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ECOLOGICAL RESTORATION AND MANAGEMENT PLAN FOR THE SOUTHERN END OF OPOUTERE BEACH RECREATION RESERVE



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Contract Report No. 3402

June 2014

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1. INTRODUCTION

Wildland Consultants Ltd was engaged by the Department of Conservation to prepare an ecological restoration and management plan for the southern end of Opoutere Beach Recreation Reserve (henceforth referred to as the “project area”) (see Figure 1). Opoutere Beach Recreation Reserve stretches north along Opoutere Beach from the northern edge of the Wharekawa Harbour almost to Motuhaua Rock. It is contiguous with a Maori burial ground reserve to the south (which includes the Wharekawa Spit Wildlife Reserve) to the south and the Opoutere Coastal Camp Ground to the east. The project area covers 39 ha and comprises the southern part of Opoutere Beach Recreation Reserve and the Maori burial ground reserve (Figure 1).

Vegetation and habitat types within project area comprise radiata pine (*Pinus radiata*) forest, wīwī (*Ficinia nodosa*) sedgeland, and spinifex (*Spinifex sericeus*)-wīwī sedgeland. Walking tracks present through the pine forest provide access to the reserve from the main visitor carpark and the adjoining Opoutere Coastal Camp Ground. The radiata pine forest is approximately 80 years old and many trees are beginning to collapse, which has made the tracks within the forest hazardous to visitors, particularly during moderate to high wind events (>20 km/hr). Trees on the edge of the estuary have also fallen down which has damaged the banks leading down to the estuary and beach, accelerated coastal erosion, and exposed large sections of midden.

This report comprises an ecological restoration plan for the southern portion of Opoutere Beach Recreation Reserve. The plan focusses on managing the pines to ensure the reserve is safe for users, and encompasses pest plant management and ecological enhancement opportunities, along with suggestions on suitable plant species for the site.

2. OBJECTIVES

The objectives of the project are to develop an ecological restoration and management plan for the southern portion of Opoutere Beach Recreation Reserve, by addressing the following:

- Identify a low cost ecological approach for managing the pine plantation, so that the health and safety of users of the reserve is ensured, and the historic cultural values (midden and urupā) are preserved.
- Identify existing ecological values within the reserve including the location and abundance of threatened species;
- Identify and prioritise management of plant and animal pests and other threats to biodiversity values.

3. EXISTING INFORMATION

3.1 Ecological context

Opoutere Beach Recreation Reserve is located on the east coast of the Coromandel Peninsula, in the coastal bioclimatic zone of the Tairua Ecological District, within the Coromandel Ecological Region. Tairua Ecological District (c.89,900 ha), extends from the east coast between Whitianga to Whangamata, west through the lowlands to the eastern slopes of the Coromandel Range, and southwest to include the western slopes of the range south of Thames. It is characterised by steep hill country, smaller areas of alluvial plains, and several large river estuaries, including Whitianga Harbour, Whangamata Harbour, the Otahu Estuary, Wharekawa Harbour, and Tairua Harbour. Whitianga Harbour, 18 kilometres to the north of the town of Tairua, covers 2,228 ha and contains ‘the largest and best example of mangroves and intertidal rushlands in Tairua Ecological District and the Coromandel Ecological Region’ (Humphreys and Tyler 1995). Tairua Harbour has several areas where estuarine wetlands grade into coastal forest and scrub, and provides important wildlife habitat.

Tairua Ecological District is one of the most modified Ecological Districts within the mainland Coromandel Ecological Region. Much of the lowland and coastal areas are now covered in farmland, exotic forest, and scrub as a result of extensive kauri (*Agathis australis*) logging and repeat burning of these areas. The submontane zones and steep rugged areas of lowland along the spine of the main range are still forested, but highly modified by logging. Most of this forested terrain lies within the Coromandel Forest Park.

Sheets of ignimbrite and rhyolite breccia containing extensive rhyolitic lava intrusions are dominant in the area. Andesite dykes are an attractive feature of Table Mountain (846 m asl). Soils are yellow-brown earths on hill and steepland country. A deep mantle of volcanic ash has been preserved on the large areas of easy terrain resulting in significantly different soils from those on the Thames side of the Coromandel Range. Recent soils from alluvium (Ohinemuri loamy sand to clay loam) are of high fertility and occur mainly around Whitianga Harbour and along the Waiwawa, Whenuakite and Tairua Rivers (Kessels and Associates 2010).

Historical accounts of the Tairua ED are extremely limited prior to large-scale modifications carried out by Europeans. However, the few remnants of indigenous vegetation in the lower lowland and coastal areas provide some clues to the vegetation types that occurred on various landforms in these areas. The vegetation structure and composition of the upper lowland and montane areas remain relatively unmodified.

Extensive estuaries are a significant feature of the Tairua Ecological District coastal zone. There has been little drainage of these areas for farmland and town development, so the estuarine communities remain essentially intact. Drainage and salinity gradients dictate the vegetation zones, with the deep tidal areas of the mudflats being dominated by mangroves and eelgrass (*Zostera muelleri*), followed by a stretch of sea rush, which in some places, is mixed with oioi (*Apodasmia similis*). The latter becomes more prominent further inland and is accompanied by scattered marsh ribbonwood (*Plagianthus divaricatus*).



Freshwater wetlands remaining behind Opoutere Beach and Whitianga Harbour comprise species such as *Machaerina*, *Eleocharis*, raupō (*Typha orientalis*), harakeke (*Phormium tenax*), and mānuka (*Leptospermum scoparium*). Coastal cliffs still possess most of their original vegetation, with locally dominant pōhutukawa (*Metrosideros excelsa*) and karo (*Pittosporum crassifolium*)-taupata (*Coprosma repens*)-harakeke shrubland. Herbaceous plants such as glasswort (*Sarcocornia quinqueflora*), native ice plant (*Disphyma australe* subsp. *australe*), *Selliera radicans* and *Samolus repens* are found on the very steep rocky cliffs and platforms close to sea level. Generally only small remnants of pōhutukawa, pūriri (*Vitex lucens*), karaka (*Corynocarpus laevigatus*), kohekohe (*Dysoxylum spectabile*), and kauri remain on the sheltered hillslopes and gullies along the coast. Tawa (*Beilschmiedia tawa*), northern rātā (*Metrosideros robusta*) and pōhutukawa × northern rātā hybrids (*Metrosideros excelsa* × *M. robusta*) are thought to have once occurred along inland facing slopes with pūriri, kohekohe and pōhutukawa.

Land Environments of New Zealand is a classification of New Zealand landscapes using climate, landform, and soil variables (Leathwick *et al.* 2003). Data derived from the Landcover Database (Landcare Research 2004) and protected areas databases can be used to classify land environments based on the proportion of each land environment that retains a cover of indigenous vegetation and the proportion that is legally protected. The six land environment classifications are:

- Acutely threatened: a land environment in which less than 10% of indigenous cover remains.
- Chronically threatened: a land environment in which 10-20% of indigenous cover remains.
- At risk: a land environment in which 20-30% of indigenous cover remains.
- Critically underprotected: a land environment in which more than 30% of indigenous cover remains, but less than 10% is protected.
- Underprotected: a land environment in which more than 30% of indigenous cover remains, but only 10-20% is protected.
- Better protected and less reduced: a land environment in which more than 30% of indigenous cover remains and more than 20% is protected.

Forty-six percent (46%; 18.1 ha) of the project area is located on Acutely Threatened land environments and 19% (7.5 ha) is located on Critically Underprotected land environments; the remaining 35% (13.4 ha) has not been classified.

3.2 Historical context

The wider Opoutere Beach area including Wharekawa Harbour and Ohui was an important area for Māori and European settlers, evidenced by the large number (104¹) of archaeological sites for the area that are recorded in the New Zealand Archaeological Association database. There is evidence of >700 years of Māori occupation including food processing sites and middens, pā, terraces, kūmara storage pits, kāinga sites, and places where stone was worked into tools. European sites include the site and buildings of a former native school, drives and shafts of gold mining sites and associated hut sites, timber workers huts, and residual kauri logging structures (Furey 2011).

Several middens are present within the project area, including the largest recorded midden on the Coromandel Peninsula, which dates back to the Kaharoa eruption (c.1314 AD) (Neville Richie pers. comm.). This midden contains evidence of the traditionally important summer activity of gathering shellfish, opening shells, and drying of flesh to take away and store at other settlements; Wharekawa was known for its abundant shellfish with people coming from some distance to harvest them. The midden is unique on the Coromandel Peninsula for the depth of occupation evidence over a long period of time (hundreds of years) (Furey 2011). The southernmost part of the project area has been identified as an urupā and as such is wāhi tapu for local iwi and hapū (Figure 1).

The plantation pine forest within the project area was part of a European settler farm. Some local residents consider the forest to be of historical significance due to the age of the pine stand, and the fact that horse races were regularly held within the forest in the mid-1900s.

4. METHODS

Digital and hard copy information relating to the ecology of the study site, including background information, GIS layers, and digital aerial photographs was compiled. Hard copy field maps showing the project area boundary on aerial photographs, were prepared. An on-site meeting with the Conservation Services Ranger Nick Hamon from Department of Conservation Coromandel office was undertaken on 14 May 2014. A walk through survey of the site was undertaken, vegetation types were identified, described, and mapped, a plant species list was compiled, and the location and extent of pest plant species were recorded and mapped. Incidental observations of indigenous and exotic bird species seen or heard were also made.

5. VEGETATION AND HABITAT TYPES

Three vegetation and habitat types were identified and described within the project area. These are mapped in Figure 2 and described below:

¹ The number of archaeological sites recorded with the New Zealand Archaeological Association does not reflect the totality of sites present within the Wharekawa, Opoutere, Ohui general area. Parts of this area have not been surveyed for archaeological sites or artefacts.



Legend

- Project area

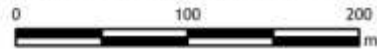
Vegetation and habitat types

- 1. Radiata pine /houpara-māpou-lancewood × honepara forest
- 2. Wīwī/pōhuehue sedgeland
- 3. Spinifex-wīwī sedgeland
- 4. Sandfield

Data Acknowledgment
 Maps contain data sourced from LINZ
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 Waikato Regional Aerial Photography Service 2012.

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Figure 2. Vegetation and habitat types at the southern part of the Oputere Beach Recreation Reserve, May 2014



Wildlands 2014
 www.wildlands.co.nz, 0800 WILDHZ

Scale: 1:4,000
 Date: 25/06/2014
 Cartographer: KM
 Format: A3

1. Radiata pine/houpara-māpou-lancewood × houpara-mingimingi forest (23.2 ha)

Most of this vegetation and habitat type comprises a patchy canopy of radiata pine (*Pinus radiata*), a few large planted macrocarpa (*Cupressus macrocarpa*), and scattered wilding maritime pine (*Pinus pinaster*) up to c.20 m height. The indigenous subcanopy and understorey are dominated by houpara (*Pseudopanax lessonii*), horoeka (lancewood)-houpara hybrids (*Pseudopanax crassifolius* × *P. lessonii*), māpou (*Myrsine australis*), and mingimingi (*Leucopogon fasciculatus*) with common *Coprosma macrocarpa* and shining karamū (*Coprosma lucida*). *Lepidosperma laterale* and mauri (*Astelia trinervia*) are common in the groundcover where the pine canopy is less dense, while elsewhere the groundcover is dominated by kōwaowao (*Microsorium pustulatum*), with pātītī (*Microlaena stipoides*) and *Oplismenus hirtellus* subsp. *imbecillis* on the margins of tracks. Wild ginger (*Hedychium gardnerianum*) is locally common within parts of this site. Within a small part of this area, pines have been felled and brush wattle (*Paraserianthes lophantha*) is regenerating amongst pine slash, along with māpou, inkweed (*Phytolacca octandra*), kawakawa (*Piper excelsum* subsp. *excelsum*), and blackberry (*Rubus fruticosus*).

Towards the sea, woody indigenous cover decreases significantly. The groundcover here is dominated by bracken (*Pteridium esculentum*), wīwī (*Ficinia nodosa*), pōhuehue (*Muehlenbeckia complexa*), and pātītī, with scattered pines over scattered houpara, kawakawa, and māpou. In the south-western parts of the project area, scattered pōhutukawa, with epiphytic *Astelia banksii*, leather-leaf fern (*Pyrrosia eleagnifolia*), and *Asplenium flaccidum*, lean out over the sand and estuary margins. The groundcover within this area comprises dense *Machaerina juncea*.

Locally, where pines are absent from the canopy, dense houpara, horoeka × houpara hybrid, māpou, and mingimingi often form a canopy to c.6 m height.

2. Wīwī/pōhuehue sedgeland (5.3 ha)

Wīwī and pōhuehue form locally dense cover behind the foredunes with locally common cocksfoot (*Dactylis glomerata*), bracken, and blackberry, and scattered houpara, harakeke (*Phormium tenax*), akeake (*Dodonaea viscosa*), and pampas (*Cortaderia selloana*).

Wīwī dominates areas where pines were removed in 2005, with pampas scattered to locally common throughout. Where pines were felled c.2-3 years ago, wīwī grows amongst pine debris with common catsear (*Hypochaeris radicata*), Yorkshire fog (*Holcus lanatus*), and shore bindweed (*Calystegia soldanella*), and scattered clumps of lupin (*Lupinus arboreus*) and pōhuehue.

3. Spinifex-wīwī sedgeland (4.6 ha)

Spinifex and wīwī sedgeland with local patches of sand coprosma (*Coprosma acerosa*) and tauhinu (*Ozothamnus leptophyllus*), is present on the mid- and fore-dunes. Sand bindweed and catsear are common, and harestail (*Lagurus ovatus*)

and pōhuehue are scattered throughout. Occasional pōhutukawa and wilding radiata pine seedlings are also present. Scattered pīngao (*Ficinia spiralis*) are present on the fore-dunes.

4. Sandfield (5.9 ha)

This type comprises bare sand between the base of the dunes and the ocean.

6. FLORA

One hundred and fifty-five vascular plant species were recorded in the reserve, comprising 92 indigenous species, and 63 exotic species. Four At Risk species (as per de Lange *et al.* 2013) were noted in 2014 - sand coprosma (At Risk-Declining), *Tetragonia tetragonioides* (At Risk-Naturally Uncommon), *Pomaderris rugosa* (At Risk-Naturally Uncommon), and pīngao (At Risk-Declining). One sand pimelea (*Pimelea villosa*; At Risk-Declining) plant has previously been recorded from the project area (one plant seen by SMB pers. obs. 1989; see also Regnier and Broekhuizen 1990), but this species was not found during the 2014 site inspection. In 1989 sand pimelea was also present north of the project area (Regnier and Broekhuizen 1990) and is likely to still be present.

The *Tetragonia tetragonioides* population is located at the base of an erosion scar on the estuary side of Vegetation Type 1 (Radiata pine/houpara-māpou-horoeka × houpara-mingimingi forest), growing alongside the non-threatened *Tetragonia implexicoma*. Three clumps of *T. tetragonioides* (covering c.1.3 m²) were observed, with a few other scattered plants also present along the estuary margin.

Patches of sand coprosma are locally common within Vegetation Type 3 (Spinifex-wīwī sedgeland). Occasional pīngao are present at the seaward side of Vegetation Type 3 (Spinifex-wīwī sedgeland). One *Pomaderris rugosa* shrub was found within Vegetation Type 1 (Radiata pine/houpara-māpou-horoeka × houpara-mingimingi forest), but other plants are likely to be present within the reserve (Regnier and Broekhuizen 1990 recorded it as being common in 1989).

Table 1: Location of At Risk plant species within the study area.

Species	GPS	Vegetation Type
<i>Coprosma acerosa</i> (sand coprosma)	Throughout Vegetation Type 3.	Vegetation Type 3 (Spinifex-wīwī sedgeland)
<i>Ficinia spiralis</i> (pīngao)	Occasional within Vegetation Type 3.	Vegetation Type 3 (Spinifex-wīwī sedgeland)
<i>Pomaderris rugosa</i>	E1856133 N5889672 (approximate)	Vegetation Type 1 (radiata pine/houpara-māpou-horoeka × houpara-mingimingi forest)
<i>Tetragonia tetragonioides</i>	E1856143 N5889308 E1856254 N5889241 E1856255 N5889235	Vegetation Type 1 (radiata pine/houpara-māpou-horoeka × houpara-mingimingi forest)

One plant of *Hebe pubescens* subsp. *pubescens*, a plant species endemic to the Coromandel Peninsula was also found in the project area adjacent to the estuary.

7. FAUNA

7.1 Avifauna

Seventeen bird species were recorded within the project area during the field survey (see Appendix 2). Thirteen species were indigenous and four were introduced. Three indigenous species are classified as ‘Threatened-Nationally Vulnerable’ in the most recent threat classification for New Zealand birds (Robertson *et al.* 2013): North Island kākā (*Nestor meridionalis septentrionalis*), banded dotterel (*Charadrius bicinctus bicinctus*), and northern New Zealand dotterel (*Charadrius obscurus aquilonius*).

Forty-one indigenous bird species have been recorded from the wider Opoutere area including 19 Threatened or At Risk species, and four international migrants (Dowding 2012). Dowding (2012) identified the area as particularly important as a major breeding and flocking site for the New Zealand dotterel and the variable oystercatcher.

7.2 Pest animals

Pest animals likely to be present in the reserve include rabbits (*Oryctolagus cuniculus cuniculus*), possums (*Trichosurus vulpecula*), rats (*Rattus* spp.), mice (*Mus musculus*), feral cats (*Felis catus*), hedgehogs (*Erinaceus europeaeus occidentalis*), and mustelids (*Mustela* spp.). Rabbits and possums damage vegetation through grazing and browsing. Rats, mice and hedgehogs eat a wide range of seeds, and thus prevent regeneration. They also eat a range of invertebrates. Possums, rats, mustelids, cats and hedgehogs prey on birds, eggs and lizards. Pest animal control is recommended to ensure the survival of plantings and to increase numbers of birds in the reserve. Ongoing pest animal control will also ensure that palatable plant species are able to survive and reproduce successfully, which will help to restore natural vegetation composition and structure.

8. PEST PLANTS

Of the 64 exotic vascular plant species recorded at the site, 16 are environmental pest plant species that have the capacity to threaten ecological values within the reserve, four are listed as pest plant species in the Waikato Regional Pest Management Strategy 2008-2013 (Waikato Regional Council (WRC) 2008), and two are listed in the National Pest Plant Accord (Ministry for Primary Industries 2012). Ragwort, listed as a containment species in the RPMS, is not an environmental pest plant and is therefore (along with other exotic species recorded within the project area) not considered further here.

Environmental pest plant species recorded within the study area are listed in Table 2 below. Figure 3 shows the distribution of these weeds within the project area.

Table 2: Environmental pest plant species recorded in the Opoutere Beach Recreation Reserve (Southern end)

Scientific Name	Common Name	RPMS Management Status	Priority for Control
<i>Cortaderia selloana</i>	Pampas	Containment pest	High
<i>Hedychium gardnerianum</i>	Kahili ginger	Containment pest	High
<i>Paspalum vaginatum</i>	Saltwater paspalum	Potential pest	Medium
<i>Lilium formosanum</i>	Formosan lily	National pest plant accord	Medium
<i>Lonicera japonica</i>	Japanese honeysuckle	National pest plant accord	Medium
<i>Agapanthus praecox</i>	Agapanthus	N/A	Medium
<i>Ammophila arenaria</i>	Marram	N/A	High
<i>Berberis glaucocarpa</i>	Barberry	N/A	Medium
<i>Crocasmia x crocosmiiflora</i>	Montbretia	N/A	Medium
<i>Paraserianthes lophantha</i>	Brush wattle	N/A	Medium
<i>Pinus pinaster</i>	Maritime pine	N/A	High
<i>Pinus radiata</i>	Radiata pine	N/A	High
<i>Teline monspessulana</i>	Montpellier broom	N/A	Medium
<i>Cupressus macrocarpa</i>	Macrocarpa	N/A	High
<i>Prunus persica</i>	Peach tree, nectarine	N/A	Medium
<i>Gladiolus</i> sp.	Gladioli	N/A	High

9. ECOLOGICAL VALUES

The project area was identified as part of a recommended area for protection (RAP TAI 12-Wharekawa Harbour) in the Coromandel Ecological Region Protected Natural Areas study (Humphreys and Tyler 1990) and is part of a significant natural area identified within the Thames-Coromandel District (BB36P483-Opoutere Beach Recreation Reserve) (Kessels and Associates 2010). The Opoutere Beach Recreation Reserve has been ranked as of national significance due to the presence of Threatened and At Risk indigenous species, the presence of duneland (an under-represented habitat type), and the buffering function it provides to Wharekawa Harbour and its important shorebird habitat.

Vegetation and habitats present within the project area at Opoutere Beach Recreation Reserve are of moderate to high ecological value. The pine forest within the project area has moderate to high ecological values. Although this vegetation type has been modified for recreation and pest plant infestations are common, indigenous plant species diversity is relatively high and the forest provides habitat for one At Risk plant species (*Pomaderris rugosa*). The sand dune habitat is of high ecological value. The dunes provide important habitat for two At Risk plant species (pīngao and sand pimelea), and provide important breeding habitat for two Threatened bird species (banded dotterel and northern New Zealand dotterel). The estuary margins are of high ecological value and provide habitat for one At Risk plant species (*Tetragonia tetragonioides*).

10. MANAGEMENT APPROACH

The vegetation and habitat types within the project area retain a high degree of naturalness and will respond well to selective management of key pest plant and pest animal species. This section outlines the options and opportunities for management within the restoration area and guidelines for restoration implementation.

The main aim of this plan is to provide a safe environment for recreational users of the reserve. A further aim of the plan is to manage the southern part of Opoutere Beach Recreation Reserve back to indigenous dominated vegetation by controlling and removing pest plant species, and planting with indigenous species where appropriate. Currently walking tracks traverse old 'over mature' (c.80 years old) plantation pine forest. These trees have become a health and safety issue for visitors to the reserve during winds of 20 km/hr or more. Despite high levels of modification, the pine forest contains moderate to high ecological values. Consequently, it is a high priority to manage the pine forest safely, and in a way that will not adversely affect current ecological and archaeological values within the site. Additionally, along the estuary margin, trees have previously fallen into the estuary where they have created focal points for eddies to form during tidal movement, which has resulted in some erosion to the estuary margins. Removal of remaining trees along the estuary margins is required to ensure no further erosion occurs.

10.1 Management zones

Management zones have been identified according to priority for management. These are described below and illustrated in Figure 3.

Management Zone 1 - Radiata pine forest

This area comprises most of the plantation pine forest within which the walking tracks are located and is the highest priority for management. The priority within this area is to remove pine trees within a minimum of three tree lengths (60 m) of the track (Figure 4). This will ensure that in high wind events, the likelihood of a user of the track being hit by a falling pine tree is minimal.

Pine Tree Removal - Recommended Methods

- Option 1 - Most sites (except for estuary margins, see below)
 - Fell trees located within 60 meters either side of the walking track (Figure 4) using ground-based crew and chainsaws (i.e. no heavy machinery). Fell to waste and leave trees to rot.
 - Remove debris from felled trees from the track.
 - If possible, avoid felling trees into known locations of *Pomaderris rugosa*. The one known plant should be located and its safety ensured. If several plants are found during this process then it will be sufficient to take steps to ensure that most known plants are not affected by tree felling operations.

This option is the most cost-effective and requires the fewest resources. Although felling of the trees into the understorey will result in some damage to the

understorey vegetation, in areas where this has already occurred, the understorey vegetation is recovering quickly.

Pulling felled trees from where they lie to a central stacking area is likely to damage the indigenous understorey and archaeological values of the site more than leaving fallen pines to rot in place. Pulling and stacking felled trees would also require greater levels of resources.

Estuary Margins

Trees that are growing immediately adjacent to the estuary will generally require felling into the estuary (to prevent damage to the low but steep and vulnerable estuary margins). Felled trees can then be removed by lifting the butt of the tree with an excavator, which can be swung around onto the estuary mudflats. The tree can then be lifted and carried by a skidder up to the debris pile that already exists within the pine plantation area.

- Option 2

An arborist to “dismantle¹” trees located within 60 meters either side of the walking track and on estuary margins. Leave dismantled trees to rot *in situ*. Remove any debris from the track.

This option has the potential to have minimal impact on the indigenous understorey as the arborist dismantling the trees can choose where to drop limbs and stems. However, this option is time consuming and therefore expensive.

Other Work Required in This Area

- Once the pine trees within 60 meters either side of the track have been felled, reassess the risk to visitors of the remaining area of pines. Fell any trees if required based on risk assessment.
- Erect signs to warn users to stay out of areas covered by a pine canopy because of the risks.
- Control other pest plant species (shown in Figure 3). Wild ginger, montbretia, agapanthus, brush wattle, pampas, gladioli, and Formosan lily are the priorities for control in Management Zone 1.
- Enrichment planting of eco-sourced² pōhutukawa, pūriri, kohekohe, and ngaio (*Myoporum laetum*) at 5-10 m spacings could be considered in this area in the future to speed up natural regeneration processes.

¹ Dismantling of trees involves an arborist climbing each tree and cutting sections out of the tree to take the tree down piece by piece. Cut sections of tree are then either lowered to the ground using ropes or, dropped to appropriate locations. This technique involves heavy duty ropes, pulleys, and harnesses and is often used where trees are located close to buildings, or to minimise impact on surrounding vegetation.

² Sourced from naturally-occurring indigenous species in the mainland parts of the Coromandel Ecological Region.





Management Zone 2 - Wīwī-pōhuehue sedgeland

This area comprises the area behind the foredunes contiguous with the radiata pine forest. This area is of medium priority for management. Management within this area focuses on pest plant control.

- Pampas and wilding radiata pine should be controlled as a priority in this area and the area should be monitored for regrowth and reestablishment of these species. Gladioli should also be controlled, along with Formosan lily.
- Indigenous sand dune species are colonising and growing rapidly within this area. Additional restoration planting is not required however enrichment planting could be considered in the future.
- Enrichment planting of sand pimelea, hinarepe (*Poa billardierei*), and New Zealand spurge (*Euphorbia glauca*) could be considered in this area in the future. These species should be eco-sourced as follows: sand pimelea - from Opoutere Beach if plants are still present, otherwise from other Coromandel populations (e.g. Otama Beach); hinarepe - Coromandel Ecological Region; New Zealand spurge - sandy sites in Coromandel Ecological Region.

Management Zone 3 - Spinifex-wīwī sedgeland

This area comprises the mid and fore-dunes of the recreation reserve. This area is a medium priority area for management. Recommended management within this area focuses on pest plant control.

- Marram (herbicide) and wilding radiata pine (fell) should be controlled as a priority in this area and the area should be monitored for regrowth and reestablishment of these species. Gladioli should also be controlled.
- After marram control, spinifex should be fertilised to encourage growth of this species into habitats where marram has been controlled.
- Enrichment planting of pīngao, sand pimelea, hinarepe, and New Zealand spurge could be considered in this area in the future. If planting of these species is desired, only ecosourced plant stock should be used, as per Management Zone 2 recommendations, and pīngao stock to be sourced from Tairua Ecological District.

Management Zone 4 - Brush wattle scrub

Management Zone 4 comprises a small area at the northern end of the pine plantation where pines have been felled to waste. Dense regeneration of brush wattle, māpou, inkweed, kawakawa, and blackberry is occurring within the pine slash.

- Brush wattle and blackberry should be should be controlled as a priority in this area and the area should be monitored for regrowth and reestablishment of these species.
- Secondary indigenous forest species are colonising and growing rapidly within this area. Additional restoration planting is not required.

- Enrichment planting of eco-sourced¹ pōhutukawa, pūriri, kohekohe, and ngaio at 5-10 m spacing could be considered in this area in the future to speed up natural regeneration processes.

Management Zone 5 - Recent slip

Management Zone 5 comprises a small area at the southern end of the pine plantation forest where some slumping of a sand bank has occurred since removal of a few radiata pine trees at the top of the slope. This area predominantly comprises bare soil and sand with patches of Yorkshire fog and scattered herbaceous and woody species including akeake, mingiminigi, houpara, pampas, Montpellier broom (*Teline monspessulana*), bracken, and lupin.

- Pampas should be controlled as a priority in this area, and the area should be monitored for regrowth and reestablishment of this species.
- Enrichment planting of pōhutukawa and houpara could be undertaken on this slope at 5-10 m spacings to accelerate regeneration of indigenous species and reduce opportunities for pest plant establishment. These species and other indigenous species are already naturally establishing on the bank, so restoration planting in this area is not a high priority.

10.2 Enrichment planting

The site has good existing indigenous species diversity, and further regeneration of indigenous species will occur over time to fill the spaces left following pest plant removal, but enrichment planting could be undertaken to accelerate revegetation of parts of the site, or to enhance species diversity within the site. Pōhutukawa, pūriri, kohekohe, and ngaio could be planted at 5-10 metre spacings in areas left open by removal of the pine canopy. Pīngao, sand pimelea, hinarepe, and New Zealand spurge could be planted on the dunes.

If enrichment planting were undertaken at the site, care should be taken to ensure only locally-sourced species are used. For all species other than sand pimelea, these should be sourced from the Tairua Ecological District or Coromandel Ecological Region. Sand pimelea should be sourced from other plants within the Opoutere Beach Recreation Reserve. Scattered plants were present along the dunes within the reserve in the late 1980s and are still likely to be present.

10.3 Pest animal control

Existing pest animal control programmes should be continued and could be complemented by feral cat control. If planting is to be undertaken then pest animal control will be required prior to and following planting, until plants are well established.

¹ Sourced from naturally-occurring indigenous species in the mainland parts of the Coromandel Ecological Region.

Rabbit damage was not evident on the dunes, but these habitats are very sensitive to rabbit damage. Regular inspections of the site should be undertaken (see below) and rabbit control should be implemented if levels of rabbit browse are medium-high or higher.

11. MONITORING

Monitoring is an important tool in helping to ensure the success of weed control and other restoration initiatives. It is recommended that a series of strategically placed permanent photopoints be established to monitor the success of weed control operations. Comprehensive records should be kept of all planting and weed control operations, track works and pest animal control, and any other management action undertaken within the project area.

11.1 Photopoints

Permanent photopoints are used to capture images of the vegetation or landscape over time. This is particularly useful for observing changes in growth patterns, vegetation density, and/or, sand deposition. It is recommended that permanent photopoints be established adjacent to planting nodes, significant weed infestations, and pōhutukawa stands (to monitor canopy health), and at high points (to record representative portions of the project area). Photopoint locations may be marked with a stake, or simply by recording a GPS point. The direction and focus of the photograph should be determined for each photopoint prior to the initial observation, and recorded so that it can be repeated as closely as possible for successive photographs. The pōhutukawa canopy should also be inspected to assess its condition and identify whether pest animal control is required. Each time a new photograph is taken, notes should be made on the size, density, and extent of the dominant vegetation type, along with other species or environmental factors of interest.

Photopoints should be established prior to any restoration activities commencing. Photopoints should be re-measured, where works are taking place, annually for the first three years after which biennial photographs would be sufficient. Additional photopoints to monitor particular features/management can be established as required.

11.2 Weed surveys

Regular weed surveys are an important management tool for assessing the success of weed control operations, identifying when follow up control is required, reviewing priorities, and identifying any new weed species and infestations that may establish.

The areas most vulnerable to reinvasion by weeds are the reserve boundaries, public access points and tracks, estuary margins, and bare areas exposed by erosion, track works, or previous weed control. It is recommended that a survey of these areas is undertaken at least annually for the first five years, and a comprehensive survey of the entire reserve is undertaken at 3-5 year intervals.

11.3 Bird surveys

Birds could be monitored to document changes in species diversity and relative abundance in response to the enhancement of habitats, and to provide information which could be used to promote the project and to provide interpretive material for the benefit of visitors. Periodic walk-through surveys and records of incidental observations would be appropriate techniques.

12. IMPLEMENTATION PLAN

Ideally, pest plants would be controlled in Management Zone 1 prior to felling of the pines. However, due to the safety aspect of this project, this may not be appropriate. If control of pest plants in Management Zone 1 is undertaken after tree felling, then it should be a priority in Year 2. All pest plant control should be undertaken in conditions favourable to its success i.e. no or low wind, no rain.

Year 1

- Establish monitoring within the management zone prior to works being undertaken. A minimum of one photopoint in each of the management zones should be established. About 10-15 photopoints should be established. All of these do not require to be remeasured each year.
- Fell pines on the harbour margin. Fell pines into the estuary then remove from estuary using a combination of excavator and digger to manoeuvre stems to the skid site on the southern edge of the forest.
- Fell pines within 60 meters either side of the walking track. Fell to waste. Trim and remove debris from walking track.
- Control black wattle and blackberry within Management Zone 4.
- Control pampas and wilding radiata pines in Management Zones 2, 3, and 5.
- Monitor dune vegetation (for rabbit damage) and pōhutukawa (for possum damage) six monthly or annually, and implement control as required.

Year 2

- Control wild ginger, montbretia, agapanthus, brush wattle, Japanese honeysuckle, blackberry, pampas within Management Zone 1.
- Undertake six-monthly surveillance and control of weeds within the area where pines were felled in Year 1, and within Management Zones 2, 3, 4, and 5.
- Control marram in Management Zone 3. Fertilise spinifex after control of marram.
- Remeasure photopoints established in Year 1 and reassess management priorities.

- Monitor dune vegetation (for rabbit damage) and pōhutukawa (for possum damage) six monthly or annually, and implement control as required.

Year 3

- Control barberry, Formosan lily, and saltwater paspalum in Management Zone 1, and saltwater paspalum in Management Zone 2, and gladioli in Management Zone 1, 3, and 5. It is likely that Formosan lily also occurs in Management Zone 3, and this should also be controlled.
- Undertake surveillance and control of weeds within the area where pines were felled in Year 1, and within Management Zones 2, 3, 4, and 5.
- Remeasure photopoints established in Year 1 and reassess management priorities.
- Monitor dune vegetation (for rabbit damage) and pōhutukawa (for possum damage) six monthly or annually, and implement control as required.

Year 4 Onwards

- Undertake surveillance and control of weeds annually within all management zones.
- Remeasure photopoints established in Year 1 biennially and reassess management priorities as required.
- Monitor dune vegetation (for rabbit damage) and pōhutukawa (for possum damage) six monthly or annually, and implement control as required.

ACKNOWLEDGMENTS

We would like to thank Nick Hamon (DOC, Coromandel) for organising this project and providing useful background information.

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VASCULAR PLANT SPECIES RECORDED AT OPOUTERE RECREATION RESERVE (SOUTHERN END), 2014

INDIGENOUS SPECIES

Monocot. trees and shrubs

Cordyline australis tī kōuka, cabbage tree

Dicot. trees and shrubs

Avicennia marina subsp. *australasica* mānawa, mangrove
Brachyglottis repanda rangiora
Coprosma acerosa sand coprosma, tarakupenga. tātaraheke
Coprosma grandifolia kanono, raurēkau, raurākau,
Coprosma lucida karamū, kāramuramu, glossy karamu
Coprosma macrocarpa subsp. *minor* karamū, kāramuramu
Coprosma rhamnoides
Coprosma robusta karamū, kāramuramu
Coprosma macrocarpa subsp. *minor* ×
C. robusta
Dodonaea viscosa akeake
Geniostoma ligustrifolium var. *ligustrifolium* hangehange
Hebe pubescens var. *pubescens* Coromandel koromiko
Kunzea ericoides kānuka
Leptecophylla juniperina var. *juniperina* prickly mingimingi
Leucopogon fasciculatus mingimingi
Leucopogon fraseri pātōtara
Metrosideros excelsa pōhutukawa
Myrsine australis māpou, matipou, māpau
Olearia rani var. *colorata* heketara
Ozothamnus leptophyllus tauhinu
Pimelea villosa s.s.¹ autetauranga; sand pimelea
Piper excelsum subsp. *excelsum* kawakawa
Pittosporum crassifolium karo
Plagianthus divaricatus marsh ribbonwoodmākaka
Pomaderris amoena tauhinu
Pomaderris kumeraho kūmarahou
Pomaderris rugosa
Pseudopanax arboreus whauwhaupaku, puahou, five finger
Pseudopanax crassifolius horoeka, lancewood
Pseudopanax crassifolius × *P. lessonii*
Pseudopanax lessonii houpara

¹ Observed in 1989 by one of the authors (SMB) (see also Regnier and Broekhuizen 1990), but not found in 2014.

Vitex lucens

pūriri

Dicot. lianes

Calystegia soldanella

panahi, shore bindweed

Muehlenbeckia complexa

pōhuehue

Ferns

Asplenium flaccidum

makawe, ngāmakawe o Raukatauri

Asplenium oblongifolium

huruhuru whenua

Asplenium polyodon

petako

Doodia australis

pukupuku

Hymenophyllum demissum

irirangi, piripiri, filmy fern

Microsorium pustulatum

kōwaowao, pāraharaha, hound's tongue fern

Pteridium esculentum

rārahu, bracken

Pteris macilenta

titipo, sweet fern

Pteris tremula

turawera, shaking brake

Pyrrhosia eleagnifolia

leather-leaf fern

Rumohra adiantiformis

karuwai

Orchids

Earina autumnalis

raupeka

Earina mucronata

peka-a-waka

Grasses

*Deyeuxia avenoides**Lachnagrostis billardierei*

sand wind grass

Microlaena stipoides

pātītī, meadow rice grass

Oplismenus hirtellus subsp. *imbecillis**Poa anceps* agg.*Poa imbecilla**Poa pusilla**Rytidosperma gracile**Spinifex sericeus*

kōwhangatara, spinifex

Sedges

*Carex dissita**Carex testacea**Cyperus ustulatus* f. *ustulatus*

toetoeupoko-tangata

Ficinia nodosa

wīwī

*Isolepis cernua**Lepidosperma laterale**Machaerina juncea**Machaerina tenax**Uncinia uncinata*

kamumatau a Maui, kamu

Rushes

<i>Apodasmia similis</i>	oioi
<i>Juncus kraussii</i> var. <i>australiensis</i>	wi, wīwī sea rush
<i>Luzula picta</i> var. <i>picta</i>	

Monocot. herbs (other than orchids, grasses, sedges, and rushes)

<i>Astelia banksii</i>	kakaha, pūwharawhara, wharawhara, kōwharawhara
<i>Astelia solandri</i>	kōwharawhara
<i>Astelia trinervia</i>	mauri
<i>Collospermum hastatum</i>	kahakaha
<i>Dianella nigra</i>	tūrutu
<i>Phormium tenax</i>	harakeke, flax
<i>Triglochin striata</i>	arrow grass

Composite herbs

<i>Euchiton sphaericus</i>	
<i>Lagenifera pumila</i>	papataniwhaniwha
<i>Senecio diaschides</i>	fireweed
<i>Senecio glomeratus</i>	pukatea
<i>Senecio hispidulus</i>	

Dicot. herbs (other than composites)

<i>Apium prostratum</i> subsp. <i>prostratum</i>	tūtae-kōau, New Zealand celery
var. <i>filiforme</i>	Mercury Bay weed
<i>Dichondra repens</i>	piripiri
<i>Gonocarpus incanus</i>	toatoa
<i>Haloragis erecta</i> subsp. <i>erecta</i>	punakura
<i>Lobelia anceps</i>	sand oxalis
<i>Oxalis rubens</i>	kopata
<i>Pelargonium inodorum</i>	māakoako
<i>Samolus repens</i> var. <i>repens</i>	remuremu, rekoreko, raumangu
<i>Selliera radicans</i>	raupeti
<i>Solanum americanum</i>	kōkihi, rengamutu, rengarenga, tūtae-ikamoana
<i>Tetragonia implexicoma</i>	kōkihi, rengamutu, rengarenga, tūtae-ikamoana
<i>Tetragonia tetragonioides</i>	

NATURALISED AND EXOTIC SPECIES

Gymnosperms

<i>Cupressus macrocarpa</i>	macrocarpa
<i>Pinus pinaster</i>	maritime pine
<i>Pinus radiata</i>	radiata pine

Dicot. trees and shrubs

<i>Berberis glaucocarpa</i>	barberry
<i>Eucalyptus</i> sp.	eucalyptus
<i>Lupinus arboreus</i>	lupin
<i>Melilotus indica</i>	King Island melilot
<i>Paraserianthes lophantha</i>	brush wattle
<i>Prunus persica</i>	peach tree, nectarine
<i>Rubus</i> sp. (<i>R. fruticosus</i> agg.)	blackberry
<i>Teline monspessulana</i>	Montpellier broom

Dicot. lianes

<i>Lonicera japonica</i>	Japanese honeysuckle
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Grasses

<i>Aira praecox</i>	early hair grass
<i>Ammophila arenaria</i>	marram
<i>Anthoxanthum odoratum</i>	sweet vernal
<i>Cortaderia selloana</i>	pampas
<i>Cynodon dactylon</i>	Indian doab
<i>Dactylis glomerata</i>	cocksfoot
<i>Ehrharta erecta</i>	veldt grass
<i>Holcus lanatus</i>	Yorkshire fog
<i>Lagurus ovatus</i>	haretail
<i>Miscanthus nepalensis</i>	Himalaya fairy grass
<i>Paspalum dilatatum</i>	paspalum
<i>Paspalum vaginatum</i>	saltwater paspalum
<i>Schedonorus arundinaceus</i>	tall fescue
<i>Sporobolus africanus</i>	ratstail
<i>Stenotaphrum secundatum</i>	buffalo grass

Sedges

<i>Cyperus eragrostis</i>	umbrella sedge
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Rushes

<i>Juncus tenuis</i> var. <i>tenuis</i>	track rush
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Monocot. herbs (other than orchids, grasses, sedges, and rushes)

<i>Agapanthus praecox</i>	agapanthus
<i>Crocasmia ×crocosmiiflora</i>	montbretia
<i>Gladiolus</i> sp.	gladiolus
<i>Hedychium gardnerianum</i>	kahili ginger, wild ginger
<i>Lilium formosanum</i>	Formosan lily

Composite herbs

<i>Aster subulatus</i>	sea aster
<i>Cirsium vulgare</i>	Scotch thistle
<i>Conyza sumatrensis</i>	broad-leaved fleabane
<i>Erechtites valerianifolia</i>	Brazilian fireweed
<i>Hypochaeris radicata</i>	catsear
<i>Jacobaea vulgaris</i>	ragwort
<i>Leontodon taraxacoides</i>	hawkbit
<i>Leucanthemum vulgare</i>	oxeye daisy
<i>Mycelis muralis</i>	wall lettuce
<i>Senecio elegans</i>	purple groundsel
<i>Sonchus asper</i>	prickly puha
<i>Sonchus oleraceus</i>	puha, sow thistle

Dicot. herbs (other than composites)

<i>Anagallis arvensis</i>	scarlet pimpernel
<i>Atriplex prostrata</i>	orache
<i>Cakile maritima</i>	sea rocket
<i>Galium aparine</i>	cleavers
<i>Geranium molle</i>	dovesfoot cranesbill
<i>Lotus pedunculatus</i>	lotus
<i>Oxalis</i> sp.	
<i>Physalis peruviana</i>	cape gooseberry
<i>Phytolacca octandra</i>	inkweed
<i>Plantago lanceolata</i>	narrow-leaved plantain
<i>Prunella vulgaris</i>	selfheal
<i>Rumex acetosella</i>	sheep's sorrel
<i>Rumex obtusifolius</i>	broad-leaved dock
<i>Solanum lycopersicum</i>	tomato
<i>Trifolium repens</i>	white clover
<i>Veronica plebeia</i>	Australian speedwell
<i>Vicia sativa</i>	vetch

AVIFAUNA RECORDED IN OPOUTERE BEACH
RECREATION RESERVE (SOUTHERN END), MAY 2014

INDIGENOUS

<i>Charadrius bicinctus bicinctus</i>	tūturiwhatu; banded dotterel
<i>Charadrius obscurus aquilonius</i>	tūturiwhatu; northern New Zealand dotterel
<i>Circus approximans</i>	kahu; Australasian harrier
<i>Gerygone igata</i>	riroriro; grey warbler
<i>Haematopus unicolor</i>	tōrea, tōrea pango, variable oystercatcher
<i>Hemiphaga novaeseelandiae</i>	kereru; New Zealand pigeon
<i>Hirundo neoxena neoxena</i>	welcome swallow
<i>Larus bulleri</i>	black-billed gull
<i>Larus novaehollandiae scopulinus</i>	tarapunga; red-billed gull
<i>Nestor meridionalis septentrionalis</i>	North Island kākā
<i>Prothemadera novaeseelandiae</i>	tui
<i>Rhipidura fuliginosa</i>	piwakawaka, fantail
<i>Todiramphus sanctus vagans</i>	kotare; New Zealand kingfisher

INTRODUCED

<i>Fringilla coelebs</i>	chaffinch
<i>Gymnorhina tibicen</i>	Australian magpie
<i>Platycercus eximius</i>	eastern rosella
<i>Turdus merula merula</i>	Eurasian blackbird





Plate 1: Tall, over-mature radiata pine forest on the south-western margin of Opoutere Beach Recreation Reserve beside the Wharekawa estuary. Some standing dead trees are present.



Plate 2: Regeneration of indigenous species is occurring around pines that have been felled c.2-3 years ago and left to rot *in situ*.



Plate 3: Exposed roots of radiata pine and macrocarpa trees on the southern margin of the project area. The trees are leaning towards the estuary.



Plate 4: A small section along the southern boundary of the project area has been cleared of pines. Some slipping of the bank has occurred and a mixture of indigenous and exotic species are colonising the bare slope.



Plate 5: Pampas is locally common within wīwī-pohuehue sedgeland (Vegetation Type 2) on the mid- and back-dunes of the project area. Pine debris is present at the western edge of this type where pines were felled c.2-3 years ago.



Plate 6: Patches of sand coprosma occur within spinifex-wīwī sedgeland (Vegetation Type 3). A wilding radiata pine seedling is visible in the upper right of this photograph.



Plate 7: Local patches of agapanthus are present along the estuary margins on the southern side of the project area.



Plate 8: A patch of the At Risk New Zealand spinach (*Tetragonia tetragonioides*; At Risk Naturally Uncommon) at the base of a scarp at the edge of the estuary on the southern margin of the project area.



Plate 9: Part of the walking track through the project area. Several pines in the photograph are leaning out over the track.



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