

# THREATENED PLANT LIVING COLLECTION PLAN



Partners:



Royal  
Botanic  
Gardens  
Victoria



## **Acknowledgement of Traditional Owners**

The City of Melbourne respectfully acknowledges the Traditional Owners of the land we govern, the Wurundjeri Woi-Wurrung and Bunurong Boon Wurrung peoples of the Eastern Kulin and pays respect to their Elders past, present and emerging.

We acknowledge and honour the unbroken spiritual, cultural and political connection the Wurundjeri, Bunurong, Dja Dja Wurrung, Taungurung and Wadawurrung peoples of the Eastern Kulin have to this unique place for more than 2000 generations.

We are committed to our reconciliation journey, because at its heart, reconciliation is about strengthening relationships between Aboriginal and non-Aboriginal peoples, for the benefit of all Victorians.

# TABLE OF CONTENTS

<b>Executive summary</b>	<b>5</b>
<b>1. Introduction</b>	<b>6</b>
1.1 Plant conservation explained	8
1.1.1 <i>What is a threatened species?</i>	8
1.1.2 <i>What is integrated plant conservation and where does ex situ conservation fit?</i>	9
1.1.3 <i>Why is genetic diversity important in ex situ collections?</i>	11
1.1.4 <i>What is a Living Collection?</i>	12
1.2 Conservation policy and legal context	15
1.2.1 <i>Who is responsible for conservation of threatened species?</i>	16
1.2.2 <i>Broader policy for ex situ conservation</i>	18
<b>2. Threatened Plant Living Collection Plan</b>	<b>20</b>
2.1 Objectives	21
2.2 Current status	21
2.3 Opportunities and benefits	22
2.4 Constraints and risks	23
2.5 Management considerations	23
2.5.1 <i>Sourcing plants</i>	23
2.6 Landscape typologies	24
2.7 Engagement and impact objectives	25
<b>3. Selection of priority species</b>	<b>27</b>
3.1 Threatened Species Assessment Tool	27
3.1.1 <i>Species assessed</i>	27
3.1.2 <i>Ratings descriptions</i>	27
3.1.3 <i>Total score</i>	31
3.1.4 <i>Exclusion thresholds</i>	31
<b>4. Priority species list</b>	<b>33</b>
<b>5. Next steps</b>	<b>37</b>
5.1 Future research needs	38
5.2 Monitoring and evaluation: what does success of this plan look like?	38
<b>6. References</b>	<b>40</b>

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**Front cover image:** Swamp Everlasting (*Xerochrysum palustre*). Photo by Nicoletta Centrofanti, December 2022.

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### **Acknowledgements**

Special thanks to Rodger Elliot, Neville Walsh, Marie Velthoven and Matthew Henderson.

Please cite this document as:

**Larke, R., Hirst, M., Williams, N.S.G. and Arnott, J. (2023) City of Melbourne Threatened Plant Living Collection Plan. Report for the City of Melbourne.**

# EXECUTIVE SUMMARY

The Earth is currently undergoing a mass-extinction event driven by human activity, with species going extinct at rates 100-1000 times faster than they should. City of Melbourne declared a climate and biodiversity emergency in 2019, recognising that climate change and loss of biodiversity pose serious risks to the people and ecosystems of Melbourne and Australia. Later that year, much of eastern and southern Australia was burnt in catastrophic bushfires of unprecedented extent and duration that pushed many threatened species closer to extinction and caused many previously secure species to be listed as threatened for the first time. These mega-fires burnt the habitat of 69% of Australia plant species, including 44% of threatened species. This resulted in hundreds of plant species requiring emergency protection and stretched the limits of natural resource managers across the region.

This City of Melbourne Threatened Plant Living Collection Plan aims to widen the focus of the city's parks and gardens from primarily amenity purposes to include the cultivation of threatened plant species to make meaningful contributions towards their conservation.

Through collaboration with the Royal Botanic Gardens Victoria, city green spaces can contribute to the preservation of Victoria's unique biodiversity by:

- Providing material for propagation thereby removing or reducing collecting pressure on wild populations
- Providing material for translocation or habitat restoration and management
- Providing material for conservation research
- Maintaining species that cannot be kept in a seed bank (such as species that do not reproduce easily by seed)
- Generating skills and knowledge to support wider conservation aims
- Contributing to education and raising public awareness about plant conservation
- Expanding captive population size to
  - 1) increase genetic diversity of species held, or
  - 2) reducing the risk of losing genetic diversity by increasing (replicating) the number of individuals held.

Some threatened plant species are already common in cultivation; however, without proper record keeping, preservation of diverse wild genomes (e.g. not just multiple clones), or interpretation material about the plant's threatened status, such plants are unlikely to contribute to threatened species conservation. By planning and managing a Living Collection of threatened plant species for city parks and gardens, we can use existing resources invested in green space management to provide urgent support for species suffering from the biodiversity crisis.

The next steps towards planting the species short-listed in this document will be to compile more detailed information about each species' specific conservation requirements and find suitable locations for them in city landscapes.

# 1. INTRODUCTION

Plants are vital to our existence, sustaining all life on earth. Plants, stabilise ecosystems and provide food, fibre, timber, medicine and an enormous number of cultural and economic benefits. En masse they can even influence the weather. However, the earth is currently undergoing a mass-extinction event driven by human activity, with species going extinct at rates 100-1000 times greater than prior to the modern era (Ward et al., 2021).

Australia is recognised as one of only seventeen 'megadiverse' countries. Collectively they support more than 70% of the world's species whilst covering only 10% of the planet surface. Australia is home to over 21,000 vascular plant species of which 91% are endemic, meaning they occur nowhere else in the world (Chapman, 2006). This uniqueness is due to the geographic isolation of Australia, its wide range of habitats and diverse landscapes that range from alpine heathlands to tropical rainforests and arid desert. Some plant species are habitat specialists while others occur in many different ecosystems.

The most recent assessment of Victorian plant species outlines that 1,556 plants and 43 plant communities (EVCs) are currently at risk (VBA, 2023). A strategic approach to prioritise threatened species management is required because conditions are worsening for some species resulting in increased threat status and/or likely extinction.

There are 79 local governments in Victoria of which 31 are in metropolitan Melbourne. Although each manages significantly different budgets all councils have broadly similar roles and responsibilities. All Victorian councils reside within a bioregion and may contain one or more EVCs.

The greater Melbourne area supports approximately 1,864 native plant species of which about 178 are considered threatened. For example, within the City of Melbourne the Matted Flax-lily (*Dianella amoena*) is an example of a once locally common lily that is now critically endangered due to a 95% decline across its range.

While local governments have legislative responsibility to protect naturally occurring threatened plant species, for example those that grow in remnant vegetation, they can also consider more innovative ways to further plant conservation objectives. One such way is to grow threatened plant species within their city green spaces – a form of ex situ conservation. However proper consideration must be given to the objectives, opportunities, constraints, priorities, practicalities, risks and benefits of doing this.

This document will describe and guide the selection, acquisition, maintenance, documentation, interpretation and display of threatened plant species in green spaces managed by the City of Melbourne. The Threatened Plant Living Collection Plan is the result of a collaborative initiative between the City of Melbourne (CoM) and the Royal Botanic Gardens Victoria (RBGV) and incorporates methods typically undertaken by botanical gardens to curate a living collections.



The endangered Matted  
Flax-lily (*Dianella  
amoena*) is successful in  
home gardens.

Photo: Lee Harrison

# 1.1 Plant conservation explained

## 1.1.1 What is a threatened species?

A **threatened species** is one that is at risk of extinction in the near future. The combination of risks affecting each plant species are unique but commonly include habitat loss, inappropriate or high frequency fire regimes, encroachment of environmental weeds, grazing and other damage caused by feral animals; and an increase in extreme weather events.

Species can be formally recognised as threatened by a range of authorities, including the International Union for the Conservation of Nature (IUCN), the Australian Government and individual States and Territories. For a species to be formally recognised, there is typically a process that involves species nomination, assessment using agreed criteria, review by experts and a formal, published acceptance by an authority.

Threatened species are classified into categories depending on their risk of extinction (i.e., conservation status) generally Extinct, Critically Endangered, Endangered, or Vulnerable. Species are categorised based on agreed criteria such as population size and trajectory, and area of habitat, according to guidelines published by the IUCN (IUCN, 2022).

The Australian Government legislation for describing and protecting threatened species is the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), and the Victorian Government legislation is the Flora and Fauna Guarantee Act 1988 (FFG Act). Currently, 1419 plant species are listed as threatened at a national level under the EPBC Act and over a third of all Victorian plant species are listed under the FFG Act at a state level.



*A Living Collection: The yellow flowered Swamp Everlasting pictured in the Raising Rarity outdoor research plots, within the Australian Garden Cranbourne, Royal Botanic Gardens Victoria. Photo: Royal Botanic Gardens Victoria.*



### 1.1.2 What is integrated plant conservation and where does ex situ conservation fit?

**Integrated plant conservation** is a multidisciplinary approach aimed at the protection, enhancement and management of biodiversity. Plant conservation can occur in two places. **In situ (on site)** conservation occurs in the species' natural habitat. **Ex situ (off site)** conservation takes place away from natural habitat such as when species are kept in zoos, botanical gardens or seed banks.

Ideally threatened species should be protected in their natural habitat (in situ) so they can continue to evolve and adapt to their natural environment and contribute to the function of the ecosystem in which they occur. However, in some cases, species require protection away from their natural environment, ex situ.

**In situ conservation actions** include managing wild populations, their threatening processes, population enhancement, reintroductions, translocations and assisted migration, site population monitoring and associated field research.

Ex situ conservation is used as an important tool in integrated conservation plans to ensure a reserve of plant material is maintained to protect species from the direct threat of extinction. The ex situ storage and use of various types of plant material is referred to collectively as germplasm. Germplasm can include pollen, spores, seed, tissue culture (e.g. a section of a leaf), cryopreservation, and living plants.

**Ex situ conservation actions** include off-site management of germplasm for a wide range of purposes and applications, such as:

- A source for population enhancement, reintroduction, and translocation programs
- Targeted research (propagation and cultivation protocols, taxonomy, genetics)
- Conserving genetically representative samples of threatened wild plant populations ('backstop populations')
- Living collections of species where seed cannot be collected or stored
- Conservation displays for education, interpretation and learning.

## Ex situ conservation: The Royal Botanic Gardens Victoria Bushfire Recovery program

The 2019-2020 Australian mega-fires burnt the habitat of 69% of Australia plant species, including 44% of our threatened species.

Recommendations by Gallagher et al., (2023, p 123) from the post fire analysis included:

*“Increase representation of species and populations in ex situ conservation. For species with highly restricted distributions or threatened status, the strategic creation, expansion and monitoring of translocated insurance populations or ex situ germplasm collections can contribute to long-term persistence and support future recovery actions...”*

After the 2019-20 Victorian Bushfires RBGV science and horticulture staff planned and conducted extensive field work to survey and collect germplasm (seed and vegetative material) from at risk species. This interdisciplinary program resulted in the establishment of a bushfire recovery ex situ living collection which contained 250 target species. This is an example of an integrated and collaborative approach between RBGV Cranbourne Horticulture, the Victorian Conservation Seedbank and the RBGV Conservation Genetics Team together with multiple partners including the Victorian Department of Energy, Environment and Climate Action (DEECA), Moogji Aboriginal Council East Gippsland Inc., and the Friends of Mallacoota Inc.

This program included:

- Collection of 105 species for the Victorian Conservation Seedbank
- Propagation and cultivation of genetic and geographic representative ex situ populations of 250 species as part of the living collections at the RBGV Cranbourne.
- Engagement of multiple community organisations including the Friends of Mallacoota, Mallacoota Endemic Gardens, Field Naturalists and Traditional Owner Groups.



Caitlin Gray (RBGV Cranbourne) collecting a target bushfire recovery species, *Grevillea jephcotii*, at Pine Mountain post the 2019-20 bushfires. Photo: Andre Messina.

### 1.1.3 Why is genetic diversity important in ex situ collections?

**Genetic diversity** is defined as the variation of genes present within a species across its distribution, which may arise through mutation and recombination. It is important to maintain as much genetic diversity as possible. This ensures the adaptive potential of a species can be retained, which is important because it underpins a species' ability to reproduce, resist pests, diseases, climate change pressures and ensure healthy populations can be maintained.

*'An ex situ conservation strategy should aim to capture genetic variation at the species, population, individual and allelic levels as genetic diversity provide the basis for adaptation of an organism to its existing environment and its potential for adaptation to future environmental changes. Ex situ germplasm conservation enables the use of this captured diversity in a variety of ways, primarily to enhance in situ conservation efforts'*

(van der Merwe et al. 2021)

Threatened species are particularly vulnerable to loss of genetic diversity. This is because they typically have reduced population sizes and occur in fragmented habitat patches, which leads to reduced gene flow, genetic drift, and inbreeding. Consequently, they may have already lost a significant proportion of their gene pool by the time they are listed. Loss of even a small number of individuals can lead to potentially disastrous and irreversible consequences for species.

Population genetics is a tool used to interpret the characteristics of gene variation in a species population/s. This information is beneficial for understanding the level of genetic diversity present, information that may support conservation outcomes, such as disease resistance or identifying genes that may enhance adaptation to changing environmental conditions.

When a species is reliant on ex situ conservation measures, for example one that is extinct in the wild and only exist as a seed collection or a species that survives as living plants in cultivation, genetic resources must be carefully managed to retain as much diversity as possible. Although some threatened species are numerous in cultivation, they may not possess much genetic diversity from their wild range, perhaps because the original source was only a few plants. In other cases, captive plants may only represent a few individuals of the species or may be clones of a single individual. Clones can be a significant issue because self-incompatibility affects approximately 50% of flowering plants. This means clones may not be able to produce viable seeds and even if their seeds were viable, they may be inbred, resulting in offspring with reduced fitness.

It is particularly challenging to maintain the genetic diversity of species kept as living collections. Botanical gardens are typically constrained by available space and resources needed to maintain and curate large, diverse holdings. Opportunities to increase the number of individuals in ex situ plant conservation beyond botanical gardens may help ease these constraints and expand the genetic diversity conserved. A further benefit of growing living collections beyond the gates of botanical gardens is the increased likelihood these public plantings will raise awareness about threatened species.

#### 1.1.4 What is a Living Collection?

A **Living Collection** is a term used by botanical gardens to describe 'a group of plants grown for a defined purpose, including for reference, research, conservation, education or ornamental display' (Royal Botanic Gardens Kew, 2019).

The difference between a typical garden and a living plant collection is that collections are curated. Curated collections are actively managed with specific objectives around how plants are selected, acquired, maintained, documented, interpreted and displayed (BGANZ, 2014; Shade et al., 2021).

A Living Collection may be located together in one place or distributed throughout a broader landscape. The Royal Botanic Gardens Melbourne, for example, houses over twenty Living Collections including the Aotearoa New Zealand Living Collection, the Eucalypt Living Collection, and the Australian Rare and Threatened Species Living Collection.

Growing plants in a living collection is required for the ex situ conservation of threatened species that:

- Cannot be reliably stored in seed banks (e.g. seed is short lived, desiccation intolerant)
- Cannot be propagated from seed
- Are sterile
- Require short to long term insurance populations due to the exhaustion of natural seed banks by events such as fire or floods.

Living plants can be used:

- As a source of material for species conservation
- As a source of material for broad scale habitat restoration
- To provide source material for genetic rescue of a population suffering from inbreeding
- To relieve pressure on natural populations for collection of seed and/or vegetative material
- To undertake conservation research (e.g. about environmental tolerances)
- In horticultural displays for community engagement and education
- To increase understanding of propagation techniques.

## The Critically Endangered Swamp Everlasting and Raising Rarity: Building ex situ Living Collections through education and outreach programs.



Left – A wild population of the Swamp Everlasting (*Xerochrysum palustre*) showing buds opening on a warm summer day. Photo: Nicoletta Centofanti

Right – Swamp Everlasting goes to school: Penleigh Essendon Grammar School and the Raising Rarity team setting up a living collection of the Swamp Everlasting for the students to care and cultivate on campus. Photo: K. Qu.

The Royal Botanic Gardens Victoria (RBGV) Raising Rarity Project aims to raise awareness of Victoria's threatened flora by growing and displaying rare and threatened plant species to increase public engagement and involvement and contribute to the ex situ conservation of threatened species.

The Swamp Everlasting (*Xerochrysum palustre*) is currently being worked on as part of the Raising Rarity Project. It is a critically endangered species which was once widespread throughout Victoria, however habitat loss through swamp draining and land use change has limited its range to only a few sites in south-eastern Australia. The continued loss of habitat due to altered hydrology (changes in water flow associated with draining or drying wetlands), weed invasion, habitat loss and reduced rainfall is likely to lead to this species declining further.

The Raising Rarity Program encourages school groups to become plant guardians and care for their own living collection of this nationally vulnerable species. Students learn to cultivate, monitor growth, record flowering time, collect seed for safeguarding at the Victorian Conservation Seedbank and establish additional ex situ populations. In addition, monitoring information and data collection provides insight into how the species performs in cultivation. The program involves an interdisciplinary team at the RBGV including conservation horticulture, seed ecology, population genetics, outreach, and the education team.

This is a great example of how community led projects can contribute to the ex situ conservation of threatened species through living collections, increased seed collection and increase awareness of Victoria's threatened flora and the conservation work required to safeguard their future.

Researchers collecting leaf samples of Swamp Everlasting (*Xerochrysum palustre*) for population genetics research.



## 1.2 Conservation policy and legal context

Conserving biodiversity is a global priority. On an international scale, there are numerous treaties, conventions, and targets, such as the United Nations (UN) Convention on Biological Diversity and the UN Sustainable Development Goals that highlight the role of cities in achieving sustainability outcomes.

At a regional level, it is becoming increasingly clear that cities can and should play a vital role in preserving biodiversity, not only in terms of education and advocacy but also by providing refugia for some of the most vulnerable species. Typically, urban local governments achieve this by conserving remnant vegetation. However, cities contain many novel ecosystems, designed habitats such as parks, gardens, green roofs and rain gardens that may be suitable for ex situ plant conservation (Kowarik 2011; Mayrand & Clergeau 2018; Blair & Osmond 2020). Responsible and efficient stewardship of urban biodiversity by local government is critical and can greatly improve local, regional, and global sustainability.

This plan will contribute to Melbourne being at the forefront of urban plant conservation internationally and further its reputation as a forward-thinking liveable city. It fits within a wider context of sustainability action at the regional, state, national and international levels including:

- A global strategy for plant conservation is proposed for incorporation into the Post-2020 Global Biodiversity Framework. This includes numerous references to the need for ex situ conservation, biodiverse greening in cities, capacity building and public engagement.
- Australian Government *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Australian Government *Australia's Strategy for Nature 2019-2030*
- Victorian Government *Flora and Fauna Guarantee Act 1988* (FFG Act).
- Victorian Government *Protecting Victoria's Environment – Biodiversity 2037*
- RBGV Corporate Plan 2021 –2024
- RBGV Science Strategy 2022 - 2031
- RBGV Cranbourne Master Plan 2016-2026
- RBGV Cranbourne and Melbourne Living Collections Plan
- City of Melbourne *Nature in the City Strategy 2017*.
- City of Melbourne Climate and Biodiversity Emergency declaration and action plan

## 1.2.1 Who is responsible for conservation of threatened species?

### Australian Government

The Australian Government is responsible for conservation of threatened species through its central piece of environmental legislation, the EPBC Act. This act provides a legal framework for the protection and management of nationally and internationally significant species, called 'matters of national environmental significance' under the Act. *Australia's Strategy for Nature 2019-2030* guides how governments, the community, industry and scientists manage and protect Australia's plants, animals and ecosystems.

### Victorian Government

Species that are threatened with extinction in Victoria are not always threatened on a national scale. The Victorian Government Department of Energy, Environment and Climate Action (DEECA) is the key agency responsible for managing and protecting species threatened in Victoria.

*Protecting Victoria's Environment - Biodiversity 2037* is the Victorian Government's strategy for management of biodiversity, including threatened species. It highlights the responsibility of government organisations to actively contribute to ongoing conservation projects and prioritises the need to engage in plant conservation initiatives. Without effective and sustainable action to protect Victoria's rare and threatened flora, species will continue to increase in threatened status and extinctions will undoubtedly occur.

DEECAs role is to:

- Strategically plan to protect and preserve biodiversity through a range of programs
- Administer the FFG Act and ensure the list of threatened species is comprehensive and up to date
- Support and deliver the management of public land that contains (among other things) threatened species
- Conduct research

- Set targets and indicators, identify priority actions, and monitor and report on progress of the status of threatened species
- Influence other agencies strategic alignment with Biodiversity 2037.

### City of Melbourne

As a municipal council, the City of Melbourne is responsible for land managed and/or owned by the city in accordance with relevant legislation, including the EPBC Act and the FFG Act. Local governments are also responsible for administration of the local planning scheme, including permits for the clearing of native vegetation under the Planning and Environment Act (1987).

The City of Melbourne has a range of strategies and supporting policies and documents that work together to help the city adapt to climate change, and improve liveability, community health and biodiversity.

The most relevant strategies are the Nature in the City Strategy 2017, and to some extent, the Urban Forest Strategy 2012, which contain specific commitments related to plant conservation including:

- Protect and enhance nationally and regionally threatened species
- Review and implement national and state action plans relating to threatened species
- Connect people with nature to initiate broader support for local and international conservation efforts
- Influence conservation actions in other cities and towns across Australia and internationally
- Publish plans and guidance documents that target specific actions to ensure all our work is in line with international conventions, treaties, and targets.



The Nature in the City Strategy also states that the city will support international, national and regional targets, initiatives and action plans for biodiversity such as the Victorian Government's *Protecting Victoria's Environment – Biodiversity 2037*, and the Australian Government's *Australia's Strategy for Nature 2019-2030*.

Collaborators including other governments, the Royal Botanic Gardens Victoria and universities are identified in these strategies as critical to delivering the city's strategic outcomes.



*City of Melbourne Nature in the City Strategy.*

### Royal Botanic Gardens Victoria

The Royal Botanic Gardens Victoria (RBGV) is the central life science institution for plant conservation in Victoria. The RBGV operates across two sites: The Royal Botanic Gardens Melbourne and the Royal Botanic Gardens Cranbourne. The RBGV Board is a body of DEECA and is responsible to the Victorian Minister for Environment and Climate Change.

The RBGV has a number of responsibilities towards the management of threatened species in Victoria. Their role is to:

- Document Victorian plant species (i.e., vascular, fungi, ferns and allied species, mosses and lichens) in the State Botanical Collection
- Collect and safeguard seed and spores of Victoria's rare and threatened plants for long term storage in the Victorian Conservation Seedbank
- Safeguard the genetic potential of threatened species by ensuring different populations of the same species are conserved.
- Increase public knowledge and awareness of Victoria's rare and threatened plants and plant communities

By necessity, the RBGV must prioritise limited resources and space towards the highest priority species.

Priority actions on threatened species are driven by a range of strategies across the organisation. The Corporate Plan (2021 – 2024) drives the overall strategic priorities. The Science Strategy (2022 – 2031) focusses on three strategic goals across Melbourne and Cranbourne sites -create and share knowledge - protect plants - innovate and inspire. This is followed with themed areas that align within RBGV science programs - Discovering, documenting and understanding algae, fungi and plants - Building and maintaining diverse collections - Improving the impact and awareness of RBGV Science.

The RBGV Cranbourne Master Plan (2016-2026) concentrates on key priorities and their implementation relating to the vision of these gardens as a key hub of the environmental, economic, social and cultural network of the region. There are two overarching RBGV Living Collections Plans, Cranbourne and Melbourne Gardens. Both plans are specifically targeted to the direct needs of each site, with very different landscapes and history of which species selection, curation and future planning can be quite contrasting in comparison.

### 1.2.2 Broader policy for ex situ conservation

The Australian and Victorian Government strategies for nature cover a broad range of goals, targets and actions related to many different areas of biodiversity management, in line with their remit under legislation. They both include aspects of ecosystem health, human health and wellbeing, and knowledge management and exchange.

Both the Australian and Victorian strategies include targets that utilise ex situ conservation to contribute to broader conservation goals. Their specific ex situ targets are summarised to the right.

#### **Victorian Government:**

##### **Protecting Victoria's Environment – Biodiversity 2037**

A state-wide target for a net improvement in the outlook across all species by 2037, as measured by Change in Suitable Habitat, with the expected outcome including:

*'That all critically endangered and endangered species will have at least one option available for being conserved ex situ or re-established in the wild (where feasible under climate change) should they need it.'* (Page 20)

#### **Australian Government: Australia's Strategy for Nature 2019-2030**

This strategy includes three goals, each with a number of objectives. Under Goal 2, 'Care for nature in all its diversity', progress measure 6D is the:

*'Number and success of strategic ex-situ conservation programs and emergency interventions implemented for the most at-risk species'* (Page 23).

**Morning Flag (*Orthrosanthus multiflorus*) is commonly used in public landscaping and is listed as endangered in Victoria.**



Photo: Freya Thomas

## 2. THREATENED PLANT LIVING COLLECTION PLAN

To responsibly house threatened plant species in publicly accessible city green spaces, consideration must be given to the objectives, opportunities, constraints, priorities, practicalities, risks and benefits of doing so. The level of maintenance will depend on the species, the planting location and the level monitoring available.

The method this document uses to plan a Living Collection that can be housed across a variety of green spaces managed by the City of Melbourne, is typical of those performed by botanical gardens to create living collections. It works with the understanding that different green spaces will require a tailored suite of species to match the growing conditions, the design objectives and the available resources for successful plant establishment. This species selection process may range from incorporating just a single threatened species into a design palette to creating meadows using an array of threatened plant species.

This document will describe and guide the selection, acquisition, maintenance, documentation, interpretation and display of **threatened plant species** in city green spaces for the purposes of plant conservation.

## 2.1 Objectives

This collaboration between the City of Melbourne and the Royal Botanic Gardens Victoria can improve the amenity and biodiversity of city green spaces while also providing additional space for the curation of threatened plant species, using the expert guidance of the RBGV.

By housing an ex situ threatened plant Living Collection, the City of Melbourne's parks and gardens can contribute to the survival and continued natural evolution of species in their natural habitat (in situ) by:

- Providing material for propagation thereby removing or reducing collecting pressure on wild populations
- Providing material for translocation or habitat restoration and management
- Providing material for conservation research
- Maintaining species that cannot be kept in a seed bank (such as species that do not reproduce easily by seed)
- Generating skills and knowledge to support wider conservation aims
- Contributing to education and raising public awareness about plant conservation
- Expanding the ex situ population size to 1) increase genetic diversity of species kept in ex situ, or 2) reducing the risk of losing genetic diversity by increasing (replicating) the number of individuals held.

The end-use of material held in the collection will depend on the conservation needs and programs for individual species and form part of the decision making regarding which species to include in the Living Collection.

## 2.2 Current status

Many threatened plant species are already common in cultivation; however, without proper record keeping referencing the origin, preservation of wild genomes (e.g. not heavily selected for commercial production), or interpretation material about the plant's threatened status, such plants are unlikely to make meaningful contributions to threatened species conservation. By widening the focus of the city's parks and gardens from primarily amenity purposes to including cultivating plants for conservation objectives, the City can contribute to the preservation of Victoria's unique biological diversity.

For example, the following plants are listed on the FFG Act and are already common in cultivation in Melbourne: Weeping Myall (*Acacia pendula*), Matted Flax-lily (*Dianella amoena*), Large-fruited Yellow Gum (*Eucalyptus leucoxylon* subsp. *megalocarpa*), Sandpaper Fig (*Ficus coronata*), Wilga (*Geijera parviflora*), and Cabbage-tree Palm (*Livistona australis*).

## 2.3 Opportunities and benefits

By using the City's existing investments in horticulture, in combination with additional record keeping and management procedures, this plan can contribute to the protection of many threatened species within existing and future green spaces with little to no sacrifice in design or appeal.

The incorporation of new threatened species may improve amenity in addition to the conservation benefits. Many species that are not commonly cultivated could make spectacular floral displays, and the plant material produced could go towards ex situ conservation actions (e.g. seed banks). Furthermore, including such species in horticultural plantings could be a great tool for public engagement and education, adding a novel drawcard to city parks and gardens.

Other opportunities could include:

- Training and learning for City horticultural staff and contractors in the management of uncommon species. These education opportunities could also be extended to the broader industry and community through professional development workshops.
- Strengthening and fostering relationships and networks across botanical gardens, species experts, and the broader horticultural, scientific and sustainability communities.
- Reciprocal cultivation arrangements with other land managers and institutions who hold species that are predicted to lose suitable habitat under climate change, or for the management of genetic diversity.
- Expansion and replication of genotypes in ex situ care.
- Increased understanding of plant biology through practice and easier access by researchers.
- Increased availability of plant material for research, particularly for local students and without depleting wild populations.
- Reintroduction of locally extinct indigenous species to local ecosystems, supporting other trophic levels.
- Increasing the available plant palette to foster creative and innovative garden and landscape design.

## 2.4 Constraints and risks

The same constraints that apply to any municipal plantings also apply to threatened plants. These include herbivore browsing, heritage requirements for species selection, climate-readiness, suitability to growing conditions in any given context and public safety.

Additional considerations for threatened plants may include:

- The possibility of increased plant theft due to a high demand for some rare or highly attractive plants
- The need to make plant material (seed, plant cuttings) available for use by other conservation organisations when required
- Best-use of limited numbers of individuals of some species
- Some specialised methods may be needed for best-practice management
- Managing risks of domestication e.g. increased flower size, early germination

## 2.5 Management considerations

Frequent considerations in City landscapes are requirements to meet obligations under the Heritage Act 2017, individual park master plans, precinct plans, and operational considerations such as maintenance budget constraints.

The FFG Act applies to council-managed land and so if natural populations of species that would have once occurred in the city become established, they could be subject to the FFG Act.

### 2.5.1 Sourcing plants

The process for acquiring plants for the living collection will largely depend on their availability and purpose or end-use.

Considerations include:

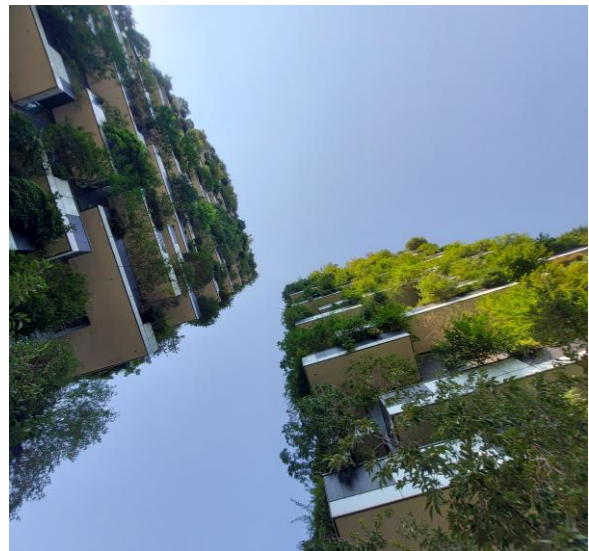
- Plants being used for research purposes, for example where they may be destroyed at the end of the research (such as root growth studies or biomass)
- Plants intended to be used to return progeny to the wild where genotype information may be highly important
- Rarity of their genotype and risk of specimen loss due to theft or plant death
- Expense or difficulty in acquiring plants
- Whether plants are being used for display and education purposes, where genotype may be of secondary importance
- Available information about the population of origin. For example where source is uncertain, plants might not be suitable for reintroduction to the wild or for use in breeding
- Sustainability of source populations and availability of permits for collection (if required).

## 2.6 Landscape typologies

The City of Melbourne is not a life science institution and does not manage any botanical gardens. Nonetheless, the City manages a wide variety of green spaces, with varying landscape objectives.

It is not possible to list all the objectives of every landscape in this document. However, landscapes can be grouped by shared attributes that can be used for planning a Living Collection. These include:

- Existing landscapes containing natural vegetation communities – for example grassy woodlands in Royal Park, saltmarsh in Riverside Park in Kensington, creek line and riverbank plant communities along the Yarra River Birrarung, Maribyrnong River, Moonee Ponds Creek, and Westgate Park in Fisherman’s Bend.
- Renewal and expansion of existing garden beds such as the Australian Native Garden in Royal Park, among many others around the city.
- Temporary or changing plant displays. For example the Fitzroy Gardens Conservatory, annual bed displays, Town Hall planter displays, among others.
- Temporary spaces such as future development sites, and city activation projects such as temporary pop-up park planters
- Entirely new green spaces that are created as part of business-as-usual capital works projects such as the Climate Adapted Streets Program (CASP), Greenline, University Square, and Market square.
- Places with specialised growing conditions such as steep rocky slopes, and wetlands and their analogues such as floating wetlands and water sensitive urban design (WSUD) rain gardens.
- Green walls, roofs and facades managed by the city such as the CH2 roof and potentially future installations at CH1 and the Munro Library.
- Under-utilised spaces such as road verges.



*Examples of landscape typologies that may be used for planning a Living Collection.*



## 2.7 Engagement and impact objectives

The City of Melbourne has a wide range of engagement and impact objectives that can be delivered through threatened plant conservation projects. Many of these are described in the policy context section. Similarly, RBGV have set conservation objectives to meet their responsibilities as noted in their corporate plans and science strategy (see 1.2.1 and 1.2.3 on policy and masterplans).

Each threatened species faces a unique set of challenges. Some threats can be alleviated by increasing public awareness and raising the profile of species. Increasing public engagement for some threatened species could reduce threats such as inadvertent mismanagement or habitat damage, lack of resources (addressed by community volunteers), lack of interagency communication and lack of research and monitoring (can be increased through citizen science programs) (Soanes et al. 2020).

Conversely, increasing public awareness of individual specimens can result in negative impacts to threatened species. Too much public attention may result in trampling, vandalism and theft and therefore communication and visibility of the location of species must be considered in combination with risk management.

**Wildflower meadows  
can be used to grow  
threatened plant species  
whilst avoiding some of  
the risks of plant  
domestication.**

Photo: David Hannah



# 3. SELECTION OF PRIORITY SPECIES

## 3.1 Threatened Species Assessment Tool

The Threatened Species Assessment Tool provides a framework to assess and prioritise the inclusion of threatened species into landscape plantings. It includes information and scoring for cultivation requirements, conservation benefits and horticultural potential which are the foundation of the assessment. Also included is a score for additional benefits specific to the City of Melbourne and potential weed threat.

### 3.1.1 Species Assessed

For inclusion in the Threatened Species Assessment Tool, all species were required to be listed as threatened in Victoria.

Two hundred threatened species (listed on the FFG Act) were selected for assessment. All species have been grown at the RBGV therefore, propagation and cultivation information was available to inform the assessment. Furthermore, a range of growth forms were included (e.g. trees, shrubs, groundcovers) to provide a balanced assessment of a range of species that could be used in different landscape contexts. This included 22 species indigenous to the City of Melbourne, 23 species indigenous to greater Melbourne and 155 found in the remainder of Victoria.

### 3.1.2 Ratings Descriptions

Individual components of the tool were assigned a score, and summed into a subtotal for three categories: Cultivation Requirements Subtotal ('Cultivation Potential'), Conservation Subtotal and Additional Local Benefits Score. These were then summed to provide the total score.

### **Cultivation Requirements Subtotal**

Cultivation Potential was the sum of ratings for cultivation protocols and propagation protocols. Additional information including habit, light requirements, preferred soil type and horticultural potential are provided to assist in the selection of suitable planting sites but were not used in scoring.

*Box 1. Description of ratings for each component of Cultivation Requirements Subtotal.*

#### **A) Cultivation Protocols (1 - 5)**

1 = Short lived - exacting in its cultivation requirements (e.g. a terrestrial orchid or hemi-parasitic plant)

2 = Difficult (but not impossible) to cultivate - short lived or has specific requirements for cultivation such as misting or mycorrhizal associates or pot culture

3 = Can be cultivated with specific growing conditions e.g. moist well drained soils - would need to be replaced within 5 years to maintain high quality plant

4 = Can be cultivated and is reasonably tolerant of a range of garden situations/conditions - Longer lived 5+ years

5 = Easily cultivated and highly adaptable across a range of garden situations/conditions - Long lived 10+ years

#### **B) Propagation Protocols (1 – 3)**

1 = Difficult to propagate

2 = Can be propagated - but requires significant time/effort

3 = Easily propagated

#### **A+B = Cultivation Requirements Subtotal**

Cultivation Protocol + Propagation Protocol = Cultivation Requirements Subtotal

## Horticultural Potential

Horticultural Potential was scored using a rating of 1-5 based on a species ornamental value (Box 2). This category is particularly important when ornamental value is an important consideration for landscape plantings.

This score is provided as a design consideration and therefore does not apply to all landscapes equally. Therefore it is not included in the Total Score.

*Box 2. Description of ratings for Horticultural Potential.*

### **Horticultural Potential (1 - 5)**

1 = Little or no ornamental/display potential

2 = Plant with limited ornamental attributes, (form/flowers/fruit etc.) - Limited display potential

3 = Plant with some ornamental attributes (form/flowers/fruit etc.) at various times of the year and could be reasonably incorporated into mixed plantings

4 = Plant with many ornamental attributes (form/flowers/fruit etc.) throughout year

5 = Highly ornamental - feature plants

Cultivation Requirements (Box 1) and Horticultural Potential (Box 2) were assessed by an expert panel of RBGV Horticulturists utilising current knowledge and practice, information from the RBGV Living Collections Database, consultation with Lee Harrison (City of Melbourne), Rodger Elliot (RBGV Honourable Associate) and additional information sourced from published literature (Elliot and Jones, 1980; Bull and Stolfo 2014).

## Conservation Subtotal

Conservation Subtotal is the sum of scores for Conservation Status, Germplasm Source, Germplasm Origin and Provenance, and Additional Conservation Benefits (Box 3).

*Box 3. Descriptions of ratings for each component of the Conservation Subtotal.*

### **A) Conservation Status (1-5)**

- 5 = Critically Endangered
- 4 = Endangered
- 3 = Threatened
- 2 = Vulnerable
- 1 = Not Threatened

### **B) Germplasm Source (1-5)**

- 1 = Not held in RBGV collection with little prospect of collecting
- 2 = Not held, moderately difficult to collect
- 3 = Not held in collection but easily obtained
- 4 = Currently held, limited propagation material
- 5 = Currently held in collection

Germplasm source is directly related to taxa that is currently held at the RBGV.

### **C) Germplasm Origin (0-3)**

- 3 = Wild
- 1 = Cultivated
- 0 = Unsourced

### **D) Provenance (0-2)**

- 2 = Indigenous to CoM
- 1 = Indigenous to Greater Melbourne
- 0 = Native to Vic

### **E) Additional Conservation Benefits (1 point for each)**

- GC = Genotyped Collection
- BR = Bushfire Recovery
- RL = Living collection critical as sufficient seed is not or cannot be collected and stored

### **A+B+C+D+E = Conservation Subtotal**

Conservation Status + Germplasm Source + Germplasm Origin + Provenance + Additional Conservation Benefits = Conservation Subtotal value

Species conservation status was obtained from the most recent assessment of Victorian threatened plant species listed in the Flora and Fauna Guarantee Act 1988 - Threatened List September 2022 (DEWLP, 2021).

Provenance information was determined from species distributions in VicFlora and the Australian Virtual Herbarium (VicFlora, 2023; AVH, 2023) and the City of Melbourne Pre-colonial Plant List. Additional conservation benefits information was sourced from the RBGV Living Collections Database.

### **Additional Local Benefits**

An additional point was added to the total score for each individual local benefit or potential use for the species in the city. Locally indigenous species were awarded a point for their cultural values and another point was awarded if the species can be used in green infrastructure projects such as green walls, rain gardens and green roofs.

### **3.1.3 Total Score**

An overall score was given for each species which included: the Cultivation Requirements Subtotal, the Conservation Subtotal and the Additional Local Benefits to the City of Melbourne (Box 4).

*Box 4. Description of ratings for overall total score.*

#### **a) Total Score**

A combined total score including:

- Cultivation Requirements Subtotal ('Cultivation Potential')
- Conservation Subtotal
- Additional Local Benefits Subtotal

### **3.1.4 Exclusion Thresholds**

Thresholds were set in five in categories which resulted in the removal of species from selection (Box 5). Additionally, a threshold was set for the overall total to prioritise species selection for City of Melbourne ex situ conservation programs.

**Box 5.** *Thresholds for species exclusion. Species that scored the following were removed from the final list.*

**Cultivation Protocols:**

1 = Short lived and exacting in its cultivation requirements (e.g. terrestrial orchid or hemi-parasitic plant)

2 = Difficult (but possible) to cultivate - short lived or has specific requirements for cultivation such as misting or mycorrhizal associates or pot culture

**Propagation Protocols:**

1 = Difficult to propagate

**Germplasm Source**

1 = Not held in collection with little prospect of collecting

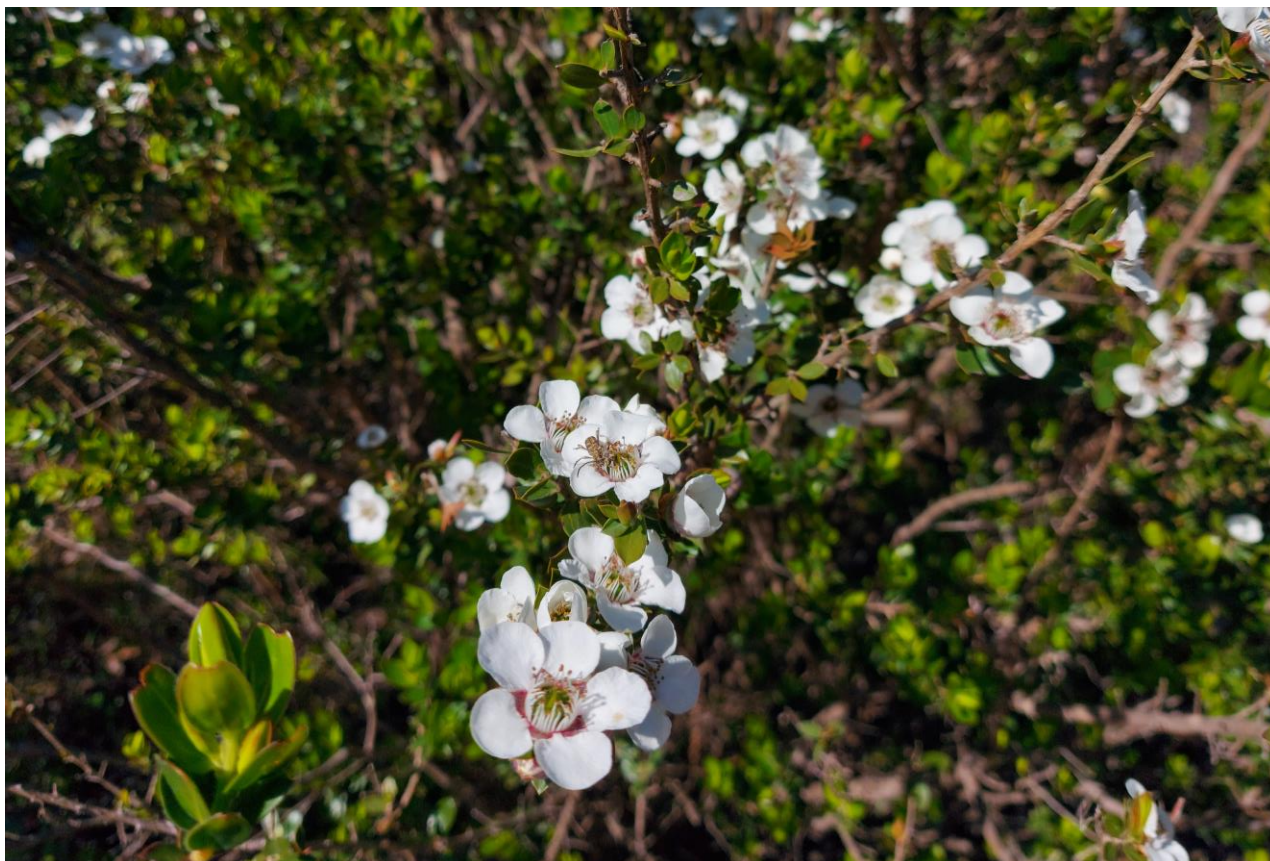
2 = Not held moderately difficult to collect

**Weed Risk**

All species rated as High Risk were removed.

**Overall Threshold**

An overall total rating threshold (see Box 4) of 20 was chosen for final species selection. The final species list consisted of 56 species from the possible 200.



*Shiny Tea-tree (Leptospermum turbinatum) is the largest-flowered Leptospermum and is listed as endangered in Victoria. Photo: Lee Harrison.*



# 4. PRIORITY SPECIES LIST

The key objective of this project is to increase the planting of rare and threatened plant species in council landscapes. Therefore, higher priority is given to taxa which are the most threatened and are indigenous to the City of Melbourne. However, the Threatened Species Assessment Tool has been designed to allow decision makers to tailor species selection to suit both organisational objectives and requirements of specific landscapes and gardens (e.g. Carlton gardens vs a roadside verge). For example, if the primary aim is to include plants in high display value horticultural landscapes, then the horticultural merit and reliability of species may be prioritised. Conversely, if the primary aim is to conserve threatened species, then prioritisation would be given to species that require urgent conservation action.

Table 1 lists the 56 species short-listed by the Threatened Species Assessment Tool. These are the threatened species appropriate for planting in City of Melbourne green spaces. It includes 9 species indigenous to CoM, 10 plants from Greater Melbourne and 37 plants originating from other regions of Victoria.

Table 1. Final 56 selected priority threatened plant species.

Species Name	Common Name	Cultivation Requirements Subtotal	Conservation Subtotal	Local Benefits Subtotal	Overall Total
<b>Indigenous to the City of Melbourne</b>					
<i>Coronidium gunnianum</i>	Pale Swamp Everlasting	7	14	1	22
<i>Dianella amoena</i>	Matted Flax-lily	7	16	1	24
<i>Eucalyptus leucoxylo</i> <i>subsp. connata</i>	Melbourne Yellow Gum	8	14	1	23
<i>Microseris scapigera</i>	Yam Daisy	7	14	2	23
<i>Pimelea spinescens subsp. spinescens</i>	Spiny Rice-flower	6	14	1	21
<i>Podolepis linearifolia</i>	Basalt Podolepis	6	14	1	21
<i>Rutidosia leptorhynchoides</i>	Button Wrinklewort	7	14	2	23
<i>Swainsona behriana</i>	Southern Swainson-pea	6	13	1	20
<i>Xerochrysum palustre</i>	Swamp Everlasting	7	16	2	25
<b>Indigenous to Greater Melbourne</b>					
<i>Amphibromus pithogastrus</i>	Plump Swamp Wallaby-grass	7	13	0	20
<i>Asterolasia asteriscophora subsp. albiflora</i>	White Star-bush	6	14	2	22
<i>Austrostipa rudis subsp. australis</i>	Veined Spear Grass	8	12	0	20
<i>Beyeria lanceolata</i>	Pinkwood	6	14	0	20
<i>Bossiaea cordigera</i>	Wiry Bossiaea	7	12	1	20
<i>Craspedia canens</i>	Grey Billy-buttons	8	14	0	22
<i>Eucalyptus yarraensis</i>	Yarra Gum	7	13	0	20
<i>Olearia asterotricha subsp. lobata</i>	Rough Daisy-Bush	7	13	0	20
<i>Phebalium squamulosum subsp. squamulosum</i>	Forest Phebalium	8	13	0	21
<i>Pomaderris vacciniifolia</i>	Round-leaf Pomaderris	8	14	1	23

Species Name	Common Name	Cultivation Requirements Subtotal	Conservation Subtotal	Local Benefits Subtotal	Overall Total
<b>Native to Victoria</b>					
<i>Acacia boormanii</i> subsp. <i>gibba</i> (East Gippsland)	Snowy River Wattle	8	13	1	22
<i>Acacia lucasii</i>	Woolly Bear Wattle	6	15	0	21
<i>Acacia pendula</i>	Weeping Myall	7	13	0	20
<i>Alectryon subcinereus</i>	Native Quince	7	13	0	20
<i>Aphanopetalum resinosum</i>	Gum Vine	7	13	1	21
<i>Baeckea linifolia</i>	Swamp Baeckea	7	12	1	20
<i>Bauera sessiliflora</i>	Grampians Bauera	7	13	1	21
<i>Callistemon subulatus</i>	Dwarf Bottlebrush	8	13	1	22
<i>Calostemma purpureum</i>	Garland Lily	7	12	1	20
<i>Commersonia dasyphylla</i>	Kerrawang	6	15	1	22
<i>Commersonia prostrata</i>	Dwarf Kerrawang	6	13	2	21
<i>Correa lawrenceana</i> var. <i>genoensis</i>	Genoa River Correa	7	15	0	22
<i>Eremophila maculata</i> subsp. <i>maculata</i>	Spotted Emu-bush	8	12	0	20
<i>Eucalyptus froggattii</i>	Kamarooka Mallee	7	13	0	20
<i>Eucalyptus polybractea</i>	Blue Mallee	7	13	0	20
<i>Eucalyptus wimmerensis</i>	Wimmera Mallee-box	7	13	0	20
<i>Eupomatia laurina</i>	Bolwarra	6	13	1	20
<i>Grevillea dimorpha</i>	Flame Grevillea	7	13	0	20
<i>Grevillea jephcottii</i>	Green Grevillea	7	14	1	22
<i>Grevillea pachylostyla</i>	Buchan River Grevillea	5	15	0	20
<i>Grevillea parvula</i>	Genoa Grevillea	7	14	1	22
<i>Grevillea willisii</i>	Rock Grevillea	7	13	0	20
<i>Leptospermum turbinatum</i>	Shiny Tea-tree	8	12	0	20
<i>Livistona australis</i>	Cabbage Fan-palm	8	12	1	21
<i>Mirbelia rubiifolia</i>	Heathy Mirbelia	7	13	0	20
<i>Myoporum floribundum</i>	Slender Myoporum	7	13	0	20
<i>Nematolepis wilsonii</i>	Shiny Nematolepis	6	13	1	20
<i>Olearia tomentosa</i>	Toothed Daisy-bush	7	13	0	20
<i>Orthrosanthus multiflorus</i>	Morning Flag	8	12	1	21
<i>Pomaderris aurea</i>	Golden Pomaderris	8	12	0	20

Species Name	Common Name	Cultivation Requirements Subtotal	Conservation Subtotal	Local Benefits Subtotal	Overall Total
<b>Native to Victoria</b>					
<i>Pomaderris subplicata</i>	Concave Pomaderris	7	13	0	<b>20</b>
<i>Sannantha crenulata</i>	Fern-leaf Baeckea	7	13	0	<b>20</b>
<i>Scaevola calendulacea</i>	Dune Fan-flower	8	11	1	<b>20</b>
<i>Swainsona greyana</i>	Hairy Darling-pea	7	13	1	<b>21</b>
<i>Thomasia petalocalyx</i>	Paper Flower	8	12	0	<b>20</b>
<i>Westringia cremnophila</i>	Snowy River Westringia	6	13	1	<b>20</b>
<i>Westringia senifolia</i>	Alpine Westringia	6	14	0	<b>20</b>

# 5. NEXT STEPS

The process of bringing a species back from the brink of extinction is usually complex and involves many stakeholders responsible for a range of different actions. These plans are ideally described in a specific-species recovery plan. However, not all threatened species have recovery plans and existing ones may not be up-to-date.

The next steps towards planting the species prioritised in this document will be to compile more detailed information about each species specific conservation requirements and suitable locations for them in city landscapes.

Location considerations will include meeting the cultivation requirements of the plants, the conservation objectives, the landscape design objectives of planting location and community engagement.

Traditional Owners have a continuing connection to the city and it will be important to discuss the conservation priorities and opportunities identified in this document with representatives from Melbourne's Registered Aboriginal Parties. The cultural values of Traditional Owners should also be explored further before implementation.

The City of Melbourne threatened plant living collection will need:

- The botanical expertise to identify, prioritise and procure permits and plants for cultivation in city gardens.
- Procedures for record keeping
- Training or guidance on specific plant management needs.
- In some cases, a willingness to adjust planting designs to accommodate new plant species.
- A willingness to learn from, experiment with and share information about the cultivation of new plant species.

## Potential applications and considerations for species shortlisted include:

- What would be the specific plant conservation outcomes for each species? For example, research on species biology, reducing pressure on wild populations, public awareness etc.
- Is there somewhere the species can sensibly be grown in the city? For example, what are the risks of theft, trampling, genetic contamination (if seed was to be collected), maintenance needs etc.
- What are the opportunities and constraints for incorporating species into themed or dedicated displays for art, storytelling, education, awareness, or advocacy? For example, in city managed assets such as the Fitzroy Gardens Conservatory, Melbourne Town Hall planter boxes displays.
- What themes could be explored in the public plantings? These could include Victorian plants threatened by climate change, threatened ecosystems (e.g. grasslands and grassy woodlands), bushfire impacted, or Traditional Owner cultural values.

## 5.1 Future research needs

Future research needs should align with federal and state goals listed in current plant conservation strategies (section 1.2 and 1.2.1). It should incorporate targets and assessments from *Australia's Strategy for Nature 2019-2030* – particularly Goal 2, 'Care for nature in all its diversity', progress measure 6D; and *Protecting Victoria's Environment-Biodiversity 2037 - Change in Suitable Habitat*.

Furthermore, actions should align with research needs outlined in City of Melbourne *Nature in the City 2017* and the Royal Botanic Gardens Victoria Science Strategy. Some examples could include:

- Identifying candidate species that are 'climate ready' (i.e. future proofing) through successful establishment, monitoring and citizen science
- The impact of ex situ Living Collections on existing green spaces and maintenance plans.
- Identifying potential trade-offs with an increase in planting diversity
- The social impact of using threatened flora in public green spaces: Is there a rise in plant conservation awareness?

## 5.2 Monitoring and evaluation: what does success of this plan look like?

There are a number of ways evaluate the outcomes and success of this plan. These include:

- Increase in number of threatened plant species and genotypes held in ex situ
  - Increase in public understanding and support for threatened plant conservation
- Threatened species being down listed or removed from species lists as a result (in part) of this plan
- Amount of germplasm from ex situ collections used in situ conservation programs
- Quality and quantity of research conducted on threatened species held in ex situ collections in Melbourne (or because of Melbourne collections)
- Increase in suitable habitat for threatened species (i.e., Victorian Government nature strategy target)
- Increase in the number and success of ex situ conservation programs and emergency interventions implemented (i.e. Australian Government nature strategy progress measure 6D).



Photo: David Hannah

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Business hours, Monday to Friday  
(Public holidays excluded)

### Fax:

03 9654 4854

### In writing:

City of Melbourne  
GPO Box 1603  
Melbourne VIC 3001  
Australia



### Interpreter services

We cater for people of all backgrounds  
Please call 03 9280 0726

03 9280 0717 廣東話  
03 9280 0719 Bahasa Indonesia  
03 9280 0720 Italiano  
03 9280 0721 普通話  
03 9280 0722 Soomaali  
03 9280 0723 Español  
03 9280 0725 Việt Ngữ  
03 9280 0726 عربي  
03 9280 0726 한국어  
03 9280 0726 हिंदी  
03 9280 0726 All other languages

### National Relay Service:

If you are deaf, hearing impaired or speech-impaired,  
call us via the National Relay Service: Teletypewriter (TTY)  
users phone 1300 555 727 then ask for 03 9658 9658  
9am to 5pm, Monday to Friday (Public holidays excluded)

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CITY OF MELBOURNE