

2022

Bushland Management Plan for Koolunga Native Reserve and Vaughan Road Reserve, Ferntree Gully

Prepared for

Knox City Council

by

Graeme S. Lorimer, PhD

Biosphere Pty Ltd

ABN 28 097 295 504

www.biosphere.net.au

18 Marie St, Boronia, Vic. 3155

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- Bill Ireland, who has provided photographs and oral history about the reserves and their surroundings going back as far as the 1950s;
- Dru Taylor, James Rose, Nadine Gaskell and Andrew Barr from Knox City Council for facilitating this document, contributing a range of information about the reserves’ management and coordinating contact with stakeholders;
- Niels Unger – Council’s stormwater coordinator – for information about stormwater inflows to the reserves and prospects of improved management within the reserves;
- Sharon Merritt and Brian Earl of the Country Fire Authority for advising about fire hazard management and its integration with ecological management;
- Kelly Bayton of Melbourne Water for providing her organisation’s perspectives on stream management in the reserves; and
- Rita Fernandez and Zhipeng Cai of Group GSA Pty Ltd for cooperating to coordinate this document with their Community Engagement and Landscape Plan for Koolunga Native Reserve.

– Dr Graeme Lorimer

Summary

This report provides information and management advice about the natural environment (not visitor facilities) at two forested council reserves in Ferntree Gully: the six-hectare Koolunga Native Reserve and the half-hectare Vaughan Road Reserve. The reserves are separated by only 15 m, with a creek flowing through them both.

Matters related to wildlife habitat, water pollution, erratic stream flows and catchment management are in common between the two reserves. Topography and vegetation management requirements differ between them.

The following biological highlights are in common between the two reserves:

- They each contain small populations of two globally-endangered plant species (*Acacia stictophylla* and *Platylobium infecundum*). The latter is a matter of National significance;
- They each contain vegetation types listed as ‘endangered’ by the Victorian Government;
- They provide prey and roost sites for some Powerful Owls (listed as Vulnerable in Victoria), whose large home ranges include the neighbourhood; and
- Two migratory native fish species (Shortfin Eel and Broadfin Galaxias) live in the creek that flows through the reserves.

Koolunga Native Reserve also contains the following additional biological highlights:

- One of only two known patches of the grass, Graceful Fescue (*Festuca asperula*), in Knox, with only nine other valid records of the species in the Port Phillip and Western Port region through history;
- Approximately 60 wild, indigenous plant species that are threatened with dying out throughout Knox; and
- A total of approximately 150 wild, indigenous plant species (including mosses and liverworts), which is a large number for a single site in Knox.

Vaughan Road Reserve contains the following biological highlights not found in Koolunga Native Reserve:

- This study found a single Floodplain Groundsel (*Senecio campylocarpus*), which is listed as ‘endangered’ under the Victorian *Flora and Fauna Guarantee Act*. It has since washed away;
- The steep, southeast-facing slope differs significantly in soil type and topography from any other site in Knox that retains as much native vegetation; and
- The reserve contains eleven wild, indigenous plant species whose risk of dying out in Knox is rated as either endangered or critically endangered by Lorimer (2010).

The two reserves’ natural environment also provides humanity with the following benefits:

- *Practical ‘ecosystem services’*: The vegetation provides shade, wind reduction, cooling by transpiration and purification of air and water;
- *Satisfying the human need to connect with nature*, by offering experiences in a natural environment and thereby providing benefits to health, wellbeing, childhood development and quality of life;
- *Natural heritage*: Nature’s contribution to sense of place and our concepts of who we are, how we fit into history and nature’s grand design, and what we should pass on to future generations; and

- *Financial and economic benefits* such as through reducing health costs and increasing property values in the vicinity.

Threats

Living things in the reserves are facing the following main threats:

- Climate change, which may well make the habitat unfit for many indigenous plant and animal species within 1–2 decades, leading to collapse of the ecosystem;
- Declining eucalypt health due to the drying climate, a fallen water table (due to impervious surfaces in the water catchment), unnaturally high populations of ringtail and brushtail possums, and perhaps soil-borne fungal disease. Eucalypts represent a cornerstone of the reserves' overall ecology;
- Ecological decline of the vegetation, including habitat of threatened species, due to the same factors just mentioned as well as: (a) precariously small population sizes of many indigenous plant species; (b) disruption of ecological balances due to the thin eucalypt canopy; and (c) unclear factors, e.g. perhaps loss of specific pollinators due to insect declines or displacement of bird species by Noisy Miners;
- Environmental weeds – particularly vines;
- Pulsing of stream flows (i.e. very high flows during rainfall events and no flow for extended periods) due to a high cover of impervious surfaces in the catchment;
- Stream erosion due to the flow pulses;
- Death of stream life such as fish and invertebrates when the watercourses run dry; and
- Water pollution, e.g. toxins, turbidity and excessive nutrients.

Recommended Management Actions

The following is an abridged summary of the management actions recommended to deal with the abovementioned threats as well as bushfire safety:

Catchment management

- Prepare a water management plan for the eastern Blind Creek catchment to achieve the above objectives. The main objectives would be to: (a) Encourage more rainwater in the catchment to infiltrate to groundwater or be detained (rather than running down pipes) and hence more steadily feed water to plants, animals and streams; (b) Reduce flooding in the catchment; and (c) Improve water quality in watercourses. *High importance*

Bushfire hazard

- Maintain firebreaks and extend the one adjacent to Sassafras Court residences to facilitate passage by fire trucks. *High importance*
- Arrange some controlled burns for reasons of bushfire protection, ecological regeneration and Aboriginal culture. *Moderate importance*

Environmental weed control

- Urgently increase the effort to control rampant vine weeds within the forest at Vaughan Road Reserve. *Very high importance*

- Urgently increase the effort to control blackberry, Wonga Vine and (to a lesser degree) Japanese Honeysuckle and Sweet Pittosporum, within an area northeast of the footbridge near the end of St Elmo Av. The area contains the endangered vegetation type, Swampy Woodland, and rare plants. *Very high importance*
- Hand-weed around a tiny patch of the regionally-rare grass, Graceful Fescue (*Festuca asperula*), which had not been known to occur in Knox until this patch was discovered in 2020. *High importance*
- Use grass-specific herbicide to selectively control Kikuyu and Panic Veldt-grass near the northern entry to Koolunga Native Reserve from Forest Rd. *Moderate importance*
- Do some weeding and pruning of the ‘Indigenous Demonstration Garden’ at the end of St Elmo Av to allow the garden to fulfill its intended purpose. *Moderate importance*
- Continue other existing weed control efforts but avoid directing too many resources to trying to remove Wandering Trad or Creeping Buttercup along the watercourses, as such efforts are very unlikely to create lasting change. *High importance*
- Council and the Friends group should regularly review the weed control effort being expended on the various parts of the reserves to maintain an appropriate balance between areas. *Moderate importance*

Tree management

- Conduct regular arboricultural inspections of trees overhanging paths or close to areas accessible to the public. Remove hazardous wood or trees. *High importance*
- Avoid providing nest boxes that might house more brushtail possums, which are already so unnaturally abundant that they are contributors to eucalypt deaths. *Moderate importance*

Planting and Horticultural Activity

- Prepare and implement a management plan for the few known populations of the regionally-rare Graceful Fescue in and near Knox, focused on exchange of propagated plants between the sites. The aim is to improve the species’ security, reproduction and genetic diversity. The species normally only flowers in the summer following a fire. Therefore, before the proposed burn in Koolunga Native Reserve, introduce propagated individuals *ex* Roselyn Crescent Reserve and Bungalook Conservation Reserves to exchange pollen during post-fire flowering. *High importance*
- Plant clusters of mixed eucalypt species in canopy gaps of Koolunga Native Reserve. Tag and document every plant and monitor their height and health over the years to determine the relative success of the different species in filling canopy gaps. *High importance*
- Plant paperbarks just west of Koolunga Native Reserve’s boardwalk to provide competition with Creeping Buttercup and Wandering Trad. *Moderate importance*
- Transplant some of the Common Bird-orchids (*Chiloglottis valida*) from Vaughan Road Reserve into a suitable location in Koolunga Native Reserve. *Low importance*
- Ensure that all people who select positions to insert plants into the forest are aware of the danger of inadvertently digging up plants of higher importance in the process. *High importance*
- Avoid planting shrubs in parts of the forest where shrubs are already denser than desirable. *High importance*

Paths and access

- Close and revegetate a 20 m-long path parallel to the Forest Road Drain, 12 m northeast of the footbridge near the dead end of St Elmo Av. *Moderate to high importance*

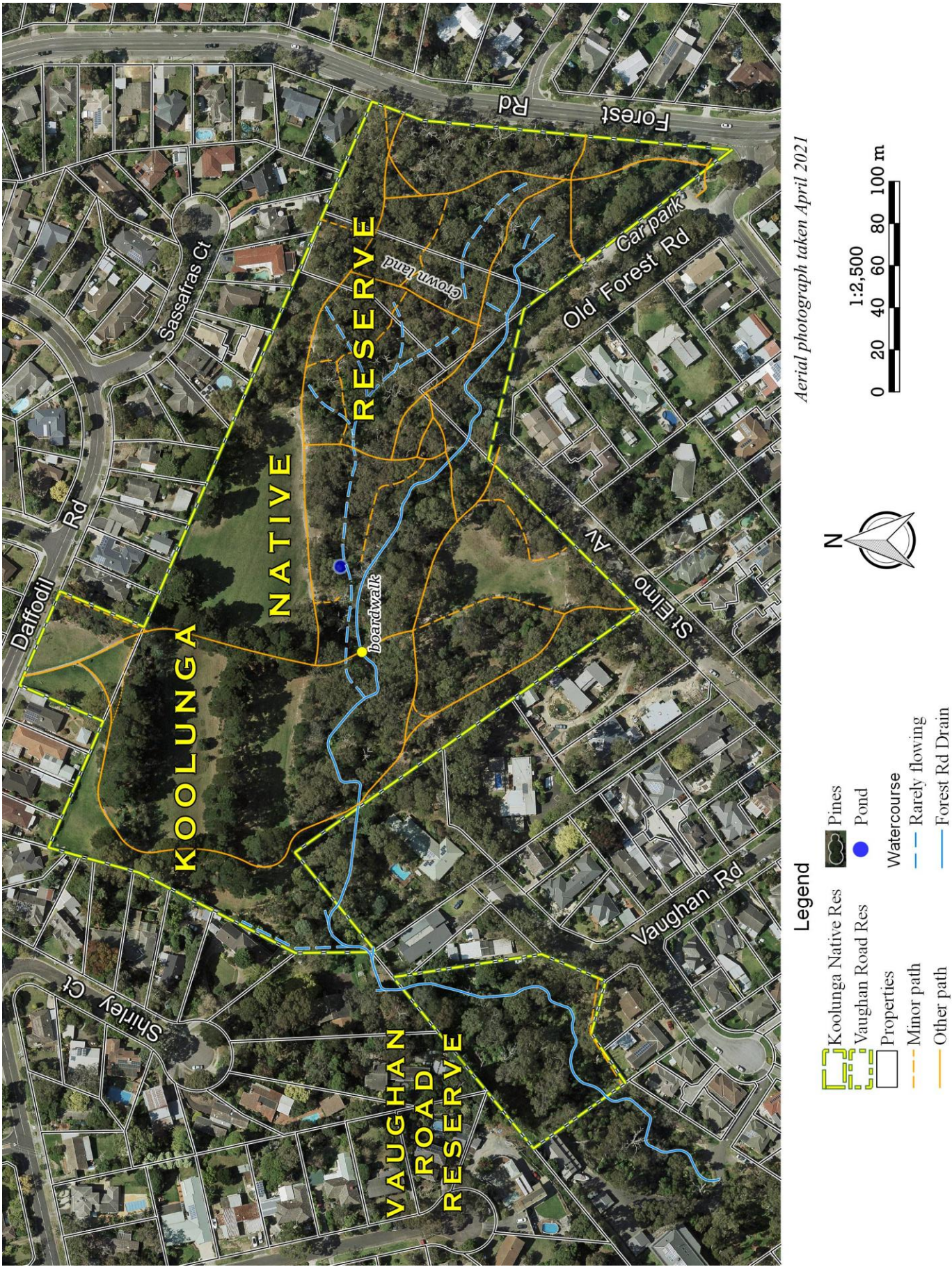
Liaison between Council, the Friends of Koolunga Native Reserve and the community

- Council to increase liaison with the Friends of Koolunga Native Reserve and provide training, so the Friends can maximise their effectiveness and thereby gain a greater sense of achievement. *Moderate importance*
- Council to offer the Friends group regular scheduled meetings or inspections regarding what Council, its contractors and the Friends group are planning to do in Koolunga Native Reserve and Vaughan Road Reserve. Matters for discussion include management activities and projects such as the Sugar Glider project. *Moderate importance*
- Include recognition of the Friends group in the new signage of the reserve that is being contemplated. Subject to the views of the Friends group, include information about their upcoming activities, either by updatable signs (e.g. blackboard) or reference to online information (e.g. QR code). *Moderate importance*
- Conduct periodic public guided nature walks and workshops, including Aboriginal perspectives, catchment management issues, climate change and the connection of these things with how we live our lives. *Moderate importance*

Further fauna survey

- Assess the affordability of a survey for microbats and an environmental DNA survey of aquatic fauna. *Low to moderate importance*

Figure 1. Marked-up aerial image of Koolunga Native Reserve and Vaughan Road Reserve in 2021.



1. The Investigation for this Management Plan

This management plan has been prepared mainly from the author's own fieldwork and investigations, aided by prior information sources and consultation with people from:

- Knox City Council regarding arboriculture, Aboriginal engagement and management of vegetation, fire and stormwater;
- The Friends of Koolunga Native Reserve regarding their management of that reserve, their ideas about future management and their observations of flora and fauna in that reserve and Vaughan Road Reserve;
- The Country Fire Authority regarding fire hazard management and ecological burning;
- Melbourne Water regarding management of stormwater and riparian vegetation; and
- Group GSA regarding outcomes of their community consultation as part of the Koolunga Native Reserve 'Future Directions Plan'.

1.1 Pre-existing Sources of Information

- An [1865 'Plan of the Agricultural Area of Narree Worrان'](#) (which included Ferntree Gully);
- An [1876 annotated plan](#) of Crown Allotments on 'Country Lands' between Boronia, Montrose and Croydon, marked with key features of vegetation, drainage and topography;
- [Sheet 1 of the 1884 Parish Plan](#), heavily marked-up with updates to the 1980s, as well as copies of other editions from [1878](#) to [1963](#);
- Monochrome aerial photographs of the area in [1946](#), 1951, 1954, 1967, 1968, [1971](#), and 1976;
- Colour aerial photographs of the area in [1981](#), 1982, [1984](#), 1985 and 2021;
- Certificates of Title for eastern parts of Koolunga Native Reserve from 1917 and 1921;
- Victoria Government Gazettes from 1918 (p. 2,795) and 1978 (p. 3,574) gazetting changes to the status of road reserves in eastern parts of Koolunga Native Reserve;
- Proclamation of St Elmo Avenue in the Victorian Government Gazette of 1950, pp. 4293–4;
- The 1959 Plan of subdivision LP56705, in which Vaughan Road Reserve was delineated;
- Vesting of Vaughan Road Reserve in the Shire of Knox in the Victorian Government Gazette of 1965, p. 3947;
- Documents held by the Friends of Koolunga Native Reserve about that reserve's history between 1917 and recently;
- Oral history and photographs dating as far back as the 1950s, from lifetime-local-resident Bill Ireland;
- A brochure titled '*An Introduction to Koolunga Native Reserve*' by the Knox Environment Society dated 1984, and a revised edition dated 1997;
- A brochure titled '*An Introduction to the Vaughan Road Bushland Regeneration Project*' by the Knox Environment Society dated 1986;
- Extensive records of flora and fauna by Kathleen Loxton of the Friends of Koolunga Native Reserve dating as far back as the 1980s, along with verbal accounts of the group's management experience in the reserve over many years;

- A plant list and data from ten quadrats (numbers N1320100-N1321000 in the Victorian Biodiversity Atlas) gathered from Koolunga Native Reserve by Mr Andrew Paget in March and April 1985 and documented in his final project report for BAppSc (Landscape Architecture) at RMIT in 1985;
- An incomplete list of plant species in Vaughan Road Reserve by Mr Paget in 1986;
- Lists of plant and bird species in Koolunga Native Reserve appended to the book, *'Knox Nature Trail'* (Western 1985);
- Fauna observations contributed by Rowan Jennion and Morya Farrington of the Friends of Koolunga Native Reserve, mostly gathered to support the present study;
- All relevant flora and fauna records in the online Victorian Biodiversity Atlas and the Atlas of Living Australia;
- The 1994 document, *'A Management Plan for Koolunga Native Reserve, Forest Road, Ferntree Gully'* by Mark Allaway, which (in part) includes extensive information about the reserve's history since 1968 and aerial photographs from 1951 and 1985;
- The 1994 report, *'Koolunga Flora and Fauna Reserve...Botanical Survey – Recorded Data, Analysis and Community Descriptions'*, including data from three quadrats (numbers N0190800-N0191000 in the Victorian Biodiversity Atlas) and compilations of earlier plant records. Authorship was claimed by Mark Allaway and Associates but the work was principally done by Mr Damien Cook;
- The author's *'2006 Bushland Management Plan for Koolunga Native Reserve, Ferntree Gully'* (Lorimer 2006), including its mapping of vegetation types;
- Overland flow catchment boundaries as mapped in the ['Melbourne Water Stream Network' online resource by the University of Melbourne](#);
- Mapping of stormwater pipes and their connection points, provided by Knox City Council;
- The aerial image of the area depicted in Figure 1, flown in April 2021 and provided by Knox City Council;
- Contour mapping with 0.1 m vertical precision derived from lidar mapping flown in November 2017;
- Other documents listed in the References section of this report (page 67).

1.2 Fieldwork

The author has conducted prior vegetation monitoring surveys in Koolunga Native Reserve in 1999, 2001–2, 2007, 2014 and 2020. He also conducted an extensive investigation of the reserve's flora, fauna and management in 2004–2006 for his *'2006 Bushland Management Plan for Koolunga Native Reserve, Ferntree Gully'*. He and his colleague, Rik Brown, conducted a brief ecological survey of Vaughan Road Reserve in 2002 for the first edition of *'Sites of Biological Significance in Knox'* (Lorimer 2004), plus a brief update for the second edition in 2010.

For the present management plan, he conducted fieldwork intermittently between August 2021 and December 2022, spanning all four seasons.

1.2.1 Botanical Surveys

The present study searched for every species of fern, conifer, flowering plant, moss and liverwort in each reserve, whether indigenous or not. Planted plants were listed separately from wild plants.

Fungi were sought much less concertedly except for Honey Fungus (*Armillaria luteobubalina*), which was considered as a possible cause of eucalypt deaths and ill-health. Where practicable, data were segregated by vegetation type.

For Koolunga Native Reserve, most of the botanical data had already been gathered during December 2020 for the abovementioned vegetation monitoring project. The present study checked for changes in that data. It sought and found some plant species that had escaped detection in 2020 either for seasonal reasons or due to natural variability over the years. This study also updated the populations of the scarcest plant species.

For Vaughan Road Reserve, the prior (1986 & 2002) botanical data was too old to satisfy the needs of this study. Therefore, a very detailed botanical survey was conducted in 2021–2022. It recorded the abundance of every species of moss, liverwort, fern and seed-producing plant (indigenous or not) within four parts of the reserve: the creek channel (with alluvial soil); southeast of the channel, the northwestern perimeter firebreak; and the rest of the land northwest of the channel.

1.2.2 Fauna Surveys

Fauna searching was done in all four seasons during 2021–2022, focusing on birds, mammals and butterflies. In addition to incidental observations made during all the other fieldwork, concerted searching was done:

- In Koolunga Reserve for a total of approximately 8 daytime hours and 2½ hours at night; and
- In Vaughan Road Reserve for a total of approximately 3 daytime hours and 1½ hours at night.

The nocturnal surveys included sessions beginning just before sunset in both reserves.

2. The Study Area and Surroundings

2.1 The Physical Environment

Koolunga Native Reserve and Vaughan Road Reserve have a cool temperate, Mediterranean climate with an annual average rainfall of approximately 1,000 mm.

Although separated by only 15 m and with the same creek flowing through them, the reserves have significantly different topography, geology and streamflow characteristics (hydrology), as follows.

Koolunga Native Reserve

Size: 6 hectares

Landform: The area north of the bushland is a floodplain associated with the non-perennial watercourses shown on Figure 1. The watercourses are incised at depths of up to 4 m into the floodplain. The areas south and northeast of the watercourses form part of the foot of the western slopes of the Dandenong Ranges.

Elevation: 118–135 m, Australian Height Datum

Slope: Outside the creek channels, the slope is typically 1:30 in the west, grading to 1:15 in the east (or steeper on the artificial embankment of Forest Rd). Parts of the creek banks are very steep.

Geology: The floodplain is made up of alluvium washed down by the watercourses. The bedrock exposed in part of the (apparently artificial) creek bed northwest of the car park is of Devonian volcanic origin, at the junction between formations of rhyodacite and hornfels. The surface geology of the rest of the reserve comprises Quaternary colluvium that has slumped downhill from the rhyodacite rock of Chandlers Hill.

Soil: Alluvial and colluvial clay loams, with sediments of various coarseness on the watercourse beds.

Streamflow: Non-perennial; All flow ceased several times in summer and autumn during this study despite two years of 'La Niña' conditions.

Vaughan Road Reserve

Size: 0.56 hectares

Landform: The land northwest of the creek shown on Figure 1 is a steep, southeast-facing, lower slope of a hill. The creek channel is steep-sided and of variable width, with zero to two terrace levels. The southeastern side of the creek, next to Vaughan Rd, forms part of the toe of the western slope of the Dandenong Ranges. The land next to 9 Vaughan Rd is clay fill, built up to extend that property's garden and driveway into the reserve.

Elevation: 115–131 m, Australian Height Datum

Slope: To the northwest of the creek, the slope is 1:3 to 1:2½, facing southeast. The creek channel has slopes from flat to almost vertical. Southeast of the creek, the slope is typically 1:20, similar to Koolunga Native Reserve.

Geology: The rock that has formed the slope to the northwest of the creek is hornfels, itself formed by baking of Lower Devonian siltstone by the Dandenong Ranges volcanics. There are alluvial terraces and shoals within the creek channel. Between Vaughan Rd and the creek channel is Quaternary colluvium that has slumped downhill from the rhyodacite rock of One Tree Hill.

Soil: Clay loams and silty alluvium.

2.2 Habitat Links to Other Land

Koolunga Native Reserve and Vaughan Road Reserve are separated by only 15 m, so the two function to a large degree as a single ecological unit.

The immediate surroundings of the reserves are residential in character, with detached dwellings on lots of quite variable sizes, the median being approximately 750 m². A small proportion of properties retain remnant eucalypts but only the two largest ones retain any significant amount of remnant understorey.

Consequently, nearly all the birds in the reserves belong to common species that are rather tolerant of (or even favour) suburbia. The exceptions only use the reserves as part of much larger home ranges and they are not seen to breed in the neighbourhood. A key example is the Powerful Owl, which is regularly observed in the neighbourhood except during breeding season (June to September). It is reasonable to presume that the core habitat for such species is in the Dandenong Ranges National Park, which lies 600 m east of Koolunga Native Reserve.

A few of the butterfly species seen in the reserves, such as Banks Brown, are normally seen in extensive areas of forest and presumably rely on proximity to the national park. There is too little information about other highly mobile invertebrates, and bats, to draw conclusions about their reliance on the national park.

Some fauna that move between areas of habitat carry pollen, spores or seeds of plants, helping to maintain or introduce populations of plants in the reserves.

The partly-forested property immediately southwest of Vaughan Road Reserve represents a significant extension of that reserve's habitat, including understorey and aquatic habitat. A mixture of native and exotic trees provides a rudimentary habitat link from there to the Belgrave Railway Line corridor, which is a recognised site of biological significance (Lorimer 2010).

There is quite fragmented and rudimentary habitat further west along the Blind Creek corridor. The closest habitat node is at the Blind Creek Billabong and the adjacent former Norvel Road Quarry.

Obviously, the creek that flows through the reserves provides a route for aquatic fauna to move between the two reserves as well as further upstream and downstream, through Blind Ck and Dandenong Ck. Both species of fish known to be currently present in the reserves (i.e. Shortfin Eel and Broadfin Galaxias) are migratory, spending part of their life at sea before swimming up streams where they reach maturity. They are therefore reliant on the aquatic habitat between the reserves and Port Phillip Bay. The migration route includes many drop-structures and many kilometres of pipe. The eels are able to slither overland around drop structures and the galaxias are known to climb up obstacles.

Aquatic fauna are also very sensitive to water pollution and land use in the catchment. Those in the reserves are affected by various types of pollution as well as the impacts of impervious surfaces – see Section 7.2.2.

3. History

Koolunga Native Reserve and Vaughan Road Reserves are in Wurundjeri country.

The Wurundjeri people would have observed a major change in the vegetation and fauna of the area since the end of the last Ice Age maximum around 20,000 years ago. The climate was drier and several degrees colder than now, and Australia's tree cover was greatly reduced ([Petherick et al. 2013](#)).

After a period of thawing, the climate and coastline of temperate Australia have been fairly similar to now over the past 12,000 years – the Holocene period (*op. cit.*). Vegetation, animals and Aboriginal existence therefore had many thousands of years to stabilise before European colonisation.

Koolunga Native Reserve and Vaughan Road Reserve still retain many of the natural resources that provided the Wurundjeri people with water, vegetables, meat, fish, confectionary, fishing gear, medicines, fibre, firewood, fire starters, skins, tools, construction materials, sporting equipment and weapons. Those same natural resources and their habitat sustained the Wurundjeri spiritual and cultural life. Their continued existence makes the reserves culturally important.

Colonisation of the district paid little regard to such things. Within one generation from Melbourne's establishment, most Wurundjeri died (Jones 1983), the few survivors were displaced (*ibid.*) and much of the land was cleared¹.

Perhaps the first clearing and breaking of the ground within the reserves was for the original alignment of Forest Rd. [Sheet 1 of the 1884 Parish Plan](#) shows the original Forest Rd went along what is now Old Forest Rd and the Crown land marked on Figure 2. Crown allotments each side of Forest Rd were being taken up during the 1870s and 1880s, so the road was probably constructed around 1870.

Careful interpretation of the current-day topography in the Crown land reveals earthwork from the old road, which was abandoned in favour of the current alignment in 1917². The earthwork can be easily seen in the 10 cm contour lines in Figure 2. On the ground, the clearest exposures of the old road formation are near the reserve's northern boundary and the crossing over a rarely-flowing creek marked with a dashed-blue line on Figure 2. There may be a culvert buried under the creek crossing.

The main creek that currently flows through Koolunga Native Reserve and Vaughan Road Reserve is known as the Forest Road Drain, pending selection of a new name by Wurundjeri elders. In the eastern two-thirds of Koolunga Native Reserve, the proximity of the Forest Road Drain's northern bank to the southern bank of the abovementioned creek strongly suggests that only one of them is natural; Otherwise, as the creeks meandered over the millennia, they would have united. The deep, steep and unstable banks of that reach of the Forest Road drain suggest that it is artificial. However, this study could find no records of a creek diversion or the way in which the original Forest Rd crossed the creek(s).

The current-day Crown land marked on Figure 2 remained an unused road reserve until 1978, when it was gazetted as a Crown land reserve and the City of Knox was appointed Committee of Management³. That situation remains to this day. Together, the Crown land and unused sections of the road reserve near the junction of Old Forest Rd and St Elmo Av occupy 0.5 ha or 8½% of

¹ As evidenced by 19th Century photographs, such as the one labelled 'Ferntree Gully late 1890s' at the Knox Historical Museum, 'Ambleside'.

² Certificate of Title, Vol. 4030, Folio 805833.

³ Victoria Government Gazette 1978, pp. 3,574 and 3,925.

Koolunga Native Reserve. At the time the reserve was created (1968), the road reserve for St Elmo Av included the yellow-shaded area on Figure 2, bringing to 10% the fraction of the reserve that had been set aside for roads. The yellow-shaded land was absorbed into Koolunga Native Reserve in 1973 following the reserve's creation⁴.

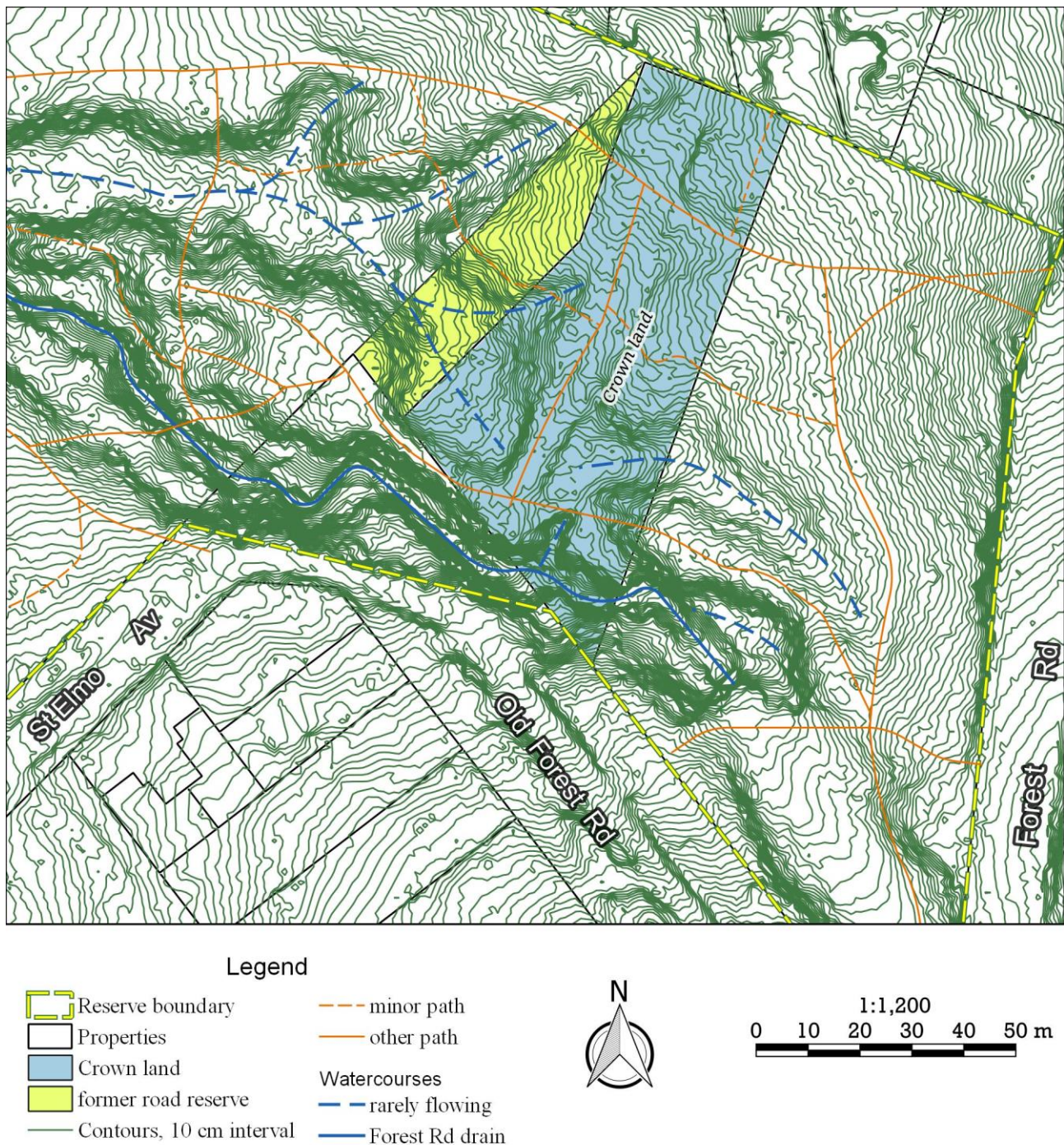


Figure 2. Contour map of the eastern half of Koolunga Native Reserve in 2017, showing the original alignment of Forest Rd along the axis of the Crown Land.

The earliest available aerial photograph of Koolunga Native Reserve and Vaughan Road Reserve is from 1946, reproduced in Figure 3. It shows parts of Koolunga Native Reserve that were cleared at that time, as well as an indication of areas that had been cleared and allowed to regenerate.

⁴ City of Knox file no. 26/17/30 – entry dated 11/12/73.

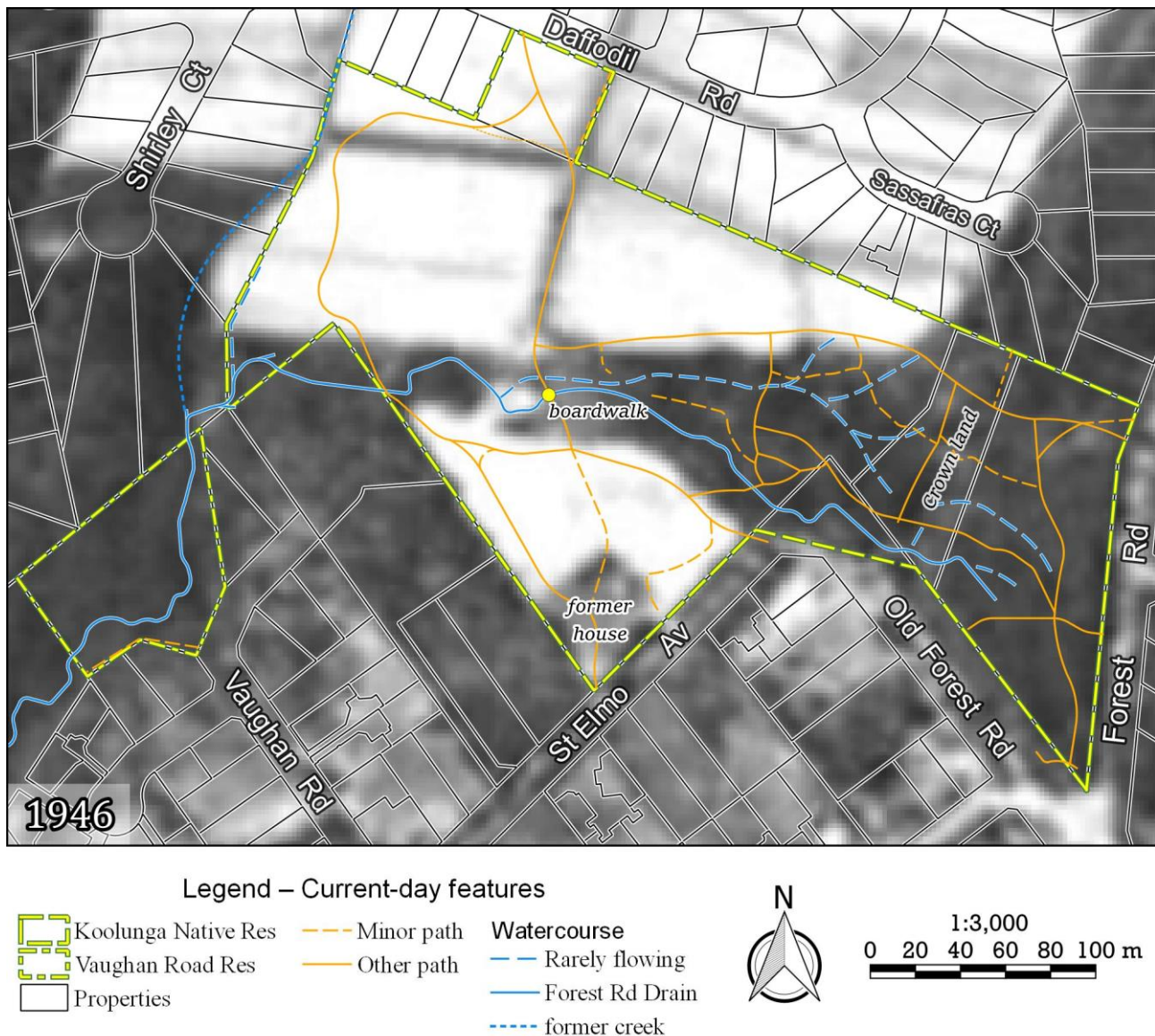


Figure 3. Marked-up aerial photo from 1946.

The white, straight-edged patches of the 1946 photograph seen within Koolunga Native Reserve and extending northward from it are daffodil fields. The grey strips dividing the fields are perennial groundcover, mostly with drains running along them. The fields were part of the farm owned by Gilbert Lawrence ('Gib') Chandler (and earlier by his father, Alfred Elliot Chandler from c. 1913⁵ to his death in 1935). The farm extended south to St Elmo Av but not southwest of the current-day Koolunga Native Reserve.

Today, furrows of the daffodil fields persist in the grassy expanses in the northern half of Koolunga Native Reserve. One can also see vestiges of the drain that ran beside the current-day path that extends northward from the boardwalk. A pair of dead eucalypt trunks that can still be seen beside that path correspond to the two trees seen there on the 1946 aerial photo.

Immediately south of the drain and east of the current-day boardwalk, the 1946 photo shows a treeless, light grey area of approximately 1,500 m². Immediately west of the boardwalk, the photo shows a smaller, white (completely denuded) area on the creek. At an on-site public information session on 22nd May 2022, local identity Bill Ireland explained that this section of the creek

⁵ According to his grandson, Gilbert Chandler, in a talk to the Friends of Koolunga Native Reserve in 2003.

formed the Chandlers' rubbish tip during the 1940s–1960s, including for the demolition of a large farmhouse. Council officer, James Rose, says that dumped asbestos-cement sheets were uncovered there some years ago, so soil disturbance has been avoided there since. The asbestos also has implications for any future ideas that might disturb soil in that vicinity.

Returning to the 1946 aerial photograph of Figure 3, the grey square labelled 'former house' next to St Elmo Av previously contained a cottage and garden for relatives of the Chandlers following the First World War⁵. The white expanse between there and the creek was a flower field, as seen more clearly in the 1954 aerial photograph discussed below.

A dotted blue curve on Figure 3 marks where a creek flowed just west of the current-day Koolunga Native Reserve. That creek has since been filled in and replaced by stormwater pipes – see below.

The mottled light- to dark-grey areas of the 1946 aerial photograph in and around Koolunga Native Reserve and Vaughan Road Reserve represent regrowth of native vegetation. The darker grey blobs are eucalypt crowns, mostly between 8 m and 12 m diameter but with one outlier at 20 m near the middle of current-day Koolunga Native Reserve. The outlier is consistent with an old-growth eucalypt; the others are consistent with adolescent eucalypt regrowth. (The diameters of the current day canopy trees seen in Figure 1 are in the range 12–16 m.) The eucalypts in 1946 were therefore overwhelmingly regrowth following clearing of the whole area. The clear separation between the crowns is unnatural, presumably the result of removal of eucalypts for firewood and/or timber.

The lightest grey blobs scattered between the eucalypt crowns on the 1946 aerial photograph, within and east of the Crown Land, indicate very sparse vegetation.

The mottled grey within the current-day Vaughan Road Reserve in 1946 is similar to the land between Forest Rd and the Crown land. The crown diameters of the canopy eucalypts are mostly in the range 10–16 m – very similar to today. The density of canopy eucalypts was unnaturally low, similar to the aftermath of the windstorms of 2021, which blew some large eucalypts over.

Outside the boundaries of Figure 3, aerial photographs from 1945–1946 show that nearly the whole region of greater Melbourne had been cleared at least once by then. Eucalypt crowns in the nearby Dandenong State Forest (now Dandenong Ranges National Park) were also unnaturally sparse and overwhelmingly in the diameter range of 8–12 m.

Even by 1874, when the district had very few settlers, the local forest was largely denuded. In a report that year for the Minister for Lands, [W. Ivey wrote](#), 'The amount of cutting that has taken place is considerable, and, coupled with the large area destroyed by fire, has diminished very seriously the amount of timber available for present use', and 'Upon the range at the head of the Fern Tree Gully, of which the One Tree Hill forms a part, the existing timber is but of moderate size, and the trees do not stand thickly together, evidently having been thinned'.

The denudation of hills leads to flash-flooding, stream erosion and landslips. So does residential development, which was at an early stage in 1946 (as seen in aerial photography). These phenomena explain why Bill Ireland recalls that there used to be a deeply-incised watercourse immediately upstream (east) of Koolunga Native Reserve before it was replaced by a pipe discharging into the reserve. They also explain the deep incision within the reserves today.

The 1951 aerial photograph in the upper image of Figure 4 shows little change since 1946 within the current-day Koolunga Native Reserve. The main change there is the appearance of dark trees (later seen to be pines) in the two east-west strips to the north and northwest of the boardwalk. The pines have crown diameters of typically 3 m, indicating they were planted in the late 1940s.

Figure 4 also shows that in 1951 within Vaughan Road Reserve, some trees were removed since 1946 and the light grey patches indicate where shrubs had also been removed.

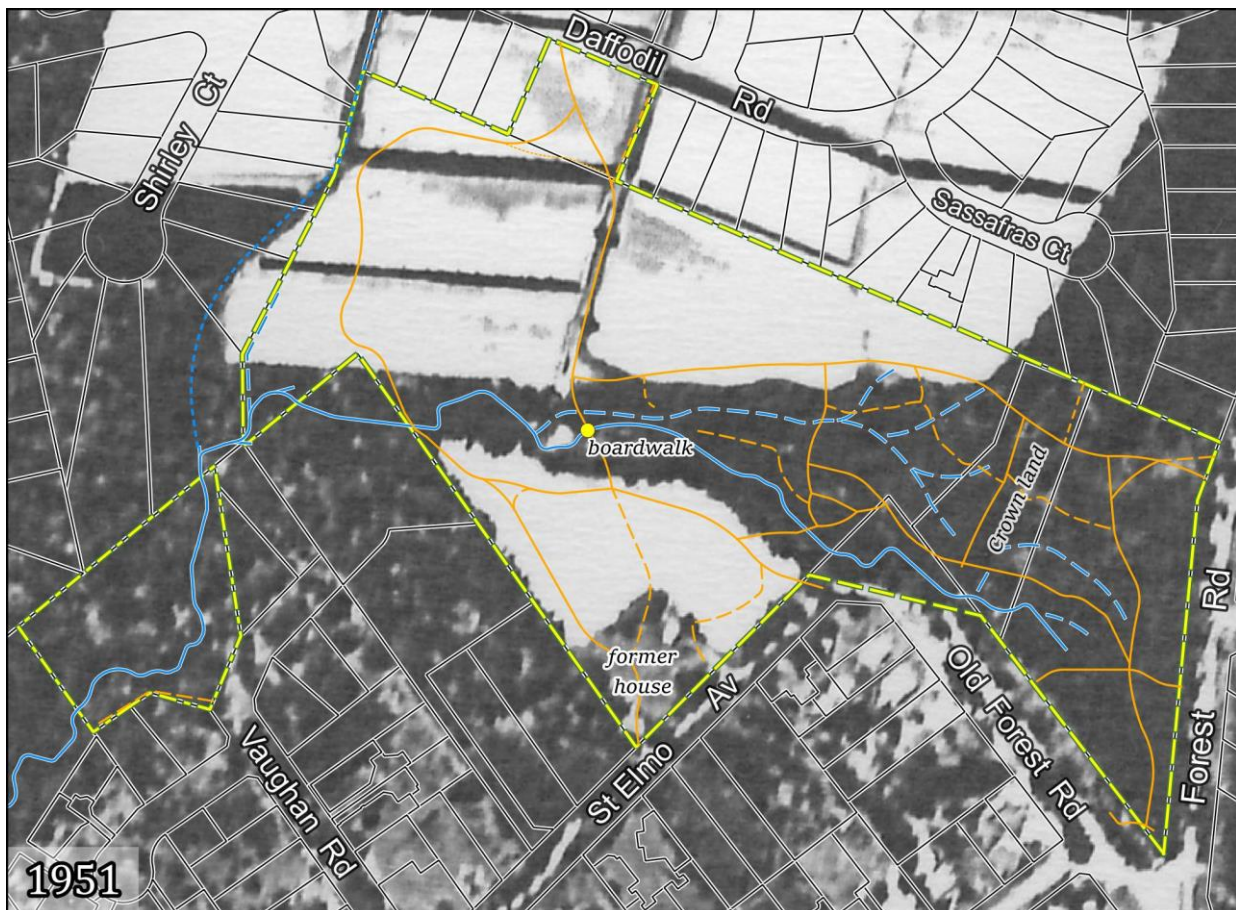
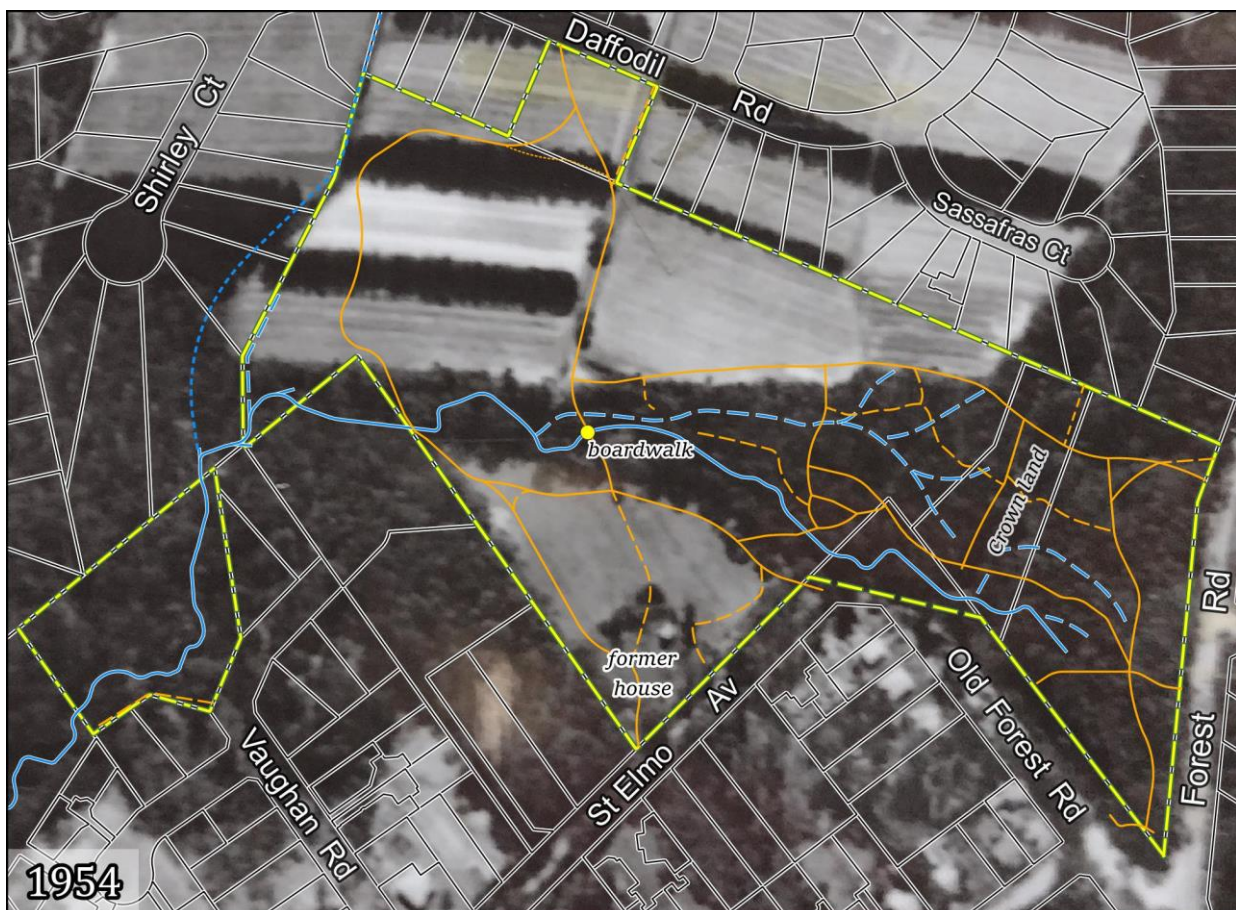


Figure 4. The same scene as Figure 3 but with aerial photos from 1951 (above) and 1954 (below).



The 1954 aerial photograph in the lower image of Figure 4 shows that the abovementioned pines grew markedly since 1951, even allowing for the exaggeration caused by long shadows to the south. The two eucalypts north of the boardwalk stand out. No other clear change is seen within the current-day reserves, just a hint that there may have been more understorey.

Knox City Council's files document the creation of Vaughan Road Reserve as part of the subdivision of the Vaughan Rd / Carmel Av estate by H.R. Roscoe in September 1959.

Mr Chandler's daffodil farm was subdivided during the 1960s, starting near Boronia Rd. In 1968, Mr Chandler submitted to Council the 'Stage 3' subdivision plan in Figure 5, which includes a faint image of a 2021 aerial photograph for context. The subdivision envisioned the filling in of the creeks and the extension of St Elmo Av within its pre-existing road reserve.

Council resolved to seek to acquire the parts of the subdivision lying within the current-day Koolunga Native Reserve. Council's minutes of 17/7/68 show that a deal was struck in which the rectangular lot that now abuts Daffodil Rd would become the developer's open space contribution and Council would buy the other two parcels of private land (i.e. each side of the pre-existing road reserve)⁶. The transaction was completed in September 1968.

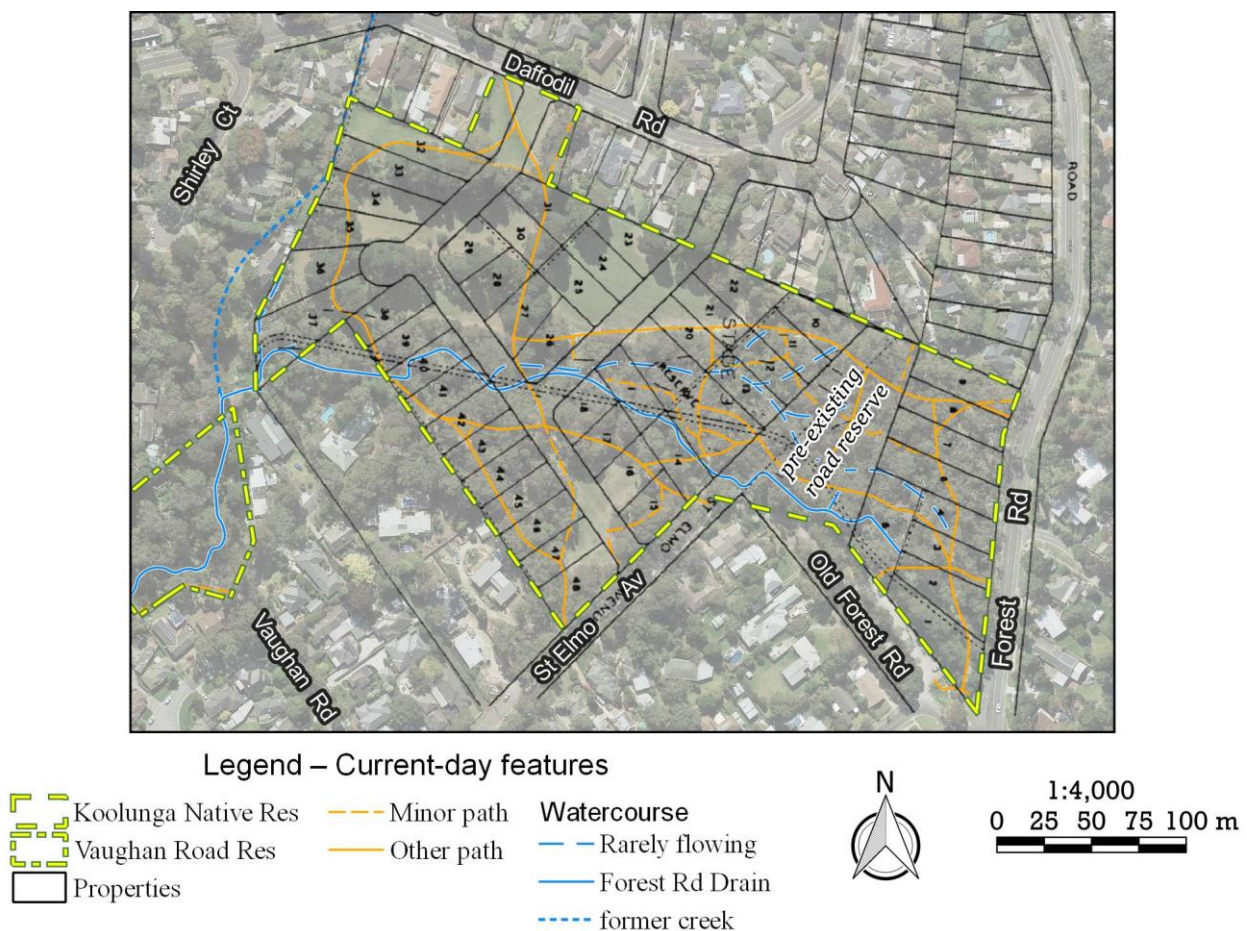


Figure 5. G.L. Chandler's 1968 proposed subdivision plan, overlaid on current-day features. The subdivision plan is from Knox City Council file 42/36.

⁶ The agreed purchase price was \$43,000, compared with a valuation of \$39,000 – Shire of Knox file 42/36.

Figure 6 shows an aerial photograph from 1968 – the year the deal was done to create Koolunga Native Reserve (though that name was not adopted until 1976). Note that the photograph was taken early in the morning, so trees and buildings have long shadows to the west (left).

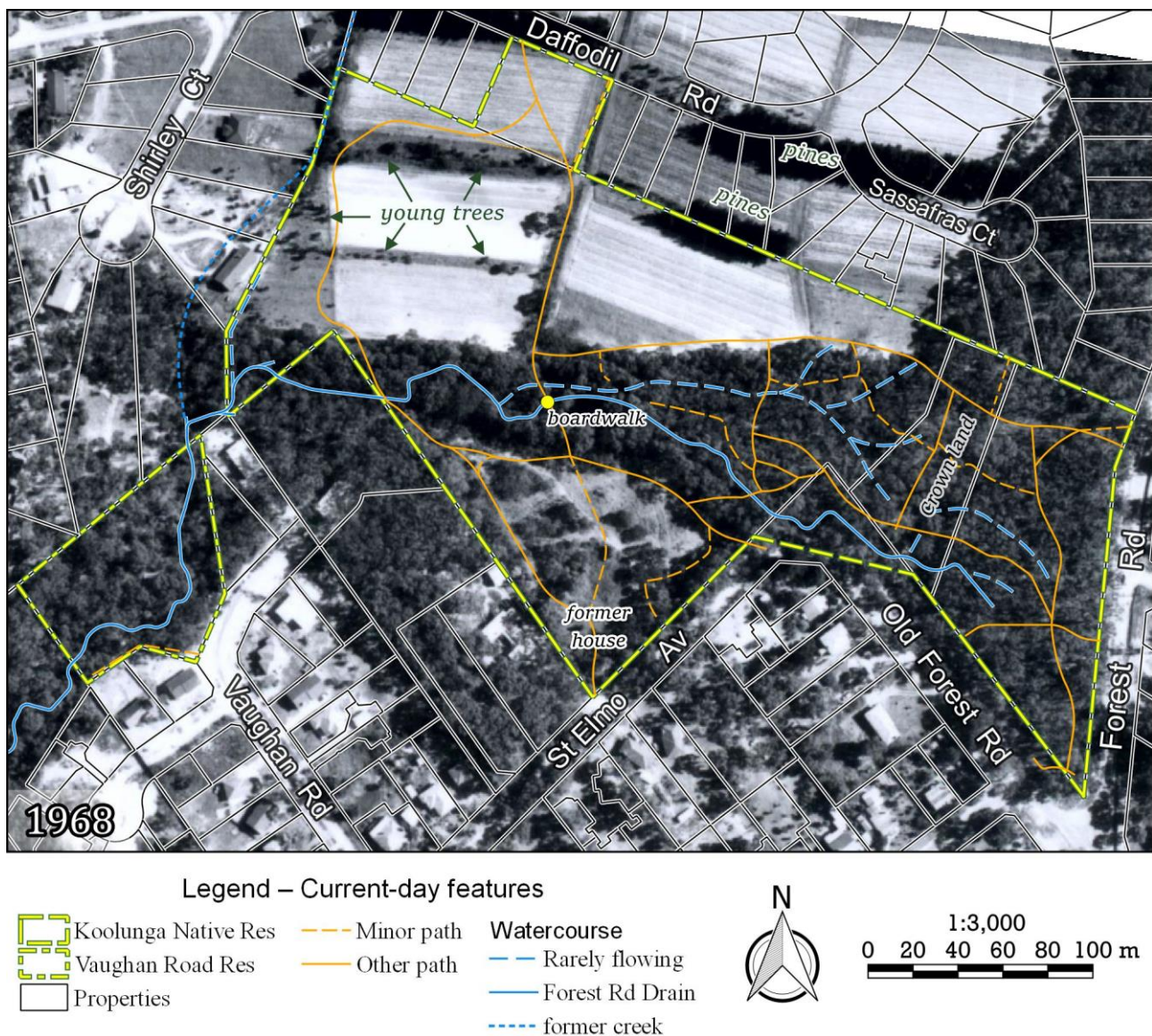


Figure 6. The same scene as Figures 3 & 4 but with an aerial photo from 1968.

The 1968 photograph reveals no clear change within Vaughan Road Reserve since 1954 (Figure 4, p. 15) except for loss of vegetation on the edge of the newly-constructed (but not yet paved) Vaughan Rd. Most eucalypt crowns in and around the reserve remained 8–10 m in diameter (i.e. not fully-grown), suggesting on-going tree removal. Residential development was under way along Vaughan Rd, Bradman Ct (northwest of Vaughan Road Reserve) and Shirley Ct.

A broader view of the 1968 aerial photograph shows a significant increase in residential development and tree loss in the rest of the water catchment of Vaughan Road Reserve and Koolunga Native Reserve, increasing the problems of erratic stream flows and stream erosion. The properties were unsewered and creeks like those of interest here normally ran grey and smelly.

The 1968 photograph in Figure 6 shows three main changes within Koolunga Native Reserve since the 1954 photograph:

- Eucalypts and other trees grew up in what had been fields abutting St Elmo Av;
- The crowns of eucalypts increased significantly in diameter; and
- The east-west strips of dense, maturing pines in 1954 had been harvested and replaced by the scattered young trees marked on Figure 6.

The pines were evidently harvested by c. 1965. That is when the photograph in Figure 7 was taken, showing only scattered seedlings where the maturing pines had been. Recalling from p. 14 that the harvested pines were planted in the late 1940s, it follows that they grew there for 15–20 years out of the farm's 45-year life. Had the pines been left to become fully-grown (like the ones presently in Koolunga Native Reserve), their shade and root systems would have prevented daffodil-growing in a significant fraction of the adjacent fields.



Figure 7. A photograph taken c. 1965, looking southwest from the northern end of what is now the north-south row of pines in Koolunga Native Reserve. Bill Ireland is in the foreground. The Bradman Ct ridge and the newly-built house at 9 Shirley Ct are in the background, unobscured by the east-west strip of pines that had recently been removed from the alignment marked on the photograph by a light blue line.

Most (but not all) of the young trees marked on Figure 6 were pines, judging from their darkness and shadow shape on the aerial photograph. The trees' random distribution, varied ages, mixed species and their germination when plans were under way to subdivide the land indicate they were not planted.

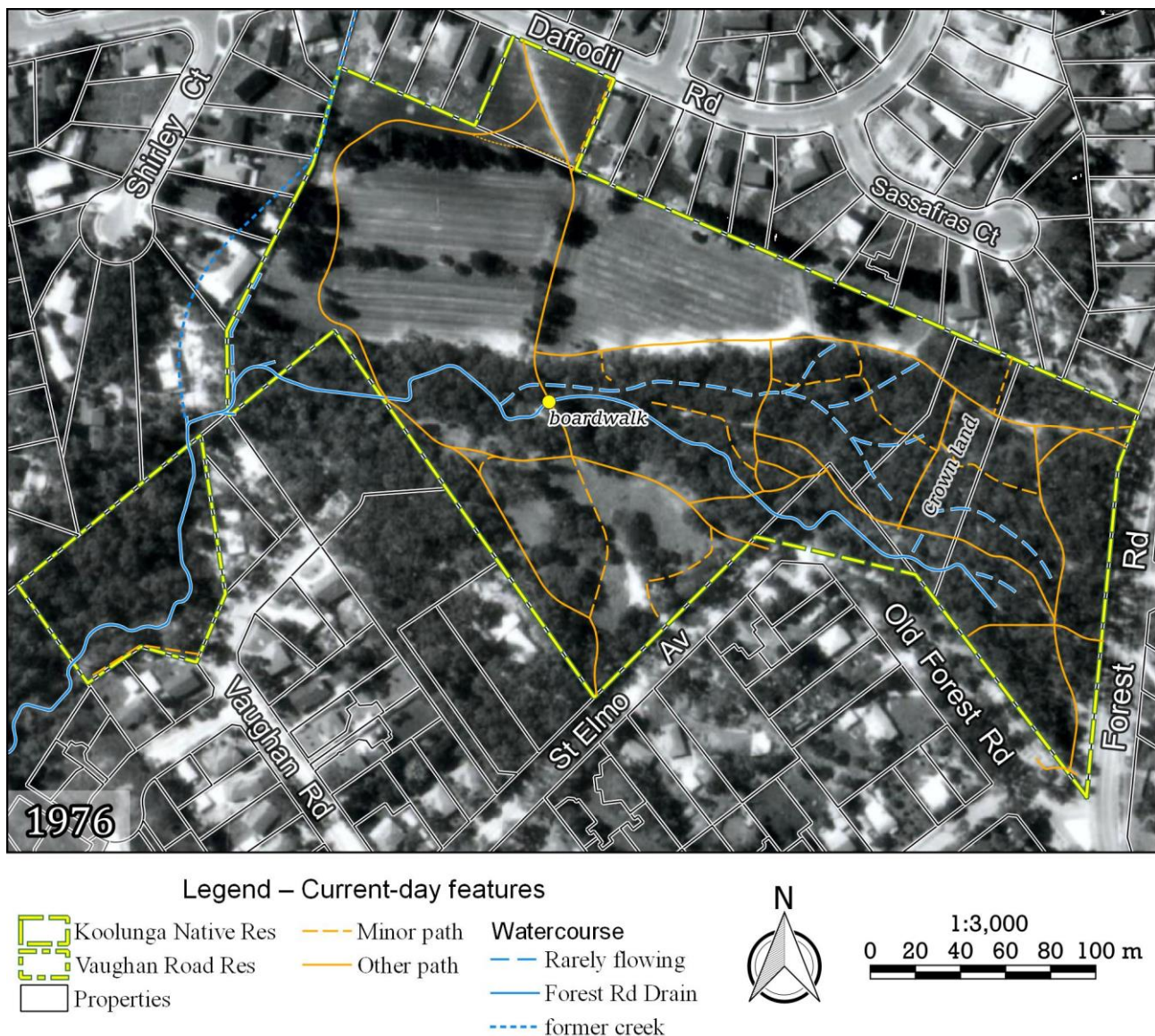
Figure 6 shows that in 1968, the pines that now grow beside the footpath leading north from the boardwalk were yet to appear, as for those that now grow east of that footpath.

Bill Ireland recalls being among the firefighters who conducted a controlled burn of the bushland of Koolunga Native Reserve in 1968. Only a small part of the bushland has been burnt since.

The ward councillors acted as a Committee of Management of Koolunga Native Reserve for most of the period from 1968 to 1975. According to council files, they focused on drainage works, fencing, a car park and spraying of weeds. In 1975, a public meeting elected a new Committee of Management, which raised concerns about minibikes, slashing of 'heath' areas and the need for

planting of the former daffodil fields. The name, 'Koolunga Native Reserve', was adopted in September 1976 in the belief that 'Koolunga' means riverbank in an Aboriginal language.

1976 is also the year of the next available aerial photograph of Koolunga Native Reserve and Vaughan Road Reserve after 1968 – see Figure 8. (An aerial photograph from 1971 includes only part of the former reserve and none of the latter.) The aerial photograph shows some signs of the tree canopy thickening in Vaughan Road Reserve except where excavations to level the residential lot to the east (9 Vaughan Rd) encroached approximately 8 m into the reserve. That encroachment is still used as part of the garden and driveway of 9 Vaughan Rd today – see Figure 1 on p. 5.



In Koolunga Native Reserve, the 1976 aerial photo shows that:

- Vegetation had been cleared since 1968 for the Old Forest Rd car park;
- Trees in the area between St Elmo Av and the Forest Road Drain had grown noticeably, apart from some that had been removed. The only visible understory is grass – a situation

attributable to slashing that is evidenced by rows of hay in the 1968 and 1971 aerial photographs;

- Paths through the forest are more visible than in the 1968 photograph, reflecting a thinning of foliage in the eucalypt canopy. A minor contributor could be widening of the paths by the abovementioned minibikes and increased visitor usage of other kinds;
- Young pines had established in the old daffodil fields east of the path that leads north from the boardwalk;
- The pine trees that arose west of that path in 1965–1968 had, by 1976, grown to crown diameters up to 10 m and been joined by new ones, including some along the path; and
- A house had been constructed at 11 Shirley Ct (abutting both reserves) on top of the creek that previously skirted the reserve's western boundary. That was achieved by replacing the creek with the pipe whose outlet can be seen today from the northeast corner of Vaughan Road Reserve.

A broader view of the 1976 aerial photograph than depicted in Figure 8 shows that much of the former daffodil farm had been developed following approval a few years prior. By the end of the 1970s, nearly all the private land in the catchment of Koolunga Native Reserve and Vaughan Road Reserve had been developed, adding to the pre-existing problems of water pollution, stream erosion, low stream flows between rainfall events and a falling water table.

Within the reserves, aerial photographs between 1976 and 2021 (Figure 1, p. 5) show a gradual change between those two, the most notable features being:

- A major increase in the size and numbers of pines within Koolunga Native Reserve except for the replacement of about six pines south of 10 & 11 Sassafras Ct with revegetation;
- A less dramatic (but still significant) increase in the diameters of eucalypts in both reserves;
- A shift in the distribution of tree cover in the vicinity of the former house next to St Elmo Av; and
- Successful establishment of revegetation next to 38 Daffodil Rd and along the southern edge of the former daffodil farm.

In 1978, Council prepared a development plan for Koolunga Native Reserve – not seen in this study. Allaway (1994) cites Council's files as indicating that the development plan was expected to address a pond, tree planting, a barbecue shelter, toilet block, playground, the car park, rubbish bins and fencing to protect regenerating native vegetation. The pond, barbecue shelter, toilet block and playground never materialised, despite the last two of these being periodically approved and dropped during the 1980s.

In 1979 and 1980, Council's file no. 14/5/26 indicates (in part) that the Committee of Management raised concerns about the impact of bicycles and pedestrians on and off paths.

Changes to the *Local Government Act* in 1980 forced the Committee of Management to be replaced by the Koolunga Reserve Residents Liaison Committee.

In 1984, the Knox Environment Society (established in June 1982) produced a brochure titled 'An Introduction to Koolunga Native Reserve', with text by Doug Western and illustrations by Andrew Paget. It mentions and illustrates some of the reserve's indigenous plants and wildlife. It states:

- 'An altered water table is thought to be a major reason for the deaths of many of the trees in this reserve. Note the skeletons still standing';

- ‘Sadly, blackberries, pittosporums and honeysuckles are overgrowing these ferny areas and creek banks’; and
- ‘Having formed an opinion of Koolunga during your walk, please express it to the City of Knox, the Koolunga Reserve Residents Liaison Committee and/or the Knox Environment Society’.

Tree deaths and blackberries remain a significant problem to this day but not pittosporums or honeysuckles.

In 1985, Andrew Paget conducted the first methodical botanical survey of Koolunga Native Reserve for his B.App.Sci. (Landscape Architecture). The data is available today through the Victorian Biodiversity Atlas but the locations mapped there are further southwest than Paget’s project report shows, typically by 100 m.

In 1986, Paget compiled a list of indigenous plant species that he observed in Vaughan Road Reserve. That information and Paget’s illustrations of plants formed the basis for the Knox Environment Society to produce the 1986 brochure titled ‘An Introduction to the Vaughan Road Bushland Regeneration Project’. The brochure provided information about the reserve’s existing nature conservation values and the group’s (largely, Paget’s) proposal to remove introduced plants and plant indigenous ones. Readers were encouraged to provide their feedback about the proposal.

The present study found no records of the community reaction or to what degree the bushland regeneration proposal was implemented. The only signs of planting in Vaughan Road Reserve in 2022 are from the past five years (approximately), along the northern fringe and on the left (generally southern) bank of the Forest Road Drain.

The Knox Environment Society continued its advocacy for Koolunga Native Reserve. In November 1993, it successfully requested Knox City Council to urgently obtain a management plan for the reserve. A public meeting chaired by Councillor Geoff Dempster was held in March 1994 to seek community feedback on the draft plan, similarly to the current ‘Koolunga Native Reserve Future Directions Plan’ process. The final management plan, by landscape architect Mark Allaway, was completed that May. It can be viewed at Ferntree Gully and Boronia libraries. A supplementary document containing botanical survey data and analysis by Damien Cook (but with authorship claimed by Mark Allaway & Associates) is available at Ferntree Gully library.

The management plan process led to the formation in 1994 of the Friends of Koolunga Native Reserve. The group has conducted on-ground management activities such as planting, weeding and environmental monitoring in conjunction with Knox City Council ever since.

In 1997, the Knox Environment Society revised its 1984 brochure about Koolunga Native Reserve. The [new brochure](#) stated:

- That progress had been made in controlling blackberry, pittosporum and honeysuckle; and
- ‘Other orchids found in significant numbers are the Slender Sun Orchid and Common Onion Orchid in the grassy areas between the pine trees. The grass there is kept unmown at times to allow them to set seed. In the same areas are the Tall Sundews that like swampy ground and catch and digest tiny insects’.

Each of these comments remains current in 2022.

In February 1999, the present author commenced long-term monitoring of Koolunga Native Reserve’s vegetation for Knox City Council. Subsequent rounds of the monitoring program have been in summer 2001–2002, 2007, 2014 and 2020.

Melbourne Water undertook major stream stabilisation work along the Forest Road Drain within Koolunga Native Reserve in c. 1996. Many of the rocks in the stream originate from then. There have been lesser stream stabilisation works since then.

In 2004, the Friends of Koolunga Native Reserve created an indigenous plant demonstration garden near the dead end of St Elmo Av. The garden remains but is not looking its best.

In 2006, the present author prepared a management plan to replace the 1994 one. The document you are reading is an update of the 2006 one.

In 2019, Knox City Council and Melbourne Water began investigating ways to deal with local problems associated with stormwater; namely water pollution, stream erosion, degraded aquatic habitat and the current highly variable water table and stream inflows. A potential solution was devised, involving diversion of a stormwater pipe into an artificial wetland northeast of the boardwalk in Koolunga Native Reserve. The proposal received divergent community reaction and so was shelved in 2021.

2021 also saw the initiation of the 'Koolunga Native Reserve Future Directions Plan' and the document you are now reading.

The Knox Environment Society provides some interesting historical photographs of Koolunga Native Reserve and other parts of the Chandler daffodil farm at:
https://www.kes.org.au/environment/bushlandreserves/koolunga_native_reserve.

4. Vegetation

4.1 Vegetation Types

Figure 9 is a map of the different types of native vegetation in Koolunga Native Reserve and Vaughan Road Reserve. The first five types of vegetation in the legend refer to the state-wide classification system called Ecological Vegetation Classes, or EVCs. The other types refer to vegetation that falls outside the EVC system. There is also aquatic and semi-aquatic native vegetation growing in the watercourses. The uncoloured parts of the reserves on the map have no (or almost no) native vegetation.

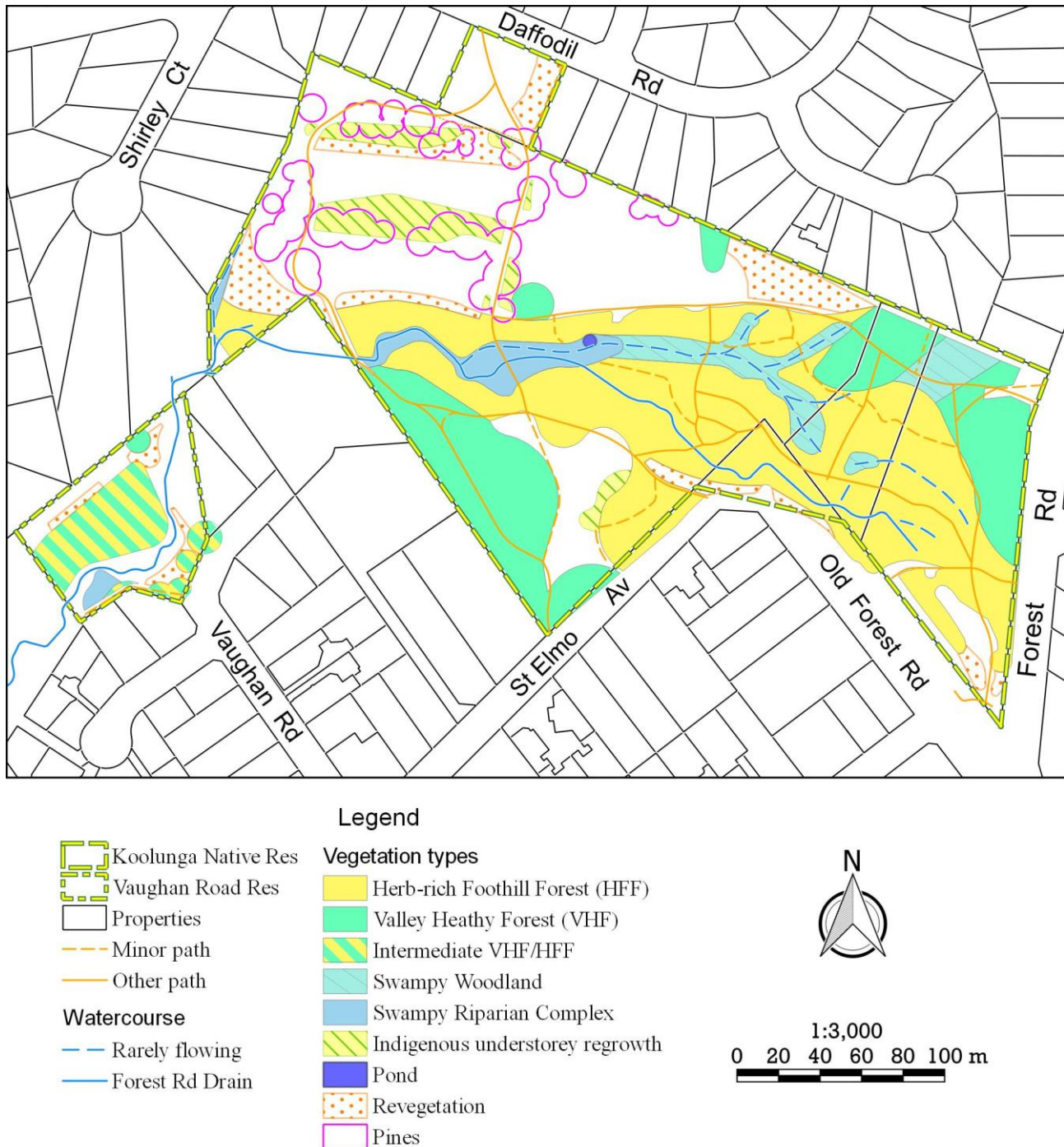


Figure 9. Map of vegetation types. ‘Indigenous understorey regrowth’ refers to areas with many indigenous understorey plants but no indigenous canopy due to mowing or out-competition by pines.

The boundary between Valley Heathy Forest and Herb-rich Foothill Forest is indistinct, having been blurred by the land's chequered history described above.

In the following descriptions of the different vegetation types, the EVC numbers and threat ratings (endangered or vulnerable) are those assigned by the Department of Environment, Land, Water and Planning. The descriptions do not include introduced species, which reflect what humans have done to the vegetation more than natural communities in which they occur.

4.1.1 Herb-rich Foothill Forest (EVC 23)



Figure 10. Herb-rich Foothill Forest.

Regional threat rating: Vulnerable.

Area occupied: approximately 2.0 ha, on the most undulating parts of Koolunga Native Reserve.

Canopy trees: Dominated by Messmate Stringybark (*Eucalyptus obliqua*), with somewhat fewer Narrow-leaved Peppermint (*E. radiata*), Bundy (*E. goniocalyx*) and Red Stringybark (*E. macrorhyncha*), and small numbers of Mountain Grey Gum (*E. cypellocarpa*).

Lower trees: Cherry Ballart (*Exocarpos cupressiformis*) is abundant. Blackwood (*Acacia melanoxylon*) and Silver Wattle (*A. dealbata*) are thinly scattered.

Shrubs: The shrub layer is moderately to quite dense, having thickened significantly since the end of the Millennium Drought in 2010. The dominant species are Prickly Currant-bush (*Coprosma quadrifida*), Dandenong Range Cinnamon Wattle (*Acacia stictophylla*) and Hop Goodenia (*Goodenia ovata*). Less abundant species include Sweet Bursaria (*Bursaria spinosa*), Common

Cassinia (*Cassinia aculeata*), Snowy Daisy-bush (*Olearia lirata*) and Tree Everlasting (*Ozothamnus ferrugineus*).

Climbers: Abundant, including the vigorous climbers Mountain Clematis (*Clematis aristata*) and Wonga Vine (*Pandorea pandorana*), the light twiners Common Apple-berry (*Billardiera mutabilis*) and Twining Glycine (*Glycine clandestina*), and the parasite Downy Dodder-laurel (*Cassytha pubescens*).

Ferns: Modest-sized, scattered patches of Common Maidenhair (*Adiantum aethiopicum*), Common Ground-fern (*Calochlaena dubia*) or Austral Bracken (*Pteridium esculentum*).

Other groundcover: Grassy, dominated by Thatch Saw-sedge (*Gahnia radula*), Sword Tussock-grass (*Poa ensiformis*) and Spiny-headed Mat-rush (*Lomandra longifolia* subsp. *longifolia*). Other abundant species include Tasman Flax-lily (*Dianella tasmanica*), Common Raspwort (*Gonocarpus tetragynus*), the wood-sorrel *Oxalis perennans*, the flat-pea *Platylobium infecundum* and Forest Wire-grass (*Tetrarrhena juncea*).

4.1.2 Valley Heathy Forest (EVC 127)



Figure 11. Valley Heathy Forest near the northern entry to Koolunga Native Reserve from Forest Rd.

The patches of Valley Heathy Forest in Koolunga Native Reserve have been losing their distinction from the adjacent Herb-rich Foothill Forest this century. In the west, that has been due to removal of shrubs and groundcover for bushfire hazard reduction, followed by loss of orchids and other sensitive species. In the northeast (e.g. in Figure 11), it has been associated with ecological decline during the Millennium Drought and partial removal to widen a firebreak, followed by an increase in introduced species.

Regional threat rating: Endangered.

Area occupied: approximately 1.0 ha, on shallow slopes, mostly coinciding with the areas of greatest historical disturbance followed by natural regeneration.

Canopy trees: Messmate Stringybark (*Eucalyptus obliqua*), Mealy Stringybark (*E. cephalocarpa*), Red Stringybark (*E. macrorhyncha*), Bundy (*E. goniocalyx*), Narrow-leaved Peppermint (*E. radiata*) and a single Yellow Box (*E. melliodora*) in the northern corner of Vaughan Road Reserve. Most of Koolunga Native Reserve's *E. cephalocarpa* have died over recent decades (particularly due to out-competition by pines); they are now better-represented on private land on the opposite side of St Elmo Av.

Lower trees: Cherry Ballart (*Exocarpos cupressiformis*) is fairly abundant and Black Wattle (*Acacia mearnsii*) less so.

Shrubs: Except where removed for fire protection, the shrub layer is dense and fairly rich in species, dominated by Sweet Bursaria (*Bursaria spinosa*) and Prickly Currant-bush (*Coprosma quadrifida*). Other species include Dandenong Range Cinnamon Wattle (*Acacia stictophylla*), Hop Wattle (*A. stricta*), Prickly Tea-tree (*Leptospermum continentale*) and a range of other species.

Climbers: Common Apple-berry (*Billardiera mutabilis*) and Love Creeper (*Comesperma volubile*) are fairly abundant. Wonga Vine (*Pandorea pandorana*) is dense where soil has been disturbed.

Ferns: Minor occurrence, limited to occasional Common Maidenhair (*Adiantum aethiopicum*) and Austral Bracken (*Pteridium esculentum*).

Other groundcover: Densely grassy, dominated by Soft Tussock-grass (*Poa morrisii*), Kangaroo Grass (*Themeda triandra*), Veined Spear-grass (*Austrostipa rudis*), Tall Spear-grass (*A. pubinodis*), Weeping Grass (*Microlaena stipoides*) and Thatch Saw-sedge (*Gahnia radula*). Other abundant species include Honeypots (*Acrotriche serrulata*), Common Raspwort (*Gonocarpus tetragynus*), the wood-sorrel *Oxalis perennans*, the flat-pea *Platylobium infecundum*, Trim Sun-orchid (*Thelymitra peniculata*) and Small Grass-tree (*Xanthorrhoea minor*). The following additional species serve as ecological indicators: Pale Grass-lily (*Caesia parviflora*), Pale Flax-lily (*Dianella longifolia*), Spreading Flax-lily (*D. revoluta*) and Common Rice-flower (*Pimelea humilis*).

4.1.3 Intermediate Valley Heathy Forest / Herb-rich Foothill Forest



Figure 12. Intermediate Valley Heathy Forest / Herb-rich Foothill Forest.

The mixture of eucalypt species in the canopy of the steep, southeast-facing slope at Vaughan Road Reserve is typical of Valley Heathy Forest, consistent with the ridge that extends northward from there. The understorey, on the other hand, is more consistent with Herb-rich Foothill Forest, e.g. with dense Victorian Christmas Bush (*Prostanthera lasianthos*), Snowy Daisy-bush (*Olearia lirata*), ferns and Tasman Flax-lily (*Dianella tasmanica*). There is also abundant Forest Wire-grass (*Tetrarrhena juncea*), which is more typical of Lowland Forest but occasionally occurs in Herb-rich Foothill Forest and Valley Heathy Forest.

Mountain Grey Gum (*Eucalyptus cypellocarpa*) is one of the dominant species, southeast of the creek in Vaughan Road Reserve. That species is not expected in Valley Heathy Forest and atypical in Herb-rich Foothill Forest. It is usually associated with very moist soils in hillier topography.

The difficulty classifying the vegetation in the EVC system is because the topography of Vaughan Road Reserve is very unusual: a steep, southeast-facing slope on deep, orange clay loam derived from hornfels, surrounded by Valley Heathy Forest.

The vegetation is also changing rapidly. During the ten months of the present study, roughly 10% of the mature eucalypts fell during windstorms and vine weeds increased greatly, particularly Blue Morning Glory (*Ipomoea indica*) and Cape Ivy (*Delairea odorata*). In extrapolating backwards to what the vegetation might have been like long ago, the longest-lived plants provide the best indication. They are the eucalypts, which best match Valley Heathy Forest.

Regional threat rating: Endangered, by association with Valley Heathy Forest.

Area occupied: approximately 0.25 ha, representing most of the native vegetation at Vaughan Road Reserve.

Canopy trees: Dominated by Narrow-leaved Peppermint (*Eucalyptus radiata*), followed by Bundy (*E. goniocalyx*) and Red Stringybark (*E. macrorhyncha*), then Messmate Stringybark (*E. obliqua*) and two Mountain Grey Gum (*E. cypellocarpa*).

Lower trees: Fairly sparse, represented by Blackwood (*Acacia melanoxylon*), Black Wattle (*A. mearnsii*) and Cherry Ballart (*Exocarpos cupressiformis*).

Shrubs: The shrub layer is patchy due to disturbance but dense in places and fairly rich in species. It is dominated by Victorian Christmas Bush (*Prostanthera lasianthos*) and Prickly Currant-bush (*Coprosma quadrifida*), followed by Snowy Daisy-bush (*Olearia lirata*), Yarra Burgan (*Kunzea leptospermoides*), plus small numbers of Dandenong Range Cinnamon Wattle (*Acacia stictophylla*), Prickly Moses (*A. verticillata*) and one each of Common Cassinia (*Cassinia aculeata*) and Elderberry Panax (*Polyscias sambucifolia*). Sweet Bursaria (*Bursaria spinosa*) was also present until recently and may well reappear.

Climbers: Wonga Vine (*Pandorea pandorana*) is abundant; Mountain Clematis (*Clematis aristata*) moderately so; Love Creeper (*Comesperma volubile*) and Small-leaf Bramble (*Rubus parvifolius*) scarce.

Ferns: Fairly dense through much of the area, represented (in decreasing order of abundance) by Austral Bracken (*Pteridium esculentum*), Common Maidenhair (*Adiantum aethiopicum*) and Common Ground-fern (*Calochlaena dubia*).

Creepers: Kidney-weed (*Dichondra repens*) and Rainforest Crane's-bill (*Geranium homeanum*) are fairly abundant. *Platylobium infecundum* is represented by two patches.

Other groundcover: Dominated by Thatch Saw-sedge (*Gahnia radula*) followed by Tasman Flax-lily (*Dianella tasmanica*) and Forest Wire-grass (*Tetrarrhena juncea*). The following species are fairly abundant: Wattle Mat-rush (*Lomandra filiformis* subsp. *coriacea*), Spiny-headed Mat-rush (*L. longifolia* subsp. *longifolia*), Weeping Grass (*Microlaena stipoides*), Slender Wallaby-grass (*Rytidosperma penicillata*), the Heath Star-moss (*Campylopus introflexus*) and the liverwort, Green Worms (*Chiloscyphus semiteres*). The following species are scarce: Short-stem Sedge (*Carex breviculmis*), Common Bird-orchid (*Chiloglottis valida*), Pale Flax-lily (*Dianella longifolia* var. *longifolia*), Tall Sword-sedge (*Lepidosperma elatius*), Soft Tussock-grass (*Poa morrisii*), the pocket-moss *Fissidens curvatus* and the moss *Sematophyllum homomallum*. The absence of additional forbs is quite unnatural.

4.1.4 Swampy Woodland (EVC 937)



Figure 13. Swampy Woodland, looking east from the centre of the largest patch, in 2007 (top) and 2021 (bottom).

Swampy Woodland has changed greatly since the end of the Millennium Drought, as reflected in the two matched scenes in Figure 13 and the information below.

Regional threat rating: Endangered.

Area occupied: approximately 0.3 ha, on the alluvial beds of gullies. This vegetation type once included what is now mapped as the patch of Swampy Riparian Complex near the boardwalk.

Dominant canopy trees: Pure stands of Swamp Gum (*Eucalyptus ovata*), moderately dense.

Lower trees: Small numbers of Cherry Ballart (*Exocarpos cupressiformis*).

Shrubs: Currently dominated by dense thickets of Victorian Christmas Bush (*Prostanthera lasianthos*), which was absent in 1994 and scarce in the early 2000s. Reciprocally, the Dandenong Range Cinnamon Wattle (*Acacia stictophylla*) has declined from being fairly abundant to almost absent. Hop Goodenia (*Goodenia ovata*) has remained quite abundant throughout. Other shrub species (e.g. *Ozothamnus ferrugineus*) are scarce and declining.

Climbers: Mountain Clematis (*Clematis aristata*) has been consistently rather abundant. Wonga Vine (*Pandorea pandorana*) was absent in 1994 but is now similarly abundant to the clematis. Common Apple-berry (*Billardiera mutabilis*) is moderately abundant and Small-leaf Bramble (*Rubus parvifolius*) is scarce.

Ferns: There are scattered patches of Common Maidenhair (*Adiantum aethiopicum*) and Austral Bracken (*Pteridium esculentum*). Common Ground-fern (*Calochlaena dubia*) was fairly abundant in 1994 but now almost absent. There is also an isolated patch of Common Rasp-fern (*Blechnum parrisiae*).

Creepers: Centella (*Centella cordifolia*), Glandular Brooklime (*Gratiola pubescens*), Angled Lobelia (*Lobelia anceps*) and Leafy Bog-rush (*Schoenus maschalinus*) have died out, whereas Kidney-weed (*Dichondra repens*) was absent but is now fairly abundant. Bidgee-widgee (*Acaena novae-zelandiae*) and the wood-sorrel *Oxalis perennans* have been fairly abundant throughout. Hairy Pennywort (*Hydrocotyle hirta*) comes and goes over the years, always scarce.

Other groundcover: Tall Sword-sedge (*Lepidosperma elatius*) provided around 75% cover until the later years of the Millennium Drought but has now died back to less than 25%. It remains the dominant groundcover species, ahead of Thatch Saw-sedge (*Gahnia radula*), Slender Tussock-grass (*Poa tenera*) and Forest Wire-grass (*Tetrarrhena juncea*). Tasman Flax-lily (*Dianella tasmanica*) has also become fairly abundant in recent years.

4.1.5 Swampy Riparian Complex (EVC 126)



Figure 14. Swampy Riparian Complex, looking east toward the boardwalk.

The name, ‘Swampy Riparian Complex’, has been applied in the Melbourne region to classify riparian (i.e. stream-side) vegetation that does not have the well-developed eucalypt canopy of Swampy Woodland or Swampy Riparian Woodland and is not as scrubby as Swamp Scrub. In this case, the lack of eucalypts and the abundance of Swamp Paperbark are due to a century of impacts by machinery, particularly stream stabilisation works by Melbourne Water in the late 1990s and early 2000s. The same causes have resulted in very high abundances of the introduced Creeping Buttercup (*Ranunculus repens*) and Wandering Trad (*Tradescantia fluminensis*)

Regional threat rating: Endangered.

Area occupied: approximately 0.2 ha, on frequently-inundated alluvium around Koolunga Native Reserve’s boardwalk and in the southern tip of Vaughan Road Reserve. At least part of the former patch was converted from Swampy Woodland by Melbourne Water’s stream stabilisation works.

Trees: Thickets of Swamp Paperbark (*Melaleuca ericifolia*) with a few scattered Blackwood (*Acacia melanoxylon*) and Swamp Gums (*Eucalyptus ovata*) as remnants of the former Swampy Woodland.

Shrubs: Restricted to a few *Coprosma quadrifida* and *Ozothamnus ferrugineus*.

Climbers: Absent.

Ferns: There are c. 6 young Rough Tree-ferns (*Cyathea australis*) and at least one Tender Brake (*Pteris tremula*), as well as a large patch of Ruddy Ground-fern (*Hypolepis rugosula*) beside the boardwalk.

Grassy species: Except in the weediest areas, the lowest vegetation stratum is dominated by Tall Sedge (*Carex appressa*) mixed with somewhat fewer Tassel Sedge (*C. fascicularis*). Both those species were planted about two decades ago and have proliferated. Green Rush (*Juncus gregiflorus*) and Forest Wire-grass (*Tetrarrhena juncea*) are scarce.

Scramblers: Slender Knotweed (*Persicaria decipiens*) and Rainforest Crane's-bill (*Geranium homeanum*) are abundant. Small-leaf Bramble (*Rubus parvifolius*) is very scarce.

Creeper: Bidgee-widgee (*Acaena novae-zelandiae*) is scarce.

Other groundcover: Indian Weed (*Sigesbeckia orientalis*) is scarce. The pocket-moss, *Fissidens curvatus*, grows seasonally in silt, in quantities that probably fluctuate greatly.

4.1.6 Indigenous Understorey Regrowth

The indigenous understorey regrowth mapped on Figure 9 (p. 23) contains indigenous groundcover species (mostly dominating the groundcover) and a few indigenous shrubs but the tree cover is restricted to the mapped pines and some clumps of understorey trees. Other trees are either suppressed by mowing or have been killed by competition from pines, e.g. the two eucalypts north of the boardwalk, seen in all the historical aerial photographs.

Trees: The indigenous understorey trees are localised. They include Blackwood (*Acacia melanoxylon*), Cherry Ballart (*Exocarpos cupressiformis*), Swamp Paperbark (*Melaleuca ericifolia*) and some (possibly planted) Black Wattles (*Acacia mearnsii*).

Shrubs: Represented by a few Prickly Currant-bush (*Coprosma quadrifida*) and one or two Sweet Bursaria (*Bursaria spinosa*), Prickly Tea-tree (*Leptospermum continentale*) and Prickly Tea-tree (*Leptospermum continentale*). A single Silver Banksia (*Banksia marginata*) grew under pines until it succumbed to them a decade or so ago.

Climbers: Absent.

Ferns: Absent.

Creepers: Represented only by one or two small plants of Bidgee-widgee (*Acaena novae-zelandiae*).

Grassy species: Thatch Saw-sedge (*Gahnia radula*), Weeping Grass (*Microlaena stipoides*) and Slender Wallaby-grass (*Rytidosperma penicillata*) are abundant. Veined Spear-grass (*Austrostipa rudis* subsp. *rudis*), Toad Rush (*Juncus bufonius*), Broad-leaf Rush (*J. planifolius*), Wattle Mat-rush (*Lomandra filiformis* subsp. *coriacea*), Spiny-headed Mat-rush (*Lomandra longifolia* subsp. *longifolia*) and Common Bog-rush (*Schoenus apogon*) are fairly abundant. The scarcer species include Common Love-grass (*Eragrostis brownii*), three Tall Sword-sedge (*Lepidosperma elatius*), Wattle Mat-rush (*Lomandra filiformis* subsp. *filiformis*), the rushes *Juncus amabilis*, *J. pallidus* and *J. sarophorus*, and a single Small Grass-tree (*Xanthorrhoea minor*). Smooth Wallaby-grass (*Rytidosperma laeve*) was recorded in 2014 and probably persists but escaped detection in late 2021.

Other groundcover: Scattered and localised occurrences of Trim Sun-orchid (*Thelymitra peniculata*), Slender Onion-orchid (*Microtis parviflora*), Branched Sundew (*Drosera hookeri*), Black-anther Flax-lily (*Dianella revoluta*), Water Blinks (*Montia fontana*), Common Raspwort (*Gonocarpus tetragynus*), Small StJohn's Wort (*Hypericum gramineum*), Common Cotula (*Cotula australis*), Spreading Crassula (*Crassula decumbens*), Common Cudweed (*Euchiton involucratus*) and the moss *Ceratodon purpureus*.

4.1.7 The Pond



Figure 15. The artificial pond 40 m east of the boardwalk.

Natural wetlands are classified by the Department of Environment, Land, Water and Planning as regionally Endangered. However, the wetland (pond) 40 m upstream of the boardwalk has been created artificially. It is approximately 60 m² in area and 0.5 m deep.

Tall Sedge (*Carex appressa*) and Tassel Sedge (*Carex fascicularis*) fringe the pond. Slender Knotweed (*Persicaria decipiens*) grows in the pond. The duckweeds, *Lemna disperma* and *Spirodela punctata* float on the pond but only the former was seen in 2020–2022.

The pond represents an important refuge for fish and other aquatic fauna when the Forest Road Drain runs dry. There is less than 10 cm rise in ground level between the pond and the bed of the creek, giving fauna a good chance of taking refuge as the water level in the drain becomes low. The system's fish species (Shortfin Eel and Broadfin Galaxias) are both able to move across land when required.

4.1.8 Revegetation

The habitat provided by remnant native vegetation in Koolunga Native Reserve is enhanced by substantial areas of revegetation, although some of the species that have been chosen for planting in years gone by are not ideally suited.

There is also a garden at the northeastern end of St Elmo Av, established in 2004, specifically to demonstrate indigenous plants suitable for gardens that need little watering. Some of its original

plants have died and introduced species such as Panic Veldt-grass (*Ehrharta erecta*) have flourished.

4.2 Botanical Diversity

Appendix A (p. 68) contains lists of taxa of mosses, liverworts, ferns and seed-producing plants that have been recorded in Koolunga Native Reserve. Appendix B (p. 79) contains the same for Vaughan Road Reserve. ('Taxa' refers to species, subspecies and varieties.) In each case, separate lists are given for wild, indigenous species, planted species and wild, introduced species.

Table 1 provides some useful statistics about the species in the lists. Comparisons are made between the investigation for this document and the previously most thorough investigations, which were in 2004–2005 at Koolunga Native Reserve and in 2002 at Vaughan Road Reserve.

Table 1. Statistics about plant taxa in the two reserves.

	Koolunga Native Res		Vaughan Road Res	
	2004–2005	2020–2022	2002	2021–2022
No. wild, indigenous taxa of mosses & liverworts	No data	10	No data	6
No. other wild, indigenous taxa seen	150	9	41	56
No. planted, indigenous taxa seen	No data	59	0	27
No. wild, introduced taxa seen	69	118	28	75

The number of wild, indigenous plant taxa in each reserve is slightly above-average for similarly-sized nature reserves in peri-urban Melbourne.

The differences in numbers of taxa between the two reserves can be explained by Koolunga Native Reserve's:

- Much greater size;
- Greater range of vegetation types;
- Presence of some areas in a more natural condition than anywhere at Vaughan Road Reserve; and
- Planting activity by the Friends group.

The differences in statistics between the current investigation and previous investigations can be explained by:

- A significant decline in the number of indigenous plant species in Koolunga Native Reserve;
- The 2002 survey of Vaughan Road Reserve was not as thorough as this study and done on only one day in April (a poor time of year) whereas the current study spanned all seasons; and
- There has been a lot of planting in both reserves over the past decade or so.

Koolunga Native Reserve's participation in periodic ecological monitoring provides additional information about changes over time, up to 2020. Table 2 provides some statistics reproduced from the latest report of the monitoring (Lorimer 2022). Note that the figures relate to species, not subspecies or varieties, and that the survey effort varied greatly between surveys. The aggregate figure of 201 species is the tally of species recorded across all surveys.

Table 2. Numbers of wild, indigenous species of wild plants (excluding mosses and liverworts) detected in various surveys of Koolunga Native Reserve.

	Years when investigation occurred							
	Pre-1986	1994	1999	2001	2004	2007	2014	2020
No. of species:	89	95	121	106	148	81	136	128
								201

After allowing for varying survey effort, there seems to have been an underlying trend toward losing more wild indigenous species than gaining new ones. This was predicted in the 2007 monitoring report on the basis that some species had very low populations and often other threats. The Millennium Drought also explains the loss of some species, e.g. mistletoes.

The decline in numbers of indigenous plant species from Koolunga Native Reserve as a whole is not as concerning as when one looks at smaller parts of the reserve. In the reserve's four monitoring plots, the number of indigenous species (excluding mosses and liverworts) in 2020 was significantly less than in any prior survey.

These declines cannot be explained by seasonal or inter-annual variability; The 2020 survey was done under good conditions, the results were scarcely different from 2021–2022 and the lost species were mainly perennial species that are unlikely to have been overlooked. The declines in each of the monitoring plots are greater than the decline in the number of species across the whole reserve because a species lost from one plot (or a similar-sized area) often persists somewhere else in the reserve where conditions are more favourable to it.

Future declines can be expected in the number of wild, indigenous plant species in Koolunga Native Reserve and Vaughan Road Reserve because a significant fraction of species are represented by critically few individuals (often fewer than five). Some such species show remarkable persistence but most are vulnerable to problems such as failed pollination, misadventure and inbreeding. Those matters are discussed in Section 4.3.

In addition to wild plants, this study detected 55 planted indigenous species in Koolunga Native Reserve and 27 in Vaughan Road Reserve. Little if any planting has been done in Vaughan Road Reserve until recent years and it is rather clear which plants have been planted. By contrast, the distinction between planted plants, their descendants and fully-wild plants is often obscure in Koolunga Native Reserve because planting began in the 1970s (see p. 64 of Allaway 1994) and has been voluminous.

At least 26 of the indigenous species that have been planted in Koolunga Native Reserve can be confidently concluded to have died out. Some of those species are innately sensitive and are dying out in the wild, too; e.g. Glandular Brooklime (*Gratiola pubescens*). Conversely, a few species that have been planted have established quite viable, reproducing populations; e.g. Large Kangaroo Apple (*Solanum laciniatum*).

The Friends of Koolunga Native Reserve has encouraged its members to propagate indigenous plants at home for planting in the reserve (e.g. the Friends Group's newsletter number 18 of 1999) and plantings have been only partly documented, rarely with details of exact locations. Ferns have been a particular focus for planting (as in the newsletter just cited), which makes it very difficult to tell whether ferns such as Green Rock Fern (*Cheilanthes austrotenuifolia*) were planted or freak natural occurrences.

The presence or absence of species from early plant lists for the reserve sometimes helps in a small way to determine whether a species is only present due to planting. However, the early lists are demonstrably incomplete, they do not always distinguish reliably between planted and natural

occurrences, and some species that occur naturally today may not have been present or visible in the past (e.g. due to recent germination of seed brought in by wind or birds).

4.3 Threatened Plant Species

By international convention, a species is called a ‘threatened species’ globally or within a defined area if it meets the ‘Red List’ criteria for the categories, ‘Critically endangered’, ‘Endangered’ or ‘Vulnerable’.

Three species recorded in Koolunga Native Reserve and/or Vaughan Road Reserve are listed under the Victorian *Flora and Fauna Guarantee Act* as being threatened with dying out in the whole of Victoria:

- The flat-pea, *Platylobium infecundum*, is listed as Critically endangered because until this study (December 2022), it had never been observed to produce mature seeds anywhere and its entire known global distribution lies within Knox, Maroondah, adjacent parts of the Dandenong Ranges, and a specimen from ‘Maroondah Hwy, c. 5 km NE of Healesville’. In Koolunga Native Reserve, it is represented by approximately 12 patches, some of them large and probably containing multiple individuals. Two patches were found in Vaughan Road Reserve. The main threats in the reserves and more widely are climate change and inability to adapt to change through natural selection of offspring. General decline in the ecological condition of the reserves’ habitat is also a risk.
- The Dandenong Range Cinnamon Wattle (*Acacia stictophylla*) is abundant in Koolunga Native Reserve (roughly 30 wild plants plus many planted) and scarce in Vaughan Road Reserve (two wild plants and a few planted). The species’ entire global range extends from the Dandenong Ranges to Wantirna and Warrandyte. This species has a large population within that area but it is listed as Endangered in Victoria because of its limited spatial distribution. Its main threat in the reserves and more widely is climate change. General decline in the ecological condition of the reserves’ habitat is also a risk.
- The Floodplain Fireweed (*Senecio campylocarpus*) is a short-lived, opportunistic species that colonises bare, boggy ground, usually associated with flooding. Its windblown seeds spread widely across the landscape. It is listed as Endangered in Victoria. A single plant (not a viable population) established in Vaughan Road Reserve in 2021 before being washed away in fast-flowing water. Such occurrences are not uncommon beside any stream or waterbody.

The first column of Appendix A (p. 68) indicates which species were assessed by Lorimer (2010) as meeting the Red List criteria for their risk of dying out in Knox. For each species rated ‘Critically endangered’ or ‘Endangered’ in Knox, the alphabetical list in Table 3 provides its population details and threats. Colour-coding in the left-most cells of the table is used to indicate which species fall into the ‘critically endangered’ category (red) or the ‘endangered’ category (yellow). The newly-discovered Graceful Fescue (*Festuca asperula*) is clearly ‘Critically endangered’ because there are only two known patches in Knox (perhaps only one or two plants each) – the one in Koolunga Native Reserve and one discovered in November 2022 in Roselyn Crescent Reserve, Boronia.

Table 3. Population details of plant species ‘Endangered’ or ‘Critically endangered’ in Knox.

Where ‘small population’ or ‘critically small population’ is indicated below as a threat, there is a risk of reproductive problems (e.g. inbreeding) or destruction by chance events such as trampling or dog urination.

Species & changes	Population details	Threats
<i>Acacia myrtifolia</i> (Myrtle Wattle) Died out (temporarily?)	This short-lived wattle was seen continuously in Koolunga Native Reserve through the 1990s to 2001. Only planted individuals have been seen since, except for one tiny seedling in June 2014 that may be this species, growing near Forest Rd where there had been a fire in late 2013.	Small population; Lack of fire
<i>Acacia pycnantha</i> (Golden Wattle) Stable	A few apparently wild individuals continue to grow beside St Elmo Rd in Koolunga Native Reserve, as well as planted individuals elsewhere in the reserve.	Small population; Lack of fire
<i>Amphibromus archeri</i> (Pointed Swamp Wallaby-grass) Disappeared; may return	One plant was found in late 2004 at the western edge of a monitoring plot in Koolunga Native Reserve. It has not been seen since. It may be seen again following a fire in the swamp or after a drought followed by a rainy year.	Critically small population; Climate change and consequent drought; Competition by Blackberry
<i>Amyema pendula</i> (Drooping Mistletoe) Not seen since 2004	Like most other reserves, all mistletoes appear to have died in Koolunga Native Reserve and Vaughan Road Reserve during the late stages of the Millennium Drought. They are unlikely to recolonise in the foreseeable future because Mistletoebirds (who spread the seeds) are no longer attracted to the reserve.	Climate change and consequent drought; Lack of seed source
<i>Arthropodium milleflorum</i> (Pale Vanilla-lily) Last seen in 1999	Kathleen Loxton reports having seen 3 or 4 plants in Koolunga Native Reserve prior to 1999, but none have been found since.	
<i>Asperula conferta</i> (Common Woodruff) Probably died out since 2014	From 1994 to at least 2014, a sprawling patch was located on the ridge just east of the bridge near the end of St Elmo Av. In 2020, the plant was not found but dense grass weeds (<i>Ehrharta erecta</i> and <i>Dactylis glomerata</i>) were present. Many other species that grew around the woodruff in 2014 could not be found in 2020, either. That raises concern about general ecological decline and the potential for the woodruff to be found again in future.	Critically small population; General ecological decline of habitat
<i>Banksia marginata</i> (Silver Banksia) Died out in c. 2012	Two plants used to grow beneath pines behind 38 Daffodil Rd. They both died around 2012, attributable to the pines.	
<i>Blechnum minus</i> (Soft Water-fern) Not seen since 2004	Two plants were found beside the Forest Road Drain within Koolunga Native Reserve in 1999 and were presumed to have been wild. They soon died out and a young plant was found in 2004, perhaps as a result of planting. It soon disappeared, too.	
<i>Blechnum parrisiae</i> (Common Rasp-fern) Stable	In 1999, three wild (or perhaps planted) specimens grew in the tiny, most southeasterly patch of Swampy Woodland in Koolunga Native Reserve. They died out by 2014 but approximately ten were planted between there and the creek in 2013. Four or five plants were found in 2020 at the original location. It is unclear whether they are wild or some of the plants planted in 2013.	Small population; Climate change and consequent drought

Species & changes	Population details	Threats
<i>Caladenia carnea/catenata</i> (Pink or White Fingers) Not seen for >20 years (if ever)	Said by Paget (1985) (contrary to Western (1985)) to have been seen previously by Gary Cheers. Questionable.	
<i>Caladenia ?phaeoclavia</i> (a spider-orchid) Not seen for >30 years (if ever)	As above.	
<i>Cassytha melantha</i> (Coarse Dodder-laurel) Rediscovered (1 plant)	Very small numbers occurred in the southwest of Koolunga Native Reserve (near St Elmo Av) and just northeast of the end of St Elmo Av until 2004. Like mistletoes, all of these hemi-parasites appeared to die out during the Millennium Drought. In 2020, a very healthy clump was found on a <i>Eucalyptus macrorhyncha</i> near the northwest end of the Koolunga car park.	Small population.
<i>Cheilanthes austrotenuifolia</i> (Green Rock Fern) Seen only in 2004	A single plant was observed in the 2004 survey of Koolunga Native Reserve. It became sickly during the Millennium Drought and could not be found in subsequent surveys. It may have also been hit by a large fallen eucalypt limb. The very unusual habitat suggests it may have been planted. Otherwise, it was a chance, sporadic occurrence.	
<i>Correa reflexa</i> (Common Correa) Stable	In 2020, four or five were just east of the footbridge north of St Elmo Av, where two or three were recorded in 2007 and 2014. There were none on the slope of the gully to the north, where three or four were recorded in 2014. Many apparent hybrids have been planted in the reserve, posing a risk that even the natural plants will produce hybrid offspring.	Hybridisation; Small population; Climate change and consequent drought
<i>Cyathea australis</i> (Rough Tree-fern) Stable	Six healthy individuals (some large) grow beside the creek in Vaughan Road Reserve. Only small ones grow in Koolunga Native Reserve: a few beside the Forest Rd Drain and 5 in a drain behind 9 Shirley Ct (in the reserve's west), where pines were removed about a decade ago.	Climate change and consequent drought; Small population; Competition from Bracken and weeds
<i>Daviesia latifolia</i> (Hop Bitter-pea) Change uncertain	Recorded in Koolunga Native Reserve by Hallpike and Beardsell in 1980, possibly on the basis of the planted specimens. No wild ones were seen for decades, but a few seedlings were found in 2014 near the southern corner of Koolunga Native Reserve abutting St Elmo Rd, perhaps the progeny of planted individuals. By 2020, so many had been planted that it was unclear whether any of the possibly wild plants of 2014 had survived.	Small population
<i>Deyeuxia densa</i> (Heath Bent-grass) Not seen since 2004	The author observed up to eight plants in the main patch of Swampy Woodland in Koolunga Native Reserve each summer from 1999 to 2004 but not since. It may reappear following fire in the swamp.	Critically small population; Climate change and consequent drought
<i>Dipodium roseum</i> (Rosy Hyacinth-orchid) Stable	This species spends most of its life underground, only emerging in some years to flower. Flowering stems appear in Koolunga Native Reserve at unpredictable locations, most years.	General ecological decline of habitat
<i>Diuris orientis</i> (Wallflower Orchid) Not seen for over 37 years, if ever	A 1984 Knox Environment Society brochure about Koolunga Native Reserve implied this species to be present in the reserve. That is the only report from the reserves.	

Species & changes	Population details	Threats
<i>Eucalyptus macrorhyncha</i> (Red Stringybark) Stable	Red Stringybark remains a dominant species in both reserves. However, they appear to have sparse foliage, so their health may be in decline.	Climate change and consequent drought; Disease; General ecological decline
<i>Eucalyptus radiata</i> (Narrow-leaved Peppermint) Stable	Both reserves have healthy populations. Koolunga Native Reserve has roughly one hundred mature trees, making it perhaps the best stand of the species in Knox.	Climate change and consequent drought; Disease; General ecological decline
<i>Exocarpos strictus</i> (Pale-fruit Ballart) Probably died out since 2014	Koolunga Native Reserve's only recorded plant, which grew in the northeastern Valley Heathy Forest, could not be found in 2020.	Inability to reproduce.
<i>Festuca asperula</i> (Graceful Fescue) New discovery	The 2020 monitoring study made the first discovery of this species in Knox's history. The sprawling, cryptic nature of the species makes it hard to distinguish separate species but there may be only one or two in the reserve. Another, similar patch was discovered in Roselyn Crescent Reserve, Boronia, in 2022. The plant in Koolunga Native Reserve must be at least 53 years old and probably over a century, as the species produces seed only in the summer following a fire and the last fires appear to have been in 1968 and the 19th Century.	Critically small population; Climate change and consequent drought; General ecological decline of habitat
<i>Galium gaudichaudii</i> (Rough Bedstraw) Rediscovered	A single individual was found in 2020, near the middle of the main patch of Swampy Woodland in Koolunga Native Reserve. The species was recorded to be scarce (perhaps just one) in each survey from 1999 to 2004 but not in 2007 or 2014.	Critically small population; Climate change and consequent drought; General ecological decline of habitat
<i>Gastrodia sesamoides</i> (Cinnamon Bells) Seen only in 2001–2	The author saw <i>Gastrodia sesamoides</i> only in the summer of 2001–2. The species lives mainly underground, emerging only in some years. It is therefore difficult to assess its population or trends.	Small population; Weed competition
<i>Geranium homeanum</i> (Rainforest Crane's-bill) Increased	This species is rather abundant in both reserves, particularly among introduced plants beside the Forest Road Drain. It no longer qualifies as locally threatened in Knox. The species favours disturbance, so the decline of other species may have favoured this species.	Climate change and consequent drought
<i>Glossodia major</i> (Wax-lip Orchid) Not seen for over 20 years (if ever)	Said by Paget (1985) (contrary to Western (1985)) to have been seen previously in Koolunga Native Reserve by Gary Cheers. Questionable.	
<i>Gratiola pubescens</i> (Glandular Brooklime) Seen only once, 1994	Found in substantial numbers by Damien Cook in the main patch of Swampy Woodland in Koolunga Native Reserve in January 1994. Not seen in subsequent surveys, except for ten or so that were planted near the boardwalk in 2013 and have since died.	Drought; Climate change

Species & changes	Population details	Threats
<i>Hackelia suaveolens</i> (Sweet Hound's-tongue) Stable (one plant)	Represented by 10–20 plants just east of the footbridge north of St Elmo Av until the early 2000s, then reduced to a few patches in 2007 and apparently just one in 2014 and now. Many other indigenous species have died out since 2014 in the adjacent monitoring plot, indicating a general ecological decline in the area.	Critically small population; Competition from Bracken and weeds; General ecological decline of habitat
<i>Hypolepis rugosula</i> (Ruddy Ground-fern) Reappeared	One sickly plant discovered by the creek between Koolunga Native Reserve's footbridge and boardwalk in 1999 had disappeared by 2002, perhaps due to creek stabilisation works that had occurred in the interim. A thriving patch has arisen in recent years next to the boardwalk.	Climate change and consequent drought; Water pollution
<i>Hypoxis hygrometrica</i> (Golden Weather-glass) Not seen since the 1990s	Six plants were seen (and one photographed) by Kathleen Loxton in Koolunga Native Reserve in the 1990s. It may have died out but it is extremely hard to detect except for the few days each year when it flowers.	
<i>Juncus holoschoenus</i> (Joint-leaf Rush) Not seen since 2004	Small numbers were seen by the author in the creek in Koolunga Native Reserve between 2001 and 2004. Creek erosion and engineering works have apparently destroyed the population but it may return if the creek is able to recover.	Creek erosion; Weed competition
<i>Juncus pauciflorus</i> (Loose-flower Rush) Stable	This species is scattered along the creek in Koolunga Native Reserve. Some may have been planted.	Climate change and consequent drought
<i>Juncus planifolius</i> (Broad-leaf Rush) Stable, within normal fluctuations	The population size of this annual species varies greatly from year to year according to the amount of winter rainfall. 2021 was a very good year and dozens were seen in the lawns near the pines, plus a few near 9 Shirley Ct.	Climate change and consequent drought
<i>Lemna disperma</i> (Common Duckweed) Subject to natural fluctuations	Prior to 2020, the only record from either reserve was in 2002, in the creek in Vaughan Road Reserve. The species appeared in 2020 as a small population in the pond 40 m east of the boardwalk in Koolunga Native Reserve. Now there are thousands there. The species is spread by waterbirds and it often dies out in a wetland before being re-introduced during suitably wet conditions. It should therefore be expected to come and go.	Climate change and consequent drought
<i>Leptospermum scoparium</i> (Manuka) Stable, within normal fluctuations	The population size of this short-lived shrub species varies greatly over the years according to rainfall and vegetation disturbance. In 2020, the species was fairly abundant in Koolunga Native Reserve.	Climate change and consequent drought
<i>Melaleuca ericifolia</i> (Swamp Paperbark) Increased	Thickets of this suckering species are slowly expanding at locations beside the creek in both reserves. Some of the plants in Koolunga Native Reserve may have been planted.	Climate change and consequent drought
<i>Montia fontana</i> (Water Blinks) Probably stable	This tiny annual appears in winter and spring of some years in the middle of the lawn near St Elmo Avenue, but not in recent years. No trend can be ascertained because the population size is hard to measure and likely to fluctuate according to each year's rainfall.	Small population; Climate change and consequent drought
<i>Muellerina eucalyptoides</i> (Creeping Mistletoe) Not seen since 2001	Like most other reserves, all mistletoes appear to have died in the reserves during the Millennium Drought. They are unlikely to recolonise in the next few years because Mistletoebirds (who spread the seeds) are no longer attracted to the reserve.	Drought; Climate change and consequent drought; Lack of seed source

Species & changes	Population details	Threats
<i>Olearia argophylla</i> (Musk Daisy-bush) Not seen wild since 2004	Until at least 2004, Koolunga Native Reserve had one plant that may have been natural or planted. By 2014, it appeared that only planted specimens remained. In 2020, one (presumably planted) plant was seen beside the creek, one-third of the way from the reserve's western corner to the eastern boundary.	Climate change and consequent drought
<i>Olearia myrsinoides</i> (Silky Daisy-bush) Stable	This species is scattered through Koolunga Native Reserve in 2022. Only one individual was found in Vaughan Road Reserve during this study.	Climate change and consequent drought
<i>Ozothamnus ferrugineus</i> (Tree Everlasting) Stable	This species remains scattered through Koolunga Native Reserve.	Climate change and consequent drought
<i>Patersonia occidentalis</i> (Long Purple-flag) Not seen for over 30 years (if ever)	Allaway (1994) lists <i>Patersonia occidentalis</i> as an 'unconfirmed' recollection of Bill Ireland. It has not been reported in any survey since 1982.	
<i>Pelargonium inodorum</i> (Kopata) New discovery	Two plants of this highly opportunistic annual species were found in Koolunga Native Reserve in 2020: one next to where the creek exits the reserve and the other north-northeast of the dead end of St Elmo Av. The species often persists as seed in the soil for scores of years, until fire or minor soil disturbance stimulates germination.	Critically small population
<i>Pimelea axiflora</i> (Bootlace Bush) Not seen wild since 1999	Two individuals found in 1999 died. Others were planted just downstream of where the creek enters the reserve from a pipe but they appear to have died, too.	Climate change and consequent drought
<i>Plantago debilis</i> (Shade Plantain) Died out, perhaps temporarily	This short-lived, opportunistic species appears periodically in the reserve after fire or soil disturbance. Colonies arose north of the footbridge north of St Elmo Av between 1999 and 2002 before dying out for about a decade. In 2014, a cluster of five seedlings appeared beside a path near the same location. None have been seen in the past few years.	Small population; Climate change and consequent drought; Lack of fire
<i>Poa tenera</i> (Slender Tussock-grass) Stable	This species is scattered through Koolunga Native Reserve, mainly around the centre, as in previous surveys. This study found none in Vaughan Road Reserve, where the species was recorded in 2002.	Climate change and consequent drought
<i>Polyscias sambucifolia</i> (Elderberry Panax) Change uncertain	A single plant grows in Vaughan Road Reserve despite the species not being recorded in 1986 or 2002. In Koolunga Native Reserve, just one plant was found continuously from 1999 to 2014, on the eastern edge of a ditch, 5 m from the creek and 90 m from Forest Rd. It has disappeared but there are healthy, new thickets on the left bank of the creek in the reserve's west, presumably the result of planting.	Climate change and consequent drought
<i>Polystichum proliferum</i> (Mother Shield-fern) Died out before 2014	The two apparently natural specimens found up to 2007 died and were then replaced by planting. In 2020, four apparently planted individuals grew just upstream of the St Elmo Rd footbridge.	Climate change and consequent drought; Weeds; Creek erosion

Species & changes	Population details	Threats
<i>Prostanthera lasianthos</i> (Vic. Christmas Bush) Major increase, perhaps due to planting	Abundant northwest of the creek in Vaughan Road Reserve. In Koolunga Native Reserve, several plants appeared to be growing naturally in the 1990s. The few plants seen in 2014 were thought to be perhaps all planted. In 2022, the species is abundant and widespread, perhaps aided by planting.	Climate change and consequent drought
<i>Pterostylis alpina</i> (Mountain Greenhood) Possibly died out	Several plants were seen regularly from the late 1990s to at least 2007, just northeast of the footbridge near the end of St Elmo Av. None could be seen in 2014, by which time the location had become densely covered with grass, sedges and shrubs, leaving little opportunity for an orchid to receive its needs for sunlight. The situation was the same in 2020–2022. Thinning of competing vegetation would be beneficial to all the orchid species in this area.	Lack of fire; Small population; Climate change and consequent drought; General ecological decline
<i>Pterostylis melagramma</i> (Tall Greenhood) Possibly died out	This species has been recorded in previous surveys as thinly scattered around the central area of Koolunga Native Reserve's bushland. In the Millennium Drought, it exploited the drying out of the Swampy Woodland to find new habitat where previously it was out-competed by swamp plants. The lack of records during the last decade raise serious concerns for the species' survival.	Small population; Climate change and consequent drought; Competition from weeds and bracken
<i>Pterostylis pedunculata</i> (Maroon-hood) Possibly decreased	Until at least 2006, there were several dispersed colonies of many plants each. They could not be found in the 2014 or 2020–2022 surveys, nor by members of the Friends group during that period.	Lack of fire; Climate change and consequent drought; General ecological decline
<i>Rubus parvifolius</i> (Small-leaf Bramble) Stable	This species is scattered through Koolunga Native Reserve (as in previous surveys) and a few patches grow in Vaughan Road Reserve.	Climate change and consequent drought
<i>Schoenus maschalinus</i> (Leafy Bog-rush) Seen only once, 1994	Found in substantial numbers by Damien Cook in Koolunga Native Reserve's main patch of Swampy Woodland in January 1994; not seen since.	Climate change and consequent drought
<i>Senecio ?odoratus</i> (Scented Groundsel) Seen only once, 1994	Between one and a few were reported in Koolunga Native Reserve by Damien Cook in January 1994; not seen since. If the identification was correct, the plant(s) are best regarded as a transient, chance occurrence.	
<i>Senecio minimus</i> (Shrubby Fireweed) Stable, within normal fluctuations	Population sizes of this opportunistic species tend to fluctuate from year to year according to soil moisture availability. It was scattered fairly abundantly through Koolunga Native Reserve in 2022, as in some previous surveys.	Climate change and consequent drought
<i>Solanum ?aviculare</i> (Kangaroo Apple) A brief occurrence	This species was recorded in Vaughan Road Reserve in 2002. A young plant that appeared consistent with this species was seen in the reserve in 2021 but it was washed away before it flowered, thereby preventing confirmation of the identity.	Climate change and consequent drought; Unnaturally fast stream flows
<i>Sigesbeckia orientalis</i> (Indian Weed) Large increase	In 2022, the species fairly abundant in both reserves, concentrated near the Forest Road Drain. It is perhaps benefiting from the decline or death of so many other indigenous plants in recent years. There were far fewer (or none) in previous surveys.	

Species & changes	Population details	Threats
<i>Spirodela punctata</i> (Thin Duckweed) Seen only in 2014	Only seen in 2014, when a small number were floating in Koolunga Native Reserves pond 40 m upstream of the boardwalk. The species is spread by waterbirds and it often dies out in a wetland before being re-introduced during suitably wet conditions. It may therefore return, just as Common Duckweed appeared in 2020.	Small population; Climate change and consequent drought
<i>Stylidium armeria</i> (Grass Trigger-plant) Rediscovered (1 plant)	One plant was found in 2020, just northeast of quadrat QK023. None were seen in 2007 or 2014 but the species was fairly abundant and widespread in the reserve in prior years.	Critically small population; Climate change and consequent drought; General ecological decline of habitat
<i>Tetralochea ciliata</i> (Pink-bells) Died out by 2004	Up to the 2001 survey, two apparently wild individuals grew near the footbridge near the end of St Elmo Av. Only planted ones were seen in 2014 and none at all in 2020–2022.	
<i>Thelymitra arenaria</i> (Forest Sun-orchid) Change unknown	A small number of this seasonal species was found in November 2004 in the southwest of Koolunga Native Reserve. The groundcover there is now suppressed for a firebreak. The sun-orchid could not be found during flowering season in 2021.	Small population; Firebreak management
<i>Thysanotus tuberosus</i> (Common Fringe-lily) Last seen in 2001	Until 2001, a handful of plants occurred on the western edge of the patch of Valley Heathy Forest that abuts Forest Rd. The species is easily overlooked except when flowering but it appears to have died out.	
<i>Veronica derwentiana</i> (Derwent Speedwell) Maintained by planting	In 2020, three plants (quite possibly planted) grew by the creek, between the boardwalk and the footbridge near the end of St Elmo Av. In a similar location in 2014, one large (possibly planted) specimen was found alongside approximately a dozen recently planted ones. In 2006, five apparently wild plants grew along the same stretch of the creek.	Climate change and consequent drought; Small population; Weeds; Creek erosion

The 2006 management plan for Koolunga Native Reserve recommended propagation and planting of eleven species in Table 3 above, each one identified as having a precariously small population. Some of those have since been successfully established in adequate numbers and others did not succeed. The only failed species worth trying again is the Grass Trigger-plant (*Stylidium armeria*). A recommendation to that effect is included in Section 8.5 (p. 64). The recently-discovered Graceful Fescue (*Festuca asperula*) is also worth planting, in the hope of broadening genetic diversity.

5. Fauna and Habitat

5.1 Fauna Species

Appendix C (p. 84) lists the species of vertebrate fauna and butterflies recorded in Koolunga Native Reserve and Vaughan Road Reserve.

The Powerful Owl is observed fairly regularly in the reserves and the neighbourhood, outside breeding season (May to September). The Powerful Owl is listed as Vulnerable under the Victorian *Flora and Fauna Guarantee Act*. It is the only known fauna species that was listed as threatened at the time it was last seen in either reserve.

Otherwise, the recently-observed fauna are found fairly commonly in parts of Knox and Melbourne's outer east and northeast. Perhaps the most notable aspect of the list is the absence of recent records of some species that are fairly common in peri-urban forests, e.g. the Olive-backed Oriole, Common Froglet and Spotted Marsh Frog.

5.2 Habitat Features

The following habitat features were observed during the fieldwork for this management plan:

- Diverse and moderately intact native vegetation with all natural strata present;
- Areas of densely grassy ground flora that attract certain butterfly species for laying eggs and feeding their young;
- Areas of dense sedges and mat-rushes that attract skipper butterflies for laying eggs and feeding their young (including planted *Gahnia sieberiana* once used by Swordgrass Brown butterflies);
- An artificial wetland that suits breeding by frogs and certain invertebrates;
- Trees (alive and dead) containing hollows suitable for nesting or roosting by native birds, bats, possums and insects;
- A modest number of logs on the ground, providing cover for lizards and invertebrates;
- Nest boxes, including some specifically for Krefft's Glider (a species of Sugar Glider);
- In places, a dense layer of prickly shrubs, providing cover and food for small species of native birds such as scrubwrens;
- An almost-perennial stream occupied by two migratory fish species and unknown invertebrates;
- Rockwork and overhanging vegetation along the creek, which may provide habitat for the reserves' fish and aquatic invertebrates.

6. Biological Significance Ratings

The Victorian Government's [published criteria for assessing biological significance \(Amos 2004\)](#) yield the following ratings for Koolunga Native Reserve:

National significance for the presence of a viable population of the flat-pea, *Platylobium infecundum*, which is listed as Critically endangered under the *Flora and Fauna Guarantee Act* and only occurs within a few tens of kilometres of the reserves. The discovery of well-formed seeds on the plants in the reserve in 2022 – the first such record anywhere – adds to the significance;

State significance for the presence of a viable population of the Dandenong Range Cinnamon Wattle (*Acacia stictophylla*);

State significance for the presence of patches of three Ecological Vegetation Classes listed as Endangered (namely, Valley Heathy Forest, Swampy Woodland and Swampy Riparian Complex);

Regional significance for the presence of a patch of the regionally-vulnerable Herb-rich Foothill Forest with a 'Habitat Hectares' score exceeding 30/100;

Regional significance for the habitat provided to the Graceful Fescue (*Festuca asperula*) and the Powerful Owl;

Local significance due to viable populations of plant species that meet the 'Red List' criteria as threatened species in the context of the City of Knox; and

Local significance due to the riparian vegetation and the position on a local habitat corridor.

The only differences for Vaughan Road Reserve are that: (a) Vaughan Road Reserve is not known to contain any Graceful Fescue; and (b) Valley Heathy Forest is the reserve's only EVC to qualify as significant.

The overall biological significance rating of a site is the highest rating of any attribute that it possesses. That means **both reserves are of National significance**.

Separately from the matters of biological significance considered under Victorian Government criteria, it should be recognised that flora, fauna and ecological communities possess additional values to humanity. Lorimer (2020) identifies those additional values as:

- *Practical 'ecosystem services'* such as microclimate moderation, erosion control or purification of air and water;
- *Financial and economic benefits* such as through supporting employment and property values;
- *Satisfying human attachment to nature* by offering experiences in natural environments, thereby providing benefits to health, wellbeing, childhood development and quality of life; and
- *Natural heritage*: Nature's contribution to sense of place and our concepts of who we are, how we fit into history and nature's grand design, and what we should pass on to future generations.

It is also worth bearing in mind that this study does not consider natural values other than flora, fauna and ecological communities, e.g. geological significance.

7. Management Issues

This section of the management plan discusses the principal management issues associated with Koolunga Native Reserve and Vaughan Road Reserve. The actions recommended in response to the issues are provided in Section 8.

7.1 Environmental Weeds

Environmental weeds represent the greatest management issue in Vaughan Road Reserve and a major issue in Koolunga Native Reserve. The two reserves' environmental weed problems differ significantly in their nature, severity, urgency and hence appropriate responses.

In Vaughan Road Reserve, the tractable environmental weed problems are (in decreasing order):

1. Smothering of forest understorey by the introduced vine species, Blue Morning Glory (*Ipomoea indica*), Japanese Honeysuckle (*Lonicera japonica*) and Ivy (*Hedera helix*), exacerbated by unnaturally dense Wonga Vine (*Pandorea pandorana*) and loss of the shade of some eucalypts due to windthrow in recent storms; and
2. The threat of displacement of indigenous forest understorey by the introduced trees, Sweet Pittosporum (*Pittosporum undulatum*) and Large-leafed Privet (*Ligustrum lucidum*).

There are other, equally serious environmental weeds along the creek (particularly Cape Ivy, *Delairea odorata*) but those problems are intractable due to catchment-related problems that are discussed in Section 7.3. The assessment of tractability and other matters for prioritising environmental weed problems is discussed in Section 7.1.2.

In Koolunga Native Reserve, the main tractable environmental weed problems are (in decreasing order):

1. Smothering of understorey in the main patch of Swampy Woodland by Blackberry (*Rubus anglocandicans*), Wonga Vine and (to a lesser degree) Japanese Honeysuckle and Sweet Pittosporum;
2. Replacement of indigenous groundcover in the reserve's northeastern corner (Valley Heathy Forest) by Kikuyu (*Cenchrus clandestinus*) and Panic Veldt-grass (*Ehrharta erecta*);
3. Smothering of understorey in the eastern half of the reserve by unnaturally dense Wonga Vine; and
4. Continual colonisation of the whole forest by Sweet Pittosporum and Large-leafed Privet.

Koolunga Native Reserve also has a range of other environmental weeds that are either less environmentally-damaging or less tractable (for reasons discussed below). Some of them, such as Panic Veldt-grass (*Ehrharta erecta*), have concentrations within about 1 m on each side of paths. That concentration can be attributed to physical disturbance of vegetation and ground by path users (including dogs) and to high concentrations of nitrogen and phosphorus deposited in the urine and faeces of dogs. Such impacts are discussed in Section 7.8 (p. 58).

It is worth noting that the Koolunga Native Reserve's environmental weeds have abated in many respects over the years. The main problem species from reservation in 1968 until the 1990s were Blackberry, Japanese Honeysuckle, Sweet Pittosporum, pines, Sallow Wattle and other introduced trees. A 1984 brochure about the reserve by the Knox Environment Society stated, 'Sadly, blackberries, pittosporums and honeysuckles are overgrowing these ferny areas and creek banks'. Blackberry and honeysuckle are now much less prevalent (despite recent resurgence in the Swampy Woodland), Sweet Pittosporum is reduced to scattered young plants to head-high, and

the other weedy trees (except pines) have been completely eradicated for many years. Pines, on the other hand, are now much larger than at any time in the reserve's history.

In order to extend the successes of the past, it is necessary to understand some theory, as follows.

7.1.1 Principles of Environmental Weed Assessment

The term, 'weed', is just a value-laden, pejorative term for a plant whose presence is not wanted by the user of the word. By contrast, the term 'environmental weed' has an objective, value-neutral meaning; It means a plant that is displacing indigenous flora or fauna except if the displacement is part of a natural cycle.

Most environmental weeds belong to introduced species but that is far from universal. Wonga Vine (*Pandorea pandorana*) in the two reserves of interest here provides a good example. It is convincingly indigenous and it is an environmental weed because changes to the environment (and probably the plants' genetics) have resulted in it killing numerous other indigenous plants.

Conversely, not all wild, introduced plants in natural environments are environmental weeds. Many of the introduced plants in the two reserves are only present because the environment has been changed so much at their location that no indigenous flora can persist. Such introduced plants should be regarded as symptoms of unnatural underlying environmental conditions, not a problem in themselves. Removing them is more a matter of aesthetics or gardening than environmental management.

It is often very hard to distinguish between plants that are driving ecological change from those that are just symptoms, or somewhere between the two extremes.

These are critical concepts for managing introduced plants in Koolunga Native Reserve and Vaughan Road Reserve. Two examples will illustrate.



Figure 16. Blue Morning Glory smothering indigenous plants in Vaughan Road Reserve.

Firstly, as noted in Section 4.1.3 (p. 27), the forest at Vaughan Road Reserve changed significantly during the present study, largely in the rapid spread of the introduced vine weeds, Blue Morning Glory (*Ipomoea indica*) and Cape Ivy (*Delairea odorata*). Figure 16 shows dense Blue Morning Glory smothering indigenous shrubs and groundcover in the middle distance, in April 2022. The previous September, the vines had not reached far into the scene of Figure 16. The indigenous shrubs and groundcover beneath the vines will soon die. The capacity of the forest to regenerate following removal of the vines will soon cease.

The vines are driving rapid, permanent ecological change but they could be repelled with enough resources. The ecological return on investment would probably be high. There would be much less benefit from removing the same vine species from areas without any native vegetation.

As a quite different example, a large proportion of the floodplain around Koolunga Native Reserve's boardwalk is dominated by the introduced species, Creeping Buttercup (*Ranunculus repens*) – see Figure 14 on p. 31. More generally, that species grows in consistently wet soil with higher nutrient content than is natural in Victoria. The Creeping Buttercup in Koolunga Native Reserve has not significantly changed over some years and it is not expected to spread. It would be out-competed by other species if the Forest Road Drain did not bring in so much nutrient. It would also be diminished if there were more shade; The eucalypts that used to provide shade have nearly all died due to hydrologic changes from engineering works by Melbourne Water.

Imagine you had a magic method to remove the Creeping Buttercup (which is quite intractable with existing techniques) and you did not magically remove the nutrients from the water and floodplain. The space vacated by the Creeping Buttercup would soon become dominated by either more Creeping Buttercup (washed in) or something just as undesired, particularly the currently-subdominant Wandering Trad (*Tradescantia fluminensis*).

There is no effective way to physically or chemically remove these species from around the boardwalk for the medium- to long-term. Instead, an appropriate strategy is to do what we can about the underlying problems, e.g. planting paperbarks for shade and developing a catchment management strategy to deal with the aquatic problems.

These examples illustrate how important it is to interpret whether a particular undesired plant is driving ecological change or a symptom of underlying drivers – or somewhere in between. These examples are much easier to interpret than many others; Sometimes, one has to experiment with removal of a sample of the plants in question and see how the environment responds.

The examples also show that it is important to have an idea of how tractable it is to remove the plants of concern. Creeping Buttercup and Wandering Trad are quite intractable (although a biological control may soon help with the latter); Blue Morning Glory is tractable. Again, one sometimes has to experiment to determine tractability.

7.1.2 Prioritisation

The considerations above form part of a sound basis for prioritisation of efforts to control environmental weeds. The full range of considerations can be summarised as follows:

1. Seriousness of the displacement of indigenous flora and fauna that is going on;
2. Rapidity of the problem worsening;
3. Tractability: the difficulty, effectiveness, safety & environmental hazards of control;
4. Pros and cons of the plants' non-environmental attributes, e.g. Koolunga's pines appeal to some in the community despite the associated displacement of indigenous flora and fauna;
5. Legal or organisational obligations that require or prevent action.

Based on these considerations, Appendix D (p. 87) provides a step-by-step guide for assigning priority to a particular environmental weed problem.

It is then necessary to assign resources, taking into account priorities unrelated to environmental weeds.

The prioritisation process has led to the recommended management actions in Section 8.3 below (p. 62).

7.2 Tree Management

7.2.1 Eucalypt Ill-health and Deaths

Eucalypts in both Koolunga Native Reserve and Vaughan Road Reserve display widespread debilitation and deaths. This is an ecological problem not just for the sake of the trees but also because eucalypts are critical to the overall functioning of the forest. For example, in a healthy eucalypt forest, the eucalypts:

- Capture more sunlight than the vegetation strata below, thereby doing most of the photosynthesis that creates the base of the food chain;
- Create most of the forest litter that feeds and houses many invertebrates and adds organic material to soil;
- Bind soil;
- Provide homes and foraging places for numerous fauna species; and much more.

Because of these factors, eucalypts largely dictate and stabilise the overall ecological balance of a forest. The loss of eucalypts destabilises a forest ecosystem and can lead to a much different stable state. In a place like the reserves of interest here, that changed state will have fewer indigenous species of flora and fauna and greater cover of introduced species (if not numbers of species).

In addition to these ecological considerations, the debilitation and death of eucalypts impacts on the human enjoyment of the reserves and they create a safety risk of falling trees, which needs to be managed by an arborist.

The long-term monitoring of Koolunga Native Reserve's native vegetation reported by Lorimer (2022) shows a steady thinning of the eucalypt canopy since monitoring began in 1999. A 1984 brochure about the reserve by the Knox Environment Society noted that 'An altered water table is thought to be a major reason for the deaths of many of the trees in this reserve. Note the skeletons still standing'. An altered water table is a quite plausible explanation, considering the residential development of the catchment at the time; eucalypts are very sensitive to changes in soil moisture levels. The water table has inevitably continued to change due to the catchment-related problems discussed in Section 7.4, exacerbated by climate change.

The clearest example of water table changes killing eucalypts is around Koolunga Native Reserve's boardwalk – see Figure 14 on p. 31. Nearly all the eucalypts in the Swampy Riparian Complex are dead. Some of them are Swamp Gums that belong in swampy conditions and some are stringybarks whose root systems would not have experienced prolonged soil saturation prior to Melbourne Water's stream engineering works in the late 1990s. Those works raised the water table within the affected area, leading to the eucalypt deaths and the creation of the Swampy Riparian Complex. Urbanisation of the catchment and probably climate change have resulted in the water table dropping greatly during drought periods, further threatening the few surviving eucalypts.

Outside the Swampy Riparian Complex, the water table has generally fallen. That is because much of the rainfall in the catchment is now diverted into stormwater pipes rather than percolating into the soil and recharging the groundwater. Mature eucalypts tap into groundwater to varying degrees, so a falling water table can leave them with insufficient water, particularly in dry periods.

Groundwater change is not the only cause of eucalypt decline in Koolunga Native Reserve and Vaughan Road Reserve. It could not even be a plausible major contributor to the serious problem on the steep slope of Vaughan Road Reserve.

Browsing of canopy foliage by possums appears to be a significant contributor in both reserves. As indicated in Appendix C, up to 33 Common Ringtail Possums and 5 Common Brushtail Possums were seen in a night-time walk around Koolunga Native Reserve during this study. The total population is vastly greater than expected in a near-pristine forest of similar kinds – a phenomenon commonly observed in suburban nature reserves (Harper 2005). It is therefore not surprising that many of the eucalypts' leaves show bite-marks consistent with possum browsing.

Ringtail possums tend to browse soft, young leaves and brushtail possums (being heavier) tend to browse older leaves, further from the branch tips. Krefft's Gliders (or Sugar Gliders) are [not browsers](#) ([Smith 1982](#)). Defoliation by possums tends to be greatest in winter and early spring, when the trees put on very little growth but the possums continue to eat.

One factor that may be contributing to the high density of brushtail possums is the provision of nest boxes, some of which have been attached to eucalypts already suffering severe defoliation (e.g. Figure 17). Attracting possums to ailing trees can hasten the trees' death.



Figure 17. A possum nest box on a severely defoliated Red Stringybark in Vaughan Road Reserve. Red Stringybark is a species threatened with local extinction whereas possums are not. The tree was apparently already in poor health before the nest box was erected.

Another possible contributor to the high density of possums is the relocation of possums into the reserve from nearby residences.

Leaf-eating insect larvae are much more prevalent in summer than winter. Significant defoliation can occur as a result in some seasons.

For these reasons, any assessment of eucalypt defoliation should span the seasons and look for variability.

Fungi might also be rotting the roots of some eucalypts in the reserves. The present study included an autumn search for the conspicuous fruiting bodies ('toadstools') of Australian Honey Fungus (*Armillaria luteobubalina*), which is known to cause extensive eucalypt deaths and debilitation. No such fruiting bodies were found. Other fungal disease cannot be discounted, due to the difficulty of detection.

'Cinnamon Fungus' (*Phytophthora cinnamomi*, not really a fungus) is often posited as a cause of eucalypt dieback. The symptoms are very rapid death when soil dries out, particularly in summer and on soil prone to waterlogging. (The pathogen spreads in water.) These symptoms do not seem to match the situation in the reserves of interest, except in the Swampy Riparian Complex where different causes are apparent.

The eucalypt management recommendations in Section 8.2 follow from these considerations.

7.2.2 Pine Senescence

As explained in Section 3, the pines in Koolunga Native Reserve volunteered themselves as seedlings around the time the reserve was created, particularly around 1970. At their current ages of around fifty years, they are 'over-mature' in an arboricultural sense. A few have become dangerous and been removed; the rest will progressively become dangerous over coming years.

Knox City Council's current plans are to remove mature pines only as they become dangerous. In anticipation of pines being removed over time, Council planted replacement trees parallel to the east-west rows of pines several years ago. Council has had no plans to replace the pines closer to the boundary with Shirley Court properties or beside the path extending north from the boardwalk.

This management plan proposes no further action in response to the aging of the pines.

7.3 Shrub Management

The more natural parts of Koolunga Native Reserve and Vaughan Road Reserve have a higher density of indigenous shrubs than is normally expected for their vegetation types. The long-term monitoring of Koolunga Native Reserve reported by Lorimer (2022) shows that the shrub density in that reserve is higher than at any time since monitoring began in 1994. The most graphic change is that Victorian Christmas Bush (*Prostanthera lasianthos*) was completely absent from the main patch of Swampy Woodland in 1994, scarce in 1999 and 2001, and continued to steadily increase to become quite dense now. Figure 13 (p. 29) illustrates the change.

An exception to the general increase in shrub density is in the Valley Heathy Forest that abuts Forest Rd. It may be a coincidence, but that area was burnt in December 2013 whereas the rest of the reserve has not been burnt since 1968. It seems unlikely that Vaughan Road Reserve has burned for at least sixty years.

A quite plausible cause of the general increase in shrub density is the increase of sunlight, soil moisture and nutrients available to the understorey due to the debilitation of the eucalypt canopy.

This study was unable to determine whether planting of shrubs may have contributed.

The increase in shrub density has been associated with an increase in indigenous vines climbing over them. The main indigenous vine species are Wonga Vine (*Pandorea pandorana*), Mountain Clematis (*Clematis aristata*) and Downy Dodder-laurel (*Cassytha pubescens*). In Vaughan Road Reserve, the vines are overwhelmingly introduced species (e.g. Figure 16 on p. 47). In many cases, the vines are smothering and debilitating the plants beneath them, which may represent a natural control over shrub density.

While shrubs as a group have generally increased over the decades, at least one shrub species – Snowy Daisy-bush (*Olearia lirata*) – is being suppressed by browsing by Common Ringtail Possums. Figure 18 shows some heavily-browsed branches and foliage, attributed to Common Ringtail Possums as they are the only local browsing animals light enough to perch on such slender branches. (Deer and Black Wallabies have not been reported in the area.)



Figure 18. Branches and foliage of a Snowy Daisy-bush severely browsed by ringtail possums.

7.4 Fire

This section seeks to harmonise bushland management in Koolunga Native Reserve and Vaughan Road Reserve with bushfire hazard management. It is subservient to the [Knox Municipal Fire Management Plan](#) and the many organisations involved therewith. It has been prepared after consulting staff of the Country Fire Authority (CFA) and the resources of the Victorian Fire Risk Register.

In recognition of the bushfire risk associated with northerly and (increasingly) northeasterly winds, a firebreak has been created in recent years beside the fence between Koolunga Native Reserve and residences to the southwest. Although the vegetation there belongs to an endangered type (Valley Heathy Forest), the shrub layer has been removed from most of that strip and groundcover is mown in the summer months.

The opposite effect has occurred immediately east of the former Daffodil fields. Some years ago, a revegetation plot was planted as close as 1 m from the rear fence of 9–12 Sassafra Ct. Not only has this put bushfire fuel close to the fence but it has blocked the prior fire truck access along the fence. Section 8.2 includes a recommendation to restore the firebreak and fire truck access.

If done under the right conditions, controlled burning of undergrowth can have the twin benefits of regenerating native vegetation and temporarily reducing bushfire fuel. However, controlled burning sometimes does not achieve either benefit. In 2013, it was hoped that periodic burning would boost Koolunga Native Reserve's number of indigenous plant species, or at least prevent decline. However, the number of indigenous plant species in a monitoring plot near Forest Rd declined markedly when the plot was burned in late 2013. The reduction in ground fuel lasted only a few years and the relatively low density of stringybarks there meant there was little reduction in the hazard associated with tree bark.

Nevertheless, there is still hope that a burn in a different part of Koolunga Native Reserve could achieve benefits for bushfire safety and ecology. A promising area was identified and discussed on-site with CFA staff. A recommendation to burn that area appears in Section 8.2.

One of the reasons the area was selected for burning is that it includes one of only two occurrences in Knox of the native grass species, Graceful Fescue. That species only flowers after fire and it is extremely hard to detect when not in flower or seed. It is hoped that an inspection following the proposed burn will detect additional plants, allow the population size to be determined more reliably and result in the collection and propagation of seed.

In Section 8.2, a small area immediately northeast of the footbridge near the end of St Elmo Av is proposed to be burned on the same day as the burn just discussed. Until two decades ago, that area had by far the reserve's largest concentration of orchids. Since then, the undergrowth has become dense and only one of the orchid species can now be seen, in reduced numbers. It is hoped that some orchid tubers or seeds will regenerate following the burn.

An area of Koolunga Native Reserve abutting St Elmo Av was identified as a good place to seek an Aboriginal cultural burn. Such a burn would be done by the Wurundjeri Narrap team and be subject to competing demands for Aboriginal cultural burns elsewhere.

Vaughan Road Reserve is not amenable to burning because of its mostly steep terrain and the high moisture content of its vegetation during controlled-burning seasons. That moisture is also a favourable factor for bushfire protection. Steep slopes usually represent a high risk factor but in this case, the slope faces southeast, which is the least-hazardous orientation.

Bushfire hazard in Vaughan Road Reserve has been managed by maintaining firebreaks along the northwestern and southern boundaries. The eastern boundary lies within the garden of 9 Vaughan Rd, preventing the creation of a firebreak.

Discussion with CFA staff did not produce any ideas for changed management of Vaughan Road Reserve.

7.5 Climate Change

Climate change poses a very serious threat to the survival of most species and ecosystems on Earth. It is also greatly raising bushfire risk and reducing the opportunities for controlled burning.

In the short term, the predicted increase in the severity and frequency of droughts poses probably the greatest ecological threat to Koolunga Native Reserve and perhaps also in Vaughan Road Reserve. In particular, long-term monitoring of bushland reserves in Knox (Lorimer 2022) showed that plant species specially adapted to seasonally-saturated soils died out during the Millennium

Drought in greater numbers than any other group of plants. Species in Swampy Woodland and non-perennial wetlands were worst-affected. Wetland species mostly regenerated quickly when the drought broke but most species strongly associated with Swampy Woodland (e.g. Glandular Brooklime and Pygmy Sundew) have been permanently lost to Knox or been reduced to tiny populations at one or two locations.

The same phenomenon was observed in Maroondah (pp. 37–39 of Vol. 1 of [Lorimer 2020](#)).

Nothing was (or is) known about the biology or ecology of species like Glandular Brooklime or Pygmy Sundew that led anyone to predict their uncommon vulnerability to prolonged, extreme drought.

The vegetation structure and species present in Koolunga Native Reserve's Swampy Woodland are now substantially different from before the Millennium Drought (Figure 13 on p. 29), more so than the rest of the reserve. Such a demonstrated sensitivity to drought does not auger well for the predicted increase in the severity and frequency of future droughts.

Conversely, some other indigenous plant species have demonstrated remarkable capacity to persist through major climate change. Thatch Saw-sedge (*Gahnia radula*) and the critically-endangered flat-pea, *Platylobium infecundum*, have hardly ever been known to produce seed in the Melbourne region (or anywhere else, in the latter case). It is therefore very likely that their presence in Knox today reflects persistence (rather than immigration) since the last Ice Age, which ended roughly 12,000 years ago.

More generally, the response to climate change by wild plants and animals in forests is very complex and unpredictable (Section 4.1 of [Boulter 2012](#)). Despite a rather shaky theoretical basis and no experimental evidence, it has been posited that southeastern Australian forests can be made more resilient to climate change by introducing species or genetic strains from hotter or drier climates. Much less attention is given to the risk of such an introduction causing the local extinction of indigenous flora or fauna species that might otherwise survive. In reality, there is rarely enough information available to weigh up the risks and benefits except when ecological decline is already evident.

An alternative approach to build ecosystem resilience in Koolunga Native Reserve and Vaughan Road Reserve is to ameliorate the effects of climate change on the existing flora and fauna. As water stress in dry periods is likely to be the root of the worst ecological impacts of climate change, an appropriate response would be to reduce the current intermittency of water entering the reserves. That would involve encouraging more of the water in the reserves' catchment to infiltrate to groundwater (rather than running down pipes) and hence more steadily feed water to the reserves' plants, animals and fungi. Such an approach is discussed below. Associated recommendations for action are provided in Section 8.1 (p. 61).

7.6 Water Catchment Matters

The environmental health of Koolunga Native Reserve and Vaughan Road Reserve is greatly affected by land use and activities in the catchment. The main issues relate to erratic stream flows and altered groundwater depth, followed by water pollution. The erratic stream flows and groundwater changes are caused by the catchment's prevalence of impervious surfaces that divert rainwater into pipes rather than recharging groundwater. The main consequences are:

- The deaths and debilitation of eucalypts caused by lowering of the water table in both reserves (Section 7.2.1);

- Stream erosion and consequent deepening of the channel of the Forest Road Drain, causing more loss of native vegetation, lowering of the water table and consequent deaths of eucalypts;
- The Forest Road Drain now goes dry from time to time because of reduced inflows from groundwater, severely affecting aquatic fauna such as fish and invertebrates;
- Nutrient runoff, mainly from fertiliser applied to residential gardens, is depositing in the creek's alluvium. That favours introduced plants over indigenous ones and causes major ecological shifts toward an exotic-dominated vegetation type. The Swampy Riparian Complex described in Section 4.1.5 (p. 31) is an example but a more graphic one is the creek channel and terraces in Vaughan Road Reserve;
- Each rainfall event results in turbid (cloudy) inflows to the reserves. The turbidity is unhealthy for aquatic life and probably weakly toxic;
- Periodic water pollution events such as the one illustrated by Figure 19 have the potential to kill or adversely affect aquatic fauna and organisms higher on the food chain, in the reserves and downstream. The Friends of Koolunga Native Reserve report at least several such events each year, with water of various colours. Melbourne Water and the Environment Protection Authority have indicated a lack of capacity to investigate the chemicals or their origins.



Figure 19. The Forest Road Drain, turned milky by a pollution event in 2022 that lasted many hours.

Climate change and changes in the residential landscape are expected to worsen these problems and the problems are expected to compound the impacts of climate change.

The concepts of '[Water Sensitive Urban Design](#)' (WSUD) and its variant, '[Sponge Cities](#)', provide options for reducing problems related to erratic stream flows and falling water tables in a landscape like the one of interest here. The options include:

- Diversion of stormwater from pipes into bioinfiltration wetlands, as at Wicks Reserve in The Basin;

- Creation of ‘rain gardens’ or ‘bioretention swales’ to receive runoff from impervious surfaces and promote infiltration into the ground;
- Use of planning schemes to impose minimum lot sizes and/or regulate the amount of impervious surface that results from development proposals;
- Community engagement to encourage residents to maximise the infiltration of water into the ground;
- Provision of incentives for rainwater tanks so that rain on roofs is not sent directly to stormwater pipes but instead used in toilets or on gardens over extended periods;
- Establishing a program to create a network of ‘smart tanks’, i.e. domestic rainwater tanks that release water into the environment in a centrally-regulated way, as needed; and
- Maintaining or planting vegetation on stream banks to reduce stream erosion during peak flows.

Typical options for reducing water pollution (including nutrients and turbidity) in streams include:

- Diversion of stormwater into treatment wetlands, which can double as bioinfiltration wetlands (as at Wicks Reserve);
- Maintenance of roads and tracks to minimise release of gravel, soil and other detritus;
- Installation of ‘gross pollutant traps’, ‘trash racks’ or sediment traps to filter larger and denser solids such as litter and gravel from water in pipes or streams;
- Enforcement of anti-pollution laws; and
- Community engagement to encourage people to avoid excessive use of fertiliser, disposal of waste liquids into stormwater pipes, and letting water used in car-washing enter pipes or road gutters.

Many of the options above also provide benefits to wildlife (e.g. wetland birds) and amenity.

Ideally, these sorts of measures are considered as part of a catchment plan or strategy so that the optimal combination can be chosen, for the benefit of not just one or two nature reserves but with a broader perspective. A recommendation to that effect appears in Section 8.1 on p. 61.

The following information is provided to assist the development of a plan or strategy.

Figure 20 is a map showing the natural catchments feeding the Forest Road Drain, as at the downstream limits of Vaughan Road Reserve (the outer orange outline) and Koolunga Native Reserve (east of the internal orange line). The former measures 167 ha and the latter, 107 ha. Most of the difference relates to the marked former tributary that flows into the Forest Road Drain between the two reserves.

Groundwater and stormwater pipes do not always flow directly downhill, relative to the ground surface above them. For example, piped stormwater from a stretch of Forest Rd just north of Koolunga Native Reserve enters the Forest Road Drain between the two reserves, whereas the natural flow would enter within Koolunga Native Reserve. Flows within the pipe system are further complicated by a distributary junction at the Forest Rd / Hansen Rd corner, where incoming flow is divided between two outlets, with uncertain apportionment.

The uppermost 35 ha (or 21%) of the reserves’ catchment is on Chandlers Hill in the Dandenong Ranges National Park. Most rain falling there is expected to enter groundwater or be taken up by plants. However, unpaved management tracks may make a material contribution to turbidity in the reserves; no assessment has been undertaken.

The aerial photograph in Figure 20 shows that Koolunga Native Reserve's natural catchment has much more vegetation than the catchment of the former tributary. No associated quantitative data is available about the spatial distribution of impervious surfaces.

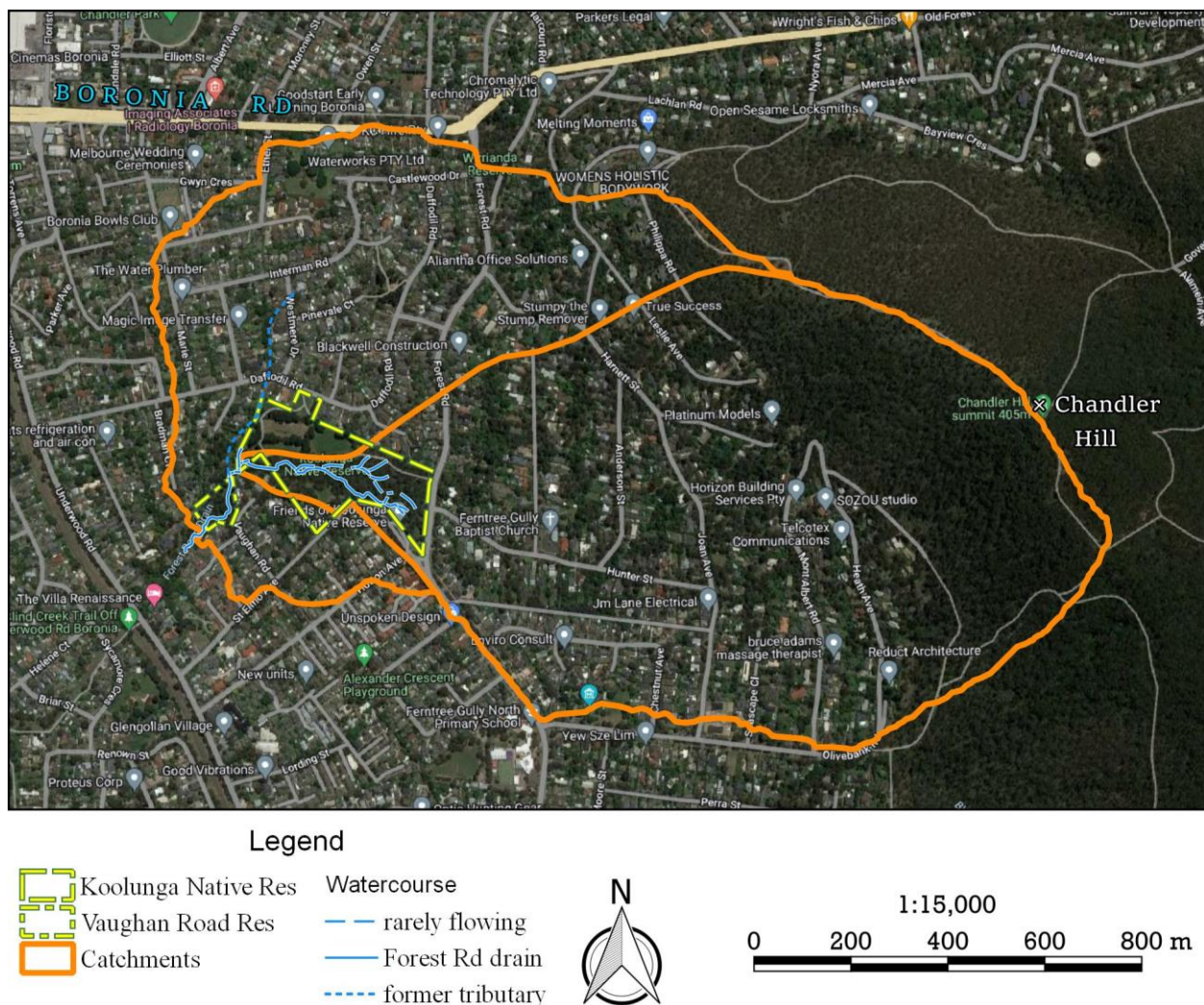


Figure 20. Catchments of Forest Rd Drain for the two reserves. The outer orange outline is for Vaughan Road Reserve. The area east of the internal orange line is the catchment for Koolunga Native Reserve.

7.7 Planting

As discussed in Section 4.2 (p. 34), large numbers of plants of many species have been planted in Koolunga Native Reserve since the 1970s. In the cases of many of those species that were already present, it is impossible to tell what fraction of the current population (if any) are planted plants or their descendants. Even if all planted members of a species have died, they may still have improved pollination rates, seed production or genetic viability in the wild population.

On the other hand, some of the species planted were not previously present in the reserve and are unlikely to have immigrated naturally, so the current-day populations must have derived solely from the plantings. The most successful of those are probably Tall Sedge (*Carex appressa*) and Tassel Sedge (*C. fascicularis*), which have gone through multiple generations of reproduction.

In the past decade, an increasing number of locally-threatened species have been planted. Such plantings could help avert those species from dying out locally, as long as they reproduce to create

self-sustaining populations. This study found no evidence of reproduction yet, though many have been growing well over that past two (La Niña) years. The test will be whether they reproduce and they, or their descendants, are present after the next drought or bushfire.

Some other planted species have either died out (e.g. the Small Mosquito-orchid, *Acianthus pusillus*) or show little prospect of reproducing (e.g. *Banksia marginata*). Some failures can be justified as experimentation or sometimes for aesthetic or demonstration purposes.

The demonstration garden created at the end of St Elmo Av in 2004 is a case in point. Unfortunately, it now contains many grass weeds and is not the advertisement for indigenous plants that was intended. That could be corrected with some weeding and pruning, as recommended in Section 8.5 (p. 64).

Planting in Vaughan Road Reserve appears to have begun only in recent years. Some scattered saplings – particularly Mountain Grey Gum (*Eucalyptus cypellocarpa*) – grow adjacent to the northwestern firebreak, where they may suppress the growth of groundcover weeds. Near Vaughan Rd, plants of all strata were planted a few years ago. Some of them are growing vigorously while some sensitive species are struggling to compete with groundcover weeds such as Panic Veldt-grass (*Ehrharta erecta*).

The planting of eucalypts in Koolunga Native Reserve and Vaughan Road Reserve offers the prospect of redressing the serious problem of eucalypt deaths and health discussed in Section 7.2.1 (p. 49). Planting of eucalypts appears to have occurred recently in some canopy gaps. It would be desirable to document and monitor such plantings to see which species (if any) thrive.

It would also be desirable to add Yellow Box (*Eucalyptus melliodora*) as a minority component of such plantings. Yellow Box tends to be a more robust species than the reserves' other eucalypt species. The species has not been recorded in Koolunga Native Reserve but one grows at Vaughan Road Reserve and it offers hope of better health than is typical of the other eucalypt species, particularly as climate change progresses.

This study found no reason to plant any species other than Yellow Box outside their normal vegetation types until it becomes clearer what the impacts of climate change will be on the existing species. The planting of one robust species new to the reserves might cause or accelerate the dying out of many indigenous species of flora or fauna.

Future plantings in the natural parts of Koolunga Native Reserve and Vaughan Road Reserve should avoid increasing the density of shrubs where shrubs are already significantly denser than expected for the type of vegetation. On the other hand, dense shrubs in mulched revegetation plots have the benefit of suppressing the growth of groundcover weeds beneath them.

Any planting of shrubs should have regard to bushfire hazard.

7.8 Paths, Access and Dogs

Paths through nature reserves have an important role in providing people with an enjoyable, health-giving experience but they can conflict with nature conservation. Koolunga Native Reserve's moderately high visitation presents a conflict but not Vaughan Road Reserve's very low visitation.

The main problem in Koolunga Native Reserve is the displacement of indigenous plants beside paths by introduced species. That effect can be attributed to trampling by people and dogs, scratching by dogs and enrichment of nitrogen and phosphorus by dogs' urine and faeces. The result is that a path typically represents a 2–3-metre-wide swathe of poor-quality habitat and an environmental weed problem.

People and dogs using paths also disturb adjacent fauna (e.g. echidnas, lizards, birds and insects), further impairing the habitat.

The maps in this document show a high density of paths immediately northeast of the footbridge near the dead end of St Elmo Av, enveloping the reserve's highest concentration of orchids. That area occupies 800 m², of which 350 m² (or 44%) lies within 1 m of a path. To have such a high proportion of the land degraded by paths cannot be justified by public access. A recommendation to close and revegetate one of the paths appears in the next section.

Vaughan Road Reserve has no paths, partly because most of it is steep and can only be reached by crossing a deep creek channel. The present study could find no practicable or affordable way to provide a worthwhile path.

8. Recommended Management Actions

This section contains the actions recommended in response to the issues discussed in Section 7. Implementation of the actions should be done with an understanding of the context provided by Section 7.

The goal of the recommendations is to maximise the safety and environmental values of Koolunga Native Reserve and Vaughan Road Reserve, within reasonable bounds of funding and resources. Visitor facilities are being considered separately in the Koolunga Native Reserve Future Directions Plan.

Figure 21 is a map of the locations of recommended management actions that could not be well described in the text.

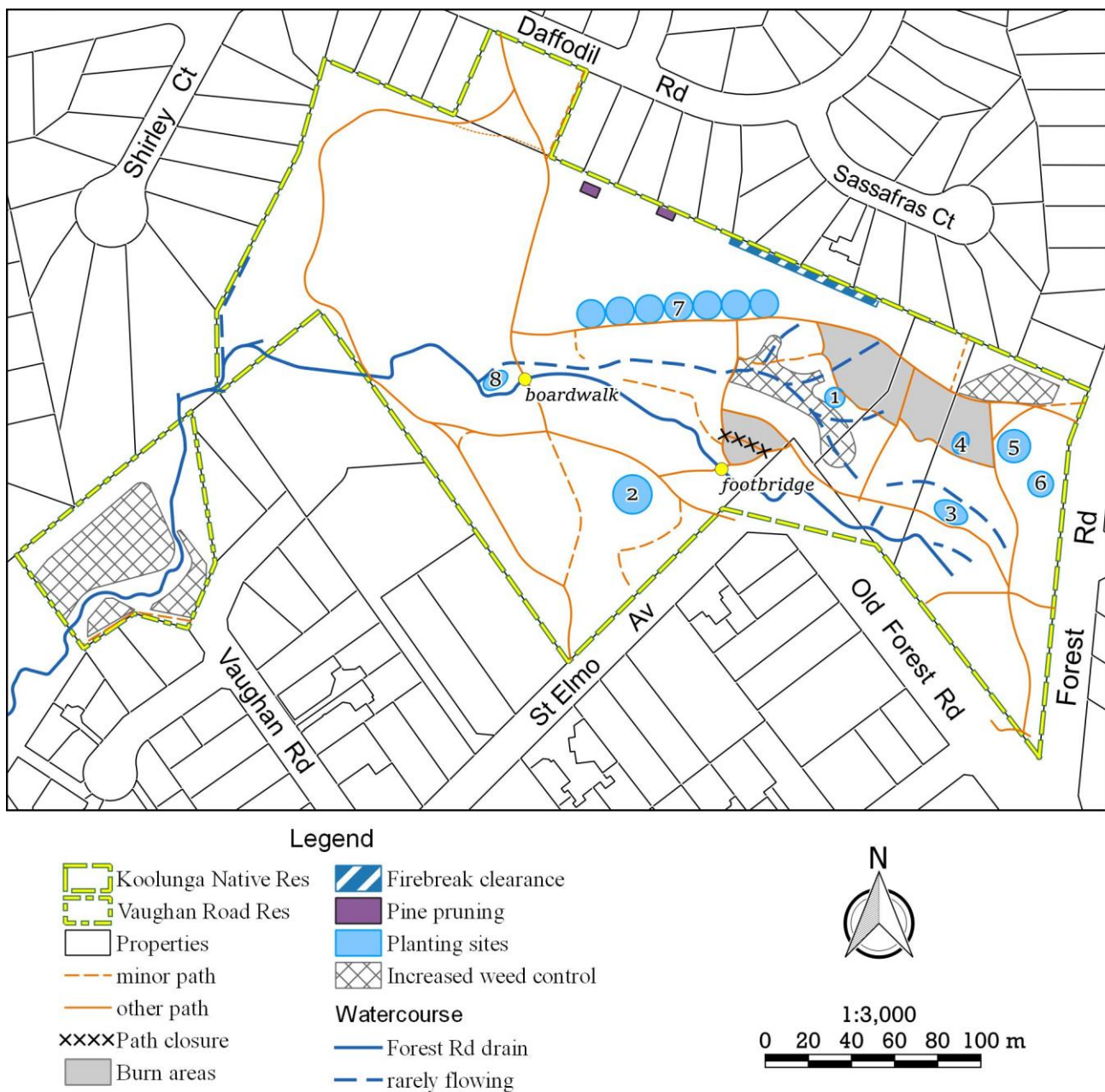


Figure 21. Map showing locations of recommended management actions.
The numbers are referenced in Section 8.5.

The recommendations may cease to be appropriate whenever conditions change either due to externalities (e.g. drought) or the results of management actions. They should be reviewed within five years, in any case.

8.1 Catchment Management

Objectives: (a) Encourage more rainwater in the catchment to infiltrate to groundwater or be detained (rather than running down pipes) and hence more steadily feed water to plants, animals, fungi and streams; (b) Reduce flooding in the catchment; (c) Improve water quality in watercourses; (d) Improve stream ecology; and (e) Make better use of stormwater.

Rationale: See Section 7.6 (p. 54.).

Recommended action:

- R1 Prepare a water management plan for the eastern Blind Creek catchment to achieve the above objectives. The document would consider the issues and potential solutions discussed in Section 7.6, expanded to cover the whole catchment.

Importance: High.

Timing: Fairly urgent.

8.2 Fire Management

Objectives: Reduce fire hazard, stimulate forest regeneration, stimulate flowering and seed production of the Graceful Fescue and allow the population size of Graceful Fescue to be determined.

Rationale: See Section 7.4 (p. 52.).

Recommended actions:

- R2 Remove revegetation from the blue-striped strip on Figure 21 (p. 60) along Koolunga Native Reserve's fence abutting 9–12 Sassafras Ct. A corridor 4 m wide × 4 m high free of vegetation should be created and maintained as a firebreak and for firefighting access. Along the same fence, prune pines in the map's plum-coloured rectangles adjacent to 40 & 44 Daffodil Rd to provide the same access.

Importance: High.

Timing: Before the next period of high fire danger.

- R3 Continue maintenance of other firebreaks as at present.

Importance: High.

Timing: Annually before the declared fire danger period, and during that period when required.

- R4 Arrange controlled burns in the grey areas on Figure 21 (p. 60). All the usual precautions and community notification that normally accompany a burn should be undertaken.

Importance: Moderate.

Timing: Not urgent; dependent on weather and availability of fire brigades and CFA staff. It would be desirable to commence planting of Graceful Fescue into the area before the burn – see recommendation R20 on p. 64.

- R5 Consider making a video of the abovementioned burns for display and the Knox City Council website, to explain how such burns benefit bushfire safety and nature conservation.

Importance: Low.

Timing: Prior to the burns.

- R6 Discuss with the Wurundjeri Narrap team what priority should be given to a ‘trickle burn’ in the southern part of Koolunga Native Reserve near St Elmo Av, for cultural and fire protection purposes.

Importance: Moderate.

Timing: Probably best done at the end of the autumn burning season.

8.3 Environmental Weed Control

Control of environmental weeds is a core, routine task of any bushland management. The following recommendations seek only to refine the existing weed control program in the reserves and redirect some of its focus, leaving the rest of the program unchanged.

It should be borne in mind that weed control is done by both Knox City Council and the Friends of Koolunga Native Reserve.

Objective: To bring under control environmental weed outbreaks that are currently proliferating, while maintaining control over species that are already in check.

Rationale: See Section 7.1 (p. 46).

Recommended action:

- R7 Urgently increase the effort to control vine weeds within the forest on both sides of the creek in Vaughan Road Reserve, particularly the northeast side. The relevant areas are cross-hatched on Figure 21 (p. 60). (Vines outside the forest are of low priority except for preventing them spreading into the forest.)

Method: A reasonable first step would be to trace vines climbing over shrubs and trees to near ground level, where they should be cut. Once those vines die, the locations of the rootstocks should be more apparent, allowing more thorough removal by physical and/or chemical means.

Importance: Very high.

Timing: Urgent.

- R8 Increase the effort to control blackberry, Wonga Vine and (to a lesser degree) Japanese Honeysuckle and Sweet Pittosporum, within the Swampy Woodland area northeast of the footbridge near the end of St Elmo Av. The relevant area is cross-hatched on Figure 21 (p. 60). It contains a concentration of small, sensitive, rare plants, so sensitivity is required.

Method: Manual removal can deal with some of the weeds but chemical will probably be unavoidable for controlling blackberry. Considerable care needs to be taken to avoid off-target herbicide damage, which caused significant harm some years ago at this location.

Importance: Very high.

Timing: Urgent, with action to be concentrated during November to March.

- R9 Carefully hand-weed around the tiny patch of Graceful Fescue (*Festuca asperula*) and monitor at least annually for the need to repeat the weeding.

Method: Graceful Fescue is extremely hard to spot and identify. It would be very easy to

inadvertently tread on it or pull some out. The present author has undertaken some initial weeding and trained Council staff to take over for the future.

Importance: High.

Timing: Moderately urgent; seasonality is unimportant.

- R10 Use grass-specific herbicide (possibly with manual follow-up) to selectively control Kikuyu and Panic Veldt-grass within the enclosure (no longer fenced on the northern side) near the northern entry to Koolunga Native Reserve from Forest Rd. The area is cross-hatched on Figure 21 (p. 60) and depicted in the photograph of Figure 11 (p. 25). The herbicide should be confined to areas where there are few if any indigenous grasses, particularly along the northern and eastern edges. Testing on *Platylobium infecundum* would also be desirable. If this action is found to be quite successful, it could be extended to Kikuyu in adjacent forest.

Importance: Moderate.

Timing: Not very urgent.

- R11 Control weeds (particularly Panic Veldt-grass and Squirrel-tail Fescue) in the 'Indigenous Demonstration Garden' at the end of St Elmo Av, to make the garden a better advertisement for growing indigenous plants.

Method: Hand-weeding would be satisfactory but herbicide could be used with care. Some pruning would also help.

Importance: Moderate.

Timing: Not urgent. These gardening tasks should be scheduled to be done at least annually. Squirrel-tail Fescue and some of the lesser annual weeds can only be effectively controlled in spring.

- R12 Continue the existing weed control effort in areas other than those involved in the recommendations above. If necessary to free resources for the last three recommendations, weed control can be relaxed in the creek channel of the Forest Road Drain, including the Swampy Riparian Complex mapped on Figure 9 (p. 23) – see also p. 48.

Importance: High.

Timing: No change is needed in the timing of weed control activities. The spatial distribution of effort in the reserves should be reviewed at least quarterly.

- R13 Council and the Friends group should regularly review the weed control effort being expended on the various parts of the reserves to maintain an appropriate balance between areas. Section 7.1.2 (p. 48) and Appendix D (p. 87) may help the prioritisation process. Council's expertise may assist the Friends group regarding the feasibility of bringing a particular environmental weed population under long-term control.

Importance: Moderate.

Timing: There are no timing requirements.

8.4 Eucalypt Management

In addition to the following two actions related to eucalypt management, Section 8.5 recommends some experimental planting of eucalypts with the aim of filling canopy gaps.

Objectives: (a) Protect reserve users and neighbours from falling timber; and (b) Avoid increasing the population of Common Brushtail Possums, which contribute to eucalypt debilitation and deaths.

Rationale: See Section 7.2.1 (p. 49).

Recommended actions:

R14 Conduct regular arboricultural inspections of trees overhanging paths or close to areas accessible to the public. Include pines in the inspections. Remove hazardous wood or trees.

Method and timing: As per Council's usual inspection program, plus incidental observations by council rangers whenever working in the reserves.

Importance: High.

R15 Determine which nest boxes in the reserves might provide homes for Common Brushtail possums. Those which do, either remove or adapt to restrict entry to other species.

Importance: Moderate.

Timing: As soon as practicable.

8.5 Planting

Objectives: (a) Fill gaps in the eucalypt canopy; (b) Experiment to determine which eucalypts are best able to provide a healthy eucalypt canopy; (c) Plant paperbarks to fill a canopy gap in the Swampy Riparian Complex; (d) increase the numbers and security of three locally-threatened species; (e) avoid compounding the problem of overly-dense shrubs in parts of the reserves; and (f) provide shade and other benefits of tree cover along a path abutting the northern side of Koolunga Native Reserve's forest.

R16 Plant several Yellow Box slightly northwest of the existing young eucalypts at the location shown as a light blue circle numbered 1 on Figure 21 (p. 60). Tag and document each of the existing and new young trees and monitor their height and health to determine the relative success of the species. Thin the plants to a sustainable density once it is clear which individuals are strongest.

Importance: High.

Timing: Plant as soon as practicable within the normal seasons for planting.

R17 At the locations in Koolunga Native Reserve numbered 2 to 6 and shaded light blue on Figure 21 (p. 60), plant Yellow Box, Red Stringybark, Messmate Stringybark and Narrow-leaved Peppermint. At locations 2 and 3, plant several of each species. At the other locations, plant one of each species. Tag and document every plant and monitor their height and health over the years to determine the relative success of the different species in filling canopy gaps. Thin the plants to a sustainable density once it is clear which individuals are strongest.

Importance: High.

Timing: Plant as soon as practicable within the normal seasons for planting.

R18 Plant a line of seven Yellow Box trees, 13 m apart, beside the popular path along the northern edge of Koolunga Native Reserve's forest (labelled '7' on Figure 21).

Importance: High.

R19 At the location just west of Koolunga Native Reserve's boardwalk, numbered 8 and shaded light blue on Figure 21 (p. 60), plant one or two Swamp Paperbarks to provide competition with Creeping Buttercup and Wandering Trad.

Importance: Moderate.

Timing: Avoid planting during the summer drought; otherwise, timing is unimportant.

R20 Prepare and implement a management plan for the few known populations of the regionally-rare Graceful Fescue in and near Knox, focused on exchange of propagated plants between

the sites. The aim is to improve the species' security, reproduction and genetic diversity. The species normally only flowers in the summer following a fire. Therefore, before the proposed burn in Koolunga Native Reserve, introduce propagated individuals *ex* Roselyn Crescent Reserve and Bungalook Conservation Reserves to exchange pollen during post-fire flowering.

Importance: High.

Timing: As soon as possible, as the plants from Bungalook Conservation Reserves will not be available for long.

- R21 Re-establish a population of Grass Trigger-plant (*Stylidium armeria*) by niche planting into the most natural areas of groundcover within Koolunga Native Reserve and in mulched garden beds.

Importance: Low.

Timing: Anytime within the normal seasons for planting.

- R22 Transplant some of the Common Bird-orchids (*Chiloglottis valida*) from Vaughan Road Reserve into a suitable location in Koolunga Native Reserve. The plants would need a spell in a nursery before being planted out.

Importance: Low.

Timing: Anytime within the normal seasons for planting.

- R23 Ensure that all people who select positions to insert plants into the forest are aware of the dangers of inadvertently digging up plants of higher importance in the process or creating a bushfire hazard. (Such problems have occurred in the past.)

Importance: High.

Timing: As soon as practicable.

- R24 When planning future plantings within the forest, pay attention to whether the shrub layer is already denser than desirable in any part of the area under consideration and avoid compounding any such problem.

Importance: High.

8.6 Paths and Access

Objectives: Reduce the adverse impacts of foot traffic on indigenous flora and fauna where there is least need for that traffic.

Rationale: See Section 7.8 (p. 58).

Recommended action:

- R25 Close and revegetate the 20 m-long connecting path parallel to the Forest Road Drain, 12 m northeast of the bridge near the dead end of St Elmo Av – highlighted with black crosses on Figure 21 (p. 60).

Importance: Moderate, or high if the proposed burn in that area is to proceed.

Timing: As soon as practicable. The fence on the southern side of the path will need to be removed before the proposed burn can occur.

8.7 Liaison: Council, Friends Group & Community

Objectives: To increase coordination and collaboration between Council and the Friends of Koolunga Native Reserve, and increase the local community's appreciation of the reserve.

Recommended actions:

It is recommended that Knox City Council:

R26 Provides training opportunities for the Friends of Koolunga Native Reserve so the Friends can maximise their effectiveness and thereby gain a greater sense of achievement.

Importance: Moderate.

R27 Offer the Friends group regular scheduled meetings or inspections regarding what Council, its contractors and the Friends group are planning to do in Koolunga Native Reserve and Vaughan Road Reserve. Matters for discussion include management activities and projects such as the Sugar Glider project.

Importance: Moderate.

R28 Include recognition of the Friends group in the new signage of the reserve that is being contemplated. Subject to the views of the Friends group, include information about their upcoming activities, either by updatable signs (e.g. blackboard) or reference to online information (e.g. QR code).

Importance: Moderate.

R29 Conduct periodic public guided nature walks and workshops, including Aboriginal perspectives, catchment management issues, climate change and the connection of these things with how we live our lives.

Importance: Moderate.

8.8 Fauna Survey

Objective: To redress gaps in our knowledge of the reserves' wildlife.

Rationale: Microbats can be seen flying within the reserves but none have been able to be identified due to the need for specialised traps and/or ultrasonic sensors. Two fish species have been seen but other aquatic vertebrates may well be going undetected. Filling these knowledge gaps might lead to additional management actions.

Recommended action:

R30 Assess the affordability of a survey for microbats and an environmental DNA survey of aquatic fauna.

Importance: Low to moderate.

Timing: Not urgent.

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Appendix A – Koolunga Plant Species Lists

This appendix provides an inventory of the species of mosses, liverworts, ferns and seed-producing plants that have been recorded in Koolunga Native Reserve. Separate lists are provided for wild, indigenous species, planted species and wild, introduced species.

Except for mosses and liverworts, the ‘Status’ column indicates the risk of extinction in Knox, as assessed by Lorimer (2010) according to the international ‘Red List’ criteria. The codes for the ‘Status’ column are:

- EX Extinct in Knox;
- CR Critically Endangered;
- EN Endangered;
- VU Vulnerable.

Entries in the ‘Abundance’ column indicate each species’ abundance in 2021–2022, using the following symbols:

- Scarce;
- ✓ Present in moderate numbers, not dominant within a vegetation stratum;
- D Dominant (or sharing dominance) within the relevant vegetation stratum, at least in some areas;
- M Many individuals but with too little cover to be dominant in the relevant vegetation stratum.

Species not seen in 2021–2022 are indicated in the last column by the year of their last record. Records from the 1980s are less reliable than later records.

Council, the Friends of Koolunga Native Reserve and neighbours have planted extensively in the reserve since the 1970s. This makes it hard in some cases to determine whether a species is occurring naturally as opposed to planting or as descendants of planted individuals. Species whose names are written in blue are those with greatest uncertainty about whether there are any natural occurrences.

Wild indigenous species			Abundance	Missing since
Status	Scientific Name	Common Name		
<u>Indigenous Mosses and Liverworts</u>				
	<i>Breutelia affinis</i>	Common Breutelia		2014
	<i>Campylopus clavatus</i>	Broody Swan-neck Moss	✓	
	<i>Campylopus introflexus</i>	Heath Star Moss	✓	
	<i>Ceratodon purpureus</i>	Redshank	✓	
	<i>Chiloscyphus semiteres</i>	Green Worms	M	
	<i>Dicranoloma billardieri</i>	a moss	–	
	<i>Eurhynchium praelongum</i>	Common Feather-moss	✓	
	<i>Fissidens curvatus</i>	a pocket-moss	–	
	<i>Funaria hygrometrica</i>	Common Fire-moss	–	
	<i>Lunularia cruciata</i>	Moonwort	✓	
	<i>Ptychomnion aciculare</i>	Paper Moss, Pipe-cleaners	–	
	<i>Racopilum cuspidigerum</i> var. <i>convolutaceum</i>	a moss	–	
	<i>Rhynchostegium tenuifolium</i>	a feather moss	–	2007
	<i>Rosulabryum billardieri</i>	Common Thread-moss	–	
	<i>Thuidiopsis furfurosa</i>	Golden Weft-moss	✓	
	<i>Wijkia extenuata</i>	Spear Moss	–	

Wild indigenous species			Abundance	Missing since
Status	Scientific Name	Common Name		
Indigenous Ferns				
VU	<i>Adiantum aethiopicum</i>	Common Maidenhair	D	
CR	<i>Blechnum minus</i>	Soft Water-fern		2004
CR	<i>Blechnum parrisiae</i>	Common Rasp-fern		1999
VU	<i>Calochlaena dubia</i>	Common Ground-fern		2014
CR	<i>Cheilanthes austrotenuifolia</i>	Green Rock Fern		2004
EN	<i>Cyathea australis</i>	Rough Tree-fern	–	
CR	<i>Hypolepis muelleri</i>	Harsh Ground-fern	–	
VU	<i>Lindsaea linearis</i>	Screw Fern		1999
EN	<i>Polystichum proliferum</i>	Mother Shield-fern	–	
	<i>Pteridium esculentum</i>	Austral Bracken	D	
EN	<i>Pteris tremula</i>	Tender Brake	✓	
Indigenous Flowering Plants				
	<i>Acacia dealbata</i>	Silver Wattle	✓	
VU	<i>Acacia mearnsii</i>	Black Wattle	✓	
VU	<i>Acacia melanoxylon</i>	Blackwood	✓	
EN	<i>Acacia myrtifolia</i>	Myrtle Wattle		2004
	<i>Acacia paradoxa</i>	Hedge Wattle	–	
EN	<i>Acacia pycnantha</i>	Golden Wattle	–	
VU	<i>Acacia stictophylla</i>	Dandenongs Cinnamon Wattle	✓	
EN	<i>Acacia stricta</i>	Hop Wattle	–	
VU	<i>Acacia verticillata</i> subsp. <i>cephalantha</i>	Prickly Moses	✓	
	<i>Acaena novae-zelandiae</i>	Bidgee-widgee	✓	
CR	<i>Acianthus ?pusillus</i>	Small Mosquito Orchid		1980s
VU	<i>Acrotriche prostrata</i>	Trailing Ground-berry	–	
	<i>Acrotriche serrulata</i>	Honey-pots	–	
	<i>Alisma plantago-aquatica</i>	Water Plantain	–	
CR	<i>Amphibromus archeri</i>	Pointed Swamp Wallaby-grass		2004
CR	<i>Amyema pendula</i>	Drooping Mistletoe		2004
	<i>Anthosachne scabra</i>	Common Wheat-grass	–	
	<i>Arthropodium strictum</i>	Chocolate Lily	✓	
CR	<i>Asperula conferta</i>	Common Woodruff		2014
	<i>Austrostipa pubinodis</i>	Tall Spear-grass	–	
	<i>Austrostipa rudis</i> subsp. <i>rudis</i>	Veined Spear-grass	D	
EN	<i>Banksia marginata</i>	Silver Banksia		2004
	<i>Billardiera mutabilis</i>	Common Apple-berry	✓	
	<i>Bossiaea prostrata</i>	Creeping Bossiaea		2001
VU	<i>Brunonia australis</i>	Blue Pincushion		2004
	<i>Burchardia umbellata</i>	Milkmaids	–	
	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	Sweet Bursaria	D	
VU	<i>Caesia parviflora</i>	Pale Grass-lily	✓	
CR	<i>Caladenia carnea/catenata</i>	a caladenia		1980s
EX	<i>Caladenia</i> sp. (spider-orchid group)	a spider-orchid		1980s
	<i>Carex appressa</i>	Tall Sedge	✓	
	<i>Carex breviculmis</i>	Short-stem Sedge	–	
	<i>Cassinia aculeata</i>	Common Cassinia	✓	
VU	<i>Cassinia longifolia</i>	Shiny Cassinia	–	
	<i>Cassinia sifton</i>	Sifton Bush		2014
CR	<i>Cassinia trinerva</i>	Three-nerved Cassinia		2014
EN	<i>Cassytha melantha</i>	Coarse Dodder-laurel	–	
EN	<i>Cassytha pubescens</i>	Downy Dodder-laurel	–	
EN	<i>Centella cordifolia</i>	Centella		2014
VU	<i>Chiloglottis valida</i>	Common Bird-orchid		1990s

Wild indigenous species

Status	Scientific Name	Common Name	Abundance	Missing since
VU	<i>Clematis aristata</i>	Mountain Clematis	D	
	<i>Clematis decipiens</i>	a small-leafed clematis	✓	
VU	<i>Comesperma volubile</i>	Love Creeper	–	
VU	<i>Coprosma quadrifida</i>	Prickly Currant-bush	D	
VU	<i>Coronidium scorpioides</i>	Button Everlasting		2004
EN	<i>Correa reflexa</i> var. <i>reflexa</i>	Common Correa	–	
VU	<i>Cotula australis</i>	Common Cotula	–	
VU	<i>Crassula decumbens</i>	Spreading Crassula	–	
	<i>Cynoglossum</i> – see <i>Hackelia</i>			
EN	<i>Daviesia latifolia</i>	Hop Bitter-pea		2014
EN	<i>Daviesia leptophylla</i>	Narrow-leaf Bitter-pea		1980s
CR	<i>Deyeuxia densa</i>	Heath Bent-grass		2004
	<i>Deyeuxia quadriseta</i>	Reed Bent-grass	✓	
VU	<i>Dianella longifolia</i> var. <i>longifolia</i>	Pale Flax-lily	✓	
	<i>Dianella revoluta</i>	Black-anther Flax-lily	✓	
VU	<i>Dianella tasmanica</i>	Tasman Flax-lily	✓	
	<i>Dichelachne rara</i>	Common Plume-grass	✓	
	<i>Dichondra repens</i>	Kidney-weed	M	
VU	<i>Dillwynia cinerascens</i>	Grey Parrot-pea		2007
EN	<i>Dipodium roseum</i>	Rosy Hyacinth-orchid	–	
CR	<i>Diuris orientis</i>	Wallflower Orchid		1980s
VU	<i>Drosera aberrans</i>	Scented Sundew		1980s
VU	<i>Drosera auriculata</i>	Tall Sundew		2004
EN	<i>Drosera hookeri</i>	Branched Sundew	✓	
VU	<i>Epacris impressa</i>	Common Heath		2014
	<i>Epilobium billardioreanum</i> subsp. <i>intermedium</i>		–	
		Robust Willow-herb	–	
	<i>Epilobium hirtigerum</i>	Hairy Willow-herb	–	
	<i>Eragrostis brownii</i>	Common Love-grass	M	
VU	<i>Eucalyptus cephalocarpa</i>	Mealy Stringybark	–	
VU	<i>Eucalyptus cypellocarpa</i>	Mountain Grey Gum	–	
	<i>Eucalyptus goniocalyx</i>	Bundy, Long-leaf Box	✓	
EN	<i>Eucalyptus macrorhyncha</i>	Red Stringybark	D	
VU	<i>Eucalyptus obliqua</i>	Messmate Stringybark	D	
VU	<i>Eucalyptus ovata</i>	Swamp Gum	D	
EN	<i>Eucalyptus radiata</i>	Narrow-leaved Peppermint	M	
EN	<i>Euchiton involucratus</i>	Common Cudweed	–	
VU	<i>Euchiton japonicus</i>	Creeping Cudweed	–	
VU	<i>Exocarpos cupressiformis</i>	Cherry Ballart	D	
EN	<i>Exocarpos strictus</i>	Pale-fruit Ballart		2014
CR ⁷	<i>Festuca asperula</i>	Graceful Fescue	–	
	<i>Gahnia radula</i>	Thatch Saw-sedge	M	
EN	<i>Galium gaudichaudii</i>	Rough Bedstraw	–	
CR	<i>Gastrodia sesamoides</i>	Cinnamon Bells		2001
CR	<i>Geranium homeanum</i>	Rainforest Crane's-bill	M	
VU	<i>Geranium potentilloides</i>	Cinquefoil Crane's-bill	–	
CR	<i>Glossodia major</i>	Wax-lip Orchid		1980s
VU	<i>Glyceria australis</i>	Australian Sweet-grass		2014
VU	<i>Glycine clandestina</i>	Twining Glycine	–	
EN	<i>Gonocarpus humilis</i>	Shade Raspwort	–	
	<i>Gonocarpus tetragynus</i>	Common Raspwort	✓	
	<i>Goodenia lanata</i>	Trailing Goodenia		2014
	<i>Goodenia ovata</i>	Hop Goodenia	D	

⁷ The only known occurrences of Graceful Fescue in Knox are two small patches, so the species clearly fits the 'critically endangered' category of risk of dying out in Knox.

Wild indigenous species

Status	Scientific Name	Common Name	Abundance	Missing since
CR	<i>Gratiola pubescens</i>	Glandular Brooklime		1994
EN	<i>Hackelia suaveolens</i>	Sweet Hound's-tongue	–	
VU	<i>Hardenbergia violacea</i>	Purple Coral-pea	–	
VU	<i>Hemarthria uncinata</i>	Mat Grass		2007
VU	<i>Hovea heterophylla</i>	Common Hovea		2004
VU	<i>Hydrocotyle hirta</i>	Hairy Pennywort	–	
EN	<i>Hypericum gramineum</i>	Small St John's Wort	–	
CR	<i>Hypoxis hygrometrica</i>	Golden Weather-glass		1994
EN	<i>Imperata cylindrica</i>	Blady Grass	–	
VU	<i>Isolepis inundata</i>	Swamp Club-rush	✓	
	<i>Juncus amabilis</i>	Hollow Rush	✓	
	<i>Juncus bufonius</i>	Toad Rush	M	
	<i>Juncus gregiflorus</i>	Green Rush	✓	
CR	<i>Juncus holoschoenus</i>	Joint-leaf Rush		2004
	<i>Juncus pallidus</i>	Pale Rush	✓	
EN	<i>Juncus pauciflorus</i>	Loose-flower Rush	✓	
EN	<i>Juncus planifolius</i>	Broad-leaf Rush	–	
	<i>Juncus sarophorus</i>	Broom Rush	–	
EN	<i>Juncus subsecundus</i>	Finger Rush	–	
	<i>Kunzea leptospermoides</i>	Yarra Burgan	✓	
	<i>Lachnagrostis filiformis</i>	Common Blown-grass	–	
EN	<i>Lagenophora stipitata</i>	Blue (or Common) Bottle-daisy		1999
EN	<i>Lemna disperma</i>	Common Duckweed	–	
	<i>Lepidosperma elatius</i>	Tall Sword-sedge	D	
	<i>Leptospermum continentale</i>	Prickly Tea-tree	–	
EN	<i>Leptospermum scoparium</i>	Manuka	✓	
EN	<i>Lobelia anceps</i>	Angled Lobelia		2004
	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Wattle Mat-rush	✓	
	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	Wattle Mat-rush		2014
	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	✓	
VU	<i>Luzula meridionalis</i>	Common Woodrush		2004
VU	<i>Lythrum hyssopifolia</i>	Lesser Loosestrife	✓	
EN	<i>Melaleuca ericifolia</i>	Swamp Paperbark	D	
	<i>Microlaena stipoides</i>	Weeping Grass	D	
	<i>Microtis parviflora</i>	Slender Onion-orchid	✓	
CR	<i>Montia fontana</i>	Water Blinks		2014
CR	<i>Muellerina eucalyptoides</i>	Creeping Mistletoe		2001
EN	<i>Olearia argophylla</i>	Musk Daisy-bush		2004
VU	<i>Olearia lirata</i>	Snowy Daisy-bush	✓	
EN	<i>Olearia myrsinoides</i>	Silky Daisy-bush	✓	
VU	<i>Opercularia varia</i>	Variable Stinkweed		2014
	<i>Oxalis exilis/perennans</i>	Wood-sorrel	✓	
EN	<i>Ozothamnus ferrugineus</i>	Tree Everlasting	✓	
	<i>Pandorea pandorana</i>	Wonga Vine	D	
CR	<i>Pelargonium inodorum</i>	Kopata	–	
	<i>Persicaria decipiens</i>	Slender Knotweed	M	
EN	<i>Persicaria ?lapathifolia</i>	Pale Knotweed		2014
CR	<i>Pimelea axiflora</i>	Bootlace Bush		1999
VU	<i>Pimelea humilis</i>	Common Rice-flower	–	
CR	<i>Plantago debilis</i>	Shade Plantain		2014
VU	<i>Plantago varia</i>	Variable Plantain		2007
VU	<i>Platylobium infecundum</i>	a flat-pea	✓	
VU	<i>Platylobium obtusangulum</i>	Common Flat-pea		2014
	<i>Poa ensiformis</i>	Sword Tussock-grass	✓	
	<i>Poa morrisii</i>	Soft Tussock-grass	✓	
EN	<i>Poa tenera</i>	Slender Tussock-grass	✓	
EN	<i>Polyscias sambucifolia</i>	Elderberry Panax	✓	

Wild indigenous species			Abundance	Missing since
Status	Scientific Name	Common Name		
	<i>Poranthera microphylla</i>	Small Poranthera	✓	
VU	<i>Potamogeton ochreatus</i>	Blunt Pondweed		2004
EN	<i>Prostanthera lasianthos</i>	Victorian Christmas-bush	D	
EX	<i>Pterostylis ?× ingens</i>	Sharp Greenhood		1980s
CR	<i>Pterostylis alpina</i>	Mountain Greenhood		2004
EN	<i>Pterostylis melagramma</i>	Tall Greenhood		2007
	<i>Pterostylis nutans</i>	Nodding Greenhood	✓	
CR	<i>Pterostylis pedunculata</i>	Maroonhood		2004
VU	<i>Pultenaea gunnii</i>	Golden Bush-pea		2014
EN	<i>Rubus parvifolius</i>	Small-leaf Bramble	✓	
	<i>Rytidosperma fulvum</i>	Leafy Wallaby-grass	–	
	<i>Rytidosperma laeve</i>	Smooth Wallaby-grass	✓	
	<i>Rytidosperma pallidum</i>	Silvertop Wallaby-grass	✓	
	<i>Rytidosperma penicillatum</i>	Slender Wallaby-grass	✓	
VU	<i>Rytidosperma pilosum</i>	Velvet Wallaby-grass	M	
	<i>Rytidosperma racemosum</i>	Clustered Wallaby-grass	M	
EN	<i>Rytidosperma semiannulare</i>	Tasmanian Wallaby-grass		2014
	<i>Rytidosperma setaceum</i>	Bristly Wallaby-grass	✓	
	<i>Rytidosperma tenuius</i>	Purplish Wallaby-grass	✓	
	<i>Schoenus apogon</i>	Common Bog-rush	–	
CR	<i>Schoenus maschalinus</i>	Leafy Bog-rush		1994
	<i>Senecio glomeratus</i>	Annual Fireweed		2014
	<i>Senecio hispidulus</i>	Rough Fireweed	✓	
EN	<i>Senecio minimus</i>	Shrubby Fireweed	✓	
CR	<i>Senecio ?odoratus</i>	Scented Groundsel		1994
EN	<i>Senecio prenanthoides</i>	Common Fireweed		2001
	<i>Senecio quadridentatus</i>	Cotton Fireweed	✓	
CR	<i>Sigesbeckia orientalis</i>	Indian Weed	✓	
VU	<i>Solanum laciniatum</i>	Large Kangaroo Apple	✓	
VU	<i>Solenogyne ?dominii</i>	Smooth Solenogyne		2004
VU	<i>Solenogyne ?gunnii</i>	Hairy Solenogyne		1999
CR	<i>Spirodela punctata</i>	Thin Duckweed		2014
EN	<i>Stylidium armeria</i>	Grass Trigger-plant	–	
	<i>Tetrarrhena juncea</i>	Forest Wire-grass	M	
EN	<i>Tetradlea ciliata</i>	Pink-bells		2001
CR	<i>Thelymitra arenaria</i>	Forest Sun-orchid		2004
VU	<i>Thelymitra peniculata</i>	Trim Sun-orchid	✓	
	<i>Themeda triandra</i>	Kangaroo Grass	✓	
VU	<i>Thysanotus patersonii</i>	Twining Fringe-lily		2004
EN	<i>Thysanotus tuberosus</i>	Common Fringe-lily		2001
CR	<i>Veronica derwentiana</i>	Derwent Speedwell	–	
EN	<i>Viola hederacea</i>	Ivy-leaf Violet	–	
EN	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell		2014
VU	<i>Xanthorrhoea minor</i>	Small Grass-tree	–	
EN	<i>Xanthosia dissecta</i>	Cut-leaf Xanthosia		2004

The table below lists plant species that have been recorded as planted in Koolunga Native Reserve. Some of them are also present naturally in the reserve. There are no doubt other species that have been planted in the reserve that have never been documented. Some of those may have been confused with wild plants and therefore appear above.

Species without an entry in the 'Abundance' column could not be found in 2020–2022. Some of those were observed in past botanical surveys, in which case the most recent year of a record is noted under 'Missing since'.

Most species not seen in the present study can be presumed to have died out.

Planted species			Abundance	Missing since
Status	Scientific Name	Common Name		
Planted Indigenous Species				
	<i>Acacia aculeatissima</i>	Thin-leaf Wattle		
	<i>Acacia dealbata</i>	Silver Wattle	–	
VU	<i>Acacia mearnsii</i>	Black Wattle	–	
VU	<i>Acacia melanoxylon</i>	Blackwood	✓	
EN	<i>Acacia myrtifolia</i>	Myrtle Wattle	–	
	<i>Acacia paradoxa</i>	Hedge Wattle	–	
EN	<i>Acacia pycnantha</i>	Golden Wattle	–	
VU	<i>Acacia stictophylla</i>	Dandenongs Cinnamon Wattle	–	
EN	<i>Acacia stricta</i>	Hop Wattle		
VU	<i>Acacia verticillata</i>	Prickly Moses	✓	
	<i>Acaena novae-zelandiae</i>	Bidgee-widgee		
CR	<i>Acianthus pusillus</i>	Small Mosquito Orchid		2004
VU	<i>Allocasuarina littoralis</i>	Black Sheoak	✓	
	<i>Arthropodium strictum</i>	Chocolate Lily		
EN	<i>Banksia marginata</i>	Silver Banksia	–	
CR	<i>Blechnum parrisiae</i>	Common Rasp-fern	–	
	<i>Bossiaea prostrata</i>	Creeping Bossiaea		
	<i>Brachyscome multifida</i>	Cut-leaf Daisy	–	
VU	<i>Brunonia australis</i>	Blue Pincushion	–	
EN	<i>Bulbine bulbosa</i>	Yellow Bulbine-lily		
	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	Sweet Bursaria	✓	
	<i>Calystegia marginata</i>	Forest Bindweed		
	<i>Carex appressa</i>	Tall Sedge	✓	
EN	<i>Carex fascicularis</i>	Tassel Sedge	D	
	<i>Cassinia aculeata</i>	Common Cassinia		2014
EN	<i>Centella cordifolia</i>	Centella		2014
CR	<i>Chrysocephalum semipapposum</i>	Clustered Everlasting	–	
VU	<i>Clematis aristata</i>	Mountain Clematis		
	<i>Clematis decipiens</i>	a small-leafed clematis		
VU	<i>Coprosma quadrifida</i>	Prickly Currant-bush		
EN	<i>Cyathea australis</i>	Rough Tree-fern		
EN	<i>Daviesia latifolia</i>	Hop Bitter-pea	✓	
EN	<i>Daviesia leptophylla</i>	Narrow-leaf Bitter-pea	–	
VU	<i>Dianella longifolia</i> var. <i>longifolia</i>	Pale Flax-lily		2014
	<i>Dianella revoluta</i>	Black-anther Flax-lily		
VU	<i>Dianella tasmanica</i>	Tasman Flax-lily	–	
CR	<i>Dichelachne crinita</i>	Long-hair Plume-grass	–	
CR	<i>Drosera pygmaea</i>	Pygmy Sundew		
CR	<i>Eleocharis gracilis</i>	Slender Spike-rush	–	
	<i>Eragrostis brownii</i>	Common Love-grass		
VU	<i>Eucalyptus cephalocarpa</i>	Mealy Stringybark		2014
VU	<i>Eucalyptus cypellocarpa</i>	Mountain Grey Gum		
	<i>Eucalyptus goniocalyx</i>	Bundy, Long-leaf Box		2014
VU	<i>Eucalyptus obliqua</i>	Messmate Stringybark		
VU	<i>Eucalyptus ovata</i>	Swamp Gum		
EN	<i>Eucalyptus radiata</i>	Narrow-leaved Peppermint	–	
EN	<i>Eucalyptus viminalis</i> subsp. <i>viminalis</i>	Manna Gum	–	
EN	<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge	✓	
CR	<i>Gonocarpus micranthus</i>	Creeping Raspwort		
EN	<i>Goodenia humilis</i>	Swamp Goodenia		2014
	<i>Goodenia ovata</i>	Hop Goodenia		

Planted species			Abundance	Missing since
Status	Scientific Name	Common Name		
CR	<i>Gratiola pubescens</i>	Glandular Brooklime		2014
EN	<i>Gynatrix pulchella</i>	Hemp Bush		
CR	<i>Hakea nodosa</i>	Yellow Hakea	–	
CR	<i>Hakea ulicina</i>	Furze Hakea	✓	
VU	<i>Hardenbergia violacea</i>	Purple Coral-pea		
EN	<i>Hibbertia riparia</i>	Erect Guinea-flower		
CR	<i>Histiopteris incisa</i>	Bat's Wing Fern		
CR	<i>Hookerchloa hookeriana</i>	Hooker Fescue		2014
EN	<i>Hypericum gramineum</i>	Small St John's Wort		
EN	<i>Indigofera australis</i>	Austral Indigo	–	
EN	<i>Juncus pauciflorus</i>	Loose-flower Rush		2014
CR	<i>Kennedia prostrata</i>	Running Postman		
	<i>Kunzea leptospermoides</i>	Yarra Burgan	✓	
EN	<i>Lagenophora stipitata</i>	Blue (or Common) Bottle-daisy		
VU	<i>Lagenophora sublyrata</i>	Slender Bottle-daisy		
VU	<i>Leptorhynchus tenuifolius</i>	Wiry Buttons		
EN	<i>Leptospermum scoparium</i>	Manuka	✓	
EN	<i>Linum marginale</i>	Native Flax	✓	
EN	<i>Lobelia anceps</i>	Angled Lobelia		2014
	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Wattle Mat-rush	–	
	<i>Lomandra longifolia longifolia</i>	Spiny-headed Mat-rush	D	
CR	<i>Lomandra multiflora</i>	Many-flowered Mat-rush	–	
EN	<i>Melaleuca ericifolia</i>	Swamp Paperbark	–	
CR	<i>Melaleuca squarrosa</i>	Scented Paperbark	✓	
	<i>Microlaena stipoides</i>	Weeping Grass		
EN	<i>Olearia argophylla</i>	Musk Daisy-bush	–	
VU	<i>Olearia lirata</i>	Snowy Daisy-bush	✓	
EN	<i>Olearia myrsinoides</i>	Silky Daisy-bush	–	
EN	<i>Ozothamnus ferrugineus</i>	Tree Everlasting		2014
CR	<i>Patersonia occidentalis</i>	Long Purple-flag	✓	
CR	<i>Pelargonium australe</i>	Austral Stork's-bill	–	
	<i>Persicaria decipiens</i>	Slender Knotweed		
CR	<i>Pimelea axiflora</i>	Bootlace Bush		
CR	<i>Plantago debilis</i>	Shade Plantain		
VU	<i>Platylobium obtusangulum</i>	Common Flat-pea		
	<i>Poa ensiformis</i>	Sword Tussock-grass	✓	
	<i>Poa morrisii</i>	Soft Tussock-grass		
EN	<i>Poa labillardierei</i>	Common Tussock-grass	✓	
DD	<i>Poa sieberiana</i> var. <i>sieberiana</i>	Grey Tussock-grass	–	
EN	<i>Polyscias sambucifolia</i>	Elderberry Panax		
EN	<i>Polystichum proliferum</i>	Mother Shield-fern	–	
EN	<i>Pomaderris aspera</i>	Hazel Pomaderris	✓	
CR	<i>Pomaderris lanigera</i>	Woolly Pomaderris	–	
EN	<i>Prostanthera lasianthos</i>	Victorian Christmas-bush	✓	
VU	<i>Pultenaea gunnii</i>	Golden Bush-pea	–	
CR	<i>Pultenaea hispidula</i>	Rusty Bush-pea	–	
CR	<i>Pultenaea pedunculata</i>	Matted Bush-pea		
CR	<i>Pultenaea scabra</i>	Rough Bush-pea	–	
EN	<i>Rubus parvifolius</i>	Small-leaf Bramble		2014
EN	<i>Rytidosperma caespitosum</i>	Common Wallaby-grass	–	
	<i>Schoenus apogon</i>	Common Bog-rush		
VU	<i>Solanum laciniatum</i>	Large Kangaroo Apple		2014
CR	<i>Sphaerolobium minus</i>	Leafless Globe-pea		
EN	<i>Spyridium parvifolium</i>	Australian Dusty Miller	–	
EN	<i>Stackhousia monogyna</i>	Candles		
EN	<i>Stylidium armeria</i>	Grass Trigger-plant		
EN	<i>Tetralochea ciliata</i>	Pink-bells		

Planted species			Abundance	Missing since
Status	Scientific Name	Common Name		
	<i>Themeda triandra</i>	Kangaroo Grass	✓	
CR	<i>Veronica derwentiana</i>	Derwent Speedwell	–	
VU	<i>Veronica gracilis</i>	Slender Speedwell	–	
EN	<i>Viola hederacea</i>	Ivy-leaf Violet		
	<i>Villarsia / Ornduffia</i> sp.	a marsh-flower		
EN	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell		
EN	<i>Wurmbea dioica</i>	Early Nancy		
EN	<i>Xanthosia dissecta</i>	Cut-leaf Xanthosia		

Planted Non-indigenous Species

<i>Acacia fimbriata</i>	Fringed Wattle		
<i>Acacia retinodes / uncifolia</i>	Wirilda		
<i>Blechnum nudum</i>	Fishbone Water-fern		
<i>Correa</i> hybrids		–	
<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint		
<i>Grevillea robusta</i>	Southern Silky Oak	–	
<i>Kunzea</i> sp. (Upright form)	Forest Burgan	–	
<i>Melaleuca styphelioides</i>	Prickly Paperbark		
<i>Microsorium pustulatum</i>	Kangaroo Fern		2014
<i>Pandorea pandorana</i> cultivar	‘Golden Showers’		
<i>Phormium ?tenax</i>	New Zealand Flax	–	
<i>Pinus radiata</i>	Monterey Pine	D	

The table below lists wild introduced plant species that have been recorded within native vegetation in Koolunga Native Reserve.

Wild introduced species			Abundance	Missing since
Scientific Name	Common Name			
<i>Acacia elata</i>	Cedar Wattle			1999
<i>Acacia floribunda</i>	White Sallow-wattle			2014
<i>Acacia howittii</i>	Sticky Wattle	–		
<i>Acacia longifolia</i> subsp. <i>longifolia</i>	Sallow Wattle			2001
<i>Acer negundo</i>	Box Elder	✓		
<i>Agapanthus praecox</i> subsp. <i>orientalis</i>	Agapanthus	–		
<i>Agrostis capillaris</i>	Brown-top Bent	–		
<i>Aira caryophyllea</i>	Silvery Hair-grass	✓		
<i>Allium triquetrum</i>	Angled Onion	M		
<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass	M		
<i>Apium graveolens</i>	Celery	–		
<i>Arctotheca calendula</i>	Cape Weed	–		
<i>Asparagus scandens</i>	Asparagus Fern	✓		
<i>Avena barbata</i>	Bearded Oat	–		
<i>Bellis perennis</i>	English Daisy	–		
<i>Briza maxima</i>	Large Quaking-grass	M		
<i>Briza minor</i>	Lesser Quaking-grass	–		
<i>Bromus catharticus</i>	Prairie Grass	✓		
<i>Bromus diandrus</i>	Great Brome	–		
<i>Bromus hordeaceus</i>	Soft Brome	–		
<i>Callitriche stagnalis</i>	Common Water-starwort	✓		

Wild introduced species

Scientific Name	Common Name	Abundance	Missing since
<i>Cardamine flexuosa</i>	Wood Bitter-cress	✓	
<i>Cardamine ?hirsuta</i>	Common Bitter-cress		2014
<i>Cenchrus clandestinus</i>	Kikuyu	✓	
<i>Centaurea erythraea</i>	Common Centaury	✓	
<i>Cerastium glomeratum</i>	Sticky Mouse-ear Chickweed	–	
<i>Chrysanthemoides monilifera monilifera</i>	Boneseed		2001
<i>Cirsium vulgare</i>	Spear Thistle	–	
<i>Coprosma repens</i>	Mirror-bush	–	
<i>Cordyline australis</i>	New Zealand Cabbage Tree	–	
<i>Cortaderia selloana</i>	Pampas Grass		1980s
<i>Cotoneaster glaucophyllus</i>	Cotoneaster		2014
<i>Cotoneaster pannosus</i>	Cotoneaster	–	
<i>Crataegus monogyna</i>	Hawthorn		1994
<i>Crepis capillaris</i>	Smooth Hawksbeard	✓	
<i>Crococsmia × crocosmiiflora</i>	Montbretia	✓	
<i>Cyathea cooperi</i>	Scaly Tree-fern	–	
<i>Cynodon dactylon</i>	Couch	✓	
<i>Cynosurus echinatus</i>	Rough Dog's-tail	–	
<i>Cyperus eragrostis</i>	Drain Flat-sedge	✓	
<i>Cyperus involucratus</i>	Umbrella Papyrus	–	
<i>Dactylis glomerata</i>	Cocksfoot	D	
<i>Digitaria sanguinalis</i>	Summer-grass		1999
<i>Dimorphotheca fruticosa</i>	Dimorphotheca	–	
<i>Dipogon lignosus</i>	Common Dipogon		1994
<i>Disa bracteata</i>	South African Orchid	–	
<i>Echinochloa crus-galli</i>	Common Barnyard Grass		2014
<i>Ehrharta erecta</i>	Panic Veldt-grass	D	
<i>Ehrharta longiflora</i>	Annual Veldt-grass	✓	
<i>Epilobium ciliatum</i>	Glandular Willow-herb	✓	
<i>Erica lusitanica</i>	Spanish Heath		2014
<i>Erigeron karvinskianus</i>	Seaside Daisy	✓	
<i>Erigeron sumatrensis</i>	Fleabane	✓	
<i>Euphorbia peplus</i>	Petty Spurge	✓	
<i>Fraxinus angustifolia</i>	Desert Ash	✓	
<i>Fumaria bastardi</i>	Bastards Fumitory	✓	
<i>Galium aparine</i>	Cleavers	✓	
<i>Gamochaeta purpurea</i>	Spiked Cudweed	✓	
<i>Genista monspessulana</i>	Montpellier Broom	–	
<i>Geranium robertianum</i>	Herb Robert		2014
<i>Gladiolus undulatus</i>	Wild Gladiolus		2007
<i>Hakea salicifolia</i>	Willow-leaf Hakea		2014
<i>Hedera helix</i>	Ivy	✓	
<i>Holcus lanatus</i>	Yorkshire Fog	✓	
<i>Homalanthus populifolius</i>	Bleeding Heart	–	
<i>Hypochaeris radicata</i>	Cat's Ear	✓	
<i>Ipomoea indica</i>	Lear's Morning-glory		2001
<i>Isolepis levysiana</i>	Tiny Flat-sedge	✓	
<i>Ixia polystachya</i>	Variable Ixia	✓	
<i>Jasminum polyanthum</i>	Pink Jasmine	–	
<i>Juncus articulatus</i>	Jointed Rush	✓	
<i>Juncus bulbosus</i>	Bulbous Rush	M	
<i>Juncus pallescens</i>	a rush	–	
<i>Lactuca serriola</i>	Prickly Lettuce	✓	
<i>Leontodon saxatilis</i>	Lesser Hawkbit	–	
<i>Lepidium didymum</i>	Lesser Swine's-cress		2014
<i>Ligustrum lucidum</i>	Large-leaved Privet	–	
<i>Linum trigynum</i>	French Flax	–	

Wild introduced species

Scientific Name	Common Name	Abundance	Missing since
<i>Lolium × hybridum</i>	Hybrid Rye-grass	–	
<i>Lonicera japonica</i>	Japanese Honeysuckle	✓	
<i>Lotus corniculatus</i>	Bird's-foot Trefoil		2014
<i>Lotus subbiflorus</i>	Hairy Bird's-foot Trefoil	✓	
<i>Lysimachia arvensis</i>	Pimpernel	–	
<i>Malus pumila</i>	Domestic Apple		1994
<i>Medicago lupulina</i>	Black Medic	–	
<i>Medicago polymorpha</i>	Burr Medic		1994
<i>Melissa officinalis</i>	Lemon Balm	–	
<i>Modiola caroliniana</i>	Carolina Mallow		1999
<i>Myosotis laxa</i> subsp. <i>caespitosa</i>	Water Forget-me-not		1999
<i>Myosotis sylvatica</i>	Wood Forget-me-not	✓	
<i>Nandina domestica</i>	Sacred Bamboo	–	
<i>Narcissus</i> cultivar	Daffodil	–	
<i>Nasturtium officinale</i>	Watercress		2004
<i>Orobancha minor</i>	Lesser Broomrape		
<i>Oxalis incarnata</i>	Pale Wood-sorrel	M	
<i>Oxalis pes-caprae</i>	Soursob	✓	
<i>Oxalis purpurea</i>	Large-flower Wood-sorrel		2014
<i>Paraserianthes lophantha</i>	Cape Wattle	–	
<i>Paspalum dilatatum</i>	Paspalum	–	
<i>Passiflora</i> sp.	a passion-flower	–	
<i>Pinus radiata</i>	Monterey Pine	D	
<i>Piptatherum miliaceum</i>	Smilo Grass, Rice Millet		2014
<i>Pittosporum undulatum</i>	Sweet Pittosporum	✓	
<i>Plantago coronopus</i>	Buck's-horn Plantain	–	
<i>Plantago lanceolata</i>	Ribwort	M	
<i>Plantago major</i>	Greater Plantain	✓	
<i>Poa annua</i> (non <i>P. infirma</i>)	Annual Meadow-grass	–	
<i>Poa infirma</i>	Early Meadow-grass	✓	
<i>Polycarpon tetraphyllum</i>	Four-leafed Allseed	–	
<i>Polygonum aviculare</i>	Hogweed	–	
<i>Polypogon viridis</i>	Water Bent	–	
<i>Potentilla indica</i>	Indian Strawberry	–	
<i>Prunella vulgaris</i>	Self-heal	M	
<i>Prunus cerasifera</i>	Cherry-plum	–	
<i>Pseudoscleropodium purum</i>	Neat Feather-moss	✓	
<i>Pteris ?cretica</i>	Cretan Brake	–	
<i>Quercus robur</i>	English Oak		2014
<i>Ranunculus repens</i>	Creeping Buttercup	D	
<i>Raphanus raphanistrum</i>	Wild Radish	✓	
<i>Romulea rosea</i>	Common Onion-grass	✓	
<i>Rosa rubiginosa</i>	Sweet Briar	–	
<i>Rubus anglocandicans</i>	Blackberry	M	
<i>Rumex conglomeratus</i>	Clustered Dock	M	
<i>Rumex crispus</i>	Curled Dock	✓	
<i>Rumex obtusifolius</i>	Broad-leaf Dock		2014
<i>Sagina apetala</i>	Common Pearlwort	–	
<i>Salix</i> sp.	unidentified willow		1994
<i>Senecio vulgaris</i>	Common Groundsel		2014
<i>Setaria parviflora</i>	Slender Pigeon Grass	–	
<i>Sisyrinchium micranthum</i>	Blue Pigroot		2014
<i>Solanum americanum</i>	Glossy Nightshade	–	
<i>Solanum mauritianum</i>	Tobacco-bush	–	
<i>Solanum nigrum</i>	Black Nightshade	✓	
<i>Soliva sessilis</i>	Jo Jo	✓	
<i>Sonchus asper</i>	Rough Sow-thistle		2014

Wild introduced species

Scientific Name	Common Name	Abundance	Missing since
<i>Sonchus oleraceus</i>	Sow-thistle	✓	
<i>Sporobolus africanus</i>	Rat-tail Grass	–	
<i>Stachys arvensis</i>	Stagger Weed		1999
<i>Stellaria media</i>	Chickweed		2014
<i>Symphyotrichum subulatum</i>	Aster-weed		2014
<i>Taraxacum officinale</i> spp. agg.	Garden Dandelion	–	
<i>Thunbergia alata</i>	Black-eyed Susan	–	
<i>Torilis arvensis</i>	Spreading Hedge-parsley	–	
<i>Tradescantia fluminensis</i>	Wandering Jew	M	
<i>Trifolium dubium</i>	Suckling Clover		2014
<i>Trifolium glomeratum</i>	Cluster Clover	–	
<i>Trifolium repens</i>	White Clover	✓	
<i>Veronica arvensis</i>	Wall Speedwell	–	
<i>Veronica persica</i>	Persian Speedwell		2014
<i>Viburnum tinus</i>	Laurustinus	–	
<i>Vicia disperma</i>	French Tiny Vetch	✓	
<i>Vicia hirsuta</i>	Tiny Vetch	–	
<i>Vicia sativa</i> subsp. <i>nigra</i>	Narrow-leaf Vetch	–	
<i>Vinca major</i>	Blue Periwinkle	M	
<i>Viola odorata</i>	Fragrant Violet	–	
<i>Vulpia bromoides</i>	Squirrel-tail Fescue	✓	
<i>Zantedeschia aethiopica</i>	White Arum Lily	–	

Appendix B – Vaughan Road Reserve Plant Species Lists

Similarly to Appendix A, this appendix provides an inventory of the species of mosses, liverworts, ferns and seed-producing plants that have been recorded in Vaughan Road Reserve. Separate lists are provided for wild, indigenous species, planted species and wild, introduced species.

Except for mosses and liverworts, the ‘Status’ column indicates the risk of extinction in Knox, as assessed by Lorimer (2010) according to the international ‘Red List’ criteria. The codes for the ‘Status’ column are:

- EX Extinct in Knox;
- CR Critically Endangered;
- EN Endangered;
- VU Vulnerable.

Entries in the four columns to the right of the species’ names indicate abundance in each of four parts of the reserve during 2021–2022, using the following symbols:

- Scarce;
- ✓ Present in moderate numbers, not dominant within a vegetation stratum;
- D Dominant (or sharing dominance) within the relevant vegetation stratum, at least in some areas;
- M Many individuals but with too little cover to be dominant in the relevant vegetation stratum.

Species not seen in 2021–2022 are indicated in the last column by the year of their last record. There have only been two prior records for the reserve: an apparently incomplete list by Andrew Paget in 1986 and a thorough list by Rik Brown in 2002. Neither of those lists included mosses or liverworts.

Wild indigenous species

Status	Scientific Name	Common Name	NW of creek	SE of creek	Creek	NW firebreak	Missing since
<u>Indigenous Mosses and Liverworts</u>							
	<i>Campylopus introflexus</i>	Heath Star Moss	✓				
	<i>Fissidens curvatus</i>	a pocket-moss	–				
	<i>Rhynchostegium tenuifolium</i>	a feather moss			✓		
	<i>Sematophyllum homomallum</i>	a moss	–				
	<i>Chiloscyphus semiteres</i>	Green Worms	✓				
	<i>Lunularia cruciata</i>	Moonwort			✓		
<u>Indigenous Ferns</u>							
VU	<i>Adiantum aethiopicum</i>	Common Maidenhair	M				
VU	<i>Calochlaena dubia</i>	Common Ground-fern	✓				
EN	<i>Cyathea australis</i>	Rough Tree-fern			✓		
	<i>Pteridium esculentum</i>	Austral Bracken	D	D			
<u>Indigenous Flowering Plants</u>							
VU	<i>Acacia mearnsii</i>	Black Wattle	✓				
VU	<i>Acacia melanoxylon</i>	Blackwood	✓	–?			
VU	<i>Acacia stictophylla</i>	Dandenong Range Cinnamon Wattle	–				
VU	<i>Acacia verticillata</i>	Prickly Moses			–?		
	<i>Acaena novae-zelandiae</i>	Bidgee-widgee		✓			

Wild indigenous species

Status	Scientific Name	Common Name	NW of creek	SE of creek	Creek	NW firebreak	Missing since
	<i>Arthropodium strictum</i>	Chocolate Lily					1986
	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	Sweet Bursaria					2002
	<i>Carex appressa</i>	Tall Sedge			–		
	<i>Carex breviculmis</i>	Short-stem Sedge	–	–			
	<i>Cassinia aculeata</i>	Common Cassinia	–				
VU	<i>Chiloglottis valida</i>	Common Bird-orchid	–				
VU	<i>Clematis aristata</i>	Mountain Clematis	–				
VU	<i>Comesperma volubile</i>	Love Creeper	–				
VU	<i>Coprosma quadrifida</i>	Prickly Currant-bush	M		–	–	
VU	<i>Dianella longifolia</i> var. <i>longifolia</i>	Pale Flax-lily	–				
	<i>Dianella revoluta</i> var. <i>revoluta</i>	Black-anther Flax-lily					2002
VU	<i>Dianella tasmanica</i>	Tasman Flax-lily	M	–		–	
	<i>Dichondra repens</i>	Kidney-weed	✓				
VU	<i>Epacris impressa</i>	Common Heath					2002
VU	<i>Epilobium billardioreanum</i> subsp. <i>?cinereum</i>	Variable Willow-herb			–		
VU	<i>Eucalyptus cypellocarpa</i>	Mountain Grey Gum		–			
	<i>Eucalyptus goniocalyx</i>	Bundy, Long-leaf Box	✓	–		–	
EN	<i>Eucalyptus macrorhyncha</i>	Red Stringybark	✓	–			
VU	<i>Eucalyptus melliodora</i>	Yellow Box	–				
VU	<i>Eucalyptus obliqua</i>	Messmate Stringybark	–	–			
VU	<i>Eucalyptus ovata</i>	Swamp Gum					2002
EN	<i>Eucalyptus radiata</i>	Narrow-leaved Peppermint	D				
VU	<i>Exocarpos cupressiformis</i>	Cherry Ballart	✓	–			
	<i>Gahnia radula</i>	Thatch Saw-sedge	D	–			
CR	<i>Geranium homeanum</i>	Rainforest Crane's-bill	✓		M		
	<i>Gonocarpus tetragynus</i>	Common Raspwort					2002
	<i>Goodenia ovata</i>	Hop Goodenia					2002
VU	<i>Isolepis inundata</i>	Swamp Club-rush			✓		
	<i>Juncus amabilis</i>	Hollow Rush			–		
	<i>Juncus bufonius</i>	Toad Rush		✓			
	<i>Juncus gregiflorus</i>	Green Rush			–		
	<i>Kunzea leptospermoides</i>	Yarra Burgan	✓				
VU	<i>Laphangium luteoalbum</i>	Jersey cudweed		✓			
EN	<i>Lemna disperma</i>	Common Duckweed					2002
	<i>Lepidosperma elatius</i>	Tall Sword-sedge	–				
	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Wattle Mat-rush	✓				
	<i>Lomandra longifolia</i> subsp. <i>longifolia</i>	Spiny-headed Mat-rush	✓				
EN	<i>Melaleuca ericifolia</i>	Swamp Paperbark			D		
	<i>Microlaena stipoides</i>	Weeping Grass	✓			✓	
VU	<i>Olearia lirata</i>	Snowy Daisy-bush	✓		–?		
EN	<i>Olearia myrsinoides</i>	Silky Daisy-bush	–				
	<i>Oxalis exilis/perennans</i>	Wood-sorrel		✓			
	<i>Pandorea pandorana</i>	Wonga Vine	M			–	
	<i>Persicaria decipiens</i>	Slender Knotweed			M		
VU	<i>Platylobium infecundum</i>	a flat-pea	–				
	<i>Poa ensiformis</i>	Sword Tussock-grass	–		✓		
	<i>Poa morrisii</i>	Soft Tussock-grass	–				
EN	<i>Poa tenera</i>	Slender Tussock-grass					2002
EN	<i>Polyscias sambucifolia</i>	Elderberry Panax	–				
EN	<i>Prostanthera lasianthos</i>	Victorian Christmas-bush	D				
EN	<i>Rubus parvifolius</i>	Small-leaf Bramble	–				
	<i>Rytidosperma penicillatum</i>	Slender Wallaby-grass	✓				
EN	<i>Senecio campylocarpus</i>	Floodplain Groundsel			–		
CR	<i>Sigesbeckia orientalis</i>	Indian Weed			✓		
CR	<i>Solanum ?aviculare</i>	Kangaroo Apple			–		

Wild indigenous species

Status	Scientific Name	Common Name	NW of creek	SE of creek	Creek	NW firebreak	Missing since
EN	<i>Stylidium armeria</i>	Grass Trigger-plant					1986
	<i>Tetrarrhena juncea</i>	Forest Wire-grass	M				
EN	<i>Viola hederacea</i>	Ivy-leaf Violet					1986

Planted species

Status	Scientific Name	Common Name	NW of creek	SE of creek	Creek	NW firebreak	Missing since
	<i>Acacia dealbata</i>	Silver Wattle	–				
VU	<i>Acacia mearnsii</i>	Black Wattle	–			✓	
VU	<i>Acacia melanoxylon</i>	Blackwood		D			
EN	<i>Acacia myrtifolia</i>	Myrtle Wattle	–				
VU	<i>Acacia stictophylla</i> Dandenong Range	Cinnamon Wattle	–				
EN	<i>Banksia marginata</i>	Silver Banksia	–				
	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	Sweet Bursaria		✓			
	<i>Cassinia aculeata</i>	Common Cassinia	–				
VU	<i>Cassinia longifolia</i>	Shiny Cassinia	–				
	<i>Corymbia ficifolia</i> (ornamental cv.)	Red Flowering Gum	–				
EN	<i>Daviesia leptophylla</i>	Narrow-leaf Bitter-pea	–				
VU	<i>Dianella longifolia</i> var. <i>longifolia</i>	Pale Flax-lily		✓			
	<i>Eucalyptus cypellocarpa</i>	Mountain Grey Gum				✓	
	<i>Eucalyptus ?goniocalyx</i>	Bundy, Long-leaf Box		✓			
VU	<i>Eucalyptus ?melliodora</i>	Yellow Box	–				
	<i>Goodenia ovata</i>	Hop Goodenia		✓			
CR	<i>Hakea nodosa</i>	Yellow Hakea	–				
	<i>Leptospermum continentale</i>	Prickly Tea-tree	–				
EN	<i>Leptospermum scoparium</i>	Manuka		✓			
	<i>Lomandra longifolia</i> subsp. <i>longifolia</i>			✓			
		Spiny-headed Mat-rush					
EN	<i>Olearia argophylla</i>	Musk Daisy-bush	–				
VU	<i>Olearia lirata</i>	Snowy Daisy-bush		✓			
EN	<i>Ozothamnus ferrugineus</i>	Tree Everlasting	–				
	<i>Poa ensiformis</i>	Sword Tussock-grass		✓	✓		
EN	<i>Poa tenera</i>	Slender Tussock-grass	–				
CR	<i>Pomaderris lanigera</i>	Woolly Pomaderris	–				
EN	<i>Spyridium parvifolium</i>	Australian Dusty Miller	–				
CR	<i>Veronica derwentiana</i>	Derwent Speedwell	–				

Wild introduced species

Scientific Name	Common Name	NW of creek	SE of creek	Creek	NW firebreak	Missing since
<i>Acer negundo</i>	Box Elder			–		
<i>Allium triquetrum</i>	Angled Onion	M	✓	M	D	
<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass	✓	–		✓	
<i>Asparagus scandens</i>	Asparagus Fern	✓				
<i>Briza maxima</i>	Large Quaking-grass				–	
<i>Bromus catharticus</i>	Prairie Grass		✓	–	✓	
<i>Bromus diandrus</i>	Great Brome		✓	–		
<i>Callitriche stagnalis</i>	Pond (or Common) Water-starwort			✓		

Wild introduced species

Scientific Name	Common Name	NW of creek	SE of creek	Creek	NW firebreak	Missing since
<i>Cardamine hirsuta</i>	Common Bitter-cress			✓		
<i>Catapodium rigidum</i>	Fern Grass			–		
<i>Cenchrus clandestinus</i>	Kikuyu	✓		✓	D	
<i>Centaurea erythraea</i>	Common Centaury	–				
<i>Centranthus ruber</i>	Red Valerian		–			
<i>Cerastium glomeratum</i>	Common Mouse-ear Chickweed			–		
<i>Cirsium vulgare</i>	Spear Thistle	–	–		✓	
<i>Cordyline australis</i>	New Zealand Cabbage Tree	✓	–			
<i>Cotoneaster glaucophyllus</i>	Cotoneaster					2002
<i>Cotoneaster pannosus</i>	Cotoneaster	–				
<i>Crepis capillaris</i>	Smooth Hawksbeard		–	–		
<i>Crocsmia × crocosmiiflora</i>	Montbretia	✓	✓	✓	✓	
<i>Cyperus eragrostis</i>	Drain Flat-sedge			✓		
<i>Dactylis glomerata</i>	Cocksfoot	✓		✓	–	
<i>Delairea odorata</i>	Cape Ivy	–	✓	D		
<i>Ehrharta erecta</i>	Panic Veldt-grass	M	D	✓	D	
<i>Ehrharta longiflora</i>	Annual Veldt-grass	✓				
<i>Epilobium ciliatum</i>	Glandular Willow-herb			✓		
<i>Erigeron sumatrensis</i>	Fleabane	?	–	✓	✓	
<i>Eriobotrya japonica</i>	Loquat	✓				
<i>Euphorbia peplus</i>	Petty Spurge			–		
<i>Fraxinus angustifolia</i> subsp. <i>angustifolia</i>	Desert Ash	?	✓	✓	–	
<i>Fumaria bastardii</i>	Bastards Fumitory	✓	–	✓		
<i>Galium aparine</i>	Cleavers	✓	✓	✓	✓	
<i>Gamochaeta purpurea</i>	Spiked Cudweed			–		
<i>Genista monspessulana</i>	Montpellier Broom	?	–	✓		
<i>Hedera helix</i>	Ivy	M	–	M	–	
<i>Holcus lanatus</i>	Yorkshire Fog	✓		✓		
<i>Homalanthus populifolius</i>	Bleeding Heart			–		
<i>Hyacinthoides non-scripta</i>	English Bluebell				–	
<i>Hypochaeris radicata</i>	Cat's Ear	?	–	–	✓	
<i>Ilex aquifolium</i>	Holly					2002
<i>Ipomoea indica</i>	Lear's Morning-glory	D	–		✓	
<i>Jasminum polyanthum</i>	Pink (or Winter) Jasmine	✓	D	D		
<i>Lactuca serriola</i>	Prickly Lettuce		–	–		
<i>Ligustrum lucidum</i>	Large-leafed Privet	✓	✓	–	–	
<i>Ligustrum vulgare</i>	European Privet					2002
<i>Lonicera japonica</i>	Japanese Honeysuckle	D	–	?		
<i>Melissa officinalis</i>	Lemon Balm			–		
<i>Myosotis sylvatica</i>	Wood Forget-me-not	–	–	✓		
<i>Oxalis corniculata</i>	Creeping Wood-sorrel			–		
<i>Oxalis incarnata</i>	Pale Wood-sorrel	✓	✓	✓	M	
<i>Oxalis pes-caprae</i>	Soursob	–				
<i>Paraserianthes lophantha</i> subsp. <i>lophantha</i>	Cape Wattle					2002
<i>Paspalum dilatatum</i>	Paspalum				–	
<i>Passiflora tarminiana</i>	Banana Passionfruit	✓				
<i>Phalaris aquatica</i>	Toowoomba Canary-grass	–			–	
<i>Pinus radiata</i>	Monterey Pine					2002
<i>Pittosporum undulatum</i>	Sweet Pittosporum	✓	–		–	
<i>Plantago lanceolata</i>	Ribwort	–		–	M	
<i>Plantago major</i>	Greater Plantain			✓		
<i>Polycarpon tetraphyllum</i>	Four-leafed Allseed			–		
<i>Polypogon viridis</i>	Water Bent			–		
<i>Prunella vulgaris</i>	Self-heal			–		
<i>Prunus cerasifera</i>	Cherry-plum	–				
<i>Ranunculus muricatus</i>	Sharp Buttercup		–	–		
<i>Ranunculus repens</i>	Creeping Buttercup		✓	D		

Wild introduced species

Scientific Name	Common Name	NW of creek	SE of creek	Creek	NW firebreak	Missing since
<i>Rubus anglocandicans</i>	Blackberry	✓	–	✓		
<i>Rumex conglomeratus</i>	Clustered Dock			✓		
<i>Rumex obtusifolius</i> subsp. <i>obtusifolius</i>	Broad-leaf Dock			✓		
<i>Salix × rubens</i>	White Crack Willow					2002
<i>Solanum nigrum</i>	Black Nightshade			–	✓	
<i>Sonchus asper</i>	Rough Sow-thistle					
<i>Sonchus oleraceus</i>	Sow-thistle	–	✓	✓	✓	
<i>Stellaria media</i>	Chickweed		✓	✓		
<i>Taraxacum officinale</i> spp. agg.	Garden Dandelion		–		✓	
<i>Tradescantia fluminensis</i>	Wandering Jew	–	D	D	✓	
<i>Tropaeolum majus</i>	Nasturtium		–	✓		
<i>Veronica persica</i>	Persian Speedwell			✓		
<i>Vicia disperma</i>	French Tiny Vetch			✓	✓	
<i>Vinca major</i>	Blue Periwinkle		✓	✓	✓	
<i>Viola odorata</i>	Fragrant Violet		–	–		
<i>Vulpia bromoides</i>	Squirrel-tail Fescue		✓			
<i>Zantedeschia aethiopica</i>	White Arum Lily	–	–	✓	✓	

Appendix C – Fauna List

The following table lists the vertebrates and butterflies recorded in Koolunga Native Reserve and Vaughan Road Reserve.

An asterisk before a species' name indicates that it is introduced to Victoria.

The pair of columns to the right of the species names indicate the maximum number of individuals observed at one time in each reserve during the present study (2021–2022) by the present author, Rowan Jennion and Moyra Farrington. For those species detected previously but not during this study, the final column indicates the year of the most recent record from data in the Victorian Biodiversity Atlas or in lists compiled by Western (1985), Gary Cheers (dated 1986) and Kathleen Loxton 1995–2002.

The Powerful Owl is listed as Vulnerable under the Victorian *Flora and Fauna Guarantee Act*. It is the only known fauna species that was listed as threatened at the time it was last seen in the reserves.

		Max no. during 2021–2022		Missing since
		Koolunga	Vaughan Rd	
<u>Butterflies</u>				
Dispar (or Barred) Skipper	<i>Dispar compacta</i>			2009
Flame Skipper, Flame Sedge-skipper	<i>Hesperilla idothea</i>			2008
Splendid Ochre, Symmomus Skipper		1		
	<i>Trapezites symmomus soma</i>			
Yellow-banded Dart, Greenish Grass-dart		1		
	<i>Ocybadistes walkeri sothis</i>			
Dainty Swallowtail	<i>Papilio (Eleppone) anactus</i>			2008
Orchard Swallowtail	<i>Papilio (Princeps) aegeus</i>			2011
*Cabbage White Butterfly	<i>Pieris rapae</i>	1	1	
Caper White	<i>Belenois java teutonia</i>			2008
Australian (or Yellow) Admiral	<i>Vanessa itea</i>	1		
Australian Painted Lady	<i>Vanessa kershawi</i>		1	
Banks Brown	<i>Heteronympha banksii</i>	1	1	
Common Brown	<i>Heteronympha merope</i>	1	2	
Cyril’s Brown	<i>Argynnis cyrila</i>			2009
Klug’s (or Marbled) Xenica	<i>Geitoneura klugii</i>			2008
Meadow Argus Butterfly	<i>Junonia villida</i>	2		
Monarch or Wanderer Butterfly	<i>Danaus plexippus</i>			2008
Ringed Xenica	<i>Geitoneura acantha</i>			2008
Shouldered Brown	<i>Heteronympha penelope</i>			2008
Varied Swordgrass Brown	<i>Tisiphone abeona</i>			1999
Common Grass-blue	<i>Zizina otis labradus</i>	1		
Imperial Hairstreak	<i>Jalmenus evagoras</i>	5		
<u>Fish</u>				
Broadfin Galaxias	<i>Galaxias brevipinnis</i>	4–5		
Shortfin Eel	<i>Anguilla australis</i>	3	1	
<u>Frogs</u>				
Southern Bullfrog	<i>Limnodynastes dumerilii</i>	1		
Southern Brown Tree Frog	<i>Litoria ewingii</i>	5	4	

		Max no. during 2021–2022		Missing since
		Koolunga	Vaughan Rd	
<u>Reptile</u>				
Delicate Skink	<i>Lampropholis delicata</i>	2		
Garden Skink	<i>Lampropholis guichenoti</i>	1		
McCoy's Skink	<i>Anepischetosia maccoyi</i>	1		
<u>Birds</u>				
Australian Wood Duck	<i>Chenonetta jubata</i>	1		
Pacific Black Duck	<i>Anas superciliosa</i>	5	1	
White-faced Heron	<i>Egretta novaehollandiae</i>			1999
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	1	1	
Brown Goshawk	<i>Accipiter fasciatus</i>	2		
Wedge-tailed Eagle	<i>Aquila audax</i>	1	1	
*Spotted Dove	<i>Spilopelia chinensis</i>	2	2	
Common Bronzewing	<i>Phaps chalcoptera</i>	4-6		
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	8	1	
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>			2002
Galah	<i>Eolophus roseicapilla</i>	2	4	
Little Corella	<i>Cacatua sanguinea</i>	1		
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	20	1	
Rainbow Lorikeet	<i>Trichoglossus molucannus</i>	4	5	
Musk Lorikeet	<i>Glossopsitta concinna</i>			2002
Australian King-Parrot	<i>Alisterus scapularis</i>	2	3	
Crimson Rosella	<i>Platycercus elegans</i>	10	3	
Eastern Rosella	<i>Platycercus eximius</i>	2		
Horsfield’s Bronze-Cuckoo	<i>Chrysococcyx basalis</i>			2002
Powerful Owl	<i>Ninox strenua</i>	1		
Southern Boobook	<i>Ninox boobook</i>	1		
Tawny Frogmouth	<i>Podargus strigoides</i>	2	1	
White-throated Needletail	<i>Hirundapus caudacutus</i>			1999
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	8-10	2	
Sacred Kingfisher	<i>Todiramphus sanctus</i>			1986
White-throated Treecreeper	<i>Cormobates leucophaea</i>			2002
Superb Fairy-wren	<i>Malurus cyaneus</i>		1	
Spotted Pardalote	<i>Pardalotus punctatus</i>	2	2	
Striated Pardalote	<i>Pardalotus striatus</i>			1986
White-browed Scrubwren	<i>Sericornis frontalis</i>	4	4	
Brown Thornbill	<i>Acanthiza pusilla</i>	5-10	5	
Striated Thornbill	<i>Acanthiza lineata</i>	2	?	
Red Wattlebird	<i>Anthochaera carunculata</i>	10-12	8	
Bell Miner	<i>Manorina melanophrys</i>			1986
Noisy Miner	<i>Manorina melanocephala</i>	10	3	
Lewin’s Honeyeater	<i>Meliphaga lewinii</i>	1		
Yellow-faced Honeyeater	<i>Caligavis chrysops</i>		1	
White-plumed Honeyeater	<i>Ptilotula penicillata</i>			1986
Crescent Honeyeater	<i>Phylidonyris pyrrhopterus</i>			1986
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	2	3	
Scarlet Robin	<i>Petroica boodang</i>			1986
Rose Robin	<i>Petroica rosea</i>			2002
Eastern Yellow Robin	<i>Eopsaltria australis</i>	1		
Eastern Whipbird	<i>Psophodes olivaceus</i>			1999
Varied Sittella	<i>Daphoenositta chrysoptera</i>	1		
Crested Shrike-tit	<i>Falcunculus frontatus</i>			1986
Australian Golden Whistler	<i>Pachycephala pectoralis</i>	2	1	
Rufous Whistler	<i>Pachycephala rufiventris</i>			1986
Grey Shrike-thrush	<i>Colluricincla harmonica</i>			

		Max no. during 2021–2022		Missing since
		Koolunga	Vaughan Rd	
Leaden Flycatcher	<i>Myiagra rubecula</i>			1986
Satin Flycatcher	<i>Myiagra cyanoleuca</i>			1986
Magpie-lark	<i>Grallina cyanoleuca</i>			
Grey Fantail	<i>Rhipidura albiscapa</i>	6-8	1	
Willie Wagtail	<i>Rhipidura leucophrys</i>			1986
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	1		
Olive-backed Oriole	<i>Oriolus sagittatus</i>			1999
Grey Butcherbird	<i>Cracticus torquatus</i>	2	2	
Australian Magpie	<i>Gymnorhina tibicen</i>	8-10	2	
Pied Currawong	<i>Strepera graculina</i>	5	2	
Grey Currawong	<i>Strepera versicolor</i>			2004
Little Raven	<i>Corvus mellori</i>	4	2	
Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>	1		
Richard's Pipit	<i>Anthus australis</i>			1986
Red-browed Finch	<i>Neochmia temporalis</i>			1986
*European Greenfinch	<i>Chloris chloris</i>			1986
*European Goldfinch	<i>Carduelis carduelis</i>			1986
Mistletoebird	<i>Dicaeum hirundinaceum</i>			1999
Welcome Swallow	<i>Hirundo neoxena</i>			1999
Tree Martin	<i>Petrochelidon nigricans</i>			1986
Silvereye	<i>Zosterops lateralis</i>	5-10	2-4	
*Common Blackbird	<i>Turdus merula</i>	2	2	
*Common Starling	<i>Sturnus vulgaris</i>			2002
*Common Myna	<i>Acridotheres tristis</i>	6		

Mammals

Short-beaked Echidna	<i>Tachyglossus aculeatus</i>	1	
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	5	3
Kreffft's (Sugar) Glider	<i>Petaurus breviceps</i>	2	
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	33	4
*Red Fox	<i>Vulpes vulpes</i>	3	

Appendix D – Environmental Weed Prioritisation

The following is a step-by-step guide to prioritisation of the control of a particular population of environmental weeds or pest animals, with prompts about what factors to consider.

Step 1 – Define the Campaign

Decide and write down:

- What area of control to consider, e.g. within the forest in Vaughan Road Reserve:
.....
- What is the target species or group of species of environmental weed or pest animal:
.....
- The proposed control approach, e.g. initial spraying followed by two years of spot-spraying for follow-up, or planting of trees to shade out the weeds:
.....

If you have in mind multiple alternative control approaches, repeat Steps 3 & 4 for each approach, then adopt the approach with the highest priority.

Step 2 – Assess the Threat

Predict the weeds' (or pests') overall potential impact (on-site and off-site) in 5 years' time if not controlled. Seek informed opinions of others.

First, to help you avoid overlooking anything, you can make individual assessments of the threat by circling 'low', 'medium' or 'high' for each of the following contributing considerations:

Threatened vegetation types:	Low Medium High
Non-threatened vegetation types:	Low Medium High
Threatened flora/fauna species:	Low Medium High
Non-threatened species:	Low Medium High
Aquatic habitat:	Low Medium High
Spread off-site:	Low Medium High
Is it in a priority conservation site?:	Yes No
What positive aspects do the weeds have, e.g. as food for desirable fauna?:	
Non ecological concerns, e.g. fire hazard:	

Weigh up these answers and circle an overall threat rating from these options:

Low Medium High

Step 3 – Assess Tractability

Using the checklist below, assess how well you expect your chosen treatment will reduce the identified threats over (say) 5 years. Seek informed opinions of others.

Take into account:

- Whether your target species is/are drivers, passengers or intermediate;
- Possible recolonisation of your target(s) from outside the treatment area;
- Replacement of the target(s) by another species following treatment.

Caution: People often overestimate the likelihood of the benefit of their control measures because the target is actually not a driver of change but a symptom of underlying problems that remain uncorrected.

Looking ahead 5 years (say), record your expectations of:

- How much of the threat assessed in Step 2 will be reduced.....
- Permanence of threat reduction.....
- Practical ease of control method
- Cost
- Difficulties getting permission
- Safety of workers and the public.....
- Collateral environmental harm.....
- Collateral benefits (e.g. fire safety).....

Choose an overall tractability rating from:

Low Medium High

Step 4 – Find Priority in the Triage Matrix

On the left-hand side of the triage matrix below, find the row corresponding to your overall rating from Step 2.

Move along that row to the cell beneath the heading that corresponds to your overall rating from Step 3. The recommended priority is in that cell.

That priority might need to be considered alongside any applicable legal or organisational priorities.

		Tractability – Capacity to safely achieve sustainable improvement in conservation values		
		High	Medium	Low
Net level of threat to biodiversity (seriousness & rate of spread)	High	A – Treatment is critical, immediate, targeted and long-term	B – Treatment needs to occur promptly and long-term	C – Broad management (i.e. of multiple threats simultaneously)
	Medium	D – Treatment needs to occur promptly and long-term	E – General management to reduce the impact of the target	F – General low-level management to reduce the threat
	Low	G – Act to minimise the threat and prevent further elevation of the problem	H – Low level of management only	I – No immediate action, management action required only after completion of higher priorities

Adapted from: [Downey P.O., Williams M.C., Whiffen L.K., Auld B.A., Hamilton M.A., Burley A.L. and Turner P.J. \(2010\). Managing alien plants for biodiversity outcomes – the need for triage. *Invasive Plant Science and Management* 3: 1–11.](#)