Eurasian Coot								+		+			+	+
Rallidae	<i>Porphyrio porphyrio</i>	Purple Swamphen	+	+	+	+	+		+	+	+	+	+	+	+	+
Recurvirostridae	<i>Himantopus himantopus</i>	Black-winged Stilt									+					
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail	+	+	+	+	+		+	+	+	+	+	+	+	+
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail	+	+		+	+			+	+	+	+	+	+	+
Scolopacidae	<i>Gallinago hardwickii</i>	Latham's Snipe									+					
Sturnidae	<i>Sturnus tristis</i>	*Common Myna							+							
Sturnidae	<i>Sturnus vulgaris</i>	*Common Starling					+									
Threskiornithidae	<i>Threskiornis molucca</i>	Australian White Ibis	+	+							+	+				+
Threskiornithidae	<i>Plegadis falcinellus</i>	Glossy Ibis									+					+
Threskiornithidae	<i>Threskiornis spinicollis</i>	Straw-necked Ibis	+									+				+
Timaliidae	<i>Zosterops lateralis</i>	Silvereye		+	+						+	+	+	+	+	+
TOTALS			31	22	26	22	32	12	22	17	30	32	32	20	19	26





Table 10 Bird species recorded from the South Swamp by Kleinfelder 2008 to 2015

Family	Scientific Name	Common Name	Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Summer 2010	Autumn 2011	Spring 2011	Autumn 2012	Spring 2012	Autumn 2013	Spring 2013	Autumn 2014	Spring 2014	Autumn 2015
Acanthizidae	<i>Acanthiza pusilla</i>	Brown Thornbill		+										+		
Acanthizidae	<i>Acanthiza lineata</i>	Striated Thornbill											+			
Acanthizidae	<i>Sericornis frontalis</i>	White-browed Scrubwren								+	+					
Acanthizidae	<i>Acanthiza nana</i>	Yellow Thornbill									+					
Accipitridae	<i>Pandion haliaetus cristatus</i>	Eastern Osprey													+	
Accipitridae	<i>Aviceda subcristata</i>	Pacific Baza						+								
Accipitridae	<i>Circus approximans</i>	Swamp Harrier	+	+			+									+
Accipitridae	<i>Haliaeetus spheerurus</i>	Whistling Kite	+		+		+	+			+					
Accipitridae	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle						+			+			+		
Acrocephalidae	<i>Acrocephalus australis</i>	Australian Reed-Warbler	+		+		+		+		+		+		+	
Alcedinidae	<i>Ceyx azureus</i>	Azure Kingfisher								+	+	+				
Anatidae	<i>Chenonetta jubata</i>	Australian Wood Duck						+				+	+			+
Anatidae	<i>Cygnus atratus</i>	Black Swan		+	+	+	+	+	+	+	+	+	+	+	+	+
Anatidae	<i>Anas castanea</i>	Chestnut Teal	+		+	+	+	+	+	+	+	+	+	+	+	+
Anatidae	<i>Anas platyrhynchos</i>	Domestic Duck									+					
Anatidae	<i>Anas gracilis</i>	Grey Teal			+				+			+				+
Anatidae	<i>Aythya australis</i>	Hardhead							+							
Anatidae	<i>Anas superciliosa</i>	Pacific Black Duck	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Anhingaidae	<i>Anhinga melanogaster</i>	Australasian Darter								+			+			
Ardeidae	<i>Ardea ibis</i>	Cattle Egret			+						+		+			
Ardeidae	<i>Ardea alba</i>	Great Egret									+				+	
Ardeidae	<i>Mesophoyx intermedia</i>	Intermediate Egret														+



Family	Scientific Name	Common Name	Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Summer 2010	Autumn 2011	Spring 2011	Autumn 2012	Spring 2012	Autumn 2013	Spring 2013	Autumn 2014	Spring 2014	Autumn 2015
Ardeidae	<i>Egretta garzetta</i>	Little Egret									+		+			
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron	+	+	+		+		+		+			+		
Ardeidae	<i>Ardea pacifica</i>	White-necked Heron	+													
Artamidae	<i>Cracticus tibicen</i>	Australian Magpie	+	+	+		+	+		+			+			
Artamidae	<i>Cracticus torquatus</i>	Grey Butcherbird	+	+	+	+		+		+			+			
Artamidae	<i>Cracticus nigrogularis</i>	Pied Butcherbird		+	+											
Artamidae	<i>Strepera graculina</i>	Pied Currawong	+	+												
Artamidae	<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	+	+	+		+	+		+			+			
Cacatuidae	<i>Eolophus roseicapillus</i>	Galah					+							+		
Cacatuidae	<i>Cacatua sanguinea</i>	Little Corella									+					
Cacatuidae	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	+	+	+	+										
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike				+	+	+		+						
Campephagidae	<i>Coracina tenuirostris</i>	Cicadabird	+			+										
Campephagidae	<i>Lalage tricolor</i>	White-winged Triller									+		+			
Charadriidae	<i>Vanellus miles</i>	Masked Lapwing	+	+	+		+	+								
Cisticolidae	<i>Cisticola exilis</i>	Golden-headed Cisticola	+	+	+	+	+	+			+		+			
Columbidae	<i>Leucosarcia picata</i>	Wonga Pigeon											+			
Climacteridae	<i>Cormobates leucophaea</i>	White-throated Treecreeper														
Coraciidae	<i>Eurystomus orientalis</i>	Dollarbird	+				+	+		+			+			
Corvidae	<i>Corvus coronoides</i>	Australian Raven	+	+	+	+	+	+			+		+			
Cuculidae	<i>Cacomantis variolosus</i>	Brush Cuckoo	+	+	+		+									
Cuculidae	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo		+									+			
Cuculidae	<i>Eudynamys orientalis</i>	Eastern Koel	+								+		+			



Family	Scientific Name	Common Name	Spring 2008	Autumn 2008	Spring 2009	Autumn 2009	Summer 2010	Autumn 2010	Spring 2011	Autumn 2011	Spring 2012	Autumn 2012	Spring 2013	Autumn 2013	Spring 2014	Autumn 2014	Spring 2015	Autumn 2015
Cuculidae	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	+		+				+		+		+					
Cuculidae	<i>Chrysococcyx basalix</i>	Horsfield's Bronze-cuckoo									+							
Cuculidae	<i>Centropus phasianinus</i>	Pheasant Coucal			+	+	+	+										
Cuculidae	<i>Chalcites lucidus</i>	Shining Bronze-Cuckoo	+															
Estrildidae	<i>Neochmia temporalis</i>	Red-browed Finch		+									+					+
Eupetidae	<i>Psophodes olivaceus</i>	Eastern Whipbird	+	+		+	+	+		+	+	+	+	+	+	+	+	+
Halcyonidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	+	+	+				+				+	+		+		
Halcyonidae	<i>Todiramphus sanctus</i>	Sacred Kingfisher	+		+		+		+		+	+	+	+			+	
Hirundinidae	<i>Petrochelidon ariel</i>	Fairy Martin			+		+							+	+			
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Maluridae	<i>Malurus lamberti</i>	Variagated Fairy-wren									+		+					
Megaluridae	<i>Megalurus gramineus</i>	Little Grassbird	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+
Megaluridae	<i>Megalurus timoriensis</i>	Tawny Grassbird	+		+													
Meliphagidae	<i>Manorina melanophrys</i>	Bell Miner	+	+	+	+	+	+		+	+			+	+	+	+	+
Meliphagidae	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill										+						
Meliphagidae	<i>Meliphaga lewinii</i>	Lewin's Honeyeater		+	+	+		+		+			+	+	+			
Meliphagidae	<i>Philemon corniculatus</i>	Noisy Friarbird	+															+
Meliphagidae	<i>Manorina melanocephala</i>	Noisy Miner	+	+	+	+	+	+	+	+								+
Meliphagidae	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater																+
Meliphagidae	<i>Plectorhyncha lanceolata</i>	Striped Honeyeater	+	+	+	+												
Meliphagidae	<i>Lichenostomus leucotis</i>	White-eared Honeyeater										+						
Meliphagidae	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	+		+		+	+					+	+	+			



Family	Scientific Name	Common Name	Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Summer 2010	Autumn 2011	Spring 2011	Autumn 2012	Spring 2012	Autumn 2013	Spring 2013	Autumn 2014	Spring 2014	Autumn 2015
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater	+													
Monarchidae	<i>Myiagra rubecula</i>	Leadend Flycatcher	+													
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird							+				+	+		+
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella											+			
Oriolidae	<i>Sphecotheres vieilloti</i>	Australasian Figbird					+									
Oriolidae	<i>Oriolus sagittatus</i>	Olive-backed Oriole			+	+					+		+			
Pachycephalidae	<i>Pachycephala pectoralis</i>	Golden Whistler	+		+											+
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrike-thrush									+			+		
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler	+		+		+		+				+			
Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote	+			+										
Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian Pelican									+					
Petroicidae	<i>Eopsaltria australis</i>	Eastern Yellow Robin			+						+					
Phalacrocoracidae	<i>Phalacrocorax carbo</i>	Great Cormorant							+	+						
Phalacrocoracidae	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant			+				+		+					+
Phalacrocoracidae	<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	+		+				+	+	+					+
Phalacrocoracidae	<i>Phalacrocorax varius</i>	Pied Cormorant								+		+				
Podicipedidae	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe			+	+			+		+	+	+			
Psittacidae	<i>Alisterus scapularis</i>	Australian King-Parrot							+							
Psittacidae	<i>Platycercus eximius</i>	Eastern Rosella	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Psittacidae	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet		+		+		+	+	+		+			+	+
Rallidae	<i>Gallinula tenebrosa</i>	Dusky Moorhen	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Rallidae	<i>Fulica atra</i>	Eurasian Coot				+			+			+	+		+	+



Family	Scientific Name	Common Name	Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Summer 2010	Autumn 2011	Spring 2011	Autumn 2012	Spring 2012	Autumn 2013	Spring 2013	Autumn 2014	Spring 2014	Autumn 2015
Rallidae	<i>Porphyrio porphyrio</i>	Purple Swamphen	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail	+	+	+	+				+	+	+	+			
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail	+	+	+	+	+	+		+	+	+	+			
Scolopacidae	<i>Gallinago hardwickii</i>	Latham's Snipe										+				
Sturnidae	<i>Sturnus tristis</i>	*Common Myna						+								
Sturnidae	<i>Sturnus vulgaris</i>	*Common Starling					+									
Threskiornithidae	<i>Threskiornis molucca</i>	Australian White Ibis									+				+	
Threskiornithidae	<i>Plegadis falcinellus</i>	Glossy Ibis									+					
Threskiornithidae	<i>Platalea regia</i>	Royal Spoonbill			+						+				+	
Timaliidae	<i>Zosterops lateralis</i>	Silvereye									+					
TOTALS			46	31	47	29	36	29	32	30	48	34	43	30	37	30





Table 11 Roosting bird count results from the Main Swamp 2008 to 2014

Family	Scientific Name	Common Name	7:15 PM 15/10/2008	7:40 PM 5/03/2009	7:50 PM 18/11/2009	7:20 PM 23/03/2010	8:40 PM 23/12/2010	8:00 PM 23/03/2011	7:20 PM 19/10/2011	7:20 PM 20/03/2012	7:50 PM 2/11/2012	7:15 PM 5/03/2013	7:00 PM 4/12/2013	8:00 PM 12/12/13*	7:30 PM 10/03/2014	6:50 PM 26/03/2015
Anhingiidae	<i>Anhinga melanogaster</i>	Darter													1	
Ardeidae	<i>Ardea ibis</i>	Cattle Egret	57	170	67	26			188	80		120		80		280
Ardeidae	<i>Ardea pacifica</i>	White-necked Heron	1													
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron								4		20				29
Monarchidae	<i>Grallina cyanoleuca</i>	Maggie-lark													1	
Phalacrocoracidae	<i>Phalacrocorax carbo</i>	Great Cormorant				2				15		2		3	7	
Phalacrocoracidae	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	17	10	5	14			1	5	15			8	2	
Phalacrocoracidae	<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant			8	3						6	1	10		
Phalacrocoracidae	<i>Phalacrocorax varius</i>	Pied Cormorant										10				
Rallidae	<i>Porphyrio porphyrio</i>	Purple Swamphen											2			
Threskiornithidae	<i>Threskiornis molucca</i>	Australian White Ibis	9	50	37	44		2	1							276
Threskiornithidae	<i>Threskiornis spinicollis</i>	Straw-necked Ibis	125	40	8	3						400				13
Total No. of individuals			209	270	125	50	42	2	190	104	15	563	3	101	11	598

*12/12/2013: Many birds were observed flying in to roost south of the visible roost in Main Swamp.

21/03/2014: roost was empty

Nov 2014: roost was empty





Table 12 Bird species recorded by Hunter Valley Bird Observers July 2014.

Family	Scientific Name	Common Name
Acanthizidae	<i>Acanthiza lineata</i>	Striated Thornbill
Acanthizidae	<i>Acanthiza pusilla</i>	Brown Thornbill
Acanthizidae	<i>Acanthiza nana</i>	Yellow Thornbill
Accipitridae	<i>Accipiter novaehollandiae</i>	Grey Goshawk
Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle
Accipitridae	<i>Circus approximans</i>	Swamp Harrier
Anatidae	<i>Cygnus atratus</i>	Black Swan
Anatidae	<i>Anas castanea</i>	Chestnut Teal
Anatidae	<i>Anas gracilis</i>	Grey Teal
Anatidae	<i>Anas superciliosa</i>	Pacific Black Duck
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron
Artamidae	<i>Cracticus torquatus</i>	Grey Butcherbird
Artamidae	<i>Strepera graculina</i>	Pied Currawong
Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon
Columbidae	<i>Streptopelia chinensis</i>	*Spotted Dove
Estrildidae	<i>Neochmia temporalis</i>	Red-browed Finch
Eupetidae	<i>Psophodes olivaceus</i>	Eastern Whipbird
Halcyonidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra
Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren
Meliphagidae	<i>Anthochaera chrysoptera</i>	Little Wattlebird
Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian Pelican
Phalacrocoracidae	<i>Phalacrocorax varius</i>	Pied Cormorant
Podicipedidae	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe
Rallidae	<i>Gallinula tenebrosa</i>	Dusky Moorhen

*denotes introduced species



APPENDIX 3. WATER BODY PHOTOGRAPHS



Plate 16 Stitched photograph of South Swamp taken in November 2011.

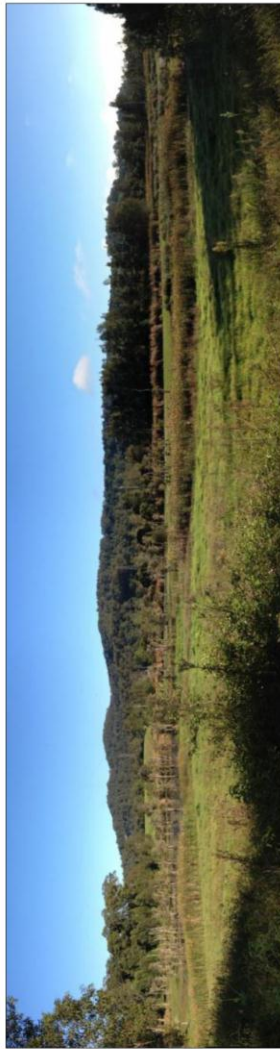


Plate 17 Stitched photograph of South Swamp taken in March 2012.



Plate 18 Stitched photograph of South Swamp taken in March 2014

Ref: WBA14R09204
Copyright 2014 Kleinfelder

Page 77
Appendix 3

24 April 2015



Plate 19 Stitched photograph of South Swamp taken in March 2015



Plate 20 Stitched photograph of Main Swamp taken in November 2011.

Ref: WBA14R09204
Copyright 2014 Kleinfelder

Page 78
Appendix 3

24 April 2015





Plate 21 Sitched photograph of Main Swamp taken in March 2012.



Plate 22 Sitched photograph of Main Swamp taken in March 2014.

24 April 2015

Page 79
Appendix 3

Ref: WBA14R09204
Copyright 2014 Kleinfelder

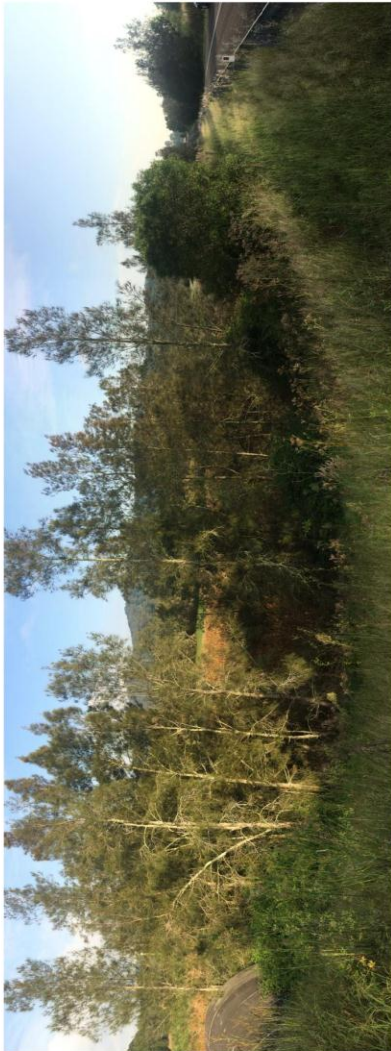


Plate 23 Stitched photograph of Main Swamp taken in March 2015.



Plate 24 Stitched photograph of North Swamp taken in November 2011.





Plate 25 Stitched photograph of North Swamp taken in March 2012.



Plate 26 Stitched photograph of North Swamp taken in March 2014.



Plate 27 Stitched photograph of North Swamp taken in March 2015.

24 April 2015

Page 82
Appendix 3

Ref: WBA14R09204
Copyright 2014 Kleinfelder



APPENDIX 4. STAFF CONTRIBUTIONS

The following staff were involved in the compilation of this report.

Name	Qualification	Title/Experience	Contribution
Fred Rainsford	BSc Env & Mgt (Hons)	Ecologist (Ornithologist)	Report writing
Luke Foster	BSc Env & Mgt MEnvSci&Mgt (Wildlife Ecology)	Ecologist (Mammalogist)	Fauna survey and report review
Gayle Joyce	BSc (Forestry) (Hons)	GIS Specialist	Spatial data and figures
Gilbert Whyte	PhD	Senior Ecologist (Botanist)	Flora survey and report writing
Kristy Peters	B.ParkMgt (Hons)	Senior Ecologist (Ornithologist)	Bird surveys, report writing
Feach Moyle	BSc (Hons), ADAS	Principal Ecologist	Bird surveys



APPENDIX 5. LICENSING

Kleinfelder employees involved in the current study are licensed or approved under the *National Parks and Wildlife Act 1974* (License Number: SL100730, Expiry: 31 March 2016) and the *Animal Research Act 1985* to harm/trap/release protected native fauna and to pick for identification purposes native flora and to undertake fauna surveys.