ASSESSMENT OF POTENTIAL THREATS TO THE ECOLOGY OF CLIFFTOP COASTAL PŌHUTUKAWA FOREST WITHIN THE ŌRĀKEI WARD, AUCKLAND

providing outstanding ecological services to sustain and improve our environments

Wildlands

R3987

ASSESSMENT OF POTENTIALTHREATS TO THE ECOLOGICAL OF CLIFFTOP COASTAL PŌHUTUKAWA FOREST WITHIN THE ŌRĀKEI WARD, AUCKLAND

Contract Report No. 3987

June 2016

Project Team:
Sarah Roth - Report author
Nick Goldwater - Project manager, peer review
Steve Rate – Peer review

Prepared for:
Tāmaki Drive Protection Society Inc
C/- Juliet Yates
11 Berowald Place
St Heliers 1071

CONTENTS

Reviewed and approved for release by:

_____

Steve Rate
Senior Ecologist
Wildland Consultants Ltd

1. EXECUTIVE SUMMARY

The Tāmaki Drive Protection Society (the Society) is a locally elected not-for-profit organisation whose main objective is to promote the protection and preservation of Tāmaki Drive and Ōrākei Ward for its amenity, ecological, economic and transport values. As part of their endeavours, the Society has commissioned Wildland Consultants Ltd to assess the potential threats to the ecology of the coastal pōhutukawa (*Metrosideros excelsa*) forest remnants within the Ōrākei Ward.

The assessment largely consisted of a desktop review of existing ecological reports and evidence regarding the ecology of this area, and subsequently identifying important issues and threats that may compromise the ecological integrity of the coastal vegetation within the Ōrākei Ward. Within the report, threats are prioritised from the most to the least severe based on their potential adverse impacts on the environment.

Results from this research indicate that residential and commercial development within the project area poses the most risk to the ecological integrity of the remaining pōhutukawa forest. Associated with the threat of development is that of clifftop instability which can be largely remedied by the retention and revegetation of indigenous coastal forest, particularly pōhutukawa. Competition by pest plants is potentially the most serious threat in terms of preventing the regeneration of coastal forest, but is placed behind development and cliff instability due to the importance of retaining all remaining pōhutukawa forest. Other potential threats to pōhutukawa include indiscriminate trimming or pruning which may result in the compromised survival of individuals, diseases, and browsing pest animals.

2. INTRODUCTION

The Tāmaki Drive Protection Society has made submissions to Auckland Council requesting amendments to the regulations that protect coastal vegetation within the Tāmaki Drive Masterplan area (2012), and it is currently acquiring information to promote the values and enhance public awareness of the coastal forest remnants. To this end, the society commissioned Wildland Consultants Ltd to investigate potential threats to the clifftop pōhutukawa forest within the Ōrākei Ward. This report provides detailed information on the following potential threats to these areas:

- Vulnerability of clifftop areas to instability and erosion;
- Competition from invasive pest plants;
- Pest plant, insect and disease incursions;
- Browsing by pest animals;
- Indiscriminate trimming, pruning or removal of indigenous vegetation;
- Public infrastructure and future development within the coastal clifftop area; and
- Private home and future development within the coastal clifftop area.

In addition, the report outlines broad recommendations on how to minimise or mitigate some of these potential risks.

3. BACKGROUND

The Tāmaki Drive Protection Society is a locally elected not-for-profit organisation whose main objective is to promote the protection and preservation of Tāmaki Drive for its amenity, ecological, economic and transport values. In 2012, The Ōrākei Local Board, with strong support from the Tāmaki Drive Protection Society, produced the first draft of the Tāmaki Drive Masterplan (henceforth referred to as 'the Masterplan'; for a map of the area considered within the Masterplan refer to Appendix 1), which was subsequently approved by the Auckland Council. The Masterplan focuses on preserving the unique environment of Tāmaki Drive. The Masterplan area extends from Mechanics Bay in the west to Glover Park in the east, and to St Heliers Bay Road in the south. Also included in the Masterplan area are Whenua Rangatira, a large cultural reserve, and Kepa Bush, a large conservation reserve and the largest area of contiguous indigenous vegetation remaining on the Auckland isthmus.

The area included in the Masterplan, along with much of urban Auckland, has been subject to policy changes which have resulted in reduced protection for vegetation, particularly along the coast. Prior to the Resource Management (Simplifying and Streamlining) Amendment Act 2009, the coastal protection yard[1] required that the natural character of the coastal environment be retained by preventing the destruction or modification of indigenous vegetation and exotic trees of a nominated size. Following the 2009 Amendment, protection of vegetation is limited to individual trees or groups of trees that have been scheduled under the Proposed Auckland Unitary Plan (PAUP), and vegetation within Significant Ecological Area (SEA) overlays. A key objective of the Masterplan is to protect and preserve the natural character of Tāmaki Drive[2], describing the area as a "seaside village" with "coastal character," an "environment connecting the land and sea," and an area with "unique ecology." Ecologically, the trees are a critical component of Tāmaki Drive due to their role in forming a wildlife corridor for indigenous fauna and providing buffering for the cliffs, yet the Society fears that many trees are not protected under any legislation.

In 2015, the Society commissioned Wildland Consultants Ltd to carry out a survey of the coastal, clifftop pōhutukawa forest remnants within the Tāmaki Drive/Ōrākei Ward area that consisted of an initial desktop assessment focussing on coastal vegetation, followed by a ground-truthing survey. Results indicated that the indigenous-dominated vegetation is the most abundant vegetation type, covering approximately 23.3 ha (46%) of the area surveyed. Pōhutukawa forest covers 14.8 ha, which is 64% of the area covered by indigenous-dominated vegetation, and 29% of the total area surveyed. In contrast, exotic-dominated vegetation covers only 5.9 ha (12% of the total area surveyed).

Some of the indigenous-dominated vegetation, including pōhutukawa forest, is old growth, while most is regenerating (*c*.60-80 years old). Much of the regenerating indigenous vegetation can be characterised as amenity planting, and some areas

---

[1] The coastal protection yard is defined as a yard measured in a landward direction from mean high water springs imposed on all (i) business zoned and mixed use zone land within 20 metres of MHWST mark; and (ii) other land (excluding roads) within 10 metres of MHWST mark (PAUP 2013).

[2] "Tāmaki Drive" will henceforth refer to the area included in the Masterplan, and is not limited to the seaside road unless specifically stated.

contain a range of exotic weeds in the understorey. Furthermore, much of the exposed coastal cliffs along the north-eastern extent of the area surveyed are dominated by pest plants such as pampas (*Cortaderia selloana*), tree privet (*Ligustrum lucidum*), Chinese privet (*L. sinense*), boneseed (*Chrysanthemoides monilifera*), sweet pea shrub (*Polygala myrtifolia*) and gorse (*Ulex europaeus*).

4. METHODS

Information was collated primarily from databases and websites, particularly those of Auckland Council. An assessment of potential threats to the ecology of the clifftop pōhutukawa forest was carried out based on background research and surveys, including the previous Wildlands surveys, and the potential effects of those threats were assessed. Opportunities to avoid, remedy, or mitigate potential adverse effects were investigated. A literature review was carried out to identify relevant information on the potential threats to pōhutukawa forest.

A desktop survey of the most vulnerable areas was carried out using a combination of Google Earth Pro (Version 7.1.5.1557) and the Auckland Council GIS viewer, which facilitated the identification of vegetation and potential development sites within Tāmaki Drive, together with layers from Land Information New Zealand (LINZ) and Technical Publications from Auckland Council, particularly the Potential Growth Strategy series.

Sites where revegetation and pest plant control could be undertaken to improve ecological values were assessed using knowledge and information from previous surveys in combination with recent aerial imagery from Google Earth Pro. These sites were prioritised and mapped using ArcGIS 10.3.

5. ECOLOGICAL AND CULTURAL CONTEXT

The study site is centrally located in the Tāmaki Ecological District, at the mouth of the Waitemata Harbour. The Tāmaki Ecological District, which encompasses the heavily urbanised isthmus between the Manukau and Waitemata Harbours, is one of the most modified ecological districts in New Zealand and is continuing to change as urbanisation intensifies (Lindsay *et al.* 2009). Despite some regulatory efforts to conserve the remaining green space, the few areas of indigenous vegetation present only cover 11.7% of the ecological district (Land Cover Database 3[1]).

5.1 Tamaki Ecological District

Prior to human settlement, Auckland's eastern bays from Ōrākei Basin to West Tāmaki Point were probably dominated by pōhutukawa, forming a contiguous belt of coastal forest along the steep cliffs and headlands of Tāmaki Drive. In the open areas, mixed coastal broadleaved species forest would have dominated amongst brackish estuarine vegetation and freshwater wetlands in the low lying areas that are now

[1] LCDB3 - Landcare Research *Manaaki Whenua*, 2012.

Mission Bay, Kohimarama and St Heliers Bay. Little of these vegetation types remain in the Tāmaki Ecological District, with coastal forest in particular reduced to *c*.2% of its original extent (Lindsay *et al.* 2009).

The clearance of indigenous forest cover has occurred in the area for hundreds of years, starting with early Polynesian occupation, and followed by rapid rural and urban development (Esler 1987). Some kauri (*Agathis australis*) remnants with hard beech (*Fuscospora truncata*) remain on the North Shore and very small patches of volcanic boulderfield remain on volcanic cones. In city parks, there are remnants of lowland forest and fringes of pōhutukawa present on steep coastal cliffs throughout the district. Mangroves (*Avicennia marina* subsp. *australasica*) have been reduced from their former extent, but are still present in estuaries and harbours (Lindsay *et al*. 2009).

Most remaining areas of indigenous vegetation are heavily impacted by edge effects, invasion by introduced animal and plant pests, and their isolation from larger, more contiguous tracts of indigenous vegetation (Myers 2005). The introduction and spread of these pest plants were by means of agriculture, horticulture, trade and industry of the early to mid 1800s (Esler 1987). The impact and spread of many introduced plants were intensified by the changing landscape, which was characterised by clearance of bush, filling of shallow wetlands, and suppression of indigenous restoration in areas otherwise suitable for development. Reflecting this pattern of clearance, 32% of Tāmaki Ecological District lies on 'Acutely Threatened' Land Environments (land where <10% of indigenous vegetation cover remains; refer to Walker *et al.* 2007).

5.2 Local Context

Today, Tāmaki Drive is characterised by planted pōhutukawa along the coastal walkway from Okura Point to Achilles Point. Coastal forest dominated by pōhutukawa with occasional karaka (*Corynocarpus laevigatus*), ngaio (*Myoporum laetum*), pūriri (*Vitex lucens*), tarata (*Pittosporum eugenioides*) and karamū (*Coprosma robusta*) still persists in small remnant forests throughout Tāmaki Drive. Mixed exotic shrubland and scrub dominate the open coastal cliffs, while pōhutukawa dominates the forest canopy along the seaward side of the road. Parks and reserves are characterised by specimen trees of pōhutukawa and large exotic species such as sheoak (*Allocasuarina littoralis*), Moreton Bay fig (*Ficus macrophylla*), Norfolk pine (*Lagunaria patersonia* subsp. *patersonia*) and Queensland brush box (*Lophostemon confertus*).

All freshwater wetlands and associated freshwater vegetation along Tāmaki Drive have been drained and filled, and converted into parks and sports fields, while only small remnants of brackish estuarine vegetation persist on the south-western coastline associated with Ōrākei Basin.

The ecological values of all remnant coastal forest, including clifftop pōhutukawa forest, are considered to be high because they (i) provide of habitat for indigenous flora and fauna, (ii) provide ecosystem services in terms of stormwater filtering, wind breaking and erosion control, and (iii) are representative of a much reduced habitat type. Within a local context, vegetation within Tāmaki Drive characterises habitat types that are considerably reduced in extent and provides:

- Bird and lizard habitat;
- Wildlife corridor/stepping stone habitat;
- Representative coastal habitat;
- Protection from coastal erosion; and
- Buffering during extreme weather events.

As such, the coastal cliffs dominated by pōhutukawa are considered to have relatively high ecological values.

5.3 Cultural context

Tāmaki Drive has a rich cultural history from early Māori settlement to modern tourism, recreation and coastal living (Masterplan 2014). The land, sea and ecology of Tāmaki Drive have played an important role throughout its history, with its distinctive coastal cliffs, estuarine and brackish mangroves, as well as wetlands and forests.

6. STATUTORY CONTEXT

6.1 Policies to Protect Ecological Values

The Resource Management Act (RMA 1991) was drafted and approved to "promote the sustainable management of natural and physical resources" including "safeguarding the life-supporting capacity of air, water, soil and ecosystems." Despite this, green space is declining in Auckland as urban intensification drives the removal of vegetation and the proportional increase of impermeable surfaces (Wyse *et al*. 2015). The removal of vegetation, particularly indigenous trees, results in a loss of food and habitat resources for indigenous fauna and a reduction in ecosystem services and ecological integrity. Furthermore, aspects of community well-being, natural character and Māori customary values are lost as vegetation in both the public and private domain is altered or removed (Brown *et al.* 2015).

One of the main reasons for the decline of green space in Auckland is the shift away from blanket protection of all trees above a certain height or trunk size (Wyse *et al.* 2015). This shift resulted in a schedule of "notable" trees being the only legislative protection for trees outside Significant Ecological Areas or coastal and riparian margins (Wyse *et al.* 2015). A comprehensive study carried out by Wyse *et al*. (2015) concluded that the case-by-case tree protection strategy (i.e., the schedule of notable trees) provides insufficient protection for Auckland's urban biodiversity. Of the vegetation (indigenous and exotic) on private property that was previously protected through blanket tree protection policies, only 15% is protected under the current legislation. In Auckland, private property comprises over 65% of green space, so the change in tree protection policy greatly reduces the protection of urban green space.

Fortunately, much of the vegetation within the study area is protected due to its proximity to the coast in combination with the steep terrain that is characteristic of the headlands. The PAUP legislation requires consent to be sought for the "Restricted-

Discretionary" activity of alteration or removal of more than 25 m^2 of contiguous vegetation or tree alteration, or tree removal of any indigenous tree over 3 m in height that are (a) within 20 m of MHWS or (b) within 20 m of a top of a cliff with a slope exceeding 18 degrees where the cliff is located within 150 m of MHWS. However, this is not often known to private residents and enforcement of the policy is sometimes difficult, particularly in areas where properties extend to MHWS and neighbours may be unable to see vegetation changes on the property.

6.2 Significant Ecological Areas

Much of the coastal vegetation and marine area within the Masterplan is within an SEA overlay. Under the PAUP, most vegetation alteration or removal within an SEA requires resource consent, unless falling under certain exceptions[1]. However, vegetation removal of 300 m^2 or less within an SEA for the purpose of building a platform or access way for a dwelling is a Controlled activity. This means that consent is required, but will always be granted, sometimes with certain conditions imposed to minimise adverse ecological impacts. This condition reduces the protection to indigenous vegetation within SEAs.

7. ECOLOGICAL THREATS

Clifftop pōhutukawa and associated coastal forests and vegetation located within the Masterplan area, and throughout Auckland, face a range of threats, both anthropogenic and natural in origin. The main ecological threats are described below in order of greatest risk to least risk to the ecological integrity of the pōhutukawa forest.

7.1 Future development within the coastal clifftop area

Residential and commercial development of the coastal clifftops near urban centres is considered desirable by people throughout the world, and therefore poses a risk for the success of indigenous species that would otherwise occupy that area (Buxton 2012). The east coast of the Auckland region will likely continue to experience property loss and/or damage due to dense urban development on the top of actively eroding coastal cliffs (City of Auckland 2015).

Requirements for building setback from the coast ensure that new buildings do not undermine the level of amenity currently enjoyed by coastal landowners and the public. However, in many parts of the foreshore the natural functioning of coastal processes has been undermined by development that has occurred historically and is

[1] Vegetation management in SEAs is permitted in the following situations: biosecurity tree works; deadwood removal; vegetation alteration or removal for routine maintenance and repair of existing tracks, lawns, gardens, fences and other lawfully established activities; vegetation alteration or removal for customary use; emergency tree works; existing forestry and farming activities; pest plant removal; conservation planting; vegetation alteration or removal for routine, maintenance within 3 m of existing dwelling; vegetation alteration or removal for routine, maintenance within 3 m of existing buildings greater than 100 m^2; tree trimming within 10 m of existing buildings.

consequently being maintained. This is particularly true for causeways, including those on Tamaki Drive, that are often flooded by spring tides or storm surges.

Buildings, including fencing and structures like swimming pools, are restricted within the coastal marine area throughout Auckland so as to maintain the soft green character of the coastal edge, as well as in recognition of the coastal erosion issues such structures raise (Auckland Council 2012b).

The PAUP outlines that most vegetation removal or alternation within the coastal marine area is a restricted discretionary activity requiring consent, but it is possible that consent applications will be granted under certain conditions resulting in reduced vegetation cover within the coastal marine area. It is likely that more changes to vegetation management regulations will occur when decisions surrounding the PAUP are released, and therefore it will be necessary to consult the most up to date Unitary Plan Rules to determine their impacts on pōhutukawa forest.

7.1.1 Public development

Due to the nature of the urban environment that characterises the Masterplan area, the capacity for public development of business and infrastructure within instable clifftop areas is limited to less sensitive areas. It is most likely that any future development would happen in the low-lying commercial areas near the beaches of St Heliers, Kohimarama and Mission Bay, where pōhutukawa that have been planted in reclaimed soils and retain high amenity value are unlikely to be disturbed.

7.1.2 Private development

The scope for private development is far greater than that of public development within the project area. According to the Potential for Growth Studies report (Balderston & Fredrickson 2014) there is capacity under the provisions in the PAUP for between 258,487 additional dwellings (utilising infill) and 417,079 additional dwellings (utilising redevelopment) throughout the Auckland region; however, the feasible capacity based on external factors including economic sustainability is much lower. A map of areas most at risk of future development within residential areas within the Masterplan area is provided in Figure 1.

Within the project area, the majority of development is likely to occur within residential areas that will increase in density. Densification will largely be characterised by an increase of one or two dwellings per lot; however, some areas that are capable of supporting higher density living will house apartments or townhouses. One development project that has received media attention is the Ōrākei Bay Village Development located within the Ōrākei Basin. This development has been underway since 2007, having been delayed by Auckland Council policies and procedures, and currently proposes to build 700 apartments with the scope of increasing development opportunities in the future. Other potential hotspots for development include Brenton Place, along Kepa Road between Kupe Street and Dudley Road, along Tamaki Drive north-west of Kohimarama Road, and the area contained by Polygon Road south to Paunui Street/Sylvia Road and between Goldie Street and Yattendon Road (see Figure 1).

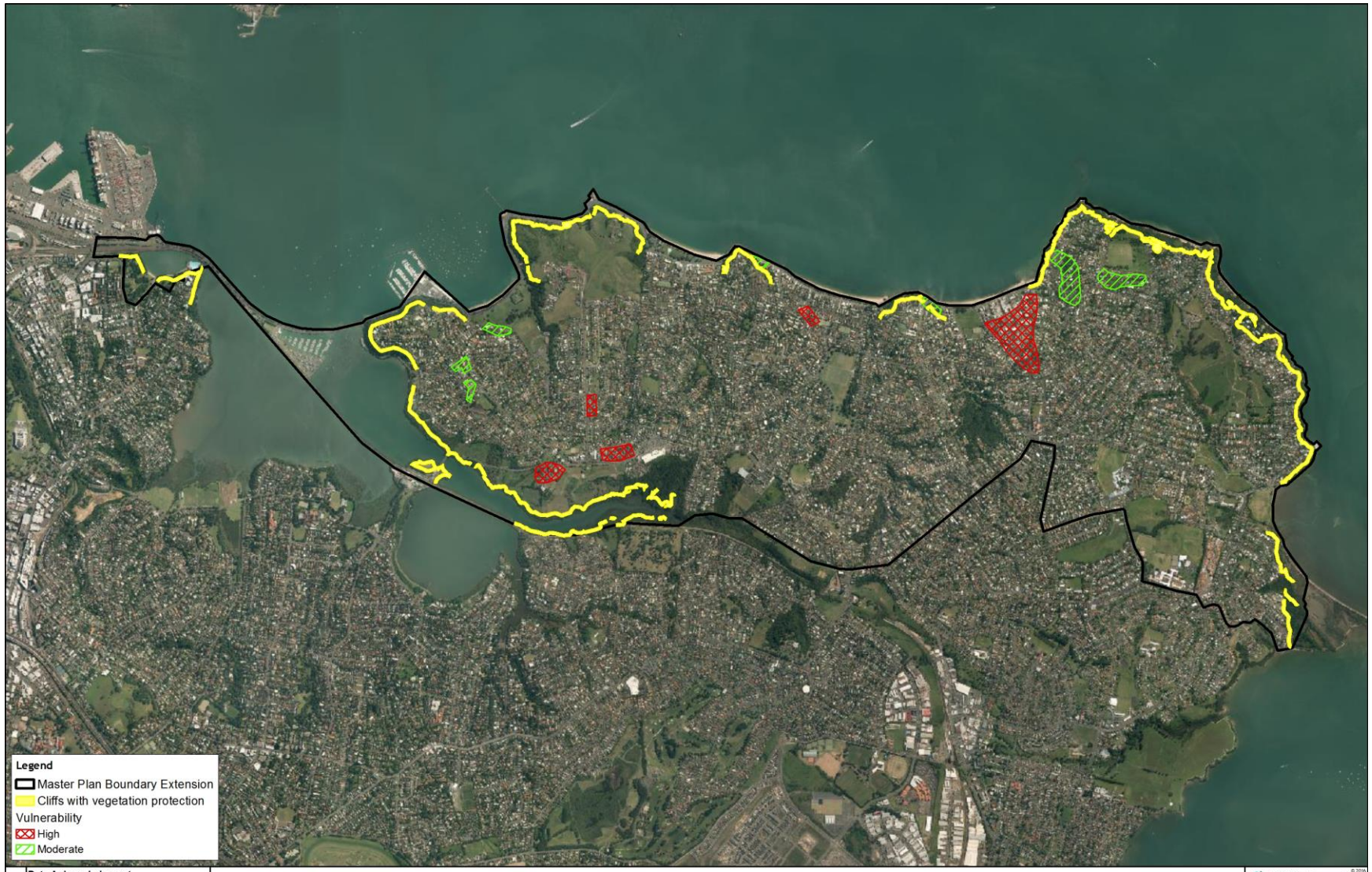
The development of potential hotspots identified in Figure 1 poses a risk to the survival of the pōhutukawa forest and associated ecosystem within these areas, some of which are characterised by steep coastal cliffs. Pōhutukawa can be compromised by a number of activities including those that are anthropogenic and ecological in nature. For a range of reasons, pōhutukawa continue to come into conflict with the ambitions of local residents, which has resulted in their removal from exposed clifftop areas on multiple occasions.

7.2 Clifftop instability and erosion

Coastal erosion is a natural part of the dynamic environment that is the interface between land and sea. Erosion, however, becomes problematic once modification of the coastal system occurs by anthropogenic means (Shepherd 2009). Although many natural landforms including beaches, dunes, cliffs and estuaries are termed hazardous in terms of development (Auckland Regional Council 2000), many of these features are in a state of dynamic equilibrium that ensures the coast and its physical features are able to absorb and recover from the effects of natural coastal events such as storms, sea level rise and tsunamis. Although more than 80% of the world's shorelines are eroding at rates varying from centimeters to metres per year (Pilkey and Hume 2001), coastal communities and near-shore structures are often protected naturally by healthy foredunes, which are able to absorb the effects of storms (Auckland Regional Council 2000). The high rates of erosion seen in most coastal settlements throughout the world are due to the poor management of the land-sea interface, especially where heavy use and dense populations are not anticipated or planned for appropriately (Parks Recreation and Heritage Forum 2013).

Much of the coastal cliffs along Tamaki Drive are characterised by soft sedimentary mud and sandstones (Waitemata Group) and are therefore vulnerable to coastal hazards such as erosion and slumping (Auckland Regional Council 2000). The impacts of coastal hazards are widespread and include social, economic and environmental effects that inhibit the healthy functioning of a myriad of systems. Naturally, the coastal environment is dynamic and the ecosystems that have evolved in these environments are able to adapt to changing winds and water levels, storms and erosion. However, the majority of the human population lives within 1.5 km of the coastline and the associated human occupation of coastal environments has resulted in a considerable decline of habitat available for local flora and fauna. This reduction in habitat diminishes the ability of coastal ecosystems to respond to the rapid changes that are occurring in the already dynamic coastal environment.

Although reduced in extent, pōhutukawa is still prevalent along the coastal cliffs of the Masterplan area (Figure 1); the trees that remain provide a valuable service in terms of reducing erosion and improving cliff stability. Pōhutukawa forests form a significant habitat type for indigenous fauna along the upper half of the North Island's coastline (Haines *et al*. 2007). The pōhutukawa fringe along Auckland's coastal cliffs makes a significant contribution to the visual amenity of the city's coastline and helps to slow down the rate of natural erosion (Auckland Council 2012b). Pōhutukawa has evolved to thrive on exposed, coastal rock faces, and it has aerial roots that can re-sprout if a slip occurs. The roots of pōhutukawa stabilise the soft sedimentary rock that characterises much of Auckland's coastline.



Data Acknowledgment
Map contains data sourced from LINZ
Crown Copyright Reserved

Report: R3987
Client: TAMAKI
Ref: 06 0765
Path: E:\gis\AK_Cliff\mxd\
File: Redevelopment_capactly.mxd

Figure 1. Areas of potential urban intensification within the Masterplan area and extension to Tahuna Torea Nature Reserve

0 1,000 2,000 m

Wildlands © 2016
www.wildlands.co.nz, 0508 WILDNZ

Scale: 1:25,000
Date: 08/07/2016
Cartographer:
Format: A3R

7.3 Pest plants

In Auckland, the number of exotic species vastly outnumbers that of indigenous species, resulting in the claim of Auckland being one of the weediest cities in the world (Esler 1988). Most of these exotic species have thus far been unable to naturalise, and only a handful (over 200) are identified as noxious weeds in the Auckland Regional Pest Management Strategy (Auckland Regional Council 2007). Nonetheless, weed invasion is a serious threat to the ecological integrity of indigenous vegetation, including vegetation on coastal cliffs throughout the country. Pest plants that have been specifically identified by the New Zealand Plant Conservation Network as threats to indigenous coastal vegetation and habitats include gorse, ice plant (*Carpobrotus edulis*), pig's ear (*Cotyledon orbiculata*), boneseed, evergreen buckthorn (*Rhamnus alaternus*) and Chilean rhubarb (*Gunnera tinctoria*).

Of these species, evergreen buckthorn is of most concern in the cliffs surrounding the Ōrākei Ward. Evergreen buckthorn is an aggressively growing perennial evergreen shrub that grows to 5-8 m in height and is prevalent throughout coastal areas in Auckland. Evergreen buckthorn has the ability to out-compete pōhutukawa and other indigenous plants by colonising available ground space, eventually excluding all other species (Fromont 1997). It is particularly prevalent on offshore islands where it can achieve 80-100% ground cover very quickly (Fromont 1995).

7.4 Indiscriminate trimming, pruning and/or removal of indigenous vegetation

A change in vegetation protection regulations following the Streamlining and Simplification Amendment (2009) resulted in many trees being felled in urban Auckland. Although pruning of trees that are not otherwise protected is permitted without the need for consent in certain areas, the tree must not be damaged or destroyed during pruning, maintenance or other activity in the vicinity, or within the dripline, of the tree. Furthermore, if a tree is removed or destroyed, a replacement tree or trees must be provided elsewhere on the site or in the vicinity, where appropriate (the size and species must be approved by the Council; Auckland Council 2012b). Care should therefore be taken to prevent damage or mortality to any tree that is pruned. Furthermore, tree regulations should be consulted, particularly if the tree is located near the coast or near a coastal cliff, to ensure the correct regulations are being followed as many tree regulations still apply despite the Streamlining and Simplification Amendment.

7.5 Browsing by pest animals

Browsing pest animals, particularly the brushtail possum (*Trichosurus vulpecula*), have caused severe damage to indigenous vegetation in New Zealand (Fitzgerald 1981). Eradication of possums from inshore and offshore islands has resulted in forest recovery (Atkinson 1992). Unfortunately, possum control on the mainland is limited due to the wide distribution of the pests, rapid reinvasion of controlled sites, and limitations in current control methodologies.

Possums feed mainly on leaves, but will also eat buds, flowers, fruits and seeds, bark, and fungi. Possums will also eat invertebrates, will opportunistically eat native birds and their eggs when they encounter nests, and will occasionally scavenge on carcasses

of larger animals. Possums will selectively feed on their favoured tree species to the point that they can cause their local extinction. Favoured tree species include pōhutukawa, rata (*Metrosideros* spp.), tōtara (*Podocarpus totara*), kōwhai (*Sophora* spp.) and kohekohe (*Dysoxylum spectabile*), although comprehensive studies quantifying death rate of these species by possum damage has not been carried out. Nonetheless, control of possums is essential to protect forest ecosystems.

Few pest animal control projects have been documented within the Masterplan area, probably due to the fragmented nature of the green space present in the area and the fact that most of it is in private ownership. Pest animals such as rats (*Rattus* spp.), stoats (*Mustela erminea*) and possums are being controlled within some parks and reserves by community groups, iwi and/or landowners, e.g. Mechanics Bay, Kepa Bush Reserve, Bastion Point, Churchill Park and Point England Reserve (Predator Free NZ 2014).

Increased levels of possum control, particularly within private property, would result in resurgence of pōhutukawa as possum browsing pressure would be reduced.

7.6 Insects

In general, populations of pōhutukawa show limited sign of insect damage to mature individuals, although evidence of damaged foliage by chrysomelid, phasmids and/or scarab beetles occasionally cause noticeable damage to old foliage or young individuals (Hosking and Hutcheson 1993). Overall, no immediate threats to the succession of indigenous species currently present within the coastal environment of the project area exist due to insects; however, there are many potential threats that have the ability to reduce the fecundity of plants and compromise their survival. Insects that pose the highest potential threat to coastal plants are detailed below:

(i) Gypsy moth (*Lymantria dispar dispar*)

The gypsy moth causes severe damage to forest and shade trees and is widespread internationally, although is not presently found in New Zealand (MPI 2015). In a study conducted by Hough and Pimentel (1978), white oak (*Quercus alba*) and red oak (*Q. rubra*) generally produced the greatest survival, most rapid development, heaviest pupae and highest fecundity of gypsy moth. Oaks are part of the Fagaceae family, which include New Zealand indigenous species such as beech (*Fuscospora* spp. and *Lophozonia menziesii*); as such these species are potential hosts for the gypsy moth but are uncommon along coastal areas.

(ii) Fall webworm (*Hyphantria cunea*)

The fall webworm is well-known for its ability to feed on several hundred different species of plants, with a preference for cherries (*Prunus* spp.), mulberry (*Morus* spp.), dogwoods (*Cornus* spp.), sycamores (*Plantanus* spp.), persimmons (*Diospyros* spp.), poplar (*Populus* spp.), willows (*Salix* spp.), white birch (*Betula papyrifera*), apple trees (*Malus domestica*) and sweet gum (*Liquidambar styraciflua*) overseas (Hoover 2001). The fall webworm is currently listed as an "Unwanted Organism" according to the Ministry for Primary Industries. It was discovered in Auckland in 2003, but is now considered to be eradicated. However, if the fall webworm were to resurface in New

Zealand it would threaten a wide range of fruit and deciduous broadleaved tree species of which few are indigenous.

(iii) Painted apple moth (*Teia anartoides*)

The painted apple moth is an aggressive and indiscriminate feeder that results in the defoliation of plants by eating their leaves. It has been found on several indigenous host species including kōwhai, ribbonwood (*Plagianthus* spp.), karaka and mangrove, but prefers Australian plant species as hosts that mainly include wattles (*Acacia* spp.). The painted apple moth is currently listed as eradicated in New Zealand (MPI 2015) and has a limited history of being detected in New Zealand, predominantly around ports. However, due to the ability of the moth to adversely affect coastal tree species including kōwhai, karaka and mangrove, the introduction and spread of this pest would post a potential threat to the sustainability of coastal forests in the study area.

7.7 Disease

Although diseases have not been well-documented for pōhutukawa, a number of leaf spot and saprophytic fungi have been recorded that have inconsequential effects on overall tree health (Hosking and Hutcheson 1993). Nonetheless, the potential for disease entering New Zealand from overseas or the hybridisation/evolution of species currently present in New Zealand still pose future risks, some of which are described below:

(i) Dieback fungus (*Phytophthora* spp.)

Phytophthora are microscopic fungi-like plant pathogens that infect and kill a wide range of species. Some species of *Phytophthora* (there are over 130 known) are producing hybrid pathogens, known to be the cause of widespread and serious plant diseases. There is limited evidence of *Phytophthora* infecting coastal species in New Zealand and therefore the risks of adverse impacts are likely to be minimal. However, due to the ability of this organism to hybridise, potential impacts exist.

(ii) Myrtle rust (*Puccinia psidii*)

Myrtle rust is a fungal disease of plants that attacks the new shoots, flowers and leaves of species in the Myrtaceae family. The disease can have potentially devastating impacts on a range of indigenous and exotic species. Fortunately, myrtle rust has not yet reached New Zealand, although it is expected to do so in the near future due to the close proximity of sources in eastern Australia and New Caledonia. The rust may have potentially serious consequences on the following indigenous species: pōhutukawa, rata, mānuka (*Leptospermum scoparium*), kānuka (*Kunzea* spp.), ramarama (*Lophomyrtus bullata*), rōhutu (*L. obcordata*) and swamp maire (*Syzygium maire*). Pōhutukawa, kānuka and mānuka are relatively common within the coastal habitat of the Auckland region.

8. RECOMMENDATIONS TO AVOID, REMEDY OR MITIGATE

8.1 Overview

This report covers a relatively small coastal area of the Auckland region, although one which has become increasingly urbanised. Urban forests are becoming reduced in extent and more isolated in cities around the world, yet their values are identified in numerous regulations and policies, and by community groups, organisations and economic enterprises. As such, the scope for a regional study and protection of the ecologically valuable remnants of Auckland's urbanised coasts is necessary. It is acknowledged that this is an extensive undertaking, so focussing on the most vulnerable areas is recommended as a priority (some of these have been identified in Section 8).

Recommendations to avoid, remedy or mitigate potential adverse impacts on the ecological of the coastal area are outlined below based on topics covered in this report, with a focus on pōhutukawa forest.

8.2 Development within the coastal clifftop area

The development of the potential hotspots identified in Figure 1 poses a risk to the survival of the pōhutukawa forest and associated ecosystem within these areas, some of which are characterised by steep coastal cliffs. Where possible, construction should be avoided within 150 m of any coastal cliff with a slope greater than 18 degrees and all vegetation should be retained.

8.3 Clifftop instability and erosion

The rate of erosion on coastal cliffs can be drastically reduced by minimising land modification and protecting existing landforms from development. Existing landforms can most practically be protected during the design phase of landscaping and development that is approved to take place near and around coastal areas. The design of any landscaping (including indigenous revegetation and restoration works) should be sympathetic to the topography of the land. This will minimise disturbance of the soils, avoid disruption of existing hydrological regimes, and prevent the possibility of destroying any evidence of historical land use or blocking coastal views. The use of heavy equipment should be avoided as it results in compaction of soils and alters the soil structure, potentially leading to erosion (Parks Recreation and Heritage Forum 2013).

Furthermore, grading of driveways, roads and building platforms can create problems with stormwater management, leading to increased sediment run-off during construction with potential longer term impacts. According to Auckland Council, stormwater shall be disposed of in locations other than the coastal edge, highlighting the erosion and sedimentation risks associated with stormwater discharging into the coastal environment. The Council goes on to require that all above-ground stormwater infrastructure in the Coastal Conservation Area, including pipes protruding from cliff faces, shall be a Restricted Discretionary activity and therefore require consent that, in order to be granted, must prove that the proposal 'will not increase the natural rate of

erosion or create significant risk of accelerated erosion and/or instability of the site or adjacent land' (Auckland Council 2012b).

The aforementioned techniques and legal requirements surrounding development within the coastal margin should be followed at all times, along with best practice design of infrastructure and landscaping. Revegetation using indigenous species that have evolved to survive in the dynamic coastal environment will benefit any areas currently exposed to high rates of erosion.

8.4 Revegetation of indigenous vegetation

Erosion-prone clifftops can be naturally stabilised by revegetating exposed areas and areas dominated by shallow-rooted pest plants. Plant roots are important soil binders on coastal cliffs, both shallow and deep. Different root structures can work together to help stabilise cliffs, e.g. one species may have shallow roots that act to reduce surface erosion, while another species may have deep roots to reduce the risk of slips. Herbaceous and shrubby plants have shallower root systems, while larger trees such as pōhutukawa generally have spreading and deeper roots.

To offset the adverse effects of development on cliff stability and coastal erosion, planting should be undertaken along steep coastal cliffs, within associated riparian and coastal margins, and in exposed areas. Appropriate indigenous tree species should be selected that enhance the ecological values and have strong root systems.

A map of areas suitable for revegetation is provided in Figure 2; priorities are identified by colour with areas specified as revegetation and/or pest plant control only; an indicative planting schedule is provided below.

Table 1: Indicative planting schedule for coastal areas.

Species	Common Name	Grade	Spacing (m)
Carex flagellifera[2]		0.5L	1.4
Coprosma repens[2]	taupata	2L	1.4
Coprosma macrocarpa subsp. *minor*[2]	coastal karamū	0.5L	1.4
Cordyline australis[1]	tī kōuka	0.5L	1.4
Entelea arborescens[3]	whau	2L	5
Hebe stricta[2]	hebe	0.5L	1.4
Kunzea robusta	kānuka	0.5L	3
Melicytus ramiflorus subsp. *ramiflorus*[3]	māhoe	2L	1.4
Metrosideros excelsa[3]	pōhutukawa	2L	5
Myoporum laetum[3]	ngaio	0.5L	3
Pittosporum crassifolium[3]	karo	0.5L	1.4
Plagianthus divaricatus[1]	Saltmarsh ribbonwood	0.5L	1.4
Pseudopanax lessonii[3]	houpara	0.5L	1.4
Sophora chathamica[3]	kōwhai	2L	5

[1] Plant along the lower coastal margin.

[2] Plant along the upper banks.

[3] Plant along the mid-slopes.

Data Acknowledgment
Map contains data sourced from LINZ
Crown Copyright Reserved

Report: R3987
Client: TAMAKI
Ref: 06 0765
Path: E:\gis\AK_Cliff\mxd\
File: Pot_restoration_areas_sheet_1.mxd

N

Figure 2. Potential restoration areas within the Masterplan area and extension to Tahuna Torea Nature Reserve. (Sheet 1 of 2)

0 1,000 2,000 m

Wildlands
www.wildlands.co.nz, 0508 WILDNZ
© 2016

Scale: 1:15,000
Date: 07/07/2016
Cartographer: RB
Format: A3R

Data Acknowledgment
Map contains data sourced from LINZ
Crown Copyright Reserved

Report: R3987
Client: TAMAKI
Ref: 06 0765
Path: E:\gis\AK_Cliff\mxd\
File: Pot_restoration_areas_sheet_1.mxd

N

Figure 2. Potential restoration areas within the Masterplan area and extension to Tahuna Torea Nature Reserve. (Sheet 2 of 2)

0 1,000 2,000 m

Wildlands © 2016
www.wildlands.co.nz, 0508 WILDNZ

Scale: 1:15,000
Date: 07/07/2016
Cartographer: RB
Format: A3R

8.5 Pest plants

Environmental pest plants are classified as introduced species that threaten the ecological processes and values within the area where they are present. To ensure the survival and spread of indigenous flora and fauna, environmental pest plants should be removed and replaced with indigenous species suitable for the environment. The process of removing pest plants prior to revegetation with indigenous species is key to the success of any restoration project, especially in areas that are currently vulnerable to erosion and dominated by pest plants, such as the coastal margins of the Masterplan areas.

The Auckland Council Regional Pest Management Strategy (RPMS) provides a strategic and statutory framework for efficient and effective management of plant pests in the Auckland Region. The three RPMS categories can be used as control priorities: (i) Total Control Pest Plants, (ii) Containment Pest Plants, and (iii) Surveillance Pest Plants, with category (i) being the highest priority for control. It is also useful to include a further category : (iv) pest plants not currently covered by the RPMS in any of the above categories, but for which control is recommended. Brief descriptions of the respective categories of pest plants are listed below.

(i) Total Control Pest Plants

Total Control Pest Plants have a limited distribution or density within the Auckland Region, or defined areas of the Region. They are considered to be of high potential threat to the Region, and the Auckland Council assumes full responsibility for funding and implementing appropriate management programmes for these species. The aim is to eradicate these plants from the Region or defined areas of the Region, over a period of time, which may exceed the life of the current RPMS (ARC 2007).

(ii) Containment Pest Plants

Containment pest plants are those that are abundant in certain habitats or areas in the region. Landowners/occupiers are required to control these plants whenever they appear on their land. There are two categories of Containment Pest Plants:

- Removal – Landowners/occupiers are required to completely remove these pest plants from their properties
- Boundary Control – Landowners/occupiers are required to maintain control of these pest plants to a specified distance from all property boundaries, if the neighbouring property is clear of, or being cleared of, the pest plant.

Note that some Containment Pest Plants may be included in this category throughout the entire Auckland region, or only in specified areas. All containment pest plants are banned from sale, propagation, distribution, and exhibition through the entire Auckland Region (ARC 2007).

All containment pest plants are banned from sale, propagation, distribution, and exhibition through the entire Auckland Region (ARC 2007).

(iii) Surveillance Pest Plants

Surveillance Pest Plants include species that have been identified as having significant impacts on the biosecurity values of the Auckland Region. The Auckland Council seeks to prevent their establishment or spread by prohibiting their sale, propagation, distribution, and exhibition (ARC 2007).

(iv) Environmental Pest Plants not Within the RPMS 2007-2012

Environmental pest plant species that are present in small to moderate amounts within the project area and are not identified in the RPMS (ARC 2007) in any of the above categories, but for which control is recommended.

8.6 Indiscriminate trimming, pruning and/or removal of indigenous vegetation

The death of indigenous plants due to trimming or pruning can be avoided by following best practice arboricultural techniques or by hiring professionals to carry out the work. Removal of indigenous vegetation should be avoided, particularly in areas that are vulnerable to erosion or slumping.

8.7 Browsing by pest animals

Trapping and baiting of possums could be undertaken to minimise browsing effects on pōhutukawa. Collaboration with neighbouring landowners is advisable to reduce the potential for possum reinvasion following control and to enhance biodiversity benefits across a wider area. It can often be more cost effective to control pest species across larger areas as part of a group of landowners as opposed to individual landowners undertaking control independently.

The most effective way to control possums within a forest area is to undertake an intensive knockdown (preferably using cyanide) of the population followed by ongoing maintenance control achieved through the use of traps and/or poison bait stations. Once the population has been reduced it is important to prevent immigration into the cleared area by establishing a line of traps or bait stations around the perimeter. A sparse grid of devices within the forest should then control any individuals that were missed in the knockdown or that avoided the perimeter line of defence. Ideally there should be a device every 50-100 m around the perimeter and around one device per hectare within the forest interior.

It is important to reduce rodent numbers before starting possum control to limit rodent interference with baits. Possum control pulses can coincide with rodent control pulses. It very hard to sustain low population densities of rodents, but regular control pulses can reduce numbers sufficiently to provide biodiversity benefits.

Pulsed control for possums should be used in areas that are difficult to access, cannot be regularly serviced or have limited support (e.g. in terms of funding and/or

personnel), whereby bait stations are serviced a minimum of three times per year over fifteen days (filled every fifth day).

Strikers (a single-use biodegradable bait station) filled with a paste containing cholecalciferol or diphacinone are a useful tool for an initial knockdown of possum numbers as they are easily transported and large numbers can be distributed in a day. Ongoing control of possums can be undertaken using permanent bait stations or strikers, if support is available.

8.8 Insects and disease

Potential incursions of insects and disease pose a threat to healthy and compromised ecosystems alike. The most serious threat to the coastal pōhutukawa forest of those identified is myrtle rust, which is likely to arrive in New Zealand from Australia in the near future. Although unlikely to be controlled, the disease should be identified and any infected individuals should be reported to MPI to care can be taken to monitor the spread.

9. CONCLUSIONS

A survey of the vegetation of coastal clifftops within the Tāmaki Drive Masterplan area was undertaken as part of a previous study, with an emphasis on quantifying the presence of pōhutukawa. The vegetation cover of indigenous and exotic vegetation was quantified using aerial maps of the survey area, which covered *c*.50 ha. Indigenous-dominated vegetation covers 23.3 ha (*c*.46%), and pōhutukawa forest covers 14.8 ha (*c*.29%), of the survey area. Much this vegetation is located on unstable coastal cliffs and clifftops. Mixed indigenous-exotic scrub and vegetation dominated by exotic species (5.9 ha or 12% of the total area surveyed) is common along exposed cliff faces and in residential areas.

Pōhutukawa, along with other broadleaved coastal forest species, provide a range of ecological services. Coastal vegetation is important in reducing coastal erosion and provides a buffer during extreme weather events. Furthermore, pōhutukawa along the coastal margin act as a wildlife corridor for indigenous fauna, forming a contiguous band of vegetation around the coast. Pōhutukawa is also important for its amenity value throughout the Auckland region.

This report has focused on the threats to broadleaved coastal forest species, particularly pōhutukawa, including future urban development, clifftop instability and erosion, competition from pest plants, indiscriminate trimming or pruning of indigenous species, potential insects and disease infestations and risk of browsing by pest animals. Overall, the study found that potential urban/residential development within the project area poses the biggest threat to the ecological integrity of the remaining pōhutukawa forest. Associated with the threat of development is the threat of clifftop instability, which can be largely remedied by the retention and revegetation of indigenous coastal forest, particularly pōhutukawa. Competition by pest plants is likely the most serious threat in terms of preventing the regeneration of the coastal forest, but is placed behind residential development of instable cliffs due to the ecological importance of retaining remaining pōhutukawa forest. Indiscriminate

trimming or pruning of indigenous species, particularly pōhutukawa, may result in the compromised survival of individuals and is therefore also a potential threat, along with some diseases and browsing pest animals.

Broad management recommendations to reduce risk to pōhutukawa forest include avoiding urban development within 150 metres of coastal cliffs, particularly if they are characterised by vegetation, indigenous or otherwise. The most effective means of improving and maintaining the ecological integrity of the coastal forest within the project area are carrying out pest plant control and revegetation planting. Priority areas for planting and pest plant control, which are characterised by coastal cliffs, particularly those dominated by pest plants or exposed, have been identified. A detailed ecological management plan of the coastal yard should be compiled to guide restoration works within the Tāmaki Drive Masterplan area. However, the information provided here should be able to guide individual landowners to carry out small scale restoration works.

ACKNOWLEDGMENTS

Juliet Yates and Ross Duder (Tāmaki Drive Protection Society Inc) provided client liaison and useful background information.

Ōrākei Local Board provided funding to the Tāmaki Drive Protection Society for this research to be carried out.

REFERENCES

Atkinson, I.A.E. 1992: *Effects of possums on the vegetation of Kapiti Island and changes following possum eradication*. DSIR Land Resources Contract Report 92/52. Department of Scientific and Industrial Research, Lower Hutt.

Auckland Council 2012: Tāmaki Drive - A masterplan for the future. Prepared by Ōrākei Local Board. December 2012.

Auckland Council 2012b: *Section 8: Natural Environment*. North Shore District Plan June 2002.

Auckland Regional Council 2000: *Coastal Hazard Strategy: Coastal Erosion Management Manual*. Auckland Regional Council Technical Publication No. 130.

Auckland Regional Council 2007: Auckland Regional Pest Management Strategy (2002-2007).

Balderston K. and Fredrickson C. 2014: *Capacity for Growth Study 2013*. Proposed Auckland Unitary Plan: results, Auckland Council technical report, TR2014/010.

Bergin D. and Hosking G. 2006: Pohutukawa - Ecology, Establishment, Growth and Management. *New Zealand Indigenous Tree Bulletin Series No. 5*. Ensis in association with the Project Crimson Trust, 2006.

Brown M.A., Simcock R., and Greenhalgh S. 2015: Policy Brief No 13 - Protecting Urban Forest. Landcare Research Manaaki Whenua (ISSN: 2357-1713).

Buxton R. 2012: *Natural Events*. New Zealand Plant Conservation Network (http://www.nzpcn.org.nz/page.aspx?threats_other_natural).

City of Auckland 2015: *Part 5B: Coastal.* District Plan Isthmus Section – Operative 1999. Updated 16 September 2015.

de Lange P.J., Rolfe J.R., Champion P.D., Courtney S.P., Heenan P.B., Barkla J.W., Cameron E.K., Norton D.A., and Hitchmough R.A. 2013: Conservation status of New Zealand indigenous vascular plants, 2012. *New Zealand Threat Classification Series 3*. Department of Conservation, Wellington. 70 pp.

Easterling D.R., Meehl G.A., Parmesan C., Changnon A., Karl T.R., and Mearns L.O. 2000: Climate Extremes: Observations, Modeling, and Impacts. *Science*. Vol 289 (2068 - 2074).

Esler A.E. 1987: The naturalisation of plants in urban Auckland, New Zealand 1. The introduction and spread of alien plants, 1986. *New Zealand Journal of Botany*. Vol 25:4, 511-522 pp.

Esler A.E. 1988: The naturalization of plants in urban Auckland, New Zealand. 5. Success of the alien species. *New Zealand Journal of Botany.* Vol 26:5, 565–584 pp.

Fitzgerald A. 1981: Some effects of the feeding habits of the possum *Trichosurus vulpecula.* Proceedings of the First Symposium on Marsupials in New Zealand. Victoria University of Wellington, Wellington.

Fromont M.L. 1995: Ecological Research for Management of *Rhamnus alaternus.* Unpublished MSc Thesis, University of Auckland.

Fromont M.L. 1997: *Rhamnus alaternus* – Environmental weed on Motutapu and Rangitoto Islands, Auckland. *Tane 36*: 57-66 pp.

Haines L., Julian A. and Wilcox M. D. 2007: *New Zealand Vegetation Patterns.* Natural History of Rangitoto Island Hauraki Gulf, Auckland. Auckland Botanical Society Inc. Auckland.

Hoover G.A. 2001: Fall Webworm Factsheet. *Insect Advice from Extension*. Pennsylvania State University.

Hosking G. and Hutcheson J. 1993: *Pohutukawa (Metrosideros excelsa) health and phenology in relation to possums (Trichosurus vulpecula)and other damaging agents*. New Zealand Journal of Forestry Science. 23(1). 49-61pp.

Hough J. H. & Pimentel D. 1978: *Influence of host foliage on development, survival, and fecundity. of the gypsy moth*. Environ. Entomol. 7: 97-102.

Lindsay H., Wild C., and Byers S. 2009: Auckland Protection Strategy. A report to the Nature Heritage Fund Committee. Published by the Nature Heritage Fund. Wellington.

Ministry for Primary Industries online. Accessed May 2015.

Myers S. (compiler) 2005: North Shore City Ecological Survey: A survey of sites of ecological significance in Tāmaki and Rodney Ecological Districts. Auckland Regional Council and North Shore City Council.

Ngāti Whātua o Ōrākei 2012: Ko te Pūkākī Twelve Year Review prepared for Auckland Council by Ngāti Whātua Ōrākei Māori Trust Board.

Parks Recreation and Heritage Forum 2013: *Draft: Auckland Design Manual – Parkland Design Guidelines – Section A: Design Guidelines*. 35-40pp.

Pilkey O., and Hume T. 2001: Shoreline erosion problems; lessons from the past. NIWA (National Institute of Water and Atmosphere) Water & Atmosphere V.9n. p.2. NZ June.

Predator Free New Zealand Trust. 2014. *The Big Picture – Predator Control.* Predator Control Map. http://pfnz.maps.arcgis.com/apps/Viewer/index.html?appid=00e67ff4ce7347b5976d7142b3dcc227

Resource Management Act 1991.

Shepherd D. 2009: Redefining Coastal Erosion. Master of Landscape Architecture – Unitec Institue of Technology.

Walker S., Cieraad E., Grove P., Lloyd K., Myers S., Park T., and Porteous T. 2007: Threatened Environment Classification: Guide For Users (Ver. 1.1., August 2007). Landcare Research Manaaki Whenua.

Wyse S.V., Beggs J.R., Burns R.R., and Stanley M.C. 2015: Protecting trees at an individual level provides insufficient safeguard for urban forests. Landscape and Urban Planning 141: 112-122 doi:10.1016/j.landurbplan.2015.05.006.

Wildlands

Providing outstanding ecological services to sustain and improve our environments

Call Free 0508 WILDNZ
Ph: +64 7 343 9017
Fax: +64 7 3439018
ecology@wildlands.co.nz

99 Sala Street
PO Box 7137, Te Ngae
Rotorua 3042,
New Zealand

Regional Offices located in
Auckland, Hamilton, Tauranga,
Whakatane, Wellington,
Christchurch and Dunedin

ECOLOGY RESTORATION BIODIVERSITY SUSTAINABILITY

www.wildlands.co.nz