

Biodiversity Study of the Waverley Local Government Area



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for Waverley Council

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1 Introduction

1.1 Background

Australian Museum Business Services (AMBS) was commissioned by Waverley Council (Council) to undertake biodiversity surveys and a wildlife habitat corridor study within the Waverley Local Government Area (LGA). Council is in the process of building on existing biodiversity related studies, with the intention of using updated studies as a baseline for future comparative studies. This project includes field surveys targeting terrestrial vertebrates and invertebrates, and a wildlife habitat corridor study, which will provide a foundation of baseline reference data that can be further utilised in the management, protection and rehabilitation of fauna species and their habitats within the LGA. The outcomes are also expected to assist Council in planning and management decisions relating to the local biodiversity.

This report presents the results obtained from current field surveys and a summary of previous records for fauna species from the Waverley LGA and the broader locality. Previous biodiversity studies conducted within the LGA are reviewed. The report identifies areas of high conservation significance in terms of fauna species or their habitats, and provides recommendations on the future conservation and enhancement of sites for biodiversity within the Waverley LGA. The report also considers the extent of existing wildlife habitat corridors and provides recommendations for how they can be improved to facilitate the movement of fauna species throughout the LGA.

1.2 Study Area

The Waverley LGA is a highly urbanised area in the eastern suburbs of Sydney (Figure 1). It includes the localities of Bondi Junction, Queens Park, Bronte, Waverley, Bondi, North Bondi, Tamarama, Dover Heights and parts of Rose Bay and Vaucluse (Waverley Council 2009). The LGA covers an area of approximately 930 hectares (Waverley Council 2009) and has been extensively modified since European settlement. Developmental pressures has led to extensive land degradation in the coastal zone from land clearing, destruction of native vegetation, introduction of exotic weeds, erosion and increased urban runoff (Waverley Council 2009). Currently, approximately 112 hectares (12%) of the Waverley LGA is designated as open space covering 82 parks and reserves (Waverley Council 2009). Of this only five percent (approximately 6 hectares) is native remnant vegetation (Waverley Council 2009). These small areas of remnant vegetation provide important refuges for native flora and fauna that occur in the locality.

A number of previous biodiversity related studies have been completed throughout the Waverley LGA and these are listed in Table 1. These studies have contributed to Waverley Council's various initiatives, including recent attempts to improve the biodiversity values within the LGA through implementation of the following:

- Bush regeneration by community volunteer Bushcare groups;
- State and Federal Government funded rehabilitation projects;
- Council policy such as planting and maintaining a minimum 200 trees per year; and
- Ongoing Council run community programs such as: Adopt a Tree, Footpath Gardens and Pocket Parks.

1.3 Objectives

This project was commissioned to provide additional information to be incorporated into Council's Environmental Action Plan (EAP). The EAP aims to establish baseline information and consolidate previous single-issue environmental action plans. During the investigations undertaken to determine current environmental trends, knowledge gaps were found. One knowledge gap was Council's baseline

biodiversity data. The project was also designed to contribute towards Waverley Council's Management Plan 2008-2012, which outlined a number of key biodiversity directives and strategies aimed at protecting native vegetation within the LGA, regenerating and linking areas with native vegetation to improve habitats for local populations of plants and animals, and promote local biodiversity through community education.

The aims of this study were to:

- identify the fauna biodiversity values within the Waverley LGA through database searches, reviews of existing literature, and targeted vertebrate and invertebrate surveys;
- undertake habitat assessments at selected sites to determine their suitability for fauna species that could occur within the locality;
- determine the extent of existing wildlife habitat corridors within the Waverley LGA and provide recommendations on strategies for improvement; and
- provide Council with recommendations in relation to the management, protection and rehabilitation of fauna habitat and biodiversity values within the Waverley LGA.



Figure 1: The Waverley Local Government Area.

AUSIMAGE © Sinclair Knight Merz Pty Ltd (Aerial photography obtained from SIX Viewer).

2 Methods

2.1 Background Review

A desktop review of existing information regarding previous records of fauna species within the Waverley LGA and broader locality was undertaken. Information sources included:

- the NSW Department of Environment, Climate Change and Water (DECCW) Atlas of NSW Wildlife database;
- the Birds Australia database;
- records from the Australian Museum collections;
- the NSW Wildlife Information Rescue and Education Service (WIRES) database; and
- previous reports in relation to fauna surveys conducted within the Waverley LGA.

Searches of the Australian Museum database were conducted for entomological (insect) records and malacology (mollusc) records. Search criteria used were to search on all suburbs within the Waverley LGA. Records with doubtful locations or ones that were likely to be from outside of the LGA were then excluded.

2.2 Fauna Surveys

2.2.1 Invertebrates

An initial reconnaissance of potential sampling sites within the Waverley LGA was undertaken on 25 November 2009, following a desktop assessment using aerial photographs. Eight survey sites were selected during the initial reconnaissance (Table 1).

Table 1: Invertebrate Survey Sites.

Site Name	AM Collection Event Code	Latitude	Longitude	Date
Diamond Bay Reserve, Vaucluse	WAV009_001	33°51'41.08"S	151°16'54.82"E	10/12/2009
Rodney Reserve, Dover Heights	WAV009_002	33°52'26.25"S	151°16'59.27"E	10/12/2009
Marks Park, Tamarama	WAV009_004	33°53'55.72"S	151°16'30.43"E	10/12/2009
Tamarama Park, Tamarama	WAV009_005	33°53'53.78"S	151°16'30.55"E	10/12/2009
Bronte Park, Bronte	WAV009_006	33°54'7.95"S	151°15'48.81"E	11/12/2009
Varna Park, Waverley	WAV009_007	33°54'23.98"S	151°15'22.86"E	11/12/2009
Queens Park, Queens Park	WAV009_008	33°54'0.74"S	151°14'55.53"E	11/12/2009
York Road Bushland Regeneration (inside Moriah College)	WAV009_009	33°54'2.26"S	151°14'33.63"E	11/12/2009

Targeted invertebrate surveys were conducted over 2 days on 10 and 11 December 2009 (four sites/day). At each site, invertebrates were sampled using three different methods:

- beat/sweep netting – this method was carried out for a period of 1.5 hours at each site. The method targets a wide range of aerial invertebrate fauna. Invertebrates were sampled from a variety of plants at each site using a combination of two netting techniques:
 - Beating – where a shallow collecting net is placed under a branch of a plant whilst the branch is beaten with a stick or shaken vigorously to dislodge insects so that they fall into the net;
 - Sweep netting – where foliage is repeatedly passed over using an aerial insect net in a sweeping motion;
- yellow pan traps – five yellow collecting dishes filled with a solution of water with a few drops of dishwashing detergent (used to break surface tension of water) were placed in suitable

locations at each site. Traps were set out in the morning and recovered in the late afternoon (Table 2). This method targets aerial invertebrate fauna, particularly flies (Diptera) and tiny parasitic wasps (Hymenoptera);

- litter sample – a bag of leaf litter was taken from each site. The litter was then placed into a Tullgren Funnel in the laboratory, which enables ground-dwelling invertebrate fauna to be extracted and captured in a collecting jar placed beneath the funnel.

On both survey days, each of the four sites was initially visited in the morning to set up yellow pan traps. Then other sampling methods were carried out at each site. Yellow pan traps were retrieved from each site in the afternoon. Invertebrate specimens collected by all trapping methods were taken to the Australian Museum, where they were identified to the highest classification that was possible for each group, depending on the taxonomic expertise of available Museum staff.

A visual survey of invertebrates was also conducted at each site. Methods included bark peeling, searches under stones and rocks and observation (particularly of aerial invertebrates such as butterflies). The focus of these surveys was butterflies (Lepidoptera) and spiders (Araneae). These two groups were selected because both groups are highly visible in parklands and the surveyors had the expertise to identify species by sight, without need to remove individuals from the habitat. Field observations of species of these two groups were recorded in field notebooks.

Weather conditions for the two survey days varied, with 10 December 2009 varying from cool, cloudy and windy to cloudy, humid and warm, whilst 11 December 2009 was sunny and warm throughout the day (Table 2). The timing of the field survey was good as this is a favourable time of year, when plenty of insects are active.

Table 2: Invertebrate survey weather conditions and yellow pan trap times.

Site Name	Weather conditions	Yellow pan traps sampling times	Date
Diamond Bay Reserve, Vaucluse	Cloudy, occasional light rain	11:20 am-4:15pm	10/12/2009
Rodney Reserve, Dover Heights	Cloudy, cool, windy (in afternoon)	11:00am-4:00pm	10/12/2009
Marks Park, Tamarama	Cloudy, cool, windy (in afternoon)	10:30am-3:45pm	10/12/2009
Tamarama Park, Tamarama	Cloudy, humid, warm	9:55am-3:30pm	10/12/2009
Bronte Park, Bronte	Sunny, warm	10:00am-12:30pm	11/12/2009
Varna Park, Waverley	Sunny, warm, windy (in afternoon)	9:45am-1:30pm	11/12/2009
Queens Park, Queens Park	Sunny, warm	9:30am-3:15pm	11/12/2009
York Road Bushland Regeneration (inside Moriah College)	Sunny, warm	9:10am-2:00pm	11/12/2009

2.2.2 Vertebrates

Targeted fauna surveys were conducted at 13 sites within the Waverley LGA, using standardised survey techniques for frogs, reptiles, birds and mammals. A summary of the fauna groups targeted at each survey site is provided in Table 3. The location of each survey site is shown on Figure 2.

Table 3: Vertebrate fauna survey sites.

Site	Amphibians		Reptiles		Birds		Mammals	
	Nocturnal	Diurnal	Nocturnal	Diurnal	Nocturnal	Spotlight	Anabat	
Queens Park North				✓				
Queens Park Cliff		✓	✓		✓	✓	✓	
Queens Park Pond	✓	✓	✓	✓	✓	✓	✓	
Calga Reserve	✓			✓				
Bronte Park	✓	✓	✓	✓	✓	✓	✓	
Waverley Park				✓				
Thomas Hogan Reserve		✓	✓	✓	✓	✓	✓	
Diamond Bay Reserve	✓	✓	✓	✓	✓	✓	✓	
Hugh Bamford Reserve		✓	✓	✓	✓	✓	✓	
Hunter Park				✓				
Marks Park				✓				
Tamarama Park	✓	✓	✓	✓	✓	✓	✓	
York Road		✓	✓	✓	✓	✓	✓	

Frogs

Frog surveys were conducted nocturnally on 22 December 2009 by AMBS ecologists Mark Semeniuk and Gina Barnett. Survey sites were those that contained waterbodies. Aural surveys were carried out for 5 minutes at each site and involved standing quietly near the waterbody and listening for calling frogs. Call playback was not used. Aural surveys were carried out prior to conducting visual searches. Visual searches involved actively searching for species using spotlights for 30 person minutes at each site. Any frogs detected by either sight or call were recorded. Data recorded included weather, time of day, species present, number of individuals and microhabitat. Any opportunistic detections of other vertebrate fauna were also recorded.

Reptiles

Diurnal reptile surveys were carried out on 19 and 21 January 2010 by AMBS ecologists Mark Semeniuk and George Madani. A standard area within each survey site (0.5 hectares) was surveyed for 30 person minutes. Potential reptile microhabitats were actively searched including basking sites, debris, fallen logs, leaf litter, fallen bark, and rock outcrops and crevices. An additional 10 minutes survey effort was also conducted in nearby areas (outside of the standard sampling area) that were considered to contain suitable habitat for reptiles, in order to obtain additional records of species that may not have been detected during the standardised sampling.

Reptiles were also searched for and recorded during nocturnal spotlighting surveys. These surveys were conducted on 8 February 2010 by AMBS ecologists Mark Semeniuk and George Madani using head lamps. Each site was surveyed for 30 person minutes, targeting nocturnal reptile microhabitats such as debris, fallen logs, leaf litter, fallen bark, and rock outcrops and crevices.

Data recorded included weather, time of day, species present, number of individuals and microhabitat. Any opportunistic detections of other vertebrate fauna were also recorded.

Birds

Diurnal bird surveys were carried out on 19 and 21 January 2010 by AMBS ecologists Mark Semeniuk and George Madani. A standard area within each survey site (1 hectare) was surveyed for 20 minutes and birds were identified by either by direct observation or by their calls. Birds that were outside the standard area were also recorded and it was noted whether the species was within or

outside the standard sampling area. An additional 10 minutes survey effort was also conducted in nearby areas (outside of the standard sampling area) that were considered to contain suitable habitat for birds, in order to obtain additional records of species that may not have been detected during the standardised sampling.

Data recorded included weather, time of day, species present, number of individuals and microhabitat. Any opportunistic detections of other vertebrate fauna were also recorded.

Owls and other nocturnal birds were surveyed during the nocturnal spotlighting surveys. Call-playback surveys were not employed because of the potential to disturb local residents.

Mammals

Nocturnal spotlighting surveys for mammals were conducted on 8 February 2010 by AMBS ecologists Mark Semeniuk and George Madani. Each site was surveyed for 30 person minutes. Insectivorous bats were sampled concurrently using the Anabat II call detection system (used for recording ultrasonic calls). Mammal traps or hair sampling devices were not used (due to the high sampling effort required, potential for vandalism and low success in trapping native mammals in highly urbanised areas) and no suitable locations were found for use of harp traps targeting insectivorous, microchiropteran bats.

Data recorded included weather, time of day, species present, number of individuals and microhabitat. Any opportunistic detections of other vertebrate fauna were also recorded.

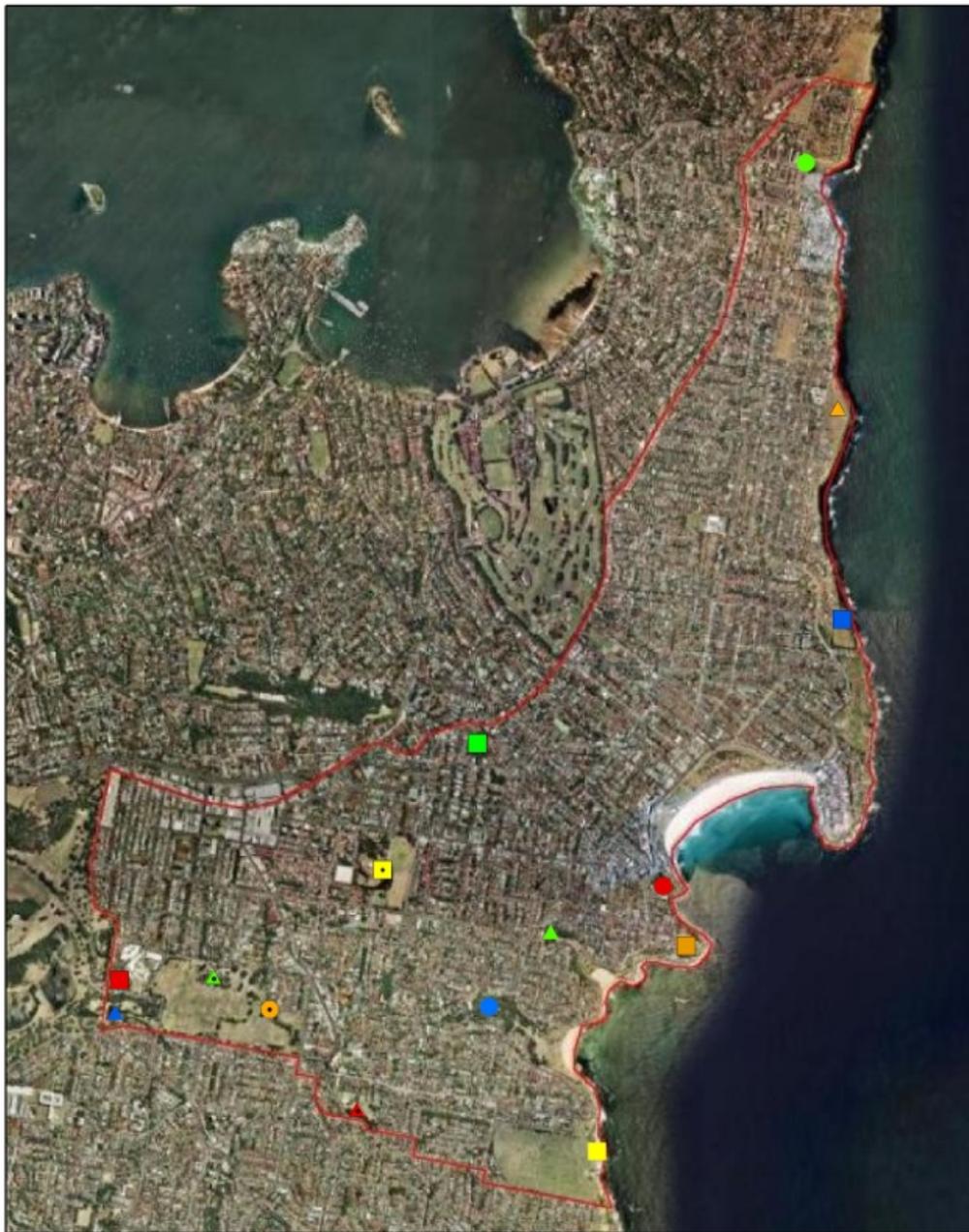
2.3 Habitat and Corridor Assessment

Habitat assessments were conducted at each of the thirteen sites. Data recorded at each site included vegetation type, topography, dominant plant species, canopy cover, shrub cover, ground cover, and habitat features that could be utilised by animal species in the locality (e.g. leaf litter, large rocks, logs, grass, hollow bearing trees, feed trees). Photographs were taken at each site for a visual record of the condition of the habitat at the time of the survey.

In order to assess existing and potential wildlife habitat corridors within the Waverley LGA aerial photographs, vegetation maps and previous studies were examined. The largest remaining vegetated areas were identified and their relative connectivity to other vegetated areas within and outside the Waverley LGA was assessed. The Wildlife Habitat Corridors Study for Waverley Council (Ondinea 1996) was reviewed and assessed in the context of current conditions. A field assessment was carried out on 13 April 2010 to further investigate the areas identified from the aerial photography and to ground-truth the recommendations provided in the previous wildlife habitat corridor study (Ondinea 1996).

2.4 Survey Limitations

The field surveys conducted as part of this project have several limitations that need consideration. The data were collected for a relatively short period and during only one season, and are therefore expected to detect only a sample of the total animal species present within the survey area. Repeat surveys during different years, seasons and conditions would be required to determine the full suite of species that occur within the habitats of the study area. The recommendations in this report are therefore based on information from a variety of sources in addition to the field data collected during the current study. Nonetheless, the standard survey methods which were undertaken provide baseline data that will enable repeat surveys to be undertaken over time.



Legend

- | | | | |
|------------------------|---------------------|--------------------|-----------------|
| ● Bronte Park | ● Hunter Park | ▲ Queens Park Pond | ▲ Varna Park |
| ■ Calga Reserve | ■ Marks Park | ▲ Rodney Reserve | ■ Waverley Park |
| ● Diamond Bay Reserve | ● Queens Park Cliff | ▲ Tamarama Park | ■ York Road |
| ■ Hugh Bamford Reserve | ▲ Queens Park North | ■ Thomas Hogan | |



AUSIMAGE © Sinclair Knight Merz Pty Ltd (Aerial Imagery courtesy of Waverley Council)

Figure 2: Invertebrate and vertebrate survey sites.

3 Results

3.1 Background Review

3.1.1 Database Searches: Invertebrates

The Australian Museum entomology collection has a wealth of history associated with the Waverley area. In the early 1900's, G. A. Waterhouse, author of the definitive reference book '*What butterfly is that?*' lived in Waverley and collected material locally. His extensive insect collection, which included important 'type' material, was presented to the Museum in 1930. Dr D.K. McAlpine, retired research scientist with the Australian Museum lived for many years in Bronte from the mid 1940's to early 1970's. Several new species have been described based on material from the area collected by him during that period. All material collected by Dr McAlpine in the Waverley Council area is in the Australian Museum collection.

A search of the Australian Museum database records produced over 500 catalogue records for insect specimens collected in the Waverley Council area dating back as far as 1897. Type specimens are the most important in collections as these are specimens that are selected by an author in an original scientific description of a species to represent that species as a 'standard' reference for all future taxonomic work. From the records of specimens collected in Waverley Council area, 72 specimens are registered as 'type' material, emphasising the historical significance of Waverley's invertebrate fauna. There are also 167 mollusc records from the Waverley Council area listed in the database.

Terrestrial invertebrate species described from material collected in Waverley Council area include:

- Mollusca – Family Cerithiopsidae – *Tubercliopsis macalpanei* (Laseron 1951) – type locality – Bronte, NSW
- Diptera: Family Lonchaeidae – *Dasiops phrikosifrons* (J. McAlpine 1964) – holotype, allotype, paratypes – all from Bronte, NSW March 1958
- Diptera: Family Lauxaniidae – *Homoneura intricata* (Kim 1994) – holotype and some paratypes – Bronte, NSW
- Diptera: Family Dolichopodidae – *Parentia vulgaris* (Bickel 1994) – paratypes from Bronte, NSW, various collection dates
- Diptera: Family Chryomyidae – *Notiochryomya* new sp. (det. M.J. Ebejer 2009)
- Diptera: Family Muscidae - *Dichaetomyia parimpar* (Pont 1969) – paratype - North Bondi, NSW
- Diptera: Family Agromyzidae – *Liriomyza obscurata* (Spencer 1963) – paratype – Bronte, NSW
- Diptera: Family Scenopinidae – *Scenopinus minutus* (Kelsey 1969) – holotype, paratype – Bronte, NSW
- Diptera: Family Drosophilidae – *Luzonimyia cineracea* (Bock 1982) – paratypes – Bronte, NSW
- Diptera: Family Platystomatidae - *Euprosopia filicornis* (McAlpine 1973) – paratype – Bronte, NSW
- Diptera: Family Platystomatidae – *Duomyia pallipes* (McAlpine 1972) – paratype – Bronte, NSW
- Lepidoptera: Family Pieridae – *Catopsilia pyranthe crokera* (W.S. Macleay 1826) – lectotype – Waverley, NSW.

Other species recorded for Bronte by Kim 1994 include:

- *Homoneura uncioclava* (Kim)
- *Homoneura barnardi* (Bergroth)
- *Homoneura fumifrons* (Malloch).

3.1.2 Database Searches: Vertebrates

The database searches obtained a number of previous records for fauna within the Waverley LGA and the broader locality. The locality was defined as an area encompassing a radius of 5 kilometres from the Waverley LGA. Records of marine species and terrestrial vertebrates recorded more than 50 years ago were excluded from the results. Species considered to be predominantly marine, but which may use terrestrial habitats (such as flooded grasslands) occasionally, were included. Previous records of terrestrial fauna within the locality include:

- 10 species of frog;
- 36 species of reptile;
- 225 species of bird; and
- 25 species of mammal.

The reliability of some of the records sourced from the databases was questionable, for example records that were well outside of known distributions of the species and may be erroneous or records of escaped captive animals. These records have not been considered in the total numbers of species indicated above, but are noted in Appendix E.

Forty-four of the vertebrate species recorded within the LGA and locality have been listed as threatened or migratory on the TSC Act and/or the EPBC Act (Appendix E). Among these were 23 species listed as vulnerable, endangered or critically endangered on the TSC Act, of which three are also listed as vulnerable, endangered or critically endangered on the EPBC Act. A total of 22 bird species listed as migratory on the EPBC Act (including those listed on JAMBA and CAMBA international agreements) have previously been recorded in the locality (Appendix E).

3.1.3 Previous Studies

A limited number of previous studies documenting the fauna of the LGA have been undertaken. Previous fauna studies made available to AMBS included the following:

- Wildlife Habitat Corridor Study for Waverley Council (Ondinea 1996);
- Frog Survey and Habitat Assessment, Coastal Walk Site, Waverley Cemetery (White 1998a);
- Lizard Fauna of Waverley Coastal Bushland Reserves (White 1998b); and
- AVI-Fauna Report for the Bush Regeneration Project, Bronte Coast Remnant (Fabbro 1998).

The Wildlife Habitat Corridor Study (Ondinea 1996) involved a review of fauna records within the Waverley LGA through consultation with local residents, Council staff, and WIRES. Field assessments were conducted at areas containing potential fauna habitat. Areas surrounding potential habitat were also assessed in conjunction with aerial photographs to determine potential wildlife habitat corridors. No fauna trapping or monitoring, or detailed vegetation surveys were conducted. Local residents identified 35 bird species throughout the Waverley LGA between July 1994 and June 1996, while the records from WIRES included Common Brushtail Possums (*Trichosurus vulpecular*) and Common Ringtail Possums (*Pseudocheirus peregrinus*).

A targeted frog survey was conducted in a coastal remnant adjacent to the Waverley Cemetery (White 1998a), with one frog species being recorded, the Common Eastern Froglet (*Crinia signifera*). Surveys targeting lizards were also conducted within several of the coastal bushland reserves (White 1998b). The surveys identified a total of ten species of reptile. The most common species recorded were the Delicate Skink (*Lampropholis delicata*), Grass Skink (*Lampropholis guichenoti*), and the Eastern Water Skink (*Eulamprus quoyii*). Tamarama Bay displayed the greatest diversity with nine of the ten species recorded.

The bird fauna report prepared by Fabbro (1998) provided a list of bird species for the locality and identified species that were likely to utilise Bronte Park for breeding. The report outlined the elements of ecosystem that are important for bird species that could use the site, and made recommendations on how to minimise the impacts of bush regeneration projects and improvements to the long term habitat quality of the site.

3.2 Invertebrate Surveys

3.2.1 Butterflies (Lepidoptera)

During the two-day survey, adults representing nine butterfly species were observed in flight (Table 4), including *Zizina labradus* (Common Grass-blue), *Pieris rapae* (Cabbage White), *Ocybadistes walkeri* (Greenish Grass-dart), *Trapezites symmokus* (Symmokus Skipper), *Junonia villida* (Meadow Argus; Plate 2), *Papilio aegus* (Orchard Swallowtail), *Vanessa itea* (Yellow Admiral; Plate 1), *Graphium sarpedon* (Blue Triangle) and *Belenois java* (Caper White).

All species observed are relatively common in Sydney. It is important to note that the species observed are well adapted to the urban Sydney environment due to the presence of suitable food plants on which their caterpillars feed. Caterpillars of the Common Grass-blue and the Greenish Grass-dart are generalist grass feeders (Poaceae) whilst the Cabbage White feeds on plants from the family Brassicaceae (cabbage, cauliflower, broccoli etc). The caterpillars of the nymphalid butterflies *Junonia villida* (Meadow Argus) feed on broadleaf weed species such as *Plantago* whereas the Yellow Admiral feed on thistles (*Urtica* sp.). The caterpillars of the Orchard Swallowtail feed on a variety of Citrus species. Symmokus Skipper caterpillars feed on *Lomandra longifolia* and the individual observed at Tamarama was landing on a stand of this food plant. A number of different food plants have been recorded for the Blue Triangle, however the most common choice of food plant in urban areas is on the Camphor Laurel tree (*Cinnamomum camphor*), an introduced species now largely regarded as a weed species. The only non-resident exception is the Caper White, which is a well known migratory species, commonly seen in Sydney in large numbers during an annual migratory event that usually occurs late spring/early summer. The caterpillar stage of this species generally occurs in habitat north and west of Sydney, where the favoured food plant *Capparis* sp. is readily available.

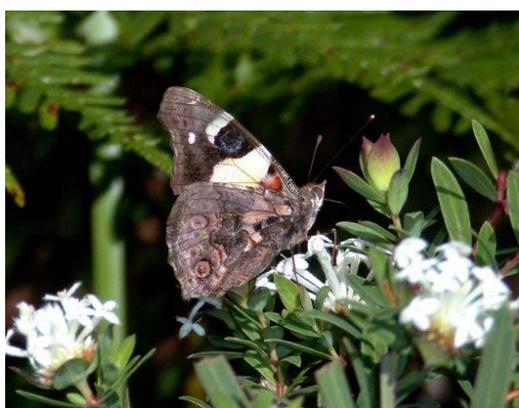


Plate 1: *Vanessa itea* (Yellow Admiral)

Photo: Bruce Hulbert



Plate 2: *Junonia villida* (Meadow Argus)

Photo: Bruce Hulbert

In addition to the nine butterfly species observed during the survey period, there are another 38 species for which there are catalogue records in the Australian Museum database. Several species, such as *Protographium leosthenes* (Four-barred Swordtail) and *Eurema herla* (Pink Grass-Yellow) are rarely seen in Sydney. Even when encountered they are generally a transitory visitor, with the southern limit of their stable ranges only reaching as far south as the mid north coast of NSW. Other more readily encountered species, such as *Hypocysta pseudirius* (Grey Ringlet), *Toxidia peron* (Dingy Grass-skipper)

and *Heteronympha merope* (Common Brown) were not seen during our survey, but could certainly be expected to be seen in the council area as their caterpillars are generalist grass feeders. A palm feeder, *Cephrenes augiades* (Orange Palm-dart) is often encountered in urban gardens, so it could also be expected to still be a resident in the council area. *Delias nigrina* (Black Jezebel) is a common species that often flies in the winter months. Its caterpillars feed on mistletoe species. It is unfortunate that mistletoes are often removed from trees because they are a parasite of the host tree, because without its presence this species cannot persist. It would be expected to be seen around the tops of eucalypts in the council area. *Tirumala hamata* (Blue Tiger) is a migratory species, which can be extremely plentiful in Sydney in certain years. *Ogyris ianthis* (Golden Azure) is a very rare species wherever it occurs. Its caterpillars not only require mistletoe as food plant, but also have an obligate relationship with ant attendants (*Froggattella* sp.). It is unlikely that this species is still in existence in the area. Hirschfeld (1998) recorded the plant species *Monotoca elliptica* from Tamarama Gully. Its presence suggests that it is possible there could be a remnant population of *Neolucia mathewi* (Dull Heath-blue) at this site, since it is the food plant of this species. Other suitable food plants recorded in Hirschfeld's report include *Pimelea linifolia* on which *Candalides xanthospilos* (Yellow Spotted-blue) breeds, and *Cassytha* sp., which is a food plant of *Candalides hyacinthina* (Varied Dusky-blue). *Hesperilla ornata* (Spotted Sedge-skipper), *Hesperilla picta* (Painted Sedge-skipper), *Hesperilla donmyssa* (Varied Sedge-skipper) and *Tisiphona abeona* (Varied Sword-grass Brown) all rely on *Gahnia* species to be present as a foodplant to complete their life cycle. Hirschfeld indicated that remnant *Gahnia* stands may still be present, but it may well be that these species are no longer present within the Waverley Council area.



Plate 3: *Papilio aegus* (Orchard Swallowtail)
Photo: Pavel German



Plate 4: *Graphium sarpedon* (Blue Triangle)
Photo: Australian Museum

Table 4: Waverley Council Invertebrate Survey December 2009, Lepidoptera observations.

Species		Sites							
Scientific name	Common name	Diamond Bay Reserve	Rodney Reserve	Marks Park	Tamarama Park	Bronte Park	Varna Park	Queens Park	York Road
<i>Zizina labradus</i>	Common Grass-blue	present	present	present	present	present	present	present	present
<i>Pieris rapae</i>	Cabbage White	present	present	present	present	present	present		present
<i>Ocybadistes walkeri</i>	Greenish Grass-dart				present	present	present	present	present
<i>Junonia villida</i>	Meadow Argus				present		present		
<i>Trapezites symmomus</i>	Symmomus Skipper				present				
<i>Papilio aegaeus</i>	Orchard Swallowtail				present	present			
<i>Vanessa itea</i>	Yellow Admiral					present			present
<i>Graphium sarpedon</i>	Blue Triangle					present			
<i>Belenois java</i>	Caper White								present

Table 5: Waverley Council Invertebrate Survey December 2009, Araneae observations.

Species		Sites							
Scientific name	Common Name	Diamond Bay Reserve	Rodney Reserve	Marks Park	Tamarama Park	Bronte Park	Varna Park	Queens Park	York Road
<i>Leucauge</i> sp.	Silver _orb-weaving spider	present				present			
<i>Phonognatha graeffei</i>	Leaf-curling Spider	present	present			present			
<i>Stiphidion facetum</i>	Sombrero or Crinoline Spider	present					present		
<i>Achaearanea</i> sp.		present		present					
<i>Nephila</i> sp.	Golden Orb-weaving Spider					present		present	
<i>Eriophora</i> sp (<i>transmarinalbiapicata</i>)	Garden Orb-weaving Spider				present				
<i>Nephila plumipes</i>	Golden Orb-weaving Spider				present				
<i>Argiope keyserlingi</i>	St Andrew's Cross Spider				present	present			

Table 6: Butterfly species with historical records in the Australian Museum database from the Waverley LGA but not encountered during this survey.

Scientific Name	Common Name	Status
<i>Cephrenes augiades</i>	Orange Palm-dart	Still likely to be encountered
<i>Taractrocera papyria</i>	White-banded Grass-dart	Still likely to be encountered
<i>Suniana lascivia</i>	Dark Grass-dart	Still likely to be encountered
<i>Motasingha trimaculata</i>	Large Brown Skipper	Likely to be extinct in the area
<i>Hesperilla ornata</i>	Spotted Sedge-skipper	Likely to be extinct in the area
<i>Ogyris ianthis</i>	Golden Azure	Likely to be extinct in the area
<i>Catopsilia pyranthe</i>	White Migrant	Vagrant – unlikely to be encountered
<i>Ocybadistes flavovittata</i>	Narrow-brand Grass-dart	Still likely to be encountered
<i>Erysichton lineata</i>	Hairy Line-blue	Likely to be extinct in the area
<i>Candalides hyacinthina</i>	Varied Dusky-blue	Still likely to be encountered
<i>Neolucia mathewi</i>	Dull Heath-blue	Still likely to be encountered
<i>Candalides cyprotus</i>	Dusky Pencil-blue	Likely to be extinct in the area
<i>Hesperilla picta</i>	Painted Sedge-skipper	Likely to be extinct in the area
<i>Ogyris abrota</i>	Dark Purple Azure	Still likely to be encountered
<i>Candalides xanthospilos</i>	Yellow spotted-blue	Still likely to be encountered
<i>Toxidia doubledayi</i>	Lilac Grass-skipper	Still likely to be encountered
<i>Hesperilla donnysa</i>	Varied Sedge-skipper	Likely to be extinct in the area
<i>Hypocysta euphemia</i>	Rock Ringlet	Still likely to be encountered
<i>Delias nysa</i>	Yellow-spotted Jezebel	Likely to be extinct in the area
<i>Appias paulina</i>	Yellow Albatross	Still likely to be encountered
<i>Elodina parthia</i>	Striated Pearl-white	Vagrant – unlikely to be encountered
<i>Netrocoryne repanda</i>	Bronze Flat	Likely to be extinct in the area
<i>Lampides boeticus</i>	Long-tailed Pea-blue	Still likely to be encountered
<i>Hypolimnas bolina</i>	Varied Eggfly	Vagrant – unlikely to be encountered
<i>Delias nigrina</i>	Black Jezebel	Still likely to be encountered
<i>Mesodina halyzia</i>	Eastern Iris-skipper	Likely to be extinct in the area
<i>Eurema herla</i>	Pink Grass-yellow	Vagrant – unlikely to be encountered
<i>Candalides absimilis</i>	Common Pencil-blue	Still likely to be encountered
<i>Toxidia peron</i>	Dingy Grass-skipper	Still likely to be encountered
<i>Tisiphone abeona</i>	Varied Sword-grass Brown	Likely to be extinct in the area
<i>Heteronympha merope</i>	Common Brown	Still likely to be encountered
<i>Protographium leosthenes</i>	Four-barred Swordtail	Vagrant – unlikely to be encountered
<i>Graphium euryplyus</i>	Pale Triangle	Vagrant – still likely to be encountered
<i>Eurema smilax</i>	Small Grass-yellow	Still likely to be encountered
<i>Polyura sempronius</i>	Tailed Emperor	Still likely to be encountered
<i>Acraea andromacha</i>	Glasswing	Vagrant – unlikely to be encountered
<i>Hypocysta pseudirius</i>	Grey Ringlet	Still likely to be encountered
<i>Tirumala hamata</i>	Blue Tiger	Vagrant – still likely to be encountered

3.2.2 Spiders (Araneae)

Thirty-nine species representing 14 families of spiders were recorded. Eight of these species were observed in our visual inspection of the sites (Table 5). Four species were observed at both Diamond Bay and Bronte Park. The sampling part of the survey resulted in more species being recorded (see Appendix C for full list). Species diversity ranged from 4-12 species across the sites, with Bronte Park having the highest number of species. Spider families represented are predominately arboreal (Araneidae (Orb-Weavers), Linyphiidae (Money Spiders), Oxyopidae (Lynx Spiders), Tetragnathidae (Long-jawed Orb Weavers) or ground dwelling (Lycosidae [Wolf Spiders], Gnaphosidae [Ground spiders], Dysderidae [Cell Spiders]) and some inhabit both zones (Theridiidae [Comb-footed Spiders], Salticidae [Jumping Spiders]). The Woodlouse Spider *Dysdera crocata* is an introduced species, native to Europe.

3.2.3 Other invertebrate groups

For a full summary of species recorded at each site by three sampling methods (sweep/beat netting, yellow pan traps and litter sampling) see Appendix A. Identifications were undertaken to the level possible within the budget of the project and the available expertise. High level identification of diverse groups such as beetles (Coleoptera), bugs (Hemiptera) and wasps (Hymenoptera) require time-consuming detailed analysis by specialists, which was not possible within the scope of this survey.

Ants (Formicidae)

A diverse suite of ant species was observed at all sites (see Appendix B). Species diversity ranged from 8-16 species at each site with a total of at least 22 morphospecies identified in total. Tamarama Park had the greatest species diversity with 16 species recorded. *Pheidole megacephala* is a widespread invasive tramp. Generally most of the species were indicative of, or tolerate disturbed conditions. The exception is *Strumigenys*, which likes moist, mossy places. They are specialist feeders on Springtails (Collembola) which play an important role in breakdown of leaf litter.

Flies (Diptera)

Yellow pan traps are well suited to trapping flies from the family of long-legged flies, the Dolichopodidae. At least one species from this family was recorded at each site. The greatest diversity was seen at Bronte Park, with four recorded species. *Austrosclaptus connexus* was the most abundant species, being recorded at six of the eight sites. All major subgroups of flies (Nematocera, Orthorrhapha, Acalyptrata and Calyptrata) were represented in the sample catch, with species from a total of 34 family groups recorded. Diversity at the eight sites ranged from 14-26 morphospecies (individual taxonomic units that have not been identified with a full scientific name), with Marks Park being the most diverse for this category.

Book Lice (Psocoptera)

This small group provided some interesting results, with two probably undescribed species recorded at Queens Park, and one at Varna Park. Varna Park also had the greatest diversity, with three species recorded at this site.

Additional observations

Several dragonfly and damselfly species (Odonata) were observed at Diamond Bay, Tamarama Park, Bronte Park and York Road but were not captured, making positive identification difficult. The Christmas beetle *Anoplognathus* sp. was sighted at Rodney Reserve and Marks Park. A Cowboy Beetle *Chondropyga dorsalis* was also seen at Marks Park. Several specimens of day flying moth (vine moth – *Phalaenoides glycinae*) were observed near the water course at Bronte Park. Empty Cicada ‘shells’ were detected at Tamarama Park, confirming their presence in the area.

3.3 Vertebrate Surveys

3.3.1 Overview

A total of 66 species were detected within the Waverley LGA during the targeted surveys and habitat assessments. This included species from all fauna groups surveyed including frogs, reptiles, birds and mammals. One threatened species was recorded; the Grey-headed Flying-fox (*Pteropus poliocephalus*), which is listed as a vulnerable species under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

3.3.2 Frogs

Four species of frog were detected during the field surveys; the Brown-striped Frog (*Limnodynastes peronii*), Eastern Dwarf Tree Frog (*Litoria fallax*), Bleating Tree Frog (*Litoria dentata*) and the Common Eastern Froglet (*Crinia signifera*). The Brown-striped Frog and the Eastern Dwarf Tree Frog were both recorded within the Queens Park pond, while the Bleating Tree Frog was recorded within Tamarama Park. The Eastern Dwarf Tree Frog was also heard calling nearby Tamarama Park, from a private property on the southern slope of the Park. The Common Eastern Froglet was heard calling during the day in a coastal heath remnant near Rodney Reserve.

3.3.3 Reptiles

Eleven species of reptile were detected during the field surveys. Nine of these species were detected during the diurnal surveys and included the Three-toed Skink (*Saiphos equalis*; Plate 6), Dark-flecked Garden Sunskink (*Lampropholis delicata*), Pale-flecked Garden Sunskink (*Lampropholis guichenoti*), Cream-striped Shinning-skink (*Cryptoblepharus virgatus*), Eastern Water-skink (*Eulamprus quoyii*; Plate 5), Pale-lipped Shadenskink (*Saproscincus spectabilis*), Eastern Blue-tongue (*Tiliqua scincoides*; Plate 7), an unidentified turtle within the Queens Park pond, and probable identification of a Weasel Skink (*Saproscincus mustellinus*) which was being eaten by a Laughing Kookaburra (*Dacelo novaeguineae*). Two species were recorded during the nocturnal spotlighting, the Broad-tailed Gecko (*Phyllurus platurus*) and Lesueur's Velvet Gecko (*Oedura lesueurii*).



Plate 5: The Eastern Water-skink (*Eulamprus quoyii*) was common in areas near water.

Photo: Mark Semeniuk (AMBS).

The Eastern Water Skink and the Dark-flecked Garden Sunskink were the two most common species recorded during the standardised surveys, with seven records each. The Pale-lipped Shadenskink was the next most common, with six records, although these were all from the one site, Tamarama Park. The Three-toed Skink was also frequently recorded with five records across four sites.



Plate 6: The Three-toed Skink (*Saiphos equalis*) was common in areas with leaf litter accumulations. Photo: Mark Semeniuk (AMBS).



Plate 7: The Eastern Blue-tongue (*Tiliqua scincoides*) was sighted in Tamarama Park. Photo: Mark Semeniuk (AMBS).

3.3.4 Birds

Forty-three species of bird were detected during the field surveys and habitat assessments, six of which are introduced species. Thirty-five species were recorded during the standardised surveys and the most abundant were the Rainbow Lorikeet (*Trichoglossus haematodus*), Noisy Miner (*Manorina melanocephala*), Rock Dove (*Columba livia*), Common Starling (*Sturnus vulgaris*), Superb Fairy-wren (*Malurus cyaneus*), Red Wattlebird (*Anthochaera carunculata*) and Australian White Ibis (*Threskiornis molucca*). The records from these species account for approximately 64% of all observations (Figure 3). When the results are extended to include all species recorded at a given site (i.e. not just within the quadrat), Australian Magpies (*Gymnorhina tibicen*), Little Corellas (*Cacatua sanguinea*) and Welcome Swallows (*Hirundo neoxena*) were also very common (Figure 3).

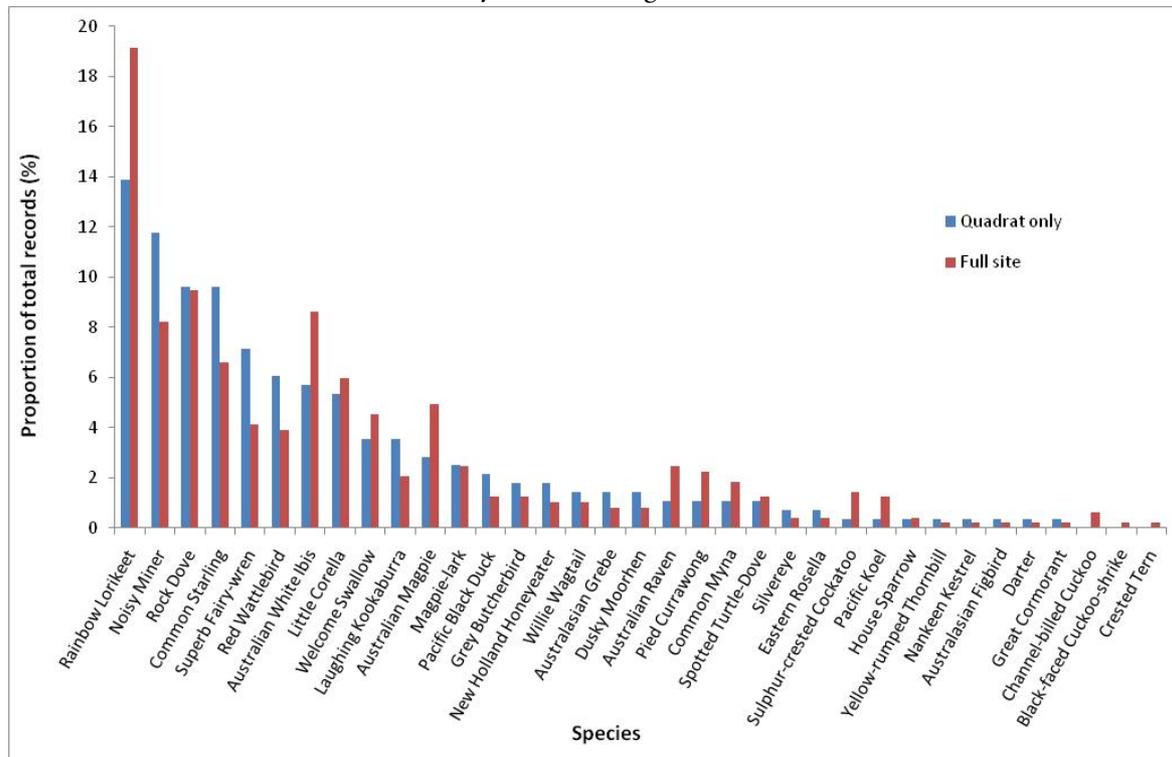


Figure 3: Bird species recorded within the Waverley LGA during standardised surveys.

N.B. additional species recorded opportunistically or outside the standardised areas include the Crested Pigeon (*Ocyphaps lophotes*), Silver Gull (*Larus novaehollandiae*), Little Wattlebird (*Anthochaera chrysoptera*), Chestnut Teal (*Anas castanea*), Red-whiskered Bulbul (*Pycnonotus jocosus*), Yellow-tailed Black-Cockatoo (*Calyptorhynchus funereus*), Scaly-breasted Lorikeet (*Trichoglossus chlorolepidotus*) and Tawny Frogmouth (*Podargus strigoides*).

Noisy Miners were recorded from nine of the 12 bird sites, making it the most widespread species. Rainbow Lorikeets were the next most widespread being recorded from eight sites, followed by the Red Wattlebird (seven sites), Welcome Swallow (*Hirundo neoxena*) and Rock Dove (six sites) and the Laughing Kookaburra (*Dacelo novaeguineae*; five sites).

One Yellow-rumped Thornbill (*Acanthiza lineata*) was recorded at Hugh Bamford amongst a flock of Silvereyes (*Zosterops lateralis*). This species is considered to be regionally significant by DECCW.

One nocturnal bird species was recorded, the Tawny Frogmouth (*Podargus strigoides*). A feather from this species was identified from Tamarama Park during the nocturnal frog surveys. This species has also been recorded in the WIRES database.

3.3.5 Mammals

Eight species of mammal were detected during the field surveys and habitat assessment, of which four are native. Native species recorded included the Common Brushtail Possum (*Trichosurus vulpecular*), Grey-headed Flying-fox (*Pteropus poliocephalus*; Plate 8), Gould's Wattled Bat (*Chalinolobus gouldii*; Plate 9) and the Eastern Freetail Bat (*Mormopterus* sp.). Introduced species recorded included the Brown Rat (*Rattus norvegicus*), Dog (*Canis lupus familiaris*), Cat (*Felis catus*) and Fox (*Vulpes vulpes*).

Common Brushtail Possums were recorded during spotlighting at four sites, namely Queens Park pond, Bronte Park, Diamond Bay Reserve and Tamarama Park. The Grey-headed Flying-fox was recorded flying over-head or foraging at the same sites, but also at Thomas Hogan Reserve and York Road. It is likely the species utilises foraging resources throughout much of the Waverley LGA. This species is listed as vulnerable under the TSC Act and the EPBC Act. The Gould's Wattled Bat was recorded from Bronte Park, Diamond Bay, Hugh Bamford and the Queens Park pond. The Eastern Freetail Bat was recorded at Hugh Bamford and Tamarama Parks.



Plate 8: Grey-headed Flying-foxes (*Pteropus poliocephalus*) were recorded foraging throughout much of the LGA.

Photo: Martin Schulz.



Plate 9: Gould's Wattled Bat (*Chalinolobus gouldii*) was recorded in four locations within the LGA.

Photo: Martin Schulz.

3.4 Wildlife Habitat Corridors

Existing wildlife habitat corridors within the Waverley LGA are difficult to define. As discussed earlier, 112 hectares (12%) of the Waverley LGA is designated as open space and of this only five percent (approximately 6 hectares) is native remnant vegetation (Waverley Council 2009). Attempting to recreate the original vegetative characteristics of the area would be an impossible task, considering the degree of urbanisation that has occurred. Decisions regarding priorities for action and the use of available resources are necessary, because not all goals will be able to be achieved immediately, and there is always more that needs to be done than there are resources available for implementation (Bennett 1998, 2003).

The previous wildlife habitat corridor study (Ondinea 1996) outlined several attributes that are desirable features for a wildlife habitat corridor:

- vegetation structure with a range of age classes, heights, dense understorey and a range of flowering and fruiting periods;
- ground habitat features such as leaf litter, logs, rocks and unpolluted water;
- habitat compatible with target species;
- absence of barriers to movement (e.g. roads, fences, unsuitable habitat);
- short corridor length and as straight as possible (few sharp bends); and
- corridor should be as wide as possible (to reduce impacts of edge effects).

The study also recommended four principles to consider when creating wildlife habitat corridors:

- identify and protect remnant vegetation and fauna;
- restore remnant vegetation;
- identify, protect and maintain other important habitat for existing wildlife; and
- recreate habitat within the proposed wildlife corridor.

Recommendations for actions to be undertaken throughout the proposed wildlife habitat corridor area were also provided. Recommendations included:

- increasing the density of existing shrub plantings and the areas of such plantings;
- reduce underpruning of shrub plantings to increase protection for small birds;
- plant shrubs around existing mature trees;
- plant steep slopes in grassy parks and other open space;
- plant shrub and tree clumps on wide road verges, median strips and pocket parks;
- plant around fences, park perimeters, carparks, toilet blocks etc;
- replace mowing with weed control in areas where regenerations of indigenous species is possible;
- use trees to lift flight paths over busy roads;
- restrict the number of indigenous fruit-bearing plants species in revegetation projects, which encourage Pied Currawongs;
- plant waterways and drainage lines to maintain bank stability;
- use locally collected indigenous plant material wherever possible in plantings;
- replace exotic and non-indigenous street trees and mixed plantings with locally native species;
- make hollow logs, excavate rock and leaf litter available to enhance habitat areas on private property, return pruned branches to areas for habitat/shelter, retain dead tree stumps; and
- place nest boxes in mature trees for existing and potential fauna.

Each of these strategies was recommended to be undertaken at one or more locations through the Waverley LGA. Some are recommended to occur everywhere. During the review it was determined

that most areas in which recommendations were made were appropriate. However, given that the majority of the LGA is either dominated by human infrastructure, mown lawn or sparse street plantings, extensive work would be required to achieve all recommendations across the entire Waverley LGA.

The study (Ondinea 1996) also proposed potential corridors for native wildlife to use for movement within and through the LGA. Upon investigation of these routes, there did not appear to be anything special or unique with regard to the fauna habitat present that would justify identifying them as habitat corridors, with the exception of the coastal strip (see below). The majority of areas contained street tree or shrub plantings, which did not differ remarkably from many other locations in which habitat corridors were not proposed. While these plantings do provide habitat for some native fauna, the current densities only allow a limited variety of species to utilise them (mainly the disturbance-tolerant species discussed in the results).

The potential for fauna to utilise the small remnants along the coastal areas of the LGA was identified in the study by Ondinea (1996) and was confirmed by this study. These areas are unique within the LGA because they are the last remaining remnants of the vegetation that originally existed.

4 Discussion

4.1 Current Threats

The original vegetation throughout the Waverley LGA was dominated by Heath on Sandstone, with smaller amounts of Eastern Suburbs Banksia Scrub on Sand (Figure 4). The majority of this vegetation has been cleared and replaced by human infrastructure or open space. Planting of vegetation within parks and on streets has contributed to increasing the amount of vegetation throughout the LGA, but is not in high enough densities, and in most cases does not sufficiently replicate the original communities that once existed. Furthermore, as residential areas increase in size, so do the impacts on the remaining areas of vegetation. This process of habitat loss and fragmentation has implications for the conservation of flora and fauna throughout the world (Bennett 1998, 2003). Major consequences for wildlife are a loss of species from isolated fragments and entire landscapes, changes to the composition of faunal assemblages, and changes to ecological processes involving animal species (Bennett 1998, 2003). As habitat areas decrease population sizes are reduced, leading to increased risk of extinction (Bennett 1998, 2003). Furthermore, as habitat fragmentation increases, so does the impact of edge effects, genetic diversity is decreased, and opportunities for re-colonising areas following local extinction are minimised (Bennett 1998, 2003).

In addition, patches of vegetation surrounded by urban development are also susceptible to threatening processes such as weed invasion, road mortality, predation by introduced predators (pet cats and dogs), direct persecution, frequent habitat disturbance (e.g. vegetation slashing, rubbish dumping, access from people), and an increased frequency of fires. The impact of these factors is greatest for smaller patches that have a larger proportion of edge habitat relative to overall area (Bennett 1998, 2003).

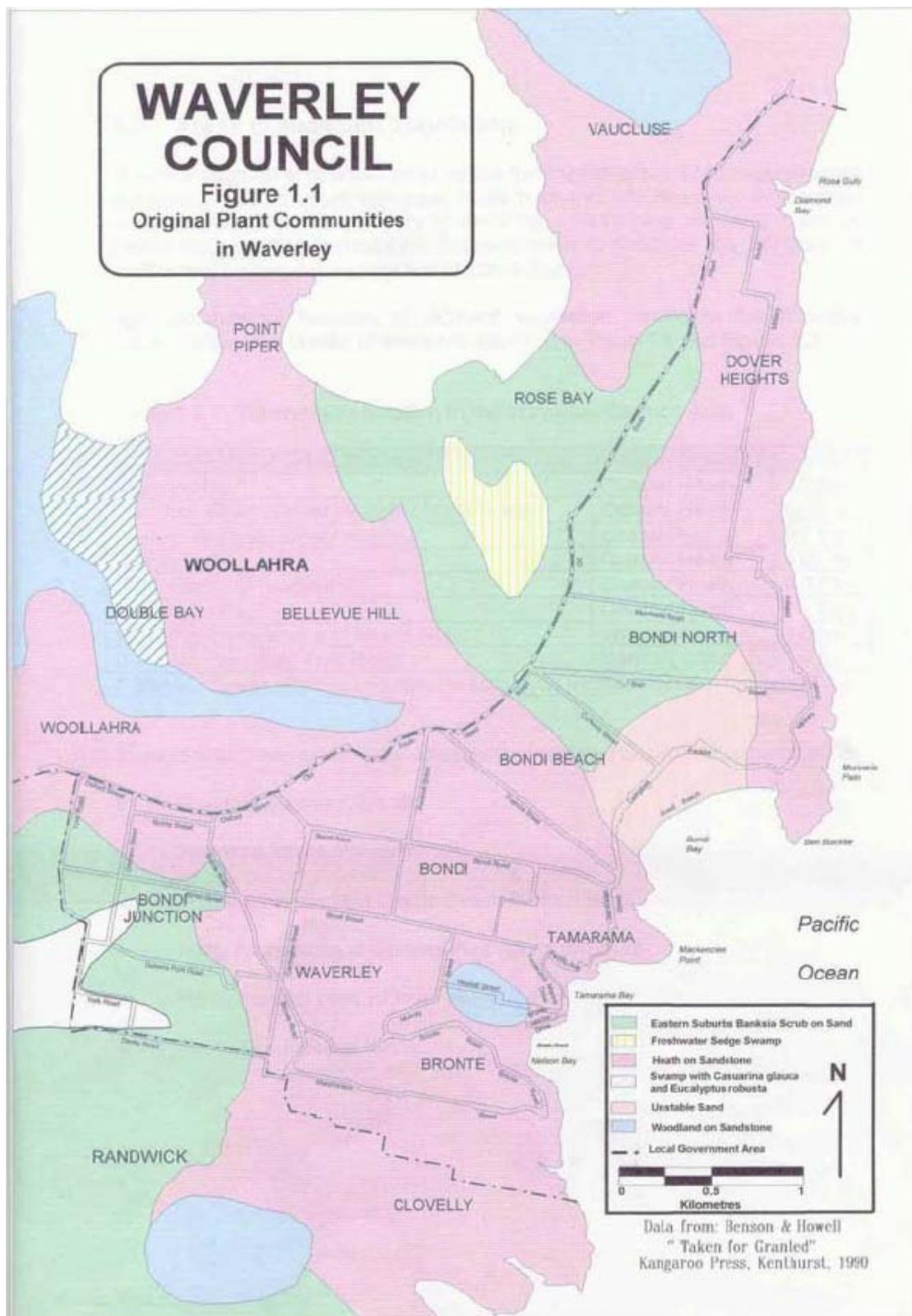


Figure 4: Original vegetation communities of the Waverley LGA.

From Benson and Howell (1990).

4.2 Invertebrates

The nine butterfly species observed during the survey are representative of the butterfly species one would typically expect to see in a heavily urbanised environment during early summer in Sydney. Provided that suitable caterpillar foodplant species persist in local gardens and parklands, these butterfly species should continue to populate the Waverley Council area.

It is important to take into consideration that a 2-day survey of invertebrate biodiversity only produces a snapshot of species present at the time of sampling. Many insect species are only visible for short periods with adults often only 'on the wing' for a few weeks of the year at very specific times (e.g. early spring, mid-summer, late autumn). Observation of nine butterfly species during the 2-day field trip confirmed that these urban-adapted species do have populations in the area. However, based on the Australian Museum database records, 38 additional butterfly species have been recorded in the council area. Whilst a number of these species could best be described as 'occasional visitors', it would not be unreasonable to expect to encounter at least 15 of these butterfly species that are present either as resident populations or are transitory visitors in the council area.

Whilst suburban gardens with suitable plantings will continue to play an important role in sustaining local breeding populations of invertebrates, it is also important to understand the role that the parklands included in the survey play for the area's invertebrate fauna. Not only do they provide areas of suitable habitat for butterfly caterpillars, but they also provide suitable flight corridors for adult butterflies, and these are integral to their courtship and mating behaviour.

It is impossible to capture a full suite of invertebrate species in a 2-day 'snap-shot' survey as has been conducted here. The selected sampling and trapping methods were chosen as they are ideally suited to optimise the biodiversity catch in the time available with little impact on the environment and species present. Other methods, such as night-time light trapping would produce another suite of insects, particularly moths. Collecting with other such techniques in future surveys would provide a more complete picture of overall invertebrate biodiversity in the LGA.

4.3 Vertebrates

4.3.1 Frogs

Ten species of frog have been recorded within the locality and the current surveys recorded three of these species. This represents 30% of the species that have previously been recorded. There is potential for some of the species that were not detected during the surveys to occur, such as the Peron's Tree Frog (*Litoria peronii*), which is reasonably common throughout other areas of Sydney. No suitable habitat is available for threatened frog species that could occur in the locality.

This survey also detected a fourth frog species, the Bleating Tree Frog (*Litoria dentata*), which has not previously been recorded within the LGA. This species is reasonably common throughout eastern NSW and are usually associated with non-flowing waterbodies such as ponds, swamps or lagoons (Robinson 1998), but can also be found in fragmented habitats with no permanent water. They generally breed after rain in spring and summer, with male frogs often heard calling from tree hollows or behind decorticating bark.

There are few areas within the Waverley LGA suitable to support breeding frog populations. Only four areas were found to contain permanent water (Queens Park, Bronte Park, Tamarama Park and Diamond Bay), while a few coastal heath remnants appeared to have potential for small ephemeral drainage lines to occur following rain (e.g. Calga Reserve).

It is likely that the creeks running through Bronte Park and Tamarama Gully are impacted by stormwater runoff, which would contain chemicals and pollutants that can affect water quality and the sensitive skins of frogs. Diamond Bay would also be impacted by salt spray increasing the salinity in the small pools. Other factors likely to reduce the potential for these creeks to support frogs include the high density of weed species at Tamarama Gully and the lack of riparian vegetation in Bronte Park (the creek is a concrete channel).

The best site for frogs is the pond within Queens Park, due to its larger size, greater variety of riparian vegetation, and lower degree of isolation (i.e. was not surrounded by houses).

4.3.2 Reptiles

A total of 36 reptile species have been previously recorded within the locality, and the current surveys recorded 11 species. This represents approximately 30% of the species that have previously been recorded. There is potential for some of these species that were not detected during the surveys to occur, such as the Red-bellied Black Snake (*Pseudechis porphyriacus*), which is reasonably common throughout other areas of Sydney. This species is diurnal and feeds mainly on frogs; however, other vertebrates will also be taken. It is likely the species still occurs in areas of Centennial Park. No suitable habitat is available for threatened reptile species that could occur in the locality.

This reptile diversity is reasonably high considering the relatively small areas of native vegetation remaining throughout the LGA. Based on the standardised surveys, the highest diversity of reptiles was recorded at Diamond Bay (five species), Hugh Bamford (four species) and York Road (three species). When the additional survey time is included as well as opportunistic observations the highest diversity is from Tamarama Park (six species). These sites typically had a high proportion of shrub cover, grass cover (not mown) or other form of ground cover such as debris or large rocks in comparison with other sites that were surveyed.

The majority of species recorded are reasonably common throughout most urban areas of Sydney. The *Lampropholis* species are commonly known from urban gardens, while the Cream-striped Shinning-skink (*Cryptoblepharus virgatus*) is also commonly seen around rock outcrops, fences and buildings. The Eastern Water Skink (*Eulamprus quoyii*) was very common in most areas that contained water, particularly in coastal areas where exposed rock allowed individuals to bask and remnant heath remained for protection. The Three-toed Skink (*Saiphos equalis*) was reasonably common where suitable habitat existed. This species burrows into soft damp soil under rocks, logs and leaf litter, and is also frequently encountered in suburban gardens.

The most interesting records were the high number of Lesueur's Velvet Gecko (*Oedura lesueurii*; Plate 7) recorded within Diamond Bay and the Pale-lipped Shadenskink (*Saproscincus spectabilis*; Plate 8) within Tamarama Gully. Four Lesueur's Velvet Geckos were recorded in Diamond Bay, which is encouraging, considering the small size and high level of disturbance of the site. Declines of this species have been implicated as a reason for the decline of the Broad-headed Snake (*Hoplocephalus bungaroides*), a species which is listed as endangered under the TSC Act and the EPBC Act. Habitat degradation and bushrock removal are likely reasons for declines in the abundance of the geckos, which are the main prey item for juvenile Broad-headed Snakes (Shine et al. 1998). The Lesueur's Velvet Gecko requires forest or heath vegetation on sandstone rock outcrops, where they shelter under exfoliations or crevices (narrow and wide). It is likely that this species exists in other sandstone areas along the coast where there is also suitable vegetation cover to support invertebrate populations.

Six Pale-lipped Shadenskinks were recorded in Tamarama Gully during the current surveys (also known as the Gully Skink, identified by White [1998b] in Tamarama). The species is considered rare and

patchy within the Sydney region (R. Sadlier *pers. comm.*), but can be locally very common. Based on records from the Australian Museum collections it is only known from 12 different locations across nine suburbs within the greater Sydney region. The nearest records outside of Sydney are near Bulahdelah (approximately 230 kilometres north). The species was very common in Tamarama Gully, on the northern slope under the thick leaf litter. Habitat requirements are usually moist gullies such as rainforest or wet forest.



Plate 10: Lesueur's Velvet Gecko (*Oedura lesueurii*) was common in Diamond Bay. Photo: Mark Semeniuk (AMBS).



Plate 11: The Pale-lipped Shadescink (*Saproscincus spectabilis*) was common in Tamarama Park. Photo: Mark Semeniuk (AMBS).

4.3.3 Birds

A total of 225 bird species have been previously recorded within the locality, and the current surveys recorded 41 species. This represents approximately 20% of the species that have previously been recorded. There is potential for some of these species that were not detected during the surveys to occur; however, habitat for many species is limited. The array of bird species recorded during the surveys is dominated by those that are well adapted to urban areas. The groups of birds that have become adapted to heavily developed areas has been well documented in many studies throughout Australia; these birds are typically the larger, more aggressive groups such as parrots (Psittaciformes), corvids (Corvidae) and large honeyeaters (Meliphagidae), while smaller birds are generally more uncommon (e.g. small insectivores) (Keast 1995; Parsons et al. 2003; Major and Parsons 2010). The remaining habitats throughout the LGA are not suitable for most threatened bird species that could occur in the locality. However, it is possible that some threatened migratory species could use the area on occasion, such as the Swift Parrot (*Lathamus discolor*), which migrates from Tasmania to mainland Australia to forage on winter-flowering eucalypts.

The Rainbow Lorikeet was the most commonly recorded species during the surveys. This nectar and pollen specialist has increased greatly in urban areas, particularly cities, which is likely a result of the number of ornamental eucalypts and other non-native plantings and their extensive flowering periods, providing the species with a near year-round supply of nectar and pollen (Smith and Lill 2008).

The Noisy Miner, the second most frequently recorded species in the LGA, has become extremely common in lightly treed park areas where they feed on nectar and glean the foliage for insects (Keast 1995). They are extremely aggressive and territorial, driving away other native species from small remnants. Vegetation clearing and habitat fragmentation has allowed the species to flourish in urban areas.

The Rock Dove and Common Starling were two very common feral species throughout the LGA. The Rock Dove was very widespread, and associated mostly with open park areas or buildings. The Common Starling was less widespread, but large flocks were recorded; 25 were recorded during the

standardised surveys on the lawn area at Hugh Bamford Reserve. Other opportunistic observations counted greater than 20 birds at Marks Park and Waverley Cemetery, and 80 birds were counted on the mown lawns of Queens Park. Starlings can be aggressive when competing for nesting sites and readily drive out native species (Birds Australia 2010).

The Superb Fairy-wren (Plate 9) was relatively common during the surveys. This insectivorous species is thought to be in decline in urban areas, and requires dense shrubs in which they spend most of their time (Parsons 2009). They forage mainly on the ground and not far away from the shrubs which provide them protection. Throughout Waverley the species was only recorded in areas where shrubs occurred, which was mostly in the coastal remnants, but also in the York Road site.



Plate 12: Female Superb Fairy-wren (*Malurus cyaneus*). This species was common in the coastal remnants. Photo: Mark Semeniuk (AMBS).

The Red Wattlebird was common throughout most of the LGA. The species was often observed foraging nectar from the coastal banksias. The White Ibis is another species that has become extremely common in the Sydney area, and was mostly recorded flying overhead. Historically the species was a water-bird that bred exclusively in areas of inland Australia (Keast 1995). Due to extended drought the species is now common in city parks and has adapted to foraging on food scraps from the ground and garbage bins (Keast 1995).

Other species that were reasonably common or widespread during the current surveys were the Pied Currawong, Australian Magpie, Laughing Kookaburra and the Grey Butcherbird. These insectivores and/or vertebrate feeders have also become very common in suburban parks and can have an impact on small birds in urban areas through foraging for nestlings (Keast 1995). The Pacific Koel was common throughout the study area and has increased greatly in the Sydney region due to increased food in suburban parks (fruits, especially fig), and increased abundance of their nest hosts, Red Wattlebird and Pied Currawong (Keast 1995).

The results of our surveys are consistent with other research documenting declines in small (less than 50g) insectivores and honeyeaters throughout eastern Australian cities, which is linked to a lack of foraging resources in exotic vegetation and a loss of shrubby vegetation (Keast 1995; Parsons et al. 2003; Catterall 2004; Major and Parsons 2010). Exotic vegetation has been shown to contain fewer herbivorous arthropods, and habitat fragmentation impedes the movement of small bird species (Recher 2004).

Throughout Australia, the presence of Noisy Miners has also been recognised as a significant factor in shaping bird communities in areas where it is common (Major and Parsons 2010). Parsons et al. (2006) found that all small bird species were negatively associated with the Noisy Miner in urban gardens in Sydney, and Grey et al. (1997) demonstrated the aggressive exclusion of small native birds from rural remnants by Noisy Miners through experimental removal. Small bird species showed rapid recolonisation of areas in which Noisy Miners were removed. Noisy Miners generally show elevated densities in areas impacted by thinning of the canopy, loss of understorey, vegetation clearing leading to small patches and more edges, and the creation of sparse eucalypt tree cover (Catterall 2004).

The sites where the most native birds were recorded during the surveys were Bronte Park, Diamond Bay, Hugh Bamford, York Road, Queens Park, Thomas Hogan and Waverley Park. However, most of the sites were dominated by a similar array of urban adapted species. The sites that were best for small birds (i.e. less than 50g) were Calga Reserve, Hugh Bamford and York Road. Small birds such as the Superb Fairy-wren were regularly recorded in many of the small coastal heath remnants.

There are many examples of small birds species with records in the locality that were not recorded during the current surveys, such as the Eastern Spinebill (*Acanthorhynchus tenuirostris*), Eastern Yellow Robin (*Eopsaltria australis*), Spotted Pardalote (*Pardalotus punctatus*), and White-browed Scrubwren (*Sericornis frontalis*). It is unclear whether these species occur still within the Waverley LGA and all are likely to be affected by the lack of suitable breeding and foraging habitat and protection from large aggressive species.

4.3.4 Mammals

A total of 25 mammal species have been previously recorded within the locality, and the current surveys recorded eight species. This represents approximately 30% of the species that have previously been recorded. There is potential for some of the species that were not detected during the surveys to occur; however, habitat for most species is severely limited, with the species recorded typical for an urban area.

Most areas of habitat within the Waverley LGA only provide potential habitat for species that have adapted to urban areas, such as the Common Brushtail Possum, and possibly the Ringtail Possum (records exist from the WIRES database). These species consume a variety of leaves, flowers and fruits, and are not reliant on tree hollows for dens or dreys. The potential for other non-flying mammal species to occur throughout the Waverley LGA is limited by the small size of the remnants and their degree of connectivity to other suitable habitats. The majority of the habitat areas throughout the locality are probably too small to sustain populations of native species. The lack of tree hollows also limits the potential for gliders to occur in the area.

The number of exotic species recorded during the surveys was of some concern, in particular the number of cats. Most of these animals were pets, but it is likely that at least a few were feral. Pet cats were observed at night within Tamarama Park and Queens Park. It is important for local residents to control pet dogs and cats, particularly at night, to minimise the potential for predation on native mammalian species.

Grey-headed Flying-foxes (listed as vulnerable under the TSC Act and EPBC Act) were numerous throughout the LGA. The species roosts by day in maternal camps, forages nocturnally on blossoms, fruits and leaves of many plants, and is an important disperser of seeds and pollen (Tidemann et al. 2008). Most individuals forage less than 20 kilometres in a night from their maternity camp (Tidemann et al. 2008); the individuals recorded during the surveys are likely to be from the Royal Botanical Gardens which contains a permanent camp. Permanent camps are unusual for the species;

they are normally highly mobile and move in relation to the availability of suitable foods. A large proportion of the diet of Grey-headed Flying-foxes can be from species of tree that are not endemic to the region (McDonald-Madden et al. 2005). A variety of planted eucalypt species can provide food for the Flying-foxes, and the highly mobile nature of the species allows it to forage these trees in a highly fragmented urban landscape (McDonald-Madden et al. 2005). Furthermore, the diversity of tree species that are planted has increased temporal availability of food resources, particularly during periods of natural food scarcity (usually winter months) (Williams et al. 2006). Such plantings have allowed flying-foxes to establish a permanent camp in Melbourne (Williams et al. 2006). It is likely the Grey-headed Flying-foxes are utilising similar foraging resources within the Waverley LGA. Increasing plantings of suitable food trees, in particular winter-flowering species would help provide additional foraging resources for the species on a year-round basis.

Common causes of mortality for Grey-headed Flying-foxes are electrocution on powerlines and entanglement in orchard nets (Tidemann et al. 2008). Extended heat waves can cause deaths to thousands, with juveniles in particular at risk (Divljan A. pers. comm.). During the birthing season (September to December), the death of a foraging female usually results in the death of their young in the roost camp (Tidemann et al. 2008).

The microbats recorded during the surveys are also species that are regularly recorded in urban areas. Gould's Wattled Bat is widespread throughout most of Australia and occurs in a variety of habitats and roosts. Recorded roost sites include tree hollows, birds' nests, buildings, bat boxes and even exhaust pipes (Dixon and Lumsden 2008). It is possible the species is using artificial structures in the locality. The species emerges very early after dark to forage on insects, which leaves it vulnerable to predation from birds, owls, feral cats, goannas and snakes (Dixon and Lumsden 2008). They can move up to 20 kilometres from the roost during foraging, which mainly occurs in open spaces above or below the canopy.

The Eastern Free-tailed Bat is less widespread, but occurs from Victoria throughout eastern Australia to northern Queensland. In urban areas the bats roost in roofs of buildings, which they can often share with Gould's Wattled Bat and the Eastern Broad-nosed Bat (*Scotorepens orion*) (Hoye et al. 2008). Several hundred can be present and occupation is often year round (Hoye et al. 2008).

4.4 Habitat Assessments

Based on the fauna habitat assessments, the locations that contained the best fauna habitat were in Queens Park, Bronte Park, Diamond Bay, Tamarama Park, Hugh Bamford, York Road and the sea-cliff remnants along the coast. These areas are a priority for conservation within the LGA. No significant areas of street habitat or open space in parks were identified as a priority for local fauna.

These areas mentioned above contained the greatest variety of habitat features, such as canopy, understory and ground cover, or were areas of remnant vegetation that possessed special features limited throughout other areas of the LGA. For example, Tamarama Park has a tall canopy, a variety of understory plants and a suitable ground cover of deep leaf litter and rock outcrops. The sea-cliff remnants are small, but they contain a dense shrub layer and often sandstone rock outcrops, features which are rare in other areas of the LGA.

4.5 Wildlife Habitat Corridors

Minimising the effects of isolation by enhancing landscape connectivity that allows animals to move through modified landscapes is one way to counter the adverse effects of fragmentation (Bennett 1998, 2003). However, as discussed earlier, the Waverley LGA has very little native remnant vegetation remaining. Due to the low levels of vegetation remaining throughout the LGA, it is extremely important to identify priorities for restoring links between the remaining wildlife habitats. Identifying

and/or diverting priorities for restoration does not discount the achievements of revegetation work that has already been completed or is intended to be undertaken in the near future, in certain areas throughout the LGA. Rather, identifying priorities for linkages will allow Council to make decisions aimed at maximising biodiversity outcomes with the availability of funds. Bennett (1998, 2003) outlined four general approaches that can be incorporated in land-use planning and land management:

1. Expand the area of habitats protected for nature conservation;
2. Maximise the quality of existing habitats;
3. Minimise impacts from surrounding land uses; and
4. Promote connectivity of natural habitats.

Measures that prevent further destruction or fragmentation of habitats, that increase the total amount of habitat managed for conservation, or that expand the overall area of habitat available to wildlife, are each ways of responding to problems associated with land clearing and associated impacts to native wildlife (Bennett 1998, 2003). Minimising the impacts of existing threatening processes, such as controlling weeds and feral predators, will also maximise the quality of existing habitats and the potential for wildlife to persist.

Patches of habitat that function together as an interacting system are a more effective means of conservation than patches that are isolated from one another. It is not only important for local animals, but also for wide-ranging migratory species and dispersing individuals. Linkages also assist in the continuity and maintenance of ecological processes, such as pollination, seed dispersal and predation (Bennett 1998, 2003). Therefore, the ultimate goal of connecting habitats for wildlife is to link the system in such a way that restores the natural flow and interchange of plants and animals across the landscape (Bennett 1998, 2003).

Considering the information discussed above, the main priorities for wildlife habitat corridors within the Waverley LGA can be summarised as follows:

1. Identify areas which contain the best fauna habitat within the LGA;
2. Determine methods for improving habitat within these areas;
3. Identify the best locations for reconnecting areas of best habitat with each other; and
4. Reconnect these areas with the most vegetated areas outside LGA.

Best fauna habitats: based on the fauna habitat assessments and targeted surveys, the best areas for fauna throughout the LGA were Queens Park, Bronte Park, Diamond Bay, Tamarama Park, Hugh Bamford, York Road, Thomas Hogan, Waverley Park and the small sea-cliff remnants along the coast.

Improving habitats: methods for improving fauna habitats for species groups are outlined in the following section. However, there are several general recommendations that can be applied in areas of existing habitat with the aim of improving the habitat for all fauna groups. Many of the recommendations were identified by Ondinea (1996), and are still applicable throughout the LGA. Reducing the amount of open space should be the primary goal, however it is noted that this will not be possible in all circumstances due to the value of open space in urban parks to local residents. Planting clumps of native shrubs around the base of trees and planting slopes in parks are methods that should not clash with the values of residents. Minimising slashing of indigenous grasses in these locations would also be beneficial. Council should aim to replant parks as much as possible, expanding from areas which contain native vegetation as far as possible without impacting on the use of the park by local residents.

Location of linkages: the most appropriate corridor which links patches of fauna habitat will likely be the shortest route (Ondinea 1996; Bennett 1998, 2003). Suggested routes to link areas of important habitat are shown in Figures 5-13. Two types of potential habitat corridors have been suggested;

Priority 1 and Priority 2. Priority 1 potential habitat corridors are areas which link the best habitat within the LGA and have the greatest potential for corridor improvement. These areas are focussed largely on the coast, where there is open space that could be revegetated, potentially linking the heath habitats. It also includes two of the larger vegetated areas in the LGA, Bronte Park and Tamarama Park. Priority 2 potential habitat corridors are areas that are likely to have more limitations to revegetation, and/or the fauna habitat is of lower quality. It is recommended revegetation efforts should focus primarily in Priority 1 areas, particularly if funding resources are limited.

Re-establishing connectivity between these stands will be strongly dependent on networks of gardens and street trees (Adam 2004), as well as utilising all available areas that could be revegetated such as beach parks, adjacent public open space, schools and other institutional sites, pocket parks and private land. Many of these principles have previously been identified in Council's Tree Management Plan (Waverley Council 2007).

Another concept identified within the Tree Management Plan was the idea of 'pseudo' street trees. This concept should be utilised wherever possible including in private residences, parks, and schools or along the perimeter boundary of other premises (Waverley Council 2007). If implemented effectively 'pseudo' street trees will have more space to develop, may not require trimming, and will provide a greater value as habitat for local fauna.

Coastal areas of the LGA are currently not being fully utilised for their potential as wildlife corridors (i.e. locations between coastal private properties and the cliff-line). As discussed earlier, the coastal areas of the LGA contain remnant heath and sedgeland communities which are unique within the LGA. These communities recorded highest abundances of small bird species, and native reptile diversity was high. Along the coast there are many areas of currently open space that could be strategically replanted without compromising their value as public open space. This is consistent with Council's aims that "habitat corridors should work towards linking areas of remnant vegetation" (Waverley Council 2007).

Community support and involvement will be a key element for improving habitats and linkages. Unless key stakeholders, management agencies and community groups are supportive of the long term goals of improving wildlife habitats, it will be difficult to achieve the outcomes of the linkages (Bennett 1998, 2003). Encouraging local residents to improve fauna habitats on own properties, such as increasing plantings in backyards and gardens, will also contribute to the biodiversity outcomes. Effective community engagement could be achieved by using individual species as indicators of success or improvements to wildlife corridors, for example the Superb Fairy-wren. Residents could report sightings of the declining species, particularly if they are seen in areas that have recently been revegetated. Due to habitat for this species being limited throughout most of the LGA, it would be a useful species to be used as an indicator, and is likely to be reasonably easily identified by most residents.

External Linkages: options for linking fauna habitats from within the Waverley LGA to nearby habitats outside the LGA are also limited. Suggested locations for linkages are shown in Figures 5-13. The proposed locations for linkages are based on the proximity of fauna habitats within the LGA to the most vegetated nearby areas.

It should be noted that it will be extremely difficult to re-establish wildlife habitat links throughout the LGA without these areas being impacted by edge effects. In Sydney, edge effects have been shown to occur up to 30 metres into a patch of vegetation (Dostal 2000), suggesting that corridors that are 60 metres wide will still be impacted by edge effects.



- Mapsheet Numbers**
- 1 - Diamond Bay
 - 2 - Rodney Reserve, Hugh Bamford Reserve
 - 3 - Hugh Bamford Reserve, Hunter Park
 - 4 - Thomas Hogan Reserve
 - 5 - Marks Park, Tamarama Park, Bronte Park, Calga Reserve
 - 6 - Thomas Hogan Reserve, Waverley Park, Bronte Park
 - 7 - Bronte Park, Varna Park, Waverley Park
 - 8 - Queens Park, York Road



AUSIMAGE © Sinclair Knight Merz Pty Ltd (Aerial Imagery courtesy of Waverley Council)

Figure 5: Wildlife Habitat Corridors map index.



Legend

-  Waverley LGA Boundary
-  Potential Habitat Corridors Priority 1
-  Potential Habitat Corridors Priority 2
-  Important Habitat Areas

0 50 100 200 300 400 Meters

Map Sheet Number 1
AUSIMAGE copyright Sinclair Knight Merz Pty Ltd
Aerial Imagery courtesy of Waverley Council



Figure 6: Wildlife Habitat Corridors Map Sheet 1.



Legend

-  Waverley LGA Boundary
-  Potential Habitat Corridors Priority 1
-  Potential Habitat Corridors Priority 2
-  Important Habitat Areas

0 50 100 200 300 400
Meters

Map Sheet Number 2
AUSIMAGE copyright Sinclair Knight Merz Pty Ltd
Aerial Imagery courtesy of Waverley Council



Figure 7: Wildlife Habitat Corridors Map Sheet 2.



Legend

-  Waverley LGA Boundary
-  Potential Habitat Corridors Priority 1
-  Potential Habitat Corridors Priority 2
-  Important Habitat Areas

0 50 100 200 300 400
Meters

Map Sheet Number 3
AUSIMAGE copyright Sinclair Knight Merz Pty Ltd
Aerial Imagery courtesy of Waverley Council



Figure 8: Wildlife Habitat Corridors Map Sheet 3.



Figure 9: Wildlife Habitat Corridors Map Sheet 4.



Legend

-  Waverley LGA Boundary
-  Potential Habitat Corridors Priority 1
-  Potential Habitat Corridors Priority 2
-  Important Habitat Areas

0 50 100 200 300 400
Meters

Map Sheet Number 5
AUSIMAGE copyright Sinclair Knight Merz Pty Ltd
Aerial Imagery courtesy of Waverley Council



Figure 10: Wildlife Habitat Corridors Map Sheet 5.

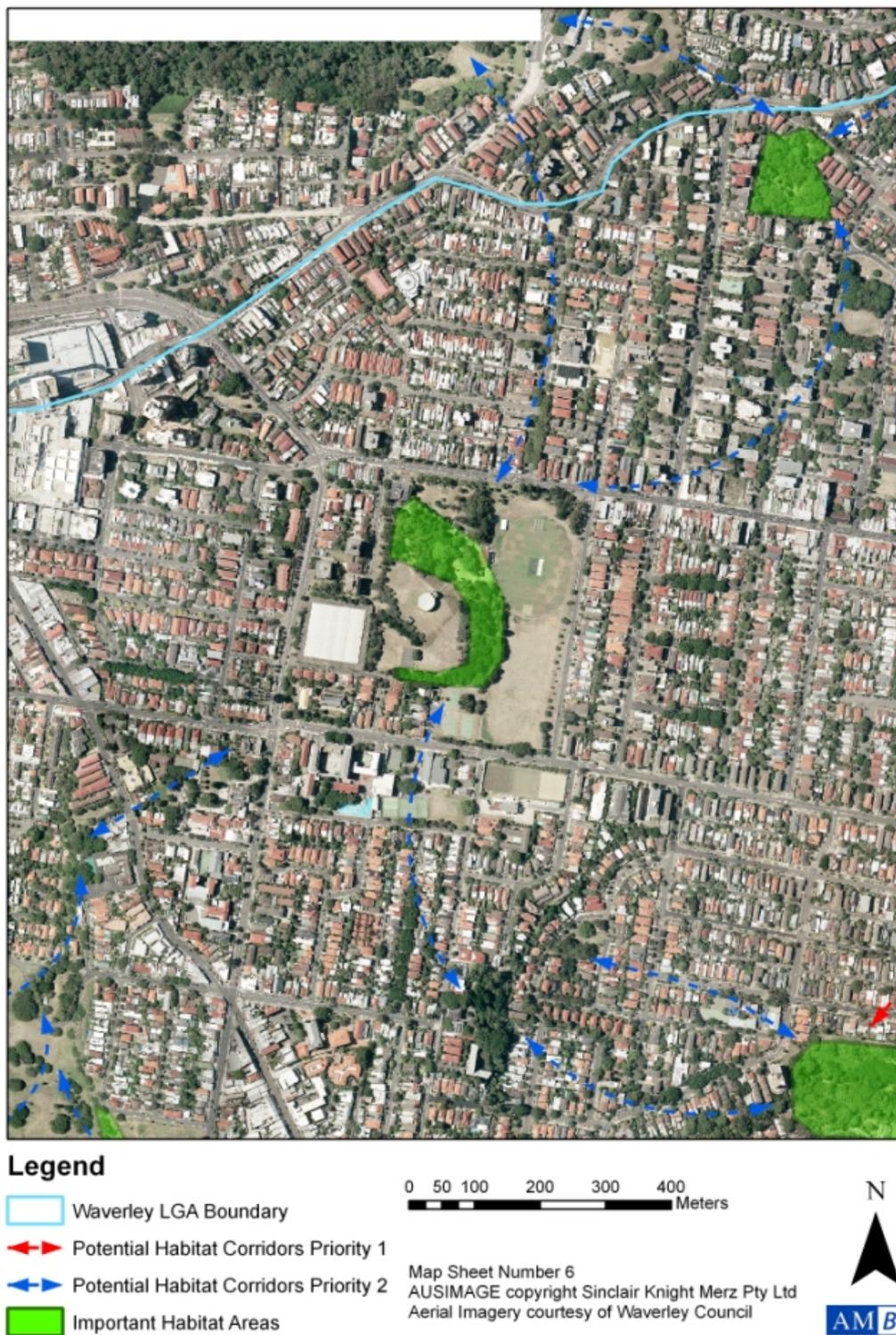
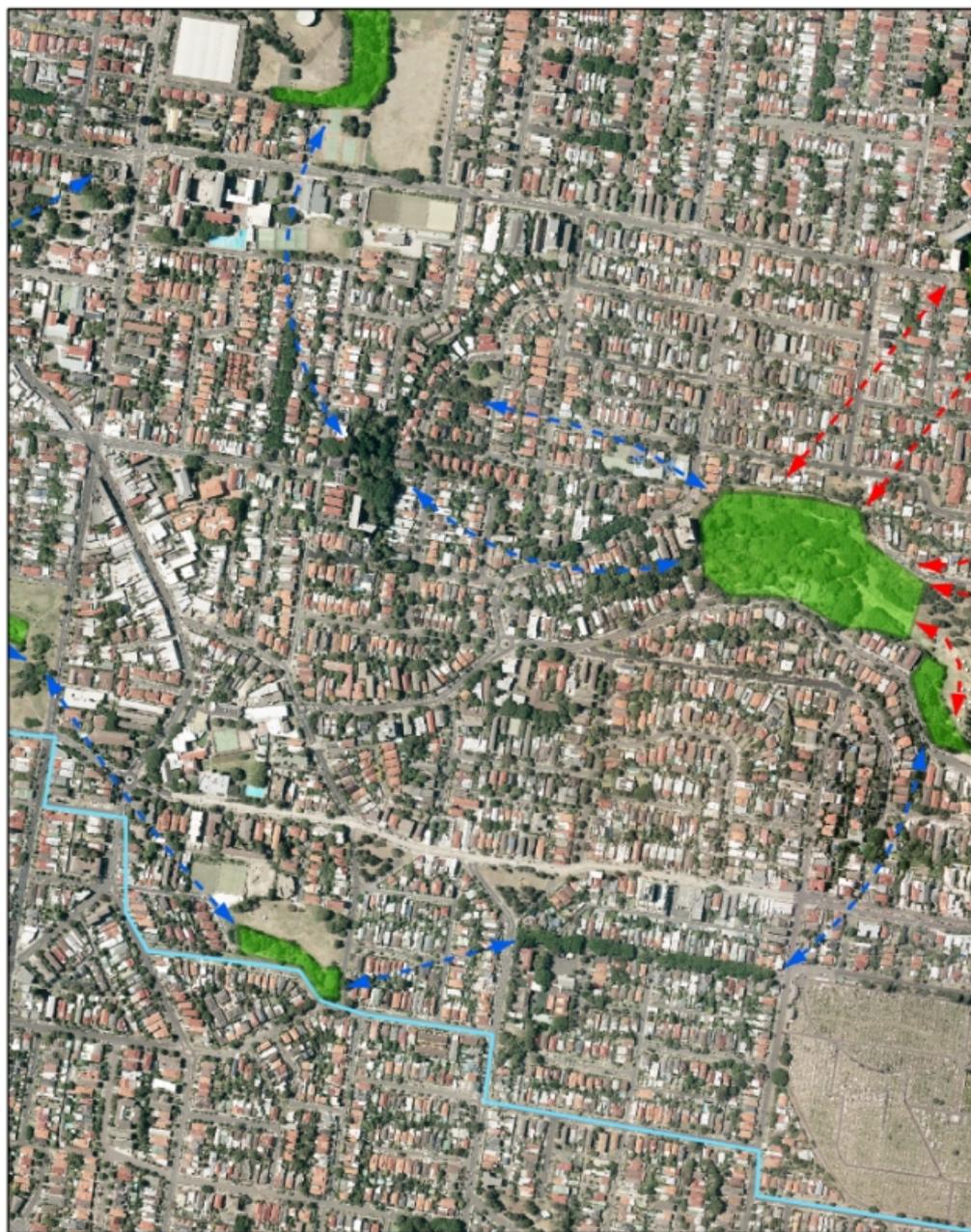


Figure 11: Wildlife Habitat Corridors Map Sheet 6.



Legend

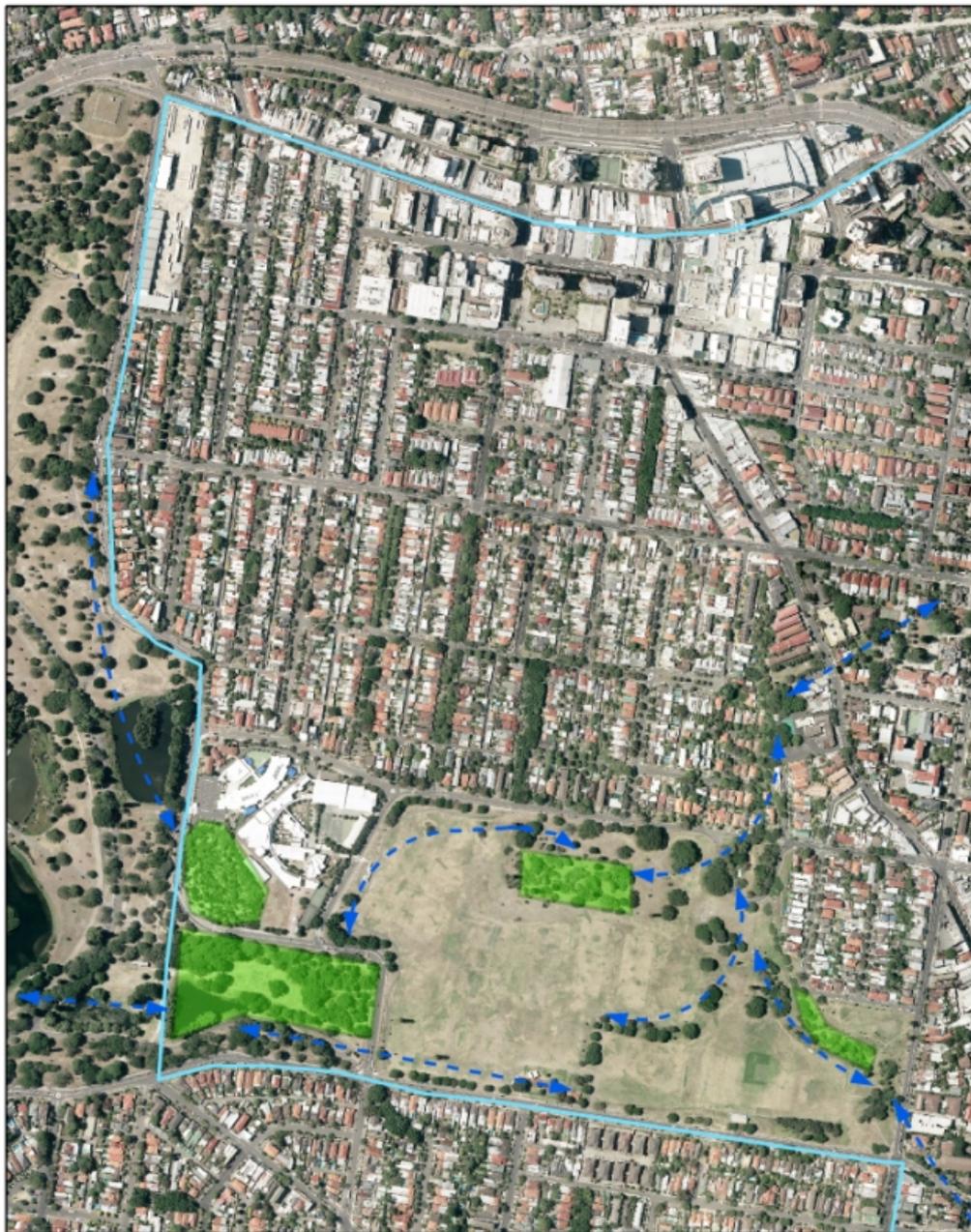
-  Waverley LGA Boundary
-  Potential Habitat Corridors Priority 1
-  Potential Habitat Corridors Priority 2
-  Important Habitat Areas

0 50 100 200 300 400
Meters

Map Sheet Number 7
AUSIMAGE copyright Sinclair Knight Merz Pty Ltd
Aerial Imagery courtesy of Waverley Council



Figure 12: Wildlife Habitat Corridors Map Sheet 7.



Legend

-  Waverley LGA Boundary
-  Potential Habitat Corridors Priority 1
-  Potential Habitat Corridors Priority 2
-  Important Habitat Areas

0 50 100 200 300 400 Meters

Map Sheet Number 8
AUSIMAGE copyright Sinclair Knight Merz Pty Ltd
Aerial Imagery courtesy of Waverley Council



Figure 13: Wildlife Habitat Corridors Map Sheet 8.

5 Recommendations

5.1.1 General

When trying to improve habitat for wildlife, three important aims should be to maximise biodiversity, minimise disturbance, and encourage involvement of the community. These ideas are applicable across all species groups. By conserving existing habitats and minimising disturbance, the existing biodiversity values within the LGA can be maintained. If the local community understands and appreciates the importance of biodiversity and ecosystem processes, it will be easier to implement management decisions relating to changes in land use.

Local residents can make a significant contribution by measures such as establishing or managing native vegetation on their land, or controlling pet cats or dogs. Predation on native wildlife by domestic pets can have a major impact on the local wildlife. This can occur during both day and night, and even cats with bells have been shown to learn how to hunt successfully. Local residents should understand these risks, and keep cats indoors wherever possible.

All the recommendations provided for species groups in the following sections can be applied by local residents. Planting native grasses, shrubs and trees in gardens or backyards, and providing additional habitat features such as clusters of rocks, fallen branches, logs and bark, can improve habitat on a small scale. The more residents that try to improve fauna habitats the greater the improvement will be across the LGA.

Additional surveys and/or monitoring, particularly during different seasons, will record a greater number of species than the “snap shot” surveys conducted during this study. For example, bird surveys during winter months would be likely to record winter migrants that would have been absent during the summer surveys. Expanding the number of survey sites may also be beneficial, particularly in areas containing remnant vegetation near the coast.

Monitoring of all fauna groups is recommended, should Council wish to assess the effectiveness of any management decisions that are implemented. Monitoring could be undertaken every five years, implementing the same methodologies as a minimum. If the same methodologies are applied, comparisons with the benchmark data obtained during this study can be made. Monitoring of invertebrates can also be a useful indicator of the effectiveness of vegetation rehabilitation (e.g. by using spider diversity as indicators, see Gollan et al. 2010).

5.1.2 Frogs

The existing frog diversity within the LGA is relatively low, most likely due to the lack of suitable sites for breeding and shelter. Bronte Park, Diamond Bay and Tamarama Park contain very small waterbodies and are likely to be impacted by stormwater runoff. There is also limited riparian vegetation. The best site for frogs was the pond in Queens Park, but terrestrial shelter near the pond was limited adjacent by grass mowing.

Council could consider creating additional habitat for frogs, such as artificial ponds. This was suggested by White (1998a) near Calga Reserve and the cemetery. This is still applicable; however, other locations throughout the LGA may be less isolated and considered more appropriate. Possible options could be Tamarama Park or Queens Park, because there are existing frog populations in or near these areas that could utilise the additional habitat for breeding or when individuals disperse. Frog ponds could be created to target specific groups; a sunken pond will provide habitat for most types, whereas a raised pond will target tree frogs. The pond should have shallow and deep water, and

should include emerging structures such as rock piles or logs/sticks. Aquatic vegetation needs to be established around the exterior, such as native sedges or rushes. Suitable terrestrial shelter sites are essential, such as large rocks, logs, or wooden boards. If Council do construct a frog pond it should be undertaken in a way which educates local residents about frog ecology and conservation. Council can also encourage local residents to create frog ponds in their gardens or backyards. It is recommended Council seek the advice of a suitably qualified consultant regarding the best location for creation of a frog pond if it is undertaken on public land.

5.1.3 Reptiles

Conservation of the existing reptile fauna will depend on the protection of the existing remnants and limiting additional disturbance. It is important to retain existing structural habitat features such as logs and large rocks and to limit disturbance to leaf litter. These features, as well as non-compacted soil, are considered important features for basking, shelter and foraging with native reptiles (Brown 2001; Webb and Shine 2000). Adequate representation of different vegetation types and maintaining the structural complexity of ground and shrub layers are also important factors to consider when conserving native terrestrial reptiles (Brown et al. 2008).

Ground cover features for native reptiles were limited throughout most of the LGA. We recommend improving habitat by increasing woody debris, logs, fallen branches, large rocks, clusters of rocks, small boulders or bricks in reserves. They should be placed in locations that would receive adequate sun or near waterbodies. For example, it has been demonstrated that the introduction of artificial concrete pavers in degraded sandstone outcrops can provide additional habitat for the velvet gecko (*Oedura lesueurii*) (Webb and Shine 2000). This could be a practical option for extending potential habitat for the species along the coastal areas throughout the LGA. It is also important to continue revegetation efforts in these coastal areas where sandstone outcrops exist. Vegetation in these areas provides necessary protection for small native reptiles and supports invertebrate populations. Continued revegetation efforts throughout the LGA will benefit most reptile species. For example, Council should consider extending revegetation efforts to the southern slope of Tamarama Park. By planting additional shrubs and canopy trees accumulation of leaf litter will gradually occur, and potential habitat for the Pale-lipped Shadescink (*Saproscincus spectabilis*) will be expanded.

Council should be aware of the potential for weedy areas to support suitable habitat for reptiles (White 1998b). If large areas of weeds providing ground cover are planned for removal, it should be undertaken gradually. Any weedy areas should be replanted with native species that will provide a similar amount of ground cover, and additional habitat resources should be introduced, such as large rocks, logs, pavers, wood boards or even iron sheets. Garden et al. (2007) demonstrated the importance of habitat structure rather than vegetation composition for native terrestrial reptiles in urban remnants in Brisbane. Similar to other research, important structural elements for reptiles were fallen woody material, presence of termite mounds and a moderate amount of weed cover. They were negatively influenced by soil compaction.

Access to reserves by people can have a negative impact on reptile habitats and areas of limited or no access in strategic locations should be considered. This may be important in areas such as Tamarama Park, which supports a relatively high diversity of reptiles compared to some other sites within the LGA.

5.1.4 Birds

Habitat for native birds could be improved by strategic replanting. Detailed guidelines on improving habitat for native birds in urban areas have been produced by the Birds in Backyards program (Best Practice Guidelines for Enhancing Urban Bird Habitat: Scientific Report). It is not within the scope

of this project to provide a detailed revegetation program, however some general principles that can be applied throughout the LGA are outlined below. Some of this information is from the Birds in Backyards Scientific Report.

The most important factor is to create structural diversity. Having a mix of canopy trees, shrubs of varying heights, and some open grass areas will maximise the diversity of birds using the area. One of the main problems discussed above is the impact of large aggressive species, which usually become more abundant in areas with tall canopy trees and no understorey. Replanting efforts should focus more on creating habitat for small birds (e.g. the Superb Fairy-wren), by planting dense shrubs rather than canopy trees. It is important to identify the area in which revegetation works will be implemented, so public access to this area will be limited. It should be possible to delegate small areas of a park as “fauna habitat”, and focus restoration efforts here. Restoration efforts should start at areas close to existing remnants, to limit fragmentation as much as possible. Concerns regarding the potential for undesirable or illegal human activities to occur would need to be addressed, for example by planting low shrubs in a dense block. Pruning these shrubs can increase densities and maintain public safety. Council should be aware that if plantings are small, have a high ratio of edge to area, and comprise widely scattered trees that are mainly eucalypts, they may be colonised by Noisy Miners once the eucalypts mature (Catterall 2004).

Native species should be planted rather than exotic species. A study in Adelaide showed nectarivore birds used native *Eucalyptus camaldulensis* (Red Gum) and bottlebrushes for foraging more frequently than the introduced *Platanus x acerifolia* (Plane tree) and *Jacaranda mimosifolia* (Jacarandas) (Young et al. 2007). The greatest abundance of nectarivores was in the red gums despite the species not flowering during the study period (Young et al. 2007). This was likely to be due to the presence of psyllids, which are an important source of carbohydrates for honeyeaters during non-flowering periods. Many small native bird species are positively associated with the proportion of native vegetation, suggesting the potential strategic plantings of native vegetation to allow small bird species to utilise urban areas (Parons et al. 2006). However, it should be cautioned that while garden characteristics can influence the presence of certain small native birds, the presence of Noisy Miners is likely to be an important influence through aggressive exclusion. Suitable shrub that could be planted throughout the LGA includes species from the genera *Banksia*, *Callistemon*, *Grevillea*, *Hakea*, *Correa*, *Epacris*, *Acacia* and *Leptospermum*. A variety of species should be selected that have varying flowering times which cover all times of the year, in particular winter-flowering species which are often limited.

Focussing planting efforts on reducing areas of open space with dense multi-layered understorey may be the most successful method for the long term control of Noisy Miner populations, rather than removing specific plant species that the species uses for foraging (Catterall 2004). However, the extensive areas of open lawn with sparse tree cover (e.g. local parks and sporting fields) throughout the Waverley LGA, combined with the species ability to dominate small heavily planted remnants may mean that plantings will never reach high enough densities to affect Noisy Miner numbers (Ashley et al. 2009).

It should be noted that restoring the bird fauna that has declined due to extensive land clearing will be difficult. Catterall (2004) suggested that remnant patches of original bushland that are less than 2 hectares, and surrounded by residential development may be unlikely to frequent visits from small bird species. This is usually due to the spatial context of the remnant in relation to the broader landscape. Furthermore, due to the tendency of Noisy Miners to occupy edges, revegetation efforts may only be effective if patches become large enough to provide some “interior” habitat; Piper and Catterall (2003) suggested the size may need to be at least 10 hectares, since Noisy Miners can occupy edge zones of 100-200 metres.

As discussed above, control of pet cats is extremely important for native birds. This is particularly important during dawn and dusk, which is a peak period of activity for birds.

5.1.5 Mammals

It will be difficult to restore the small mammal fauna that once occurred in the LGA due to the high degree of fragmentation and small size of remnants. However, corridor restoration efforts may have positive effects for native mammals such as the Common Ringtail Possum. Increased plantings will provide more foraging resources and facilitate movement throughout the LGA. It is important for local residents to control pet cats and dogs, particularly at night, to reduce the likelihood of predation on native mammals.

We recommend local residents be informed about Grey-headed Flying-fox ecology and the possibility that an electrocuted animal could have a suckling juvenile which may still be alive. If not detected the juvenile will die of starvation. Local residents should be aware of this, and observe any electrocuted flying-foxes to ensure they are not carrying young. This can be achieved by looking for small movements or using a pair of binoculars. If a young is spotted they should contact the local WIRES branch for rescue.

5.1.6 Wildlife Habitat Corridors

Currently, plantings that occur throughout the LGA are based on the Street Tree Masterplan. The concepts outlined in this document are mostly accurate, but where possible Council should consider reducing planting exotic species. Popular street plantings are the exotic Jacaranda, palms and pines; however, these species generally offer minimal habitat for native birds (see Young et al. 2007). Exotic species like palms and pines are often inhabited by exotic birds such as Common Starlings and the Common Myna.

Generally, when trying to restore habitat corridors throughout the LGA, all the recommendations identified to improve habitat for frogs, reptiles, birds and mammals can be applied throughout. This includes providing fauna habitat features including suitable ground cover, understorey and canopy. However, in coastal areas, we recommend minimising plantings of tall eucalypts in heath remnants, for a range of reasons, including that they will likely attract Noisy Miners. Planting suitable species in areas nearby the coastal sea-cliff remnants will improve connectivity, and provide habitat for species that rely on the specific habitat characteristics (e.g. Superb Fairy-wren). This is important as these habitat features are generally limited throughout most of the LGA.

As discussed in Section 4.5, Priority 1 potential habitat corridors have been identified as areas which link the best habitat within the LGA, and have the greatest potential for corridor improvement. It is recommended revegetation efforts should focus primarily in Priority 1 areas, particularly if funding resources are limited.

6 Summary

As expected in an environment that has been heavily urbanised for many years, the biodiversity of Waverley LGA is not what it once was. The vertebrate fauna surveys typically detected between 20 and 40% of the number of species previously recorded in the locality. While this is partly due to the limitations of “snap shot” surveys, it also indicates a strong decline in species diversity over time. This is not surprising, considering only 12% of the LGA is designated as open space and of this 5% percent (approximately 6 hectares) is native remnant vegetation (Waverley Council 2009). Nonetheless, the LGA still contains pockets of vegetation that provide habitat for a range of native species, including some that are in decline in urban areas generally.

Based on the fauna habitat assessments and targeted surveys, the best areas for fauna throughout the LGA were Queens Park, Bronte Park, Diamond Bay, Tamarama Park, Hugh Bamford, York Road, and the small coastal heath remnants. These surveys have shown that:

- the butterfly species persisting in the LGA are those whose food plants (for caterpillars) are likely to still occur in the parks, backyards and gardens;
- the few frog species recorded are probably a reflection of the limited amount of potential frog habitat in the LGA;
- a reasonable diversity of reptiles still occurs in places, in particular those areas where a greater proportion of shrub cover, grass cover (not mown), leaf litter, or other form of ground cover such as debris or large rocks occurs (e.g. Diamond Bay, Tamarama Park, Hugh Bamford Reserve);
- the bird fauna is dominated by aggressive and introduced species. The best sample sites for smaller birds were Calga Reserve, Hugh Bamford, York Road and some of the coastal remnants where dense shrubs occur;
- a considerable number of introduced mammals were observed, in particular, cats;
- the only threatened species recorded during the surveys was the Grey-headed Flying-fox, which was recorded foraging in numerous locations throughout the LGA, although other threatened species could occur from time to time.

Based on the fauna surveys, important areas of habitat include Tamarama Park and Diamond Bay. The Pale-lipped Shadestink (*Saproscincus spectabilis*) was numerous within Tamarama Park and this species has a limited distribution. Council should consider this area of habitat within the LGA as highly important, given the species is only known from 12 different locations in the Sydney region (based on the records of the Australian Museum). Similarly, the high numbers of Velvet Gecko (*Oedura lesueurii*) recorded in Diamond Bay are considered important within the LGA. Potential habitat for this species has been reduced throughout the Sydney region, and is likely to be limited in the LGA to the coastal sandstone remnants.

Council could consider providing additional habitat for frogs, and there is potential to improve habitat for reptiles and small birds in a number of Council parks and reserves, particularly along the coast, as well as in backyards. Control of cats should also be encouraged.

The potential for fauna to utilise the small remnants along the coastal areas of the LGA was identified by Ondinea (1996) and was confirmed by this study. It is recommended that establishment of wildlife corridors focus on this area. These areas have been identified as Priority 1 potential habitat corridors in Figures 5-13. There do not appear to be any effective wildlife corridors in other parts of the LGA and the potential to establish such corridors is limited. However, a number of locations where such corridors could be considered have been identified. Community support and involvement would be a key element for improving linkages; unless local residents are supportive of the long term goals of

improving wildlife habitats, it will be difficult to achieve the outcomes of the linkages. Encouraging residents to improve habitat on a small scale could have benefits throughout the LGA if enough people are involved. Residents could be encouraged to report sightings of indicator species such as the Superb Fairy-wren, particularly in areas that have been revegetated. This could be an effective method of engaging the community. In addition, habitat and linkage improvement needs to be carefully planned and implemented to ensure that it benefits the target fauna, rather than encouraging large numbers of aggressive species that exclude other animals (e.g. Noisy Miners).

Monitoring the effectiveness of any habitat improvements is recommended and could be undertaken by targeting some key vertebrate species and invertebrates, and drawing comparisons between the benchmark data in this study. We recommend repeating the benchmark surveys every 5 years, including surveys during other seasons to record species absent during the summer (e.g. winter migrant birds). Council could consider using invertebrates as indicators of environmental conditions, because they occur in relatively high numbers and species diversity (compared with vertebrates) and respond quickly to change.

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Appendix A: Invertebrates Recorded

Waverley Council Survey Invertebrates 10-11 December 2009

Collection Technique Legend: L=Litter sample; SW = Sweep/beat netting; YP = Yellow Pan Trap

Location	Order	No. morpho-species	Further ID	Technique
Diamond Bay Reserve	Orthorrhapha (Bee Flies, Robber flies and others)	1	Phoridae	L
Diamond Bay Reserve	Araneae (Spiders)		see Appendix C	L
Diamond Bay Reserve	Formicidae (Ants)	6	see Appendix B	L
Diamond Bay Reserve	Diplopoda (Millipedes)	3	see Appendix C - Polydesmida, Spirobolida	L
Diamond Bay Reserve	Pseudoscorpiones (False scorpions)	1	see Appendix C	L
Diamond Bay Reserve	Amphipoda (Amphipods)	1	land hoppers (probably <i>Arcitalitrus sylvaticus</i>)	L
Diamond Bay Reserve	Isopoda (Slaters, Pill bugs)	2	Garden Slater, <i>Porcellio scaber</i> ; Pillbug, <i>Armadillidium vulgare</i>	L
Diamond Bay Reserve	Chilopoda (Centipedes)	1	see Appendix C -Geophilomorpha	L
Diamond Bay Reserve	Thysanura (Silverfish)	1	Lepismatidae	L
Diamond Bay Reserve	Hemiptera (True Bugs)	3	Cydnidae, Lygaeidae, Coccoidea	L
Diamond Bay Reserve	Dermaptera (Earwigs)	1	Anisolabidinae	L
Diamond Bay Reserve	Coleoptera (Beetles)	4	Curculionidae, Staphylinidae, undetermined	L
Diamond Bay Reserve	Lepidoptera (Butterflies and moths)	3	moth larvae -1 -Arctiidae, 2 undetermined	L
Diamond Bay Reserve	Thysanoptera (Thrips)	1	Phlaeothripidae	L
Diamond Bay Reserve	Mollusca (Snails, Molluscs)	1	Punctidae - <i>Paralaoma caputspinulae</i>	L
Diamond Bay Reserve	Dolichopodidae (Long-legged flies)	2	<i>Austrosclia connexus</i> , <i>Amblysilopus zonatus</i>	SW
Diamond Bay Reserve	Empididae (Dance flies)	1	Tachydromiinae sp.	SW
Diamond Bay Reserve	Orthorrhapha (Bee Flies, Robber flies and others)	1	Asilidae, Bombyliidae - Mythocomiinae	SW
Diamond Bay Reserve	Nematocera (Mosquitoes, Midges)	4	Mycetophilidae, Sciaridae, Ceratopogonidae	SW
Diamond Bay Reserve	Acalyptrata (Fruit flies, Picture-winged flies and others)	2	Platystomatidae	SW
Diamond Bay Reserve	Calypttrata (Blow flies, House flies)	4	Muscidae, Sarcophagidae	SW
Diamond Bay Reserve	Araneae (Spiders)		see Appendix C	SW
Diamond Bay Reserve	Formicidae (Ants)	3	see Appendix B	SW
Diamond Bay Reserve	Hymenoptera (Wasps, Bees)	7	Vespidae, Spheciformes, Braconidae, Platygasteridae, Chalcidoidea	SW
Diamond Bay Reserve	Thysanoptera (Thrips)	1	Thripidae	SW
Diamond Bay Reserve	Orthoptera (Grasshoppers, crickets)	2	3 juveniles Gryllinae, 1 juvenile Acrididae	SW
Diamond Bay Reserve	Hemiptera (True Bugs)	10	Pentatomidae, Cicadellidae, Myridae, Lygaeidae, Reduviidae	SW
Diamond Bay Reserve	Coleoptera (Beetles)	7	Buprestidae, Chrysomelidae, Coccinellidae, Elateridae	SW
Diamond Bay Reserve	Neuroptera (Lacewings, Antlions)	1	Myrmelionidae	SW

Waverley Council Survey Invertebrates 10-11 December 2009

Collection Technique Legend: L=Litter sample; SW = Sweep/beat netting; YP = Yellow Pan Trap

Location	Order	No. morpho-species	Further ID	Technique
Diamond Bay Reserve	Lepidoptera (Butterflies and moths)	4	Lycaenidae + 5 moths (2 Noctuidae, 1 Geometridae larva, 1 Tortricidae, 1 undetermined)	SW
Diamond Bay Reserve	Dolichopodidae (Long-legged flies)	1	<i>Amblysilopus zonatus</i>	YP
Diamond Bay Reserve	Orthorrhapha (Bee Flies, Robber flies and others)	1	Phoridae	YP
Diamond Bay Reserve	Acalyptrata (Fruit flies, Picture-winged flies and others)	1	Platystomatidae	YP
Diamond Bay Reserve	Calypttrata (Blow flies, House flies)	1	Tachinidae	YP
Diamond Bay Reserve	Formicidae (Ants)	1	see Appendix B	YP
Diamond Bay Reserve	Thysanoptera (Thrips)	1	Phlaeothripidae	YP
Diamond Bay Reserve	Hemiptera (True Bugs)	1	Cicadellidae	YP
Rodney Reserve	Thysanoptera (Thrips)	1	Phlaeothripidae	L
Rodney Reserve	Hemiptera (True Bugs)	2	Pentatomidae, Lygaeidae	L
Rodney Reserve	Dermaptera (Earwigs)	1	Anisolabidinae	L
Rodney Reserve	Coleoptera (Beetles)	6	Curculionidae, undetermined larvae	L
Rodney Reserve	Lepidoptera (Butterflies and moths)	3	moth larvae - undetermined	L
Rodney Reserve	Nematocera (Mosquitoes, Midges)	1	Simuliidae	L
Rodney Reserve	Araneae (Spiders)		see Appendix C	L
Rodney Reserve	Formicidae (Ants)	6	see Appendix B	L
Rodney Reserve	Pseudoscorpiones (False scorpions)	1	see Appendix C	L
Rodney Reserve	Annelida (Earthworms)	1		L
Rodney Reserve	Amphipoda (Amphipods)	1	land hoppers (probably <i>Arcitalitrus sylvaticus</i>)	L
Rodney Reserve	Isopoda (Slaters, Pill bugs)	1	Garden Slater, <i>Porcellio scaber</i>	L
Rodney Reserve	Chilopoda (Centipedes)	1	see Appendix C - Scolopendromorpha	L
Rodney Reserve	Diplopoda (Millipedes)		see Appendix C	L
Rodney Reserve	Mollusca (Snails, Molluscs)	1	Punctidae - <i>Paralaoma caputspinulae</i>	L
Rodney Reserve	Dolichopodidae (Long-legged flies)	2	<i>Chrysotimus</i> sp., <i>Chrysotus</i> sp.	SW
Rodney Reserve	Orthorrhapha (Bee Flies, Robber flies and others)	2	Asilidae, Therevidae	SW
Rodney Reserve	Nematocera (Mosquitoes, Midges)	4	Chironomidae, Sciaridae, Ceratopogonidae	SW
Rodney Reserve	Acalyptrata (Fruit flies, Picture-winged flies and others)	10	Lauxaniidae, Milichiidae, Sepsidae, Chloropidae, Drosophilidae - <i>Scatomyza australis</i>	SW
Rodney Reserve	Calypttrata (Blow flies, House flies)	4	Muscidae, Sarcophagidae, Calliphoridae	SW
Rodney Reserve	Araneae (Spiders)		see Appendix C	SW
Rodney Reserve	Formicidae (Ants)	3	see Appendix B	SW
Rodney Reserve	Hymenoptera (Wasps, Bees)	20	Ichneumonidae, Braconidae, Chalcidoidea, Platygasteridae	SW
Rodney Reserve	Thysanoptera (Thrips)	2	Phlaeothripidae, Thripidae	SW
Rodney Reserve	Blattodea (Cockroaches)	1	Blattidae	SW

Waverley Council Survey Invertebrates 10-11 December 2009

Collection Technique Legend: L=Litter sample; SW = Sweep/beat netting; YP = Yellow Pan Trap

Location	Order	No. morpho-species	Further ID	Technique
Rodney Reserve	Orthoptera (Grasshoppers, crickets)	1	1 juvenile Phaneropterinae	SW
Rodney Reserve	Hemiptera (True Bugs)	20	Pentatomoidae, Myridae, Psyllidae, Cicadellidae, Dictyopharidae, Membracidae	SW
Rodney Reserve	Mantodea (Praying Mantis)	1	Mantidae - <i>Orthodera ministralis</i> - nymph	SW
Rodney Reserve	Coleoptera (Beetles)	8	Buprestidae, Chrysomelidae, Coccinellidae,	SW
Rodney Reserve	Psocoptera (Book Lice)	1	<i>Miopsocus</i> sp.	SW
Rodney Reserve	Lepidoptera (Butterflies and moths)	3	Lycaenidae + 2 moth sp	SW
Rodney Reserve	Dolichopodidae (Long-legged flies)	2	<i>Austrosciapus connexus</i> , <i>Amblypsilopus zonatus</i>	YP
Rodney Reserve	Orthorrhapha (Bee Flies, Robber flies and others)	1	Phoridae	YP
Rodney Reserve	Nematocera (Mosquitoes, Midges)	1	Sciaridae	YP
Rodney Reserve	Acalyptrata (Fruit flies, Picture-winged flies and others)	3	Platystomatidae, Chloropidae, Agromyzidae	YP
Rodney Reserve	Calypttrata (Blow flies, House flies)	4	Sarcophagidae, Muscidae, Calliphoridae	YP
Rodney Reserve	Formicidae (Ants)	1	see Appendix B	YP
Rodney Reserve	Hymenoptera (Wasps, Bees)	3	Spheciformes	YP
Rodney Reserve	Hemiptera (True Bugs)	1	Cicadellidae	YP
Marks Park	Araneae (Spiders)		see Appendix C	L
Marks Park	Formicidae (Ants)	4	see Appendix B	L
Marks Park	Annelida (Earthworms)	1		L
Marks Park	Pseudoscorpiones (False scorpions)	1	see Appendix C	L
Marks Park	Amphipoda (Amphipods)	1	land hoppers (probably <i>Arcitalitrus sylvaticus</i>)	L
Marks Park	Isopoda (Slaters, Pill bugs)	1	Garden Slater, <i>Porcellio scaber</i>	L
Marks Park	Diplopoda (Millipedes)		see Appendix C	L
Marks Park	Chilopoda (Centipedes)	2	see Appendix C - Scolopendromorpha, Geophilomorpha	L
Marks Park	Blattodea (Cockroaches)	1	Blattidae	L
Marks Park	Hymenoptera (Wasps, Bees)	1	Braconidae	L
Marks Park	Orthoptera (Grasshoppers, crickets)	1	6 juveniles Gryllinae	L
Marks Park	Hemiptera (True Bugs)	1	Pentatomidae	L
Marks Park	Dermaptera (Earwigs)	1	Anisolabidinae	L
Marks Park	Coleoptera (Beetles)	8	Curculionidae, Coccinellidae, undetermined larvae	L
Marks Park	Neuroptera (Lacewings, Antlions)	1		L
Marks Park	Lepidoptera (Butterflies and moths)	8	moths, moth larvae (Tineidae, Tortricidae, Noctuidae, Arctiidae)	L
Marks Park	Thysanura (Silverfish)	1	Lepismatidae	L
Marks Park	Dolichopodidae (Long-legged flies)	1	<i>Austrosciapus connexus</i>	SW
Marks Park	Empididae (Dance)	1	Tachydromiinae sp.	SW

Waverley Council Survey Invertebrates 10-11 December 2009

Collection Technique Legend: L=Litter sample; SW = Sweep/beat netting; YP = Yellow Pan Trap

Location	Order	No. morpho-species	Further ID	Technique
	flies)			
Marks Park	Orthorrhapha (Bee Flies, Robber flies and others)	2	Asilidae, Therevidae	SW
Marks Park	Nematocera (Mosquitoes, Midges)	1	Simuliidae	SW
Marks Park	Acalyptrata (Fruit flies, Picture-winged flies and others)	6	Sepsidae, Milichiidae, Platystomatidae, Drosophilidae - <i>Scatomyza australis</i> , <i>Scaptodrosophila ? barkeri</i>	SW
Marks Park	Calypttrata (Blow flies, House flies)	3	Calliphoridae, Sarcophagidae, Muscidae	SW
Marks Park	Araneae (Spiders)		see Appendix C	SW
Marks Park	Formicidae (Ants)	4	see Appendix B	SW
Marks Park	Hymenoptera (Wasps, Bees)	6	Ichneumonidae, Braconidae, Chalcidoidea	SW
Marks Park	Thysanoptera (Thrips)	1	Thripidae	SW
Marks Park	Orthoptera (Grasshoppers, crickets)	1	1 juvenile Gryllinae	SW
Marks Park	Hemiptera (True Bugs)	6	Myridae, Lygaeidae, Cicadellidae, Fulgoroidea	SW
Marks Park	Coleoptera (Beetles)	5	Buprestidae, Cerambycidae, Coccinellidae	SW
Marks Park	Psocoptera (Book Lice)	1	<i>Ectopsocus</i> sp.	SW
Marks Park	Lepidoptera (Butterflies and moths)	2	moth larvae (1 Geometridae, 1 undetermined)	SW
Marks Park	Dolichopodidae (Long-legged flies)	3	<i>Austrosiapus connexus</i> , <i>Amblypsilopus zonatus</i>	YP
Marks Park	Orthorrhapha (Bee Flies, Robber flies and others)	3	Phoridae, Scenopinidae, Pipunculidae	YP
Marks Park	Nematocera (Mosquitoes, Midges)	2	Sciaridae, Chironomidae	YP
Marks Park	Acalyptrata (Fruit flies, Picture-winged flies and others)	5	Chloropidae, Platystomatidae	YP
Marks Park	Calypttrata (Blow flies, House flies)	3	Muscidae, Tachinidae, Calliphoridae	YP
Marks Park	Formicidae (Ants)	2	see Appendix B	YP
Marks Park	Hymenoptera (Wasps, Bees)	6	Scelionidae, Platygasteridae, Braconidae	YP
Marks Park	Lepidoptera (Butterflies and moths)	1	moth (Nepticulidae)	YP
Tamarama Park	Annelida (Earthworms)	1		L
Tamarama Park	Pseudoscorpiones (False scorpions)	1	see Appendix C	L
Tamarama Park	Amphipoda (Amphipods)	1	land hoppers (probably <i>Arcitalitrus sylvaticus</i>)	L
Tamarama Park	Isopoda (Slaters, Pill bugs)	2	Garden Slater, <i>Porcellio scaber</i> ; Pillbug, <i>Armadillidium vulgare</i>	L
Tamarama Park	Diplopoda (Millipedes)	2	see Appendix C - Polydesmida, Spirobolida	L
Tamarama Park	Chilopoda (Centipedes)	2	see Appendix C - Scolopendromorpha, Geophilomorpha	L
Tamarama Park	Mollusca (Snails, Molluscs)	1	Charopidae - <i>Elsothera sericatula</i>	L
Tamarama Park	Araneae (Spiders)		see Appendix C	L
Tamarama Park	Formicidae (Ants)	5	see Appendix B	L
Tamarama Park	Blattodea (Cockroaches)	1	Blattidae	L

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Collection Technique Legend: L=Litter sample; SW = Sweep/beat netting; YP = Yellow Pan Trap

Location	Order	No. morpho-species	Further ID	Technique
Tamarama Park	Hymenoptera (Wasps, Bees)	1	Cynipoidea - gall wasp	L
Tamarama Park	Thysanoptera (Thrips)	1	Phlaeothripidae	L
Tamarama Park	Orthoptera (Grasshoppers, crickets)	1	3 juveniles Gryllinae	L
Tamarama Park	Hemiptera (True Bugs)	1	Lygaeidae	L
Tamarama Park	Coleoptera (Beetles)	6	Elateridae, Curculionidae, undetermined larvae	L
Tamarama Park	Embioptera (Web spinners)	1	Austrolembiidae	L
Tamarama Park	Lepidoptera (Butterflies and moths)	6	moths, moth larvae and pupae (1 Oecophoridae, 5 undetermined)	L
Tamarama Park	Dolichopodidae (Long-legged flies)	1	<i>Austrosiapus connexus</i>	SW
Tamarama Park	Orthorrhapha (Bee Flies, Robber flies and others)	4	Tabanidae, Asilidae, Pipunculidae, Syrphidae	SW
Tamarama Park	Nematocera (Mosquitoes, Midges)	4	Tipulidae, Ceratopogonidae, Culicidae	SW
Tamarama Park	Acalyptrata (Fruit flies, Picture-winged flies and others)	7	Tephritidae, Chloropidae, Agromyzidae, Milichiidae, Drosophilidae - <i>Scatopmyza australis</i> , <i>Scaptodrosophila claytoni</i>	SW
Tamarama Park	Calypttrata (Blow flies, House flies)	4	Muscidae	SW
Tamarama Park	Araneae (Spiders)		see Appendix C	SW
Tamarama Park	Formicidae (Ants)	5	see Appendix B	SW
Tamarama Park	Blattodea (Cockroaches)	1	Blattidae	SW
Tamarama Park	Hymenoptera (Wasps, Bees)	8	Spheciformes, Chalcidoidea, Braconidae, Platygastridae	SW
Tamarama Park	Thysanoptera (Thrips)	2	Phlaeothripidae, Thripidae	SW
Tamarama Park	Orthoptera (Grasshoppers, crickets)	1	4 juveniles Gryllinae	SW
Tamarama Park	Hemiptera (True Bugs)	20	Cicadellidae, Lygaeidae, Flatidae, Berytidae, Fulgoroidea, Ricaniidae	SW
Tamarama Park	Coleoptera (Beetles)	7	Mordellidae, Coccinellidae, Curculionidae, Staphylinidae, Chrysomelidae	SW
Tamarama Park	Psocoptera (Book Lice)	1	<i>Ectopsocus</i> sp.	SW
Tamarama Park	Lepidoptera (Butterflies and moths)	11	Lycaenidae; 10 moths and moth larvae (2 Noctuidae, Phycitinae, Geometridae, Gelechioidea, 5 undetermined)	SW
Tamarama Park	Dolichopodidae (Long-legged flies)	3	<i>Amblypsilopus zonatus</i> , <i>Heteropsilopus squamifer</i> , <i>Austrosiapus proximus</i>	YP
Tamarama Park	Orthorrhapha (Bee Flies, Robber flies and others)	1	Phoridae	YP
Tamarama Park	Acalyptrata (Fruit flies, Picture-winged flies and others)	2	Ephydriidae, Heteromyzidae	YP
Tamarama Park	Calypttrata (Blow flies, House flies)	1	Tachinidae	YP
Tamarama Park	Araneae (Spiders)		see Appendix C	YP
Tamarama Park	Formicidae (Ants)	4	see Appendix B	YP
Tamarama Park	Hymenoptera (Wasps, Bees)	10	Evaniidae, Braconidae, Platygastridae, Spheciformes, Chalcidoidea	YP
Tamarama Park	Hemiptera (True Bugs)	3	Psyllidae, Aphidae	YP

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Collection Technique Legend: L=Litter sample; SW = Sweep/beat netting; YP = Yellow Pan Trap

Location	Order	No. morpho-species	Further ID	Technique
Bronte Park	Annelida (Earthworms)	1		L
Bronte Park	Pseudoscorpiones (False scorpions)	1	see Appendix C	L
Bronte Park	Amphipoda (Amphipods)	1	land hoppers (probably <i>Arcitalitrus sylvaticus</i>)	L
Bronte Park	Isopoda (Slaters, Pill bugs)	2	Garden Slater, <i>Porcellio scaber</i> ; Pillbug, <i>Armadillidium vulgare</i>	L
Bronte Park	Diplopoda (Millipedes)	2	see Appendix C - Polydesmida, Spirobolida	L
Bronte Park	Chilopoda (Centipedes)	2	see Appendix C - Scolopendromorpha, Geophilomorpha	L
Bronte Park	Araneae (Spiders)		see Appendix C	L
Bronte Park	Formicidae (Ants)	5	see Appendix B	L
Bronte Park	Hymenoptera (Wasps, Bees)	1	Chalcidoidea	L
Bronte Park	Orthoptera (Grasshoppers, crickets)	1	3 juveniles Gryllinae	L
Bronte Park	Hemiptera (True Bugs)	1	Lygaeidae	L
Bronte Park	Dermaptera (Earwigs)	1	Anisolabidinae	L
Bronte Park	Coleoptera (Beetles)	8	Elateridae, Staphylinidae, Dermestidae -larvae	L
Bronte Park	Embioptera (Web spinners)	1	Austrolembiidae	L
Bronte Park	Psocoptera (Book Lice)	2	<i>Ectopsocus</i> sp., <i>Miopsocus</i> sp.	L
Bronte Park	Lepidoptera (Butterflies and moths)	7	moth larvae (Noctuidea, 2 Gelechioidea, 4 undetermined)	L
Bronte Park	Dolichopodidae (Long-legged flies)	4	<i>Austrosiciapus connexus</i> , <i>Sympycnus</i> sp., <i>Nothorhaphium aemulans</i> , <i>Neurigona angulata</i>	SW
Bronte Park	Orthorrhapha (Bee Flies, Robber flies and others)	1	Phoridae	SW
Bronte Park	Nematocera (Mosquitoes, Midges)	4	Ceratopogonidae, Chironomidae, Mycetophilidae, Culicidae	SW
Bronte Park	Acalyptrata (Fruit flies, Picture-winged flies and others)	12	Neriidae, Chloropidae, Drosophilidae - <i>Scatomyza australis</i> , <i>Scaptodrosophila sp1</i> , <i>Scaptodrosophila sp2</i> , <i>Leucophenga sp1</i> , Agromyzidae, Sepsidae, Ephydriidae, Platystomatidae, Lonchaeidae, Heteromyzidae	SW
Bronte Park	Calypttrata (Blow flies, House flies)	5	Tachinidae, Calliphoridae, Muscidae	SW
Bronte Park	Araneae (Spiders)		see Appendix C	SW
Bronte Park	Formicidae (Ants)	3	see Appendix B	SW
Bronte Park	Blattodea (Cockroaches)	1	Blattidae	SW
Bronte Park	Hymenoptera (Wasps, Bees)	10	Ichneumonidae, Braconidae, Chalcidoidea, Platygasteridae, Spheciformes, Apidae	SW
Bronte Park	Thysanoptera (Thrips)	2	Phlaeothripidae, Thripidae	SW
Bronte Park	Orthoptera (Grasshoppers, crickets)	1	2 juveniles Gryllinae (1 Gryllini)	SW
Bronte Park	Hemiptera (True Bugs)	10	Ricaniidae, Psyllidae, Cidellidae, Lygaeidae, Aphidae	SW
Bronte Park	Mantodea (Praying Mantis)	1	Mantidae - <i>Orthodera ministralis</i> - nymph	SW
Bronte Park	Coleoptera (Beetles)	8	Coccinellidae, Chrysomelidae, Cerambycidae, Troginae, Lycidae	SW

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Collection Technique Legend: L=Litter sample; SW = Sweep/beat netting; YP = Yellow Pan Trap

Location	Order	No. morpho-species	Further ID	Technique
Bronte Park	Neuroptera (Lacewings, Antlions)	3	Antlions	SW
Bronte Park	Psocoptera (Book Lice)	3	<i>Miopsocus</i> sp.	SW
Bronte Park	Lepidoptera (Butterflies and moths)	8	Lycaenidae; moths (Arctiidae <i>Amata</i> sp., Larentiinae, Phycitinae, Gelechioidea, Pyralidae), moth larvae (Geometridae, undetermined)	SW
Bronte Park	Orthorrhapha (Bee Flies, Robber flies and others)	1	Pipunculidae	YP
Bronte Park	Acalytrata (Fruit flies, Picture-winged flies and others)	1	Drosophilidae (<i>Scaptomyza</i> sp.)	YP
Bronte Park	Calytrata (Blow flies, House flies)	1	Sarcophagidae	YP
Bronte Park	Araneae (Spiders)		see Appendix C	YP
Bronte Park	Formicidae (Ants)	1	see Appendix B	YP
Bronte Park	Amphipoda (Amphipods)	1	land hoppers (probably <i>Arcitalitrus sylvaticus</i>)	YP
Bronte Park	Hemiptera (True Bugs)	1	Cydnidae	YP
Bronte Park	Coleoptera (Beetles)	1	Coccinellidae	YP
Varna Park	Annelida (Earthworms)	1		L
Varna Park	Acalytrata (Fruit flies, Picture-winged flies and others)	1	Milichiidae	L
Varna Park	Amphipoda (Amphipods)	1	land hoppers (probably <i>Arcitalitrus sylvaticus</i>)	L
Varna Park	Isopoda (Slaters, Pill bugs)	2	Garden Slater, <i>Porcellio scaber</i> ; Pillbug, <i>Armadillidium vulgare</i>	L
Varna Park	Diplopoda (Millipedes)	1	see Appendix C - Polydesmida	L
Varna Park	Araneae (Spiders)		see Appendix C	L
Varna Park	Formicidae (Ants)	3	see Appendix B	L
Varna Park	Blattodea (Cockroaches)	1	Blattidae	L
Varna Park	Thysanoptera (Thrips)	1	Phlaeothripidae	L
Varna Park	Orthoptera (Grasshoppers, crickets)	1	1 juvenile Gryllinae	L
Varna Park	Hemiptera (True Bugs)	6	Lygaeidae, Pentatomidae, Reduviidae, Miridae	L
Varna Park	Dermaptera (Earwigs)	1	Anisolabidinae	L
Varna Park	Coleoptera (Beetles)	8	Staphylinidae, Elateridae, Curculionidae, Carabidae, undetermined larvae	L
Varna Park	Psocoptera (Book Lice)	2	Undescribed sp.	L
Varna Park	Lepidoptera (Butterflies and moths)	6	moth larvae (2 Noctuidae, 4 undetermined)	L
Varna Park	Dolichopodidae (Long-legged flies)	1	<i>Austrosciapus connexus</i>	SW
Varna Park	Orthorrhapha (Bee Flies, Robber flies and others)	3	Therevidae, Stratiomyidae, Asilidae	SW
Varna Park	Nematocera (Mosquitoes, Midges)	5	Chironomidae, Ceratopogonidae	SW
Varna Park	Acalytrata (Fruit flies, Picture-winged flies and others)	10	Sepsidae, Chloropidae, Agromyzidae, Drosophilidae - <i>Scatomyza australis</i>	SW
Varna Park	Calytrata (Blow flies, House flies)	2	Sarcophagidae, Muscidae	SW

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Collection Technique Legend: L=Litter sample; SW = Sweep/beat netting; YP = Yellow Pan Trap

Location	Order	No. morpho-species	Further ID	Technique
Varna Park	Araneae (Spiders)		see Appendix C	SW
Varna Park	Formicidae (Ants)	1	see Appendix B	SW
Varna Park	Hymenoptera (Wasps, Bees)	20	Chalcidoidea, Spheciformes, Braconidae	SW
Varna Park	Thysanoptera (Thrips)	2	Phlaeothripidae, Thripidae	SW
Varna Park	Hemiptera (True Bugs)	15	Cicadellidae, Flatidae, Lygaeidae, Psyllidae, Berytidae, Pentatomidae	SW
Varna Park	Mantodea (Praying Mantis)	1	Mantidae - <i>Orthodera ministralis</i> - nymph	SW
Varna Park	Coleoptera (Beetles)	8	Mordellidae, Coccinellidae, Curculionidae, Staphylinidae, Chrysomelidae	SW
Varna Park	Neuroptera (Lacewings, Antlions)	3		SW
Varna Park	Psocoptera (Book Lice)	3	Undescribed sp., <i>Ectopsocus</i> sp., Pseudocaeciliidae sp.	SW
Varna Park	Lepidoptera (Butterflies and moths)	4	Lycaenidae; Moths (Phycitinae, undetermined), moth larvae (undetermined)	SW
Varna Park	Dolichopodidae (Long-legged flies)	1	<i>Austrosciapus connexus</i>	YP
Varna Park	Orthorrhapha (Bee Flies, Robber flies and others)	1	Stratiomyidae, Pipunculidae	YP
Varna Park	Acalyptrata (Fruit flies, Picture-winged flies and others)	1	Platystomatidae	YP
Varna Park	Araneae (Spiders)		see Appendix C	YP
Varna Park	Formicidae (Ants)	2	see Appendix B	YP
Varna Park	Hymenoptera (Wasps, Bees)	2	Spheciformes	YP
Varna Park	Hemiptera (True Bugs)	3	Berytidae, Myridae, Cicadellidae	YP
Varna Park	Coleoptera (Beetles)	1		YP
Queens Park	Isopoda (Slaters, Pill bugs)	1	Garden Slater, <i>Porcellio scaber</i>	L
Queens Park	Orthorrhapha (Bee Flies, Robber flies and others)	1	Phoridae	L
Queens Park	Nematocera (Mosquitoes, Midges)	1	Sciaridae	L
Queens Park	Araneae (Spiders)		see Appendix C	L
Queens Park	Formicidae (Ants)	5	see Appendix B	L
Queens Park	Blattodea (Cockroaches)	1	Blattidae	L
Queens Park	Thysanoptera (Thrips)	1	Phlaeothripidae	L
Queens Park	Hemiptera (True Bugs)	4	Pentatomidae, Lygaeidae	L
Queens Park	Dermaptera (Earwigs)	1	Anisolabidinae	L
Queens Park	Coleoptera (Beetles)	10	Curculionidae, Carabidae	L
Queens Park	Lepidoptera (Butterflies and moths)	2	moth larvae (Arctiidae, undetermined)	L
Queens Park	Orthorrhapha (Bee Flies, Robber flies and others)	3	Bombyliidae, Asilidae, Phoridae, Scenopinidae	SW
Queens Park	Nematocera (Mosquitoes, Midges)	2	Chironomidae. Sciaridae	SW
Queens Park	Acalyptrata (Fruit flies, Picture-winged flies and others)	8	Lauxaniidae - <i>Steganopsis melanogaster</i> , Ephydriidae, Tephritidae - <i>Spathulina acroleuca</i> (Schiner), Chloropidae, Sepsidae,	SW

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Collection Technique Legend: L=Litter sample; SW = Sweep/beat netting; YP = Yellow Pan Trap

Location	Order	No. morpho-species	Further ID	Technique
			Agromyzidae	
Queens Park	Calypttrata (Blow flies, House flies)	4	Muscidae, Sarcophagidae, Tachinidae	SW
Queens Park	Araneae (Spiders)		see Appendix C	SW
Queens Park	Formicidae (Ants)	2	see Appendix B	SW
Queens Park	Hymenoptera (Wasps, Bees)	11	Spheciformes, Chalcidoidea	SW
Queens Park	Thysanoptera (Thrips)	1	Thripidae	SW
Queens Park	Orthoptera (Grasshoppers, crickets)	2	1 juvenile Phaneropterinae, 1 juvenile Gryllinae	SW
Queens Park	Hemiptera (True Bugs)	15	Pentatomidae, Berytidae, Myridae, Psyllidae, Cicadellidae, Tingidae	SW
Queens Park	Coleoptera (Beetles)	5	Buprestidae, Chrysomelidae, Coccinellidae,	SW
Queens Park	Neuroptera (Lacewings, Antlions)	3	Myrmeleonidae	SW
Queens Park	Psocoptera (Book Lice)	2	Undescribed sp., Unknown sp.	SW
Queens Park	Lepidoptera (Butterflies and moths)	6	Hesperiidae - <i>Ocybadistes walkeri</i> ; moths (Gelechioidea, Noctuidae, undetermined), moth larvae/pupae (2 undetermined)	SW
Queens Park	Dolichopodidae (Long-legged flies)	1	<i>Heteropsilopus ingenuus</i> , <i>Austrosciapus proximus</i>	YP
Queens Park	Orthorrhapha (Bee Flies, Robber flies and others)	3	Bombyliidae, Therevidae, Scenopinidae	YP
Queens Park	Nematocera (Mosquitoes, Midges)	1	Cecidomyiidae	YP
Queens Park	Acalypttrata (Fruit flies, Picture-winged flies and others)	3	Agromyzidae, Platystomatidae	YP
Queens Park	Calypttrata (Blow flies, House flies)	1	Sarcophagidae	YP
Queens Park	Araneae (Spiders)		see Appendix C	YP
Queens Park	Formicidae (Ants)	2	see Appendix B	YP
Queens Park	Hymenoptera (Wasps, Bees)	3	Spheciformes, Pompilidae, Apoidea	YP
Queens Park	Hemiptera (True Bugs)	3	Aphidae, Cicadellidae, Lygaeidae	YP
Queens Park	Lepidoptera (Butterflies and moths)	1	Hesperiidae (<i>Ocybadistes walkeri</i>)	YP
Queens Park	Coleoptera (Beetles)	1	Mordellidae	YP
York Road	Chilopoda (Centipedes)	1	see Appendix C -Geophilomorpha	L
York Road	Araneae (Spiders)		see Appendix C	L
York Road	Formicidae (Ants)	3	see Appendix B	L
York Road	Blattodea (Cockroaches)	1	Blattidae	L
York Road	Hymenoptera (Wasps, Bees)	4	Chalcidoidea	L
York Road	Hemiptera (True Bugs)	2	Pentatomidae, Lygaeidae	L
York Road	Coleoptera (Beetles)	6	Curculionidae, Coccinellidae, Staphylinidae	L
York Road	Lepidoptera (Butterflies and moths)	4	moth larvae (Noctuidae, 3 undetermined)	L
York Road	Empididae (Dance flies)	1	Tachydromiinae sp.	SW
York Road	Orthorrhapha (Bee Flies, Robber flies and others)	2	Asilidae, Scenopinidae	SW

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Location	Order	No. morpho-species	Further ID	Technique
York Road	Nematocera (Mosquitoes, Midges)	2	Ceratopogonidae, Chironomidae	SW
York Road	Acalyptrata (Fruit flies, Picture-winged flies and others)	5	Heteromyzidae, Platystomatidae, Lauxaniidae, Chloropidae, Agromyzidae	SW
York Road	Araneae (Spiders)		see Appendix C	SW
York Road	Formicidae (Ants)	5	see Appendix B	SW
York Road	Blattodea (Cockroaches)	1	Blattidae	SW
York Road	Hymenoptera (Wasps, Bees)	10	Chalcidoidea, Pompilidae	SW
York Road	Thysanoptera (Thrips)	1	Phlaeothripidae	SW
York Road	Hemiptera (True Bugs)	10	Myridae, Lygaeidae, Pysillidae, Cicadellidae, Fulgoroidea, Pentatomidae	SW
York Road	Coleoptera (Beetles)	4	Curculionidae, Buprestidae, Coccinellidae	SW
York Road	Neuroptera (Lacewings, Antlions)	1		SW
York Road	Psocoptera (Book Lice)	1	<i>Ectopsocus</i> sp.	SW
York Road	Lepidoptera (Butterflies and moths)	1	moth larvae (Geometridae)	SW
York Road	Dolichopodidae (Long-legged flies)	1	<i>Heteropsilopus ingenuus</i>	YP
York Road	Orthorrhapha (Bee Flies, Robber flies and others)	3	Bombyliidae, Pipunculidae, Scenopinidae	YP
York Road	Nematocera (Mosquitoes, Midges)	2	Cecidomyiidae, Sciaridae	YP
York Road	Acalyptrata (Fruit flies, Picture-winged flies and others)	2	Ephydriidae, Chloropidae	YP
York Road	Calypttrata (Blow flies, House flies)	2	Tachinidae	YP
York Road	Formicidae (Ants)	2	see Appendix B	YP
York Road	Hymenoptera (Wasps, Bees)	10	Vespidae, Spheciformes, Braconidae, Chalcidoidea,	YP
York Road	Hemiptera (True Bugs)	1	Lygaeidae	YP

Appendix B: Ant Species Recorded

Table of ant species recorded in Waverley Council area

Collection Technique Legend: L=Litter sample; SW = Sweep/beat netting; YP = Yellow Pan Trap.

Location	Genus / species	No. species	No. specimens	Technique / notes
Diamond Bay Reserve	<i>Hypoponera sp.</i>	1	1	L
Diamond Bay Reserve	<i>Iridomyrmex sp.</i>	1	4	L
Diamond Bay Reserve	<i>Monomorium laeve</i>	1	1	L
Diamond Bay Reserve	<i>Paratrechina sp.</i>	2	5	L
Diamond Bay Reserve	<i>Ponera sp.</i>	1	1	L
Diamond Bay Reserve	<i>Solenopsis sp.</i>	1	2	L
Diamond Bay Reserve	<i>Iridomyrmex sp.</i>	3	19	SW
Diamond Bay Reserve	<i>Ochetellus sp.</i>	1	2	SW
Diamond Bay Reserve	<i>Paratrechina sp.</i>	2	3	SW
Diamond Bay Reserve	<i>Iridomyrmex rufoniger</i>	1	8	YP
Rodney Reserve	<i>Hypoponera sp.</i>	2	3	L
Rodney Reserve	<i>Paratrechina minutula</i>	1	1	L
Rodney Reserve	<i>Pheidole megacephala</i>	1	1	L
Rodney Reserve	<i>Rhytidoponera metallica</i>	1	25	L
Rodney Reserve	<i>Strumigenys sp.</i>	1	3	L
Rodney Reserve	<i>Technomyrmex sp.</i>	1	20	L
Rodney Reserve	<i>Iridomyrmex sp.</i>	2	29	SW
Rodney Reserve	<i>Ochetellus sp.</i>	1	1	SW
Rodney Reserve	<i>Technomyrmex sp.</i>	1	7	SW
Rodney Reserve	<i>Iridomyrmex sp.</i>	1	1	YP
Marks Park	<i>Monomorium sp.</i>	1	2	L
Marks Park	<i>Ochetellus sp.</i>	1	13	L
Marks Park	<i>Pheidole megacephala</i>	1	1	L
Marks Park	<i>Solenopsis sp.</i>	1	1	L
Marks Park	<i>Iridomyrmex sp.</i>	2	2	SW
Marks Park	<i>Monomorium laeve</i>	1	1	SW
Marks Park	<i>Ochetellus sp.</i>	1	2	SW
Marks Park	<i>Technomyrmex sp.</i>	1	2	SW
Marks Park	<i>Iridomyrmex sp.</i>	1	1	YP
Marks Park	<i>Pheidole megacephala</i>	1	1	YP
Tamarama Park	<i>Mayriella sp.</i>	1	2	L
Tamarama Park	<i>Paratrechina minutula</i>	1	89	L / nest (includes queen + 5 alate females)
Tamarama Park	<i>Pheidole megacephala</i>	1	4	L
Tamarama Park	<i>Rhytidoponera chalybea</i>	1	2	L
Tamarama Park	<i>Tapinoma sp.</i>	1	1	L
Tamarama Park	<i>Anonychomyrma sp.</i>	1	2	SW
Tamarama Park	<i>Iridomyrmex sp.</i>	2	7	SW
Tamarama Park	<i>Ochetellus sp.</i>	1	1	SW

Location	Genus / species	No. species	No. specimens	Technique / notes
Tamarama Park	<i>Paratrechina sp.</i>	2	4	SW
Tamarama Park	<i>Tapinoma sp.</i>	1	3	SW
Tamarama Park	<i>Monomorium laeve</i>	1	1	YP
Tamarama Park	<i>Ochetellus sp.</i>	1	1	YP
Tamarama Park	<i>Paratrechina sp.</i>	1	3	YP
Tamarama Park	<i>Pheidole megacephala</i>	1	1	YP
Bronte Park	<i>Mayriella sp.</i>	1	1	L
Bronte Park	<i>Rhytidoponera metallica</i> (18) + <i>chalybea</i> (1)	2	19	L
Bronte Park	<i>Solenopsis sp.</i>	1	1	L
Bronte Park	<i>Strumigenys sp.</i>	1	1	L
Bronte Park	<i>Technomyrmex sp.</i>	1	4	L
Bronte Park	<i>Paratrechina sp.</i>	2	3	SW
Bronte Park	<i>Tapinoma alate</i> (female)	1	1	SW
Bronte Park	<i>Technomyrmex sp.</i>	1	4	SW
Bronte Park	<i>Tapinoma sp.</i>	1	1	YP
Varna Park	<i>Pheidole sp.</i>	2	16	L
Varna Park	<i>Rhytidoponera metallica</i>	1	2	L
Varna Park	<i>Technomyrmex sp.</i>	1	4	L
Varna Park	<i>Iridomyrmex sp.</i>	2	6	SW
Varna Park	<i>Prolasius sp.</i>	1	1	YP
Varna Park	<i>Rhytidoponera victoriae</i>	1	7	YP
Queens Park	<i>Hypoponera sp.</i>	1	2	L
Queens Park	<i>Ochetellus sp.</i>	1	2	L
Queens Park	<i>Pheidole megacephala</i>	1	45	L
Queens Park	<i>Ponera sp.</i>	1	1	L
Queens Park	<i>Solenopsis sp.</i>	1	1	L
Queens Park	<i>Ochetellus sp.</i>	1	1	SW
Queens Park	<i>Pheidole sp.</i>	1	2	SW
Queens Park	<i>Melophorus sp.</i>	1	1	YP
Queens Park	<i>Pheidole megacephala</i>	1	6	YP
York Road	<i>Iridomyrmex sp.</i>	1	3	L
York Road	<i>Pheidole megacephala</i>	1	5	L
York Road	<i>Tapinoma sp.</i>	1	59	L / nest (6 queens)
York Road	<i>Iridomyrmex sp.</i>	1	2	SW
York Road	<i>Melophorus sp.</i>	1	1	SW
York Road	<i>Monomorium sp.</i>	1	2	SW
York Road	<i>Ochetellus sp.</i>	1	6	SW
York Road	<i>Tapinoma sp.</i>	1	2	SW
York Road	<i>Iridomyrmex sp.</i>	3	17	YP
York Road	<i>Ochetellus sp.</i>	1	4	YP

Appendix C: Arachnids Recorded

Arachnid fauna abundance recorded by combined survey methods at each site.

ORDER / SITE	Diamond Bay Reserve	Rodney Reserve	Marks Park	Tamarama Park	Bronte Park	Varna Park	Queens Park	York Road
ARANEAE (Spiders)								
Amaurobioidea								
<i>Colcarteria sp 1</i>			1	3	3	3		
Araneidae								
<i>Araneus' sp 1</i>					2			
<i>Araneus' sp 2</i>							1	1
Clubionidae								
<i>Clubiona sp 1</i>					1			
<i>Clubiona sp 2</i>		1		1				1
<i>Clubiona sp 3</i>			1					
<i>Cheiracanthium sp 1</i>			1			1		
<i>Cheiracanthium sp 2</i>	1	1						
<i>Cheiracanthium sp 3</i>							2	1
Dysderidae								
<i>Dysdera crocata</i>			1			1		
Gnaphosidae								
<i>Gen sp 1</i>								1
Linyphiidae								
<i>Gen sp 1</i>						1		
<i>Gen sp 2</i>						1		
Lycosidae								
<i>Artoria sp 1</i>		1	2					
<i>Venatrix pictiventris</i>						1		
Micropholcommatidae								
<i>Gen sp 1</i>								1
Oxyopidae								
<i>Oxyopes sp 1</i>					2			
Salticidae								
<i>Lycidas sp 2</i>	1							
<i>Lycidas sp 1</i>								1
<i>Opisthoncus sp 1</i>			3	2				
<i>Servaea sp 1</i>				1	2			
Tetragnathidae								
<i>Leucauge sp 1</i>					2			
Theridiidae								
<i>Achaearanea sp 1</i>	1							
<i>Anelosimus sp 1</i>					2			
<i>Gen sp 1</i>					3		5	1
<i>Hadrotarsinae sp 1</i>								2
<i>Theridion pyramidale</i>					3			
<i>Theridion' sp 1</i>						1		

ORDER / SITE	Diamond Bay Reserve	Rodney Reserve	Marks Park	Tamarama Park	Bronte Park	Varna Park	Queens Park	York Road
<i>Theridion' sp 2</i>			1				2	
<i>Theridion' sp 3</i>					2		2	
<i>Theridion' sp 4</i>							4	
<i>Theridion' sp 5</i>							1	
<i>Theridion' sp 6</i>							1	
Thomisidae								
<i>Diaea sp 1</i>	4	1		1			3	
<i>Diaea sp 2</i>					1			
<i>Miagrammopes sp 1</i>								1
<i>Sidymella sp 1</i>					1			
Zoridae								
<i>Gen sp 1</i>	2							
Miturgidae								
<i>Mitulidon tarantulinus</i>				1				
TOTALS								
Total no. species at site	5	4	7	6	12	7	9	9
juvenile spiders	47	75	37	68	172	65	110	123
PSEUDOSCORPIONES (Pseudoscorpions)	8	1	61	17	12			
SCOLOPENDROMORPHA (Centipedes)								
<i>Cryptops sp</i>		2	7	3	4			
GEOPHILOMORPHA								
<i>Ballophilus australiae</i>	2		6	7	10			
<i>Mecistocephalus sp</i>								2
POLYDESMIDA								
<i>Gen sp 1</i>						1		
<i>Gen sp 2</i>				1	3			
<i>Gen sp 3</i>	1							
<i>Gen sp 4</i>	2							
SPIROBOLIDA								
<i>Gen sp 1</i>	1			3	2			

Appendix D: Vertebrate Fauna Records

Birds species recorded within the Waverley LGA.

N.B. First number is the number recorded during standardised surveys within or outside the quadrat. () = number recorded within the quadrat. [] = opportunistic records. * = sign of the species recorded (i.e. track, scat, scratches, den, feather etc). + indicates minimum number recorded.

Common Name	Scientific Name	Bronte Park	Calga Reserve	Diamond Bay	Hugh-Bamford Reserve	Hunters Park	Marks Park	York Road	Queens Park North	Queens Park Pond	Tamarama Park	Thomas-Hogan Reserve	Waverley Park	Rodney Reserve	Varna Park
Australian Magpie	<i>Gymnorhina tibicen</i>	5(3)[1+]	-	-	-	1(0)	3(3)[1+]	-	5(0)	2(2)	[1+]	-	8(0)	-	-
Grey Butcherbird	<i>Cracticus torquatus</i>	1(1)	-	-	-	-	-	1(0)	[1+]	-	3(3)	1(1)[1+]	-	-	-
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	3(3)[1+]	-	-	-	2(2)[1+]	-	-	[3]	-	2(2)[1+]	1(1)[1+]	2(2)[1+]	-	-
Noisy Miner	<i>Manorina melanocephala</i>	7(2)[1+]	-	1(1)[1+]	-	6(6)[1+]	-	2(1)[1+]	6(6)[3+]	1(1)[1+]	9(9)[1+]	4(3)[1+]	4(4)[1+]	-	-
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	6(6)[20+]	1(1)	1(0)[1+]	-	2(1)[1+]	[1+]	5(0)[2+]	47(7)[1+]	10(8)[2+]	11(8)[2+]	6(4)[1+]	4(4)[2+]	-	-
Red Wattlebird	<i>Anthochaera carunculata</i>	1(1)	-	5(5)	1(1)[1+]	-	5(3)	5(5)	1(1)[1+]	1(1)	-	-	-	-	-
Welcome Swallow	<i>Hirundo neoxena</i>	2(2)[4]	3(3)	[1+]	3(1)[1+]	1(1)	-	2(2)[1+]	-	-	1(1)[1+]	-	10(0)[1+]	[1+]	-
Magpie-lark	<i>Grallina cyanoleuca</i>	1(0)[1+]	-	-	3(3)	-	-	1(0)	1(0)	2(2)[1+]	-	2(2)	2(0)	-	-
Pied Currawong	<i>Strepera graculina</i>	2(0)[1+]	-	[1+]	[1+]	-	-	3(2)[1+]	2(0)[3+]	1(0)	[1+]	1(0)[1+]	2(1)[1]	-	-
Australian Raven	<i>Corvus coronoides</i>	1(0)[2]	-	3(0)	1(0)	-	2(1)	[3]	1(0)	-	2(2)	1(0)	1(0)	-	-
Pacific Koel	<i>Eudynamys orientalis</i>	1(0)	1(0)	2(1)	[1+]	-	-	2(0)	[1+]	-	[1+]	-	-	-	-
Rock Dove	<i>Columba livia</i>	1(0)	3(3)	3(2)[4+]	-	-	5(1)[1+]	[2]	[1+]	-	5(5)[1+]	1(1)	28(15)[2+]	-	-
Common Myna	<i>Acridotheres tristis</i>	-	2(2)	-	1(0)	-	1(0)[2+]	1(0)	-	-	-	1(1)	3(0)[3+]	[1+]	-
House Sparrow	<i>Passer domesticus</i>	-	1(1)	-	-	1(0)	-	-	-	-	[1+]	-	-	[1+]	-
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>	-	2(2)	-	2(2)[1+]	[5]	-	1(1)	-	-	[2]	-	-	-	-
Superb Fairy-wren	<i>Malurus cyaneus</i>	-	3(3)	[2+]	10(10)[1+]	2(2)[1]	[1]	5(5)	-	-	[1+]	-	-	-	-
Willie Wagtail	<i>Rhipidura leucophrys</i>	-	1(1)	[1+]	1(1)	-	1(0)	1(1)[1+]	-	1(1)	-	-	-	-	-

Common Name	Scientific Name	Bronte Park	Calga Reserve	Diamond Bay	Hugh-Bamford Reserve	Hunters Park	Marks Park	York Road	Queens Park North	Queens Park Pond	Tamarama Park	Thomas-Hogan Reserve	Waverley Park	Rodney Reserve	Varna Park
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	-	-	1(0)	-	-	-	-	-	-	-	-	-	-	-
Spotted Turtle-Dove	<i>Streptopelia chinensis</i>	[1+]	-	1(0)	[1+]	-	1(0)	2(2)[1+]	-	1(1)	-	1(0)	-	-	-
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	-	-	2(0)	[1+]	-	-	4(0)	1(1)	-	-	-	-	-	-
Common Starling	<i>Sturnus vulgaris</i>	-	-	-	25(25)[1+]	-	[20+]	-	7(2)[80+]	-	-	-	[1+]	[1+]	-
Silvereye	<i>Zosterops lateralis</i>	-	-	[2]	2(2)	-	-	-	-	-	-	-	-	-	-
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	-	-	-	1(1)	-	-	-	-	-	-	-	-	-	-
Nankeen Kestrel	<i>Falco cenchroides</i>	-	-	-	-	-	1(1)	-	-	-	-	-	-	-	-
Crested Tern	<i>Sterna bergii</i>	-	-	-	-	-	1(0)	-	-	-	-	-	-	-	-
Australian White Ibis	<i>Threskiornis molucca</i>	-	-	-	-	-	[1+]	11(11)	27(1)	3(3)[7+]	-	-	1(1)[1+]	-	-
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>	[1+]	-	-	-	-	-	1(0)	2(0)	-	-	-	-	-	-
Little Corella	<i>Cacatua sanguinea</i>	-	-	-	-	-	-	13(0)	15(15)	1(0)[5+]	[40+]	-	-	-	-
Australasian Figbird	<i>Sphecotheres vieilloti</i>	-	-	-	-	-	-	-	-	1(1)	-	-	-	-	-
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>	-	-	-	-	-	-	-	-	4(4)	-	-	-	-	-
Darter	<i>Anhinga melanogaster</i>	-	-	-	-	-	-	-	-	1(1)	-	-	-	-	-
Dusky Moorhen	<i>Gallinula tenebrosa</i>	-	-	-	-	-	-	-	-	4(4)[4+]	-	-	-	-	-
Great Cormorant	<i>Phalacrocorax carbo</i>	-	-	-	-	-	-	-	-	1(1)	-	-	-	-	-
Pacific Black Duck	<i>Anas superciliosa</i>	-	-	-	-	-	-	-	-	6(6)[9+]	-	-	-	-	-
Eastern Rosella	<i>Platycercus adscitus eximius</i>	-	-	-	-	-	-	-	-	-	-	2(2)	-	-	-
Crested Pigeon	<i>Ocyphaps lophotes</i>	-	-	[1+]	-	-	-	-	[3+]	-	-	-	-	-	-
Silver Gull	<i>Larus novaehollandiae</i>	-	-	-	-	[1+]	[3+]	-	-	-	-	-	-	-	-
Little Wattlebird	<i>Anthochaera chrysoptera</i>	-	-	[1+]	-	-	-	[1+]	-	-	-	-	-	-	-

Common Name	Scientific Name	Bronte Park	Calga Reserve	Diamond Bay	Hugh-Bamford Reserve	Hunters Park	Marks Park	York Road	Queens Park North	Queens Park Pond	Tamarama Park	Thomas-Hogan Reserve	Waverley Park	Rodney Reserve	Varna Park
Chestnut Teal	<i>Anas castanea</i>	-	-	-	-	-	-	-	-	[1+]	-	-	-	-	-
Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	-	-	[1+]	-	-	-	-	-	-	-	-	-	-	-
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	-	-	-	-	-	-	-	[5+]	-	-	-	-	-	-
Scaly-breasted Lorikeet	<i>Trichoglossus chlorolepidotus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	[1+]
Tawny Frogmouth	<i>Podargus strigoides</i>	-	-	-	-	-	-	-	-	-	[1*]	-	-	-	-

Reptile species recorded within the Waverley LGA.

N.B. First number is the number recorded during standardised surveys within or outside the quadrat. () = number recorded within the quadrat. [] = opportunistic records. + indicates minimum number recorded.

Common Name	Scientific Name	Bronte Park	Calga Reserve	Diamond Bay	Hugh-Bamford Reserve	Hunters Park	York Road	Queens Park Cliff	Queens Park Pond	Tamarama Park	Thomas-Hogan Reserve	Rodney Reserve
Three-toed Skink	<i>Saiphos equalis</i>	-	-	1(1)[1+]	1(1)	-	-	2(2)	-	1(1)	2(0)	-
Dark-flecked Garden Sunskink	<i>Lampropholis delicata</i>	4(0)	-	2(2)	3(3)	-	1(1)	-	-	-	3(1)	-
Pale-flecked Garden Sunskink	<i>Lampropholis guichenoti</i>	-	-	-	1(1)	-	2(2)	-	-	-	-	-
Cream-striped Shinning-skink	<i>Cryptoblepharus virgatus</i>	-	-	-	2(2)[1+]	-	1(1)	-	-	3(0)[1+]	-	-
Eastern Water-skink	<i>Eulamprus quoyii</i>	-	[1+]	8(6)[3+]	-	[8+]	-	1(1)	-	12(0)[6+]	-	[1+]
Unidentified turtle	-	-	-	-	-	-	-	-	1(1)	-	-	-
Pale-lipped Shadskink	<i>Saproscincus spectabilis</i>	-	-	-	-	-	-	-	-	6(6)	-	-
Weasel Skink	<i>Saproscincus sp.</i>	1(0)	-	-	-	-	-	-	-	-	-	-
Eastern Blue-tongue	<i>Tiliqua scincoides</i>	-	-	-	-	-	-	-	-	1(0)[1+]	-	-
Lesueur's Velvet Gecko	<i>Oedura lesueurii</i>	-	[1+]	4(4)	-	-	-	-	-	-	-	-
Broad-tailed Gecko	<i>Phyllurus platurus</i>	-	-	6(6)[1+]	-	-	-	-	-	2(2)	-	-

Frog species recorded within the Waverley LGA.

N.B. First number is the number recorded during standardised surveys within or outside the quadrat. () = number recorded within the quadrat. [] = opportunistic records. + indicates minimum number recorded.

Common Name	Scientific Name	Bronte Park	Calga Reserve	Diamond Bay	Hugh-Bamford Reserve	Hunters Park	York Road	Queens Park Cliff	Queens Park Pond	Tamarama Park	Rodney Reserve	Thomas-Hogan Reserve	Waverley Park
Eastern Dwarf Tree Frog	<i>Litoria fallax</i>	-	-	-	-	-	-	-	10(10)[6+]	1(0)	-	-	-
Brown-striped Frog	<i>Limnodynastes peronii</i>	-	-	-	-	-	-	-	10(10)[20+]	-	-	-	-
Common Eastern Froglet	<i>Crinia signifera</i>	-	-	-	-	-	-	-	-	-	[1+]	-	-
Bleating Tree Frog	<i>Litoria dentata</i>	-	-	-	-	-	-	-	-	[10+]	-	-	-

Mammal species recorded within the Waverley LGA.

N.B. First number is the number recorded during standardised surveys within or outside the quadrat. () = number recorded within the quadrat. [] = opportunistic records. * = sign of the species recorded (i.e. track, scat, scratches, den, feather etc). + indicates minimum number recorded.

Common Name	Scientific Name	Bronte Park	Calga Reserve	Diamond Bay	Hugh-Bamford Reserve	Hunters Park	York Road	Queens Park Cliff	Queens Park Pond	Tamarama Park	Rodney Reserve	Thomas-Hogan Reserve	Waverley Park
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	1(1)	-	2(2)	-	-	-	1(0)	3(0)[1+]	[1+]	-	-	[1+*]
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	1(1)[1+]	-	-	-	-	3(3)	3(2)	3(1)[6+]	3(3)[1+]	-	3(3)	-
Gould's Wattled Bat	<i>Chalinolobous gouldii</i>	1+	-	1+	1+	-	-	-	1+	-	-	-	-
Eastern Freetail Bat	<i>Mormopterus sp.</i>	-	-	-	1+	-	-	-	-	1+	-	-	-
Cat	<i>Felis catus</i>	-	-	-	-	-	-	-	[1+]	[1+]	-	-	-
Red Fox	<i>Vulpes vulpes</i>	-	-	-	-	-	[1+*]	-	-	-	-	-	-
Dog	<i>Canis lupus familiaris</i>	[1+]	-	[1+]	[1+]	[1+]	-	-	[1+]	[1+]	-	-	-
Brown Rat	<i>Rattus norvegicus</i>	-	-	[1+]	-	-	3(3)	2(2)	1(0)	1(1)	-	-	-

Appendix E: Vertebrate Fauna Database Records

Recent and historical records of fauna from the locality of the Waverley LGA.

TSC / EPBC Act codes: V = vulnerable, E = endangered, CE = critically endangered, M = migratory (EPBC Act only). A=Current survey; B=NPWS Atlas within LGA; C=NPWS Atlas within 5km of LGA; D=WIRES within LGA; E=Birds Australia within 5km; F=Previous reports.

Common name	Scientific name	TSC Act	EPBC Act	A	B	C	D	E	F
FROGS									
Common Eastern Froglet	<i>Crinia signifera</i>	-	-	✓		✓			✓
Eastern Banjo Frog	<i>Limnodynastes dumerilii</i>	-	-			✓			
Brown-striped Frog	<i>Limnodynastes peronii</i>	-	-	✓		✓			✓
Red-crowned Toadlet	<i>Pseudophryne australis</i>	V	-			✓			
Green and Golden Bell Frog	<i>Litoria aurea</i>	E	V			✓			
Green Tree Frog	<i>Litoria caerulea</i>	-	-			✓			
Bleating Tree Frog	<i>Litoria dentata</i>	-	-	✓					
Eastern Dwarf Tree Frog	<i>Litoria fallax</i>	-	-	✓		✓			
Jervis Bay Tree Frog	<i>Litoria jervisiensis</i>	-	-			✓			
Peron's Tree Frog	<i>Litoria peronii</i>	-	-			✓			
REPTILES									
Eastern Snake-necked Turtle	<i>Chelodina longicollis</i>	-	-			✓	✓		
Murray Tortoise	<i>Emydura macquarii</i>	-	-				✓		
Wood Gecko	<i>Diplodactylus vittatus</i>	-	-			✓			
Lesueur's Velvet Gecko	<i>Oedura lesueurii</i>	-	-	✓		✓			✓
Broad-tailed Gecko	<i>Phyllurus platurus</i>	-	-	✓		✓	✓		✓
Thick-tailed Gecko	<i>Underwoodisaurus milii</i>	-	-			✓			
Burton's Snake-lizard	<i>Lialis burtonis</i>	-	-		✓	✓			
Common Scaly-foot	<i>Pygopus lepidopus</i>	-	-		✓	✓			
Jacky Lizard	<i>Amphibolurus muricatus</i>	-	-			✓			
Eastern Water Dragon	<i>Physignathus lesueurii</i>	-	-			✓	✓		
Bearded Dragon	<i>Pogona barbata</i>	-	-			✓	✓		
Lace Monitor	<i>Varanus varius</i>	-	-			✓			
Cream-striped Shinning-skink	<i>Cryptoblepharus virgatus</i>	-	-	✓		✓	✓		✓
Robust Ctenotus	<i>Ctenotus robustus</i>	-	-			✓			
Copper-tailed Skink	<i>Ctenotus taeniolatus</i>	-	-			✓			
Mainland She-oak Skink	<i>Cyclodomorphus michaeli</i>	-	-			✓			
Eastern Water-skink	<i>Eulamprus quoyii</i>	-	-	✓		✓			✓
Barred-sided Skink	<i>Eulamprus tenuis</i>	-	-			✓			
Dark-flecked Garden Sunskink	<i>Lampropholis delicata</i>	-	-	✓		✓			✓
Pale-flecked Garden Sunskink	<i>Lampropholis guichenoti</i>	-	-	✓		✓			✓
Three-toed Skink	<i>Saiphos equalis</i>	-	-	✓		✓			✓
Weasel Skink	<i>Saproscincus mustelinus</i>	-	-	✓		✓			✓
Pale-lipped Shadeskink	<i>Saproscincus spectabilis</i>	-	-	✓					✓

Common name	Scientific name	TSC Act	EPBC Act	A	B	C	D	E	F
Eastern Blue-tongue	<i>Tiliqua scincoides</i>	-	-	✓		✓	✓		✓
Proximus Blind Snake	<i>Ramphotyphlops proximus</i>	-	-			✓			
Diamond Python	<i>Morelia spilota spilota</i>	-	-			✓	✓		
Brown Tree Snake	<i>Boiga irregularis</i>	-	-			✓			
Common Tree Snake	<i>Dendrelaphis punctulatus</i>	-	-			✓	✓		
Golden-crowned Snake	<i>Cacophis squamulosus</i>	-	-			✓			
Yellow-faced Whip Snake	<i>Demansia psammophis</i>	-	-			✓			
Red-naped Snake	<i>Furina diadema</i>	-	-		✓	✓			
Tiger Snake	<i>Notechis scutatus</i>	-	-			✓			
Dwyer's Snake	<i>Parasuta dwyeri</i>	-	-			✓			
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>	-	-			✓	✓		
Eastern Brown Snake	<i>Pseudonaja textilis</i>	-	-			✓	✓		
Bandy-bandy	<i>Vermicella annulata</i>	-	-			✓			
BIRDS									
King Quail	<i>Coturnix chinensis</i>	-	-			✓	✓		
Stubble Quail	<i>Coturnix pectoralis</i>	-	-			✓		✓	
Brown Quail	<i>Coturnix ypsilophora</i>	-	-			✓		✓	
Indian Peafowl	<i>Pavo cristatus</i>	-	-				✓		
Magpie Goose	<i>Anseranas semipalmata</i>	V	-			✓			
Chestnut Teal	<i>Anas castanea</i>	-	-	✓		✓	✓	✓	
Grey Teal	<i>Anas gracilis</i>	-	-			✓		✓	
Mallard	<i>Anas platyrhynchos</i>	-	-			✓		✓	
Pacific Black Duck	<i>Anas superciliosa</i>	-	-	✓		✓	✓	✓	
Hardhead	<i>Aythya australis</i>	-	-			✓		✓	
Musk Duck	<i>Biziura lobata</i>	-	-			✓	✓	✓	
Australian Wood Duck	<i>Chenonetta jubata</i>	-	-			✓	✓	✓	
Black Swan	<i>Cygnus atratus</i>	-	-			✓	✓	✓	
Mute Swan	<i>Cygnus olor</i>	-	-			✓			
Wandering Whistling-Duck	<i>Dendrocygna arcuata</i>	-	-					✓	
Freckled Duck	<i>Stictonetta naevosa</i>	V	-					✓	
Australian Shelduck	<i>Tadorna tadornoides</i>	-	-					✓	
Pink-eared Duck	<i>Malacorhynchus membranaceus</i>	-	-			✓		✓	
Great Crested Grebe	<i>Podiceps cristatus</i>	-	-			✓		✓	
Hoary-headed Grebe	<i>Poliiocephalus poliocephalus</i>	-	-			✓		✓	
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>	-	-	✓		✓	✓	✓	
Darter	<i>Anhinga melanogaster</i>	-	-	✓		✓		✓	
Great Cormorant	<i>Phalacrocorax carbo</i>	-	-	✓	✓	✓	✓	✓	
Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>	-	-		✓	✓	✓	✓	
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	-	-		✓	✓	✓	✓	
Pied Cormorant	<i>Phalacrocorax varius</i>	-	-			✓	✓	✓	
Australian Pelican	<i>Pelecanus conspicillatus</i>	-	-			✓	✓	✓	

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Great Egret	<i>Ardea alba</i>	-	M			✓	✓	✓	
Intermediate Egret	<i>Ardea intermedia</i>	-	-			✓		✓	
White-necked Heron	<i>Ardea pacifica</i>	-	-			✓	✓	✓	
Australasian Bittern	<i>Botaurus poiciloptilus</i>	V	-			✓		✓	
Cattle Egret	<i>Bubulcus ibis</i>	-	M			✓	✓	✓	
Striated Heron	<i>Butorides striatus</i>	-	-			✓		✓	
Little Egret	<i>Egretta garzetta</i>	-	-			✓	✓		
White-faced Heron	<i>Egretta novaehollandiae</i>	-	-			✓		✓	
Eastern Reef Egret	<i>Egretta sacra</i>	-	M			✓		✓	
Black Bittern	<i>Ixobrychus flavicollis</i>	V	-					✓	
Little Bittern	<i>Ixobrychus minutus</i>	-	-			✓		✓	
Nankeen Night Heron	<i>Nycticorax caledonicus</i>	-	-			✓		✓	
Yellow-billed Spoonbill	<i>Platalea flavipes</i>	-	-			✓			
Royal Spoonbill	<i>Platalea regia</i>	-	-			✓		✓	
Australian White Ibis	<i>Threskiornis molucca</i>	-	-	✓		✓	✓	✓	
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	-	-			✓		✓	
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>	-	-			✓		✓	
Brown Goshawk	<i>Accipiter fasciatus</i>	-	-			✓		✓	
Grey Goshawk	<i>Accipiter novaehollandiae</i>	-	-			✓			
Wedge-tailed Eagle	<i>Aquila audax</i>	-	-					✓	
Swamp Harrier	<i>Circus approximans</i>	-	-			✓		✓	
Black-shouldered Kite	<i>Elanus axillaris</i>	-	-		✓	✓		✓	
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	-	M		✓	✓		✓	
Whistling Kite	<i>Haliastur sphenurus</i>	-	-			✓		✓	
Little Eagle	<i>Hieraaetus morphnoides</i>	V	-			✓			
Osprey	<i>Pandion haliaetus</i>	V	M			✓			
Brown Falcon	<i>Falco berigora</i>	-	-			✓		✓	
Nankeen Kestrel	<i>Falco cenchroides</i>	-	-	✓	✓	✓	✓	✓	
Australian Hobby	<i>Falco longipennis</i>	-	-			✓		✓	
Peregrine Falcon	<i>Falco peregrinus</i>	-	-			✓	✓	✓	
Eurasian Coot	<i>Fulica atra</i>	-	-			✓		✓	
Dusky Moorhen	<i>Gallinula tenebrosa</i>	-	-	✓		✓		✓	
Buff-banded Rail	<i>Gallirallus philippensis</i>	-	-			✓	✓	✓	
Lewin's Rail	<i>Lewinia pectoralis</i>	-	-			✓		✓	
Purple Swamphen	<i>Porphyrio porphyrio</i>	-	-			✓	✓	✓	
Australian Spotted Crane	<i>Porzana fluminea</i>	-	-			✓		✓	
Baillon's Crane	<i>Porzana pusilla</i>	-	-			✓		✓	
Spotless Crane	<i>Porzana tabuensis</i>	-	-			✓		✓	
Painted Button-quail	<i>Turnix varia</i>	-	-				✓		
Little Button-quail	<i>Turnix velox</i>	-	-			✓			
Ruddy Turnstone	<i>Arenaria interpres</i>	-	M			✓			
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	-	M			✓		✓	
Pectoral Sandpiper	<i>Calidris melanotos</i>	-	M			✓			
Red-necked Stint	<i>Calidris ruficollis</i>	-	M			✓			

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Latham's Snipe	<i>Gallinago hardwickii</i>	-	M			✓		✓	
Bar-tailed Godwit	<i>Limosa lapponica</i>	-	M			✓		✓	
Little Curlew	<i>Numenius minutus</i>	-	M			✓			
Common Greenshank	<i>Tringa nebularia</i>	-	M			✓			
Marsh Sandpiper	<i>Tringa stagnatilis</i>	-	M			✓			
Black-winged Stilt	<i>Himantopus himantopus</i>	-	-			✓		✓	
Double-banded Plover	<i>Charadrius bicinctus</i>	-	M			✓	✓	✓	
Red-capped Plover	<i>Charadrius ruficapillus</i>	-	-			✓		✓	
Black-fronted Dotterel	<i>Elseya melanops</i>	-	-			✓		✓	
Red-kneed Dotterel	<i>Erythrogonys cinctus</i>	-	-			✓			
Masked Lapwing	<i>Vanellus miles</i>	-	-			✓	✓	✓	
Banded Lapwing	<i>Vanellus tricolor</i>	-	-			✓			
Whiskered Tern	<i>Chlidonias hybridus</i>	-	-			✓			
Silver Gull	<i>Larus novaehollandiae</i>	-	-	✓	✓	✓	✓	✓	
White-headed Pigeon	<i>Columba leucomela</i>	-	-			✓			
Rock Dove	<i>Columba livia</i>	-	-	✓	✓	✓	✓	✓	
Bar-shouldered Dove	<i>Geopelia humeralis</i>	-	-			✓		✓	
Peaceful Dove	<i>Geopelia placida</i>	-	-			✓		✓	
Wonga Pigeon	<i>Leucosarcia melanoleuca</i>	-	-			✓			
Topknot Pigeon	<i>Lopholaimus antarcticus</i>	-	-			✓	✓	✓	
Brown Cuckoo-Dove	<i>Macropygia amboinensis</i>	-	-			✓			
Crested Pigeon	<i>Ocyphaps lophotes</i>	-	-	✓		✓	✓	✓	
Superb Fruit-Dove	<i>Ptilinopus superbus</i>	V	-			✓	✓	✓	
Spotted Turtle-Dove	<i>Streptopelia chinensis</i>	-	-			✓	✓	✓	
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	-	-	✓	✓	✓	✓	✓	
Little Corella	<i>Cacatua sanguinea</i>	-	-	✓		✓		✓	
Long-billed Corella	<i>Cacatua tenuirostris</i>	-	-			✓	✓	✓	
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	-	-	✓		✓		✓	
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	V	-			✓		✓	
Galah	<i>Eolophus roseicapillus</i>	-	-			✓	✓	✓	
Australian King-Parrot	<i>Alisterus scapularis</i>	-	-			✓	✓	✓	
Red-winged Parrot	<i>Aprosmictus erythropterus</i>	-	-			✓			
Australian Ringneck	<i>Barnardius zonarius</i>	-	-			✓	✓	✓	
Little Lorikeet	<i>Glossopsitta pusilla</i>	V	-			✓			
Musk Lorikeet	<i>Glossopsitta concinna</i>	-	-					✓	
Swift Parrot	<i>Lathamus discolor</i>	E	E			✓			
Budgerigar	<i>Melopsittacus undulatus</i>	-	-			✓	✓		
Orange-bellied Parrot	<i>Neophema chrysogaster</i>	CE	CE			✓			
White Cheeked Rosella	<i>Platycercus adscitus</i>	-	-			✓			
Eastern Rosella	<i>Platycercus adscitus eximius</i>	-	-	✓		✓	✓	✓	
Crimson Rosella	<i>Platycercus elegans</i>	-	-			✓	✓		
Western Rosella	<i>Platycercus icterotis</i>	-	-			✓			

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Red-rumped Parrot	<i>Psephotus haematonotus</i>	-	-			✓		✓	
Scaly-breasted Lorikeet	<i>Trichoglossus chlorolepidotus</i>	-	-	✓		✓	✓		
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	-	-	✓		✓	✓	✓	
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>	-	-			✓	✓	✓	
Brush Cuckoo	<i>Cacomantis variolosus</i>	-	-			✓			
Horsfield's Bronze-Cuckoo	<i>Chalcites basalis</i>	-	-			✓		✓	
Shining Bronze-Cuckoo	<i>Chalcites lucidus</i>	-	-			✓	✓	✓	
Pallid Cuckoo	<i>Cuculus pallidus</i>	-	-			✓		✓	
Pacific Koel	<i>Eudynamys orientalis</i>	-	-	✓		✓	✓	✓	
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>	-	-	✓		✓	✓	✓	
Pheasant Coucal	<i>Centropus phasianinus</i>	-	-			✓			
Southern Boobook	<i>Ninox boobook</i>	-	-			✓	✓	✓	
Barking Owl	<i>Ninox connivens</i>	V	-			✓			
Powerful Owl	<i>Ninox strenua</i>	V	-			✓	✓	✓	
Barn Owl	<i>Tyto alba</i>	-	-			✓	✓		
Masked Owl	<i>Tyto novaehollandiae</i>	V	-					✓	
Tawny Frogmouth	<i>Podargus strigoides</i>	-	-	✓		✓	✓	✓	
Fork-tailed Swift	<i>Apus pacificus</i>	-	M			✓		✓	
White-throated Needletail	<i>Hirundapus caudacutus</i>	-	M			✓			
Azure Kingfisher	<i>Ceyx azureus</i>	-	-			✓			
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	-	-	✓	✓	✓	✓	✓	
Sacred Kingfisher	<i>Todiramphus sanctus</i>	-	-			✓	✓	✓	
Dollarbird	<i>Eurystomus orientalis</i>	-	-			✓		✓	
Noisy Pitta	<i>Pitta versicolor</i>	-	-		✓	✓			
White-throated Treecreeper	<i>Cormobates leucophaeus</i>	-	-					✓	
Superb Fairy-wren	<i>Malurus cyaneus</i>	-	-	✓		✓	✓	✓	
Variegated Fairy-wren	<i>Malurus lamberti</i>	-	-			✓		✓	
Southern Emu-wren	<i>Stipiturus malachurus</i>	-	-			✓		✓	
Spotted Pardalote	<i>Pardalotus punctatus</i>	-	-			✓	✓	✓	
Striated Pardalote	<i>Pardalotus striatus</i>	-	-			✓		✓	
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	-	-	✓		✓		✓	
Striated Thornbill	<i>Acanthiza lineata</i>	-	-			✓		✓	
Yellow Thornbill	<i>Acanthiza nana</i>	-	-			✓		✓	
Brown Thornbill	<i>Acanthiza pusilla</i>	-	-			✓		✓	
Brown Gerygone	<i>Gerygone mouki</i>	-	-			✓		✓	
White-throated Gerygone	<i>Gerygone olivacea</i>	-	-			✓			
Rockwarbler	<i>Origma solitaria</i>	-	-			✓			
White-browed Scrubwren	<i>Sericornis frontalis</i>	-	-			✓		✓	
Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>	-	-			✓			
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	-	-		✓	✓		✓	
Red Wattlebird	<i>Anthochaera carunculata</i>	-	-	✓		✓	✓	✓	
Little Wattlebird	<i>Anthochaera chrysoptera</i>	-	-	✓		✓	✓	✓	

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White-fronted Chat	<i>Epthianura albifrons</i>	V	-			✓			
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	-	-		✓	✓	✓	✓	
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	-	-			✓	✓	✓	
Noisy Miner	<i>Manorina melanocephala</i>	-	-	✓		✓	✓	✓	
Bell Miner	<i>Manorina melanophrys</i>	-	-					✓	
Lewin's Honeyeater	<i>Meliphaga lewinii</i>	-	-			✓		✓	
White-naped Honeyeater	<i>Melithreptus lunatus</i>	-	-			✓			
Brown Honeyeater	<i>Lichmera indistincta</i>	-	-					✓	
Noisy Friarbird	<i>Philemon corniculatus</i>	-	-			✓		✓	
White-cheeked Honeyeater	<i>Phylidonyris niger</i>	-	-			✓		✓	
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>	-	-	✓		✓	✓	✓	
Eastern Yellow Robin	<i>Eopsaltria australis</i>	-	-			✓	✓	✓	
Jacky Winter	<i>Microeca fascinans</i>	-	-			✓			
Scarlet Robin	<i>Petroica boodang</i>	V	-			✓			
Red-capped Robin	<i>Petroica goodenovii</i>	-	-				✓		
Rose Robin	<i>Petroica rosea</i>	-	-			✓			
Eastern Whipbird	<i>Psophodes olivaceus</i>	-	-			✓		✓	
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	-	-			✓		✓	
Golden Whistler	<i>Pachycephala pectoralis</i>	-	-			✓	✓	✓	
Rufous Whistler	<i>Pachycephala rufiventris</i>	-	-			✓		✓	
Spangled Drongo	<i>Dicrurus bracteatus</i>	-	-			✓	✓	✓	
Magpie-lark	<i>Grallina cyanoleuca</i>	-	-	✓		✓	✓	✓	
Black-faced Monarch	<i>Monarcha melanopsis</i>	-	M			✓	✓	✓	
Spectacled Monarch	<i>Monarcha trivirgatus</i>	-	M			✓			
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	-	M			✓			
Restless Flycatcher	<i>Myiagra inquieta</i>	-	-			✓		✓	
Leaden Flycatcher	<i>Myiagra rubecula</i>	-	-			✓			
Grey Fantail	<i>Rhipidura albiscapa</i>	-	-			✓		✓	
Willie Wagtail	<i>Rhipidura leucophrys</i>	-	-	✓		✓	✓	✓	
Rufous Fantail	<i>Rhipidura rufifrons</i>	-	M		✓	✓	✓		
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	-	-	✓		✓	✓	✓	
White-winged Triller	<i>Lalage tricolor</i>	-	-			✓		✓	
Olive-backed Oriole	<i>Oriolus sagittatus</i>	-	-			✓		✓	
Australasian Figbird	<i>Sphecotheres vieilloti</i>	-	-	✓	✓	✓	✓	✓	
Dusky Woodswallow	<i>Artamus cyanopterus</i>	-	-			✓			
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>	-	-			✓			
Masked Woodswallow	<i>Artamus personatus</i>	-	-			✓			
Pied Butcherbird	<i>Cracticus nigrogularis</i>	-	-			✓			
Australian Magpie	<i>Cracticus tibicen</i>	-	-	✓		✓	✓	✓	
Grey Butcherbird	<i>Cracticus torquatus</i>	-	-	✓	✓	✓	✓	✓	
Pied Currawong	<i>Strepera graculina</i>	-	-	✓		✓	✓	✓	
Australian Raven	<i>Corvus coronoides</i>	-	-	✓		✓	✓	✓	
Little Raven	<i>Corvus mellori</i>	-	-					✓	

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Eurasian Skylark	<i>Alauda arvensis</i>	-	-			✓		✓	
Australian Pipit	<i>Anthus australis</i>	-	-			✓		✓	
House Sparrow	<i>Passer domesticus</i>	-	-	✓		✓	✓	✓	
European Goldfinch	<i>Carduelis carduelis</i>	-	-			✓		✓	
European Greenfinch	<i>Carduelis chloris</i>	-	-			✓		✓	
Chestnut-breasted Mannikin	<i>Lonchura castaneothorax</i>	-	-			✓			
Nutmeg Mannikin	<i>Lonchura punctulata</i>	-	-			✓			
Crimson Finch	<i>Neochmia phaeton</i>	-	-			✓			
Red-browed Finch	<i>Neochmia temporalis</i>	-	-			✓		✓	
Diamond Firetail	<i>Stagonopleura guttata</i>	V	-			✓			
Double-barred Finch	<i>Taeniopygia bichenovii</i>	-	-			✓		✓	
Zebra Finch	<i>Taeniopygia guttata</i>	-	-			✓	✓		
Mistletoebird	<i>Dicaeum hirundinaceum</i>	-	-			✓			
Welcome Swallow	<i>Hirundo neoxena</i>	-	-	✓	✓	✓	✓	✓	
Fairy Martin	<i>Petrochelidon ariel</i>	-	-			✓	✓	✓	
Tree Martin	<i>Petrochelidon nigricans</i>	-	-			✓		✓	
Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	-	-	✓		✓	✓	✓	
Australian Reed-Warbler	<i>Acrocephalus australis</i>	-	-			✓		✓	
Little Grassbird	<i>Megalurus gramineus</i>	-	-			✓		✓	
Tawny Grassbird	<i>Megalurus timoriensis</i>	-	-			✓		✓	
Golden-headed Cisticola	<i>Cisticola exilis</i>	-	-			✓		✓	
Silvereeye	<i>Zosterops lateralis</i>	-	-	✓		✓	✓	✓	
Eurasian Blackbird	<i>Turdus merula</i>	-	-			✓		✓	
Russet-tailed Thrush	<i>Zoothera heinei</i>	-	-			✓			
Common Myna	<i>Sturnus tristis</i>	-	-	✓	✓	✓	✓	✓	
Common Starling	<i>Sturnus vulgaris</i>	-	-	✓	✓	✓	✓	✓	
Yellow Wagtail species	<i>Motacilla sp.</i>	-	M					✓	
MAMMALS									
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>	-	-			✓			
Brown Antechinus	<i>Antechinus stuartii</i>	-	-			✓			
Long-nosed Bandicoot	<i>Perameles nasuta</i>	-	-			✓			
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	-	-			✓	✓		
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	-	-	✓	✓	✓	✓		
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	-	-				✓		
Black Flying-fox	<i>Pteropus alecto</i>	-	-			✓			
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	-	✓		✓	✓		
Little Red Flying-fox	<i>Pteropus scapulatus</i>	-	-			✓			
White-striped Freetail-bat	<i>Tadarida australis</i>	-	-			✓			
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	-	-	✓		✓	✓		
Eastern Freetail Bat	<i>Mormopterus sp.</i>	-	-	✓					
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	V	-			✓			
Southern Myotis	<i>Myotis macropus</i>	V	-			✓			
Gould's Long-Eared Bat	<i>Nyctophilus gouldi</i>	-	-				✓		

Common name	Scientific name	TSC Act	EPBC Act	A	B	C	D	E	F
Yellow-Bellied Sheath-tail-Bat	<i>Saccolaimus flaviventris</i>	V	-				✓		
Water-rat	<i>Hydromys chrysogaster</i>	-	-			✓			
House Mouse	<i>Mus musculus</i>	-	-			✓			
Bush Rat	<i>Rattus fuscipes</i>	-	-				✓		
Brown Rat	<i>Rattus norvegicus</i>	-	-	✓			✓		
Black Rat	<i>Rattus rattus</i>	-	-			✓	✓		
Rabbit	<i>Oryctolagus cuniculus</i>	-	-			✓			
Fox	<i>Vulpes vulpes</i>	-	-	✓		✓			
Cat	<i>Felis catus</i>	-	-	✓		✓			
Dog	<i>Canus lupis domesticus</i>	-	-	✓					

Marine species and other fauna records not included in the total counts.

A=Current survey; B=NPWS Atlas within LGA; C=NPWS Atlas within 5km of LGA; D=WIRES within LGA; E=Birds Australia within 5km; F=Previous reports.

Common name	Scientific name	A	B	C	D	E	F
Green Turtle	<i>Chelonia mydas</i>	-	✓	✓	-	-	-
Dugong	<i>Dugong dugon</i>	-	-	✓	-	-	-
Dwarf Minke Whale	<i>Balaenoptera acutorostrata</i>	-	-	✓	-	-	-
Humpback Whale	<i>Megaptera novaeangliae</i>	-	-	✓	-	-	-
Unidentified Whale	<i>Whale sp.</i>	-	✓	✓	-	-	-
Southern Right Whale	<i>Eubalaena australis</i>	-	-	✓	-	-	-
Pygmy Sperm Whale	<i>Kogia breviceps</i>	-	✓	✓	-	-	-
Strap-toothed Beaked Whale	<i>Mesoplodon layardii</i>	-	✓	✓	-	-	-
Common Dolphin	<i>Delphinus delphis</i>	-	✓	✓	-	-	-
Unidentified Dolphin	<i>Dolphin sp.</i>	-	✓	✓	-	-	-
Spotted Dolphin	<i>Stenella attenuata</i>	-	-	✓	-	-	-
Bottlenose Dolphin	<i>Tursiops truncatus</i>	-	-	✓	-	-	-
New Zealand Fur-seal	<i>Arctocephalus forsteri</i>	-	✓	✓	-	-	-
Australian Fur-seal	<i>Arctocephalus pusillus doriferus</i>	-	✓	✓	-	-	-
Unidentified Fur-seal	<i>Arctocephalus sp.</i>	-	✓	✓	-	-	-
Subantarctic Fur-seal	<i>Arctocephalus tropicalis</i>	-	✓	✓	-	-	-
Australian Sea-lion	<i>Neophoca cinerea</i>	-	-	✓	-	-	-
Unidentified Seal	<i>Seal sp.</i>	-	✓	✓	-	-	-
Leopard Seal	<i>Hydrurga leptonyx</i>	-	✓	✓	✓	-	-
Southern Elephant Seal	<i>Mirounga leonina</i>	-	-	✓	-	-	-
Little Penguin	<i>Eudyptula minor</i>	-	✓	✓	✓	-	-
Wilson's Storm-Petrel	<i>Oceanites oceanicus</i>	-	-		✓	-	-
Southern Giant Petrel	<i>Macronectes giganteus</i>	-	-	✓	✓	-	-
Northern Giant-Petrel	<i>Macronectes halli</i>	-	-	✓	-	-	-
Fairy Prion	<i>Pachyptila turtur</i>	-	-	✓	-	-	-
White-chinned Petrel	<i>Procellaria aequinoctialis</i>	-	-	✓	-	-	-
Gould's Petrel	<i>Pterodroma leucoptera leucoptera</i>	-	-	✓	-	-	-
Great-winged Petrel	<i>Pterodroma macroptera</i>	-	-	✓	-	-	-
Soft-plumaged Petrel	<i>Pterodroma mollis</i>	-	-	✓	-	-	-

Common name	Scientific name	A	B	C	D	E	F
Buller's Shearwater	<i>Puffinus bulleri</i>	-	-	✓	-	-	-
Flesh-footed Shearwater	<i>Puffinus carneipes</i>	-	-	✓	-	-	-
Fluttering Shearwater	<i>Puffinus gavia</i>	-	-	✓	✓	-	-
Wedge-tailed Shearwater	<i>Puffinus pacificus</i>	-	-	✓	✓	-	-
Short-tailed Shearwater	<i>Puffinus tenuirostris</i>	-	-	✓	✓	-	-
Wandering Albatross	<i>Diomedea exulans</i>	-	-	✓	-	-	-
Sooty Albatross	<i>Phoebastria fusca</i>	-	-		-	-	-
Shy Albatross	<i>Thalassarche cauta</i>	-	-	✓	-	-	-
Yellow-nosed Albatross	<i>Thalassarche chlororhynchos</i>	-	-	✓	-	-	-
Grey-headed Albatross	<i>Thalassarche chrysostoma</i>	-	-		-	-	-
Black-browed Albatross	<i>Thalassarche melanophris</i>	-	-	✓	-	-	-
White-faced Storm-Petrel	<i>Pelagodroma marina</i>	-	-	✓	-	-	-
White-tailed Tropicbird	<i>Phaethon lepturus</i>	-	-	✓	-	-	-
Australasian Gannet	<i>Morus serrator</i>	-	✓	✓	✓	-	-
Sooty Tern	<i>Sterna fuscata</i>	-	-	✓	✓	-	-
Common Tern	<i>Sterna hirundo</i>	-	-	✓	-	-	-
White-fronted Tern	<i>Sterna striata</i>	-	✓	✓	-	-	-
Great Skua	<i>Catharacta skua</i>	-	-	✓	-	-	-
Long-tailed Jaeger	<i>Stercorarius longicaudus</i>	-	-	✓	-	-	-
Arctic Jaeger	<i>Stercorarius parasiticus</i>	-	-	✓	-	-	-
Pomarine Jaeger	<i>Stercorarius pomarinus</i>	-	-	✓	-	-	-
Pacific Gull	<i>Larus pacificus</i>	-	-	✓	✓	-	-
Little Tern	<i>Sterna albifrons</i>	-	-	✓	-	-	-
Crested Tern	<i>Sterna bergii</i>	✓	✓	✓	✓	-	-
Caspian Tern	<i>Sterna caspia</i>	-	-	✓	-	-	-
Grey Plover	<i>Pluvialis squatarola</i>	-	-	✓	✓	✓	-
Sooty Oystercatcher	<i>Haematopus fuliginosus</i>	-	-	✓	-	-	-
Pied Oystercatcher	<i>Haematopus longirostris</i>	-	-	✓	-	-	-
Upland Sandpiper	<i>Bartramia longicauda</i>	-	-	✓	-	-	-
Whimbrel	<i>Numenius phaeopus</i>	-	-	✓	-	-	-
Cockatiel	<i>Nymphicus hollandicus</i>	-	-	-	✓	-	-
Major Mitchell's Cockatoo	<i>Cacatua leadbeateri</i>	-	-	-	✓	-	-
Blotched Blue-Tongued Lizard	<i>Tiliqua nigrolutea</i>	-	-	-	✓	-	-
Eastern Hooded Scaly-foot	<i>Pygopus schraderi</i>	-	-	✓	-	-	-
Elegant Seasnake	<i>Hydrophis elegans</i>	-	-	✓	-	-	-
Shingle-back	<i>Tiliqua rugosa</i>	-	-	✓	-	-	-
Yellow-Bellied Sea Snake	<i>Pelamis platurus</i>	-	-	-	✓	-	-
New Holland Mouse	<i>Pseudomys novaehollandiae</i>	-	-	-	✓	-	-
Yellow-Footed Antechinus	<i>Antechinus flaviepes</i>	-	-	-	✓	-	-
Red Kangaroo	<i>Macropus rufus</i>	-	-	-	✓	-	-
Common Wombat	<i>Vombatus ursinus</i>	-	-	-	✓	-	-

Appendix F: Site Habitat Data

Queens Park North	
Date of survey	16/12/2009
Easting	56 337984
Northing	6247515
Community type	Parkland
Litter cover	0-5%
Litter depth	1-3cm
Grass cover	25-50%
Grass height	0-10cm / mown
Dominant ground species	Exotic
Bare soil	5-25%
Logs	1
Large rocks	5-25%
Shrub cover	25-50%
Dominant species	<i>Acacia longifolia</i> <i>Monotoca elliptica</i> <i>Leptospermum laevigatum</i>
Canopy cover	25-50%
Dominant species	<i>Ficus rubiginosa</i> (Port Jackson Fig) <i>Lophostemon confertus</i>
Large dead trees	0
Tree hollows	0
Waterbodies	0
Size/depth	N/A
Level of disturbance	High
Area of vegetation	Approximately 1.5 hectares



Plate 13: North-east of the site, looking west.
Photo: Mark Semeniuk (AMBS).



Plate 14: Interior of the site. Photo: Mark Semeniuk (AMBS).

Bronte Park	
Date of Survey	15/12/2009
Easting	56 339435
Northing	6247363
Community type	Parkland, native plantings / weeds
Litter cover	25-50%
Litter depth	0-1cm
Grass cover	25-50%
Grass height	0-5cm / mown
Dominant ground species	<i>Ipomoea indica</i> (Morning Glory) <i>Tropaeolum majus</i> (Nasturtium) <i>Tradescantia fluminensis</i> (Wandering Jew) <i>Ageratina adenophora</i> (Crofton Weed)
Bare soil	0-5%
Logs	5
Large rocks	5
Shrub cover	5-25%
Dominant ground species	<i>Lantana camara</i> (Lantana) <i>Ailanthus altissima</i> (Tree of heaven)
Canopy cover	75-100%
Dominant species	<i>Jacaranda mimosifolia</i> (Jacaranda) <i>Erythrina crista-galli</i> (Coral tree) <i>Ficus macrophylla</i> (Moreton Bay Fig) <i>Cinnamoni camphora</i> (Camphor Laurel) <i>Melaleuca quinquenervia</i> (Broad-leaved Paperbark) <i>Eucalyptus pilularis</i> (Blackbutt)
Large dead trees	0
Tree hollows	1 (Coral Trees)
Waterbodies	Sandstone creek / concrete stormwater channel
Size/depth	Creek ~100m long, shallow, slow flowing, deeper pool at bottom. Concrete channel ~150m long.
Level of disturbance	Medium
Area of vegetation	Approximately 4 hectares



Plate 15: North slope. Photo: Mark Semeniuk (AMBS).



Plate 16: Bottom of gully (western side), looking east. Photo: Mark Semeniuk (AMBS).



Plate 17: South slope. Photo: Mark Semeniuk (AMBS).



Plate 18: Bottom of gully (eastern side), looking east. Photo: Mark Semeniuk (AMBS).



Plate 19: Top of south slope, bush regeneration area. Photo: Mark Semeniuk (AMBS)

Waverley Park	
Date of Survey	15/12/2009
Easting	56 338814
Northing	6248232
Community type	Parkland
Litter cover	25-50%
Litter depth	0-1cm
Grass cover	25-50%
Grass height	0-5cm / mown
Dominant ground species	<i>Ehrharta erecta</i> (Panic Veldtgrass)
Bare soil	5-25%
Logs	0
Large rocks	0
Shrub cover	0-5%
Dominant species	<i>Leptospermum laevigatum</i> (Coast Tea-tree) <i>Callistemon sp.</i>
Canopy cover	50-75%
Dominant species	<i>Banksia Integrifolia</i> (Coast Banksia) <i>Pinus radiata</i> (Radiata Pine) <i>Araucaria heterophylla</i> (Norfolk Island Pine) <i>Casuarina sp.</i>
Large dead trees	0
Tree hollows	0
Waterbodies	0
Size/depth	N/A
Level of disturbance	High
Area of vegetation	Approximately 2.5 hectares



Plate 20: Northern area of Waverley Park. Photo: Mark Semeniuk (AMBS).



Plate 21: Southern area of Waverley Park. Photo: Mark Semeniuk (AMBS).

Thomas Hogan Reserve	
Date of Survey	15/12/2009
Easting	56 339371
Northing	6248802
Community type	Parkland
Litter cover	5-25%
Litter depth	0-3cm
Grass cover	25-50%
Grass height	0-5cm / mown
Dominant ground species	<i>Tradescantia fluminensis</i> (Wandering Jew) <i>Chlorophytum comosum</i> (Spider Plant) <i>Ipomoea indica</i> (Morning Glory)
Bare soil	0-5%
Logs	1
Large rocks	5
Shrub cover	0-5%
Dominant species	None.
Canopy cover	75-100%
Dominant species	<i>Cinnamoni camphora</i> (Camphor Laurel) <i>Phoenix canariensis</i> (Canary Island Palm) <i>Erythrina crista-galli</i> (Cockspur Coral Tree)
Large dead trees	0
Tree hollows	0
Waterbodies	0
Size/depth	N/A
Level of disturbance	High
Area of vegetation	Approximately 1 hectare



Plate 22: Eastern area of the site.
Photo: Mark Semeniuk (AMBS).



Plate 23: Northern slope of the site.
Photo: Mark Semeniuk (AMBS).



Plate 24: Southern slope of the site. Photo: Mark Semeniuk (AMBS).

Diamond Bay	
Date of Survey	16/12/2009
Easting	56 341081
Northing	6251916
Community type	Sea-cliff remnant (heath and sedgeland), rock platforms / parkland
Litter cover	0-5%
Litter depth	0-1cm
Grass cover	5-25%
Grass height	0-10cm
Dominant ground species	<i>Imperata cylindrica</i> (Blady Grass) <i>Tropaeolum majus</i> (Nasturtium) <i>Ipomoea indica</i> (Morning Glory) <i>Ageratina adenophora</i> (Crofton Weed).
Bare soil	0-5%
Logs	0
Large rocks	~30
Shrub cover	25-50%
Dominant species	<i>Acacia longifolia subsp. sophorae</i> (Coast Wattle) <i>Westringia fruticosa</i> (Coastal Rosemary)
Canopy cover	0-5%
Dominant species	<i>Banksia integrifolia</i> (Coast Banksia)
Large dead trees	0
Tree hollows	0
Waterbodies	Rocky creek / stormwater outlet to ocean
Size/depth	~30m long, slow flowing, few small pools ~10-15cm deep
Level of disturbance	Medium
Area of vegetation	Approximately 0.6 hectares



Plate 25: Western area of site, looking east. Photo: Mark Semeniuk (AMBS).



Plate 26: Northern area of the site. Photo: Mark Semeniuk (AMBS).

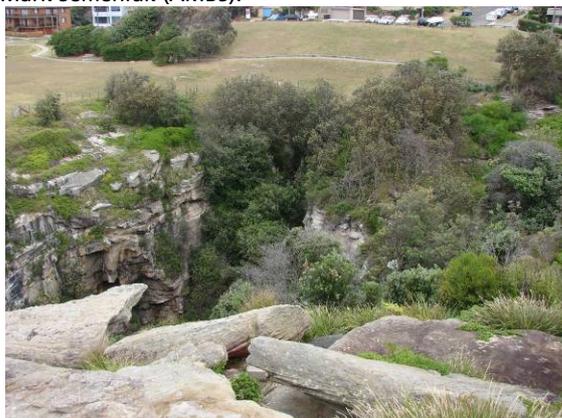


Plate 27: Western area of the site (view from the north). Photo: Mark Semeniuk (AMBS).

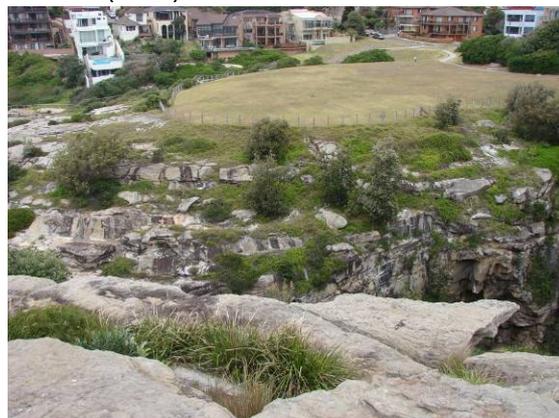


Plate 28: Southern area of the site (view from the north). Photo: Mark Semeniuk (AMBS).

Hugh Bamford	
Date of Survey	16/12/2009
Easting	56 341333
Northing	6249476
Community type	Sea-cliff remnant, Sandstone Moist Heath / parkland
Litter cover	25-50%
Litter depth	0-3cm
Grass cover	0-5%
Grass height	0-5cm / mown
Dominant ground species	Morning Glory (road section) Lantana (road section) <i>Lomandra longifolia</i> (road section)
Bare soil	5-25%
Logs	0
Large rocks	0
Shrub cover	75-100%
Dominant species	<i>Leptospermum laeviagatum</i> (Coastal Tea-tree) <i>Banksia integrifolia</i> (Banksia) <i>Acacia sp.</i>
Canopy cover	0-5%
Dominant species	None.
Large dead trees	0
Tree hollows	0
Waterbodies	0
Size/depth	N/A
Level of disturbance	Medium
Area of vegetation	Approximately 0.8 hectares



Plate 29: Northern area of the site. Photo: Mark Semeniuk (AMBS).



Plate 30: Southern area of the site (driveway). Photo: Mark Semeniuk (AMBS).

Marks Park	
Date of Survey	16/12/2009
Easting	56 340537
Northing	6247793
Community type	Parkland
Litter cover	0-5%
Litter depth	0-1cm
Grass cover	75-100%
Grass height	0-3cm
Dominant ground species	Mown, exotic.
Bare soil	5-25%
Logs	0
Large rocks	0
Shrub cover	5-25%
Dominant species	<i>Leptospermum laeviagatum</i> (Coastal Tea-tree) <i>Banksia integrifolia</i> (Banksia)
Canopy cover	0-5%
Dominant species	None.
Large dead trees	0
Tree hollows	0
Waterbodies	0
Size/depth	N/A
Level of disturbance	High
Area of vegetation	<0.5 hectares



Plate 31: Northern area of the site (view from the east). Photo: Mark Semeniuk (AMBS).



Plate 32: Southern area of the site (view from the east). Photo: Mark Semeniuk (AMBS).

Tamarama Park	
Date of Survey	16/12/2009
Easting	56 339820
Northing	6247803
Community type	Parkland / mixed plantings / Sea-cliff remnant
Litter cover	25-50%
Litter depth	0-6cm
Grass cover	25-50%
Grass height	0-5cm
Dominant ground species	Mown, exotic.
Bare soil	0-5%
Logs	0
Large rocks	~10
Shrub cover	5-25%
Dominant species	None.
Canopy cover	50-75%
Dominant species	<i>Ficus macrophylla</i> (Moreton Bay Fig) <i>Lophostemon confertus</i> (Brush Box) <i>Banksia integrifolia</i> (Coast Wattle)
Large dead trees	0
Tree hollows	0
Waterbodies	Small rocky creek, overgrown with Morning Glory
Size/depth	0-10cm
Level of disturbance	High
Area of vegetation	Approximately 0.7 hectares



Plate 33: Southern slope of site (view from the west). Photo: Mark Semeniuk (AMBS).



Plate 34: Northern slope of site. Photo: Mark Semeniuk (AMBS).

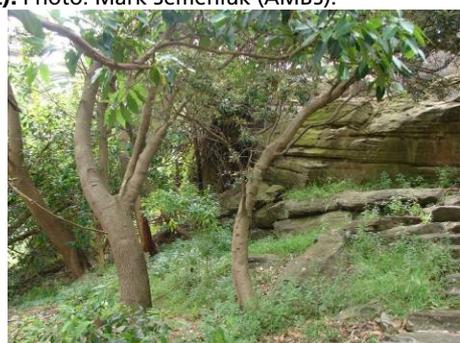


Plate 35: Northern slope of site. Photo: Mark Semeniuk (AMBS).



Plate 36: Western area of site (creek, view from the east). Photo: Mark Semeniuk (AMBS).



Plate 37: Northern slope of site. Photo: Mark Semeniuk (AMBS).



Plate 38: Centre of the site looking west. Photo: Mark Semeniuk (AMBS).

Hunter Park	
Date of Survey	16/12/2009
Easting	56 340364
Northing	6248080
Community type	Parkland
Litter cover	0-5%
Litter depth	0-1cm
Grass cover	75-100%
Grass height	0-5cm
Dominant ground species	Exotic, mown.
Bare soil	0-5%
Logs	0
Large rocks	0
Shrub cover	5-25%
Dominant species	<i>Leptospermum laeviagatum</i> (Coastal Tea-tree) <i>Acacia sp.</i> (Wattle) <i>Banksia integrifolia</i> (Coast Wattle)
Canopy cover	0-5%
Dominant species	None.
Large dead trees	0
Tree hollows	0
Waterbodies	0
Size/depth	N/A
Level of disturbance	High
Area of vegetation	Approximately 0.6 hectares



Plate 39: Western area of the site (view from the east). Photo: Mark Semeniuk (AMBS).



Plate 40: Eastern area of the site. Photo: Mark Semeniuk (AMBS).

York Road	
Date of Survey	15/12/2009
Easting	56 337513
Northing	6247509
Community type	Eastern Suburbs Banksia Scrub
Litter cover	0-5%
Litter depth	0-3cm
Grass cover	0-5%
Grass height	0-5cm
Dominant ground species	<i>Dianella revolute</i> <i>Eragrostis brownii</i>
Bare soil	25-50%
Logs	~5, +abundant woody debris
Large rocks	2
Shrub cover	50-75%
Dominant species	<i>Acacia longifolia</i> (Golden) <i>Leptospermum laevigatum</i> (Coastal Tea-tree) <i>Acacia sp.</i> <i>Leucopogon sp.</i>
Canopy cover	0-5%
Dominant species	No dominants, <i>L. laevigatum</i> and <i>A. longifolia</i> patches occurring in upper strata.
Large dead trees	0
Tree hollows	0
Waterbodies	0
Size/depth	N/A
Level of disturbance	Low
Area of vegetation	Approximately 1.3 hectares



Plate 41: View along an access track within the site. Photo: Mark Semeniuk (AMBS).



Plate 42: Habitat characteristic of the much of the site. Photo: Mark Semeniuk (AMBS).

Queens Park Cliff	
Date of Survey	20/01/2010
Easting	56 338370
Northing	6247288
Community type	Rock face / small cliff / Parkland
Litter cover	5-25%
Litter depth	0-5cm
Grass cover	5-25%
Grass height	0-5cm
Dominant ground species	Exotic grasses and creepers
Bare soil	0-5%
Logs	0
Large rocks	Many crevices / ledges
Shrub cover	0-5%
Dominant species	No dominants, some ferns.
Canopy cover	5-25%
Dominant species	<i>Ficus sp.</i>
Large dead trees	0
Tree hollows	0
Waterbodies	0
Size/depth	N/A
Level of disturbance	High
Area of vegetation	<0.5 hectares



Plate 43: Eastern area of the site. Photo: Mark Semeniuk (AMBS).



Plate 44: Western area of the site. Photo: Mark Semeniuk (AMBS).

Queens Park Pond	
Date of Survey	22/01/2009
Easting	56 337476
Northing	6247337
Community type	Pond / Parkland
Litter cover	0-5%
Litter depth	0-2cm
Grass cover	Mown grass around exterior.
Grass height	Mostly weedy bank, some isolated sedges.
Dominant ground species	
Bare soil	0-5%
Logs	0
Large rocks	0
Shrub cover	0-5%
Dominant species	No dominants
Canopy cover	5-25%
Dominant species	<i>Salix sp.</i> (Willow)
Large dead trees	0
Tree hollows	0
Waterbodies	0
Size/depth	~70m x 50m / depth unknown
Level of disturbance	High
Area of vegetation	<0.5 hectares



Plate 45: Northern area of the site (view from the east). Photo: Mark Semeniuk (AMBS).



Plate 46: Western area of the site (view from the north). Photo: Mark Semeniuk (AMBS).

Calga Reserve	
Date of Survey	22/01/2009
Easting	56 340037
Northing	6246640
Community type	Sea-cliff remnant (heath, grassland, sedgeland) / rock platforms
Litter cover	0-5%
Litter depth	0-2cm
Grass cover	0-5%
Grass height	0-5cm
Dominant ground species	No dominants
Bare soil	0-5%
Logs	0
Large rocks	Exposed rock platforms
Shrub cover	75-100%
Dominant species	<i>Baeckea sp.</i> <i>Coprosoma repens</i> (Mirror Bush) <i>Westringia frutocosa</i>
Canopy cover	0-5%
Dominant species	None.
Large dead trees	0
Tree hollows	0
Waterbodies	Small drainage area, no free water.
Size/depth	Approximately 1x5 metres
Level of disturbance	Medium
Area of vegetation	<0.5 hectares



Plate 47: Southern area of the site. Photo: Mark Semeniuk (AMBS).



Plate 48: Northern area of the site. Photo: Mark Semeniuk (AMBS).