Waverley Flora Survey Report 2015

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Cover Photo: Heath on sea cliffs, Diamond Bay Reserve, Vaucluse.
By D. Hirschfeld.

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1. Summary

The main findings of the Waverley Flora Survey 2015 were:

- 6 hectares of remnant vegetation survives in the Waverley Council area, occurring on about 40 different properties, including in Council parks, reserves and unformed roads and on private properties.
- Changes in the area of remnant vegetation since 2009/2010 included:
  - 169m^2 was gained due to natural spread of remnant vegetation.
  - 776m^2 was lost due to senescence, mowing, dense planting and possible clearing.
  - 1,205m^2 was recorded that was missed in earlier surveys.
  - Other minor changes in extent were due to being able to map vegetation previously obscured by weeds.
- 126 indigenous plant species were recorded, 5 more than in 2009/2010. This reflects the diversity of habitats and represents more than 6% of all native species in the Sydney Basin, a biodiversity hotspot in Australia in terms of flora.
- 6 species were recorded that weren't previously recorded in the Waverley Council area. Reasons include natural regeneration from the soil seedbank and natural dispersal from outside the area.
- 6 species were recorded again, after an absence in 2009/2010.
- 7 species may have become extinct in the Waverley Council area since 2009/2010. Reasons may include senescence/small populations, lack of appropriate fire regimes and pollinators, bushland fragmentation and isolation, change in environmental conditions (eg. soil moisture).
- 1 species, the Sunshine Wattle, *Acacia terminalis* subsp. *terminalis*, is listed as endangered under both the *Threatened Species Conservation Act 1995* [NSW] and the *Environment Protection and Biodiversity Conservation Act 1999* [Cth]. It was recorded on Council managed land for the first time.
- 72 species are locally rare (i.e. 3 or fewer small populations), representing almost 60% of the 126 indigenous plant species recorded.
- 15 native plant communities are present in the Waverley Council area. It is in part this diversity of communities and habitat which has allowed so many individual plant species to survive.
- 1 plant community, Eastern Suburbs Banksia Scrub, is listed as endangered under both the *Threatened Species Conservation Act 1995* [NSW] and the *Environment Protection and Biodiversity Conservation Act 1999* [Cth].

2. Project Brief

Waverley Council engaged Sydney Bush Regeneration Company P/L to undertake this flora survey of all remnant vegetation in the Council area. All field surveying was undertaken by Daniel Hirschfeld, who also carried out the Waverley Flora Survey 2009/2010, thereby providing consistency in methodology.

The survey work included:

- Field mapping of:
    - Remnant vegetation extent.
    - Remnant vegetation communities.
    - Remnant vegetation condition.
    - SEPP 19 Bushland.
- Creation of GIS layers for:
    - Remnant vegetation extent.
    - Native plant communities.
    - Remnant vegetation condition.
    - SEPP 19 Bushland.
- Field survey of indigenous flora species at each remnant vegetation location.
- Add to Council's Waverley Flora Survey 2009/2010 indigenous flora spreadsheet.
- Add to Council's Waverley Flora Survey 2009/2010 remnant vegetation spreadsheet.
- Submit the indigenous flora species recorded to the Atlas of NSW Wildlife, NSW Office of Environment and Heritage.
- Prepare this report – identifying results, changes since the Waverley Flora Survey 2009/2010 and recommendations.

3. Definitions

Indigenous plant species

As per the Waverley Flora Survey 2009/2010, this includes species believed to have been present in the Waverley Council area prior to 1788. It includes only those species believed to have survived via natural processes. The species in Table 2 were encountered during the survey and are considered indigenous to parts of the Sydney region. However, they were not recorded as indigenous during this survey, as they were either:

- Planted plants/species or plants/species originating from plantings, or
- Cosmopolitan species which are believed to have arrived via human activity.

For a few species, whether to consider them indigenous to Waverley or not was on the basis of probability, based on the abundant, but not complete, information available.

Remnant vegetation

As per the Waverley Flora Survey 2009/2010, remnant vegetation:

- Is the original (pre-1788) vegetation which has survived to this day. It includes both undisturbed and disturbed remnant vegetation.
- Also includes vegetation which has colonised disturbed areas, where there was no remnant vegetation for a period.
- Has survived and spread by natural processes, including seed dispersal and vegetative spread.
- Does not include plantings of local species or plants originating from such plantings.

"Sector Codes":

One sector code was designated to each patch of remnant vegetation, to distinguish it from other patches, and to assign characteristics, i.e.: remnant vegetation extent, condition and vegetation community and species presence and abundance. These Sector Codes appear in the GIS data and spreadsheet "Waverley Remnant Vegetation 2015", provided to Council as part of this survey.

4. The survey area

This was as per the Waverley Flora Survey 2009/2010, with the exception that Moriah War Memorial College, Queens Park, was also surveyed on this occasion. The list of all properties surveyed appears in the spreadsheet "Waverley Remnant Vegetation 2015",

provided to Council as part of this survey. Table 1 below lists only those properties in which remnant vegetation was recorded.

Table 1: Waverley Council area - Remnant vegetation locations, communities, area (m^2), 2015

No.	Property Name	Sector Codes	Vegetation Communities (SBRC)	Area (m^2)
1	Clarke Reserve, Vaucluse	Z1	Sea-cliff Heath	477
2	Jensen Avenue Reserve, Vaucluse	Z2	Sea-cliff Sedgeland: c) Ficinia nodosa	26
3	Tower St Reserve, Vaucluse	Z3	Sea-cliff Sedgeland: c) Ficinia nodosa	2
4	Diamond Bay Reserve, Vaucluse	D1a – D1c, D2a – D2b, D3a – D3c	Sea-cliff Heath Sea-cliff Sedgeland: b) Baumea juncea Sea-cliff Sedgeland: c) Ficinia nodosa	7,881
5	Kimberley St unformed, Vaucluse	Z5	Sea-cliff Sedgeland: c) Ficinia nodosa	65
6	Eastern Reserve, Dover Heights	Ea – Ed	Sea-cliff Heath Sea-cliff Sedgeland: c) Ficinia nodosa	4,803
7	Caffyn Park, Dover Heights	F1 – F6	Sandstone Dry Scrub Sandstone Moist Heath	835
8	Dover Rd unformed, Rose Bay	V	Low Woodland / Low Forest	90
9	Weonga Reserve, Dover Heights	Z6	Sea-cliff Scrub	501
10	Rodney Reserve, Dover Heights	Z7	Sea-cliff Heath	809
11	Raleigh Reserve, Dover Heights	R1 – R3	Sea-cliff Heath Sea-cliff Sedgeland: c) Ficinia nodosa	1,598
12	44 Hardy St (& possibly adjacent Onslow St properties), Rose Bay	O44	Not accessed	Not accessed
13	46 Hardy St (& possibly adjacent Onslow St properties), Rose Bay	O46	Low Woodland / Low Forest	14
14	Loombah Rd-Macleay St Cliffs unformed road, North Bondi	L1a – L1c	Low Woodland / Low Forest Sandstone Dry Scrub	577
15	25 Macleay St, North Bondi	L25a – L25b	Low Woodland / Low Forest Sandstone Dry Scrub	64
16	27 Macleay St, North Bondi	L27a – L27b	Low Woodland / Low Forest Sandstone Dry Scrub	207
17	14 Loombah Rd, North Bondi	L14	Low Woodland / Low Forest	73
18	16 Loombah Rd, North Bondi	L16	Low Woodland / Low Forest	87
19	18 Loombah Rd, North Bondi	L18	Low Woodland / Low Forest	4
20	134 Clyde St, North Bondi	L134	Sandstone Moist Heath	20
21	136 Clyde St, North Bondi	L136	Sandstone Moist Heath	6
22	Douglas Parade unformed, Dover Heights	Z8	Imperata Grassland	37
23	Hugh Bamford Reserve, Dover Heights & North Bondi	H1a – H1c, H2a	Sandstone Moist Heath Sea-cliff Heath Sea-cliff Scrub	4,400
24	Bondi Golf Course, North Bondi	G1 – G5	Sea-cliff Heath Sea-cliff Sedgeland: c) Ficinia nodosa	6,171
25	Sam Fiszman Reserve, North Bondi	Z9	Sea-cliff Grassland	271
26	Bondi Park, Bondi Beach	Z11a – Z11d	Imperata Grassland Sea-cliff Grassland Sea-cliff Herbland: b) Dianella congesta	448
27	Hunter Park, Bondi & Bondi Beach	Z12a – Z12e	Sea-cliff Grassland Sea-cliff Heath Sea-cliff Sedgeland: c) Ficinia nodosa	289
28	Marks Park, Bondi & Tamarama	Z13a – Z13j	Sea-cliff Grassland Sea-cliff Herbland: a) Lobelia alata Sea-cliff Sedgeland: a) Carex pumila Sea-cliff Sedgeland: c) Ficinia nodosa	1,909
29	Gaerloch Reserve, Tamarama	Z14a – Z14c	Sea-cliff Heath Sea-cliff Sedgeland: c) Ficinia nodosa	1,341
30	Tamarama Park, Tamarama	T1, T3a, T3b, T5, T7	Beach Grassland Sea-cliff Heath Sea-cliff Sedgeland: a) Carex pumila	3,556
31	Coast Walk Bronte, Bronte	Z15a – Z15b	Sea-cliff Herbland: a) Lobelia alata	329
32	Calga Reserve, Bronte	B1, B2, B7, B8	Sea-cliff Grassland Sea-cliff Heath	984
33	Waverley Cemetery Cliffs, Bronte	C1a – C1b C2a – C2c	Sea-cliff Heath Sea-cliff Herbland: b) Dianella congesta Sea-cliff Sedgeland: b) Baumea juncea Sea-cliff Sedgeland: c) Ficinia nodosa	2,688
34	Waverley Cemetery, Bronte	C3	Too disturbed to classify	0
35	Thomas Hogan Reserve, Bondi	Z17	Too disturbed to classify	0

36	Queens Park, Queens Park	Q1 – Q9	Eastern Suburbs Banksia Scrub Imperata Grassland / Fernland	6,890
37	York Rd Bushland, Queens Park	Y1	Eastern Suburbs Banksia Scrub	10,816
38	York Rd Bushland road verge, Queens Pk	Y2	Eastern Suburbs Banksia Scrub	629
39	Moriah War Memorial College, Queens Pk	Y3	Eastern Suburbs Banksia Scrub	1,010
Total area of remnant vegetation (m2)				**59,912**

5. Flora survey methodology

The survey was carried out as per the Waverley Flora Survey 2009/2010 – details provided below. In general, the boundary of each patch of remnant vegetation was walked, then the interior of each patch was inspected in detail to determine:

- Indigenous plant species presence and abundance.
- Remnant vegetation and SEPP19 Bushland extent.
- Native vegetation community type and condition.

Data from the Waverley Flora Survey 2009/2010 was used as a basis for field surveying.

5.1 Indigenous plant species – Nomenclature:

The National Herbarium of NSW's PlantNET website (http://plantnet.rbgsyd.nsw.gov.au) was used to name species.

5.2 Indigenous plant species – Presence:

Species were recorded while walking the boundary of each patch of remnant vegetation, then walking throughout the interior of each patch.

Only local native plant species believed to be indigenous were recorded (see "Definitions" section above). The species in Table 2 were encountered during the survey and are considered indigenous to parts of the Sydney region. However, they were not recorded as indigenous to the Waverley Council area during this survey, as they were either:

- Planted plants/species or plants/species originating from plantings, or
- Cosmopolitan species which are believed to have arrived via human activity.

Further complicating the survey was the planting of some species indigenous to Waverley, especially in and adjacent to remnant vegetation. A list of these species appears in the Recommendations section below. Hence, for some species, whether they were considered indigenous or not, was on the basis of probability, based on the abundant, but not complete, information available.

Table 2: Native plant species recorded, but not indigenous to the Waverley Council area

Species name			
Banksia integrifolia	Correa alba	Cupaniopsis anacardioides	Ficus macrophylla
Brachychiton acerifolius	Cotula australis	Cyathea australis	Hibbertia scandens
Cassinia uncata	Crassula sieberiana	Cynodon dactylon	Melaleuca quinquenervia
Casuarina glauca	Crinum pedunculatum	Eucalyptus spp.	Portulaca oleracea

5.3 Indigenous plant species – Threatened species:

The *Threatened Species Conservation Act 1995* [NSW] and the *Environment Protection and Biodiversity Conservation Act 1999* [Cth] list threatened species. A search on the *Atlas of NSW Wildlife* database of the NSW Office of Environment and Heritage (via the BioNet website, www.bionet.nsw.gov.au), showed only one species recorded is threatened, i.e. *Acacia terminalis* subsp. *terminalis*. This species is listed as endangered under both Acts. Four populations have been recorded in the Waverley Council area since 1995.

5.4 Indigenous plant species – Abundance:

An arbitrary scale was used to determine the abundance of each species in each patch of remnant vegetation. This was based on foliage projective cover, i.e. the percentage of the ground that would be covered should all the foliage of a given species in a given area be projected directly downward to the ground below.

The abundance values were:

- A: Abundant: >50% foliage projective cover.
- V: Very common: >10% to 50% foliage projective cover.
- C: Common: 1% to 10% foliage projective cover.
- U: Uncommon: <1% foliage projective cover.
- Q: Unique: Only 1 plant sighted.

Abundance was determined by visual estimation. While there is a degree of inaccuracy in this method, its benefits include being rapid and simple to apply (only 4 possible values, “unique” not being based on foliage projective cover).

This method didn’t work well for:

- Large shrubs in small remnants – their foliage projective cover can be high, but the number of individuals can be very few.
- Species with small or no leaves, eg. *Baumea juncea*, whose above ground parts consist of vertical, leafless stems. Arbitrary values were given for such species on the basis of how dense they may typically grow.

5.5 Indigenous plant species – Rarity:

An arbitrary threshold was used to determine species rarity within the Waverley Council area, i.e. 3 or fewer small populations. What was considered “a small population” was also arbitrary. For rhizomatous and stoloniferous species it is usually impossible to tell how many individual plants are present in a given area. Despite these limitations, whether a species was rare or not was clear in most instances.

5.6 Remnant vegetation – Extent:

The boundary of each property was inspected to locate remnant vegetation, except:

- Where vegetation, native or exotic, was too dense.
- Where topography was too steep, eg. sea cliffs and gully slopes.
- 44 Hardy St, Rose Bay, as access was not able to be obtained.

The boundary of each patch of remnant vegetation found within each property was inspected to determine extent.

“Sector Codes”:

The same unique Sector Codes used in the Waverley Flora Survey 2009/2010 were applied. One sector code was designated to each patch of remnant vegetation, to distinguish it from other patches, and to assign characteristics, i.e.:

- Remnant vegetation extent, condition and vegetation community.
- Species presence and abundance.

These Sector Codes appear in:

- The GIS data provided to Council as part of this survey.
- The spreadsheet “Waverley Remnant Vegetation 2015”, provided to Council as part of this survey.
- Tables within this report.

Area boundaries:

The boundary of any patch of remnant vegetation is somewhat arbitrary. It was taken to be the limit of visible remnant vegetation. Where this was discontinuous, eg. due to weed invasion, mowing or natural rock outcrops, then the following rules were applied:

- If the gap between visible indigenous plant species was >10m, then remnant vegetation on either side of the gap was mapped as separate patches.

- If the gap between visible indigenous plant species was <10m AND habitat in that gap was still likely to be able to support remnant vegetation (eg. the natural soil appeared to be relatively intact) OR the habitat was still natural (eg. rock outcrop), then remnant vegetation on either side of the gap was mapped as one patch.
- If the gap between visible indigenous plant species was <10m AND habitat in that gap was considered no longer likely to be able to support those species (eg. the soil appeared to be foreign or highly modified), then remnant vegetation on either side of the gap was mapped as separate patches.

Area size threshold:

- All patches of remnant vegetation >10m^2 were mapped. This low threshold reflects the state of remnant vegetation in Waverley, i.e. relatively little remains. Patches as small as this may have local conservation significance. Also, many patches were not significantly larger than 10m^2, hence, if the size threshold had been greater, the total area of remnant vegetation recorded may have been much less.
- The exception to the above was that patches of remnant vegetation <10m^2 were recorded where indigenous plant species within the patch were locally rare.
- Another basis for this low threshold was to avoid species extinction, which begins with extinctions of individual populations, hence knowledge of distribution is vital. So while species present in Waverley may not be at risk of extinction over their wider range, it is still desirable to maintain populations within Waverley.
- The total area of remnant vegetation mapped is believed to be close to 100% of all remnant vegetation present, despite patches <10m^2 not being mapped.

Figure 1: *Acacia suaveolens* (Sweet Wattle) in fruit, Raleigh Reserve.

5.7 Remnant vegetation – Condition:

The National Trust of Australia (NSW) (2010) method was used to map vegetation condition. It uses 4 condition "zonings": good, fair, poor, very poor. A visual estimation of the condition of each patch of remnant vegetation was made in the field against the definition of each condition zoning. This method doesn't necessarily reflect the "resilience" of any given patch remnant vegetation, i.e. its ability to improve, given best practice bush regeneration management. The method relies, in part, on weed density which is, at best, an approximation of resilience. Despite these limitations, this method benefits from being rapid, simple and visual (each zoning having a designated colour).

5.8 Remnant vegetation – Communities:

The Waverley Flora Survey 2009/2010 devised a classification with 15 vegetation communities (see Table 3 below). A 16th value of "disturbed" was allocated for patches of remnant vegetation which appear to have colonised natural but highly disturbed substrates. With one exception, the classification was based on applying the "vegetation structural formations" of Specht (1995), with dominant canopy species or habitat prefix descriptors added, to allow identification in the field.

The exception to the above vegetation community naming principle was Eastern Suburbs Banksia Scrub, which is listed as endangered under both the *Threatened Species Conservation Act 1995* [NSW] and the *Environment Protection and Biodiversity Conservation Act 1999* [Clth]. The extent of this community within Waverley Council area has been determined by the NSW National Parks and Wildlife Service.

While vegetation communities varied within many patches of remnant vegetation, the most abundant community was usually chosen to represent each patch as part of mapping. However, for a few patches of remnant vegetation, where there was a distinct and continuous change in vegetation community, more than one community was mapped. In these cases, the change in community often reflected a change in micro-habitat, e.g. sedgeland on an exposed sea cliff, then heathland in a slightly sheltered position leeward.

5.9 State Environmental Planning Policy 19: Bushland in Urban Areas:

The extent of bushland, within the meaning of s.4(1) of SEPP19, was determined by a visual estimation of the vegetation during the field survey. The land to which this SEPP applies is described in s.3, s.4(2), s.5, s.9 and Schedule 1.

Table 3: Waverley Council area – Native vegetation communities, 2015

No.	Vegetation Community Name	Canopy foliage projective cover (%)	Characteristic Canopy Species	Distribution / Habitat	Substrate
1	Beach Grassland	>10 to <30%	*Sporobolus virginicus*	Beaches	Deep marine sand
2	Sea-cliff Grassland	>10 to 100%	*Paspalum vaginatum, Sporobolus virginicus, Zoysia macrantha*	Within 10m of sea cliffs	Skeletal sand to sand lenses on sandstone, inc. drainage impeded
3	Sea-cliff Sedgeland: a) *Carex pumila*	<10 to <70%	*Carex pumila* dominant, other sedges present	Beaches & within 10m of sea cliffs	Deeper sandy soil
4	Sea-cliff Sedgeland: b) *Baumea juncea*	>10 to <70%	*Baumea juncea* dominant, other sedges present	Within 20m of sea cliffs	Sand lenses on sandstone, drainage impeded
5	Sea-cliff Sedgeland: c) *Ficinia nodosa*	<10 to <30%	*Ficinia nodosa* dominant, other sedges present	Within 20m of sea cliffs	Skeletal sand to sand lenses on sandstone, often on modified soil
6	Sea-cliff Herbland: a) *Lobelia alata*	<10 to <70%	*Lobelia alata, Samolus repens*	Within 10m of sea cliffs	Skeletal sand on sandstone, inc. drainage impeded
7	Sea-cliff Herbland: b) *Dianella congesta*	>30 to <70%	*Dianella congesta*	Within 10m of sea cliffs	Sand lenses on sandstone
8	Sea-cliff Heath	<10 to <70%	*Baeckea imbricata, Banksia ericifolia, Melaleuca armillaris, Melaleuca nodosa, Westringia fruticosa*	Within 50m of sea cliffs	Skeletal sand to sand lenses on sandstone, inc. drainage impeded
9	Sea-cliff Scrub	>10 to 100%	*Melaleuca armillaris, Melaleuca nodosa, Leptospermum laevigatum*	Within 50m of sea cliffs	Sand lenses on sandstone
10	Sandstone Moist Heath	>10 to <30%	*Banksia ericifolia, Callistemon citrinus, Callistemon linearis*	>50m from sea cliffs, sandstone slopes & ledges	Shallow to skeletal sand on sandstone, impeded drainage
11	Sandstone Dry Scrub	>10 to 100%	*Kunzea ambigua*	>50m from sea cliffs, sandstone slopes & ledges	Sand lenses on sandstone
12	Low Woodland / Low Forest	>10 to 100%	*Glochidion ferdinandi, Pittosporum undulatum*	>50m from sea cliffs, sandstone slopes & ledges	Sandy soil on sandstone
13	Eastern Suburbs Banksia Scrub	>10 to <70%	*Acacia longifolia, Banksia serrata, Leptospermum laevigatum, Monotoca elliptica*	Inland (restricted soil type)	Deep aeolian sand
14	Fernland	70 to 100%	*Gleichenia dicarpa*	In cliff faces	Skeletal soil on sandstone
15	Imperata Grassland	>10 to 100%	*Imperata cylindrica*	Widespread	Deeper, disturbed, sandy soil

6. Flora survey results

6.1 Indigenous plant species – Presence (number of species):

A total of 126 indigenous plant species were recorded during the survey. These are listed in the spreadsheet “Waverley Indigenous Flora 2015”, provided to Council as part of this survey. Five more species were recorded in 2015 than in 2009/2010. See the following three sections regarding reasons for changes in species presence.

6.2 Indigenous plant species – Presence (newly recorded species):

Six indigenous plant species, not previously recorded in the Waverley Council area, were recorded in 2015 – see Table 4.

Table 4: Waverley Council area – Indigenous plant species newly recorded, 2015

Species name	Possible reasons for presence
Apium prostratum var. filiforme	Natural regeneration from either the soil seedbank OR seed from elsewhere – an ephemeral species.
Atriplex semibaccata	Natural regeneration from either the soil seedbank OR seed from elsewhere – an ephemeral species.
Hakea dactyloides	Previously present but obscured by weeds.
Philotheca buxifolia	Either previously present but obscured by native plants or weeds OR natural regeneration from the soil seedbank.
Fimbristylis dichotoma	Natural regeneration from either the soil seedbank OR seed from elsewhere – an ephemeral species.
Schoenus ericetorum	Natural regeneration from the soil seedbank.

More species not previously recorded are likely to be found in the future, should bush regeneration continue, for a number of reasons including:

- Species previously over-looked being found.
- Species regenerating from the soil seedbank.
- Species spreading via natural processes from nearby areas.
- Work extending down difficult to access cliff faces.

6.3 Indigenous plant species – Presence (recorded in 2015 after an absence):

Six indigenous plant species, not recorded in 2009/2010, but recorded prior to that, were recorded in 2015 – see Table 5.

Table 5: Waverley Council area – Indigenous plant species recorded in 2015 after absence

Species name	Possible reasons for presence
Cheilanthes sieberi	Natural regeneration from the soil seedbank.
Cyperus sanguinolentus	Natural regeneration from either the soil seedbank OR seed from elsewhere – an ephemeral species.
Gonocarpus micranthus	Natural regeneration from the soil seedbank, possibly after smoke water treatment in the field.
Goodenia paniculata	Natural regeneration from the soil seedbank, possibly after smoke water treatment in the field.
Hakea gibbosa	Was present in 2009/2010, but was obscured by weeds.
Juncus planifolius	Natural regeneration from either the soil seedbank OR seed from elsewhere – an ephemeral species.
? Crowea saligna	1 plant may be present, but as yet too small to allow identification.

6.4 Indigenous plant species – Absence (possibly extinct):

Seven species may have become extinct in the Waverley Council area since 2009/2010 (see Table 6). Reasons may include: senescence/small populations, lack of appropriate fire regimes and pollinators, out-competed by weeds and other native plants, bushland fragmentation and isolation, change in environmental conditions (eg. soil moisture). Species may still survive in the soil as seeds or other propagules.

Another 20 or so species may also still survive (i.e. some of those with “X” in Column B in the spreadsheet “Waverley Indigenous Flora 2015”), but were not sighted due to various reasons, possibly including:

- Being over-looked, eg. not in flower, eg. *Sporobolus virginicus, Zoysia macrantha*.
- Being obscured by other vegetation, native or exotic, eg. *Veronica plebeia*, a groundcover previously sighted in dense vegetation in Hugh Bamford Reserve.
- Being annual or ephemeral, waiting for suitable growing conditions, with seeds surviving in the soil, eg. *Dichelachne crinita* and *Centrolepis* species.

- Having senesced, but with seeds surviving in the soil, eg. *Lambertia formosa*.

Table 6: Waverley Council area – Indigenous plant species possibly extinct, 2015

Species name	Possible reasons for absence
? Baumea rubiginosa	Stems sighted may be this species, but not flowering, which would allow identification.
Deyeuxia quadriseta	Survey timing not during species flowering time.
? Lambertia formosa	May have been over-looked in 2015. If not, then likely permanently extinct.
Leptocarpus tenax	Last known plant no longer present in 2015, at least above ground parts. Likely permanently extinct.
Lepyrodia scariosa	May have been over-looked in 2015.
Selaginella uliginosa	Current environmental conditions may not be favourable. May naturally regenerate in the future.
Senecio hispidulus var. hispidulus	An ephemeral species, likely to naturally regenerate from the soil seedbank in the future, in the right conditions.
Sonchus hydrophyllus	An ephemeral species, likely to naturally regenerate from the soil seedbank in the future, in the right conditions.
Spinifex sericeus	Possibly no longer present due to storm having moved beach sand. May naturally regenerate in the future via seed from other beaches.

6.5 Indigenous plant species – Presence (threatened species):

Acacia terminalis subsp. *terminalis* was the only threatened plant species to be recorded. A total of 4 populations have ever been recorded in the Waverley Council area (plants recorded in remnant vegetation Sector Codes L1b, L25a and L27b occurred within 10m of each other and are taken to be 1 population), though only 1 population was recorded during this survey, despite significant survey effort in the other 3 previously known sites. *Acacia terminalis* subsp. *terminalis* was recorded on Council land for the first time. Information is summarised in the Table 7 below (from SBRC Co. P/L 2010, Hirschfeld 1995-2004 and NSW Department of Environment, Climate Change and Water 2010b).

Table 7: Waverley Council area – *Acacia terminalis* subsp. *terminalis* populations

Property	Remnant Vegetation Sector Codes	Number of plants recorded			Threatening processes (examples)
		Before 2009	2009 / 2010	2015	
Loombah Road Cliffs (private property), North Bondi	L134 or L136	1	0	0	Weed invasion, Run-off, Bushland fragmentation & isolation
Loombah Road Cliffs (Council unformed road), North Bondi	L1b	0	0	2	Run-off, Weed invasion, Bushland fragmentation & isolation
Loombah Road Cliffs (private property), North Bondi	L25a	0	0	1	Run-off, Weed invasion, Bushland fragmentation & isolation
Loombah Road Cliffs (private property), North Bondi	L27b	0	2	0	Run-off, Weed invasion, Bushland fragmentation & isolation
Hardy St / Onslow St Cliffs, Rose Bay	O44 & O46	3	0	0	Weed invasion, Run-off, Bushland fragmentation & isolation

Dover Rd unformed, Rose Bay	V	1	0	0	Weed invasion, Run-off, Bushland fragmentation & isolation

6.6 Indigenous plant species – Presence (ROTAP species):

No Rare or Threatened Australian Plant species (Briggs & Leigh 1995) were recorded in current or previous surveys.

6.7 Indigenous plant species – Presence (locally rare species):

72 species are locally rare, representing almost 60% of the 126 indigenous plant species recorded. These species are identified by "R" in Column B in the spreadsheet "Waverley Indigenous Flora 2015", provided to Council as part of this survey.

6.8 Indigenous plant species – Abundance:

The abundance of each species in each patch of remnant vegetation is identified in the spreadsheet "Waverley Indigenous Flora 2015", provided to Council as part of this survey. No attempt was made to identify trends in abundance, as this can vary greatly, including over short periods, eg. for annual species and due to the weather conditions.

While some indigenous plant species may be in decline, others are likely to be on the increase, being tolerant of, and possibly being favoured by, urbanisation. This is likely to be the case for some of the front-line coastal species, which inhabit an environment which would naturally be prone to disturbance by wind, wave action and soil movement.

6.9 Remnant vegetation – Extent:

Almost 6 hectares (59,912m^2) of remnant vegetation were mapped, 565m^2 more than in 2009/2010. Remnant vegetation location and extent (m^2) is identified in:

- Table 1 above.
- The GIS data provided to Council as part of this survey.
- The spreadsheet "Waverley Remnant Vegetation 2015", provided to Council as part of this survey.

Changes in extent in each patch of remnant vegetation, and the reasons for, these are listed in Table 8. Four patches were not surveyed in the Waverley Flora Survey 2009/2010 and 1 patch which no longer exists. There was a 169m^2 increase in remnant vegetation due to natural spread. The main reasons for loss of remnant vegetation were senescence, clearing

and dense planting into remnant vegetation (which could no longer be distinguished). Many minor changes were corrections to 2009/2010 mapping, including after weed clearing since then, uncovering remnant vegetation.

Remnant vegetation was recorded on 38 properties (see Table 1), 1 more than in the Waverley Flora Survey 2009/2010, this being the Moriah War Memorial College, Queens Park. Remnant vegetation may also occur on several other properties, i.e.:

- 44 Hardy St, Rose Bay, where remnant vegetation was recorded in 2009/2010, but which wasn't able to be accessed for this survey.
- Properties in Onslow St adjacent to 44 Hardy St. The remnant vegetation may be at the top of a cliff, only accessible from 44 Hardy St.
- Properties in Onslow St adjacent to 46 Hardy St. The exact location of the property boundary, with respect to the cliff present, wasn't able to be determined.

Table 8 Waverley Council area – Remnant vegetation changes from 2009/2010 to 2015

Property name	Remnant vegetation Sector Code	Change in area since 2009/2010 (m^2) RED=Decrease	Possible reasons for changes in area RED=Decrease. Some changes <20m2 not shown.
Jensen Avenue Reserve, Vaucluse	Z2	+ 15	Correction of 2009/2010 mapping.
Diamond Bay Reserve, Vaucluse	D3b	+ 81	More remnant vegetation identified after weed treatment since 2010.
Eastern Reserve, Dover Heights	Ea	+ 41	Correction of 2009/2010 mapping.
Eastern Reserve, Dover Heights	Ed	– 100	Correction of 2009/2010 mapping after weed treatment since 2010.
Caffyn Park, Dover Heights	F1	– 16	Realignment of boundary between F1 & F5.
Caffyn Park, Dover Heights	F5	– 61	Realignment of boundary between F1 & F5. Correction of 2009/2010 mapping after weed treatment since 2010
Caffyn Park, Dover Heights	F6	– 233	Senescence of some shrubs.
44 Hardy St, Rose Bay.	O44	?	Not able to be accessed.
46 Hardy St, Rose Bay.	O46	– 42	Possible clearing.
Loombah Road cliffs, North Bondi	L1c	+ 9	Natural spread of remnant vegetation.
Hugh Bamford Reserve, Dover Heights	H1a	– 109	Possibly senescence &/or clearing.
Hugh Bamford Reserve, Dover Heights & North Bondi	H1c	– 16	Probably vegetation senescence. Natural spread of remnant vegetation.
Hugh Bamford Reserve, North Bondi	H2b	– 4	Possibly senescence.
Bondi Park, Bondi Beach	Z11b	+ 9	Natural spread of remnant vegetation.
Hunter Park, Bondi Beach	Z12c	+ 49	Correction of 2010 mapping after weed treatment since 2010.
Hunter Park, Bondi Beach	Z12e	+ 10	Not previously surveyed.
Marks Park, Bondi	Z13c	+ 48	More remnant vegetation identified after weed treatment since 2010.
Marks Park, Bondi	Z13h	+ 64	More remnant vegetation identified after weed treatment since 2010.
Waverley Cemetery cliffs, Bronte	C1a	– 416	Dense planting into remnant vegetation.
Waverley Cemetery cliffs, Bronte	C2c	– 41	Dense planting into remnant vegetation.
Queens Park, Queens, Park	Q4	– 44	Possibly mowing.
Queens Park, Queens, Park	Q7	+ 42	Natural spread of remnant vegetation.

Queens Park, Queens, Park	Q8	+ 180	Not previously surveyed.
Queens Park, Queens, Park	Q8	+ 5	Not previously surveyed.
York Road Bushland road verge, Queens Park	Y2	+ 109	Natural spread of remnant vegetation.
Moriah War Memorial College, Queens Park	Y3	+ 1,010	Not previously surveyed.
Total change in area (m^2)		**+ 565**	

6.10 Remnant vegetation – Condition:

The extent and area (m2) of condition zonings for each patch of remnant vegetation are identified in:

- The GIS data provided to Council as part of this survey.
- The spreadsheet "Waverley Remnant Vegetation 2015", provided to Council as part of this survey.

A summary of condition zonings is provided in Table 9. The information in this table should be interpreted with the knowledge that there have been changes in the extent of remnant vegetation, including some new areas and one area having been lost, hence this information can't directly be compared to the results of the Waverley Flora Survey 2009/2010.

Table 9: Waverley Council area – Remnant vegetation condition, 2015

Remnant vegetation condition zone	**Total area 2015** (m^2)	**Percentage of total area of remnant vegetation** (%)	**Change in area since 2009/2010** (m^2) RED=Decrease
Good	2,339	4	– 387
Fair	11,773	20	– 273
Poor	7,077	12	1,649
Very poor	38,723	65	– 424

6.11 Remnant vegetation – Communities:

Remnant vegetation communities type and extent (m^2) are identified in:

- Table 10 below.
- The GIS data provided to Council as part of this survey.
- The spreadsheet "Waverley Remnant Vegetation 2015", provided to Council as part of this survey.

Of the 15 vegetation communities recorded, only 5 total >1,000m2 (>1.7%) of what remains in the Waverley Council area. Changes in the extent of each vegetation community and the reasons for these are listed in Table 10.

Table 10: Waverley Council area – Area of each vegetation community (m^2), 2015

No.	Vegetation Community Name	Total area 2015 (m^2)	Percentage of total area of remnant vegetation (%)	Change in area since 2009/2010 (m^2) RED=Decrease	Number of patches of each community (x) = Change since 2009/2010) RED=Decrease	Possible reasons for changes in area Letter-Number = Sector Code Some changes <20m2 not shown. RED=Decrease.
1	Beach Grassland	32	0.05	0	1	
2	Eastern Suburbs Banksia Scrub	18,942	31.6	+ 1,111	6 (+ 1)	* Y2: natural spread of remnant vegetation = 108m2. * Y3: surveyed for 1st time = 1,010m2.
3	Fernland	15	0.03	+ 188	2 (+ 1)	* Q8: surveyed for 1st time = 188m2.
4	Imperata Grassland	140	0.2	– 44	3	* Q4: possible mowing of remnant vegetation = 44m2.
5	Low Woodland / Low Forest	974	1.6	– 67	9 (– 1 ?)	* O44: not accessed 2015 = 24m2. * O46: possible clearing of remnant vegetation = 42m2.
6	Sandstone Dry Scrub	758	1.3	– 239	6	* F1: correct 2010 mapping = 15m2. * F6: possible senescence of remnant vegetation = 233m2. * L1c: natural spread of remnant vegetation = 9m2.
7	Sandstone Moist Heath	391	0.7	– 71	5 (– 1)	* F5: correct 2010 mapping = 61m2. * H2b: patch no longer exists – the 1 plant died from senescence = 4m2
8	Sea-cliff Grassland	3,367	5.6	+ 65	13 (+ 1)	* Z11b: natural spread of remnant vegetation = 9m2. * Z12e: surveyed for 1st time = 10m2. * Z13c: correct 2010 mapping after weed treatment = 48m2.
9	Sea-cliff Heath	21,347	35.6	– 697	21 (– 1)	* Ed: correct 2010 mapping after weed treatment = 100m2. * H1b: community changed from Heath to Scrub = 604m2.
10	Sea-cliff Herbland: a) *Lobelia alata*	421	0.7	0	4	
11	Sea-cliff Herbland: b) *Dianella congesta*	166	0.3	– 40	2	* C2c: dense planting into remnant vegetation = 40m2.
12	Sea-cliff Scrub	4,826	8.1	+ 478	3 (+ 1)	* H1a: senescence &/or clearing of remnant vegetation = 109m2. * H1b: community changed from Heath to Scrub = 604m2. * H1c: senescence of remnant vegetation + gain in remnant vegetation due to natural spread = 16m2.
13	Sea-cliff Sedgeland: a) *Carex pumila*	327	0.5	+ 65	3	* Z13h: correct 2010 mapping after weeding = 65m2.
14	Sea-cliff Sedgeland: b) *Baumea juncea*	704	1.2	+ 82	2	* D3b: correct 2010 mapping after weed treatment = 82m2.
15	Sea-cliff Sedgeland: c) *Ficinia nodosa*	7,184	12.0	– 313	17	* Ea: correct 2010 mapping = 41m2. * Z2: correct 2010 mapping = 15m2. * Z12c: correct 2010 mapping = 49m2. * C1a: dense planting into remnant vegetation = 416m2.
NA	Too disturbed to classify	201	0.3	+ 47	2 (+ 1)	* Q7: natural spread of remnant vegetation = 42m2. * Q9: surveyed for 1st time = 5m2.
	Totals	**59,912**	**99.8**	**+ 565**	**99 (+ 2, or + 3 if Sector O44 present)**	

6.12 State Environmental Planning Policy 19 – Bushland in Urban Areas:

SEPP 19 location and extent (m^2) is identified in:

- Table 11 below.
- The GIS data provided to Council as part of this survey.
- The spreadsheet "Waverley Remnant Vegetation 2015", provided to Council as part of this survey.

The extent of SEPP19 Bushland remains unchanged since 2009/2010. The area of SEPP19 Bushland identified in Bondi Park in the Waverley Flora Survey 2009/2010 was an error.

Table 11: Waverley Council area – SEPP 19 Bushland, 2015

Property	Remnant vegetation sector codes, as per Council's GIS	Area of SEPP19 Bushland (m^2)
Diamond Bay Res.	D1b, D3b	431
Eastern Res.	Ec, Ed	968
Caffyn Park	F1	279
Rodney Res.	Z7	35
Raleigh Res.	R2	452
Hugh Bamford Res.	H1	2,932
Tamarama Park	T1	2,334
Total area (m^2)		**7,430**

7. Recommendations

- Ensure bush regeneration occurs on at least a monthly basis everywhere where work has commenced, for at least as long as it takes for remnant vegetation to control weeds and erosion on the site. This often takes 10 years for the coastal habitats present in the Waverley Council area, where vegetation grows slowly.
  If follow up weed treatments don't prevent seed set or prevent weeds outcompeting natives, the condition of remnant vegetation will almost certainly worsen.
- Avoid planting into and adjacent to remnant vegetation. Dense planting into bushland can result in the remnant vegetation no longer being able to be distinguished – this diminishes its conservation significance. Instead, leave a gap between remnant vegetation and plantings and encourage remnant vegetation to expand by natural processes, via bush regeneration.
- Remove native species which are not indigenous to the Waverley Council area from remnant vegetation, including at least those in Table 2.
- Remove certain indigenous plant species where they outcompete or inhibit natural regeneration of other indigenous plant species. Such species can include: *Microlaena stipoides, Commelina cyanea, Pittosporum undulatum, Glochidion ferdinandi, Ficus rubiginosa, Acacia longifolia, Kunzea ambigua, Leptospermum laevigatum, Melaleuca armillaris, Parsonsia straminea, Stephania japonica*.
- Require bush regeneration contractors to maintain species information for their sites, and report to Council:
  - Species list annually.
  - Species new to a site when it occurs, except annuals and ephemerals recorded in the past year.
  - Species loss from a site when it occurs, except annuals and ephemerals.
  - Species distribution and abundance changes when they occur, if significant.
  - Remnant extent changes when they occur.
  - Remnant condition annually.
- Update the spreadsheet "Waverley Indigenous Flora" at least on an annual basis.
- Update the spreadsheet "Waverley Remnant Vegetation" at least on an annual basis.
- Carry out any future flora surveys in late spring or summer, when more annual species are present, otherwise they may be missed.

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