

11. Rationale for goals, objectives and actions

This section explains the reasoning behind the actions we are taking to achieve our vision. As with the action plan, it is organised into the four themes of protect, restore, connect and research.

This section is important to ensure that everyone understands the rationale behind the decisions we are making. We are dependent on our partners and community in assisting us to achieve our vision. To work collaboratively with them, and be leaders in this area, we need to explain why we have come to the conclusions that we have.

There are also guidelines within this section. While actions are specific and have measurable timeframes, the guidelines in this section inform how the Council will operate while carrying out those actions. These guidelines are for the Council and will be implemented throughout the Council's activities.

To work collaboratively with them, and be leaders in this area, we need to explain why we have come to the conclusions that we have.

11.1 Protect

11.1.1 Introduction

The current state of our indigenous biodiversity is a legacy of human settlement and subsequent land-use changes. Much of Wellington's original habitat has been lost and altered beyond recognition. As a result there are now only small remnants that still resemble their original state. These are all modified to some extent, influenced by human processes and introduced animals and plants, many of which pose an ongoing threat. Although there has been a change in attitude to the environment, there are still a number of ongoing threats to indigenous biodiversity. This strategy recognises that we need to address these threats if we are to halt the decline of indigenous biodiversity in Wellington, and sets priorities for its protection. Our priorities for the sites we protect will be decided using our ecological significance criteria (Appendix 2). The strategy uses the Pressure-State-Response framework to identify and address threats.

- **Pressure** - Human activities exert pressures on the environment, changing both its quality and the quantity of natural resources.
- **State** - These changes alter the state, or condition, of the environment.
- **Response** - The human responses to these changes include any organised behaviour or policy that aims to reduce, prevent, or mitigate undesirable changes.

11.1.2 What do we need to protect biodiversity from?

11.1.2 (a) Environmental pests

Pressure and state

Environmental pests (Appendix 6) are one of the greatest pressures on indigenous biodiversity. Pest animals have a negative effect on native species - including birds, reptiles and invertebrates - impacting ecosystems through predation and competition, as well as browsing damaging native vegetation. Pest plants can alter ecosystems, displacing native species, preventing natural succession and, in some cases, leading to canopy collapse. Amenity weeds are those

that occur in such areas as sports fields, play areas, streets or civic gardens and are not the subject of this strategy except where they overlap with legal requirements for control.

Plants

Approximately 11 percent (2068 species) of all plants introduced to New Zealand have become established in the wild. Many of the 24,700 introduced species present could establish in the wild in the future. The greatest source of new pest plants is garden escapes and dumping of garden waste (it is estimated that 75 percent of terrestrial and 50 percent of freshwater weeds became established in this way). There are a number of pathways for pest plant spread and these will be considered by GWRC's Regional Pest Management Plan (RPMP). Roads and railways are one pathway for infestation.

Pest plants pose a threat to native ecosystems as they can out-compete and prevent natural succession of native species. Replacement of native plant communities by exotic communities can isolate populations, reducing genetic variability. Closely related exotic species can hybridise with indigenous species (such as South African iceplant (*Carpobrotus edulis*)). Non-local indigenous species can also be invasive. Karo (*Pittosporum crassifolium* and *P. ralphii*), karaka (*Corynocarpus laevigatus*), houpara (*Pseudopanax lessonii*) and pohutukawa (*Metrosideros excelsa*), all native to the northern North Island, have been introduced to the Wellington area and in some locations they are altering local plant communities.

To determine management options relating to pest plants and other exotic species, a number of factors need to be considered. Some exotic or non-local species have cultural or historic associations that will influence their management in specific sites or circumstances. For example, some karaka groves are culturally significant for local iwi and therefore protected. The value of some non-native species also needs to be recognised in providing valuable food and habitats for native species.

Animals

New Zealand also has a large number of introduced animal species - some of which are invasive and pose a significant threat to native ecosystems. These include mustelids (stoats, ferrets and weasels), possums, rats, hedgehogs, mice, cats and browsers such as goats, pigs, deer and rabbits.

These species pose a serious threat to native fauna. They find easy food in native ground and cavity-nesting bird species including saddleback, kakariki and kaka. Mustelids, possums, rats, cats and hedgehogs all predate on eggs, chicks, lizards and invertebrates. Mice feed on lizards and invertebrates. Of the mustelids stoats pose the greatest threat as they occupy a broader range of habitats and breed more quickly. Possums, rats and mice also consume vegetation and seeds, altering the composition of indigenous plant communities, and compete with native species for food. Browsers consume large quantities of vegetation thereby changing the structure of plant communities, preventing regeneration and, in some cases, resulting in removal of vegetation and the compaction of soils - aggravating erosion and creating sites for weed invasion.

Some introduced birds compete with indigenous species for resources, such as eastern rosella. Introduced fish, including brown trout, threaten freshwater ecosystems through predation, competition and habitat alteration. There are also a number of introduced invertebrates that pose a threat, including German and common wasps and Argentine ants.

There are a number of trends, such as increased temperature through climate change, which may increase the risk of new pest plants and animals becoming established in Wellington and making existing species harder to control. But there will also be opportunities offered by national and local innovations, and the continual development of new tools and techniques in pest management.

Response

The Council controls a range of pests on its land in accordance with its responsibilities under the National Pest Plant Accord, the Regional Pest Management Plan (RPMP) and other statutory responsibilities. Our primary focus for pest plants in recent years has been the control of species identified under the RPMP as the responsibility of landowners, specifically old man's beard, cathedral bells, wild ginger and banana passionfruit, as well as site-led management at sites of ecological significance. The sites may be whole sites such as a reserve, several sites in close proximity and with similar values, or the sites might be part of a bigger site with areas of lesser biodiversity value that are lower in priority for management, such as primary remnant forest in a larger park.

Species will be prioritised for control in accordance with their ability to cause significant damage within each site and the sites are prioritised in accordance with the criteria in Appendix 2. Weeds are then prioritised for each site by tier (climbers, groundcovers then woody weeds) and feasibility of control. The site focus within particular reserves will be on sites of highest ecological value, under high threat, areas currently under a restoration

programme or areas which have undergone previous control (where we don't want to lose the gains made). Each site will require its own specific programme to control the pests identified through the ranking process. Each site will be different and each programme will reflect those differences and reflect the control techniques required for each identified pest. Weed species may need the attention of specialist operators, for example large trees need to be treated by qualified arborists. Other factors such as weather, budget and labour resources will also have an influence on the methodology and timing of the programmes.

Council will assist with the eradication or control of pest species listed by GWRC as 'Total Control Species'. We will control pests on land that we own or occupy (including roadside verges for which we are responsible) in accordance with the RPMP rules. We will control species that occur on and threaten sites that are considered ecologically significant. We do not have authority to control weeds on private land without the permission of the land owner. In some instances we will gather this information as part of weed mapping to keep a watching brief on the spread and new incursions of weed species.



Above: This kaka chick from Huntleigh Park was killed by an off leash dog shortly after this photo was taken. We need to work with people to ensure their pets do not pose a threat to native fauna. Photo: Bernard Smith

Wellington City Council funds possum control work across most of the city. They are controlled in partnership with GWRC within a portion of their three Key Native Ecosystem areas. Other species have been controlled in response to the needs of specific sites and available funding. Goat control has been carried out in response to growing goat numbers in the south-west of the city, and rabbits have been controlled in localised areas dependent on biodiversity needs. Mustelids are controlled in partnership with the community, determined by community priorities. Rats are currently controlled as by kill to possum control operations, but in some areas Council will be looking at intensifying our network where threatened species are found. Rats will be the target species in some of these instances.

Rodent control on private land is the responsibility of the landowner. Rodent control may be required by Council Environmental Health Officers for public health reasons rather than in accordance with the priorities set for the protection of biodiversity values. Other species which may be controlled by Council for public health reasons as opposed to protection of biodiversity include pigeons and ducks.

Approaches to pest control

The pests to be controlled within a site are those that have the potential to adversely affect the biodiversity values of the site. These are generally the widespread species, but can also include species that are currently localised in distribution but have the potential to become significant in the future. A precautionary approach is used. The best time to eradicate or contain a pest species, if it poses a future threat, is in the early stages of infestation, when populations are small and localised. Control costs at this point are relatively low. The more widespread and established a pest, the more difficult and expensive it is to control.

Species led programmes

Species-led programmes are proactive, concentrating on a specific species throughout the region and what is required to control and restrict that species to minimise future threat. Species-led programmes are particularly relevant in managing weeds and pest

animals in the early stages of establishment, when numbers are low and/or distribution is limited, and there is potential to minimise future control costs and environmental impacts. Species-led management must assess the potential impacts of a species, how fast and how well it establishes and spreads, and how practical it is to eradicate, contain or manage it. Rapid response to a species is the optimum, but factors such as the size of the infestation, ease of control, effectiveness of control methods and the need for the cooperation of other parties will also have an influence. Two priority groups under species led programmes are climbers and wilding trees.

Site-led programmes

Site-led programmes focus on protecting identified values in ecologically significant sites. The focus is not on individual species but on the site, the values within the site and the threats to those values. These may be specific sites of ecological significance and/or rare, threatened or locally significant species. The sites may be whole sites such as a reserve, several sites in close proximity with similar values, or part of a bigger site, such as primary remnant forest in a larger park.

Pest control on private land

Plant and animal pests occur across both public and private land. Where the Council is intensively managing pests on land with significant biodiversity values, it is essential to consider how the reinvasion of these sites from adjoining non-Council land can best be managed. Education of private landowners is one method but is generally a long-term project. There are certain circumstances where Council control of pests on neighbouring land would help prevent re-infestation of Council land and reduce the need for additional pest control. Landowner/occupier consent would have to be obtained to access the land.

A priority is to look at pest control on private land to create buffer zones around our ecologically significant areas. The impacts of private land ownership and the mobility of pest animals make it more difficult to implement, but for effective control of many pest animal species the co-operation of the community is essential.

As new subdivisions are developed, we also have to consider the future threat of garden escapes, introduction of weeds and some pest animals (including domestic cats) into these areas that have previously been only lightly affected. Land uses that disturb or alter the environment also have the potential to open up new areas to invasion by weeds.

Integrated pest control

Consideration must also be given to the impacts of pest control on the environment, and the control of pests should not create opportunities for further and possibly worse pests. Within an urban context, the impact of removing one pest species on the rest of the ecosystem needs to be considered. To achieve integrated pest management, a “suite of pests” approach needs to be considered, targeting multiple pest species at once to bring their levels down together. This is particularly applicable to predators and will assist in avoiding competitor release and mesopredator release.

Methods used

Agrichemicals are the main method used for controlling pest plants. Currently this is the chosen method given the scale of land and pest species we need to control, but we recognise this level of chemical use as not desirable and other techniques will be explored over the life of this plan.

Biological control is the use of naturally occurring parasites, predators and pathogens to control target species. Biological control is primarily used against pest plants, and is strictly controlled and researched nationally to ensure the agent cannot adversely affect native ecosystems. The benefits of biological control include reductions in the use of chemicals, cost-effectiveness and being highly targeted.

Vertebrate toxic agents are primarily distributed through ground control involving a network of bait stations, and are used across most Council land, primarily targeting possums and reducing rodent numbers. They can also be used for localised ground poisoning operations that target rabbits.

Trapping is the most effective method for targeting some animal pest species, primarily mustelids and hedgehogs, rats and complements the use of toxins. Trapping is recommended for small scale operations such as in backyards to limit the amount of toxin use. Some species cannot be trapped or poisoned, and hunting is the best option for control. These species include feral goats, pigs, rabbits and hares.

Fencing is the most effective means for excluding goats, pigs, deer and livestock from sites with high biodiversity values or where the natural regeneration of native vegetation is the management objective.

11.1.2 (b) Habitat loss and fragmentation

Pressure and state

Wellington’s urban growth poses a threat to remaining indigenous ecosystems. Although large-scale habitat loss is not the threat it once was, there is a continued loss of indigenous habitat by development, land-use intensification and changes in land-use affecting bush remnants, streams and wetlands. The coastal environment is under pressures from subdivision and use, including existing infrastructure and buildings. There is also high demand for coastal sites for new and expanded infrastructure uses, including further reclamation and aquaculture. These all pose a threat to coastal habitats. The cumulative impact of incremental changes needs to be considered. Wellington’s remaining indigenous forest is particularly fragmented and its streams modified. Some remaining bush remnants on private land currently have limited protection under the District Plan, making them vulnerable. The Wellington Urban Growth Plan anticipates an additional 45,000 residents in the city by 2045. Housing, business and infrastructure demands can have associated direct, indirect and cumulative effects on biodiversity which need to be addressed and avoided or mitigated early in the development process. Some emerging issues to do with urban development are the impact of light and sound on biodiversity. There is increasing evidence from overseas that street lights and lights within parks have negative impacts on plants, animals and their behaviour.

Habitat loss at a small scale may not appear to be significant but can lead to a degradation of wider ecosystem function at a city-wide scale. This can lead to remaining areas being too small to sustain the necessary processes and remove the areas used by mobile species to travel across the landscape. In urban areas, increased development puts more pressure on ecosystems' ability to cope and potentially reduces the effectiveness of the ecosystem services provided by Wellington's natural capital.

Response

We must promote and invest in actions to reduce the negative impacts of the city's growth and development on the environment, and use a range of regulatory and non-regulatory tools to do this. There are a myriad of opportunities within Wellington for better management of our infrastructure. The Council's main mechanism for protecting indigenous biodiversity is through the provisions of the RMA 1991. In particular, the preparation of a District Plan that sets objectives, rules and policies that guide land use and the resource consent process. We will seek to strengthen the protection of our biodiversity through the District Plan, focussing on the primary forest remnants, and ensure alignment between the Council's strategies and policies to ensure biodiversity outcomes are achieved alongside economic development and other wellbeing outcomes. We will also look at Council's infrastructure practices to reduce the impact these have on our biodiversity, including the issues of street lighting. In addition to statutory policy and planning mechanisms and the delivery of services, the Council can also achieve its policy objectives to promote the protection of areas of ecological significance on private land through a number of voluntary measures as outlined in the Action Plan.

11.1.2 (c) Aquatic ecosystem degradation

Pressure and state

Everything that goes into the stormwater system eventually ends up in our streams or in the harbour. Stormwater management remains a significant issue within built environments, especially as our city grows and the climate changes. Because stormwater

travels from roads and roofs to streams, rivers and seas without treatment, contaminants in stormwater contribute to pollution of the receiving environment. As houses grow larger and sections grow relatively smaller, and with urban intensification, the resulting increase in impervious areas means increased volume and speed of stormwater runoff. Increased runoff and other activities (including stream realignment, piping, damming or creating new urban stormwater discharges) can significantly modify stream habitats.

Aquatic habitats are vulnerable to degradation through heavy metal and microbial pollution, and sediment linked to urban development and increased intensification. Increased areas of impervious surfaces - roads, roofs and car parks - leads to increased peak flow and volume of run-off and increased load on stormwater drains. Stormwater runoff is heavily influenced by surrounding land use and activities. Human and urban activities generate a wide range of contaminants that are often transported in stormwater. When it rains, contaminants are washed off hard surfaces and into stormwater networks. Research shows fairly conclusively that the sources of contamination are from buildings and neighbouring land uses. Roads are contributors, recipients and conveyors of contaminants from adjacent and often extensive contributing areas.

This contamination of stormwater can result in public health risks, close beaches and affect recreation, shellfish gathering, and cultural and tourism values as well as impacting on marine and freshwater ecosystems. Wellington and Porirua harbours, like other coastal environments surrounded by populated areas, receive significant volumes of stormwater with the potential to pollute their ecosystems.

Land development, especially on hill sites, can cause further erosion, resulting in greater sediment loading on aquatic ecosystems. Hydrodynamic modelling of Porirua Harbour indicates sedimentation rates average about 6mm per annum in the Onepoto arm and 9mm a year in the Pauatahanui Inlet. Work has shown that the biggest sediment contribution is from bare land under construction (37 percent), followed by pasture (33 percent) and with urban runoff

contributing the rest (10 percent). Silt is smothering the seabed, affecting seagrass and shellfish beds, and may be depleting the harbour's ability to attract and retain fish. Localised reduction in harbour depths is affecting navigability even for small vessels. These findings reinforce the importance of construction sediment and erosion control, and the need to manage sites in accordance with consent conditions.

Increased sediment affects aquatic ecosystem functioning and sedimentation can affect many miles of stream. Land-based effects from pollution and sediment can have a significant impact on the coastal marine area affecting values associated with the marine environment including recreation, kai moana gathering and cultural values.

Pollution from heavy metals and other chemicals can also affect biodiversity in the freshwater and marine environment. Monitoring conducted by GWRC in 2013/14 shows that water quality in the four streams monitored in the city - Porirua Stream, Makara Stream, Karori Stream and Kaiwharawhara Stream - are degraded having excessively high levels of dissolved phosphorus and (for all but Makara)

nitrogen. Raised nitrogen and phosphorus levels cause algal blooms, impacting on ecosystem health. Cyanobacterial blooms within the lower Karori reservoir are also exacerbated by introduced fish, which has downstream ramifications. Common sources of excess nitrogen and phosphorus include fertilizer, herbicides and pesticides, sewers and septic systems entering the stormwater system, domestic soaps and detergents being disposed of from private properties. These streams also have excessive levels of E. Coli, making them unsafe to swim in. Despite this, the macroinvertebrate index (MCI) in these streams is still excellent to fair - showing that it is not too late to restore the health of these streams. This pollution also affects other species up the food chain, including sea birds and marine mammals such as orca.

Response

The Council is planning to address land use and growth impacts on soil, water and biodiversity within catchments as Wellington grows. This needs to happen primarily through planning and policy documents, and as part of Integrated Catchment Management Plans (ICMP) and the Whaitua process being run by GWRC.



Above: Blue cod are recovering well since Taputeranga Marine Reserve was formed. They now come out to meet divers.
Photo: Michael Johnston, Friends of Taputeranga Marine Reserve

An ICMP is a plan that takes a holistic approach to managing the inputs and outputs of a stormwater catchment. An integrated approach means taking a range of factors into consideration - activity and urban development in the catchment, the state of the stormwater and wastewater networks, levels of contamination, flooding - when planning how to improve things. In a broader sense, integrated catchment management planning is a subset of environmental planning. It aims for sustainable, resilient outcomes - the quality of water entering the receiving environment, for example - through joint land and water management. An integrated approach contrasts with one that treats the two elements separately. ICMPs also take into account the cyclical nature of an ecosystem, and use scientific and technical data to understand the natural world.

Both Integrated Catchment Management Plans and the Whaitua process are designed to ensure collaborative development of catchment specific programmes and an integrated approach to the management of land and water resources. This includes impacts on the harbour and coast as well as the streams that run through the city. We need to reduce the environmental impacts of urban

development and transport, while enhancing our existing natural environmental assets - growing our natural capital.

We need to incorporate Wellington's Water Sensitive Urban Design (WSUD) guidelines into relevant Council plans and policy to minimise future effects on our aquatic ecosystems. We will also take the opportunity to incorporate WSUD into infrastructure upgrades and new development to improve the treatment of stormwater runoff within urban catchments. The management of our closed landfills also must ensure that leachate doesn't enter our aquatic ecosystems.

Our coastal areas such as Taputeranga Marine Reserve are significant assets for the Council. Although management is not the Council's direct responsibility, we manage the coastal reserves adjoining the marine environment, footpaths, roads and other infrastructure that impacts directly on marine waters. Supporting, managing and improving the health of biodiversity and the functioning of infrastructure assets neighbouring the reserve is a priority.

Everyone in Wellington, property owner or not, shares a responsibility for keeping stormwater



Above: Healthy freshwater is not only beneficial for biodiversity, but also for people to safely interact with our urban streams.

clean. There are many opportunities for education to increase the number of people that are aware of their impacts on our aquatic ecosystems. A recent survey in Porirua Harbour showed that 40 percent of people were not aware that the stormwater network drained untreated to our streams and sea. Existing education programmes can be strengthened, working closely with Wellington Water Limited where joint objectives can be met.

11.1.2 (d) Climate change

Pressure and state

The effects of climate change on Wellington's indigenous ecosystems are difficult to predict exactly. Ministry for the Environment climate change¹⁸ predictions for the Wellington Region suggest that Wellington City will experience increased temperatures, rainfall and wind, and sea level rise of at least 0.5m over the next 100 years.

This is leading to increased coastal erosion. Increased storm surges and inundation is damaging remaining dunes and other already fragmented coastal ecosystems (coastal turf communities, coastal scrub), as roads and landward development prevent them from adapting to change by "retreating" landward. The capacity of stormwater systems will be exceeded more frequently due to heavy rainfall events leading to surface flooding and increased number of sewer overflows. More frequent and intense rainfall events will lead to more erosion and landslides, threatening property, infrastructure and the "green ribbon" provided by road reserves and streamside areas. Climate change may lead to an increase in the proliferation of pest species, and subtropical pests may become established - requiring new approaches to pest management.

Response

Our response to the pressures presented by climate change is described in the Council's Climate Change

Action Plan (2013). The main linkages with this plan relate to the implementation of Water-Sensitive Urban Design into future urban development (including the use of more water permeable media for surface drainage), increasing the city's ability to sequester carbon by increasing vegetated areas and the importance of pest control in maintaining existing forest cover. With climate change in mind, we also need to ensure that the species we select for planting are continually revised, so we are confident in their ability to handle current and future changes in conditions. Dune restoration can also be used to protect our coastal environment from further damage, and ensuring healthy kelp and seaweed beds around the reefs will absorb energy from the waves.

11.1.3 Guidelines

Environmental pests

- 1 Preventing new species of pest plants and animals from establishing is more effective than eradicating or controlling them.
- 2 If total exclusion or eradication is not practical or economic, eradication in discrete areas, combined with containment in specific areas and preventing future spread is the next priority.
- 3 Where pests are established and widespread, and eradication is impractical or uneconomic, the focus will be on controlling them to minimise their adverse impacts on areas with the highest biodiversity values.
- 4 A precautionary principle will be used when we believe a pest species poses a serious threat to priority ecosystems or species. A lack of detailed knowledge or understanding of a pest plant or animal's full potential for damage is not a reason to do nothing.
- 5 All pest management must be environmentally, socially, culturally sustainable and financially prudent. Consideration must also be given to the impact of pest control on the environment and the management required. Control of pests should not create opportunities for further and possibly worse pests.

¹⁸ Ministry for the Environment (2008). *Climate Change Effects and Impacts Assessment: A Guidance Manual for Local Government in New Zealand*. 2nd Edition. Mullan B; Wratt D; Dean S; Hollis M; Allan S; Williams T, Kenny G and MfE. Ministry for the Environment, Wellington.

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- 6 All animal pest control will be carried out in accordance with the Animal Welfare Act 1999 to ensure it is carried out humanely.
 - 7 Any traps used by the Council, agents of the Council or groups supported by the Council must meet the requirements of approved best practice. If traps are used in urban reserves or near to residential properties they must be safe for non-target species.
 - 8 Regular, ongoing baiting will be undertaken to ensure that pest populations remain at low levels and less toxin is required.
 - 9 New technologies will be trialled and evaluated as part of the animal predator control network.
 - 10 Qualified hunters will be employed to carry out any hunting operations on Council land and adequate notification of hunting operations will be given to ensure health and safety requirements are met.
 - 11 Fencing effort will be prioritised along the Outer Green Belt where grazing areas are adjacent to ecologically significant areas such as Otari-Wilton's Bush, Khandallah Park and Redwood Bush.
 - 12 All agrichemicals and vertebrate toxic agents will be used safely within guidelines by suitably qualified staff, contractors and volunteers where appropriate.
 - 13 While recognising the necessity of toxin and chemical use, alternatives such as biocontrol, new technologies, and bait station placement will be considered to gradually reduce the amount of toxins and chemicals entering the environment.
 - 14 Chemical and toxin free approaches will be promoted where practicable, such as in small urban backyards.
 - 15 Native vegetation should not be accidentally damaged during the use of agrichemicals, and where possible we will reduce our reliance on these chemicals by exploring new techniques.
 - 16 Biological control will be used where practicable for species that are widespread and in high densities, current examples being Darwin's barberry, tradescantia and gorse.

Habitat loss and fragmentation

- 17 Soil disturbance within ecologically significant sites should be minimised. Ground disturbance, within these sites will undergo evaluation as to whether it should proceed.
- 18 The Council Parks, Sport & Recreation team will advocate for the protection of natural areas across the Council's business groups, and provide information and advice on the ecological impacts of proposed activities and advice and examples of good practice to reduce or mitigate any impacts.

Aquatic ecosystems

- 19 There should be no further loss of natural streams within Wellington City
- 20 The impact of land based activities on our freshwater and marine ecosystems will be recognised and addressed through all Council projects
- 21 All Council projects should follow the principles of Water Sensitive Urban Design

In addition to protecting indigenous biodiversity, its restoration is also essential for Wellington to become a truly Natural Capital.

11.2 Restore

11.2.1 Introduction

In addition to protecting indigenous biodiversity, its restoration is also essential for Wellington to become a truly Natural Capital. Much of the Council's restoration work is based around the restoration planting programme to increase the area of indigenous vegetation cover in the city, based on the assumption that if the habitat needs of species are met, species diversity will increase and ecological functions will be enhanced.

Our key focus areas to restore our indigenous biodiversity are:

Ecologically significant sites that closely resemble Wellington's original natural environment. We value these systems because they are rare and irreplaceable.

Ecological functions that are provided by species diversity or habitat structure to support a broad array of species.

Remaining natural open spaces that form an important part of wider ecological networks through supporting biodiversity and/or providing future restoration sites. These areas may not be considered of high ecological significance in isolation, but form the backbone of our green spaces and are a crucial feature in the restoration of our city.

Nationally, regionally and locally significant species that are rare or threatened in New Zealand or the Wellington region, uncommon in Wellington City, have cultural importance, or their loss would threaten the functioning of remaining indigenous ecosystems.

We are aiming to achieve self-sustaining ecosystems that can maintain their structure, species composition and function with ever decreasing input from Council. We also want these to be resilient ecosystems that can deal with (and recover from) the disturbance from outside urban influences, while retaining the same essential structure and functions.



Above: Council staff from a range of different teams plant 45,000 natives every winter as part of our restoration programme.

Restoration planting programme

The Council's Berhampore Nursery grows around 100,000 native plants every year, of which 45,000 are planted and maintained by the Council for habitat and species restoration. An additional 35,000 are distributed among community groups and residents for the same purpose. The nursery grows up to 100 species, from hardy pioneer species to emergent tree species. The plants are all grown from eco-sourced seeds, collected by Council staff. Many community nurseries are also involved in growing plants for restoration programmes across the city, including Forest & Bird - Wellington Branch.

We use plants that would have originally occurred in the ecosystem as they are adapted for that area. This keeps the distinctiveness of Wellington's local flora, avoids the risk of planting species that could become invasive and, as local plants are better suited to Wellington's conditions, they are quicker to establish and more likely to survive. We also want to recreate habitat for Wellington's indigenous fauna and the best way of doing this is to look at what grew here originally. Ecosourcing means a much higher commitment in terms of seed collection but is the best way to protect and restore our indigenous biodiversity. Ecosourcing guidelines can be found on the Wellington City Council website.

11.2.2 Priority areas for restoration planting

Restoring the integrity of areas

To restore the ecological integrity of core areas of indigenous forests and shrubland, we need to ensure that there are no gaps in the vegetation cover, thereby reducing potential for weed invasion and establishment. Where areas of habitat can be increased and made denser, the adverse impacts facing forest remnants will be somewhat reduced. Large intact areas are also much easier to efficiently manage than small fragmented areas, and more likely to be resilient and self-sustaining.

Increasing the size and complexity of habitat increases available resources and creates more ecosystem niches, supporting a greater diversity of species and

larger populations - making them more sustainable. Larger, intact forest areas have higher quality interior habitat. Planting buffer zones around the outside of these areas not only increases the size but reduces the edge effects.

Weed control, construction work, slips and trail building create canopy gaps, disturb the soil and release buried weed seeds. For this reason the restoration planting programme is tied in very tightly with our environmental weed control and trail programme. Canopy gaps can also be caused by natural processes such as tree fall.

Ensuring the integrity of our few remaining sand dunes is also very important. Not only are dunes a threatened ecosystem within Wellington, healthy functioning dunes provide a defence for the city in the event of large storms. Our native sand-binders (spinifex and pingao) produce dunes with a low regular profile, which are more stable. Vegetation won't stop the erosion of the dune, but native sand-binding species are critical for its recovery after a storm event. This was proven in the storm of June 2013 where the dune at Island Bay protected the infrastructure behind it, and is already on its way to recovery. The seawall, however, had no dune in front of it due to the restricted size of the beach and was severely damaged by the force of the waves.

Restoring missing species

Despite historical clearance of native forest, some areas of Wellington have experienced natural regeneration comprising a mixture of exotic and native species. In most of these sites the usual successional sequence has been altered owing to the presence of exotic species such as gorse and Darwin's barberry. Areas where natives are regenerating through gorse tend to lack the species richness of natural succession as would occur through kanuka, leading to a different final forest composition¹⁹. Within many areas of regenerating forest as well as

¹⁹ Sullivan, J. J., Williams, P. A., & Timmins, S. M. (2007). Secondary forest succession differs through naturalised gorse and native kanuka near Wellington and Nelson. *New Zealand Journal of Ecology*, 31(1), 22-38.

restored planting areas, there is now single tier forest with little structural complexity, and there is little evidence of missing species returning to these areas naturally.

Owing to the lack of seed sources and natural dispersal mechanisms for the more common canopy and emergent species, areas where natives have naturally regenerated through gorse tend to be mahoe-dominant. To restore Wellington's native forest to anything like its original state will require enrichment planting in certain areas to increase species diversity and restore functioning ecosystems.

Even in many of Wellington's more mature forest remnants there is a lack of some of the species that are considered to be indicators of primary forest, including large podocarps. As well as the podocarps and missing tree species, a range of plant types are required to increase the complexity of a functioning ecosystem. In many areas the forest floor, understorey, subcanopy and emergent layer are missing. Plant types within these layers need to include not just trees and shrubs but grasses, ferns, fungi, climbers and epiphytes to ensure that each tier of the ecosystem holds a full range of representative species.

Threatened plant conservation will also entail restoring these species to their original habitats. This involves the need for careful sourcing of seed, propagating, planting in appropriate locations and monitoring to observe survival. Species which would be restored under this approach include *Muehlenbeckia astonii*, *Muehlenbeckia ephedroides*, *Pimelia aridula* and *Euphorbia glauca*.

Another challenge faced in Wellington is the gradual transition of the conifer forest (pines and macrocarpas) across the city (primarily within the Wellington Town Belt) back into native forest. By 2065 we are aiming to have 65 percent of the Wellington Town Belt in indigenous forest. This needs to be a gradual transition from one vegetation type to the other. Underplanting can accelerate the successional development under these degraded exotic conifer forests²⁰.

Restoring connectivity

At present, many areas of remnant habitat are not large enough to ensure long-term survival of

²⁰ Forbes, S., Norton, D., Carswell, F. *Underplanting degraded exotic Pinus with indigenous conifers assists forest restoration*. Ecological Management & Restoration. 2014 Ecological Society of Australia and Wiley Publishing Asia Pty Ltd.



Above: *Pittosporum cornifolium* is an uncommon epiphytic species. Different planting techniques are currently being trialled so we can restore it to Wellington's forest.

populations of different species in isolation. In the urban area, it is often difficult if not impossible to extend the size of these core areas through buffer planting. To allow populations to expand and survive localised extinctions or reductions in populations, strategically located clusters of vegetation that provide core habitat for indigenous invertebrates, birds and lizards need to be connected. There is the potential to create a greater area of habitat by linking together these remnants. Creating connectivity across the landscape for fauna also enables them to cross-pollinate plants and disperse seeds.

Creating connectivity between our fragmented areas of habitat facilitates wildlife movement and connects significant areas of vegetation. Ensuring connectivity across the reserve network increases the resilience of populations, as they can be mobile in the face of events such as fluctuating food supply, increasing population and human-induced habitat changes. Without linkages between natural areas, individuals and populations can become isolated, which reduces their food supply and restricts their breeding ability. Animals often rely upon vegetated areas for movement because they cannot move through more inhospitable urban environments.

The aim for restoring our ecological connectivity is not to create continuous vegetated corridors but rather focus on existing natural areas and restoration projects that can contribute to a patchwork of habitats and refuges across the landscape. Such existing areas include parks, road reserves, horticultural and amenity areas, streambanks, coastal fringes, open space and backyards. These areas can be valuable for their undeveloped character and ability to provide connectivity through the surrounding landscape. Wellington is fortunate in its level of native regeneration, so some of these areas can restore themselves to a certain extent with minimal human intervention.

In the urban environment we tend to plant forest patches as “stepping stones” as opposed to a continuous forest tract (corridor). This is a practical solution where city infrastructure is also a priority. Stepping stones through the city facilitate movement

of mobile species, for example allowing them to rest and feed while moving between core areas. Tall stature vegetation in the right location can be used to fill this function. Appropriate use of species within urban design is a key part of creating this connectivity through the urban and suburban landscape.

To understand the functional connectivity of habitats, we need to consider the behaviour of the species, the distance it can move and its ability to be supported by the habitats through which it must move. Some target species may use corridors only a few trees wide, utilise stepping stones or may fly over open ground to reach quality remnants/patches. And others require corridors tens of metres wide. There will always be species that have trouble passing barriers. For some lizards, ground-dwelling invertebrates and even sedentary, understorey-inhabiting birds, we need to ensure that the areas these species are currently living in are of a quality that can sustain the population.

Wellington City also has several significant regional ecological linkages that need to be considered. The two main cross-boundary terrestrial linkages within Wellington are links into Belmont Regional Park and into Porirua Scenic Reserve. There is also a significant link for highly mobile bird species across Wellington Harbour to Matiu-Somes Island and Eastbourne. The principal cross-boundary freshwater link is within the Porirua catchment.

11.2.3 Beyond planting

Habitat restoration

As well as planting, there are other requirements for restoring habitat for key species that can't be met in the short term by planting.

Within vegetated ecosystems, the role of logs and leaf litter cannot be underestimated. Leaf litter provides food and shelter for invertebrates. As well as playing an important role as decomposers, invertebrates are essential components of the food web for lizards and insectivorous birds. Rotting logs are good habitat for wētā, lizards and food for other invertebrates. In many areas that are naturally regenerating or being planted, there isn't much natural material to be found on the forest floor.

In an urbanised environment, we have changed things so much that “unnatural” aspects (such as built structures) and introduced species might be forming an important part of the habitat. Within many of the reserves, exotic species are currently filling the role that natives would have originally played. Substituting planting for mature stands of vegetation reduces the functionality of the vegetation as it takes many years to create mature vegetation as habitat for species. This must be considered before any removal of vegetation, whether native or exotic. This is particularly the case when it comes to emergent tree species such as solitary macrocarpas and pines within established native forest canopy. While the intention within ecologically significant areas is gradual replacement to indigenous species, this is a lengthy process and in the meantime these large trees fill an important function in terms of creating habitat. They can also provide a food source, as is the case with kaka feeding on the sap of pine trees. Another role that these large older trees play is providing the right niche for cavity nesting species, which includes kaka, kakariki, and saddleback.

Habitat can also be created through good urban design, aside from planting. If rock walls are designed

with gaps and spaces, not only can plants find a home, but they can also provide a great place for lizards. In addition, habitat restoration does not have to be limited to a terrestrial environment. In Wellington advances have been made in the restoration of marine plant communities and further experimentation in this area is required.

Also to consider is that human intervention has occasionally created areas suited to certain indigenous species. For example, grazing creates grasslands perfectly suited to native skink species. Case by case decisions will be made whether intervention will continue for the sake of the species, or if local extinction of species as natural processes continue and habitats change is an acceptable part of the restoration process. This will depend on the threat status of the species and whether the intervention is acceptable as part of ongoing management.

Restoring our waterways

Wetlands and streams are a priority for restoration as we have lost 99 percent of the wetlands in Wellington and most of our original streams are piped. Planting streamside (riparian) zones around streams is also important for water quality as it slows runoff and



Above: There are many habitat interventions that can create safe spaces for lizards such as the Ngahere gecko, seen here at a house in Karori. These include shelters, rock piles and rock walls. Photo: Michael Hamilton

filters sediment before it reaches the stream. Sites for riparian restoration are prioritised around sediment source significance and the impact on the stream and harbour depositional environments.

Actions that can minimise excessive stream sedimentation include the establishment of a sufficient riparian zone and bank stabilisation (ideally using soft engineering solutions). A sufficient riparian zone is commonly considered to be at least 10 metres wide (with a width of 15–20 metres being preferable) and consist of native woody vegetation. Within a heavily urbanised context a 5m setback might be considered adequate, whereas in a rural context at least 10m would be appropriate. Both overstorey and understorey vegetation are needed for a fully functioning riparian zone. A healthy riparian zone is important for reducing sedimentation, as well as restoring safe habitat for instream fauna. Vegetation shades the stream (native fish prefer cool temperatures) and overhanging vegetation allows detritus and insects to fall into the stream, providing a food source.

Another key to creating functioning freshwater ecosystems is to allow fish to travel throughout our catchments. Fish passage within Wellington catchments is limited by large drops, high water velocities, perched structures, low water depths and the presence of physical barriers, including weirs, culverts and fords, which block waterways. A priority will be to restore fish passage throughout the catchments that are still largely in a natural state. These will be assessed by monitoring the species above and below the barrier, identifying how much additional habitat will be opened up by the removal of the barrier, ensuring the barrier removal will not allow access to undesirable species (such as trout) and the feasibility and cost of barrier removal. Options are complete removal of barrier, creation of structures that allow fish passage, retrofitting existing structures such as culverts, and identifying areas of concern that could be addressed as upgrades occur.

Waterways can also be restored through the recreation of stream habitat, and we will aim to daylight streams where this is practical. We will be ready to make the most of opportunities to daylight streams where these arise through proposed infrastructure projects. Streams need to have sufficient room around them for their natural processes to occur, which in most cases means allowing riparian areas that may erode as the stream channel migrates. When infrastructure is proposed near streams, we will ensure that riparian areas are of sufficient width to allow for this channel migration and appropriate riparian planting. For this reason, we will promote the daylighting of streams within reserves where there is enough room for these natural processes.

11.2.4 Guidelines

Restoring integrity

- 1 Restoring the integrity and habitat complexity of our ecologically significant areas is a priority.
- 2 Our ecologically significant core areas will be buffered through planting where possible to increase their integrity.
- 3 Our ecologically significant areas will be linked together through corridors and stepping stones to allow species to move between them.
- 4 Threatened plant species will be restored to areas they are known to have existed.
- 5 Eco-sourced species will be used for all restoration planting.
- 6 Canopy gaps created as a result of weed control or construction work (including trail building) will be a high priority for restoration planting. Sites will be replanted as soon as possible, to reduce opportunities for new pest plants to become established.
- 7 Canopy gaps created through tree fall will be monitored and will be planted if there is insufficient native seed source, a weed seed bank in the soil, or if it offers an opportunity to enrich species diversity through the planting of emergent tree species.

-
- 8 Weedy sites around the edge of forest remnants will be planted as part of restoring the buffer zones.
 - 9 Weed control on sand dunes will be immediately followed by planting to ensure that sand is not mobilised. Fertiliser will be used where we need to encourage existing sand-binders to cover bare sand.
 - 10 Maintenance after planting will prioritise controlling weed species that inhibit survival rates

Missing species

- 11 Large-scale targeted “enrichment” plantings will occur across the city to reintroduce missing species and create a seed source for the city.
- 12 Within the few forest remnants where the canopy is intact and there are indigenous plants in every tier, no further planting is required. This only applies in a handful of sites in Wellington, including the core area of Otari-Wilton’s Bush and Huntleigh Park. Within these sites, enhancement planting will only occur if monitoring shows little evidence of natural recovery.

Connectivity

- 13 When planting for connectivity through the landscape for flora and fauna, we will work towards the following recommendations²¹:
 - >5-hectare patches at about 5-kilometre spacings
 - >1-hectare patches at about 1-kilometre spacings
 - 0.02-hectare groves at about 200-metre spacings
- 14 When planting street trees, we will consider their role in connectivity and whether they can be a visual attractant to move indigenous birds along a desired route
- 15 When we aim to re-establish connectivity for any species we will consider the following movements: daily foraging, dispersal to find new territory, seasonal movements following food sources, and long distance migration.
- 16 For larger highly mobile bird species (such as tui, kereru and kaka), connectivity will be focussed

on ensuring large trees and groups of trees are available in strategic locations.

- 17 For shy and forest-dependent birds that are unable to move across large expanses of highly modified landscape, we will look at opportunities to create continuous canopy and/or a dense understorey.
- 18 The role of all open space will be recognised in order to allow plant species to naturally disperse through a fragmented landscape, particularly when those species are wind or water dispersed.
- 19 The needs of target species will be prioritised when linking together core areas and restoring connectivity through private gardens and vegetated road reserve.

Habitat restoration

- 20 Where branches or trees are removed, these will be left on site if they don’t pose a weed risk, fire risk, don’t threaten the existing vegetation and don’t compromise amenity values. Leaves and other debris will be kept on site when carrying out tasks such as trail clearance, rather than removing them.
- 21 In areas where there are cavity nesting species and no natural cavities to be found, nest boxes should be installed to meet this need in the interim. The use of nest boxes for other bird species such as little blue penguins will also be supported. Nest boxes will only be installed in areas where predator numbers are actively managed, or predator-proof nest boxes will be used.

Restoring our Waterways

- 22 The role of natural stream sections will be recognised as important habitat connections.
- 23 Daylighting streams in reserve areas will be prioritised, along with maximising opportunities through planned infrastructure projects.
- 24 Riparian planting will form no less than 20 percent of total Council planting per annum and focus on areas requiring shading or stream bank stabilisation.
- 25 Marine restoration projects will be supported when these are undertaken by our partners.

²¹ Maria Ignatieva, M., Meurk, C., van Roon, M., Simcock, R., Stewart, G. *Urban Greening Manual: How to put Nature Into our Neighbourhoods*. Manaaki Whenua Press, 2008.

“After spending decades struggling to fence off nature from people, conservation is emerging on the global stage with a new vision that emphasizes the importance of connecting nature and people.”²²

²² Daily, Gretchen C., Karieva, Peter M., Polasky, Stephen., Ricketts, Taylor H., Tallis, Heather. *Natural Capital: Theory and Practice of Mapping Ecosystem Services*. Oxford University Press, 2011.

11.3 Connect

11.3.1 Introduction

We are seeking to make biodiversity a mainstream topic by raising awareness of its value to people’s wellbeing, and the steps they can take to conserve it and use it sustainably. By connecting more people to nature we want to increase the role of the community as kaitiaki of the natural environment.

Today, 85 percent of New Zealanders live in cities and, accordingly, ecological consciousness is most relevant to urban populations. The greening of urban areas is increasingly important in providing a nature experience. If people are connected to nature, value it and understand its importance in underpinning their lives this should lead to a better quality of life. Wellington already has very active community

involvement in the environment, but this can always be increased, for the sake of the environment and the people themselves.

The Council acts as a steward of urban green space, and needs to balance conservation and recreational objectives. Getting this balance right can engage park users in recreational experiences, such as mountain biking, that also helps them appreciate the need for nature conservation.

People can take action in a number of ways, all of which are needed. Actions include everything from submitting on Council policies and plan changes and making personal “pro-nature” choices to engaging with others to take action directly to protect and restore natural areas.

Biophilic cities are cities of abundant nature in close proximity to city dwellers. They are biodiverse cities that value, protect and actively restore this biodiversity. Biophilic cities are green and growing cities where residents feel a deep affinity with the unique flora and fauna found there as well as with the climate, topography and other qualities of place that serve to define their urban home. In biophilic cities, citizens can easily recognise common native species (and in turn care deeply about them). Biophilic cities provide abundant opportunities to be outside and to enjoy nature through active recreation. Biophilic cities encourage us to spend more time amongst nature - increasing our personal wellbeing and resilience.

Biophilic cities place importance on education about nature and biodiversity and on providing many and varied opportunities to learn about and directly experience nature. In biophilic cities there are many opportunities to join with others in learning about, enjoying, deeply connecting with, and helping to steward nature - whether through a nature club, organised walks or volunteering for nature restoration projects. Biophilic cities invest in the social and physical infrastructure that helps to bring residents in closer connection and understanding of nature, whether through natural history museums, wildlife centres, school-based nature initiatives, or parks and recreation programmes and projects. Biophilic cities are globally responsible cities that recognise the importance of actions to limit the impact of resource use on nature and biodiversity beyond their urban borders; biophilic cities take steps to actively support the conservation of global nature.

11.3.2 Awareness and understanding

Our vision for Wellington is that indigenous biodiversity is a part of people's everyday lives - they will encounter native plants in urban landscaping and streetscapes, they will experience the thrill of being "buzzed" by kaka on their way to work, they will see eagle rays and New Zealand fur seals on Wellington's waterfront. Encountering native species is important in raising awareness of what is native and telling stories about what has been lost and what can be restored. If people experience indigenous biodiversity first-hand they will value it more and be prepared to take action to protect and restore it. Indigenous biodiversity also contributes towards strengthening local and national identity by celebrating what is special and unique about New Zealand. The term locally significant species is used in this context as it refers to species that aren't officially listed as threatened but have cultural significance to Wellingtonians and can be used to connect them with all biodiversity.

The Council understands the value of nature to our city and one of our goals is to ensure this understanding is shared by all Wellingtonians so that they understand the importance of nature on their lives, their impact on it, and what they can do to reduce the impact. Wellington has joined a network of

cities - the Biophilic Cities Project - that is seeking to increase the connection between people and nature.

The work we are doing means that more people will experience indigenous biodiversity as part of their everyday lives. They will see increasing numbers of native birds as witnessed by the proliferation of tui as a result of Council predator control, and kaka as a result of reintroductions by Zealandia and subsequent dispersal across the city. People already experience marine biodiversity during their interaction with the waterfront through chance encounters with New Zealand fur seals, common sightings of short-tailed and eagle rays in Frank Kitts lagoon during summer, sharing Oriental Beach with variable oyster catchers, and the occasional sighting of orca, dolphins or little blue penguins in the harbour or on the south coast. Other encounters may be more common but less appreciated - such as encounters with red-billed and black-backed gulls.

People can also experience native species through amenity planting. Road reserves and street trees provide an important visual link to nature in an otherwise urban landscape. At present, many of these comprise exotic species as well as natives.

City centres are generally areas where there are limited connections to the natural world.



Above: The Wellington waterfront and Frank Kitts lagoon are visited by huge numbers of residents and visitors every day. Encouraging native biodiversity into these areas allows a wider range of people to establish a connection to nature.

However, connections can be made through references to nature as well as nature itself. References to native species and cultural forms (eg pou whenua, waharoa) in urban design and landscape architecture are an important tool in “place making” and making a city more “biophilic” - celebrating the unique natural character of a city, placing it biogeographically whilst making it a more attractive and exciting place to live and work. This can be seen through some iconic Wellington design which references nature, such as Ian Athfield’s nikau columns around the central library and the fern ball in Civic Square.

Through existing and future plans there are a number of exciting opportunities to include indigenous biodiversity in the city’s urban public spaces - making our streets green and creating an eco-inner-city. These will also shape the city in response to its local setting and create inner-city neighbourhoods that tell our stories²³.

As a city set in nature, we have many opportunities to do this²⁴. We have emphasised the importance of better green infrastructure such as open spaces,

²³ WCC Central City Framework

²⁴ Wellington Urban Growth Plan

trees and waterways. These plans also identify the importance of the coastal environment, including ensuring that coastal development and activities respect and enhance the landscape, ecological and character values of the harbour and rugged coastal areas. This offers further opportunities to reconnect people with our coastal fringe and ensure they have easy access to a healthy coastal environment.

We can also make people aware of nature through recreational activities. Mountain biking and dog walking both cause people to spend time outdoors and we can build on these activities to link them more strongly with our biodiversity outcomes. In Wellington, we also have a strong trail building community who create linkages into our natural areas. We acknowledge the importance of allowing people to access these areas, while needing to protect our ecologically significant areas from further fragmentation. We will work to resolve the tension between these two activities and find a balance that allows for both.

11.3.3 Biodiversity and human wellbeing

In order to create support for the Council to protect and restore biodiversity or take action themselves, people need to understand the importance of biodiversity and natural processes through the life-



Above: Not all experiences have to be with living things. References to native species can also encourage a relationship with the natural world.

supporting “ecosystem services” that underpin their lives. The World Health Organization now recognises the interdependence of human health and ecosystem health²⁵. The positive, innate bond between human wellbeing and nature is supported by environmental health science²⁶.

People also need to understand what is “indigenous” and why New Zealand’s biodiversity is unique and special, as well as how healthy biodiversity can influence their own health and wellbeing. The Council has a role in informing its citizens about biodiversity. To do this effectively, we also need to work in partnership with other agencies, including DOC, GWRC, NGOs and partners such as Wellington Zoo and Zealandia.

In addition to educating people about the values of our native biodiversity we need to raise awareness around threats to it and the actions we can take to help protect it.

Children must spend more time outdoors - for their good health and the health of our planet. A growing body of research is showing that it is important for children to connect with nature and the outdoors for their health, ability to learn, self-esteem and character development. Childhood engagement with nature is the key to building on this relationship for generations to come. This can include everything from natural unstructured play and edible gardening to involvement in local restoration projects.

The Council understands the importance of connecting future generations with nature, and continues to support a number of education programmes to increase environmental literacy amongst school children and young people. This includes making them aware of where food, fibre, medicine and construction materials come from. We are also developing a number of new initiatives that will help bring young people into closer contact

with nature, linked to learning outcomes. We currently support a number of initiatives working with schools to increase children’s environmental awareness, including the proposed Children’s Garden at Wellington Botanic Garden.

11.3.4 Taking action

Conserving our indigenous biodiversity is not the Council’s job alone and it requires all sections of society to become involved at some level, taking “pro-nature” action in their daily lives. This applies whether they live in a central city apartment, out in the suburbs or on a rural lifestyle block. One role of the Council is to motivate and inspire communities to get more involved - to change behaviour and enable people to take action themselves. If we do this well people will understand why it’s important to protect New Zealand flora and fauna, how their actions and choices impact biodiversity, and what they can do to help protect the natural environment.

Once people care for and value nature, including indigenous biodiversity, they are more likely to become engaged citizens taking action to protect what they value by participating in democratic processes. This includes taking the time to submit on notified resource consents, District Plan changes, and Long-term and Annual Plans. The Council involves the community in environmental decision-making through its Environmental Reference Group - an advisory group made up of non-elected members selected for their expertise or ability to represent a specific interest group.

Initiatives to support behaviour change should lead to people making “pro-nature” choices that impact positively on local and global ecosystems. This might include exercising responsible pet ownership, desisting from dumping green waste in reserves, and preventing pollution (such as car oil, paint and cement) from entering drains. Edible planting in people’s backyards and public areas also plays an important role in connecting people to the natural environment. We can also promote broader behaviour change to help reduce impacts on global ecosystems and biodiversity - for example, by influencing

25 Zinsstag J, Schelling E, Waltner-Toews D, Tanner M (2011) From “One Medicine to One Health” and systemic approaches to health and well-being. *Prev Vet Med* 101: 148-156

26 Keniger LE, Gaston KJ, Irvine KN, Fuller RA (2013) What are the Benefits of Interacting with Nature? *Int J Environ Res Public Health* 10: 913-935.

consumer choices towards buying sustainable timber, and climate change related actions, such as reducing emissions from transport, and energy conservation.

We can also encourage and enable people to take action in their own backyard to protect biodiversity. The community needs to understand the impact of their actions (both positive and negative) on indigenous ecosystems and the measures needed to protect and restore them. Private backyards play a key role in achieving positive biodiversity outcomes. This can range from removing weeds and planting native plants to providing food and habitat for birds, lizards and invertebrates to trapping or baiting to reduce predator numbers. It can involve actions such as composting, growing their own food and not using pesticides in the garden. All these actions are useful as participation can reconnect people to nature and can lead to increases in other environmentally responsible behaviours²⁷. We cannot overstate the importance of private backyards in the bigger picture of Wellington's biodiversity.

11.3.5 Partnerships

Communities and iwi feel a deep sense of stewardship/kaitiakitanga towards their green spaces and natural places, and agencies such as DOC and GWRC have their own mandate-driven reasons. We believe that our goals will only be achieved by working towards a shared vision and in partnership with these allies. We will use our influence and local leadership to agree this common vision and coordinate the effort in our area. Our main partners fall into three categories and these require slightly different partnership strategies.

- Statutory agencies and national Non-Governmental Organisations (NGOs) with an interest in biodiversity. These include DOC, GWRC, neighbouring local authorities, Porirua and Hutt City Councils, Queen Elizabeth II National Trust (QEII), The National Office of the Royal Forest & Bird Preservation Society (F&B), Te Papa, WWF-New Zealand, Zealandia and Wellington Zoo;

- Iwi and mana whenua. The Council has a partnership with these groups under the Treaty of Waitangi. In Wellington the bodies that represent mana whenua interests are the Port Nicholson Block Settlement Trust, Te Runanga o Toa Rangatira and the wider Māori community;
- Local community-based conservation and restoration groups. This includes the Wellington Branch of Forest & Bird, Wellington Botanical Society, Friends of Taputeranga Marine Reserve and many others ranging in size and formality.

We will work with the primary biodiversity management agencies (DOC and GWRC), mana whenua, NGOs and communities to develop a shared direction. This agreed direction will allow all organisations and groups to work to their strengths in a complementary way, creating the best outcome for biodiversity.

Community restoration groups

The community has an important role to play in the protection and restoration of Wellington's biodiversity and open spaces. Community support has grown considerably over the last 10 years, from 12 groups in 2002 to 114 in 2014. This is incredibly positive and demonstrates the high levels of passion and interest Wellingtonians have for their open spaces.

These groups are all involved in environmental protection, restoration, education and/or advocacy ranging from occasional restoration planting (with the support of native eco-sourced plants from the Council's Berhampore Nursery) to active biodiversity management. We also support groups which have a primary focus on other activities such as edible gardening or trail building, but play a part in furthering biodiversity. Groups range from two or three individuals working in a neighbourhood reserve to incorporated societies and trusts carrying out restoration and activities including pest animal and plant control and restoration planting over a number of years.

In recognition of the important role played by community groups, the Council supports these groups through a number of programmes. This

²⁷ Foddy, M., Smithson, M., Schneider, S., Hogg, M. A. Resolving Social Dilemmas: Dynamic, Structural and Intergroup Aspects. Psychology Press. 2014.

includes the Council supplying groups with an annual allocation of native plants grown at the Council's Berhampore Nursery, advice from Council technical staff, support from Park Rangers and training opportunities. Each group signs a Memorandum of Understanding with the Council to cover shared objectives, respective roles and responsibilities, the area they are working in and the activities they are carrying out. The Council will also work with each group, providing necessary plans and guidelines, to ensure they are following best practise with regards to restoration and pest control.

Wellington's community restoration groups are listed on the Council website or on Naturespace.org, New Zealand's ecological restoration portal.

Community involvement in open space areas is an integral and valuable part of managing of the land. However, the establishment of community groups does not always reflect the priority of the area in terms of ecological values and biodiversity. The Council is committed to supporting such groups and

their projects regardless of site significance, as it is important that everyone has the ability to connect with a restoration project in their own way. We work with groups to integrate them within the overall management of open space areas, and ensure that the projects are sustainable. This may result in resources being applied to open space in recognition of the community interest ahead of biodiversity values, recognising the future potential of a site and the importance of engaging a large number of the community. The criteria by which community group support is assessed can be obtained on the Wellington City Council website.

The Council's Our Living City grant pool supports environmental projects, including ecological restoration, smart energy, community gardens and sustainable transport. The fund runs three rounds a year with an annual cap of \$80,000, and applications are assessed by a panel comprising Council officers and elected members. Advice on applications is sought from relevant Council business units.



Above: Growing vegetables, such as this selection from Innermost Gardens, is another way of connecting people with the natural world. Often this will lead to other pro-environmental behaviour and a broader interest in the outdoors.

Ecological leadership

The Council will take a greater leadership role in determining ecological outcomes and restoration priorities for the city and will develop plant lists for specific zones or sites based on these priorities (based on the species that originally grew in these zones or sites). The plants we provide for restoration purposes in those zones will be based on those lists. The Council will also take a greater leadership role in working with and supporting community groups in terms of technical support and the provision of advice.

Pest animal and plant control

There is a growing interest from community groups in carrying out animal pest control. This brings benefits both in terms of increasing community engagement and creating opportunities to increase the area of land under active integrated pest control. Groups need intensive support and training when they start (including capital investment in traps and equipment), and there are ongoing monitoring and compliance costs to ensure groups are maintaining necessary levels of control to achieve desired biodiversity outcomes. There are also numerous health and safety issues that need to be identified and managed. There may be opportunities to strengthen networks of community groups allowing them to support each other and share experience and best practice.

Groups are also increasingly struggling with pest plant control, particularly within planted restoration sites. The Council needs to provide further assistance to groups regarding pest plant control, both technical advice and physical work. Groups need to be encouraged to monitor their sites for plant survival to ensure they are being managed in the optimal way.

Groups working collaboratively

In some areas there are a number of community groups working towards similar goals but not in a coordinated way. Resources can be allocated more efficiently and ecological outcomes achieved more effectively if groups working within a select geographic locality coordinate their activities.

One way this could be achieved is through catchment based umbrella groups. This would also help to facilitate the restoration of aquatic ecosystems, given their complicated nature. This approach has been successfully piloted in the Kaiwharawhara Stream catchment - with a forum being supported by the Council to improve coordination and communication between groups working there. The Council will promote greater sharing of resources, expertise and cooperation in catchments and may identify individuals or groups to take a lead role in a specific activity based on proven competence and approach. Groups working within a catchment will be supported to work together more closely and develop specific areas of expertise or combine their efforts by merging.

11.3.6 Guidelines

- 1 Native biodiversity will become a common experience through reintegrating it into both the city's open space network and the built environment.
- 2 To motivate a mainstream audience to take action for biodiversity, programmes will be long term and involve a range of actions and a wide array of partners.
- 3 Open spaces need to be preserved for values other than biodiversity including sports, recreation and landscape values and we will ensure that all Wellingtonians have some access to these areas.
- 4 Environmental groups will be consulted early in the policy development process to help Council officers develop policies based on good practice.
- 5 Community groups will be our partners when delivering biodiversity outcomes, guided by current agreements and Council's guidelines for community group support.
- 6 Where there are multiple groups in a single geographic area, groups will be encouraged to work together and coordinate their efforts in order to deliver better outcomes; and allocation of resources will be dependent on this collaboration.

- 7 A number of partners, including biodiversity management agencies and NGOs, carry out biodiversity projects and we will work with them to avoid duplication and share resources.
- 8 Any programme of pest control on open space must be supported by a longer-term strategy of community education and awareness raising and be in partnership with other organisations.
- 9 Mana whenua will always have the opportunity to be involved as partners in biodiversity initiatives.
- 10 Other Māori groups not connected to mana whenua interests will also be involved in exercising kaitiakitanga.
- 11 Native plant species will be highlighted in amenity planting in public spaces.
- 12 Urban designers will use representations of native species in street furniture and civic architecture where this fits with the design aesthetic.
- 13 Edible planting will be used as a way to initially engage people with the natural environment.

11.4 Research

11.4.1 Introduction

The knowledge of how urbanisation impacts upon our natural environment (and, most importantly, how we can reduce those effects) is essential to ensuring our environment remains healthy for future generations. Research and sharing information is crucial when it comes to increasing our ability to manage Wellington's indigenous biodiversity in innovative ways.

One of the challenges that we face is that we do not fully understand the complex interactions between the urban environment and the species that live around us. Much of the research on our indigenous biodiversity has occurred in large-scale natural environments and we are aware that species can behave differently within the complex mix of land uses and habitats that occur within our city.

There are many unknowns about the most efficient and effective ways of restoring Wellington's natural



Above: Auditing the rubbish collected from Wellington beach clean-ups allows organisations such as Sustainable Coastlines to monitor long-term trends.

areas, including what may or may not be achievable. Focussed research, in parallel with the Council's monitoring programme, could help us to understand some of the ecological dynamics happening in and around our city, and where best to concentrate restoration efforts.

Because of the size and type of the land under its control, the Council has a valuable resource that can be made available for study by others or used by its own staff for research and investigation. As hands-on managers of open space, and an organisation that is connected to the wider community in numerous ways, the Council has the potential to research issues that are particularly significant locally, in the context of an urban environment.

However, research should not just be limited to Council managed open space. To understand the dynamics across an urban environment, research must be conducted across all land, regardless of use and ownership. The interactions of people - including recreational users, neighbouring property owners and restoration groups - with plants, animals, land and water are also an important and evolving part of the Wellington's ecology.

We need to develop new ways to make indigenous nature and biodiversity a part of Wellingtonians' daily lives. We can do this by increasing their knowledge and appreciation of urban nature. We must be able to fully understand our natural environment through research, and be able to explain it and present it in a way that makes sense to people. This will be strengthened if we can include people in the research through their personal observations and experience.

Innovative and specific research can be expensive and generally beyond the Council's resources. The Council can partner with research organisations to identify areas of study that have direct and practical application to open space management. Other agencies, such as Greater Wellington Regional Council (GWRC), the Department of Conservation (DOC), Landcare Research, and universities, also carry out or commission research that is relevant to the ecological management of the Council's open space.

11.4.2 Levels of research

When it comes to research and monitoring, our focus will be at three main levels. These three levels allow us to engage across the community and build the most complete picture of Wellington's ecological health. A consistent approach is needed so the data can be combined and compared across projects, and used to build understanding of Wellington's ecological integrity. Data analysis is essential, particularly when involving the community in data collection, to ensure that the research is meaningful.

Broadscale research

Using a crowdsourcing/citizen science method of data collection, you can source large amounts of data over a wide geographic area for little cost. This approach would be used to find broadscale information (widespread and simple) on things such as lizard distribution in Wellington, and anyone could get involved. Future areas involving citizen scientists include monitoring biodiversity in backyards, identifying predators from sensor camera images, and establishing the presence or absence of species across the city. Citizen science requires careful planning and management to ensure that the design allows for consistent methodologies for data collection and that relevant locations are well represented. This requires initial and ongoing collaboration between the Council, scientific organisations and the participants.

Research of managed places and species

This research focusses on delivering the detailed information needed to manage places and species effectively at an appropriate scale, so is more intensive than what can be achieved through broadscale projects. While the Council can undertake some research at this level, we can get a much clearer understanding by engaging our community in monitoring. This level of research includes looking at stream, forest and coastal health and recovery. This can help show what management works best, and can be used to improve the effectiveness of future management. It will also provide locally relevant information to share with the wider community.

Targeted research

On occasion, we need to answer specific questions that require a more detailed level of research and analysis. We may conduct this research ourselves as a Council, or for this form of research, we may work in partnership with local research institutions and/or relevant organisations. This research includes questions around the effect of aspects of the urban environment on specific species, questions around preferred microclimates for threatened species, and questions around the impact of pest species.

11.4.3 Monitoring

Without good information, it is difficult to evaluate the success and cost-effectiveness of the work being undertaken. Record keeping and monitoring has not always been undertaken consistently or systematically in the past, especially in relation to restoration plantings. Consequently, consistent information about plant survival rates, maintenance and the rate of canopy closure has not been available to inform future efforts.

By regularly sharing and reporting monitoring data and assessing its usefulness, the Council, researchers and community groups will be able to review and learn from successes and failures, adapt future on-the-ground work as required, and target future monitoring to ensure useful information is being gathered in relation to:

- the health of Wellington's ecosystems
- the results of pest control
- the results of specific restoration projects.

However, the cost implications of monitoring means that the choice of what is monitored and how needs to be carefully considered.

Until recently, monitoring has tended to focus on measuring aspects of operational performance (*output* monitoring), such as the amount of bait taken from bait stations. This remains an important part of monitoring; checking performance through regular audits of weed control and planting sites ensures targets are met, ensures sound financial management and use of resources.

What such figures do not tell us is how well our desired outcomes are being achieved. For example, a possum eradication programme may remove all possums, but if it allows rats to increase substantially, then the overall improvement in the environment may be far less than expected. So we need to ensure that our monitoring programmes are comprehensive, answer the essential questions and assist us in meeting our agreed outcomes.

We also need to ensure that monitoring aspects of Council business that impact on biodiversity is considered, such as the outcomes of resource consent decisions and evaluations of projects funded through Council grants.

Baseline monitoring was started in 2002 for the following indicators:

- the distribution and relative abundance of native forest bird species
- the structure and composition of forest and coastal plant communities
- the extent of vegetation types in natural areas managed by the Council
- the condition of forest vegetation sensitive to possum browse
- the condition of stream habitat in urban areas (using Stream Habitat Assessment Protocols).

By creating a strategic monitoring programme, then continually analysing the results, we will be able to continually adapt our biodiversity management and refine our techniques. This aim for continual improvement is an essential outcome of all monitoring programmes.

11.4.4 Sharing information

With research on urban ecology (including pest control and species interactions) being given increasing priority by institutions, new information is regularly available. Some of the information is directly relevant to Wellington City and some of indirect relevance, establishing context, principles and theory. Keeping up to date on research will assist in ensuring planning and implementation is in accordance with

the latest information available. This information, as well as all information gathered by the Council, needs to be made widely available.

Reports and information gathered through monitoring and research need to be shared through public forums such as websites and newsletters.

Many different groups of people and organisations could also benefit from the availability of open biodiversity data, including the Council. For example, by having the data freely available, everyone can see the locations of ecologically significant sites and assist with their protection.

With a variety of organisations collecting and generating a wide variety of biodiversity data and information, sharing this data has many advantages:

- More citizens will engage with the Council to support biodiversity initiatives if they can access all data, it allows for transparency and empowerment;
- Advocacy groups and researchers can analyse the data potentially producing new and better insights into the issues; In scientific research, the rate of discovery is accelerated by better access to data.
- New and existing businesses (such as nature tourism) can use the data, combined with information from other sources, to produce new services and products such as smart phone applications;
- Existing biodiversity management could be significantly improved as operational data becomes available to others, allowing recommendations for improved efficiency and effectiveness.
- If we can also share biodiversity data with that from other organisations, combined data sources and patterns in large data volumes can lead to new knowledge
- Sharing data widely helps ensure that the knowledge is preserved over time.

11.4.5 Key research questions

Protect

Managing plant and animal pests across a wide range of land types, such as large forested reserves, small suburban parks, thin corridors of vegetation and private backyards, creates a unique set of challenges and most ecological pest control research has been conducted in large forest tracts or an agricultural landscape.

In addition, because the mix of environments and pests is specific to Wellington, there is constant learning by those involved, leading to continual improvement of management strategies and control techniques. Encouragement of an open learning style leads to sharing of useful information in the field. There are new technologies for pest management that need to be scientifically trialled, as well as ongoing trials of biocontrol agents.

- How do pest species behave in urban environments?
- Which urban landscape is more likely to contain high levels of pest species?
- Does the urban landscape influence the population dynamics of pest species?
- Is pest abundance influenced by socio-economic variables?
- What is the impact of mammalian predators on our native species (including the impact of cats on lizards and which species of bird are particularly prone to predation by cats)?

To find solutions for minimising the impacts of stormwater runoff and land based effects on our aquatic ecosystems we need to better understand how the whole system operates.

We also need to better understand the utility and potential of small pockets of urban vegetation, such as road reserve, so we can better assess their value to the ecological network of Wellington and we need to understand the effects of urban intensification on the importance of these remaining small vegetated areas.

- How can urban design help minimise pest problems?
- Do we understand the effects of edge effect, habitat corridors, and fragmentation in urban environments?
- What effect does the modification of land and waterways have on aquatic ecosystems?
- How can we increase the uptake of Water Sensitive Urban Design and increase knowledge of the connection between stormwater and streams?
- What native plants will work best as green infrastructure in urban design? This includes green roofs, water-sensitive urban design, and street trees.
- What is the threshold of impervious surfaces against stream health?
- What impact do street lights in Wellington have on our indigenous biodiversity?

Restore

Restoration has a number of effects on the environment that need to be further understood.

With the fragmentation of our forests and its gradual transition into a variety of states, we need to understand the processes that are occurring and where we need to intervene. It is important to have accurate knowledge of the requirements around enrichment planting and specific species' microhabitat needs, as well as propagation techniques - particularly of threatened species (national, regional and local).

Bird monitoring shows that kaka are spreading throughout the city and breeding throughout reserves. Other species known to have bred within the reserves network through monitoring programmes include kakariki, whitehead, saddleback and bellbird. Each of these species has a different set of characteristics that affects their vulnerability to urban predators. We don't yet know enough about the reasons why some species are managing to increase their numbers

and some are failing. There are a number of cavity nesting species in Wellington, such as kaka, kakariki, saddleback, morepork and kingfisher. We don't know if the significant reduction of old growth forest is limiting these species, or if there are enough natural cavities within the reserve network.

We also know very little about the ecology of other significant groups of plants and animals within Wellington City (namely lizards, bats, invertebrates, and fungi) which makes the restoration of species within these groups challenging.

- What are the microhabitat requirements for the missing plant species we aim to reintroduce?
- What is the survival rate of Council restoration plantings and how can this be improved?
- What are the habitat requirements (including for nesting) for fauna already present in the city?
- What is the relationship between soil ecology and plant establishment?
- What species are required to provide critical food resources for bird species?
- What natural succession is happening in urban forests?
- How does bird dispersal in Wellington affect the distribution of podocarp seeds?
- What are the limiting factors for a population's expansion, eg food or nesting sites, and what are their powers of dispersal?
- When is each species vulnerable, eg is it while they are nesting or feeding?
- Where are vulnerable or significant populations of our lesser known fauna, such as bats, invertebrates and fungi?
- Are browsing animals limiting natural regeneration in Wellington reserves?

Connect

There is huge potential for social research, particularly the part that people play in urban

ecology. Opportunities for researching these topics may be realised as a result of the research partnership established between the Council and Victoria University of Wellington in 2013. We need to carry out social research to better understand why the community engages with environmental projects, or the barriers to getting involved.

- What are the motivators and barriers to people using the reserve network and people engaging in various environmental restoration projects?
- How do we combat “nature deficit disorder” in Wellington?
- What are the health and wellbeing benefits of urban nature?
- How do we use effective community-based social marketing techniques?
- How do we engage people in citizen science projects?
- What are the impacts (social and ecological) of supplementary feeding on urban bird populations?
- What are the economic impacts of urban biodiversity?
- What are economic impacts of volunteer environmental restoration projects?
- What ecosystem services do Wellington’s green spaces provide and what are the values of these?



Above: We don’t know much about Wellington’s invertebrates such as the peripatus. More research needs to be done on these species to establish where they are and what they need. Photo: Zealandia

11.4.6 Guidelines

Research

- 1 Crowdsourcing and citizen science approaches will be used where the requirement is to collect large amounts of geographically based information.
- 2 Community groups will be engaged in monitoring specific sites and species, and given the support and training required.
- 3 Targeted research will be conducted in partnership with relevant organisations.
- 4 Where possible, university students will be engaged to conduct research on our behalf to support a new generation of scientists.

Monitoring

- 5 Monitoring programmes will be established or maintained to measure changes in the condition of priority sites and to determine the effectiveness of animal and plant management being undertaken.
- 6 Work done will be regularly audited to ensure it is being performed to the required standard and in accordance with all relevant policies and procedures.
- 7 Monitoring will be used to establish the effects of our urban environment on our aquatic ecosystems.
- 8 All monitoring will be consistent with a local, regional and national picture.
- 9 Monitoring data will be used to analyse trends and make recommendations for adaptive management.

Sharing information

- 10 All work will be informed by current best practice and this information will be made available to staff and contractors.
- 11 All information gathered by the Council as part of research and monitoring programmes, particularly programmes that have included the community gathering the data, will be shared with interest groups and the general public.
- 12 Relevant information gathered by the Council as part of research and monitoring programmes will inform Council plans and policies such as reserve management plans and the District Plan.