Waverley Flora Survey Report 2020

Prepared by: Sydney Bush Regeneration Company Pty Ltd
PO Box 1655 Macquarie Centre NSW 2113
Ph. 9868 6475 Fax. 9868 6476
Email: sbrc@optusnet.com.au
A.B.N. 42 070 802 416

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Cover Photo: *Banksia ericifolia*, Eastern Reserve, Dover Heights.
D. Hirschfeld, 7 Dec. 2019.

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1. Summary

In addition to this report, the Waverley Flora Survey 2020 also includes:

- GIS data for:
  - Remnant vegetation extent.
  - Native plant communities.
  - Remnant vegetation Condition.
  - "Bushland" pursuant to State Environmental Planning Policy 19.
  - Buffer plantings adjoining and nearby remnant vegetation.

- The "Waverley Remnant Vegetation 2020" spreadsheet, which includes data on:
  - Remnant vegetation extent.
  - Numbers of indigenous plant species in each patch of remnant vegetation.
  - Native plant communities: type and extent in each patch of remnant vegetation.
  - Remnant vegetation Condition: extent in each patch of remnant vegetation.
  - "Bushland" pursuant to State Environmental Planning Policy 19: extent.
  - Some other bushland related information.
  - Changes which have occurred to the above information since 2015.

- The "Waverley Indigenous Flora 2020" spreadsheet, which includes:
  - Species presence.
  - Species abundance.
  - Species conservation status, i.e. whether listed as threatened under Commonwealth or State legislation or considered locally rare.

- The "Waverley Indigenous Flora 2020 – Changes in Species Distribution" spreadsheet, which includes changes in species presence in each patch of remnant vegetation and possible reasons for the changes.

The main findings of the Waverley Flora Survey 2020 were:

- 5.6 hectares of remnant vegetation survive in the Waverley Council area, occurring on 40 different properties: 68% on 29 Council parks, reserves and unformed roads, 29% on 2 Centennial Parklands sites and 2% on 9 private properties.
- 1 threatened ecological community, Eastern Suburbs Banksia Scrub, listed as:
  - Critically endangered under the *Biodiversity Conservation Act 2016* [NSW].
  - Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* [Cth].

- 1 threatened species, Sunshine Wattle, *Acacia terminalis* subsp. *terminalis*, listed as:
  - Endangered under the *Biodiversity Conservation Act 2016* [NSW].
  - Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* [Cth].

- 15 native plant communities are present, as in 2015.

- Double the area of Good Condition remnant vegetation recorded in the 2015 survey.

- Changes in the area of remnant vegetation since the 2015 survey, including:
  - 1,746m^2 increase due to natural spread of remnant vegetation, due to:
    - Natural regeneration from the soil seedbank as a result of bush regeneration.
    - Lack of competition from weeds due to the prolonged drought.
  - 504m^2 increase after 2 "new" areas were surveyed.
  - 2,344m^2 overall decrease due to corrections, largely due to availability of better quality air photos and not including small non-remnant areas between patches of remnant vegetation.
  - 1,909m^2 decrease due to converting mostly "Very Poor" Condition remnant vegetation into local native plantings.
  - 1,698m^2 decrease due to drought, which only affected Very Poor remnant vegetation.
  - Minor decreases due to: plant senescence (80m^2) and weed invasion (92m^2).
- 10% increase in the average number of indigenous plant species per patch of remnant vegetation in 2020 compared with 2015. The total of the number of species in each patch was 857 in 2020 and 779 in 2015. Reasons for this increase possibly include:
  - Bush regeneration promoting natural regeneration of natives & reducing weed competition.
  - The prolonged drought reducing weed growth, advantaging drought tolerant natives.
- 117 indigenous plant species, 5 less than in 2015, for reasons possible including:
  - Weed invasion.
  - Prolonged drought and other weather/climate conditions affecting some species.
  - Plant senescence.
  - Poor genetics / small populations.
  - Lack of appropriate fire regimes or other natural regeneration triggers.
  - Lack of pollinators.
  - Bushland fragmentation and isolation.
- 4 "new" species that weren't previously recorded in the Waverley Council area, for reasons possible including:
  - Natural regeneration from the soil seedbank as a result of bush regeneration works.
  - Lack of competition from weeds due to the prolonged drought.
  - Possible natural dispersal from outside the area.
- 4 species which weren't recorded in 2015, but which were recorded between 1995 and 2010. These "reappeared" for reasons as for "new" species above.
- 63 locally rare species (i.e. 3 or fewer small populations), representing ~54% of the 117 indigenous plant species recorded. In 2015, 73 species were locally rare, of which:
  - 4 species are no longer "Rare", for reasons as for "new" species above.
  - 13 species weren't recorded in 2020, for reasons as for less species above.
- 40,363m^2 of buffer planting in 145 patches in 19 Council parks and reserves and in Queens Park.

2. Project Brief

Waverley Council engaged Sydney Bush Regeneration Company Pty/Ltd 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 Surveys in 2010 and 2015.

The project included:

- Field mapping of:
    - Remnant vegetation extent.
    - Native plant communities.
    - Remnant vegetation Condition.
    - SEPP 19 Bushland.
    - Buffer plantings of local natives adjoining and nearby areas of remnant vegetation.
- Creating GIS data for:
    - Remnant vegetation extent.
    - Native plant communities.
    - Remnant vegetation Condition.
    - “Bushland” pursuant to State Environmental Planning Policy 19.
    - Buffer plantings adjoining and between areas of remnant vegetation.
- Field surveying indigenous flora species presence and abundance at each remnant vegetation location.
- Updating Council’s “Waverley Indigenous Flora 2015” spreadsheet.
- Updating Council’s “Waverley Remnant Vegetation 2015” spreadsheet.
- Submitting the indigenous flora species recorded to the Atlas of NSW Wildlife, NSW Office of Environment and Heritage.
- Preparing this report.
- In addition to the project brief, creating “Waverley Indigenous Flora 2020 – Changes in Species Distribution”.

3. Definitions

Indigenous plant species:

As per Waverley Flora Surveys in 2010 and 2015, 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 are believed to:

- Have been planted, or
- Have originated from plantings, or
- Be cosmopolitan species which are believed to have arrived via human activity.

For a few species, whether they were considered indigenous or not, was on the basis of probability and the author's experience with remnant vegetation and landscaping in Sydney's eastern suburbs since 1994.

Remnant vegetation:

As per Waverley Flora Surveys in 2010 and 2015, "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":

Alphanumeric Sector Codes were assigned to patches of remnant vegetation in the Waverley Council area by the author since 1994 while undertaking flora surveys and bushland extent mapping. The Waverley Flora Survey 2010 used these Sector Codes to assign other characteristics: remnant vegetation Condition, vegetation community and plant species abundance. These Sector Codes appear in the GIS data and the spreadsheets, "Waverley Remnant Vegetation 2020" and "Waverley Indigenous Flora 2020", updated for Council as part of this survey.

“Buffer Plantings”:

These are plantings consisting almost entirely of local native plant species, within 50m of remnant vegetation, which occur in park settings on Council or Centennial Parklands managed land.

While the intent of their installation may not always have been biodiversity conservation, their current functions may include:

- To afford some protection to remnant vegetation from: edge effects, weed invasion, trampling by dogs.
- To contribute to maintaining or improving ecological processes in remnant vegetation.
- To provide habitat for native fauna, including shelter, food and for breeding.
- To facilitate the movement of:
    - Native fauna in the Council area by connecting patches of remnant vegetation.
    - Genes of native flora via dispersal of pollen and seed.

Table 1: Waverley Council area - Remnant vegetation locations, communities, area (m^2), 2020

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	Too disturbed to classify	2
4	Diamond Bay Reserve, Vaucluse	D1a – D1c, D2a – D2b, D3a – D3c	Sea-cliff Heath Sea-cliff Sedgeland: c) Ficinia nodosa	7,825
5	Kimberley St unformed, Vaucluse	Z5	Sea-cliff Sedgeland: c) Ficinia nodosa	70
6	Eastern Reserve, Dover Heights	Ea – Ed	Sea-cliff Heath Sea-cliff Sedgeland: c) Ficinia nodosa	3,761
7	Caffyn Park, Dover Heights	F1, F5, F6	Sandstone Dry Scrub Sandstone Moist Heath	780
8	Dover Rd unformed, Rose Bay	V	Low Woodland / Low Forest	46
9	Weonga Reserve, Dover Heights	Z6	Sea-cliff Scrub	134
10	Rodney Reserve, Dover Heights	Z7	Sea-cliff Heath	90
11	Raleigh Reserve, Dover Heights	R1 – R3	Sea-cliff Heath Sea-cliff Sedgeland: c) Ficinia nodosa	711
12	46 Hardy St, Rose Bay	O46	Too disturbed to classify	11
13	Loombah Rd-Macleay St Cliffs unformed road, North Bondi	L1a – L1c	Low Woodland / Low Forest Sandstone Dry Scrub	278
14	25 Macleay St, North Bondi	L25a – L25b	Low Woodland / Low Forest Sandstone Dry Scrub	52
15	27 Macleay St, North Bondi	L27a – L27b	Low Woodland / Low Forest Sandstone Dry Scrub	139
16	14 Loombah Rd, North Bondi	L14	Low Woodland / Low Forest	12
17	16 Loombah Rd, North Bondi	L16	Low Woodland / Low Forest	82
18	18 Loombah Rd, North Bondi	L18	Low Woodland / Low Forest	4
19	134 Clyde St, North Bondi	L134	Too disturbed to classify	6
20	136 Clyde St, North Bondi	L136	Too disturbed to classify	6
21	Douglas Parade unformed, Dover Heights	Z8	Imperata Grassland	43
22	Hugh Bamford Reserve, Dover Heights & North Bondi	H1a – H1c, H2a	Sandstone Moist Heath Sea-cliff Scrub	4,825
23	Bondi Golf Course, North Bondi	G1 – G5	Sea-cliff Heath Sea-cliff Sedgeland: c) Ficinia nodosa	5,787
24	Bay St Cliffs, North Bondi	Z18	Sea-cliff Sedgeland: c) Ficinia nodosa	481
25	Sam Fiszman Reserve, North Bondi	Z9	Sea-cliff Grassland	190
26	Bondi Park, Bondi Beach	Z11a – Z11d	Imperata Grassland Sea-cliff Grassland Sea-cliff Herbland: b) Dianella congesta	539
27	Hunter Park, Bondi & Bondi Beach	Z12a – Z12e	Sea-cliff Grassland Sea-cliff Herbland: b) Dianella congesta Sea-cliff Sedgeland: c) Ficinia nodosa	392
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	2,065
29	Gaerloch Reserve, Tamarama	Z14a – Z14c	Sea-cliff Grassland Sea-cliff Herbland: a) Lobelia alata	1,088
30	Tamarama Park, Tamarama	T1, T3a, T3b, T5, T7	Beach Grassland Sea-cliff Heath Sea-cliff Sedgeland: a) Carex pumila	3,593
31	Coast Walk Bronte, Bronte	Z15a – Z15b	Sea-cliff Herbland: a) Lobelia alata Sea-cliff Sedgeland: c) Ficinia nodosa	487
32	Calga Reserve, Bronte	B1, B2, B7, B8	Sea-cliff Grassland Sea-cliff Heath	1,288
33	Bronte Cutting, Bronte	Z19	Fernland	23
34	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	2,700
35	Waverley Cemetery, Bronte	C3	Too disturbed to classify	0
36	Thomas Hogan Reserve, Bondi	Z17	Too disturbed to classify	0
37	Queens Park, Queens Park	Q1 – Q9	Eastern Suburbs Banksia Scrub Fernland	5,549
38	York Rd Bushland, Queens Park	Y1	Eastern Suburbs Banksia Scrub	10,815
39	York Rd road verge, Queens Pk	Y2	Eastern Suburbs Banksia Scrub	715
40	Moriah War Memorial College, Queens Pk	Y3	Eastern Suburbs Banksia Scrub	1,010
Total area of remnant vegetation (m2)				**56,073**

4. The survey area

This included all Waverley Flora Survey 2015 sites. An additional 2 sites were also surveyed: Bay Street Cliffs, North Bondi and Bronte Cutting, Bronte, which hadn't previously been surveyed. The list of all properties surveyed appears in the spreadsheet "Waverley Remnant Vegetation 2020", updated for Council as part of this survey. Table 1 above only lists those properties in which remnant vegetation was recorded.

5. Flora survey methodology

The survey was carried out as per the Waverley Flora Surveys in 2010 and 2015 to determine:

- Remnant vegetation and SEPP19 Bushland extent.
- Vegetation community type and Condition.
- Indigenous plant species presence and abundance.

Data from the Waverley Flora Survey 2015 was used as a basis for field surveying. More details are provided in Section 5 below.

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:

Only local native plant species believed to be indigenous were recorded (see "Definitions" section above). The species in Table 2 were encountered during this and/or the 2010 and 2015 surveys 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 are believed to:

- Have been planted, or
- Have originated from plantings, or
- Be cosmopolitan species which are believed to have arrived via human activity.

Further complicating the survey was the planting of some species indigenous to Waverley 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 and on the author's experience with remnant vegetation and landscaping in Sydney's eastern suburbs since 1994.

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

Species name			
Banksia integrifolia	*Correa alba*	*Cupaniopsis anacardioides*	*Ficus macrophylla*
Brachychiton acerifolius	*Cotula australis*	*Cyathea cooperi*	*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:

Biodiversity Conservation Act 2016 [NSW]

This act lists threatened species. Records of listed species can be found on the *Atlas of NSW Wildlife* database (www.bionet.nsw.gov.au) of the NSW Department of Planning, Industry and Environment and maps of at least some records can be generated. A search of this database undertaken prior to the field survey generated a list of 61 threatened plant species for the Waverley Council area. However, only one species, *Acacia terminalis* subsp. *terminalis*, is believed to have been recorded in the Waverley Council area. The other 60 species are likely to:

- Have been recorded nearby, e.g. *Pimelea curviflora* var. *curviflora*, which the author recorded in what was the Botany Council area, or
- Be erroneous, e.g. *Allocasuarina portuensis*, which has only ever been recorded in the Woollahra Council area, or

Extensive field searches were made for *Acacia terminalis* subsp. *terminalis* during the survey in sites where it has previously been recorded and in sites with similar habitat.

Environment Protection and Biodiversity Conservation Act 1999 [Cth]

This act lists threatened species. Records of listed species can be found on the *SPRAT* database (www.environment.gov.au/webgis-framework/apps/pmst/pmst-region.jsf) of the Commonwealth Department of Agriculture, Water and Environment. A search of this database was undertaken prior to the field survey. All species generated by the search were also generated by the Bionet search.

5.4 Indigenous plant species – Abundance:

The same species abundance scale used in the Waverley Flora Surveys 2010 and 2015 was applied. Abundance was determined for each species in each patch of remnant vegetation based on foliage projective cover, i.e. the percentage of ground covered if all foliage of a given species in a given area is projected to the ground.

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, i.e. it exaggerated their abundance.
- Species with small or no leaves, e.g. *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:

The same species rarity criterion used in the Waverley Flora Surveys 2010 and 2015 was applied, i.e. 3 or fewer small populations in the Waverley Council area, noting:

- For rhizomatous and stoloniferous species it is usually not possible to determine how many individual plants are present in a given area.
- Where a species occurred in 2 or more adjacent Sector Codes, this was considered 1 population.

5.6 Remnant vegetation – Extent:

The same vegetation extent methodology used in the Waverley Flora Surveys 2010 and 2015 was applied, i.e. the boundary of each property was inspected to locate remnant vegetation, except where vegetation (native or exotic), was too dense or where the topography was too steep, e.g. sea cliffs.

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

Remnant vegetation "Sector Codes":

As described in "Definitions" above, Sector Codes were assigned to patches of remnant vegetation. These Sector Codes appear in the tables in this report and in the data updated for Council as part of this survey: the GIS data and the spreadsheets "Waverley Remnant Vegetation 2020" and Spreadsheet "Waverley Indigenous Flora 2020".

Remnant vegetation boundaries:

The boundary of each patch of remnant vegetation was taken to be the limit of visible remnant vegetation. Where this was discontinuous, e.g. 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 (e.g. the natural soil appeared to be relatively intact) OR the habitat was still natural (e.g. 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 (e.g. 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.
- 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 the Waverley Council area may not be at risk of extinction over their wider range, it is still desirable to maintain small local populations.
- The exception to the 10m^2 threshold were patches of remnant vegetation <10m^2 where indigenous plant species within the patch were locally rare.
- The total area of remnant vegetation mapped is believed to be close to 100% of all remnant vegetation present.

5.7 Remnant vegetation – Condition:

The same vegetation Condition mapping methodology used in the Waverley Flora Surveys 2010 and 2015 was applied (National Trust of Australia (NSW) (2010)). 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. Results may be biased depending on when the survey occurs in relation to monthly follow up weed treatment of annuals and how the colour codes are averaged across a site. *Banksia integrifolia* was neither considered indigenous nor was it considered a weed when determining Condition.

The National Trust method doesn't necessarily reflect the "resilience" of any given patch remnant vegetation, i.e. its ability to improve subsequent to best practice bush regeneration management being applied. 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 and simple to apply and the visual results are easy to interpret (each zoning having a designated colour).

5.8 Remnant vegetation – Communities:

The same vegetation community classification system used in the Waverley Flora Surveys 2010 and 2015 was applied (see Table 3 below). The classification system:

- Is based on applying the "vegetation structural formations" of Specht (1995), with canopy species and/or habitat prefix descriptors added, to facilitate identification.
- Has an additional value of "disturbed" for patches of remnant vegetation which appear to have colonised natural but highly disturbed substrates.

The exception to the above naming principle is the threatened ecological community, Eastern Suburbs Banksia Scrub, which was used for patches of this community.

While vegetation communities varied within many patches of remnant vegetation, the most abundant community was chosen to represent each patch as part of mapping. Where there was a distinct and continuous change in vegetation community, more than one community was mapped and a separate Sector Code was assigned. 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.

Table 3: Waverley Council area – Remnant vegetation communities in 2020

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

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 in the SEPP.

5.10 Buffer Plantings:

These were not previously mapped in Flora surveys in 2010 and 2015.

With 1 exception, buffer plantings satisfy all 6 of the following criteria:

- On Council managed land.
- In a park setting, not the streetscape, though may be in a park adjacent to a street.
- At least part of each buffer planting must be within 50 metres from remnant vegetation, OR be within 50 metres of other plantings which meet all the other criteria for buffer plantings.
- At least 90% of the individual plants in each buffer planting are indigenous to Sydney's eastern suburbs (according to records held by the relevant Councils), excepting *Crinum pedunculatum*, *Myoporum boninense* and *Myoporum insulare*, which are indigenous to coastal areas in the Central Coast Botanical Subdivision, and which count towards the 90%.
- Buffer plantings consist of shrub, groundcover and/or vine species. Tree species may also be present, but trees without shrub, groundcover and/or vine species beneath them don't meet the criteria for buffer plantings, except where such trees are within 20 metres of shrub, groundcover and/or vine species plantings, or within 20 metres of other such trees.
- Where buffer plantings have occurred within remnant vegetation, which is the case in some very poor condition remnant vegetation, the area will only be recorded as buffer planting on Council's GIS, i.e. the remnant vegetation and the buffer planting GIS layers don't overlap at any given point in time.

The exception to all 6 of the above criteria needing to be satisfied are certain plantings in Queens Park, which are consistent with 4 of the above criteria. With respect to the other 2 criteria:

- The land is managed by Centennial Parklands, not Council.
- 90% of the individual plants in each buffer planting is NOT indigenous to Sydney's eastern suburbs, this being a conscious management decision, to ensure that remnant and planted vegetation can be distinguished from each other into the future.

6. Flora survey results

6.1 Indigenous plant species – Presence – Number of species:

A total of 117 indigenous plant species were recorded during the survey. These are listed in the spreadsheet "Waverley Indigenous Flora 2020", updated for Council as part of this survey.

By comparison, 122 indigenous plant species were recorded during the 2015 survey.

See the following sections regarding reasons for changes in species presence.

6.2 Indigenous plant species – Presence – First recorded in 2020:

Four "new" indigenous plant species, not previously recorded in the Waverley Council area, was recorded during this survey – see Table 4 and the "Waverley Indigenous Flora 2020" spreadsheet.

By comparison, during the 2015 survey, six indigenous plant species were recorded that weren't previously recorded in the Waverley Council area.

Table 4: Waverley Council area – Indigenous plant species – First recorded in 2020

Species name	Possible reason/s for presence
Doodia caudata	Natural regeneration; overlooked previously, possibly obscured by weeds.
Epaltes australis	Natural regeneration from the soil seedbank – an ephemeral species. This species has been recorded in similar habitats in the adjacent Randwick Council area.
Pteris vittata	Natural regeneration; possibly obscured by weeds.
Rytidosperma longifolium	Natural regeneration after bush regeneration.

In future, more "new" species are likely to be recorded, if bush regeneration continues. Reasons for this may include:

- Species regenerating from the soil seedbank, e.g. due to bush regeneration works, including where this extends into previously unworked areas.
- Species spreading via natural processes from nearby areas.
- Species previously over-looked being found.

6.3 Indigenous plant species – Presence – Recorded again in 2020, but not recorded in 2015:

Four indigenous plant species were recorded, which had previously been recorded since 1995, but not in 2015 – see Table 5 and "Waverley Indigenous Flora 2020" spreadsheet. This "reappearance" of species after absence suggests it is premature to consider species recorded since the 1995 as locally extinct, unless soils and other habitat elements have been lost, e.g. species may survive in the soil as seeds or other propagules.

By comparison, six indigenous plant species, not recorded in 2010, but recorded prior to that, were recorded during the 2015 survey.

Table 5: Waverley Council area – Indigenous plant species – Recorded again in 2020, but not recorded in 2015

Species name	Possible reason/s for presence
Sonchus hydrophilus	Natural regeneration from either the soil seedbank OR seed arrived from elsewhere – an ephemeral species.
Centrolepis strigosa	Natural regeneration from the soil seedbank – an ephemeral species.
Deyeuxia quadriseta	2020 survey undertaken during summer when above ground parts of this are present. 2015 survey undertaken in autumn.
Themeda triandra	Natural regeneration from the soil seedbank.

6.4 Indigenous plant species – Presence – No longer Rare in 2020:

Four indigenous plant species recorded as Rare in the Waverley Council area in 2015, were no longer Rare during this survey – see Table 6 and the "Waverley Indigenous Flora 2020" spreadsheet. By comparison, 2 indigenous plant species recorded as Rare in 2010, were no longer Rare during the 2015 survey – *Juncus pallidus* and *Triglochin striatum*.

Table 6: Waverley Council area – Indigenous plant species – No longer Rare in 2020

Species name	Possible reason/s for increased abundance
Atriplex semibaccata	Conditions which support its natural regeneration on coastal rockplatforms are improving, possibly relating to substrate &/or weather.
Juncus kraussii	Conditions which support its natural regeneration are improving, possibly after weeding &/or relating to substrate &/or weather.
Lachnagrostis filiformis	2020 survey undertaken during summer when above ground parts of this annual / perennial are present. 2015 survey undertaken in autumn.
Paspalidium distans	Natural regeneration after bush regeneration weed treatment at 1 or 2 sites.

6.5 Indigenous plant species – Presence – Not recorded in 2020:

Thirteen species recorded in 2015 were not recorded during this survey – species and reasons for their absence appear in Table 7. Another species, *Commersonia hermanniifolia*, was only recorded by the author between the 2015 and 2020 surveys.

By comparison, 8 species recorded in 2010 were not recorded in 2015. Of those 8 species, 2 were recorded again in 2020, suggesting it is premature to consider species recorded since 1995 as locally extinct, unless soils or other habitat elements have been lost, e.g. species may survive in the soil as seeds or other propagules.

Table 7: Waverley Council area – Indigenous plant species – Not recorded in 2020

Species name	Possible reason/s for no recordings
Cheilanthes sieberi	Drought currently in effect. This species only occurred on 1 site on dry sand. It may resprout from rhizome or spores again when conditions become favourable.
Commersonia hermanniifolia	Drought currently in effect. Only 1 plant ever recorded, which naturally regenerated after smoke water application. It may naturally regenerate again from seed in the soil when conditions become favourable.
Gonocarpus teucrioides	Drought currently in effect. It may naturally regenerate again from seed in the soil when conditions become favourable.
Gonocarpus micranthus	Drought currently in effect. Prefers moist conditions. It may naturally regenerate again from seed in the soil when conditions become favourable.
Goodenia paniculata	Drought currently in effect. Prefers moist conditions. It may naturally regenerate again from seed in the soil when conditions become favourable.
Hakea dactyloides	Drought currently in effect and/or plant senesced. Only 1 plant has been recorded on 1 site, which is on dry sand. It may naturally regenerate again from seed in the soil when conditions become favourable.
Hakea gibbosa	Drought currently in effect and/or plant senesced. Only 1 plant was recorded on 1 site in 2015. It may naturally regenerate again from seed in the soil when conditions become favourable.
Hibbertia fasciculata	Drought currently in effect. This species only occurred on 1 site on dry sand. It may naturally regenerate again from seed in the soil when conditions become favourable.
Hybanthus monopetalus	Drought currently in effect. This species only occurred on 1 site on dry sand. It may naturally regenerate again from seed in the soil when conditions become favourable.
Lasiopetalum ferrugineum	Drought currently in effect. It may naturally regenerate again from seed in the soil when conditions become favourable.
Philotheca buxifolia	Drought currently in effect. It may naturally regenerate again from seed in the soil when conditions become favourable.
Cyperus mirus	Drought currently in effect. Prefers moist conditions. It may naturally regenerate again from seed in the soil when conditions become favourable.
Cyperus sanguinolentus	Drought currently in effect. Prefers moist conditions. It may naturally regenerate again from seed in the soil when conditions become favourable.
Fimbristylis dichotoma	Drought currently in effect. Prefers moist conditions. It may naturally regenerate again from seed in the soil when conditions become favourable.

6.6 Indigenous plant species – Presence – Threatened species:

Biodiversity Conservation Act 2016 [NSW]

A search of the *Atlas of NSW Wildlife* database, generated 61 results for threatened plant species in the Waverley Council area. However, only one species, *Acacia terminalis* subsp. *terminalis*, is believed to have been recorded in the Waverley Council area. The other 60 records are likely to:

- Have been for plants recorded nearby, e.g. *Pimelea curviflora* var. *curviflora*, which the author recorded in what was the Botany Council area, or
- Be erroneous, e.g. *Allocasuarina portuensis*, which has only ever been recorded in the Woollahra Council area, or
- Possibly be plantings.

Environment Protection and Biodiversity Conservation Act 1999 [Cth]

A search of the *SPRAT* database generated 12 results for threatened species in the Waverley Council area. Similarly to the Bionet search, only one species, *Acacia terminalis* subsp. *terminalis*, is believed to have been recorded in the Waverley Council area.

A total of 4 populations of *Acacia terminalis* subsp. *terminalis* 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). Information is summarised in the Table 8 below (from SBRC Co. P/L 2010, Hirschfeld 1995-2004 and NSW Department of Environment, Climate Change and Water 2010b). Only 1 population was recorded during this survey, despite significant survey effort in the other 3 previously known sites.

Table 8: Waverley Council area – *Acacia terminalis* subsp. *terminalis* populations

Property	Remnant Vegetation Sector Codes	Number of plants recorded				Threatening processes (examples)
		Before 2010	2010	2015	2020	
Loombah Road Cliffs (private property), North Bondi	L134 or L136	1	0	0	0	Weed invasion, Run-off, Bushland fragmentation & isolation
Loombah Road Cliffs (Council unformed road), North Bondi	L1b	0	0	2	18	Run-off, Weed invasion, Bushland fragmentation & isolation
Loombah Road Cliffs (private property), North Bondi	L25a	0	0	1	0	Run-off, Weed invasion, Bushland fragmentation & isolation
Loombah Road Cliffs (private property), North Bondi	L27b	0	2	0	1	Run-off, Weed invasion, Bushland fragmentation & isolation
Hardy St / Onslow St Cliffs, Rose Bay	O44 & O46	3	0	0	0	Weed invasion, Run-off, Bushland fragmentation & isolation
Dover Rd unformed, Rose Bay	V	1	0	0	0	Weed invasion, Run-off, Bushland fragmentation & isolation

6.7 Indigenous plant species – Presence – ROTAP species:

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

6.8 Indigenous plant species – Presence – Locally rare species:

63 species are locally rare, i.e. there are 3 or fewer small populations in the Waverley Council area, noting where a species occurred in 2 or more adjacent Sector Codes, this was considered 1 population. This represents 54% of the 117 indigenous plant species recorded. These species are identified by an "R" in Column C in the spreadsheet "Waverley Indigenous Flora 2020", updated for Council as part of this survey.
By comparison, 73 species recorded in 2015 were locally rare. The reasons for changes in "rare" status between 2015 and 2020 are:

- 4 species were recorded in 2020, but are no longer rare.
- 13 species were not recorded in 2020.

6.9 Indigenous plant species – Abundance:

The abundance of each species in each patch of remnant vegetation is identified in the spreadsheet "Waverley Indigenous Flora 2020", updated for Council as part of this survey.

No attempt was made to identify trends in abundance in each species, as this can vary greatly, including over short periods, e.g. for annual species and due to the weather conditions.

6.10 Indigenous plant species – Distribution:

There was a 10% increase in the average number of indigenous plant species per patch of remnant vegetation in 2020 compared with 2015. The total of the number of species in each patch was 857 in 2020 and 779 in 2015, as shown in the spreadsheet, "Waverley Remnant Vegetation 2020".

Possible reasons for this increase include:

- Bush regeneration promoting natural regeneration of indigenous plant species and reducing weed competition.
- The prolonged drought reducing weed growth, advantaging drought tolerant natives.

In light of a significant decrease in the extent of 2 patches of remnant vegetation, i.e. Sector Codes Ed and Z7, a new spreadsheet was prepared as part of the 2020 survey, "Waverley Indigenous Flora 2020 – Changes in Species Distribution". It was thought that a decrease in the distribution of *Commelina cyanea*, *Cyperus polystachyos* and/or *Ficinia nodosa* would explain the decrease in the extent of those patches. However, because those species are still present in what remains of those patches, it wasn't possible to determine whether they had been in those parts of those patches where remnant vegetation wasn't recorded in 2020, i.e. whether their absence resulted in the decrease in extent of the patch.

The "Waverley Indigenous Flora 2020 – Changes in Species Distribution" spreadsheet provides some insight into changes in the distribution and presence of some species:

- Increase in distribution of some species probably via seed dispersal by birds:
    - *Dianella caerulea* recorded in 4 more Sector Codes than in 2015.
    - *Dianella congesta* recorded in 3 more Sector Codes than in 2015.
    - *Monotoca elliptica* recorded in 2 more Sector Codes than in 2015.
- Increase in distribution of some species possibly due to seed dispersal by natural processes and/or changes in conditions which support their natural regeneration, possibly relating to bush regeneration, substrate condition &/or weather:
    - *Atriplex semibaccata* recorded in 6 more Sector Codes than in 2015.
    - *Epaltes australis* recorded in 2 Sector Codes and wasn't recorded in 2015.
    - *Gleichenia rupestris* recorded in 2 more Sector Codes than in 2015.
    - *Juncus kraussii* recorded in 3 more Sector Codes than in 2015.
    - *Opercularia aspera* recorded in 2 more Sector Codes than in 2015.
    - *Paspalidium distans* recorded in 4 more Sector Codes than in 2015.
    - *Sonchus hydrophilus* recorded in 2 more Sector Codes than in 2015.
    - *Triglochin striatum* recorded in 2 more Sector Codes than in 2015.
- The possible negative effect of the prolonged drought on some species:
    - The 13 species not recorded in 2020, as discussed in section 6.5 above.
    - *Adiantum aethiopicum* recorded in 2 fewer Sector Codes than in 2015.
    - *Baeckea imbricata* recorded in 2 fewer Sector Codes than in 2015.
    - *Callistemon citrinus* recorded in 1 less Sector Code than in 2015 (it was only recorded in 3 Sector Codes in 2015).
    - *Centella asiatica* still recorded in only 1 Sector Code, but 1 population died in the prolonged drought and a new population was found.
    - *Commelina cyanea* recorded in 2 fewer Sector Codes than in 2015.
    - *Cyperus polystachyos* recorded in 10 fewer Sector Codes than in 2015.
    - *Ficinia nodosa* recorded in 2 fewer Sector Codes than in 2015.
    - *Kunzea ambigua* recorded in 4 fewer Sector Codes than in 2015.
    - *Lobelia anceps* recorded in 4 fewer Sector Codes than in 2015.
    - *Melaleuca armillaris* recorded in 2 fewer Sector Codes than in 2015.
    - *Philotheca buxifolia* recorded in 1 less Sector Code than in 2015 (it was only recorded in 1 Sector Code in 2015).
    - *Smilax glyciphylla* recorded in 3 fewer Sector Codes than in 2015.
    - *Tetragonia tetragonioides* recorded in 2 fewer Sector Codes than in 2015.

The “Waverley Indigenous Flora 2020 – Changes in Species Distribution” spreadsheet may also guide months when future flora surveys take place:

- *Deyeuxia quadriseta* recorded in December 2019 in 5 more Sector Codes than in 2015 (in autumn) – above ground parts die off after flowering.
- *Dichelachne crinita* recorded in December 2019 in 2 more Sector Codes than in 2015 (in autumn) – above ground parts die off after flowering.
- *Lachnagrostis billardierei* recorded in December 2019 in 9 more Sector Codes than in 2015 (in autumn) – an annual or short-lived perennial whose above ground parts die off after flowering.
- *Lachnagrostis filiformis* recorded in December 2019 in 11 more Sector Codes than in 2015 (in autumn) – above ground parts die off after flowering.
- *Sporobolus virginicus* recorded in December 2019 in 8 fewer Sector Codes than in 2015 (in autumn) – this species can be difficult to distinguish from other grass species when not in flower.
- *Zoysia macrantha* recorded in December 2019 in 4 more Sector Codes than in autumn 2015 – this species can be difficult to distinguish from other grass species when not in flower.

The “Waverley Indigenous Flora 2020 – Changes in Species Distribution” spreadsheet may also identify indigenous plant species which have been intentionally controlled as part of bush regeneration activities to reduce their impact where they were outcompeting other indigenous plant species:

- *Microlaena stipoides* recorded in 3 fewer Sector Codes than in 2015.
- *Pittosporum undulatum* recorded in 8 fewer Sector Codes than in 2015, 2 of those absences possibly relating to the prolonged drought.

6.11 Remnant vegetation – Extent:

Over 5.5 hectares (56,073m^2) of remnant vegetation were mapped. Remnant vegetation was recorded on 40 properties, 2 more than in the Waverley Flora Survey 2015. Its location and extent (m^2) are identified in:

- Table 1 above.
- The GIS data updated for Council as part of this survey.
- The spreadsheet "Waverley Remnant Vegetation 2020", updated for Council as part of this survey.

While there was an overall decrease of 3,873m^2 of remnant vegetation recorded compared with the Waverley Flora Survey 2015:

- There was an increase of remnant vegetation extent of 2,250m^2 due to:
  - Natural spread of remnant vegetation = 1,746m^2.
  - Sites not previously surveyed = 504m^2.
- There was a decrease of remnant vegetation extent of 3,779m^2 due to:
  - Converting mostly Very Poor Condition remnant vegetation into plantings of local native species = 1,909m^2.
  - Prolonged drought = 1,698m^2, much of which is probably temporary, as species such as *Commelina cyanea*, *Cyperus polystachyos* and *Ficinia nodosa* are likely to recolonise sites in non-drought periods.
  - Weed invasion of remnant vegetation = 92m^2.
  - Senescence of indigenous plants = 80m^2.
- The balance of corrections to 2015 mapping was a 2,344m^2 decrease.

Changes in the area of remnant vegetation are detailed in:

- Table 9 "Waverley Council area – Remnant vegetation changes from 2015 to 2020 – REASONS".
- Table 10 "Waverley Council area – Remnant vegetation changes from 2015 to 2020 – SITES".

One of the main reasons for the decrease in area of remnant vegetation in 2020 was corrections to previous mapping, made possible with the availability of higher resolution, more recent orthophoto images. When distinct landmarks, such as nearby houses, aren't visible, recording data such as remnant vegetation extent and Condition can be less accurate. Below is a comparison of images used for remnant vegetation Sector Code R2 (Raleigh Reserve, Dover Heights) in 2010 (left) versus 2020 (right).

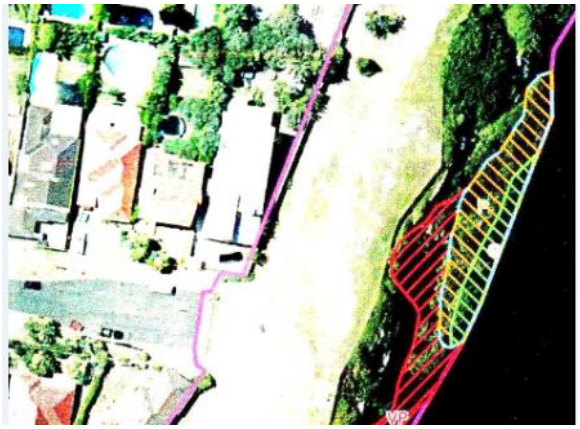

Table 9 Waverley Council area – Remnant vegetation extent changes 2015 to 2020 – REASONS

Reason for change in area of remnant vegetation	Change in area since 2015 (m^2)	Comments
Natural spread of remnant vegetation.	1,746	26 patches of remnant vegetation expanded via natural processes. Changes due to: * Natural regeneration from the soil seedbank as a result of bush regeneration. * Lack of competition from weeds due to the prolonged drought.
"New" areas were surveyed.	504	2 sites, over-looked by previous flora surveys, were visited: * Bay St Cliffs, North Bondi. * Bronte Cutting, Bronte.
Corrections to the 2015 survey.	898	Changes due to: * Better quality air photos being available. * 2020 V 2015 orthophoto images not exactly overlapping. * Weed clearing exposing more remnant vegetation.
Corrections to the 2015 survey.	– 3,242	Changes due to: * Better quality air photos being available. * 2020 V 2015 orthophoto images not exactly overlapping. * Not including small non-remnant areas between patches of remnant vegetation.
Plantings of mostly local native plants.	– 1,909	Plantings occurred in 12 patches of remnant vegetation. Council generally only plants into remnant vegetation where: * Natural regeneration from the soil seedbank has been encouraged for a number of years with no significant results, AND * Remnant vegetation Condition is Very Poor. Plantings into remnant vegetation Condition zones: – Very Poor=1,600m^2 (Parts of 12 Sector Codes) – Poor=107m^2 (Part of Sector Code C2a) – Fair=129m^2 (Part of Sector Codes C2a, Z14a) – Good=73m^2 (Part of Sector Code C2a) See section 5.10 as to what qualifies as a native "Buffer" planting.
Prolonged drought	– 1,698	The prolonged drought detrimentally affected some indigenous species (and benefitted others, due to lack of weed competition). 3 affected species, *Commelina cyanea*, *Cyperus polystachyos* & *Ficinia nodosa*, readily colonise disturbed soils and their presence (when a drought is not in effect) allows remnant vegetation to be mapped. In drier periods, they are only present as seeds in the soil and, if other indigenous species are not present, this results in a decrease in the area of remnant vegetation mapped. Drought affected: * Parts of 13 patches of remnant vegetation. * Remnant mapped as having Very Poor Condition in 2015.
Plant senescence	– 80	Some older shrubs died since the 2015 survey. Where no other indigenous plants were present, this resulted in a decrease in remnant vegetation. It is unclear whether these deaths were due to senescence &/or the prolonged drought. This only related to 2 sites.
Weed invasion	– 92	On 3 sites, weeds either killed some of the remnant vegetation or had overgrown it, such that the remnant vegetation was obscured. 2 of the sites were on private land, 1 was Council managed land near a steep sea cliff.

Table 10 Waverley Council area – Remnant vegetation extent changes 2015 to 2020 – SITES

Property name	Remnant vegetation Sector Code	Change in area since 2015 (m^2)	Possible reasons for changes in area
Diamond Bay Reserve, Vaucluse	D1a	– 70	Prolonged drought killed some plants.
Diamond Bay Reserve, Vaucluse	D1b	– 24	Planting into remnant vegetation.
Diamond Bay Reserve, Vaucluse	D2a	+ 30	Weed clearing exposed more remnant veg.
Diamond Bay Reserve, Vaucluse	D2b	+ 63 – 60	Spread of remnant vegetation. Correction – better air photos available.
Diamond Bay Reserve, Vaucluse	D3c	+ 5	Spread of remnant vegetation.
Kimberley St unformed, Vaucluse	Z5	+ 5	Spread of remnant vegetation.
Eastern Reserve, Dover Heights	Eb	+ 264 – 352	Spread of remnant vegetation. Planting into remnant vegetation.
Eastern Reserve, Dover Heights	Ec	+ 20 – 60 – 160 – 150	Correction – better air photos available. Prolonged drought killed some plants. Planting into remnant vegetation. Corrections: * Not map areas of bare rock mapped as remnant vegetation in 2015. * Better air photos available.
Eastern Reserve, Dover Heights	Ed	+ 60 – 188 – 296 – 180	Correction – better air photos available. Prolonged drought killed some plants. Planting into remnant vegetation. Correction: not map areas of bare rock mapped as remnant vegetation in 2015.
Caffyn Park, Dover Heights	F1	+ 39 – 10	Spread of remnant vegetation. Prolonged drought killed some plants.
Caffyn Park, Dover Heights	F5	– 15 – 35	Planting into remnant vegetation. Correction – better air photos available.
Caffyn Park, Dover Heights	F6	+ 20 – 19 – 35	Correction – better air photos available. Planting into remnant vegetation. Correction: Some non–remnant areas between remnant vegetation not mapped.
Dover Rd unformed, Rose Bay	Z5	– 44	Correction – better air photos available.
Weonga Reserve, Dover Heights	Z6	– 102 – 265	Planting into remnant vegetation. Correction – better air photos available.
Rodney Reserve, Dover Heights	Z7	– 719	Prolonged drought killed some plants.
Raleigh Reserve, Dover Heights	R2	– 150 – 225 – 75 – 75 – 315	Prolonged drought killed some plants. Planting into remnant vegetation. Native plant senescence. Weed invasion. Correction – better air photos available.
Raleigh Reserve, Dover Heights	R3	– 47	Prolonged drought killed some plants.
Loombah Road cliffs, North Bondi	O46	– 3	Weed invasion.
Loombah Road cliffs, North Bondi	L1a	– 16	Correction – better air photos available.
Loombah Road cliffs, North Bondi	L1b	– 197 – 115	Planting into remnant vegetation. Correction – better air photos available.
Loombah Road cliffs, North Bondi	L25a	– 12	Correction – better air photos available.
Loombah Road cliffs, North Bondi	L27b	– 68	Weed clearing exposed less remnant veg.
Loombah Road cliffs, North Bondi	L14	– 30 – 31	Prolonged drought killed some plants. Correction – better air photos available.
Loombah Road cliffs, North Bondi	L16	– 5	Native plant senescence.
Loombah Road cliffs, North Bondi	L134	– 14	Weed invasion.
Douglas Parade, Dover Heights	Z8	+ 6	Weed clearing exposed more remnant veg.
Hugh Bamford Reserve, Dover Heights	H1a	+ 202	Natural spread of remnant vegetation.
Hugh Bamford Reserve, North Bondi	H1b	+ 39	Correction – better air photos available.
Hugh Bamford Reserve, North Bondi	H1c	+ 184	Natural spread of remnant vegetation.
Bondi Golf Course, North Bondi	G1	– 77	Prolonged drought killed some plants.
Bondi Golf Course, North Bondi	G2	– 134	Corrections: * Better air photos available. * Some non–remnant areas between remnant vegetation not mapped.
Bondi Golf Course, North Bondi	G3	– 106	Prolonged drought killed some plants.
Bondi Golf Course, North Bondi	G4	– 67	Correction – better air photos available.

Table 10 CONT'D Waverley Council area – Remnant vegetation extent changes 2015 to 2020 – SITES

Property name	Remnant vegetation Sector Code	Change in area since 2015 (m^2)	Possible reasons for changes in area
Bay St Cliffs, North Bondi	Z18	+ 481	"New" patch – not previously mapped.
Ray O'Keefe and Sam Fiszman Reserves, North Bondi	Z9	+ 20 – 80 – 21	Correction – better air photos available. Prolonged drought killed some plants. Correction – better air photos available.
Bondi Park, Bondi Beach	Z11a	+ 30 + 90 – 15	Natural spread of remnant vegetation. Correction – better air photos available. Correction – better air photos available.
Bondi Park, Bondi Beach	Z11b	– 1	Prolonged drought killed some plants.
Bondi Park, Bondi Beach	Z11d	– 13	Correction – better air photos available.
Hunter Park, Bondi / Bondi Beach	Z12b	+ 8	Correction – better air photos available.
Hunter Park, Bondi / Bondi Beach	Z12e	– 1	Correction.
Hunter Park, Bondi / Bondi Beach	Z12f	+ 88	Correction – better air photos available.
Marks Park, Bondi	Z13a	+ 36	Natural spread of remnant vegetation.
Marks Park, Bondi	Z13b	+ 5	Natural spread of remnant vegetation.
Marks Park, Bondi	Z13d	– 138	Planting into remnant vegetation.
Marks Park, Bondi	Z13e	+ 20 + 102 – 15	Natural spread of remnant vegetation. Correction – better air photos available. Correction – better air photos available.
Marks Park, Bondi	Z13f	+ 10	Natural spread of remnant vegetation.
Marks Park, Bondi	Z13g	+ 8	Natural spread of remnant vegetation.
Marks Park, Bondi	Z13i	+ 91	Natural spread of remnant vegetation.
Marks Park, Bondi	Z13j	+ 11	Natural spread of remnant vegetation.
Gaerloch Reserve, Tamarama	Z14a	+ 20 + 30 – 116 – 30	Natural spread of remnant vegetation. Correction – better air photos available. Planting into remnant vegetation. Correction – better air photos available.
Gaerloch Reserve, Tamarama	Z14b	+ 3	Natural spread of remnant vegetation.
Gaerloch Reserve, Tamarama	Z14c	– 160	Prolonged drought killed some plants.
Tamarama Park, Tamarama	T1	+ 50 – 70	Weed clearing exposed more remnant veg. Correction – better air photos available.
Tamarama Park, Tamarama	T5	+ 57	Natural spread of remnant vegetation.
Coast Walk, Bronte	Z15a	+ 141	Natural spread of remnant vegetation.
Coast Walk, Bronte	Z15b	+ 17	Natural spread of remnant vegetation.
Calga Reserve, Bronte	B1	+ 43	Natural spread of remnant vegetation.
Calga Reserve, Bronte	B2	+ 203	Natural spread of remnant vegetation.
Calga Reserve, Bronte	B8	+ 58	Correction – better air photos available.
Bronte Cutting, Bronte	Z19	+ 23	"New" patch – not previously mapped.
Waverley Cemetery cliffs, Bronte	C1a	+ 80 + 139	Natural spread of remnant vegetation. Correction – better air photos available.
Waverley Cemetery cliffs, Bronte	C1b	+ 30 – 25	Correction – better air photos available. Planting into remnant vegetation.
Waverley Cemetery cliffs, Bronte	C2a	– 265 – 45	Planting into remnant vegetation. Correction – better air photos available.
Waverley Cemetery cliffs, Bronte	C2b	+ 98	Correction – better air photos available.
Queens Park, Queens, Park	Q1	+ 50 + 30 – 1,479	Natural spread of remnant vegetation. Correction – better air photos available. Corrections: * Some non–remnant areas between remnant vegetation not mapped. * Better air photos available.
Queens Park, Queens, Park	Q6	+ 53	Natural spread of remnant vegetation.
York Road Bushland, Queens Park	Y1	– 1	Correction.
York Road road verge, Queens Park	Y2	+ 86	Natural spread of remnant vegetation.
Total change in area (m^2)		– 3,873	

6.12 Remnant vegetation – Condition:

The location and area (m^2) of the Condition zones for remnant vegetation are identified in:

- The GIS data updated for Council as part of this survey.
- The spreadsheet "Waverley Remnant Vegetation 2020".

A summary of the area (m^2) of each Condition zone is provided in Table 11. The information in this table should be interpreted with the knowledge that there have been changes in the extent of remnant vegetation, including 2 new areas and a large decrease due to corrections since the 2015 survey, as discussed in the previous section above.

Good Condition – change in extent:
The area of Good Condition remnant vegetation has more than doubled. This is attributable to bush regeneration and probably the drought – the more moisture there is in the soil, the greater the weed growth. The main gains in the area of Good Condition were:

- 1,500m^2 at York Road Bushland, Queens Park (Centennial Parklands land).
- 625m^2 at York Road road verge, Queens Park (Council managed land).
- 629m^2 at Hugh Bamford Reserve, Dover Heights (Council managed land).

Fair Condition – change in extent:
By far the largest change in Fair Condition was at York Rd. While 1,500m^2 changed from Fair to Good, 717m^2 changed from Fair to Poor and 415m^2 changed from Fair to Very Poor. This may have been attributable to senescence of native vegetation (*Leptospermum laevigatum*) and a re-focus of where bush regeneration works take place.

Poor Condition – change in extent:
The largest changes in Fair Condition were:

- Hugh Bamford Reserve: ~50% of change to each of Good and Very Poor Condition.
- Tamarama Park: parts of change to each of Fair and Very Poor Condition.
- York Road Bushland: most of change from Fair Condition.

The above changes may be attributable to the same reasons as Fair Condition above.

Very Poor Condition – change in extent:
Many sites had changes in Very Poor Condition, the main reason being converting these areas into local native plantings.

Table 11: Waverley Council area – Remnant vegetation Condition in 2020

	2015			2020		
Remnant vegetation Condition zone	**Total area 2015** (m^2)	**Percentage of total area of remnant vegetation** (%)	**Change in area since 2010** (m^2)	**Total area 2020** (m^2)	**Percentage total area of remnant vegetation** (%)	**Change in area since 2015** (m^2)
Good	2,559	4	– 167	5,249	9	2,690
Fair	11,552	19	– 494	8,876	16	– 2,676
Poor	7,131	12	1,703	4,619	8	– 2,512
Very poor	38,704	65	– 443	37,330	67	– 1,374
TOTALS	59,946	100	599	56,072	100	– 3,872

6.13 Remnant vegetation – Communities:

The same 15 vegetation communities recorded in 2015 were again recorded in 2020. Their names, extent (m^2), change in extent since 2015, number of patches, change in number of patches since 2015, are identified in:

- Table 12 below.
- The GIS data updated for Council as part of this survey.
- The spreadsheet "Waverley Remnant Vegetation 2020", updated for Council as part of this survey.

Vegetation Communities – Extent:

Only 2 vegetation communities total >1 hectare in extent:

- Sea-cliff Heath = 18,902m^2.
- Eastern Suburbs Banksia Scrub = 17,628m^2.

Another 3 vegetation communities total 1,000m^2 to 1 hectare in extent.

- Sea-cliff Sedgeland: c) Ficinia nodosa = 7,350m^2.
- Sea-cliff Scrub = 4,884m^2.
- Sea-cliff Grassland = 3,456m^2.

Vegetation Communities – Changes in extent:

Only 4 vegetation communities had a change of >100m^2 in their total extent:

- Eastern Suburbs Banksia Scrub: a decrease of 1,314m^2, largely attributable to:
    - Not mapping some areas where there was no remnant between areas of remnant vegetation.
- Low Woodland / Low Forest: a decrease of 504m^2, largely attributable to:
    - Planting in areas mapped in 2015 as Very Poor Condition.
    - Correction of 2015 mapping – orthophoto images used in 2020 are clearer.
- Sea-cliff Heath: a decrease of 2,453m^2, largely attributable to:
    - Some patches now "Too disturbed to classify".
    - Change to another vegetation community.
    - Planting in areas mapped in 2015 as Very Poor Condition.
    - Correction of 2015 mapping – orthophoto images used in 2020 are clearer.
- Sea-cliff Sedgeland c) Ficinia nodosa: a decrease of 166m^2, many changes both increasing and decreasing extent.

Table 12: Waverley Council area – Remnant vegetation communities in 2020

No.	Vegetation Community Name	Total extent 2020 (m^2)	Percent of total area of remnant vegetation (%)	Change in extent since 2015 (m^2)	Number of patches of each community (x) = Change since 2015)	Possible reasons for changes in area Letter-Number = Sector Code Changes <50m^2 not shown, unless patch lost. *Italics=Decrease.*
1	Beach Grassland	32	0.1	0	1	
2	Eastern Suburbs Banksia Scrub	17,628	31.4	– 1,314	6	* Y2: 86m6 extent decrease. ** Q1: –1,399m2 extent decrease.*
3	Fernland	226	0.4	23	3 (+ 1)	* Z19: "New" patch of remnant vegetation – not previously surveyed, 23m2.
4	Imperata Grassland	142	0.3	2	2 (– 1)	** Q4: Now "Too disturbed to classify".*
5	Low Woodland / Low Forest	470	0.8	– 504	7 (– 1)	** L1b, L14, L27b: >50m2 extent decrease.* ** O46: Remnant vegetation not recorded.*
6	Sandstone Dry Scrub	725	1.3	– 33	6	
7	Sandstone Moist Heath	244	0.4	– 76	2 (– 2)	** V: 50m2 extent decrease.* ** L134, L136: Now "Too disturbed to classify".*
8	Sea-cliff Grassland	3,456	6.2	63	14 (+ 1, – 1)	* 4x Sector Codes: >50m2 extent increase. * Z13b: change from another vegetation community. ** 3x Sector Codes: >50m2 extent decrease.* ** Z12d: change to another vegetation community.*
9	Sea-cliff Heath	18,902	33.7	– 2,453	18 (+ 1, – 4)	* B2: 203m2 extent increase. * D3b: change from another vegetation community. ** Z12f: change to another vegetation community.* ** B7, G5, Z12a: Now "Too disturbed to classify".* ** 6x Sector Codes: >50m2 extent decrease.*
10	Sea-cliff Herbland: a) *Lobelia alata*	394	0.7	– 27	3 (– 1)	* Z15a: 141m2 extent increase. * Z14c: change from another vegetation community. ** Z13a, Z15b: change to another vegetation community.*
11	Sea-cliff Herbland: b) *Dianella congesta*	249	0.4	83	3 (+ 1)	* Z12f: change from another vegetation community.
12	Sea-cliff Scrub	4,884	8.7	58	4	* H1a: 202m2 extent increase. * H1c: 184m2 extent increase. ** Z6: 367m2 extent decrease.*
13	Sea-cliff Sedgeland: a) *Carex pumila*	352	0.6	25	2 (– 1)	* T5: 57m2 extent increase. ** Z13b: change to another vegetation community.*
14	Sea-cliff Sedgeland: b) *Baumea juncea*	704	1.3	0	2 (+ 1, – 1)	* C2a: 98m2 extent increase. * C1b: change from another vegetation community. ** D3b: change to another vegetation community.*
15	Sea-cliff Sedgeland: c) *Ficinia nodosa*	7,350	13.1	166	18 (+ 4, – 3)	* Z18: "New" patch of remnant vegetation – not previously surveyed, 481m2. * C1a: 219m2 extent increase. * 3x Sector Codes: change from another vegetation community. ** Z3: Now "Too disturbed to classify".* ** 5x Sector Codes: <~100m2 extent decrease.* ** 2x Sector Codes: change to another vegetation community.*
NA	Too disturbed to classify	351	0.6	114	11 (+ 8)	8x Sector Codes <30m2 and whose vegetation structure is highly disturbed.
	TOTALS	**56,073**	**100.0**	– 3,873	**101** (+ 2) **OR** **93** (–6) IF "Too disturbed" not included)	

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

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

- Table 13 below.
- The GIS data updated for Council as part of this survey.
- The spreadsheet "Waverley Remnant Vegetation 2020".

There has been a 0.1 hectare decrease in the extent of SEPP19 Bushland since 2015. Possible reasons for the change in each patch of remnant vegetation appear in Table 13.

Table 13: Waverley Council area – SEPP 19 Bushland in 2020

Property	Sector Codes	2015 (m^2)	2020 (m^2)	Possible reason/s for change in extent of SEPP19 between 2015 and 2020
Diamond Bay Reserve	D1b	250	227	Loss of structure and floristic diversity of native vegetation due to weed invasion.
Diamond Bay Reserve	D3b	181	0	Loss of structure and floristic diversity of native vegetation due to native shrub senescence.
Eastern Reserve	Ec	352	315	Loss of structure and floristic diversity of native vegetation due to native shrub senescence.
Eastern Reserve	Ed	616	811	**1)** Gain: Improvement in structure of native vegetation due to weed treatment. **2)** Loss: Loss of structure and floristic diversity of native vegetation due to native shrub senescence. **3)** NOTE: Only the balance of the Gain V Loss is shown above, i.e. 195m2 gain.
Caffyn Park	F1	279	336	**1)** GAIN: Spread of native vegetation. **2)** Loss: Correction of 2015 mapping – Orthophoto images used in 2020 V 2015 don't exactly overlap. **3)** NOTE: Only the balance of the Gain V Loss is shown above, i.e. 57m2 gain.
Rodney Reserve	Z7	35	0	Loss of structure of native vegetation due to weed invasion and possibly due to native shrub senescence.
Raleigh Reserve	R2	452	0	**1)** Correction of 2015 mapping – Orthophoto images used in 2020 V 2015: * Are clearer. * Don't exactly overlap. **2)** Loss of structure of native vegetation due to native shrub senescence and weed invasion.
Hugh Bamford Reserve	H1	2,932	2,431	**1)** Loss: * Loss of floristic diversity (groundcovers) in H1c. * Native shrub senescence in H1a. **2)** Gain: Weed treatment in H1a leading to improvement in structure of native vegetation. **3)** NOTE: Only the balance of the Gain V Loss is shown above, i.e. 501m2 Loss.
Tamarama Park	T1	2,334	2,271	**1)** Gain: Improvement in structure of native vegetation due to weed treatment. **2)** Loss: * Loss of structure and floristic diversity of native vegetation due to native shrub senescence. * Correction to 2015 mapping after weed treatment. **3)** NOTE: Only the balance of the Gain V Loss is shown above, i.e. 63m2 gain.
Total area (m^2)		**7,430**	**6,391**	

6.15 Buffer Plantings:

A total of 146 patches of buffer planting was mapped, totalling 40,363m^2. They occurred near remnant vegetation in 19 Council parks, reserves and road reserves and in Queens Park (see Table 14 and the GIS data provided to Council as part of this survey). As described in the Methodology section, private land is not included buffer planting mapping.

Plantings occurred within 12 patches of remnant vegetation. Council generally only plants into remnant vegetation where:

- Natural regeneration from the soil seedbank has been encouraged for a number of years with no significant results, AND
- Vegetation Condition is Very Poor.

Buffer planting in 2020 occurred in remnant vegetation mapped in 2015 as:

- Very Poor: 1,600m^2, parts of 12 Sector Codes.
- Poor: 107m^2, part of Sector Code C2a.
- Fair: 129m^2, part of Sector Codes C2a, Z14a.
- Good: 73m^2, part of Sector Code C2a.

Table 14: Waverley Council area – Buffer plantings in 2020

Property Name (All Council properties, plus Queens Park)	**Remnant Sector Codes** (Buffer plantings don't occur near every Sector Code)	**Number of patches of Buffer planting**
Clarke Reserve, Vaucluse	Z1	3
Jensen Avenue Reserve, Vaucluse	Z2	0
Tower St Reserve, Vaucluse	Z3	1
Diamond Bay Reserve, Vaucluse	D1a – D1c, D2a – D2b, D3a – D3c	9
Kimberley St unformed, Vaucluse	Z5	0
Eastern Reserve, Dover Heights	Ea – Ed	7
Caffyn Park, Dover Heights	F1, F5, F6	2
Dover Rd unformed, Rose Bay	V	0
Weonga Reserve, Dover Heights	Z6	5
Rodney Reserve, Dover Heights	Z7	(Included in R below)
Raleigh Reserve, Dover Heights	R1 – R3	12
Loombah Rd-Macleay St Cliffs, North Bondi	L1a – L1c	1
Douglas Parade unformed, Dover Heights	Z8	0
Hugh Bamford Reserve, Dover Heights & North Bondi	H1a – H1c, H2a	8
Bondi Golf Course, North Bondi	G1 – G5	Not considered – leased from Council
Bay St Cliffs, North Bondi	Z18	0
Sam Fiszman Reserve, North Bondi	Z9	0
Bondi Park, Bondi Beach	Z11a – Z11d	3
Hunter Park, Bondi & Bondi Beach	Z12a – Z12e	20
Marks Park, Bondi & Tamarama	Z13a – Z13j	23
Gaerloch Reserve, Tamarama	Z14a – Z14c	10
Tamarama Park, Tamarama	T1, T3a, T3b, T5, T7	17
Coast Walk Bronte, Bronte	Z15a – Z15b	0
Calga Reserve, Bronte	B1, B2, B7, B8	13
Bronte Cutting, Bronte	Z19	(Included in B above)
Waverley Cemetery Cliffs, Bronte	C1a – C1b, C2a – C2c	8
Waverley Cemetery, Bronte	C3	0
Thomas Hogan Reserve, Bondi	Z17	0
Queens Park, Queens Park	Q1 – Q9	3 Not Council managed
York Rd road verge, Queens Pk	Y2	1

7. Recommendations

- Manage areas of remnant vegetation using best practice bush regeneration principles. Undertake on-ground management actions to stimulate natural regeneration from the soil seedbank, rather than planting.
- 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.
- In areas of remnant vegetation mapped as having “Very Poor” Condition, where natural regeneration from the soil seedbank hasn’t occurred after several years of actively managing the site to promote regeneration by natural processes, consider planting.
- Ensure bush regeneration occurs on at least a monthly basis wherever work has commenced, for at least as long as required 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.
- Remove native species which are not indigenous to the Waverley Council area from remnant vegetation, including at least those in Table 2.
- Remove, or reduce the numbers of, certain indigenous plant species where they outcompete or inhibit natural regeneration of other indigenous plant species. Such species may 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.
  - Species loss from a site, except annuals and ephemerals.
  - Significant species distribution and abundance changes.
  - Remnant extent changes.
  - Remnant Condition annually.
- Update the spreadsheet “Waverley Indigenous Flora” on an annual basis.
- Update the spreadsheet “Waverley Remnant Vegetation” on an annual basis.
- Carry out any future flora surveys between September and February, when more annual species are present, otherwise they may be missed.

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