Developing Biodiversity Protection Strategies for Urban Greenspace in Melbourne

An Interactive Qualifying Project
submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfilment of the requirements for the
degree of Bachelor of Science

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Date: 29th of April, 2019

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Abstract

The industry surrounding land management and conservation in and around Melbourne consists of many stakeholders from a vast array of organizations. The goal of this project was to increase communication in this industry in order to promote better land management and more consideration for the protection of biodiversity. To develop an understanding of those involved and the current state of land management, we conducted interviews with key stakeholders and researched the region's recent environmental history, as well as its current and past land management practices. In collaboration with the Port Phillip EcoCentre, we developed a framework containing information on the common problems and effective methods for combating the issues that we found among the many groups. Finally, we proposed different ways this framework could be implemented in the future.

Acknowledgements

We would like to express our gratitude to our advisors, Althea Danielski and Susan Jarvis for their advice and support along the way. We would also like to thank the Port Phillip EcoCentre for sponsoring our project, particularly Neil Blake, whom has worked closely with us, offered us contact information of important stakeholders, and showed us around the Greater Melbourne greenspaces. We also appreciate all the kindness from other staff members at the EcoCentre that generously offered us Australian hospitality and invited us on EcoCentre excursions. We would like to thank members of the AABR group who let us sit in on their meeting and who were willing to have very informative conversations with us in the weeks after. We appreciate Peter Parrington for showing us the biolinks in Greater Melbourne and providing afternoon tea for us. We also thank residential gardeners Gill Upton and Tamasin Ramsay for welcoming us into their homes and having informative conversations about gardening in Melbourne.

We would also like to acknowledge the Kulin Nations, including the Yalukut Weelam clan of the Boon Wurrung language group, traditional owners of the land of the area we are conducting our work in. We pay respects to their Elders past, present, and emerging, and extend that respect to other Aboriginal and Elder members of our multicultural community.

Executive Summary

Introduction

The unique biodiversity in both rural and urban areas of Australia is threatened as climate change persists, resulting in extreme living conditions for the country's flora and fauna. Furthermore, cities have expanded to accommodate the increasing population and an addition of another 1.2 million people in Melbourne is expected by 2030 (Melbourne 2030, 2002). In order to mitigate the effects of climate change, local governments have begun to invest in environmental protection and sustainability initiatives. Although portions of government strategies seek to protect Melbourne's biodiversity, there is an interest among land managers, volunteers, and city officials to better integrate it into urban planning to prevent further loss of native flora and fauna species. One group who helps to facilitate these conversations and begin initiatives that will have a positive lasting environmental impact is the Port Phillip EcoCentre.

The Port Phillip EcoCentre is a non-profit, community-managed environmental group that provides a communication base for affiliate groups involved in activities that promote biodiversity, environmental sustainability, and community action.

To connect with the community, the organization focuses on citizen science programs that have the potential to advise government legislation and works with other environmental community groups to conduct research on Melbourne's ecology. Most recently the EcoCentre has been consulted by the Cities of Port Phillip and Bayside to create a wildlife management strategy for Elsternwick Park Nature Reserve (EPNR). The proposed reserve will be placed on the land vacated by the discontinued Elsternwick Golf Course and seeks to increase habitat for indigenous wildlife in and around the city. This sparked a new opportunity to investigate natural areas that can be better integrated with the city and the protection of biodiversity in those spaces.

Methodology

Our project aims to develop educational resources that focus on strategies for biodiversity protection in Melbourne, as well as suggest approaches that will strengthen the current land management schemes by investigating different classes of urban greenspace. To achieve our goal, we will complete the objectives listed below.

1. Identify and engage with key stakeholders and understand their goals of biodiversity management and land use plans in Melbourne
2. Analyze interview results by describing connections that could be established, assembling existing solutions to common challenges, and identifying the appropriate tool to be developed
3. Generate educational resources focusing on urban biodiversity protection and suggest management schemes to enhance biodiversity that can be applied to the urban planning of Melbourne

In order to achieve the first objective, we contacted stakeholders identified through research and consultation with our sponsor. We conducted semi-structured conversational interviews to learn more about stakeholder's management of the environment, their interactions with other groups, and additional information that the interviewees wanted to share. We recorded the interview content, with permission, and used this information to determine similarities and identify connections between themes such as common challenges and effective methods of biodiversity management. Finally, using the details from the interviews and the conclusions drawn from our analysis, we generated an educational resource and management scheme framework that can be implemented by the EcoCentre to better improve and information sharing among those working on preserving urban biodiversity.

Findings

From our research and interactions with the various stakeholders, we determined that the greatest challenge in enhancing urban biodiversity is a lack of communication between all parties, including government entities, community groups, private businesses, and citizens passionate about the environment. Community groups could improve information sharing amongst one another, improve government relations, and increase public outreach to attract volunteers and increase conservation efforts. Additionally, government entities could consult with community groups more on environmental projects to ensure the most beneficial scientific approach is being taken. The government can increase public outreach as well, setting the example for biodiversity awareness so the general public can follow. Furthermore, resources

could be made more accessible to all stakeholders, providing information that may assist the different groups with their efforts in protecting urban biodiversity.

Conclusions and Recommendations

Using the results of our research and considering various aspects from our interviews, we developed a framework connecting all the stakeholders through the challenges and successes that were previously identified. We developed infographics to be utilized for various purposes in environmental education as well and assembled the key players in environmental conservation that we engaged with and that were recommended by our sponsor. Using the information and identified connections, more stakeholders will have the information and resources they require to help protect and improve biodiversity in their communities. We generated a structure that can be used to create a website, or an extension of an existing website, where users can easily access the information they desire. We provided information gathered from our research for the base of this framework and additional information can be supplied by others in the future.

This framework serves as a repository for information regarding the protection and management of urban biodiversity. It seeks to connect information gathered from major stakeholders in a centralized location that is accessible to a large audience. In the future, this framework could be implemented in a number of ways and developed into a resource that is user friendly and easily distributed. Giving the public, community groups, or government departments the ability to add information to the resource, as innovative methods are discovered, new information becomes available, and the environment changes, will allow this tool to be flexible and fluid, remaining applicable as time progresses.

Authorship

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All members reviewed and edited the writing and information in all the chapters of the initial drafts and the final report.

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Chapter 1: Introduction

The unique biodiversity in both rural and urban areas of Australia is threatened as pollution and populations are on the rise causing climate change to persist, resulting in extreme living conditions for the country's flora and fauna. Furthermore, cities have expanded to accommodate the increasing population and an addition of another 1.2 million people in Melbourne is expected by 2030 (Melbourne 2030, 2002). Land clearing to accommodate this growth and the resulting erosion of habitat has led to the extinction and endangerment of many native Australian species, including 5% of Australia's higher plants, 7% of reptiles, 9% of birds, 9% of freshwater fish, 16% of amphibians and 23% of mammals (Bush Heritage Australia).

In order to mitigate the effects of climate change and other ecological threats, local governments have begun to invest in environmental protection and sustainability initiatives. However, these actions have focused predominantly on reducing carbon and greenhouse gas emissions and promoting clean energy, leaving minimal attention directed at protection for indigenous flora and fauna. Although portions of government strategies seek to protect Melbourne's biodiversity, there is an interest among land managers, volunteers, and city officials to better integrate it into urban planning to prevent further loss of native flora and fauna species. One group who helps to facilitate these conversations and begin initiatives that will have a positive lasting environmental impact is the Port Phillip EcoCentre.

The community-managed Port Phillip EcoCentre is a non-profit organization that is dedicated to environmental conservation and education with staff members consisting of experienced environmental scientists, researchers, and teachers. Officially established in 1999, the EcoCentre serves as a hub for citizens and fellow community groups to learn about the environment, biodiversity, and environmental action within greater Melbourne. To connect with the community, the organization focuses on citizen science programs that have the potential to advise government legislation and works with other environmental community groups to conduct research on Melbourne's ecology. These programs include methods such as monitoring species populations, recording desired data, and assisting in practical solutions such as building nest boxes. Most recently the EcoCentre has been consulted by the City of Bayside to create a wildlife management strategy for Elsternwick Park Nature Reserve (EPNR). The proposed reserve will be placed on the land vacated by the discontinued Elsternwick Golf Course and

seeks to increase habitat for indigenous wildlife in and around the city. This sparked a new opportunity to investigate natural areas that can be better integrated with the city and the protection of biodiversity in those spaces.

With this emerging initiative for new greenspaces in local cities, we engaged with stakeholders of urban greenspaces in Melbourne in order to understand how they interacted with these locations on a city-wide scale. Additionally, we connected with land managers of urban greenspaces, as well as the neighboring stakeholders, to gain insight into the site management of public greenspaces and residential gardens. We then analyzed data concerning biodiversity protection, biolinks, and ecosystem services that were inherent in greenspaces in and around the city. Finally, based on the analysis of the information gathered from stakeholders and identifying reoccurring themes in the data, we suggested management schemes that could be applied to the City of Port Phillip and surrounding municipalities and the framework for a resource for stakeholders to access these materials. The project results were to be presented to the EcoCentre staff, who can then implement them on their website to be used as a tool to foster communication and the proliferation of information to the public, community groups, and beyond.

Chapter 2: Background

2.1 Urban Biodiversity in Melbourne

Anthropogenic effects on the latest and current extinction event, the Holocene Extinction, have been documented by a vast number of sources and has led to the loss of indigenous species around the globe (Berger, J. 1999; Lande, R. 1998). Given its unique biodiversity, Australia has felt this impact more than other locations, with one of every three mammal extinctions in the last 400 years occurring on the continent (Australian Wildlife Conservancy, 2018). Since the Nature in the City Strategy was enacted in 2002, the City of Melbourne has been working towards mitigating these effects within its borders. While some habitats have been reserved to protect these species, there are several current threats to these greenspaces as they frequently have other uses (such as recreation) that put further pressure on the ecosystem. For example, over the past several decades, the city has expanded in corridors extending southeast, north, and west. This style of growth has led to the creation of green wedges between the developed corridors that contained various native species and had been protected under the Melbourne 2030 city planning strategy (2002). However as of 2011, a number of these areas had been rezoned to allow for development. This compounds an already troubling situation as significant loss of native habitat has already occurred due to land clearing for development of urbanized areas. Currently, areas within the inner city retain only 1.6% of native habitat, while the outer city retains 16%. Remaining areas also face a degradation of quality due to invasive species, pollution, climate change, internal fragmentation, development, and anthropogenic disturbance (Hahs et al., 2009).

The biodiversity protection problems that the City of Melbourne is facing are used as a case study in an Urbanization and Biodiversity textbook by Ives et al. The chapter details three main challenges that Melbourne faces: fringe development, insufficient commitment to conservation and restoration of both public and private land, and a lack of understanding of the co-benefits of biodiversity and human wellbeing. The implications of these challenges can be severe. First, unregulated fringe expansion has led to native temperate grasslands being put under extreme pressure, despite being within a national biodiversity hotspot, with 0.2% of their original extent remaining and only 0.1% in good ecological condition. Second, the lack of consistent conservation efforts has led to improper management of protected habitat and can be attributed to the third challenge, which is the lack of ecology knowledge and socio-political constraints (Ives

et al., 2013). The community of Melbourne must be involved with scientific initiatives that educate on the importance of biodiversity in order to have a lasting effect on the environment. Our sponsor, the EcoCentre, has been a driving force in Melbourne to increase citizen awareness and participation in such science initiatives.

2.1.1 Current State of Biodiversity in Melbourne

Australia is divided into different bio-regions which share common physical and biological features that are used as a broad framework for conservation planning and management. The State of Victoria holds 28 of these regions and Melbourne lies at the confluence of 6 of them, as shown in Figure 1. Most of Melbourne's terrain is flat with mountains to the east, the Dandenong Range, as well as several coastal ecosystems surrounding Port Phillip Bay. In addition, the Yarra River extends through the northeast and many tributaries flow into it from the north (Hahs et al., 2009). As a result, the area now supports 1,864 indigenous plant species and 520 indigenous fauna species, of which 178 and 136 are considered threatened, respectively. This high biodiversity is also resultant of past land practices that "inadvertently favoured many plants and animals" (Ives et al., 2013). For example, land reserved for freeways that has not been used currently hosts a large amount of native species (Ives et al., 2013). For more detailed information, see Appendix B.

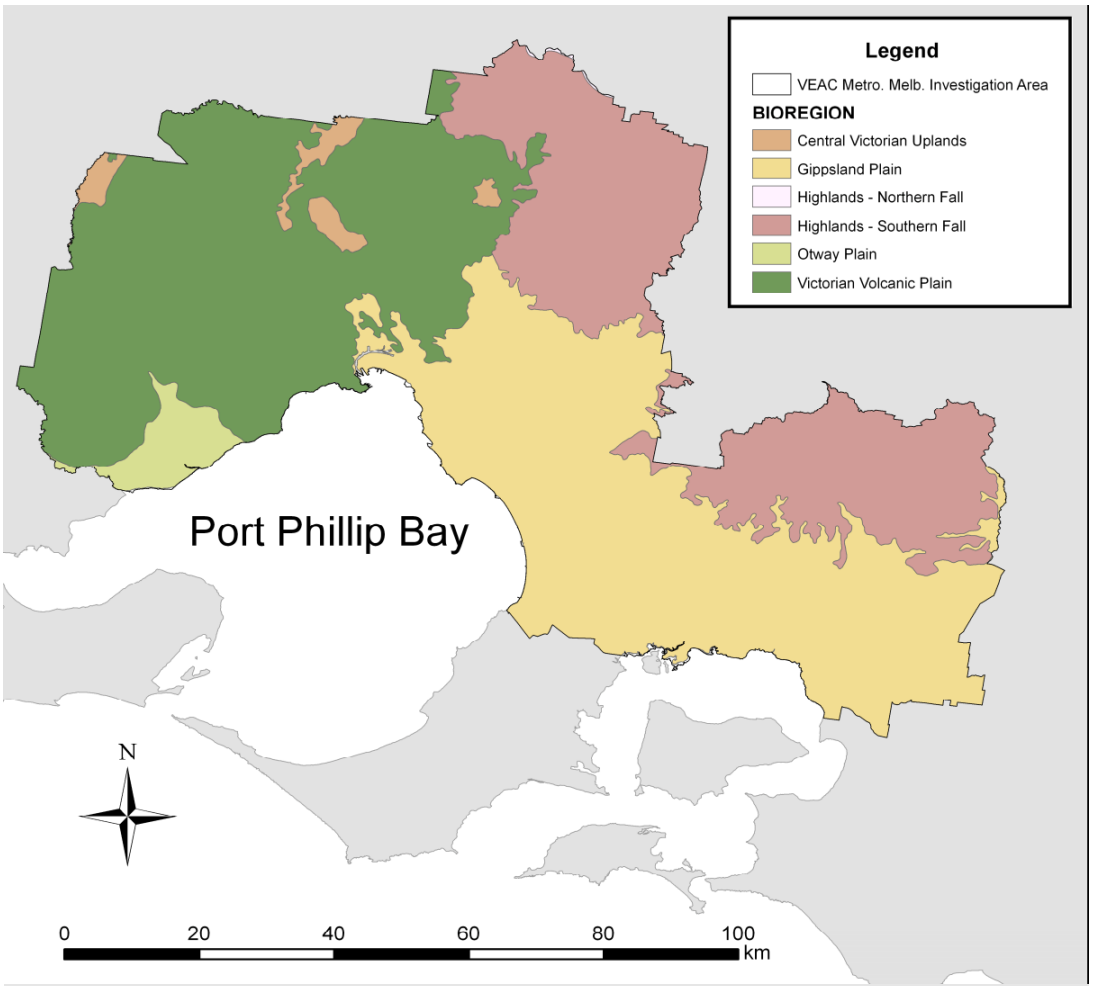

Figure 1: A map displaying the different bioregions in Melbourne (ACRUE, 2009)

2.1.2 Challenges to Monitoring and Protecting Biodiversity

There is a significant effort being put forward to encourage the protection and monitoring of biodiversity in Australia, especially in Melbourne; however, these ambitions do not come without their challenges. One of the greatest problems surrounds agricultural or pastural land in Australia, which makes up around two-thirds of the continent's landmass and has the potential to link fragmented habitats. Pickrell states that "over 60 percent of the continent is under assault by inappropriate land use" and while this occurs, "there is no valuing anything native; everything is being trampled and pushed back" (Pickrell, 2011). Agriculture lends itself to a majority of that percentage, ruining habitat and ignoring conservation efforts. Australia cannot consider minimizing the efforts of agricultural workers, as their production is essential for the country and

its citizens, thus the issue surrounds the lack of consideration for native flora on pastoralist's properties.

Melbourne itself has its own specific challenges to overcome in order to optimize the protection of the biodiversity existing within the city with some issues revolving around the city's size. The city is highly diverse with its average population concentration hovering at approximately 520 people per kilometer. However, this varies widely as the inner city can hold densities up to 8,200 people per kilometer. Melbourne is also the fastest growing Australian city, whose population is expected to double over the next twenty years. This will only add to the city's urban densification, which can increase pressure on biodiversity and ecosystems through destruction, fragmentation, and degradation of habitat (Doyle & Oke, 2017). Much of the city's growth occurs in the outer suburbs with some communities growing at a rate of 8% per year into undeveloped land, resulting in further habitat loss. According to Mike Archer of the University of New South Wales' School of Biological, Earth and Environmental Sciences, a minimum of 1.5 million square kilometers of conservation-viable land will be required to give all Australian species a good chance of surviving (Pickrell, 2011). As cities like Melbourne continue to expand, the likelihood of survival for threatened species will continue to decrease unless their conservation is taken into careful consideration throughout the urban planning process.

2.2 Managing for Biodiversity in Urban Settings

Many current land management strategies in urban areas have goals that may include improving the current ecosystems' conditions and biodiversity, building connections between natural environments throughout the city, inspiring private industries to join the environmental protection initiative, and setting conservation methods that will influence and assist other governments. Some current green initiatives include facilitating corridors, habitat restoration, water sensitive design principles, and garden roofs and walls.

2.2.1 Ecological Vegetation Classes (EVCs)

A system of organizing land in a way that is useful to the protection of biodiversity is using Ecological Vegetation Classes (EVCs). EVCs are a system of native vegetation classifications that "is described through a combination of floristic, life form, and ecological

characteristics" (Hahs et al., 2009). 300 EVCs occur in Victoria and 80 occur in the city of Melbourne, most within private land. These EVCs are particularly important as they are used as surrogates for biological communities and are therefore a key unit for conservation, planning, or management. A number of these EVC's have been identified in the Elsternwick Park Draft (2019) and will prove crucial moving forward with protection strategies. While legislation and public opinion is moving in the right direction, crucial decisions must be made in relation to urban growth on the fringe of Melbourne, habitat management in established areas, management of green assets, and promotion of biodiversity on private land in order to continue to protect wildlife. If these areas are emphasized, particularly in the next 30 years, Melbourne will be able to assure the protection of its diverse species and habitats (Ives et al., 2013).

2.2.2 Corridors and Biolinks Connecting Biodiversity and the Community

A biolink is a corridor of habitat that connects two or more habitat patches in any given scenario. Biolinks have several inherent benefits. Biologically, they allow movement of individuals between isolated populations, increasing genetic diversity and, in turn, the survivability of that population (Rauch, E. M., & Bar-Yam, Y. 2004). Biolinks also work to mitigate negative human-animal interaction by allowing animals the ability to move between patches of habitat without encroaching upon residential areas. Not having these corridors can lead to car accidents when animals try to cross roadways or undesirable interaction between humans and predators in the ecosystem (Johnson, 1999). This concept can be applicable on a large and even continental scale, with corridors including large patches of forest or grassland for example, or on a small scale, taking the form of several trees, shrubs, or gardens that link habitats together. As knowledge on the subject increases, more biolinks are being seen in the creation of greenspaces. As urban development increases, habitat becomes progressively more divided and the species within become more isolated leaving them at a higher risk of extinction (Liu, Newell, White, and Bennett, 2018). Therefore, in peri-urban areas, where there is a higher amount of greenspace as opposed to the inner city, biolinks must be emphasized before the habitat is destroyed permanently by urban sprawl. Figure 2 below shows some previous work completed using corridor mapping in Victoria, where the dark green spaces represent independent habitat patches and blue lines represent proposed biolinks.

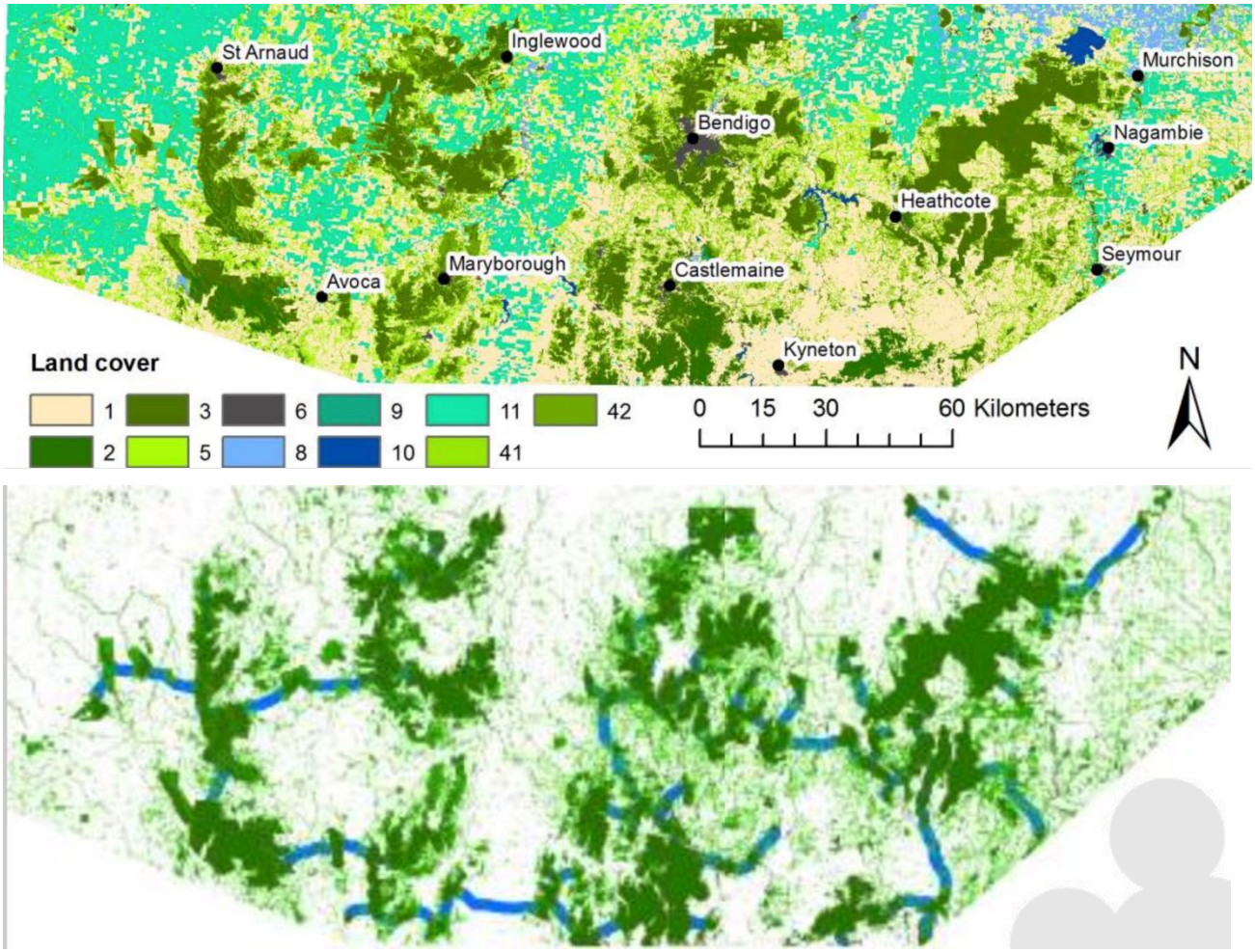

Figure 2: A diagram displaying a set of habitat patches before and after analysis for biolinks (Liu, Newell, White, and Bennett, 2018)

A recent study conducted by Liu, Newell, White, and Bennett (2018) identifies resistance surfaces - defined as a patch of habitat that an organism would encounter a form of resistance moving over - as the "basic input data for connectivity analysis". Circuit theory and least-cost path are two of the most popular methods that respectively use assumptions of animal behavior and require empirical descriptions of a species' movement through patches of habitat, the latter of which is frequently lacking. Another aspect that is periodically missing from connectivity plans is the consideration for multiple species. Historically, many protection plans have been focused around the "charismatic megafauna" that easily capture the public's interest, such as the giant panda or African elephant. While these initiatives work to conserve that one species, the greater ecosystem is still put at risk. Focusing instead on a larger group of species allows researchers to cost effectively protect habitat for many species at once. The study mentioned (2018) used two different types of methods, species distribution modelling and expert opinion, to

identify resistance surfaces and create a connectivity matrix for the study region (Figure 2). When using this method, the researchers established that using expert opinions resulted in more patches that aligned with areas that had higher ecological potential and feasibility than if done by distribution modeling.

2.2.3 Ecosystem Services and Biodiversity Benefits

Ecosystems provide a multitude of benefits that enable and enrich both the quality of biodiversity within the ecosystem and the lives of people living in and around the area. The Millennium Ecosystem Assessment (2005) classified these benefits into four different Ecosystem Services: provisioning, regulating, cultural and supporting services. These categories can also be classified as economic, environmental, human, and ecological benefits. Below, Figure 3 provides examples of the many ways an ecosystem can help humans, the environment, biodiversity and even the economy of the surrounding areas. Changes in the ecosystem can in turn alter the resulting services, effecting various aspects of people's lives.

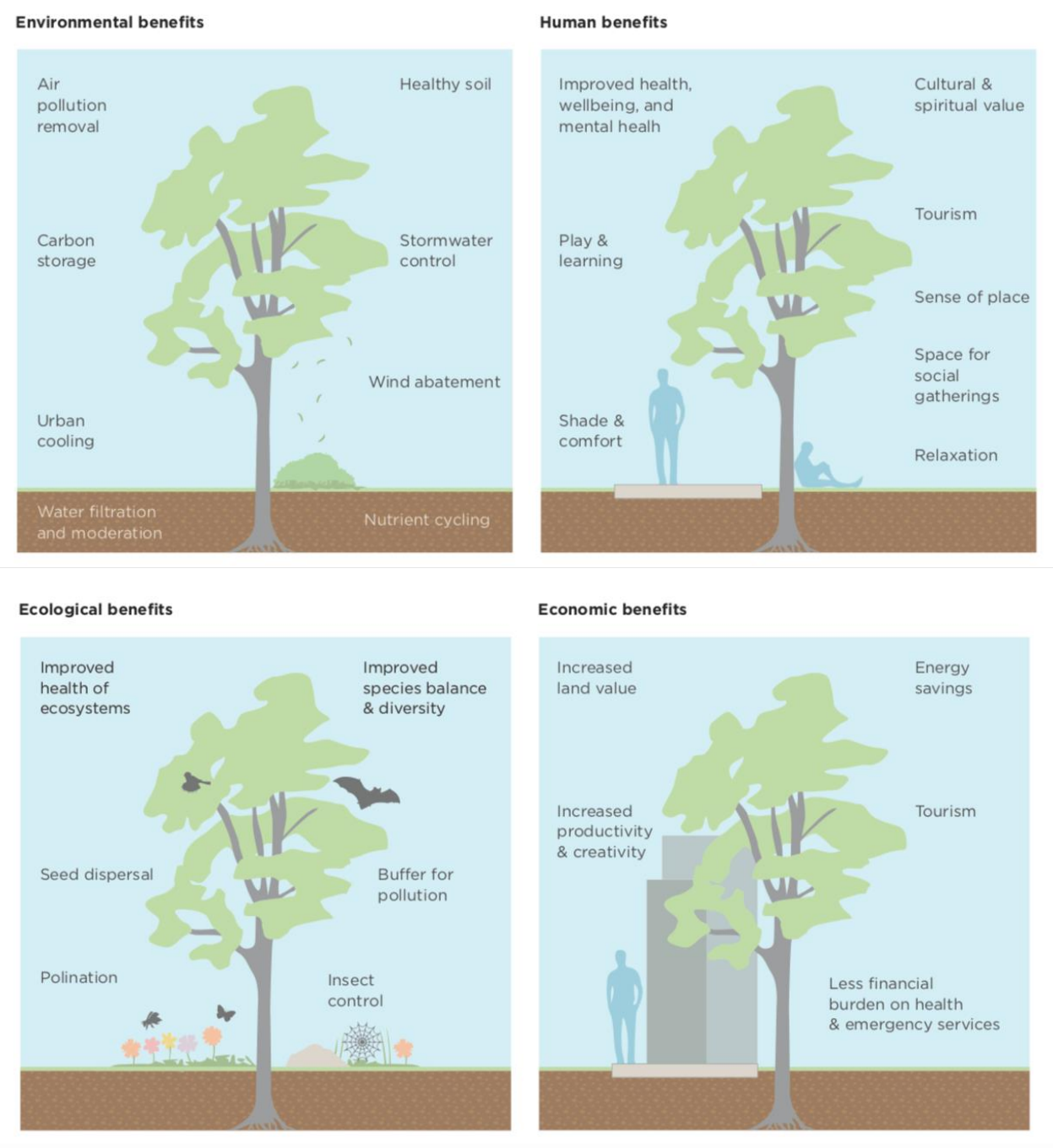

Figure 3: Ecosystem Services (Doyle, R., & Oke, C., 2017)

The first three categories have direct impact on people as well as the species in and around the ecosystem. Provisioning services include material "products obtained from the ecosystem" which can include water, crops, fuel, and other physical resources. Urban ecosystems can provide fresh water to the local wildlife and "ornamental resources," such as decorative

plants, to residents. These services often can be part of the economic and human benefits, providing resources for humans that stimulate the market. Ecosystem changes, such as climate or habitat variations, could result in a decrease in food supply, water contaminants, or reduced fuel supply (Doyle, R., & Oke, C., 2017).

Climate, water, pest, and air quality regulation are just a few merits of regulating ecosystem processes. Natural environments innately perform these services. For example, shade provided by trees can reduce the amount of reflected light from hard surfaces in cities, reducing the temperature of the area, as well as collectively contributing to the global temperature (Doyle, R., & Oke, C., 2017). Waterways and wetlands can assist with flood management and water storage, ensuring a healthy environment for biodiversity and reducing the flood damages to nearby residents. Ecosystems provide the area with natural pest predators, limiting the need of chemical pesticides. To illustrate, providing the native bat species with nesting boxes or tree hollows will encourage their population to thrive and feed on mosquitos. These types of services can provide economic and environmental benefits as well. Alterations to these natural regulations can result in catastrophic consequences, such as species extinction or severe floods (Reid & Millennium Ecosystem Assessment Panel, 2005).

Cultural, or non-tangible human benefits, such as recreational value, spiritual illumination, and social relation advancement, can be obtained by ecosystems as well. Many cultures often connect with the natural world around them, influencing their religion, beliefs, and lifestyle. Often these societies interact with the ecosystem in a variety of ways, such as farmers and fishermen trading goods (products of provisional services). A popular cultural service provided by the environment is that of recreation and beauty. Many people spend leisure time in nature and a considerable amount receive an “aesthetic value” from the environment. Though the results of these human benefits are difficult to quantify, the countless various religions, cultures, and lifestyles are examples of how an ecosystem can provide significant nonmaterial value. Cultural services can be affected by drastic changes to an ecosystem as well. Major landscape or biodiversity changes can bring disconnect between cultures, limit recreational leisure, or diminish the ecosystem’s “aesthetic value” (Reid & Millennium Ecosystem Assessment Panel, 2005).

Finally, the last category is supporting services consisting of indirect, long term, ecological and environmental benefits to the ecosystem and those around it. These can include

photosynthesis, water recycling, and soil formation. Most of these processes go unnoticed and unchanged, such as photosynthesis, however other external factors have the potential restrict these services (Reid & Millennium Ecosystem Assessment Panel, 2005). There is an abundance of merits in preserving urban ecosystems and connecting biodiversity with city planning.

2.3 Government Environmental and Biodiversity Policies in Melbourne

With the prevalence of climate change and the increase of urbanization in Melbourne, the Australian federal, state and local governments have developed environmental programs to reduce carbon and greenhouse gas emissions, lower the "heat-island effect", and conserve native species within urban areas. On the federal level, the Environment Protection and Biodiversity Conservation (EPBC) Act of 1999 restricts actions that work against biodiversity on public land. In the State of Victoria, the Flora and Fauna Guarantee Act of 1988 and Native Vegetation Framework strive to conserve biodiversity on both private and public land which is beneficial as a significant amount of the land in Melbourne is privately owned. Developmental legislation problems can occur as federal, state, and local governments may have opposing ideas on what needs to be protected and, as more private companies begin to develop, those opinions become irrelevant outside of protected areas (Ives et al., 2013).

In addition to the plans set by the Government of the State of Victoria, the many local government areas (LGAs) comprising Greater Melbourne have generated their own policies for wildlife and environmental conservation which tend to cater to the multitude of parks within the LGAs. Urban environments typically have more extreme and variable conditions compared to rural areas and different species have varying tolerances of these drastic changes. Knowledge of which species, native or non-indigenous, are best suited for the environments and the effects they have on the ecosystem is vital to constructing successful biodiversity protection programs. Governments often consult external private organizations and other science groups for ecological expertise on how to best complete the objectives as this knowledge is seldom available within the LGAs and the tasks would otherwise prove to be daunting to the government (Doyle, R., & Oke, C., 2017).

Many of the LGAs have a considerable amount of open spaces that require further management. For example, the City of Port Phillip contains about 176 hectares dedicated to public parks and 11.6 kilometers of foreshore along the Port Phillip Bay (Park Services, 2019).

In 2010, the Council of the City of Port Phillip proposed a movement to increase the sustainability and strengthen the livability of the city by adding to Melbourne's "urban forest". The main goal of the *Urban Forest Approach* is to plant new trees across the city and maintain the current vegetation. This will lead to improved air quality, human physical and mental health benefits, shade being provided for the many reflective surfaces in the city therefore limiting the "heat-island" effect, and the economic merits of reduced energy consumption.

The report set forth by Baxter et al. (2010) illustrates some methods to complete the goal, including ensuring that new urban development avoids severely disrupting the surrounding natural environment, focuses on planting new trees, shrubs, or vertical gardens in the laneways, and manages existing trees to guarantee longevity. TreeLogic, a leading company in the field of agriculture conservation, was consulted to provide insight on professional tree maintenance, in addition to the input delivered by other members in the community. The Street Tree Planting Program focused on improving the Foreshore area of Port Phillip Bay, boulevards, shopping centers, parks, and residential neighborhoods, and sought to connect various natural environments in the city. This approach illustrates a detailed timeline for each task that must be completed to achieve its goal of a significantly "greener" city (Baxter, Powning, & Bolitho, 2010). Although planting additional trees and vegetation throughout the city will potentially provide new habitats for some local wildlife, habitat creation and biodiversity promotion is not the primary goal of the project, merely an added benefit. This initiative does not examine the different flora and fauna species in the city, what resources or habitats they require in order to thrive, or how to protect them. According to the report submitted to the Port Phillip City Council, TreeLogic is the only advising company for this project, illustrating how the plan primarily focuses on expanding the vegetation and connecting the greenspace in the city. The lack of expertise dedicated to native urban fauna resulted in the consideration of biodiversity being neglected.

Neighboring the City of Port Phillip, the City of Glen Eira has also made progress with biodiversity protection plans in the *Environmental Sustainability Strategy* (ESS) put forth by the City Council. The Council has already implemented some high-level preservation operations such as maintaining the Aviary Garden in Caulfield Park and Mallanbool Reserve in Murrumbeena, as well as planting native vegetation around the city. The parks department has planted 1,000 new trees to the 50,000 street trees in 2014 and 2015 and planted indigenous flora

species in the current parks and gardens, ten percent of which originated from the Melbourne Sandbelt. (Glen Eira City Council, 2016).

In conjunction to the broader, city-wide efforts, there are several direct, site-specific plans set forth by the Council. Dr. Graeme Lorimer, PhD developed a wildlife protection report for the Glen Eira City Council to implement as a part of the ESS. Nine biodiversity hotspots were identified within this report, some of which required operational actions from the Council, while others called for advocacy and education efforts (Lorimer, 2016). For example, the Caulfield Park Aviary Garden previously mentioned was found to dissuade "small understorey birds" from entering the garden since it was located no more than six meters from the path. Furthermore, Lorimer found that visitors at the park feed the birds and pollute the lake with food, hurting both the avian and aquatic wildlife. Based on this information, Lorimer suggested adding more signs discouraging people from feeding the birds, as well as redesigning the Aviary Garden. The report also recommends improving other parks through methods such as safely maintaining orchid species in Boyd Park Sanctuary and expanding garden beds, creating habitat for "small insect-eating birds" in Packer Park (Lorimer, 2016). As shown by Dr. Lorimer's work in Glen Eira, a considerable amount of information and planning of biodiversity protection strategies already comes from local experts.

Along with the Cities of Port Phillip and Glen Eira, the City of Stonnington has made significant efforts towards sustainability within its borders. In addition to initiatives focusing on topics such as climate change, water management, and the urban environment, the "council is committed to protecting and enhancing biodiversity throughout [their] city" (Stonnington City Council, 2018). They have already identified seven key biodiversity sites that they actively manage and that are currently undergoing major projects, including the Backyard Biodiversity program which encourages individuals to consider enhancing their own backyards to accommodate for certain biodiversity goals. The largest effort towards the cause is the Yarra River Project, which started in 2010, where "the Council has invested more than $8.4 million" with hopes "to increase habitat connectivity, improve water quality, grow the urban forest and provide recreational and educational opportunities for the community to interact with Melbourne's landmark river" (Stonnington City Council, 2018). This project has focused on reinstating indigenous vegetation, reworking stormwater run-off, removing invasive species, and integrating pathways and seating around the environment for the community. Stonnington has

successfully found plans to enhance biodiversity values within the city and keep the community involved and educated throughout the process (Stonnington City Council, 2018). Awareness and contributions from citizens, scientific experts, and government officials are beneficial and necessary in order to successfully preserve the urban wildlife.

2.4 Citizen Science Initiatives

2.4.1 Monitoring Practices

An abundance of citizen science projects exist in Australia documenting the nation's biodiversity at different regional scales, such as FrogWatch, BirdLife, and Melbourne Water. It has been proven by multiple research papers that volunteer monitoring is particularly useful in understanding the presence and distributions of species on a local scale and over a long time (Simoncelli, Accordi, Pezzi, & Dallai, 2015). Citizen science datasets, compared to standardized monitoring experiments, can reach greater spatial and temporal extents and include a broader range of taxa without compromising the resolution (Theobald et al., 2015). Since urban environments typically have lower species diversity and higher individual abundance compared to rural areas, there are more opportunities for citizen programs in urban regions. Spatial bias becomes negligible if the questions are within the sampling bias because sampling effort is considerably high in urban areas (Callaghan, Lyons, Martin, Major, & Kingsford, 2017). Temporal bias can also be offset by conducting surveys on a regular basis to monitor changes in species diversity and community composition.

Additionally, there are different citizen science methodologies to collecting data and organizations should strive to find the best approach that caters for the specific need and taxa (Prudic, Oliver, Brown, & Long, 2018). Depending on the research question, applying general surveys that can serve any species may not be the best solution. Narrower tasks may help to control data quality while considering the scale and scope of biodiversity surveys. More specific management practices have been summarized in Table 1 below (see Appendix C for details).

Table 1: Summary of Management of Citizen Science Projects (Branchini et al)

	Citizen Science Project Managers	**Professionals/Expert Scientists**	**Amateurs/Volunteers**
Before Data Collection	• Identify the best methodologies for data collection based on the research context • Ensure methods applied are compatible with other data collection programs • Survey the volunteer's knowledge of data collection steps		• Know how the data will be used for the project
During Data Collection	• Establish a bond between the scientists and volunteers	• Fill in the gap of citizen science data by conducting targeted research studies in less-explored areas	• Collect data • Help expert scientists to carry out targeted small-scale research
After Data Collection	• Verify data through setting up data registry constraints and submission requirements • Calibrate data at a regional scale • Make data easily understood and accessible for both volunteers and decision-makers • Work with other citizen science organizations to coordinate projects in hope to identify gaps • Investigate other methods to recruit more people	• Validate data with volunteers through interactive activities to ensure accuracy and consistency • Merge volunteer data with conservation results to produce findings • Analyze changes over time to find opportunities for long-term projects	• Discuss data with expert scientists

It is essential to understand the well recommended methods of mapping and monitoring biodiversity so that we can recommend those that will protect the local wildlife. Thus far, "regional biodiversity network maps show areas of ecological value to be maintained and where incremental habitat loss, fragmentation and degradation should be avoided" (Regional Biodiversity Values Methodology, 2018). These network maps are intended to be used by local governments for town planning and the mapping of matters of local environmental significance, or MLES. Some of the layers that are mapped include large tracts of vegetation, terrestrial and aquatic connectivity, areas of high species and richness, unique ecosystems, and climate adaptation zones. A significant focus of mapping biodiversity is to consider each factor at a landscape scale. As Ian Pulsford, a representative of the NSW Department of Environment, stated, "Our efforts to protect individual threatened species seem to be going backwards. We've got to look at very large landscape scales...so that we don't lose the species that are [still healthy]" (Pickrell, 2011).

The South East Queensland Regional Plan of 2018 includes a methodology for mapping regional biodiversity values. This methodology takes into consideration any matters of state environmental significance and identifies conservation values at a landscape scale. By maintaining the connected network of terrestrial and aquatic ecosystems, sustaining the diversity of species and habitats, displaying the spectrum of ecosystems and unique landscape features, and ensuring that ecosystems, habitat and species are resilient to climate change, this mapping strategy "enables the protection of ecosystem functions, and associated species and genetic diversity" (Regional Biodiversity Values Methodology, 2018).

2.4.2 Citizen Science Limits in Biodiversity Monitoring

There is always a trade-off between mass participation and scientific rigor (Dennis, Morgan, Brereton, Roy, & Fox, 2017). For most programs, anyone can become a participant simply through registering an email or completing an online quiz confirming they read the "helpful tips" listed on the website. Despite this certification, there is great potential for everyday citizens without proper training to cause major disruption to the environment they are observing or for false data to be produced. In a journal article published by Williams, Stafford, & Goodenough in 2015, it was concluded that species sightings can heavily depend on the individual rather than the actual presence of the species. In this study, garden owners were

recruited to participate in online surveys to collect data on the species that frequent their gardens as well as the habitat features their garden supports. The results of the study demonstrate the disadvantages in relying on citizen science for species identification.

However, since habitat analysis requires less professional training compared to species identification, habitat and environmental data collected by citizen scientists could be viewed as more reliable (Williams, Stafford, & Goodenough, 2015). Since residential landscapes are crucial for the preservation of urban biodiversity and conducting fieldwork on private space, such as household gardens, is generally impractical for scientific experts, it is necessary for the communities to undertake initiatives on data collection in private lands (Goddard, Dougill, & Benton, 2013). Although the average participant has less knowledge on the scientific nature of biodiversity than scientific experts, it was found that citizen science sampling biases are consistent with those found in professional science (Theobald et al., 2015). Munson et al. found that the low-structure eBird checklists predict bird species occurrence almost as accurately as highly standardized North American Breeding Bird Survey data (2010).

Guiding citizen scientists through such tasks not only encourages valuable ecological data on distribution and species-habitat associations, but also increases awareness of urban biodiversity and its management. Advertising citizen science programs through websites, social media, and in-person demonstrations at local parks makes conservation strategies available to a substantial percentage of Melbourne's population interested in helping urban ecosystems. Additionally, community groups can improve governmental programs that may lack the scientific knowledge best suited to protect urban biodiversity by contributing local scientific research and expertise to the project.

Although there are government programs working to improve the conservation of Australia's biodiversity, there are many projects in place, both government and community-managed, that rely on everyday citizens to collect research data. Citizen science programs have been widely used in monitoring biodiversity in the past decade. Not only do these programs serve to collect data cost-effectively, but they also foster Earth stewardships. These projects can take various forms, from large-scale reporting of opportunistic sightings of species, to more directed, broad-scale surveys, and narrower focus hypothesis-drive monitoring (Embling, Walters, & Dolman, 2015). These projects provide a mechanism for boosting public awareness in conservation and promoting pro-ecology behaviors.

2.4.3 Ongoing Citizen Science Programs in Melbourne

The City of Melbourne initiated a BioBlitz in 2014 to increase the collection of data on different species around the city and to increase biodiversity awareness. For this project, people are encouraged to take photos of various species of flora and fauna they come across in the city, record its location with other noteworthy descriptions and submit the photos and data to the Participate Melbourne or BowerBird websites (City of Melbourne, 2016). The BioBlitz initiative joins citizens and scientists in a 24-hour search for as many species as possible in a given location. These sites then analyze and use the data to track the different species and help determine the best ways to protect the wildlife. The Royal Melbourne Institute of Technology University (RMIT) and its Centre for Urban Research worked with the City of Melbourne's BioBlitz project alongside additional organizations such as Museum Victoria, the Royal Botanic Gardens, Melbourne Zoo, and Parks Victoria. Participants found many rare species including Powerful Owl in the Fitzroy Gardens, a park located in the heart of Melbourne, on the outskirts of the City of Port Phillip (RMIT University, 2015). The Chair of the City of Melbourne's Environment Committee, Councilor Arron Wood, looks to take this project further, continuing to work closer with RMIT and the vast participating community to develop "the City of Melbourne's first Urban Ecology and Biodiversity strategy". Individual programs have been conducted around the globe from Melbourne to the SeaCoast Science Center in New Hampshire and have been endorsed locally as well as by many high-profile organizations (National Geographic, 2018).

This project is just one of many available to the public that are easy to participate in and there are numerous other projects for more experienced citizen-scientists that require more than a photograph and a smartphone. Many of these can be found on websites such as the Australian Citizen Science Association which is a hub where people search for citizen science projects of varying intensity to join (Australian Citizen Science Association, 2019). For example, the Port Phillip EcoCentre posted an ongoing project for citizens involving surveying intertidal mollusks and included detailed contact information, tasks and equipment necessary for the project (Port Phillip EcoCentre, 2012). Citizen science opportunities such as these are found in the United States as well. Cornell University's Lab of Ornithology runs NestWatch and eBird, citizen science programs that encourages people to photograph and record details of various species of

birds in the area and submit the data to the respective websites (Cornell University, 2019). Projects such as these enable ordinary people to easily contribute to furthering scientific research and improving the biodiversity of the ecosystems around them.

2.5 Background and Involvement of the EcoCentre in Melbourne

The Port Phillip EcoCentre is a non-profit organization dedicated to environmental conservation and education with staff members consisting of experienced environmental scientists, researchers, and teachers. The EcoCentre serves as a hub for citizens and fellow community groups to learn about the environment and its biodiversity as well as help further environmental action in the city. Its education programs reach out to all ages including students and teachers at local schools as well as citizens of Melbourne, often providing people with a hands-on experience supporting native wildlife, fighting climate change, and increasing sustainability.

The EcoCentre has many programs in Port Phillip geared towards protecting and maintaining the biodiversity of the city with the help of passionate citizens. Their most popular project is called Pamper the Penguins where volunteers can get a close-up, hands-on experience helping add "soil, rocks and vegetation" to the penguins' nest, improving and protecting their habitat from external hazards (Port Phillip EcoCentre, 2019-c). Other programs include assisting the EcoCentre in cleaning and monitoring the waterways and aquatic habitats both in and around the city. Participants work on cleaning litter from the beach along the Port Phillip Bay to protect wildlife such as sea birds, seals, and dolphins along with monitoring shellfish population changes, species diversity and water quality. Moreover, the work completed during this program provides the EcoCentre with evidence to present to local governments to advise them on plans to prevent litter from spreading through the city, harming the local wildlife (Port Phillip EcoCentre, 2019-b).

The EcoCentre has a prominent presence in the parks within Melbourne, offering volunteer programs that collaborate with one of the center's partners, Friends of Westgate Park. A significant portion of the volunteer work involves clearing litter in the suburban area and planting native flora to reduce the effects of erosion (Port Phillip EcoCentre, 2019-d). One of the most significant, practical initiatives includes constructing shelters for various urban species. Those in the program construct nest boxes for local birds to provide them with a safe location

that is designed for their welfare (Port Phillip EcoCentre, 2019-a). This project provides accommodations for species that would otherwise be unable to live in the dense metropolitan environment. The EcoCentre's work includes researching which flora and fauna species should be preserved, introduced, or managed along with suggesting habitats that should be maintained or created as to encourage these species[OBJ]. Not only does the EcoCentre staff provide the surrounding community with quality education, but also cooperates with other citizen science groups, neighboring LGAs, and the City of Port Phillip government improve the biodiversity and environmental welfare in Melbourne (Blake, 2018). The organization looks to connect the vast number of isolated parks, reserves, and marinas that reside in the City of Port Phillip that are shown in Figure 4.

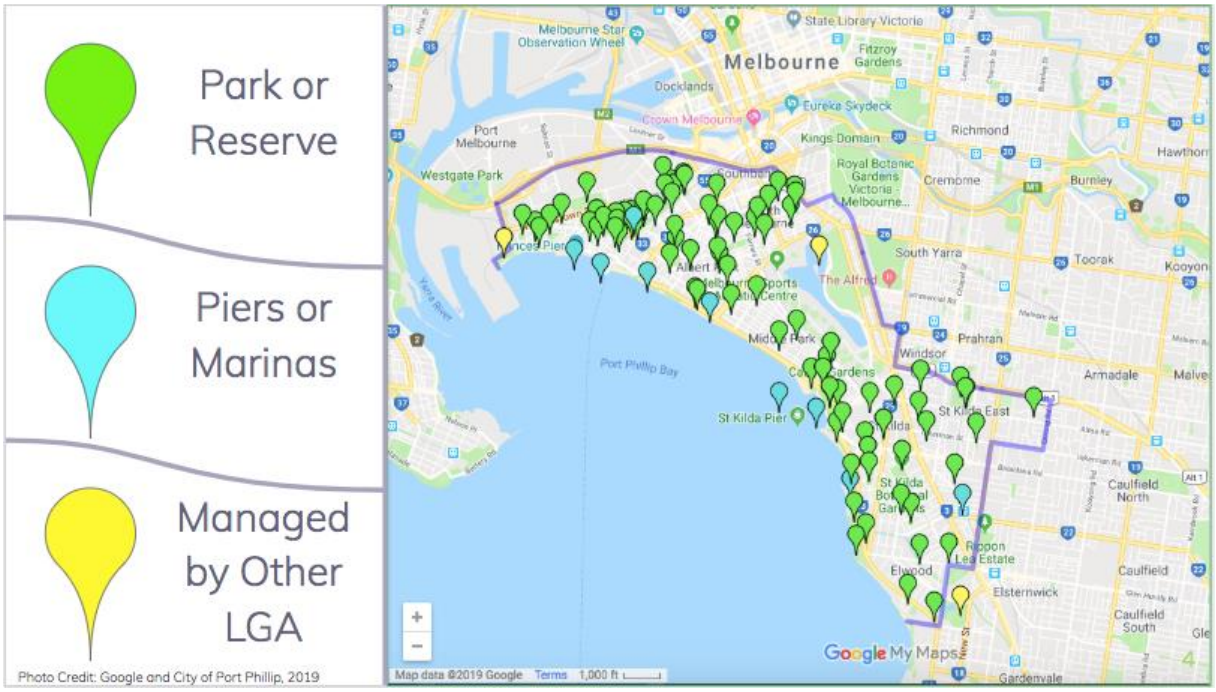

Figure 4: Map of Parks, Reserves, and Marinas in Port Phillip (City of Port Phillip, 2019)

The EcoCentre looks to investigate environmental protection methods, such as constructing biolinks, to connect these locations to better integrate and conserve urban biodiversity. They continue to work with the urban community to raise biodiversity awareness and propose protection strategies to Melbourne's local government.

2.6 Important Greenspaces in Melbourne

Within the city, there are many different greenspaces that are managed by different organizations, exhibit their own unique features, and produce different challenges to the managers and the public. We considered the management of six greenspaces as models for the various types of greenspaces in Greater Melbourne including Elsternwick Park Nature Reserve, Albert Park Golf Course, Malvern Valley Golf Course, Caulfield Park, Westgate Park, and Rippon Lea Estate. Considering the history and background of each greenspace highlights management practices for different habitats and the interactions with the surrounding community.

The EcoCentre is currently advising the Bayside City Council, the LGA adjacent to Port Phillip, on the creation of the Elsternwick Park Nature Reserve, shown in Figure 5.

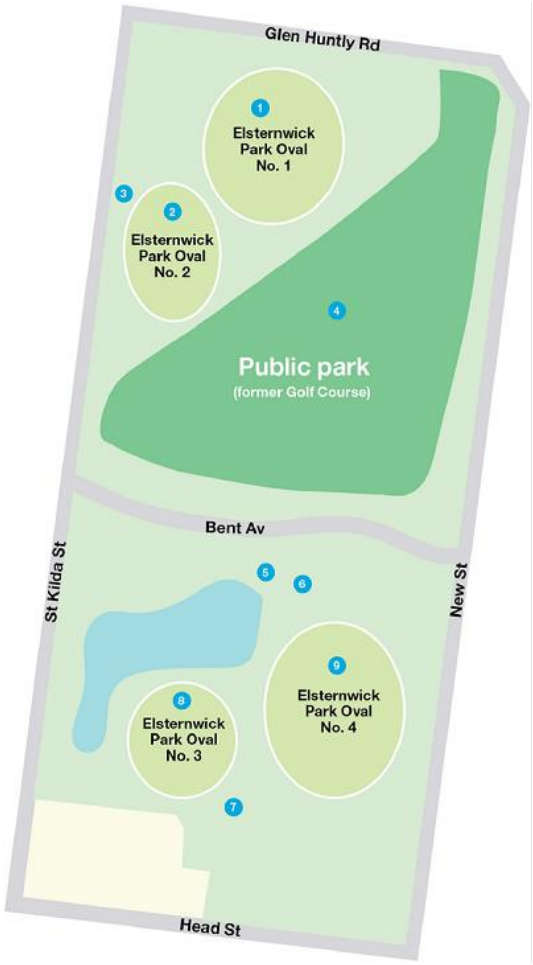

Figure 5: Map of Elsternwick Park (Bayside City Council)

After years of deliberation, the debate surrounding the park's future reached a conclusion in early 2018 after the golf course operators decided to leave the site and the decision of an environmental focused park was confirmed (Bayside City Council, 2018). Port Phillip Council responded to the Bayside City Council's decision with their support for incorporating an urban forest and expanded wetlands into Elsternwick Park North to help reduce flooding. As shown in Figures 6 and 7, the golf course resides in an ideal location to reduce flooding of Elster Creek and Elwood Canal.

Figure 6: Aerial View of Elsternwick Park (Lloyd, 2008)

Figure 7: Aerial View of Elsternwick Park Nature Reserve (Golf Course Circled in Red) (Lloyd, 2008)

The Port Phillip Council recognized this as "an exciting opportunity exists to reduce the frequency and duration of flooding during moderate rainfall events". The Port Phillip Council also hoped to gather evidence of reduced downstream flooding, improved water quality, public

amenity, enhanced biodiversity, and opportunity for water harvesting and distribution (City of Port Phillip Media Unit, 2018). The Bayside Council later decided to consult the EcoCentre on the best ways to manage the new nature reserve. With a new wetland in Elsternwick Park, water will flow and disperse into the park rather than flooding the streets and damaging the neighborhoods around the creek while simultaneously providing wildlife with a natural habitat. For more details on the use of wetlands for stormwater management, the Elsternwick Park Golf Course transformation into a nature reserve, and additional citations, see Appendix D.1.

The Albert Park Golf Course is located within the highly urbanized City of Melbourne and the park and course contain over 5,000 flora species, both native and non-native (*Albert park visitor guide*, 2016). Albert Park Lake controls the stormwater treatment and provides habitat for aquatic species including many water birds. The course is managed by the state department, Parks Victoria, which recently proposed a Master Plan for the future of Albert Park suggesting new wetlands for habitat creation and stormwater management (Parks Victoria, 2019-b). However, the public spoke out against this as it would reduce the golf course size by half. Since the golf course is set to remain as it is, the current management strategies are to be investigated to locate areas that could be enhances to encourage biodiversity. For more details on the Master Plan for Albert Park and the golf course's management, and additional citations, see Appendix D.2

The Malvern Valley Golf Course is located within the City of Stonnington, winds along with Gardiners Creek and has been known for many native species including kookaburras, red-rumped parrots, and cockatoos (City of Stonnington, 2019). In 2006, Graeme S. Lorimer conducted a report for the Boroondara City examining indigenous flora and fauna in the area and it was found that course provides a broad habitat range for native birds due to the close proximity to Gardiners Creek and the other natural environments. This biodiversity hotspot was recently identified by the Sustainable Environment Strategy Stonnington proposed by the City of Stonnington in 2018, calling for revegetation along Gardiners Creek to improve the health of the diverse wildlife (City of Stonnington, 2018). Apart from Lorimer's study in 2006 which briefly touched on the course's biodiversity, there is very limited works on the wildlife of Malvern Valley Golf Course. For additional information on the Malvern Valley Golf Course, see Appendix D.3.

Caulfield Park is located within the Glen Eira municipal and is a family friendly park attracting citizens with its "dog off-leash" option in the center of the park, open greenspaces, a lake, and a large athletic complex that caters to croquet, tennis, soccer and other sports (Glen Eira City Council Recreation Services, 2019). The City Council called for a direct report by Graeme S. Lorimer (PhD) on the biodiversity within Glen Eira in order to focus efforts on maintaining urban wildlife. Lorimer identified Caulfield Park, particularly around its lake (Lorimer, 2018), as a biodiversity hotspot, requiring "operational" work from the local government (Lorimer, 2016). Lorimer observed very few native plant species, natural wetlands hardly form in the park, and a large amount of space without native flora. Another problem is that some birds are attracted to visitor food waste which is a major health risk to the birds. Additionally, the Aviary Garden in the northern sector of the park is very small, is only six meters from the path, and discouraging most understory birds from entering (Lorimer, 2016). Lorimer suggested several solutions to these issues including a new design of the Aviary Garden and he proposed Glen Eira consult other biodiversity advocates on the plans reinforcing the biodiversity in and around the lake area (Lorimer, 2016). For more details about Lorimer's work and the management of Caulfield Park, see Appendix D.4.

Westgate Park is located within the Port Melbourne area and lies underneath the Westgate Bridge, surrounded by suburbs and with the Yarra River on the East side. The volunteer group, Friends of Westgate Park, was founded in 1999 to aid in the maintenance and conservation of Westgate Park and continue to help the current owners, Parks Victoria (Victoria State Government, 2018). Today, Westgate Park is a thriving wetland, featuring diverse species of flora and fauna that form communities despite the proximity to a densely urban area (Parks Victoria, 2019). The pink saltwater lake shown below in Figure 8 is an example of Westgate Park's unique habitats and environment.

Figure 8: Saltwater lake in Westgate Park (Westgate Bridge in Background) (Photo Credit: Ethan Lauer)

These flourishing habitats are "set out in the Park in nine EVCs" and in order to best adapt to the varying landscapes and environment (Friends of Westgate Park, 2019). Studying the success of Westgate Park can help plan for managing the "heat island effect" within Melbourne and provide examples of flora species that can adapt to climate change. Below in Figure 9 is the freshwater lake and wetland in Westgate Park, illustrating the various ecosystems. For more information on the history of Westgate Park and its management, see Appendix D.5.

Figure 9: Westgate Park Freshwater Lake and Wetland (Photo Credit: Ethan Lauer)

The Rippon Lea Estate is a National Heritage suburban estate located in Elsternwick, 7 kilometers from Melbourne's central business district (CBD). The estate owner, Frederick Sargood, was an avid gardener and imported many species of plants to suit his fancy, especially ferns and orchids. The ownership of passed between many people overtime until finally, the estate opened to the public on February 22, 1974 and has been a destination for plant and garden enthusiasts since (National Trust Australia – Victoria, 2019). Rippon Lea has a few native species and is made up of mostly exotic plants. Most urban ecology planning initiatives focus on planting native species to attract local fauna, particularly birds. These methods have struggled to attract rare native species on account of another bird, the noisy miner, which tends to be a nuisance in public parks as they favor the open landscape interspersed with trees. They are extremely territorial and kick out competing species, with a study finding "that as noisy miner population density increased from zero per hectare to 0.6 per hectare, the number of species of small bush birds halved" (Fitzpatrick, 2018). Rippon Lea is unique as it does not feature these typical habitat characteristics due to its more exotic history and maintenance. Therefore, noisy

miners are absent and less common species that aren't found in neighboring native focused parks are present with examples being eastern spinebills, brown thornbills, and silvereyes (Fitzpatrick, 2018). For more information about the history and biodiversity in Rippon Lea Estate, see Appendix D.6.

Chapter 3: Methodology

The goal of this project is to develop educational resources that focus on strategies for biodiversity protection in Melbourne, as well as suggest approaches that will strengthen the current land management schemes by investigating different classes of urban greenspace. To achieve our goal, we will complete the objectives listed below.

1. Identify and engage with key stakeholders and understand their goals of biodiversity management and land use plans in Melbourne
2. Analyze interview results by describing connections that could be established, assembling existing solutions to common challenges, and identifying the appropriate tool to be developed
3. Generate educational resources focusing on urban biodiversity protection and suggest management schemes to enhance biodiversity that can be applied to the urban planning of Melbourne

3.1 Understand the Stakeholders' Goals of Urban Greenspace Planning in Melbourne

3.1.1 Identify Land Managers and Other Key Stakeholders

We started by taking a closer look at the city planning scheme of urban greenspace, such as golf courses and public parks, mapped by the Department of Environment, Land, and Water Planning of the Victoria State Government. Through this research and through correspondence with our sponsor, we were able to identify potential stakeholders that we could interview in order to understand their perspectives and priorities. We considered stakeholders to be individuals that had high interests in conservation and urban greenspaces, as well as those who had a strong influence in the communities in Melbourne. These included government officials, members of the local community, those involved in the private sector, and select residents in the area. Shown in Table 2, we categorized stakeholders to be interviewed to gain insight on the various aspects each person specializes in.

Table 2: Stakeholders of various greenspaces in Melbourne

Local Government Representatives	Private Sector	Community Groups	Local Experts and Enthusiasts
Barry Kennedy (Port Phillip and Westernport Catchment Management Authority)	Mark Adams (Local Native Flora)	Liz Barraclough (BERG) and Tamara Keyte (Staff of Naturelinks from Mount Martha)	Amy Hahs (Urban Ecology Professor at RMIT)
Paul Gibbs and Amy Weir (Open Space Coordinator and Open Space Planning and Policy Officer from Bayside)	Richard Francis (CEO of Abzeco from Eltham)	Paul Caine (Glen Eira Environment Group Inc.)	Peter Parrington (Bird Specialist)
Chloe Horner (Environmental Education Officer from Stonnington)		Matt Chester (Rippon Lea Site Coordinator from Elsternwick)	Tamasin Ramsay (Residential Gardener from Port Phillip)
Phillip Wierzbowski (Victorian State Government - Coastcare Victoria)		George Fotheringham (President of Friends of Westgate Park from Port Melbourne)	Gill Upton (Residential Gardener from Port Phillip)
Anonymous Representative (from City of Melbourne)		Chris Long (Australian Plant Society)	Rob Youl (previous consultant of Landcare Australia)
City of Glen Eira Representative (unsuccessful)		Michael Norris (Convenor of Friends of Bay Road Heathland Sanctuary from Bayside)	
City of Port Phillip Representative (unsuccessful)		Marilyn Olliff (Hobsons Bay Wetlands Centre)	
		Trevor Phillips (Friends of Gardiner's Creek)	
		Rob Scott (Director of Naturelinks)	
		Elizabeth Walsh (President of Friends of Native Wildlife from Bayside)	

3.1.2 Engage with Stakeholders Regarding Urban Greenspace

We gained insight from stakeholders and sought information regarding the various benefits that come with urban greenspace as well as challenges in its implementation. When applicable, we also inquired as to whether the establishment and management of urban greenspace had successfully fulfilled the desired outcomes. We did this through semi-structured

conversational interviews. The interviews were conducted as a team or in pairs, using a structured conversation technique, in the hopes that the stakeholder would feel more comfortable and would elaborate on topics they felt passionate about. This allowed us to more fully understand their thoughts on urban greenspace. We learned additional benefits and drawbacks that were not previously expected. For all the interviews we conducted, we asked the stakeholders for their verbal permission to take written notes and record the conversations with our smartphones, as well as permission to use their name and association in our findings. When working in pairs, one team member recorded notes while the other took lead asking questions. When working as a team of four, two or three people took notes while the other two asked the interviewee questions. Since we conducted conversational interviews and wanted to facilitate a friendly, relaxed atmosphere, the entire team engaged with the interview, adding to topics and the conversation where appropriate. We followed the same method for each category of stakeholders. The only step of our process that varied was the some of the we asked the stakeholders based on their background in the biodiversity field which are described in the subsections below.

3.1.2.1 Government Representative Questions

We interviewed six representatives of LGAs regarding current sustainability and wildlife protection initiatives. We focused questions on current projects of the city as well as challenges they may face in implementing various urban strategies. Although we hoped to complete interviews with officials from Glen Eira and Port Phillip, we only received responses from representatives in the cities of Melbourne, Bayside and Stonnington. The following are some key questions and topics we covered with all the government officials to understand their thoughts on topics relating to urban biodiversity.

1. General Key Questions for Government Officials
    a. Tell us about your vision for biodiversity.
    b. Describe some of the key protection initiatives that have been implemented in your district.
    c. What are some key strengths the city has when supporting biodiversity?

d. What are the key factors required to effectively create change that is politically acceptable, sustainable – and ultimately successful?
e. Are there any common techniques or things to consider that you can identify when addressing problems/barriers surrounding biodiversity protection and management?
f. What are some challenges that you face when strongly advocating for your vision?
g. Has there been any thought put into establishing biolinks or habitat corridors within the city?

Additionally, we generated questions specific to each local government to better understand the work conducted on greenspaces within their borders. The following are some of the questions we presented to the city officials to spark conversation about those greenspaces in their municipality.

1. City of Melbourne
    a. Can you describe the successes and challenges of the Nature in the City Strategy that was created in 2017 (part of Future Melbourne 2026 Plan)?
2. City of Bayside
    a. Tell us about the history of Elsternwick Park and the transformation into a reserve.
    b. Can you describe how the flooding of Elster Creek and Elwood Canal affected your land and management practices?
3. City of Stonnington
    a. Tell us about the history of Malvern Valley Golf Course and its management.
    b. What are some methods you use to care for the different parts of the golf course?

The key summaries of the government representative interviews can be found in Section 4.1 while the full summaries can be found in Appendix G.1.

3.1.2.2 Private Sector Questions

We interviewed three individuals who owned private businesses in the field of land management, habitat conservation, and habitat restoration. These interviews allowed us to determine how the private sector interacts with Friends groups and government entities in the field. Some specific questions asked to these groups are below.

1. Private Sector Questions
    a. Has your group successfully collaborated with government agencies and other citizen science and community groups? If so, which ones?
    b. Who typically hires your organization and what range of desires do you see from these people?
    c. Has your group conducted any work in educating the community, groups, or local governments about biodiversity?
    d. Which biodiversity issues are your major focus?
    e. What are some practices you have taken to achieve your goals in these projects?
    f. What are some of the related projects that you have completed in the past and the learning outcomes associated with those? What worked well and what could be improved upon?
    g. Tell us about your planting strategies and focus when revegetating an area.

The key summaries of the private sector interviews can be found in Section 4.2 while the full summaries can be found in Appendix G.2.

3.1.2.3 Community Group Questions

We talked to ten local naturalists within community organizations and Friends groups (volunteer organizations). They provided us with information concerning the best practices that could be beneficial for the urban wildlife and other challenges in achieving their goals for biodiversity. The following are some key topics the group discussed with representatives from citizen science groups. Additional questions can be found in Appendix F.

1. Community Group Questions

a. Tell us about your vision for biodiversity at this site.
b. Which biodiversity issues are your major focus?
c. What are some practices you have taken to achieve these goals?
d. What are the key factors required to effectively create change that is socially acceptable, sustainable – and ultimately successful?
e. Are there other groups that you collaborate with or attempt to work with?
f. What are your planting methods and are there any tips or tricks that you use that other groups may not know about?
g. Looking ahead, do you think these types of plans can be implemented at other, similar types of land? (Could this be used as a basis/blueprint for other pieces of land, or is it too specific to the area?)
h. What are some challenges you face when strongly advocating for your vision?
i. Do you use standardizing monitoring practices, and if so, which ones?
j. What types of programs and resources do you develop to educate the community and get them involved?

The key summaries of the community group interviews can be found in Section 4.3 while the full summaries can be found in Appendix G.3.

3.1.2.4 Residential Gardener Questions

We also conducted interviews with two residential gardeners. These interviews tended to be the least structured and were conducted in the gardeners' home or garden. Some general topics that were covered are listed below.

1. Residential Gardener Topics
    a. What species do you plant and for what purposes?
    b. Where do you obtain your seeds/cuttings?
    c. Are you a member of any gardening organizations?
    d. How did you get started and what resources did you use when you began gardening?

e. What types of resources or connections would be beneficial to you and your work?
f. Do you have any thoughts on the current education system in regard to environmental sustainability lessons?

The key summaries of the residential gardener interviews can be found in Section 4.4 while the full summaries can be found in Appendix G.4.

3.2 Analyze Stakeholder Data and Connect Recurring Themes

In order to synthesize the information gathered through the interviews, we took several steps to both identify key points from each conversation and connect information between stakeholders. At the end of each interview, we listened to the recorded conversation as a group and the key themes and takeaways were discussed and tabulated. Efforts were made to use the same terminology was used across all the summaries so connections could be easily identified later in the analysis. With the main points of each conversation recorded and organized, the information was summarized in paragraph form. The shortened summaries can be found in Results (Chapter 4) and the full summaries can be found in Appendix G.

We then began by linking the themes mentioned in individual interviews across the spectrum of stakeholders and determining which were the most common discussion points amongst them. Information from the different sides of stakeholder relationships, such as government body and volunteer group interactions, were used to identify detailed links indicating the benefits and disadvantages of the existing relations. Using the main themes and links between them, a diagram was produced (see Chapter 5).

3.3 Suggest Educational Resources and Management Schemes for Future Urban Planning

With the information gathered previously and the common themes identified, we began to develop strategies that would help reduce the major challenges stakeholders face. There were many aspects we considered when generating a biodiversity management scheme and educational resources, the first of which was the type of resources that would best suit our group

of stakeholders. We looked at resources that stakeholders mentioned they wished they had access to in the past, or those that would be helpful currently, and into the future. As a main part of our target audience consists of the stakeholders we communicated with, we made sure to consider their input when deciding upon which kind of resource we wanted to generate. There has been a significant amount of biodiversity work in Melbourne and many successful tools already exist, so we considered these current methods and tools as a model to developing a potential deliverable.

Another important factor we considered was the demographic of our target audience and their thoughts on resources that already exist. By having in-person conversations with the stakeholders, we were able to gauge their attitudes towards various topics, methods, and schemes and used this as part of our decision-making process. Furthermore, we made sure to consider the resilience of our resource so that it is not only useful in the present but can also be used and modified in the future. Finally, we developed a tool that could be easily accessible, distributed, and understood by the users. This was then presented to the Port Phillip EcoCentre for future implementation across the city to engage volunteer groups, local governments, and passionate citizens.

Chapter 4: Results

After interviewing stakeholders, we developed full summaries of each conversation, found in Appendix G. The major takeaways from each conversation are detailed below.

4.1 Government Representatives

4.1.1 Barry Kennedy – Port Phillip and Westernport Catchment Management Authority

Barry Kennedy works as the regional landcare coordinator for the Port Phillip Westernport Catchment Management Authority (PPWCMA) and started in this position 6 months ago. The opinions expressed below are his own and do not reflect the views of the organization. Barry complements the work done by the vast array of volunteer organizations in the Port Phillip and Westernport catchment. He works closely with thirteen paid, part-time, volunteer facilitators to organize events such as forums, meetings, and training sessions for the 86 landcare groups in the area.

These events address skill shortages in the groups by bringing in knowledge from environmental experts. Topics range from planting methods to grant writing and are determined by a survey of interest. Two recent events focused on building and reviving group dynamics and coastal awareness. The latter was done by working with local Aboriginal groups, which is an emerging effort in the field and, although in its early stages, Barry sees a lot of potential for some great outcomes. To advertise for these events, the PPWCMA contacts groups early and uses a variety of methods, including group emails, newsletters, surveys, social media, and day-to-day interactions (see Appendix G.1.1 for example). The PPWCMA leaves most of the land management decision making to the group members and only works to provide them with access to information, funding, and communication resources that will help them achieve their justifiable goals.

Barry has seen several common problems in struggling groups, as well as some common themes in successful ones. He recognizes that several groups are struggling because of interpersonal dynamics, regardless of how many resources they have. On the other hand, successful groups have long-term, impactful plans, and diligently work towards the set goals. These groups tend to be the ones who attend workshops and get help, although they may not be

the ones who need it the most. The PPWCMA does some work in habitat connectivity, with one successful project being Yarra for Life. Here, the PPWCMA officers facilitate habitat connections through conversations and workshops so that all groups can work together towards the common goal of protecting the space and species.

4.1.2 Paul Gibbs and Amy Weir – City of Bayside

Paul Gibbs, the Bayside Open Space Coordinator, and Amy Weir, the Open Space Planning and Policy Officer, were interviewed together, and they both worked closely in creating the Bayside Biodiversity Action Plan. Their primary focus is managing various greenspaces in the city and their most successful practice is using controlled burns of fenced off heathland areas to encourage natural and native flora regeneration. Amy and Paul believe that outside of the volunteering community, the public needs to be educated on native flora and fauna in the city to increase awareness of the importance of urban biodiversity. There are about seventeen Friends groups in Bayside which help with educating volunteers, and the city itself has made efforts to promote biodiversity through multiple different channels, including hosting garden days at the Bayside Community Plant Nursery. Biodiversity education programs are present in the school system but are often dependent on personal relationships between teachers, Friends group representatives, or even government officials for them to be incorporated into the strict curriculum.

Figure 10: City of Bayside Logo (Bayside City Council, 2019)

Paul and Amy explained some difficulties they faced when developing an optimal plan for Elsternwick Park by gathering feedback from the community, local interest groups, and experts. As government representatives, they had to consider all opinions of the community, including those who oppose the nature reserve plan, such as sports organizations and the off-leash dog-walking community. Despite opposition, the proposal was approved and is underway. This golf course, along with others they manage, exhibits a high biodiversity value and acts as a seed source for many indigenous nurseries. The difficulty of creating new biolinks or reserves comes from the high cost of land, but there is the potential for creating links through peoples'

backyards, thus there is currently work being done to make indigenous nurseries more accessible to the public. There have not yet been efforts to make these connections between LGAs and there appears to be limited communication and sharing of biodiversity and land management practices.

The City of Bayside acknowledges the importance of citizen science, however, their main challenge is the inaccessibility of collected data. Discrepancies in monitoring standards and data organization restricts the city from utilizing and applying this information to their work. Therefore, Paul and Amy are looking to increase the involvement of the younger generation in environmental protection programs and the sharing of information (potentially online) between community groups, LGAs, and any other involved group. One effective method is conducting workshops with representatives from each group, providing participants with hands-on experiences in the environment.

4.1.3 Chloe Horner – City of Stonnington

Chloe Horner is the Environmental Education Officer of the City of Stonnington and she provided information about the local government's role in biodiversity education. The biggest challenge the city faces is lack of funding and staffing to achieve their goals. Most of the city's revegetation work focuses on native plants but does not cater to a specific species or plan for flood mitigation. Instead, they are simply planting species that will withstand the floods along the banks of Scotchmans and Gardiners Creeks. There are social challenges including safety concerns around high density bushes and the potential crimes that could occur near that area.

The City of Stonnington works alongside the local volunteer group, Friends of Gardiners Creek, but has not investigated using citizen science as a resource to assist in biodiversity initiatives. However, there is interest in utilizing citizen science, as the government would not have to place resources into efforts that could be managed by volunteers. The Stonnington Council hardly interacts with neighboring LGA councils despite being part of the Eastern Alliance of Greenhouse Action, a group all eastern councils are part of. A major tool that Chloe hopes is used to conduct yearly reports is the Biodiversity Monitoring in Melbourne's East tool which has not been implemented yet.

An environmental protection and biodiversity workshop, including a well-developed PowerPoint, was conducted for the City of Stonnington staff for which there was much positive feedback. It was beneficial to have these presentations for the gardeners themselves; this way,

the gardeners gain interest on their own, rather than letting the government explicitly tell them what to do. Chloe stated that online resources, videos, and workshops with impactful PowerPoints would be most beneficial in educating the public and increasing biodiversity awareness as they can quickly and easily inform large groups of people. Videos in particular can capture the problem visually and can be manipulated in creative ways to strongly convey an important message. Having in-person conversations and interactive workshops as well engages people in a topic, spreads awareness, and sparks interest in environmental protection.

4.1.4 Phillip Wierzbowski – Coastcare Victoria

Phillip Wierzbowski has been working as the Regional Facilitator for Coastcare Victoria, a group that works as a conduit between the government and community groups, for 30 years. Through their facilitation, almost all interactions are smooth with the only challenges arising from instances where the government owns land managed by other groups. Ultimately, this stems from a lack of communication and he suggests, the government delegate the land ownership to management committees. He will be organizing a forum soon, to facilitate these conversations. Another challenge is the government not giving proper recognition to community members. The government values volunteer work and will give certificates or public honors, but this isn't what volunteers want. Phillip says he is typically busy with the 150 groups he is responsible for and cannot give any of them proper attention. With more facilitators, all interactions could be managed and all the valuable volunteer contributions could be recorded to show the true benefit of their programs.

Figure 11: Coastcare Logo (State Government of Victoria, 2019)

Phillip has seen some on-the-ground problems with trampling of habitat, but this can be remedied with signage and fencing as done in Westgate Park. Phillip has also seen very successful projects that when looking for money, prepare for a grant before it is announced and emphasize the volunteers' work. Focusing on ecosystem services in applications can help as

many politicians understand the monetary value of these situations. Successful groups also modify their applications depending on monetary provider and align their goals with the benefactor to maximize the chances of receiving funds. Phillip runs grant writing information sessions to help these groups do exactly that. When possible, these groups advocate to larger corporations that are located close to their land (an example with Toyota can be found in Appendix G.1.4) in order to receive more money. The on-ground work is conducted safely and in a fun, engaging manner so volunteers are safe and return. Coastcare has a five-year plan that focuses on stakeholder engagement and has an inclusive approach to groups like the EcoCentre, Parks Victoria and the Aboriginal community. These groups are all helping draft the plan, so it is stable and robust. Coastcare desires a platform where they can measure their work's potential benefits, to convey to their successes and benefits to the public, showcase the volunteer group work, and find ways to reward volunteers.

4.1.5 Anonymous Representative – City of Melbourne

One of the main challenges in implementing the Nature in the City Strategy is planning around the pre-existing architecture and landscapes in the Central Business District as there is an abundance of human-induced structures, buildings, and a lack of green space. These factors, along with heritage values in parks and gardens limit government bodies from creating new open greenspaces. Most of the community supports urban wildlife with conflicts mainly surrounding possums and flying foxes eating people's fruits and nesting on roofs. Activists express their opposition to the removal of dead or decaying tree limbs as it removes habitat however, the City's priority is the resident's safety.

Some challenges within the Nature in the City Strategy include planting differences between trees that reduce the "heat island effect" and those that provide habitat for native wildlife, but this could be improved by generating ideas that could work towards both goals. The City of Melbourne conducted citizen science programs such as the Bioblitz and Hollowblitz with the former being more successful in reaching a broad audience range and the latter using more regulated conditions, with a process that could be easily replicated in the future. Westgate Biodiversity and Friends of Royal Park have been working with the City of Melbourne on flora maintenance and pollinator observation projects as well.

Some biodiversity education for the younger generation comes from park rangers who hold school programs in parks and while citizen science initiatives such as the BioBlitz have raised biodiversity awareness for the general population, participants of these programs already tend to be a small portion of the population. Broader education initiatives could be generated to increase participation in wildlife conservation.

4.2 Private Sector

4.2.1 Mark Adams – Local Native Flora

Mark Adams began Local Native Flora in the 1980s and the private business is contracted mainly by Parks Victoria but occasionally by different groups such as the government, community organizations, and private individuals. They are contracted to develop or restore native landscapes, ranging from 1-150 hectares. The group plants multiple strata of vegetation and acquires seeds from between 15-100 individuals, hoping to increase the population's genetic diversity.

Despite these planting methods, the group has limited freedom as they are generally handed a list of plants they must plant to complete the job. Also, as they are a private business, they must stick to the budget and cannot deviate from the plan. Although he is involved in the planting business, Mark does not think planting is the best option for preserving greenspace. He believes that planting on new land is less preferable to restoring and maintaining existing sections of intact habitat giving an example that Parks Victoria has contracted his group to plant around a car park and it is costing them about $40,000. Meanwhile, last year they spent about the same amount of money restoring and maintaining about 50-100 acres of land

Despite these issues, Mark acknowledges we have learned a lot the past couple decades about chemicals and their effects, as well as managing land with fire. He admits he has used methods in the past that he later learned were detrimental to the environment. His group is working to improve land practices by creating a mobile phone application different groups can use for land management.

4.2.2 Richard Francis – ABZECO

Richard Francis is the CEO of Applied Botany Zoology Ecological Consulting (ABZECO) and came to the bush management and restoration industry through a family history involved in the outdoors. He has a university degree in zoology and has worked on many projects including from seed collection and propagation, pest and weed control, treating waste water from a local chocolate factory to irrigate a golf course, natural area restoration, and flora and fauna surveys. His current company, ABZECO, works on projects from mountain ranges near Russia to the middle of Mebourne's CBD.

One successful project he has worked on is in the Banyule shire which aims to increase habitat connectivity in an urban landscape using sugar gliders as an indicator species. The sugar glider was chosen as an indicator because of its cuteness and the fact that it doesn't eat people's roses. In addition, the habitat the glider relies on is only present when an ecosystem is large, functioning properly, and hosts several other species. The maps shown in Figures 13 and 14 below illustrate the identified connections for sugar gliders. The legend is shown in Figure 12 for clarity. Having been involved in a few other biolink projects, he doesn't think their implementation along tram lines is the best, as railways will expand into that habitat.

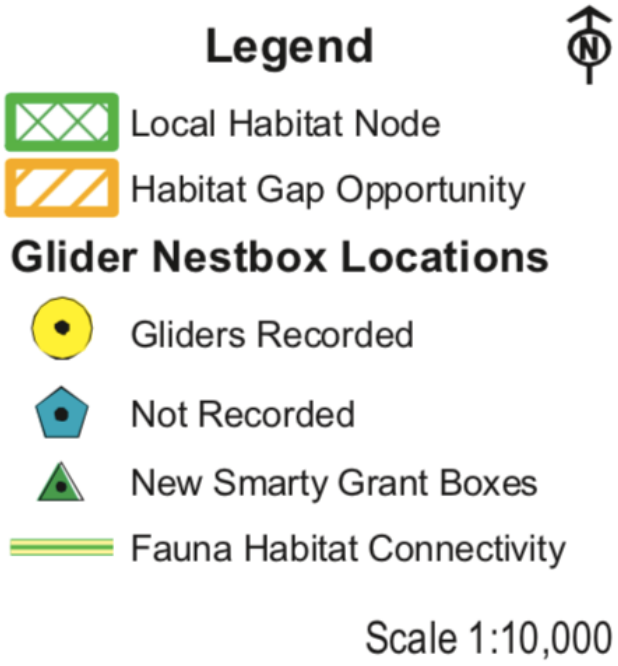

Figure 12: Legend for ABZECO Biolink Maps

Figure 13: Sugar Glider Nest Box Locations (Created by ABZECO and Provided by Richard Francis)

Figure 14: Sugar Glider Biolink Map (Created by ABZECO and Provided by Richard Francis)

Richard has conducted work on a stormwater retention project, where he saw pushback from a group advocating for a footy oval on the same land, but he was able to convince them that it was not the best location. When creating a natural greenspace, Richard stresses the importance of providing opportunities for community recreation as well as providing reasonably limited nature interaction. This simultaneously allows humans to interact with the park while giving wildlife a place for refuge. Richard suggests case studies and short, visual or video presentations are most helpful resources because anybody can apply a case study to their situation (i.e. retired schoolteacher who wants to start a Friends group).

4.2.3 Rob Scott – Naturelinks

Rob Scott is the co-owner of Naturelinks, a private company contracted by several different investors to produce natural landscapes in the state of Victoria. Rob was recently appointed as the new chairman of a local chapter of the Australian Association of Bush Regenerators (AABR), in Victoria. Naturelinks has three goals: promote community involvement, facilitate environmental interests of employees, and involve organizations. Their main clients often are governmental organizations such as Melbourne Water, Parks Victoria, and Local Government Authorities. Naturelinks has the autonomy to develop their own monitoring strategies and can work both on consulting and implementation. However, it is common for governments to split work between groups for different stages of the job. This disjointed process can create obstacles if the project needs to be changed along the way. Rob sees monitoring practices as another place of improvement as a job is often initialized too quickly and completed before there is consideration of the expected outcomes. A good model of where monitoring strategies are implemented correctly can be found in the conservation action plan used by the Bush Heritage Trust (see Appendix G.2.3).

Some common features of successful projects Rob has seen are proper site conditions, preparation, species selection, and site maintenance. In terms of species selection, genetic diversity has not been considered by Naturelinks due to the difficulty of genetic analysis; they often buy their seeds from the local nursery. However, other groups have sourced from multiple nurseries successfully. There has been success in creating biolinks and managing habitat along the St. Kilda tram line in the Light Rail Reserve and there is room for expansion in places such as the Sandringham Railway Corridor. Rob also sees communication as a challenge in the field

and the AABR is seeking to overcome this. The group's meetings have the potential to facilitate face-to-face meetings for those involved in bush regeneration to share helpful advice and other tips. Rob thinks an analysis of those involved in the industry would be helpful and allow information to flow faster.

4.3 Community Groups

"You can't pick and choose your biodiversity...you try to save as much as you can"
Paul Caine

4.3.1 Liz Barraclough – BERG & Tamara Keyte – Naturelinks

Liz Barraclough is the Field Officer for the Balcombe Estuary and Reserves Group (BERG) and Tamara Keyte is an active member of Naturelinks. These organizations are dedicated to the revegetation and management of natural areas around Mt Martha and the Greater Melbourne area. Although Mt Martha is more suburban than the inner city, many of the management practices remain applicable to densely populated regions. Their focus is on land management, including revegetation with indigenous plants, assessing the health of natural areas, and protecting indigenous flora and fauna. Additionally, they have constructed a boardwalk through a reserve (shown in Figure 15) to reduce the damage humans cause to vegetation and vouched against the destruction of vegetative areas that would be replaced with buildings or parking lots.

The groups around Mt. Martha are extremely organized and successful in their cooperative efforts. Rather than just focusing on planting, the group considers the community, funding acquisition, flora and fauna, short-term and long-term impacts on the land, and aboriginal connections to their work. BERG attempted to use controlled burns to help with revegetation, but must consider many factors including scientific and societal safety aspects. They collaborate well with other groups and have received many grants for their work. There are

a sufficient number of volunteers at BERG, most of whom are of the older generation looking for a social activity. The group is looking to attract younger volunteers potentially through corporate volunteering programs, something that has increased in recent years. They keep in mind that people often return to volunteering if they have an enjoyable experience, and try to make programs as engaging as possible.

Figure 15: Photo of the BERG Mt. Martha Boardwalk (Kirsner, 2018)

While there has been some work with local school children, the group is also hoping for new opportunities in school education and looking to have revegetation workshops for kids. The group uses social media and monthly email newsletters to connect with other Friends groups and the public. Over the past few years, social media has been essential for public outreach because people are more likely to attend an event if technology automatically reminds them of it, compared to a single email or poster advertisement.

4.3.2 Paul Caine – Glen Eira Environmental Group Inc.

Paul Caine is one of the founding members of the Glen Eira Environmental Group Inc., which formed in 1988 and has been helping with revegetation of public greenspaces and on nature strips dispersed throughout the city. While they did do some work in the Mallanbool Reserve and Parker Park, most of the parks in Glen Eira are sports fields, limiting the space they can work in. The group uses seeds from three indigenous nurseries from different LGAs

(Bayside, Port Phillip, and Oakleigh), so the gene pool is robust and there are "more chances of adapting to a certain situation". Golf courses are low traffic areas with lots of indigenous vegetation and biodiversity. This is something the course owners and nurseries are aware of and use to their advantage, with Bayside Community Nursery purchasing its seeds from local golf courses. The Garagne Reserve bushland in the urban area is large enough for trees to fall without endangering people and requires minimal management. The Glen Eira Environmental Group does not actively monitor species apart from working with the occasional individual who informally records species on slips of papers.

The Sky Rail, a rail line with several raised sections all leading to the CBD of the city, was created during 2018 by the Victorian State Government and provides a significant amount of open space underneath it, featuring indigenous river red gum trees as part of a wildlife corridor, which could be enhanced further. There are also structural corridors such as the "Skyway," a series of ropes enabling animals like possums to travel between trees over pathways and roads. This is a new idea that has not been implemented in many other locations. With a biodiversity policy established for only eight months, often the Council selected the incorrect species of plants that do not help native wildlife. Details such as the difference between native and indigenous species are often lost on the conservative councilors. The City Council could do more to consult Friends groups, attend conservation workshops, and publicly encourage biodiversity conservation by setting the example through other work in the city. The Council must also consider public safety since the increased density of bushes and vegetation along paths are a safety concern for residents.

Overall, Paul Caine explained some of the difficult challenges faced in improving the biodiversity in Glen Eira. The government's attitude towards the environment is a major factor and there is the conflict of "enterprise against ecology". There is the challenge of presenting to people that the environmental protection is important, beneficial to the community, and worth the investment. The society's perspective on the environment and "fashions" or "trends" are major factors in people's decisions. People like the balance in greenspaces including playground, open space for sports, water features, and vegetation for passive recreation such as the layout of Talbot Park. Additionally, larger areas are more centralized and easier to manage due to the low cost and with reduced natural dangers to citizens. Finally, Paul noted human transportation lanes are good locations for biolinks.

4.3.3 Matt Chester – Rippon Lee Estate

Rippon Lea Estate is an astounding piece of land in Elsternwick that was bought by Frederick Sargood in the 1800's and currently sits at nearly 14 acres. The property features a plethora of exotic trees, shrubbery, flowers, and grasses as well as a water feature (shown in Figure 16) that serves as the water source for the gardens. It is not a government managed greenspace therefore, it only receives a small amount of funding from Parks Victoria, forcing the managers to acquire their funding through either donations or membership fees. This allows them to make their own decisions regarding land management. They are primarily a historical organization, tracing their roots back to an extensive set of archives dating to the original owner Frederick Sargood; if any plant bed needs to be replaced or new species planted, the managers will the plant species identified in old photos.

They have a tree replacement program where, if a tree is nearly deceased, they will plant a tree of the same species or have one ready to plant once the older one dies. Using this process resulted in the landscape remaining largely unchanged in 150 years and still features most, if not all, the species that were present when Sargood originally planted it. The park is home to almost all exotic flora species in addition to its few indigenous ones. A reason this park is significant to the city's biodiversity is because while it maintains exotic plant life, several rare native bird species reside in the park, rather than in the more natural surrounding parks.

Figure 16: Rippon Lea Estate (Photo Credit: Joshua Driscoll)

Matt cited the absence of noisy miners to be the main cause of the presence of these native birds. Noisy miners tend to be hyper aggressive to competing species in the area and are attracted by several habitat characteristics that are absent at Rippon Lea, most notably wide-open greenspaces. Another reason might be because access to the park is restricted after dusk, so the birds are left undisturbed. Additionally, there are few possums in the area due to the parks' resident foxes, which increased the bird population.

4.3.4 George Fotheringham – Friends of Westgate Park

George Fotheringham is the president of the Friends of Westgate Park (Figure 18), also known as the Westgate Biodiversity Bili Nursery & Landcare. He is a retired landscape contractor currently working voluntarily at the Westgate Park. George explained that before the Friends group started any work on site, the park had extremely low biodiversity. Through years of development, Friends of Westgate Park grew to a size much larger than the average Friends group and successfully established itself as a corporation. The Friends group recruited local naturalist experts to understand which flora species they should select to optimize the habitat for local fauna. George attributed the outcome to the trial and error, from which they have learned valuable lessons about the planting and monitoring practices. Now they have a general strategy

of planting, starting from spraying natural herbicides, mulching, and finally planting. George estimated the average survival rate of all new vegetation to be around 75%.

They dedicated most of their efforts to making the park bird-friendly (see Figure 17 for local bird life). Their efforts have proven successful and there are many more bird species sighted at the park now. Particular bird classes, such as cockatoos and parrots, helped the Friends group understand whether the trees have reached maturity. The group has been careful with their planting strategies to ensure that invasive species, such as the Noisy Miner, is not encouraged. On the other hand, the park is mostly surrounded by roads and highways, so there is a lack of biolinks and are not many mammals or reptiles found at Westgate Park.

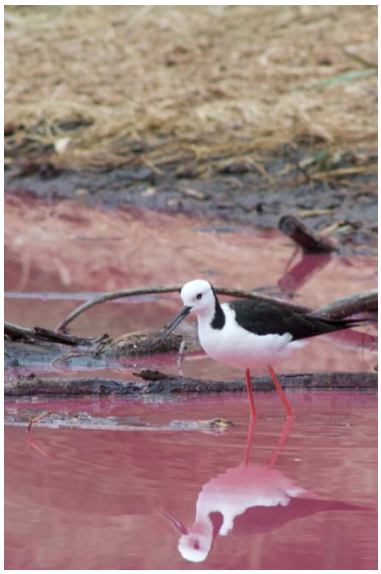

Figure 17: Black Winged Stilt at Westgate Park (Photo Credit: Joshua Driscoll)

Friends of Westgate Park primarily relies on the funding from corporate volunteers, governmental grants, and Parks Victoria to a small degree. George acknowledged corporate volunteers have been a massive contribution to their projects bringing in revenue and offering valuable human resource to help with the planting process.

Additionally, Friends of Westgate has partnered with other organizations for long-term monitoring projects on site. For instance, students and faculties from universities come to conduct pollinator studies every month. Museum Victoria cooperates with the Friends group sometimes to hold Bioblitz events and the WaterWatch group checks the water quality monthly.

Figure 18: Diagram of Westgate Park (Bili Landcare, 2019)

4.3.5 Chris Long – Australian Plant Society

Chris Long is the President of the Australian Plant Society (APS), an organization formed 61 years ago by local nature enthusiasts that have worked to preserve existing natural areas. The society has subsections within each state, scattered across Melbourne and Victoria and there are study groups focusing their efforts on particular plant families. The organization meets monthly where the group discusses specific agenda items, certain plants, and growing methods. Chris explained that having the meetings be a social activity is important when trying to maintain interest and keep volunteers involved.

Apart from their meetings, the APS encourages the planting of native flora species in private gardens and public spaces, lobbies councils to preserve existing natural areas, and donates money to organizations working in nature. The group's members are usually older volunteers and retirees and the group has difficulties recruiting the younger generation to become involved in the same capacity. They publish a quarterly magazine called *Growing Australian*

"Biodiversity…is what's going to save the planet"
- Chris Long

which provides concise details about growing indigenous plant species. Their website provides a significant amount of information including plants available for purchase and the group aims to raise awareness for Australian plants as they are often seen as "ugly scrub" since they do not exhibit large, luscious, colorful flowers.

The APS has worked with the government on large scale revegetation and weed removal projects. However, this relationship varies as they are also involved in activism and lobbying when councils are not following environmental policies. While being an advocate for Australian plants, Chris understands that in the end, the garden is there solely for the pleasure of the gardener and thinks that any diversity, even if not native, is important to any ecosystem.

4.3.6 Michael Norris – Friends of Native Wildlife and Former Bayside Councilor

Michael Norris is a co-founder of the Friends of Native Wildlife, a former City Councilor in the City of Bayside, and a lead author of a book on local birds. He has helped the Ricketts Point Marine Sanctuary get approved, organizes a group monitoring the Bay Road Heathland Sanctuary, and his primary goal is to minimize the loss of biodiversity, and restore and enhance it within the City of Bayside. Michael has helped with revegetation, identified key species, and focused on improving habitat through reducing weed invasion and other methods. Larger projects were not pursued because buying lots of habitat land costs a lot of money.

Several biodiversity hotspots were identified including the Royal Melbourne Golf Course, the Long Hollow Reserve, and other bushland and coastal strips. Michael's work did not involve monitoring specific species and he has not seen anyone using a standard for flora or fauna surveys. Creating biolinks through peoples' backyards would be most beneficial however the budget for any related initiatives "drifted away." The urban population is mainly aware of birds that don't require obvious, physical links, but not of animals like frogs, skinks and blue-tongued lizards require water flows or similar habitat connections. Emphasizing these species will have a greater impact on the biolink movement.

Michael completed work educating kids on microbats and other animals. The Friends group has also hosted play group events for kids and other workshops for the general public,

focusing on invertebrates, birds, and insects. The goal of these events, and what Michael thinks is the best form of public education, is to get participants excited about the environment through first hand experiences. Since past state education programs in biodiversity for primary school kids have disappeared, hands-on experiences and some competition is a great way to engage with the public.

The overall population is less interested in biodiversity than in the past due to a general lack of knowledge, lack of nature encounters, and lifestyle choices. Having a specific goal or cause can spark peoples' interest and gain necessary support for environmental campaigns. Since Michael left the Council in 2012, there hasn't been an "environmentally oriented" councilor to provide their input in budgeting decisions. This can lead to other departments receiving money for projects such as road maintenance. While the Council tries to promote indigenous gardening, nurseries cannot produce enough vegetation for the entire city. The Friends of Native Wildlife has worked with other Friends groups with the Elsternwick Park campaign which had some pushback from sports groups and those who wanted to walk their dog off leash. The best way to promote biodiversity is either be elected into a position of power or demonstrate to the Council the benefits of investing in environmental projects through first hand experiences like arranged walks, where an expert can show what the problems are and how to fix them.

4.3.7 Marilyn Olliff – Hobsons Bay Wetlands Centre

Marilyn Olliff is the Chair of Hobsons Bay Wetlands Centre, a working Friends group proposed in 2016 that became an incorporated group in August 2018 with the support of the Hobson Council. Their primary goal is educating the public about the natural environment. The group's main activities are educational workshops for the public including teaching participants how to observe nature ("look, don't touch") as well as workshops focused on specific species. On-site, enjoyable, hands-on experiences in nature capture the interest of many and is the first step towards gaining community support. For some monitoring programs, the Hobsons Bay Wetlands Centre works with Melbourne Water who sets the standards and provides a database to store the information. The variety of programs allows the group to attract different types of people with varying interests. The group has spoken to year seven teachers and education providers about excursions to the foreshore as part of the local school curriculum however these efforts are still in progress.

The Hobsons Bay Wetlands Centre's work requires a lot of financial support, so the group is developing a report to convince the government and public their organization is a worthwhile investment. Their marketing strategy includes social media posts and connecting to the Hobson Council website. There is a considerable amount of community support and interest and the Council has been generating a protection plan for the Graham Reserve. The Hobsons Bay Wetlands Centre surveyed 28 organizations in the area (including grocery lines, environmental groups, and other community associations) and 22 groups wrote letters in reply, expressing their support and interest in protecting the reserve and enhancing it for environmental education.

The major challenge the group is facing is acquiring facilities large enough to act as a base of operations since there is competition for space from sports groups. There is a lack of external funding because finances for reserves are small in comparison to those of sporting facilities who often have larger budgets. The best way to educate the public and the competition is to explain how environmental protection complements the work of other organizations through in-person conversations and workshops. The Hobsons Bay Wetland Centre would like to connect with Friends organizations where they can share environmental knowledge and outreach techniques.

4.3.8 Trevor Phillips – Friends of Gardiners Creek

Trevor Phillips is the president of the Friends of Gardiners Creek and has been involved in revegetation, organizing volunteers, and communicating with the local government and other local groups for years. The group relies on volunteers for the planting and maintenance Glenburn Bend Park in Glen Iris and they will often host a barbecue on planting days to transform work into a social event, bringing more volunteers and creating a fun, personal experience for those involved. They partner with other local organizations and businesses to create similar events. The group occasionally gets maintenance and planting help from school groups when possible. They rely on online resources for advertising including the Stonnington e-newsletter and the National Tree Day website, as it is the easiest way to reach many people.

When deciding on species to plant, they use a list of indigenous vegetation provided by Boroondara and they buy plants and seeds from multiple sources to ensure genetic diversity. While they plant some flora species for birds, they personally like to see in the park such as cockatoos, they do not manage the park for fauna and do not conduct bird surveys to track

species. However, they do experiment with new planting methods and different flora. The most effective weed prevention technique, as shown in Figure 19 below, that they have tried involves four steps: weed the area, put cardboard over it (providing a physical barrier and inhibiting weeds from getting sunlight to prevent weeds from growing), mulch on top of the cardboard as substrate for new plants, and plant about eighteen months afterwards when the cardboard has degraded.

Figure 19: Infographic on Weed Prevention (Tanner Gauthier)

The Friends group faces the issue of annual flooding of Gardiners Creek which destroys vegetation and ruins planting efforts along the creek. Money is a challenge as they are largely self-funded and, as a registered charity, mainly receive corporate and individual donations. The group avoids applying for grants because they prefer to work at their own pace and under their own guidelines where they are not constrained by deadlines.

Throughout their efforts, the group works and shares information with three other organizations: the Stonnington Council, Boroondara, and Melbourne Water. They often take land from Melbourne Water when they want to expand along the creek and they have never had an issue with getting approval from Stonnington Council for new plant beds in the park, showing their strong relationships with these groups. The Stonnington Council is very progressive and has made impressive leaps towards considering biodiversity on their own, including planting in other parks in the city and dedicating $3 million to biodiversity after already spending around $8 million on the Yarra River Biodiversity Project that started in 2010.

4.3.9 Elizabeth Walsh – Friends of Native Wildlife

Elizabeth Walsh is one of the founding members of the Friends of Native Wildlife in the City of Bayside, acting as President and Vice President over the past 23 years. She believes biolinks are the most important feature to further enhance urban biodiversity, but it is difficult in well-established urban settings because councils and the community are less willing to change the area because of high costs and the changes to the "norm". Biodiversity protection is a low priority of the City Council because the population density has increased and there are only small areas that allow for new indigenous vegetation.

The Friends of Native Wildlife have conducted frog and bat surveys "every month on the second Wednesday of each month" for the past ten years however, the data is not concisely organized. The group conducts outreach programs to engage the community and gather volunteers including indoor talks and nature walks held during the day and night to showcase different habitats and species. Although the variety of projects reaches many different people with varying interests, Elizabeth feels they have "failed" to get the younger generation to regularly support and volunteer at the organization. Although Elizabeth had a few school contacts who would include native wildlife workshops into their strict curriculum, these teachers or contacts have become lost as people move and leave school districts.

The Bayside Community Plant Nursery sells the Friends group's nest boxes and has helpful garden maintenance information, but this can be difficult for some to understand. Most do not ask for guidance because people don't want to be told what to do with their personal garden. The Friends of Native Wildlife low staffing makes it difficult to maintain their web presence and, while the Council's website has information, it isn't always correct, and most visitors of this webpage are looking for information unrelated to biodiversity. As a result, the "majority of the population have no idea we are around, they don't understand there are Friends groups." The Friends of Native Wildlife communicates with other Friends groups however these channels often rely on individual relationships to facilitate these connections. While it is possible to have another communication network for these groups, there are limited staff members who can be responsible for that work. Elizabeth comments that part of the success at Westgate Park is that it is centralized at one location while her group works in a municipality with dispersed green spaces in a greater urban area, proving difficult to focus work on one section. Overall, raising awareness is the biggest challenge they face and is the first step in increased urban biodiversity.

"A majority of the population have no idea we are around, they don't understand there are Friends groups"
- Elizabeth Walsh

4.4 Local Experts and Enthusiasts

"I am not a botanist... I am just a person who cares about the environment"
- Tamasin Ramsay

4.4.1 Amy Hahs – Urban Ecology Professor at RMIT

Amy Hahs has played many roles in the field of urban planning and ecology for a long period of time, conducting research on urbanization and its effect on ecosystems, serving as a professor and advisor of graduate students, and starting a consulting company two years ago.

Throughout her research, Amy worked mainly in and around Greater Melbourne, analyzing different pressures urbanization has on ecosystems such as various landscapes, design styles, and the city's global location, all while aiming to reduce the negative impact urbanization has on the environment.

In her consulting company, Amy worked with several community groups, such as the Port Phillip EcoCentre, as well as state and local governments. This work includes investigating tree canopies, fire movement through the city, multi-story habitat planning, and habitat connectivity, all of which have influenced several city plans. Overall, she perceives the Victorian government is open to integrating city planning and urban biodiversity with a particular interest in connecting people with nature. However, sometimes a city will not commit to a proposed plan, causing it to fade away. Conversations on volunteer, community and government levels are crucial in order to achieve full participation by the entire district; an example is the Urban Forest Strategy in the City of Melbourne.

Environmental protection advocates often must assign quantitative value to a resource or demonstrate the ecosystem services that will be provided by a site's conservation because the government must ensure their expensive work is worth the investment. Additionally, public perception of safety is a multifaceted problem that must be taken into consideration, with safety issues including the fear of falling tree limbs, criminals hiding behind bushes, dangerous snakes, and fire. Some of these conflicts can be remedied with careful land planning by experts, considering the present situation and how it may affect the future of the environment. One issue that may arise surrounds standing water in an urban area because as the global temperature rises, diseases in the southern hemisphere move south causing some mosquito borne illnesses to enter the city. There are methods of managing this problem, but currently Amy is unsure which is the best solution.

Citizen science is a great way of getting people involved in environmental conservation efforts, using available phone applications such as eBird and iNaturalist. Citizen science works and other educational resources can be improved by connecting it with larger, potentially global databases. A couple methods Amy uses in order to garner public attention is communicating with the local community, having multiple platforms people can share with each other, and different follow up methods. She found having online information is useful because it is easier for people to follow up on the project, can be easily shared with people, and the recipients can effortlessly

share it further. Choosing the optimal times and conditions for certain events that are aimed to attract both the public and the media and considering the target audience helps increase the awareness further.

Having conducted biolink research on a broad scale, Amy says it is better to propose a biolink where the habitat already has some strong connections or in other existing connections such as along tram lines. By identifying a focal point, other parks can mirror their work and coordinate planting efforts to connect habitats. It is important to remember a multilayered habitat attracts many different species and some species may not appear until later than anticipated.

4.4.2 Tamasin Ramsay – Residential Gardener

Tamasin Ramsay is a resident of Port Phillip and has a significant background in environmental policies having worked for an NGO in the UN, was involved in climate change negotiations, and currently works in the Parliament House as a research and policy advisor. She volunteered at the EcoCentre several times and provided the team with insight into the management of a residential garden. Her primary resource for creating the garden was the *Indigenous Plants of the Sandbelt* as it provided all the information that she needed about plant selection, maintenance requirements, and how to easily structure the garden to enhance the area's biodiversity. She said "I am not a botanist… I am just a person who cares about the environment", making this book perfect for her work. She uses plants from indigenous garden centers and is using some "experimentation to create different areas to establish a bit of an ecosystem" such as including a more natural wetland. Bird boxes are not found in her garden with the idea that if the area is naturally built well, wildlife will be attracted to the garden. Additionally, she does not do much for controlling "pest species" but instead welcomes them.

Tamasin has not worked closely with other gardeners or community groups besides the EcoCentre but she previously tried to implement some environmental change in the community, the most prominent being a push for a community compost bin. Though there was much support for this, there was a small, strong voiced portion that opposed it and the government did not follow up with her request. Tamasin said that the government needs to conduct more work on all levels, both in and out of the city, saying "we talk about nature like it's something *out there* but, we are nature". She also stressed the importance of outdoor recreation and "nature play" for all

ages as it exposes them to nature and shows them the importance of the environment first hand. When asked about resources that could help residential gardeners, Tamasin was very adamant about printed materials such as the *Indigenous Plants of the Sandbelt* book and giving people access to these materials. She was also very interested in being connected with and learning from other gardeners who share similar interests because one-on-one demonstrations are very engaging and contain a lot of information.

> *"We talk about nature like it's something out there but, we are nature"*
> **- Tamasin Ramsay**

4.4.3 Gill Upton – Residential Gardener

Gill Upton is a resident of Port Phillip, a teacher of local history, and volunteers frequently at the EcoCentre, having worked with Neil Blake in revegetating the foreshore and other properties. She planted an entirely indigenous garden and has a large community garden outside of her property which she hopes to promote and start in other areas. The garden is not overly maintained because she wants it to develop naturally. Apart from a mainstream landscape design course, she does not have much experience in land management but rather gathered the information from the *Indigenous Plants of the Sandbelt* by Neil Blake, Rob Scott, and others. She considers light exposure, soil conditions, orientation, and aesthetic when planting and is looking to add different water features to attract various bird species. There are some tricks she uses occasionally such as giving them diluted seaweed, mulching in the summer and ensuring she plants at the right time of year. Gill emphasized the importance of increasing planting along railways and wetlands as these are key locations for linking habitats. Part of Gill's garden is shown below in Figure 20.

Figure 20: Gill Upton's Residential Garden (Photo Credit: Ethan Lauer)

She does not share her practices with others besides in-person interactions such as the interview we conducted or with members at the EcoCentre, illustrating the lack of communication between community groups, Friends groups and the public. While environmentally friendly movements often are expensive and could damage the economy, it is still necessary to make changes given the environment's current situation even though government bodies may disagree. The younger generation has risen over the past few years to strongly speak about issues in the world and will make big change in government policies and society.

Environmental education in schools should be increased including hands-on projects with an emphasis on how nature affects their daily lives. Having an experienced gardener to talk to would be helpful for a new residential gardener in addition to written materials with visuals that indicate what the garden may look like. On-site demonstrations would also beneficial for people to see locations in real life and how they can mimic or protect those places.

4.4.4 Rob Youl – Retired Forester and Previous Consultant of LandCare Australia & Peter Parrington – Dedicated Bird Specialist

Rob Youl, a retired forester who works with the community and with land use policies and reclamation, has teamed up with Peter Parrington, a dedicated bird specialist and enthusiast, to determine and establish wildlife corridors across the City of Port Phillip. They have identified and mapped a dozen patches of green space across Port Phillip, along with the potential biolinks between them, largely consisting of tree-lined streets and have also communicated with local experts who conduct studies in different regions of the city. They are trying to analyze how to revegetate areas to provide habitat for the native birds of the region and hopefully bring some of them back, keeping in mind to think globally, but act locally.

The progressive and future-focused Council has supported Rob and Peter's proposal thus far, and the project has gained a significant following, with around 80 people keeping up to date via an email alias. Their plan involves planting a series of scattered bushes in corridors that smaller birds can jump between and use as shelters, as well as revegetating the wider streets that negate police and public concern with denser planting and allow for enough space to establish strong corridors linking green spaces.

Along with the Council support, they understand that community support is just as, if not more, important. There has been rising public support to protect the environment in recent years, and the community usually gets what they want from the Council representing them. The environment is a priority for people now, and "often their ideas will be ahead of your own." It is essential to inform the community through social media, pamphlets, and other resources that give them as much of a say as possible.

"Ideally the dreams come from the community itself"
- Rob Youl

One of the greatest challenges that exists is that "anything in the urban environment has to be aesthetic" (Youl). The city is full of straight lines and symmetry, but the natural bush is random, asymmetrical, and not always aesthetically pleasing to the eye. Finding a balance is key to creating successful habitats that will bring in native species and gain appeal from the public.

When identifying biolinks, Rob and Peter focus on using local knowledge and enthusiasm. Along with this, they are aware that this doesn't stop at the edges of Port Phillip.

They plan to contact neighboring LGAs to expand the links outward, providing more corridors for fauna to travel between. To determine biolinks, they had a meeting at the Port Phillip EcoCentre and put up all the maps connecting the area that display any existing green spaces. One of the maps they created is shown in Figure 21 and 22 below, with the blue highlighting the water features, the green illustrating the lakes, and the orange representing the proposed links.

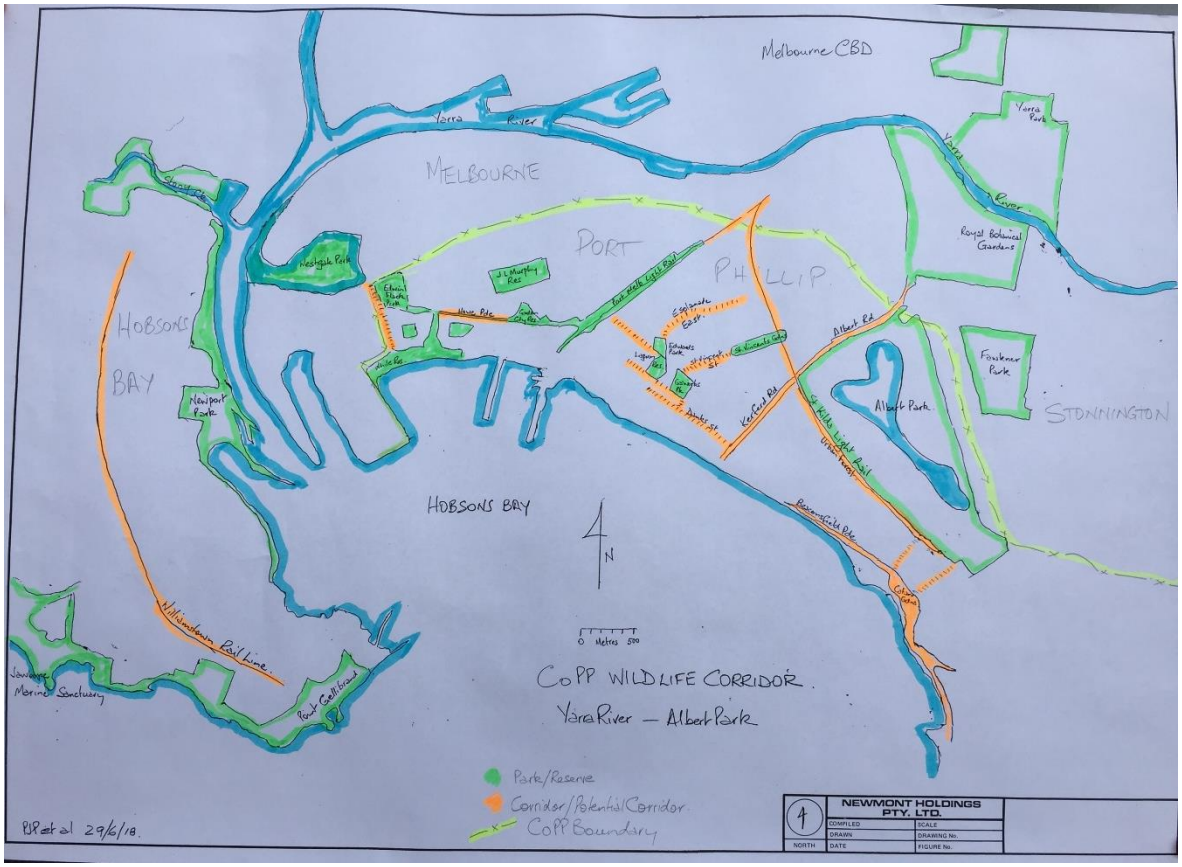

Figure 21: Wildlife Corridor (Biolink Map) Created by Rob Youl and Peter Parrington

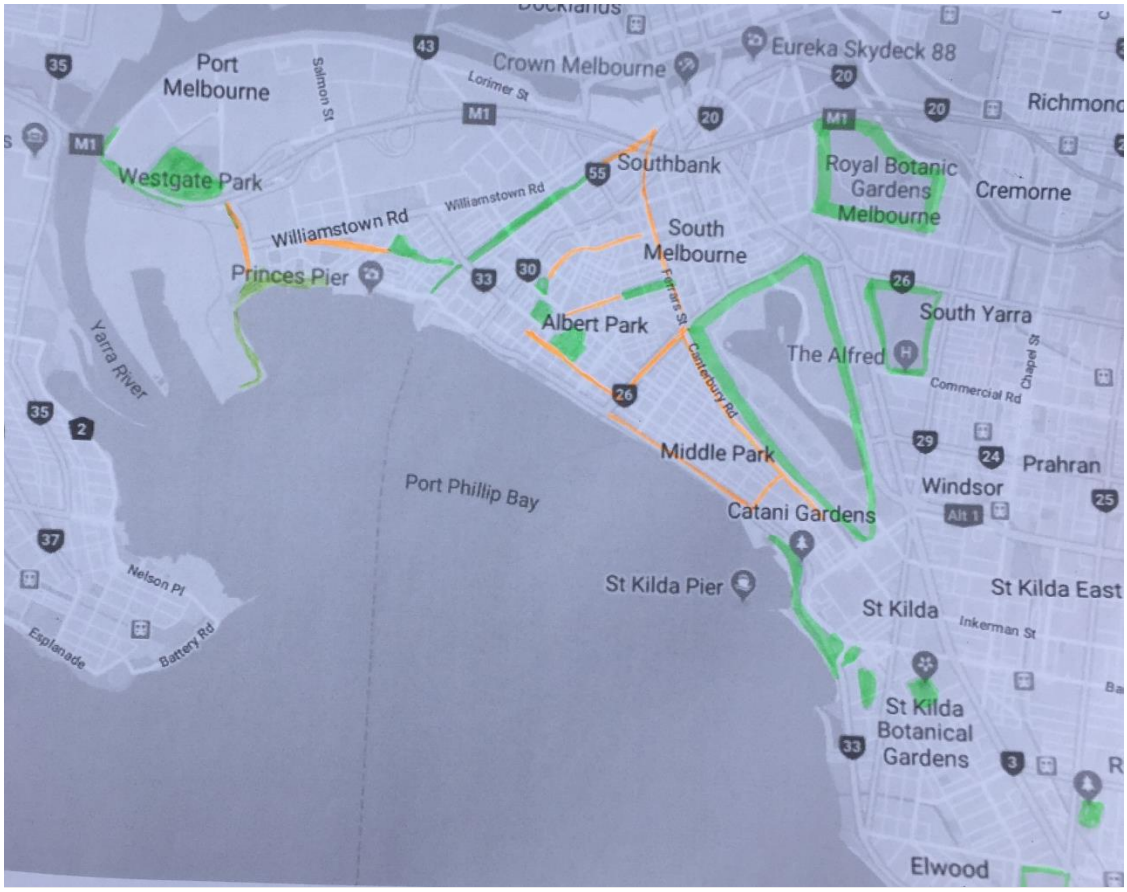

Figure 22: Biolink Map Overlaying a Street Map Created by Rob Youl and Peter Parrington

With this, people could see potential corridors between patches, including streets with medium strips and foreshore along the coast. Even though "people want a bloody view" (Youl) at the beach, there are ways to compromise with patches of low bush that still provide habitat to local fauna and don't block any views. However, the project thus far is a bit of theory and practice. It is all theoretical, with the hopes of implementation coming soon.

We discussed the interview results listed above with the purpose of identifying major commonalities between the different stakeholders. Further analysis on these results was conducted and is shown in Chapter 5 below, and this helped us determine the types of resources that would prove most beneficial to protecting, managing, and enhancing biodiversity in the Greater Melbourne area.

Chapter 5: Discussion

Using the interview results listed in Section 4, we were able to analyze the content and determine the major themes found across the various stakeholders. Shown below in Table 3 are some of the common challenges that stakeholders face. The "Successful Methods" column includes several beneficial practices that some stakeholders have used in their work in urban biodiversity that may be helpful to other groups as well.

Table 3: Major challenges and current successful methods derived from interview responses

Challenges	Successful Methods

• Lack of awareness/communication
  ○ Government to community group
  ○ Community to community group
  ○ Between community groups
  ○ Between governments
• Lack of staff/volunteers
• Lack of funding
• Opposing groups
  ○ Sports groups
  ○ Dog-walking community
• Public concern
  ○ Visibility/Public Safety
  ○ Natural hazards (ex. falling trees)
  ○ Fire
• Lack of monitoring standards
  ○ No common database or format
	• In person demonstrations
	• Multiple forms of advertisement (ex. posters, social media, workshops)
	• Incorporating a social aspect into volunteer work
	• Connections with experts
	• Visual information
	• Careful land planning
	• Encouraging the public

Next, we drew connections in an attempt to determine the most important challenges that the various stakeholders faced. Figure 23, shown below, indicates where the key challenges overlap with the categories of stakeholders and which challenges affect groups the most. The multicolored circles at the top represent the different topics and challenges that impact stakeholders. The blue circles represent the different types stakeholders we interviewed. The arrows connect the challenges to the each of the stakeholders that face said difficulties.

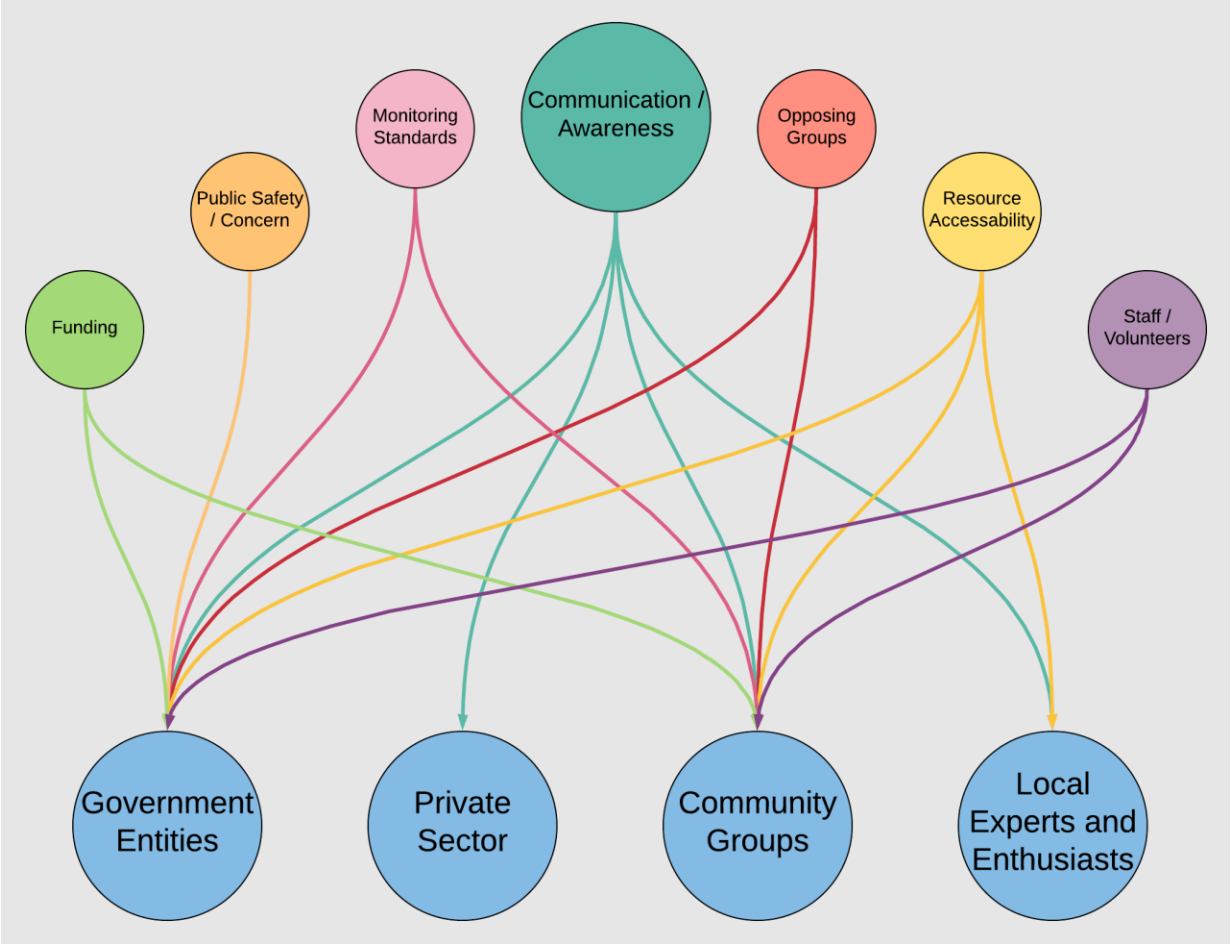

Figure 23: Major Challenges and the Affiliated Stakeholders (Ethan Lauer)

As shown above, stakeholders encounter some of the same challenges, with communication being the most common. After determining which challenges correspond with the stakeholders, we also analyzed how these challenges interact with one another.

We generated the web shown in Figure 24 below. We considered each challenge individually and compared it to each of other topics in the circle, determining if the subject influenced the other topic or if they mutually affected each other. A double-headed, green arrow was drawn between topics that have a mutual effect on one another and a single-headed, blue arrow was drawn pointing to the topic that the origin effects. For example, communication and staff have a mutual effect on one another, so a green double-headed arrow was drawn between the two. On the other hand, funding has an effect on resource accessibility, but not vice-versa, so a single headed blue arrow was drawn from funding to resource accessibility. This was repeated for all topics in the circle.

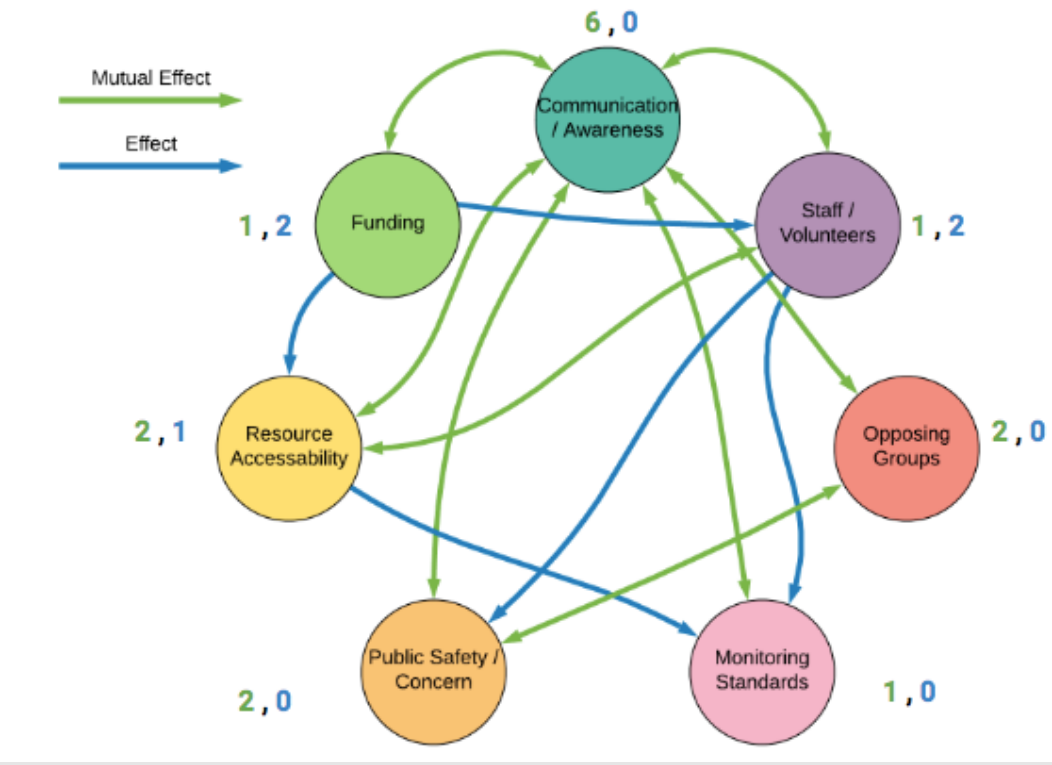

Figure 24: Major Challenges and their Affiliations with one another

Once we drew the connections between these topics, we counted how many of the different connections each of the topics are part of and displayed the results next to the respective circles in the corresponding text color. As shown above, communication has the highest number of connections and has the most influence over all challenges.

5.1 Communication

5.1.1 Public Participation

From our research, we found groups are looking to improve their communication with the public and in an effort to educate them on biodiversity principles. While some groups have received a lot of support from the community, such as the Hobsons Bay Wetland Centre, there are others, such as the Friends of Native Wildlife, that are unknown to the public. Elizabeth Walsh said the “majority of the population have no idea [they] are around; they don’t understand there are Friends groups.” Liz Barraclough mentioned how most of the volunteers are older and usually retired. The younger generation also cares for the environment, but younger adults generally have busier schedules with professional and familial commitments. Because of this,

community groups have found it difficult to attract that demographic. Apart from the Port Phillip EcoCentre, most groups have found it challenging to maintain strong connections with schools and incorporate their workshops with the curriculum, often relying on individual teachers to be interested in the topic. We determined that a way to integrate biodiversity learning into school curriculums is to engage and educate school faculty and teachers about the importance of biodiversity. This way, they are more likely to focus on the topic and incorporate on-site workshops into their schedule. Having students design their own brochures or posters about biodiversity can encourage them to research the topics they are interested in and gain more insight into its importance (see Figure 25), as one of our interviewee, Gill suggested.

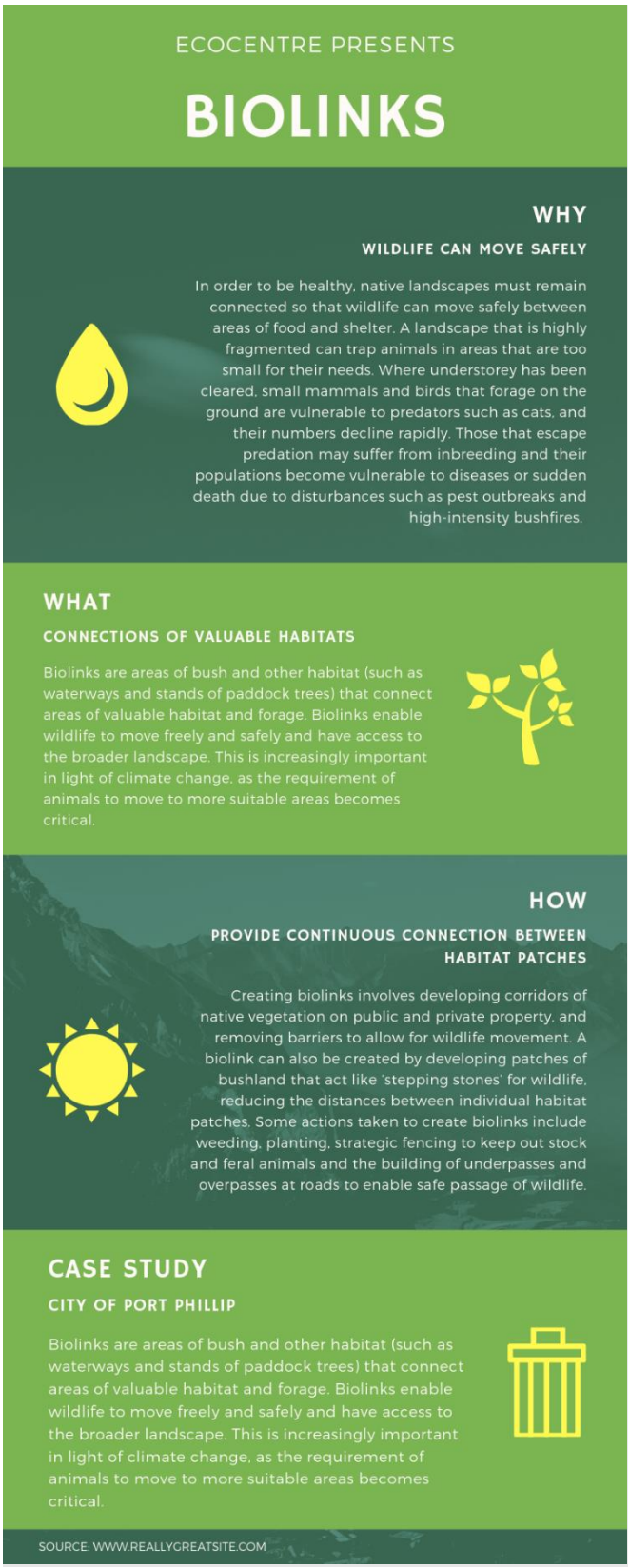

Figure 25: Infographic on Biolinks (Yihan Lin)

There have, however, been successful programs organized by community groups that attract the public and the media. Examples include the sugar glider program (see 4.2.2), various corporate volunteering events, and the Bioblitz and HollowBlitz events (see 4.1.5). Getting the public's attention is not easy; with busy schedules and the myriad of communication strategies, it is hard to choose one format that best captures the attention of the people.

Given today's technologically oriented society, a significant amount of outreach and advertisement of these programs can be done over social media. Tamara Keyte explained that having technology automatically remind people of events results in people being more likely to attend. On the other hand, Amy Hahs has successfully advertised events by asking local cafés to put up posters and sell plant seeds to promote the event. Given the diversity of volunteers involved in environmental action, we have concluded that using multiple platforms for advertising will reach members across different social strata and will be more likely to attract a larger number of people with a broad range of interests.

Getting people to come by isn't the end of the battle, as retaining volunteers is just as important. The most effective method of continuing the publics' interest in environmental activism is having in-person conversations and providing people with hands-on workshops. This gives people an enjoyable experience in the environment, catches their attention, is memorable, and makes them see the environment from a more "real", tangible perspective, rather than learning from a textbook. As stated by Sir David Attenborough, renowned naturalist and narrator of BBC and Netflix documentaries, "few people will protect the natural world if they don't first love and understand it". It is imperative that volunteers enjoy and appreciate their time working. Many groups who have found ways to encourage this, including making volunteer days social events with a lunch or dinner and having the volunteers do more time consuming, tedious jobs in the morning before finishing off with a more enjoyable task in the afternoon. The latter method is used in corporate volunteering events organized by the BERG group and has gained a lot of positive feedback. It was also brought up in the interview that the social side of these volunteering events is a great incentive for people who are not as knowledge in the benefit of biodiversity. People sometimes show up to these events just to meet up with new people after relocation.

5.1.2 Inter-Community Group Communication

After considering all the information gathered from our interviews, we determined that the biggest challenge is insufficient communication between all stakeholders and a lack of biodiversity awareness. We found that few community groups share information with one another, whether it be management and planting strategies, monitoring practices and databases, or campaigning resources.

Some groups use specialized methods and "tricks" to help them with revegetation and management practices. For example, Trevor Phillips from Friends of Gardiners Creek was told by a neighboring community group about a weeding process using cardboard and mulch (see 4.3.8 for details) which was extremely effective for their revegetation work. These lesser-known details can help groups save time, money, and manpower, increasing the effectiveness and efficiency of their work in promoting biodiversity. Occasionally community groups are unaware that similar organizations in the area are conducting work because they have a very small team of volunteers. For example, the Glen Eira Environmental Group has very few members and they do not actively monitor urban wildlife, but with further conversation with organizations like the Friends of Westgate Park, the group will be able to survey species and gather data that can support their environmental movements.

Apart from the Port Phillip EcoCentre with the Elsternwick Park project, we found that most community groups do not collaborate on greenspace projects, but rather contain their work to within the borders of their respective LGA. The Bayside Environmental Friends Network, a social hub for connecting Friends groups within the City of Bayside, contributed heavily to the biodiversity changes within Bayside and was one of the few group networks we found in our research. Additionally, the Bayside Community Nursery is one of the most popular indigenous nurseries in the area, used by several groups based in and around the city for purchasing seeds. This strong presence and connection between the city's Friends groups had a strong influence on the Elsternwick Park campaign, and it showcases the benefits of community group communication both within LGAs and between them. Increasing the communication within the volunteer community will allow groups to apply other's profound knowledge to their work, improve the scientific support for their environmental campaigns, increase the size of the organization, and improve their outreach programs to gather more interest.

We also found that most community groups are run by those of the older generation, therefore any communication between many of the groups commonly occurs through word of mouth or email aliases. Since these methods have limited capability and flexibility, the team considered alternative communication methods that would best suit the current group administrators until the younger generation becomes more integrated with the environmental protection community and can utilize other technological channels.

5.1.3 Community Group to Government Communication

As local governments develop biodiversity strategies and plans, we have found that very few departments have consulted local experts on the topic. Although the EcoCentre is being consulted by the City of Bayside concerning the Elsternwick Park project, this is a unique case that is not found across the other LGAs that we investigated. Often, it is extremely difficult for the groups to get in contact with the appropriate department, a challenge we also faced when scheduling interviews. For example, Paul Caine mentioned that the City of Glen Eira does not approach the environmental group for advice on environmental projects. Instead, the group contacts the government and is occasionally able to suggest improvements in their environmental management.

Additionally, many of the projects that community groups propose must clearly display to the government, and sometimes the public, that the project is beneficial to the community and worth the investment. Paul says that groups constantly face the conflict of "enterprise against ecology" and that often the latter is neglected. Other environmental workers, including Amy Hahs, supported the statement that environmental protection advocates usually must assign a value to a resource or demonstrate the benefits that ecosystem services will provide by conserving nature spaces. From a different perspective, Paul Gibbs and Amy Weir explained that, as government officials, all factors of urban life must be considered, including the economy. Since protecting land is expensive, other parts of the population may be opposed to certain conservation efforts.

Governments are much more likely to consider projects when community groups provide strong, scientific evidence to support their claims, as the Elsternwick Park Draft did when it was presented to the City of Bayside. Another example of this is the recent Yarra River health survey, which occurred during our time on-site (Dunstan, 2019). Using this information, we determined

that the key factors community groups must consider when proposing conservation projects to local governments are connecting with the appropriate department, providing quantitative value to the project, and citing scientific evidence detailing the benefits of conserving greenspaces.

5.1.4 Inter-Government Communication

LGAs within the Greater Melbourne area have developed separate biodiversity plans and there has been little communication and collaboration in developing these strategies. Although some of the local governments are aware of their neighbors' strategies, such as the City of Melbourne's Nature in the City Strategy, there is little to no collaboration on these plans. The inherent challenge is that wildlife does not stop at municipal borders. Collaboration between LGAs through projects such as the Elsternwick Park Nature Reserve Project, which has connected the cities of Port Phillip and Bayside and has been attempting to include Glen Eira, or other works like Rob Youl's biolinks project, is necessary to improving Melbourne's biodiversity at a holistic scale.

Given the success of the previously mentioned Bayside Environmental Friends Network, which mainly utilizes social media, as well as the few community groups who use email aliases, a similar method can be applied on the governmental level. An email alias, social media hub, or forum consisting of the environmental oriented departments of the different LGAs will facilitate communication between local governments and will provide departments with direct communication to similar people who share their interests.

5.2 Monitoring Practices

Not only is strong scientific data beneficial when proposing biodiversity projects to the government, but it is also plays an important part in effectively managing greenspaces. By monitoring the flora and fauna species, land managers can determine areas that need more vegetation, identify species that should be catered for, and check the progress of their current and previous efforts. We found that many environmental groups either do not monitor the areas they manage or do not have a standard when they complete fauna surveys. This results in the group experimenting with their management practices, which is inefficient and costly to both the group and sometimes the environment. Other organizations, like the Friends of Westgate Park and

Friends of Native Wildlife, conduct regular surveys in their respective areas. This has contributed to Westgate Park's success, as the volunteers can use the monitoring data to analyze their work and discover which aspects can be altered or improved. While these local monitoring strategies are beneficial, there are many discrepancies in strategies used by the different community groups. This includes different processes, species classification, and data organization. For example, the Friends of Native Wildlife completes monthly frog and bat surveys. However, the data is not concisely organized, and is instead kept on slips of paper. While the Glen Eira Environmental Group does not actively monitor species, the few individuals they know who do keep track on slips of paper as well. This method can lead to inaccurate information and can be challenging for others to decipher, which is a significant issue when presenting data to government officials.

This is one of the issues that Paul Gibbs and Amy Weir hope to remedy, as they do not have easy access to the field data that experts collected, and when they do, the data organization is inconsistent across the different Friends groups. This makes it very difficult for government officials to use this information to support environmental work. Fortunately, there are several larger, international monitoring standards that were developed and are used by educated experts, and they are available for the public to use, including eBird, iNaturalist, and Frogwatch. Having environmentally interested groups, both community and government, use a standardized method for monitoring wildlife will help produce more viable data that can then be used as evidence when supporting environmental efforts.

Select members of the private sector and NGOs tend to have relative success when it comes to monitoring the spaces that they work. Given that these groups are usually composed of professionals in the field with the knowledge to complete such monitoring, it is easier for them to do that. However, one problem we have seen in terms of monitoring is that private businesses are not contracted to do it, as it is common for governments to split up work between groups or businesses for different stages of the job. For example, giving the initial consulting to one group, implementation to another, and finally (if it's done at all) monitoring to another. This disjointed process also leads funds not being spent in the most efficient means, a problem that is most pressing when it comes to the dollars of the general public. Rob believes this is a place where the industry could be improved. If the entire job is given to one company, they can complete the

whole job from initialization to completion and there are no major hoops to jump through if something needs to be changed along the way.

5.3 Public Safety and Concern

One factor that has had an impact on all of our stakeholders' initiatives, in terms of generating new habitats or enhancing existing ones, is the concern for public safety. There has been a movement to increase the amount of natural biolinks connecting habitats across Melbourne, with one of the larger initiatives being led by Rob Youl. Rob and other community groups are looking to add more indigenous vegetation along nature strips between roads, alongside tram lines, and around walking paths to increase the connectivity and provide natural corridors for wildlife to travel along. However, many have encountered pushback due to citizens' fear that the increased bush density will allow criminals to easily hide and attack passersby. Additionally, people are concerned that the increased vegetation along nature strips by roads, and the decreased visibility that comes along with it may be hazardous to drivers. There are also significant concerns about wildfires, increased disease risks, and the threat of branches or trees falling. Public safety is a priority for local governments, discouraging them from supporting revegetation efforts along these areas. However, Amy Hahs and several others explained that there are certain locations and planting methods that will create biolinks without endangering the citizens. Using multiple levels of understory, planning the locations of larger trees and vegetation, and growing plants a reasonable distance from roads and pathways will appease all parties. The challenge is that the specific, detailed planting information is not known by the community or the government, therefore there must be increased communication between all parties, showing again how crucial it is in this field.

5.4 Staffing and Funding

Most environmental projects require money and manpower to complete, whether it is purchasing land, materials and plants for revegetation, or other resources. Although most local governments have a reasonable amount of funding and a sufficient number of staff members for their projects, such as the City of Melbourne's Nature in the City Strategy, some of the smaller, suburban areas and their environmental departments are very limited, reducing their ability to

make change in the environment. Community organizations face the same challenge since they are often small, non-profit groups with staff primarily consisting of volunteers. Relying on volunteers only limits the abilities of these organizations since people have the freedom to choose when to work and what they want to do.

BERG, Friends of Gardiners Creek, Port Phillip EcoCentre, and a few other organizations attract new staff members by incorporating a social aspect into their volunteer work. They found that a lot of the volunteers are looking to continue their passion for gardening and share it with others. Overall, we found that key methods of increasing staff members, particularly for volunteer groups, are to increase outreach and awareness of the organization, and to promote enjoyable volunteer involvement. This connects back to improving overall communication and awareness. As more people know about the benefits of environmental conservation and the advantages of volunteering, more people will volunteer or contribute to the environmental cause. This will increase staff members and open more funding opportunities.

For the private sector, issues related to staffing and funding are not as apparent. Contractors, consultants, or others working in the field only accept jobs that make money, and they do not have to worry about the inconsistent commitment of volunteers. Still, they require funding to keep the business alive and allow them to promote and improve upon their work. When ABZECO, the environmental consultant group started by Richard Francis, is looking for an influx of money outside of the standard jobs that they complete, they will apply for grants, and have been very successful in their efforts, including a $60,000 grant to conduct a biodiversity assessment in the area and add an additional 300 nest boxes for their sugar glider project (see 4.2.2).

Some community groups have also received grants for their work, such as BERG, who received over 10 grants in the past year. Other organizations, however, are unaware of the opportunities grants provide or how to even apply for grants, thus most groups rely on donations and the money from public workshops to purchase the necessary equipment and seeds for their work.

With the success that groups like BERG and ABZECO have had, there are some common tips and techniques that are identified and important to keep in mind when applying for grants, shown in Figure 26 below. Possibly the most important is to be “grant ready” (Richard Francis) and have the project largely written up before the application comes out. Many grants have short

application timelines, so it is important to be prepared to present the project at any time. It is also essential to have multiple agencies involved in the project by getting them to advocate for the project and provide letters of support ahead of time. Along with this, it can prove beneficial to involve both the public and private sectors. By combining a community organization with a governmental or non-governmental organization and involving both public and private land, a project will become more substantial, garner more support, and touch upon a variety of aspects that can appeal to those awarding grants.

Figure 26: Infographic on Effectively Applying for Grants (Tanner Gauthier)

5.5 Resource Accessibility

Across our interviews, we discovered that many groups did not have access to necessary resources or were unaware of how to access these resources. As mentioned previously, BERG was the most successful community group we interviewed in receiving grants, while others did not have much success and some failed to even attempt an application. There are numerous grant writing forums that are put on by different groups, such as the PPWCMA and Rob Scott from Naturelinks. These are smaller groups that have historically had a hard time finding members that can make it to these meetings and most likely do not hear about them. Providing these organizations with information on how to apply for grants in a simple, remote way would allow these organizations to acquire money for their work.

Other resources that were beneficial, particularly to the residential gardeners we interviewed, were written materials and visuals describing how to design an indigenous garden, including plant species and organization. Both Tamasin and Gill did not initially have access to the book *Indigenous Plants of the Sandbelt*, a book describing the indigenous flora species of the region, leading to them planting non-native plants that failed to provide significant habitat support. They also mentioned that they would not have had access to these resources if they had not spoken to local experts.

Government representatives are looking to have access to citizen science data digitally as well. Paul and Amy from Bayside explained the difficulty in using Friends group data that is not easily accessible, often only present in the form of paper copies (see 5.2). They explained how digitizing this information makes it easier to use and share with other interested parties, allowing for more effective methods of vouching for conservation and biodiversity related projects.

Based on the interview results in Section 4 and the analysis in Section 5, we drew conclusions on which deliverable would best suit the current state of urban biodiversity and its management.

Chapter 6: Conclusion and Recommendations

From our research, we have determined that improving the communication between all major stakeholders in the biodiversity sector, including government entities, community groups, private organizations, and Local Experts and Enthusiasts, is a major step in improving urban biodiversity. There are existing solutions to on-site and external management challenges that stakeholders face that can help many people, and by increasing the interactions between these key players, the current methods can be shared and the other challenges that people face in encouraging biodiversity, such as monitoring practices, public safety, funding, and resource accessibility, will be addressed. To facilitate this communication, we developed a framework shown in Figure 27 for connecting stakeholders, highlighting some major topics in connecting people with nature, on-site management, and other challenges people have faced.

Figure 27: Concept Map (Yihan Lin)

Using the information and identified connections, more stakeholders will have the resources they require to help preserve and improve biodiversity in their communities. We discovered that many are looking for online resources, so we generated a structure that can be used to create a website, or an extension of an existing website, where users can easily access the

information they desire. We provided information gathered from our research for the base of this framework and additional information can be supplied by others in the future. These resources include gardening examples and methods, advertisement and recruitment tips, and contact information for local experts, government environmental departments, and community groups. Some of the materials we provided can be used in other forms, such as physical infographics for formal presentations, workshops, and school lectures. The overall framework can have other uses as well, as it demonstrates to stakeholders the connectivity between each other's work and highlights the key challenges they can focus on remedying.

There are multiple ways the framework could be implemented into tangible forms. As a guide to get started, we suggest the following implementations (see Table 4), but the framework is not limited to the platforms discussed below. First, a chatbot could benefit those who are less familiar with recent technology, similar to Siri on Apple devices. This could be built using software available online and may require an extensive amount of time to train the bot to learn an algorithm, which would include learning key words and the corresponding connections. On the other hand, a website tab built off an existing website could inherit the structure of the main website and, therefore, requires less time for aesthetic design. If using existing website templates, most of the efforts could be spent creating the content, thus reducing time until implementation. Other implementations, like paper pamphlets, a Facebook Page, and forums, could be used to enhance communication and resource availability, rather than enforcing the entire framework. These additional efforts could strengthen the main platform that might be used for the entire framework.

Table 4 (shown below) contains the estimated time it would take to implement suggested resources. These estimations are based off of the personal experiences of those working on this project and, therefore, may be inaccurate based on the technical expertise of the user, amount of practice they have with certain software, and the resources available to them. We can only speak to our experiences with these implementation methods and recommend further investigation into each of these methods for those that are interested.

Table 4: Suggested Implementation Methods and Potential Costs

	Estimated Cost	Technical Experience	Estimated Implementation Time	Components Addressed	Level of Implementation Efforts Required
Chatbot	Premium Version for Platforms such as FlowXO ~ $25 per month	Yes; varying levels depending on software	~ 3 days of constant work	Entire Framework	High
Website Tab	Depends on the Server (free if hosted on EcoCentre's website)	Yes; easier if using existing template	~ 1-4 weeks	Entire Framework	High
Paper Pamphlet	Depends on the number of copies	No	~ 1 day	Resource Sharing	Low
Forum	Depends on the Server	Yes; easier if using existing template	~ 3 days if using established template	Communication	Medium
Facebook Page	Free	Minimum	~ 1 day	Communication	Low

This framework serves as a repository for information regarding the protection and management of urban biodiversity. It seeks to connect information gathered from major stakeholders in a centralized location that is accessible to a large audience. In the future, this framework can be implemented in various ways and developed into a resource that is user friendly and easily distributed. Giving the public, community groups, or government departments the ability to add information to the resource, as innovative methods are discovered, new information becomes available, and the environment changes, will allow this tool to be flexible and fluid, remaining applicable and relevant as time progresses.

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Appendix A – Figures

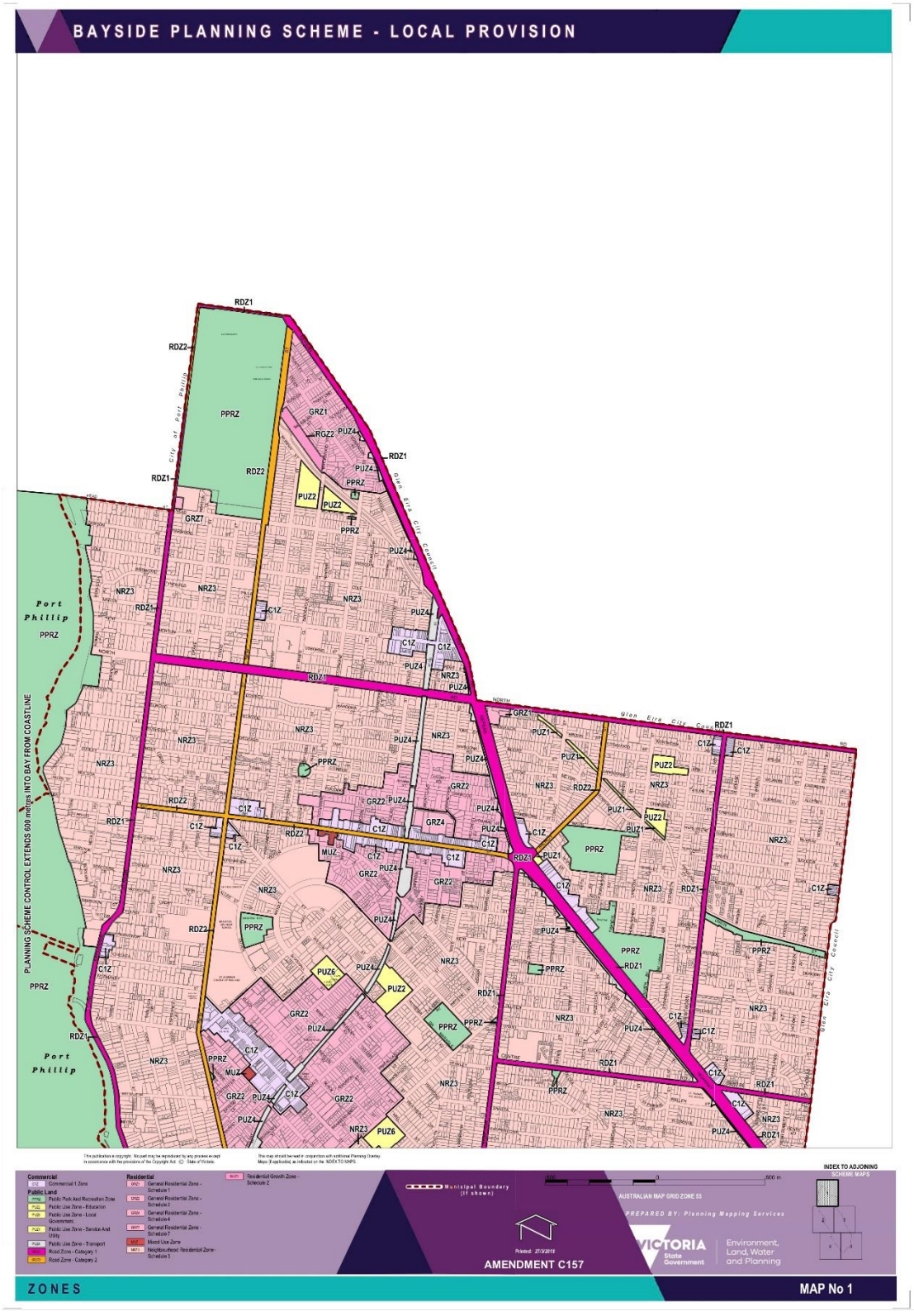

Figure 28: Bayside City Planning Map

Appendix B – Bioregions Within Victoria

There are six distinct bioregions within Victoria. These include the Victorian Volcanic Plain (VVP), Gippsland Plain (GP), Highlands-Southern Fall (HSF), Otway Plain (OP), Central Victorian Uplands (CVU), and Highlands-Northern Fall (HNF). The rainfall in these regions is highly variable occurring from 500 millimeters annually in the west to 1100 millimeters in the east. Temperature is variable by season being around 25°C in the summer and 13°C in the winter. Along with this, mean temperatures in and around the city are rising 0.14°C per decade. The geology of the area can be grouped into four basic regions. The west is predominated by basaltic lava flows while to the east lies siltstone, sandstone, and claystone and soils that are hard and alkaline with red clay subsoils. The southeast contains sand, clay, gravel, silt, limestone, and marl with coastal, sandy soils. To the northeast and east lies hard, acidic soils and yellow clay subsoils.

Appendix C – Recommended Citizen Science Project Management Practices

There must be an emphasis placed on strengthening the connections between amateurs and experts in citizen science efforts to minimize such bias stemming from disproportionate number of sightings (Theobald et al., 2015). Mass-participation cannot fully replace standardized biodiversity monitoring, and vice versa; but both practices should complement each other, contending to reconnect the urban human population with nature (Dennis, Morgan, Brereton, Roy, & Fox, 2017). Expert input is required for hard-to-detect ecosystem attributes that needs to be observed passively (Martin et al., 2015). Consequently, professionals should work together with citizen scientists and fill in when there is a need for targeted data collection of rarely detected species. They should actively identify previously unexplored locations and visit them consistently to consolidate useful data. Throughout this process, professionals can establish connections between volunteer actions and conservation results (Prudic, Oliver, Brown, & Long, 2018). In order to maintain volunteers' interest in continuing participations, volunteers must have ways to acknowledge how the collected data will be evaluated by scientists and policy-makers (Drury, 2017). To do so, it is worth considering various forms of participation to keep people engaged, for example short-term bat trapping and long-term camera analysis work, as well as other communication methods between the participants and scientists.

While citizen science sampling does not have an overwhelming amount of bias, data validation should still take place. First, data registries should be built as rigorously as possible without taking the fun and freedom away from the volunteers so that the activities can remain attractive. Second, validation by experts as the final step of the data collection, can be performed as an interactive activity.

To ensure accountability, volunteer data needs to be verified regarding at least two aspects: accuracy, which is the similarity of volunteer-generated data to reference values given by the professionals; and consistency, which is the similarity of data collected by separate volunteers (Branchini et al., 2015). It can also be beneficial to survey the volunteers' knowledge if the performed task is skill-based, such as species identification. Additional methods to address bias appearing from skill-based tasks need to be developed specific to each task. For example,

requesting submission of photographs can be one solution to confirm the species identified by citizen scientists (Lye, Osborne, Park, & Goulson, 2012).

Although it is inevitable that validation involves scrutiny and criticism, volunteer recorders and experts can establish mutual recognition as they jointly discuss specified observations. The collective validation practices can ensure close ties between volunteers and experts and thus further bonding the participants with the projects (Turnhout, Lawrence, & Turnhout, 2016). This paradigm shift, wherein scientists and non-scientists collaborate can help biodiversity projects thrive and extend the communities' knowledge.

Different citizen science organizations should collaborate in ensuring that data entries performed on each site are recorded in a general atlas to avoid conflicting data and misinterpretation. Local programs should act to fill in monitoring gaps while following tested methods of data collection to ensure that community groups will not override and create new practices that are incompatible with existing programs (Cartwright, Cvetkovic, Graham, Tozer, & Chow-Fraser, 2013). Adding to large-scale databases (e.g. Atlas of Living Australia) allows information to be readily accessed by the decision-makers. Atlases could be critical "in (1) mapping the distributions of species, (2) generating national population estimates and (3) tracking the distribution and abundance of species over time, especially as inputs into biodiversity accounting metrics for political use". Efforts should be made to calibrate the atlas data including using selected regional surveys so that weakly structured data can be used to generate robust estimates for species at a regional scale (Szabo, Fuller, & Possingham, 2012). Other recruitments methods for citizen science projects should be investigated to engage those with less knowledge or interest in ecology (Hawthorn-Jackson, Orre-Gordon, & O'Sullivan, 2017). Technological advances such as chatbots may also be used in data-quality improvements, allowing scientific knowledge of the natural world to reach more volunteers, thus producing higher quality data and resulting in pro-conservation behavioral changes (Prudic, Oliver, Brown, & Long, 2018). Furthermore, professionals should work closely with citizen science project managers to conduct question-based scientific studies over the long-term to ensure meaningful data is produced. Appropriate research questions should be determined based on the objectives and management of the urban space. Data submitted for a site should be checked on its temporal frequency so that they are comprehensive over the entire survey period before analyzing changes over time (Callaghan, Lyons, Martin, Major, & Kingsford, 2017). There needs to be a focus on

finding ways to fully utilize the data collected from citizen science projects and make them presentable to the decision-makers and urban land managers to advocate for policy changes and impact the environment.

Appendix D – Important Greenspaces in Melbourne

Within the city, there are many different greenspaces that are managed by different organizations, exhibit their own unique features, and produce different challenges to the managers and the public. The history and background on several key greenspaces in Melbourne are found in the supplementary materials document submitted along with this report to WPI's Gordon Library.

Appendix E – Government Representative Interview Questions

Government Questions

Interviewee:_____

Role:_____

Organization:_____

Interviewer:_____

Date:_____

Ok to be cited with affiliation?____

1. Introduction/Focus
    a. Tell us about your vision for biodiversity in general.
    b. Describe some of the key protection initiatives that have been implemented in your district.
    c. Can you identify any gaps in current legislation required to enhance and support biodiversity?
    d. What are some key strengths the city has when supporting biodiversity?
2. What has worked
    a. Can you identify any impacts, good or bad, resulting from changes in regulations or other planning schemes?
    b. What are the key factors required to effectively create change that is politically acceptable, sustainable – and ultimately successful?
    c. Are there any common techniques or things to consider that you can identify when addressing problems/barriers surrounding biodiversity protection and management?
3. Challenges
    a. What are some challenges that you face when strongly advocating for your vision?
    b. Are there specific organizations or groups that have expressed opposition to legislation passed in your district?

    c. Are there some that have supported your opinions?
    d. What new legislation or strategies are needed to support biodiversity and what kind of opposition is it likely to face?
4. Regulation Questions
    a. Has your organization developed ecological or environmental processes that specific habitats bring to the environment that would be beneficial to the city? For example, water filtration, clean air, reduced urban temperatures?
    b. Do you, or have you worked with other local municipalities or groups towards these efforts?
5. Council managed reserves
    a. Which Council-managed areas are most important in terms of biodiversity?
    b. Which particular species or groups of species (if any) are the focus for habitat establishment and management in local reserves?
        i. Are there any particular species that are pests in and around Council-managed reserves? If so, what sort of management strategies have been used to address these species?
    c. Have any habitat corridors been established to link local biodiversity hotspots?
        i. What are the main obstacles to establishing habitat corridors?
        ii. Does your organization collaborate with community groups in biodiversity planning and establishment?
        iii. What are the most challenging parts?
    d. What are some challenges you face in biodiversity protection in City of Port Phillip?
    e. Looking ahead, are there any local success stories or project models that can be implemented at other, similar types of land? (Could this be used as a basis/blueprint for other pieces of land, or is it too specific to the area?)
6. Our role
    a. Is there anything we can do to assist in your efforts, whether it be through research, developing educational resources, participating in programs, or anything else?

Appendix F – Community Groups Interview Questions

Community Groups

Interviewee:_____

Role:_____

Organization:_____

Interviewer:_____

Date:_____

Ok to be cited with affiliation?____

1. Introductions and focus
    a. Tell us about your vision for biodiversity at this site or biodiversity in general.
    b. When was your organization established?
    c. Which biodiversity issues are your major focus?
    d. What are some practices you have taken to achieve these goals?
    e. Why are they important?
    f. What habitats do you find to be most beneficial for biodiversity?

2. Collaboration
    a. Are there other citizen groups that you collaborate with?
    b. Has your group successfully collaborated with government agencies and other citizen science and community groups? If so, which ones?
3. Strengths
    a. What biodiversity practices or initiatives by your organization have been most successful in past or currently?
    b. What are the key factors required to effectively create change that is socially acceptable, sustainable – and ultimately successful?
    c. Are there any common techniques or things to consider that you can identify when addressing problems/barriers surrounding biodiversity protection and management?

    d. Looking ahead, do you think this type of plans can be implemented at other, similar types of land? (Could this be used as a basis/blueprint for other pieces of land, or is it too specific to the area?)

4. Challenges
    a. What are some challenges that you face when strongly advocating for your vision?
    b. Are there specific organizations or groups that have expressed opposition to the goals of your organization?
    c. What do you consider to be the key obstacles for your group to overcome to win funding and organizational support for your work?
    d. Are there some that have supported your opinions?
5. Monitoring Practices Questions
    a. What is your opinion on standardizing monitoring practices?
    b. What pieces are crucial to any standard monitoring practice?
6. Education
    a. Has your group conducted any work in educating the community, groups, or local governments about biodiversity?
        i. If so, what methods were successful?
    b. What were some areas that could be improved?
7. Our role
    a. Is there anything we can do to assist in your efforts, whether it be through research, developing resources, participating in programs, or anything else?

Appendix G – Full Interview Summaries

The full set of interview summaries can be found in the supplementary materials document submitted along with this report to WPI's Gordon Library.