Sand Dune Vegetation Mapping and Condition Assessment for Otamarakau to Cape Runaway 2009

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Prepared by Nancy Willems

Cover Photo:
Moutohora as viewed from the Piripai dunes.
Photographer Heather MacKenzie.

Acknowledgements

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Executive summary

The establishment of sand dune extent and condition monitoring for the Bay of Plenty region was completed in 2009. The work identified and mapped undeveloped sand dunes across the Bay of Plenty region. Sand dunes were mapped by walking sand dune extents, using 2007 aerial photography and a series of stratified belt transects at 1 km intervals (within sites) along the coastline.

This monitoring was carried out as a part of the Terrestrial Indigenous Biodiversity Natural Environment Regional Monitoring Network (NERMN). The data collected during this survey will provide a baseline for sand dune condition and extent in the Bay of Plenty region. Future monitoring will provide information on changes in sand dune extents, pest plants and densities and other impacts.

Otamarakau to Cape Runaway is covered in this report, along with Orokawa Bay. Wildland Consultants mapped Orokawa Bay during the mapping of the Tauranga Ecological District (ED) in 2008, however, it was not included in their report as it falls outside of the Tauranga ED.

This report should be read in conjunction with Wildland Consultants (2008a and 2008b).

Recommendations for dune maintenance will be made in a following report.

Contents

Part 1: Introduction

1.1 Purpose of report

Sand dune mapping of the Bay of Plenty region (Otamarakau to Cape Runaway/eastern Bay of Plenty only) was completed by Environment Bay of Plenty staff from February-March 2009. This was a continuation of the mapping of the Bay of Plenty region. Mapping was carried out for the Tauranga Ecological District by Wildland Consultants in 2008.

This report outlines the work and gives management priorities for transects for Orokawa Bay and from Otamarakau to Cape Runaway.

An overview report will be produced for the whole of the Bay of Plenty region to present a picture of the state of the region's sand dunes based on the initial survey.

1.2 Background

Sand dune monitoring was carried out as a part of the Terrestrial Indigenous Biodiversity Natural Environment Regional Monitoring Network (NERMN). The data collected during this survey will provide a baseline for sand dune condition and extent in the Bay of Plenty region.

Re-measures will cover the entire region and the frequency is envisaged to be every five years, coinciding with new aerial photography.

Part 2: Methods

Sand dunes of the eastern Bay of Plenty region were mapped by walking sand dune extents, using 2007 aerial photography and a series of stratified belt transects at 1 km intervals along the coast. The Tauranga Ecological District was mapped by Wildland Consultants in 2008 and the remaining coastline was mapped in-house in 2009.

Transect's bisecting areas without dune landforms were not measured. However, the numbering of transects remained the same to retain that part of the sampling design. The methodology used was developed by Wildland Consultants and can be viewed in detail in Wildland Consultants (2008a).

The mapping of the Bay of Plenty region has led to the creation of three GIS layers at 1:1,000. The data these layers capture are:

- **Site_boundary_all** – The extents of the 42 Sand Dune Vegetation Condition Monitoring Areas in the Bay of Plenty region.

- **Vege_layer_easternbop** – The spatial extent of vegetation types within each of the Sand Dune Vegetation Condition Monitoring Areas in the eastern Bay of Plenty region.

- **new_transects_with_bearings** – The locations and bearings (inland direction) of the 83 transects within the Sand Dune Vegetation Condition Monitoring Areas in the eastern Bay of Plenty region.

The first two layers have now been merged into a regional sand dune vegetation and sites layer.

Part 3: Results

3.1 Bay of Plenty region

The complete survey identified and mapped undeveloped sand dunes that occur in the Bay of Plenty region. The region's sand dunes have been divided into 42 sites with a total of 166 transects bisecting them. Below are described the results from Orokawa Bay and the eastern Bay of Plenty only. For site/transect specific data on the western Bay of Plenty region refer to Wildland Consultants (2008b).

3.2 Orokawa Bay

Orokawa Bay was monitored by Wildland Consultants in 2008, but was omitted from the report due to it being outside of the Tauranga Ecological District. Management priorities for Orokawa Bay will be covered in this report instead. Orokawa Bay has one transect (see Figure 1).

3.3 Otamarakau-Cape Runaway (Eastern Bay of Plenty)

Sand dune vegetation mapping of the eastern Bay of Plenty region mapped a total of 20 sites and 83 transects (see Figure 2, sheets 1-3). An additional transect was established between transect 143 and transect 144 (transect 144.1). Detailed vegetation types (Table 1) were mapped for site extents, these detailed vegetation types were then grouped into one of the 81 vegetation classes observed for the Bay of Plenty region (68 present in the eastern Bay of Plenty) (Table 2).

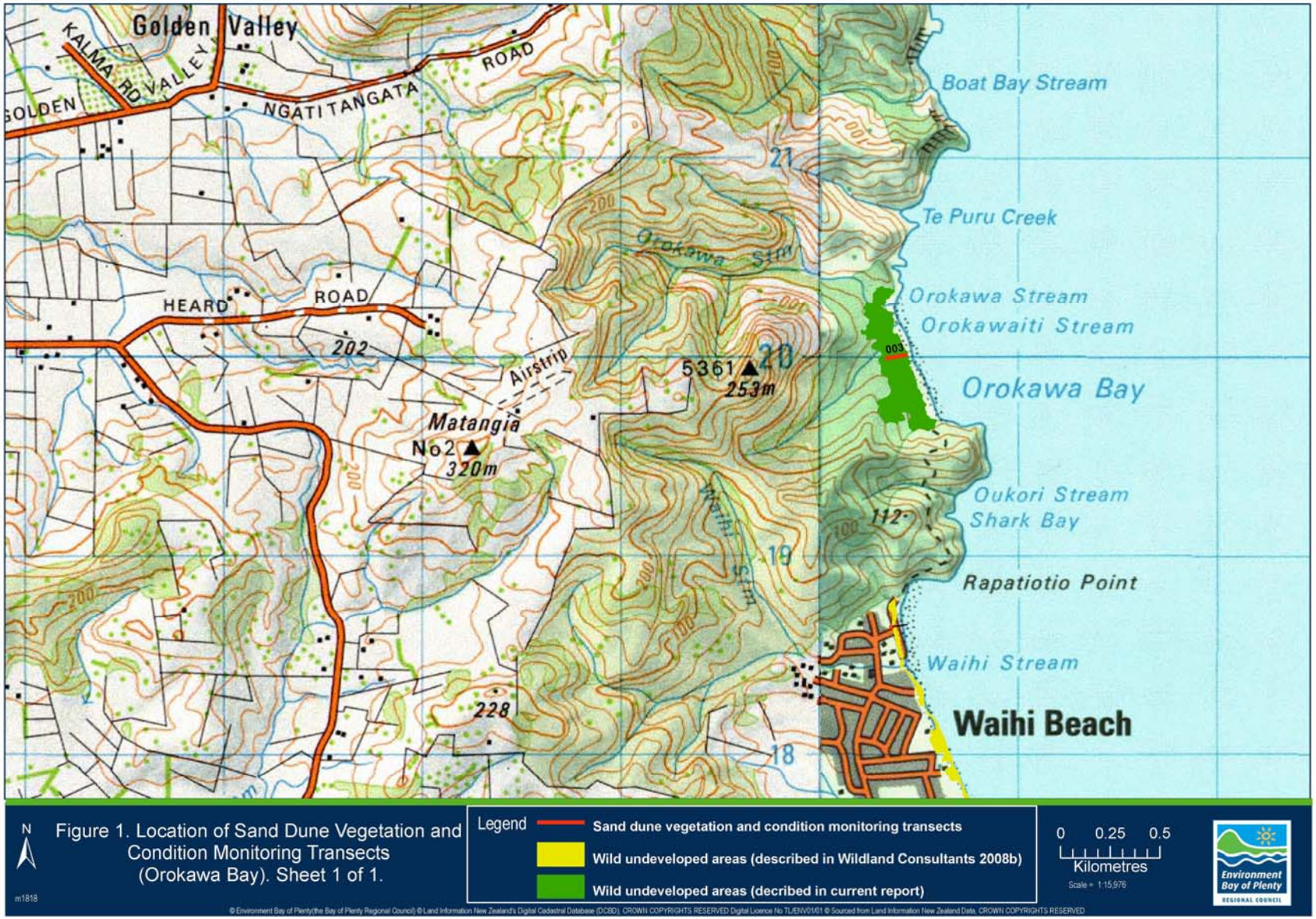

Figure 1 Location of sand dune vegetation and condition monitoring transects (Orokawa Bay).

Figure 2 Location of sand dune vegetation and condition monitoring transects (Ōtamarākau-Cape Runaway) – Sheet 1.

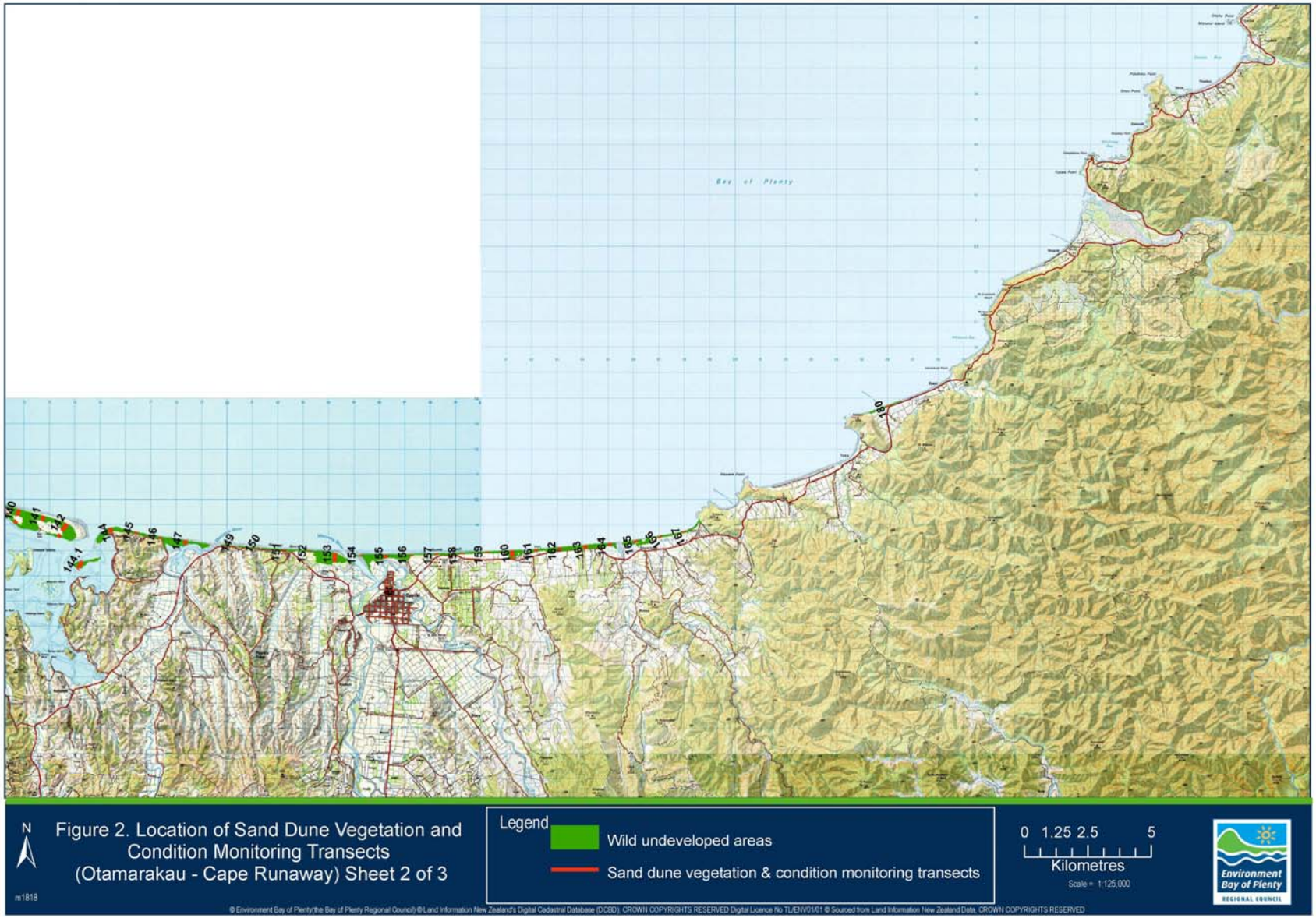

Figure 3 Location of sand dune vegetation and condition monitoring transects (Ōtamarākau-Cape Runaway) – Sheet 2.

Figure 4 Location of sand dune vegetation and condition monitoring transects (Ōtamarākau-Cape Runaway) – Sheet 3.

Table 1: Vegetation types observed during the surveying of wild unmanaged vegetation on sand dune landforms (including dune wetlands) in the entire Bay of Plenty region.

Structural Class	Vegetation Class	Vegetation Types and Habitats
01 Forest	01 Pine forest	01.01.01 Pine forest
	02 Banksia forest	01.02.01 Banksia forest
	03 Willow forest	01.03.01 Willow forest
	04 Indigenous forest	01.04.01 Indigenous forest
02 Treeland	01 Pine treeland	02.01.01 Pine treeland 02.01.02 Pine-mixed indigenous treeland
	02 Banksia treeland	02.02.01 Banksia treeland
	03 Eucalyptus treeland	02.03.01 Eucalyptus-mixed indigenous treeland
	04 Silver Poplar treeland	02.04.01 Silver poplar treeland
	05 Mixed exotic treeland	02.05.01 Mixed exotic treeland
	06 Mixed indigenous treeland	02.06.01 Mixed indigenous treeland
	07 Pohutukawa treeland	02.07.01 Pohutukawa dominant treeland
	08 Macrocarpa treeland	02.08.01 Macrocarpa-mixed indigenous treeland
03 Vineland	01 Pohuehue vineland	03.01.01 Pohuehue-*Ficinia nodosa* vineland 03.01.02 Pohuehue-bracken vineland 03.01.03 Pohuehue-marram vineland 03.01.04 Pohuehue-kikuyu vineland 03.01.05 Pohuehue-agapanthus vineland 03.01.06 Lupin/pohuehue vineland 03.01.07 Pohuehue dominant vineland 03.01.08 Pohuehue-panahi vineland 03.01.09 African boxthorn/pohuehue dominated vineland 03.01.10 Pohuehue-exotic grasses vineland 03.01.11 Pohuehue-spinifex vineland 03.01.12 Pohuehue-South African iceplant vineland
	02 Cape ivy vineland	03.02.01 Cape ivy vineland
	03 Periwinkle vineland	03.03.01 Periwinkle vineland
	04 Japanese honeysuckle vineland	03.04.01 Japanese honeysuckle vineland
	05 *Muehlenbeckia australis* vineland	03.05.01 *Muehlenbeckia australis* vineland
	06 Moth plant vineland	03.06.01 Moth plant dominated vineland
	07 Pink bindweed vineland	03.07.01 Pink bindweed-kikuyu vineland
04 Scrub	01 Mixed indigenous scrub	04.01.01 Ti kouka-karamu scrub 04.01.02 Ti kouka-mamaku-karamu scrub 04.01.03 Mixed indigenous scrub
	02 Gorse scrub	04.02.01 Gorse-pohuehue scrub 04.02.02 Gorse-broom/pohuehue scrub 04.02.03 Gorse-pampas scrub 04.02.04 Gorse dominated scrub 04.02.05 Gorse-African boxthorn scrub 04.02.06 Gorse-lupin/spinifex scrub
	03 Coast tea tree scrub	04.03.01 Coast tea tree scrub
	04 Grey willow scrub	04.04.01 Grey willow scrub 04.04.02 Grey willow-tutu scrub
	05 Blackberry scrub	04.05.01 Blackberry scrub
	06 Lupin scrub	04.06.01 Lupin/saltwater paspalum scrub
	07 Manuka scrub	04.07.01 Manuka dominated scrub
05 Shrubland	01 Manuka shrubland	05.01.01 Manuka-mixed indigenous shrubland
	02 Ti kouka-taupata shrubland	05.02.01 Ti kouka-taupata shrubland
	03 Lupin shrubland	05.03.01 Lupin/spinifex shrubland 05.03.02 Lupin dominated shrubland 05.03.03 Lupin-marram shrubland
	04 Gorse shrubland	05.04.01 Gorse/oioi-kikuyu shrubland 05.04.02 Gorse/exotic grasses shrubland 05.04.03 Gorse-pampas shrubland
	05 Coast tea tree shrubland	05.05.01 Coast tea tree-pine shrubland

Structural Class	Vegetation Class	Vegetation Types and Habitats
	06 African boxthorn shrubland	05.06.01 African boxthorn/pohuehue shrubland 05.06.02 African boxthorn/bracken shrubland 05.06.03 African boxthorn dominated shrubland
	07 Grey willow shrubland	05.07.01 Grey willow shrubland 05.07.02 Grey willow-mixed indigenous shrubland
	08 Coastal kanuka shrubland	05.08.01 Coastal kanuka shrubland
	09 Saltmarsh ribbonwood shrubland	05.09.01 Saltmarsh ribbonwood shrubland
	10 Kanuka shrubland	05.10.01 Kanuka dominant shrubland
	11 Mixed indigenous shrubland	05.11.01 Mixed indigenous shrubland
06 Tussockland	01 Sea rush tussockland	06.01.01 Sea rush tussockland 06.01.02 Sea rush-saltwater paspalum tussockland
	02 Pampas tussockland	06.02.01 Pampas-mixed indigenous tussockland 06.02.02 Pampas-*Ficinia nodosa* tussockland 06.02.03 Pampas-gorse tussockland 06.02.04 Pampas-grey willow tussockland 06.02.05 Pampas dominated tussockland
07 Fernland	01 Bracken fernland	07.01.01 Bracken-pohuehue fernland 07.01.02 Bracken dominated fernland 07.01.03 Bracken-kikuyu fernland 07.01.04 Bracken-ripgut brome fernland 07.01.05 Brush wattle/bracken fernland
08 Grassland	01 Spinifex grassland	08.01.01 Spinifex-pingao/*Calystegia soldanella* grassland 08.01.02 Spinifex/*Calystegia soldanella* grassland 08.01.03 Spinifex-marram grassland 08.01.04 Spinifex dominated grassland 08.01.05 Spinifex-sea rocket grassland 08.01.06 Spinifex-pingao grassland 08.01.07 Lupin/spinifex grassland
	02 Marram grassland	08.02.01 Marram grassland 08.02.02 Marram-*Ficinia nodosa* grassland 08.02.03 Marram-sea couch grassland 08.02.04 Marram-pohuehue-exotic grasses grassland
	03 Buffalo grass grassland	08.03.01 Buffalo grass-pohuehue grassland 08.03.02 Buffalo grass-kikuyu-sea couch grassland
	04 Kikuyu grassland	08.04.01 Kikuyu-pohuehue grassland 08.04.02 Kikuyu-blackberry grassland 08.04.03 Kikuyu grassland 08.04.04 Exotic shrubs/kikuyu grassland 08.04.05 Kikuyu-cocksfoot grassland 08.04.06 Kikuyu-sea couch grassland
	05 Cocksfoot grassland	08.05.01 Cocksfoot grassland 08.05.02 Cocksfoot dominated grassland
	06 Knot-root bristle-grass grassland	08.06.01 Knot-root bristle-grass grassland
	07 Tall fescue grassland	08.07.01 Tall fescue dominated grassland 08.07.02 Tall fescue-kikuyu grassland 08.07.03 Tall fescue-pohuehue grassland 08.07.04 Tall fescue-cocksfoot grassland
	08 Sea couch grassland	08.08.01 Sea couch dominant grassland 08.08.02 Sea couch-pohuehue grassland 08.08.03 Sea couch-kikuyu grassland 08.08.04 Sea couch-spinifex grassland 08.08.05 Sea couch-bracken grassland 08.08.06 African boxthorn/sea couch grassland 08.08.07 Sea couch-*Carex pumila* grassland 08.08.08 Sea couch-cocksfoot grassland
	09 Reed sweet grass grassland	08.09.01 Reed sweet grass grassland 08.09.02 Grey willow/reed sweet grass grassland
	10 Indian doab grassland	08.10.01 Indian doab grassland 08.10.02 Indian doab- saltwater paspalum grassland 08.10.03 Indian doab-sea couch grassland 08.10.04 Indian doab-pohuehue grassland 08.10.05 Indian doab-ripgut brome grassland 08.10.06 Indian doab-buffalo grass grassland

Structural Class	Vegetation Class	Vegetation Types and Habitats
	11 Saltwater paspalum grassland	08.11.01 Saltwater paspalum grassland 08.11.02 Saltwater paspalum *Carex pumila* grassland
	12 Smooth brome grassland	08.12.01 Smooth brome grassland
	13 Rats tail grassland	08.13.01 Rats tail dominated grassland
	14 Hares tail grassland	08.14.01 Hares tail-sea couch grassland 08.14.02 Hares tail-kikuyu grassland
	15 Ripgut brome	08.15.01 Ripgut brome dominated grassland
09 Sedgeland	01 Pingao sedgeland	09.01.01 Pingao sedgeland 09.01.02 Pingao-spinifex sedgeland
	02 *Carex testacea* sedgeland	09.02.01 *Carex testacea*-pohuehue-*Ficinia nodosa* sedgeland
	03 *Ficinia nodosa* sedgeland	09.03.01 *Ficinia nodosa*-pohuehue sedgeland 09.03.02 *Ficinia nodosa* dominated sedgeland 09.03.03 Gores/*Ficinia nodosa* sedgeland
	04 *Baumea juncea* sedgeland	09.04.01 *Baumea juncea* sedgeland 09.04.02 *Baumea juncea-Apodasmia similis* sedgeland
	05 Giant umbrella sedge sedgeland	09.05.01 Giant umbrella dominated sedgeland
	06 *Carex pumila* sedgeland	09.06.01 *Carex pumila* dominated sedgeland
	07 *Baumea articulata* sedgeland	09.07.01 *Baumea articulata*-saltwater paspalum sedgeland 09.07.02 *Baumea articulata* dominated sedgeland
	08 *Carex geminata* sedgeland	09.08.01 *Carex geminata* dominant sedgeland
	09 Marsh clubrush sedgeland	09.09.01 Marsh clubrush sedgeland
10 Rushland	01 Oioi rushland	10.01.01 Oioi rushland 10.01.02 Oioi-wiwi rushland 10.01.03 Kanuka/oioi rushland 10.01.04 Saltmarsh ribbonwood/oioi rushland
	02 Wiwi rushland	10.02.01 Wiwi rushland
11 Reedland	01 Raupo reedland	11.01.01 Raupo reedland 11.01.02 Raupo-harakeke reedland 11.01.03 Raupo/reed sweet grass reedland 11.01.04 Raupo/marsh clubrush reedland 11.01.05 Grey willow/raupo reedland
	02 *Schoenoplectus tabernaemontani-Baumea articulata* reedland	11.02.01 *Schoenoplectus tabernaemontani-Baumea articulata* reedland
13 Herbfield	01 South African iceplant herbfield	13.01.01 South African iceplant herbfield
	02 Gazania herbfield	13.02.01 *Gazania linearis*-*Arctotis*-South African iceplant herbfield 13.02.02 *Gazania linearis* dominated herbfield
	03 Flatweed herbfield	13.03.01 Flatweed herbfield 13.03.02 Flatweed-pohuehue herbfield
	04 Mixed exotic herbfield	13.04.01 Mixed exotics herbfield
	05 *Asparagus densiflorus* herbfield	13.05.01 *Ficinia nodosa*/*Asparagus densiflorus*-*Gazania linearis*-pohuehue herbfield 13.05.02 *Asparagus densiflorus*-buffalo grass herbfield
	06 Agapanthus herbfield	13.06.01 *Agapanthus praecox*-*Gazania linearis*-South African iceplant herbfield 13.06.02 *Agapanthus praecox* herbfield
	07 Canna lily herbfield	13.07.01 Canna lily herbfield
	08 *Rorripa palustris* herbfield	13.08.01 *Rorripa palustris* herbfield
	09 *Aster subulatus* herbfield	13.09.01 *Aster subulatus* herbfield
	10 Panahi herbfield	13.10.01 Panahi -*Carex pumila* herbfield
	11 Inkweed herbfield	13.11.01 Inkweed-Indian doab herbfield
19 Sandfield	01 Sandfield	19.01.01 Spinifex dominated sandfield 19.01.02 Pingao-spinifex sandfield 19.01.03 *Carex pumila* dominated sandfield 19.01.04 *Ficinia nodosa*-panahi sandfield 19.01.05 Sea rocket sandfield 19.01.06 *Carpodrotus edulis* sandfield 19.01.07 Panahi sandfield 19.01.08 Beach sand sandfield 19.01.09 Sea rocket -spinifex sandfield 19.01.10 Sand-stone-debris sandfield

Structural Class	Vegetation Class	Vegetation Types and Habitats
		19.01.11 Panahi -*Carex pumila* sandfield 19.01.12 Sea rocket -kikuyu sandfield 19.01.13 Sand-driftwood debris sandfield 19.01.14 Sea couch-panihi sandfield 19.01.15 Panahi-inkweed-wiwi sandfield 19.01.16 Marram sandfield
22 Open water	01 Open water	22.01.01 Open freshwater 22.01.02 Impounded open water

Table 2: Extent of each vegetation class for Orokawa Bay and the Eastern Bay of Plenty.

Structural Class	Vegetation Class	Area (ha)
01 Forest	03 Willow Forest	0.63
	04 Indigenous Forest	8.28
		8.91
02 Treeland	01 Pine treeland	2.02
	03 Eucalyptus treeland	18.76
	04 Silver poplar treeland	0.58
	05 Mixed exotic treeland	5.25
	06 Mixed indigenous treeland	9.65
	07 Pohutukawa treeland	3.53
	08 Macrocarpa treeland	0.55
		40.34
03 Vineland	01 Pohuehue vineland	239.38
	02 Cape ivy vineland	0.25
	04 Japanese honeysuckle vineland	1.89
	05 *Muehlenbeckia australis* vineland	0.18
	06 Moth plant vineland	0.03
	07 Pink bindweed vineland	0.21
		241.94
04 Scrub	01 Mixed indigenous scrub	1.41
	02Gorse scrub	35.17
	04 Grey willow scrub	9.29
	05 Blackberry scrub	0.25
	07 Manuka scrub	0.21
		46.33
05 Shrubland	01 Manuka shrubland	0.63
	02 Ti kouka-taupata shrubland	0.17
	03 Lupin shrubland	13.71
	04 Gorse shrubland	3.04
	06 African boxthorn shrubland	4.65
	07 Grey willow shrubland	0.09
	08 Coastal kanuka shrubland	9.62
	09 Saltmarsh ribbonwood shrubland	1.53
	10 Kanuka shrubland	0.59
	11 Mixed indigenous shrubland	0.63
		34.66
06 Tussockland	01 Searush tussockland	2.99
	02 Pampas tussockland	14.52
		17.51
07 Fernland	01 Bracken fernland	52.51
		52.51
08 Grassland	01 Spinifex grassland	73.90

	02 Marram grassland	59.86
	03 Buffalo grass grassland	1.85
	04 Kikuyu grassland	28.38
	05 Cocksfoot grassland	30.05
	06 Knot-root bristle-grass grassland	1.94
	07 Tall fescue grassland	70.09
	08 Sea couch grassland	143.18
	09 Reed sweet grass grassland	2.66
	10 Indian doab grassland	7.40
	11 Saltwater paspalum grassland	5.98
	12 Smooth brome grassland	0.33
	13 Rats tail grassland	0.23
	14 Hares tail grassland	0.13
	15 Ripgut brome grassland	0.08
		426.06
09 Sedgeland	01 Pingao sedgeland	0.05
	03 *Ficinia nodosa* sedgeland	2.91
	04 *Baumea juncea* sedgeland	4.97
	05 Giant umbrella sedge sedgeland	9.00
	06 *Carex pumila* sedgeland	2.08
	07 *Baumea articulata* sedgeland	2.83
	08 *Carex geminata* sedgeland	0.25
	09 Marsh clubrush sedgeland	0.85
		22.93
10 Rushland	01 Oioi rushland	13.20
	02 Wiwi rushland	2.87
		16.07
11 Reedland	01 Raupo reedland	114.78
	02 *Schoenoplectus tabernaemontani-Baumea articulata* reedland	0.01
		114.79
13 Herbfield	01 South African iceplant herbfield	0.75
	02 Gazania herbfield	0.49
	03 Flatweed herbfield	0.99
	04 Mixed exotic herbfield	2.19
	06 Agapanthus herbfield	0.46
	10 Panahi herbfield	0.42
	11 Inkweed herbfield	0.82
		6.13
19 Sandfield	01 Sandfield	26.18
		26.18
22 Open water	01 Open water	33.86
		33.86
GRAND TOTAL (ha)		**1088.23**

Part 4: Management priorities for transect in the Eastern Bay of Plenty

Management priorities for transects in the eastern Bay of Plenty are listed below. The site name is followed by the transect numbers occurring within the site. The management priorities are predominantly the main pest plant species that could be eradicated or controlled to most benefit the sand dunes.

One transect bisects multiple sites and is therefore in this section twice (out of order the second time). As noted in the methods there will be gaps in the numbering of transects due to some sections of the coastline not being dune landforms.

4.1 Orokawa Bay

003 There are no management priorities here. Californian thistle (Cirsium arvense) is present, but should eventually be shaded out by the regeneration forest.

4.2 Ōtamarākau-Matatā-Whakatāne dunes

This site is a long extent of dunes that is heavily utilised by the public for recreation. There is increased erosion due to impacts of four-wheel vehicle tracking along and through the dunes. Vehicle access to the dunes will continue to damage the dunes, increase erosion and reduce indigenous duneland vegetation. Although this is a complex issue it needs to be addressed.

087 Eradication of moth plant (*Araujia sericifera*), dimorphotheca (*Osteospermum fruticosum*) and pampas (*Cortaderia selloana*) would enhance the ecological values of the dune system. Control of marram grass (*Ammophila arenaria*) on foredune would allow for natural regeneration by spinifex (*Spinifex sericeus*).

088 Eradicate pampas and control exotic grasses on the foredune. Control of marram grass on foredune would allow for natural regeneration by spinifex.

089 There are a number of large blow outs resulting from vehicle tracking. Control of marram and planting of spinifex in areas of erosion would aid in reducing blowouts. Spot spray pampas.

090 Eradicate small area of blackberry (*Rubus fruticosus*). Control marram.

091 Eradicate the small amounts of blackberry and boxthorn (*Lycium ferocissimum*). Control marram. Planting of blowouts with spinifex would reduce further erosion.

092 Remove the few mature eucalyptus trees (*Eucalyptus botryoides*) present. Eradicate blackberry and kikuyu (*Pennisetum clandestinum*) alongside railway track.

093 Control blackberry.

094 Control kikuyu on the margins of the transect to prevent further spread into the dunes. Control blackberry.

095 Eradicate boxthorn and pampas. Control marram from undulating swale.

096 Eradicate Pampas, blackberry and boxthorn by spot spraying. Control marram.

097 Eradicate brush wattle (*Paraserianthes lophantha*), grey willow (*Salix cinerea*) and woolly nightshade (*Solanum mauritianum*). Control blackberry.

098 Eradicate boxthorn and brush wattle. Continue with pampas control. One of the management regimes (three options[1] in the Wildland Consultants 2007) for the regenerating dune forest under the eucalyptus trees should be initiated. We recommend the use of management Option 2, to maintain the current understorey regeneration. Once the indigenous understorey has achieved sufficient canopy closure, the removal of large eucalyptus trees (via ring-barking/poisoning) should be considered.

099 Control of marram and planting of spinifex to reduce blow outs on foredune. Control of pampas that dominates the dune swale where debris from slips has been deposited. Recommend to initiate management of regenerating dune forest option 2 (see transect 098).

100 Eradication of South African iceplant (*Carprobrotus edulis*) and replacement planting of spinifex would enhance the foredune area.

101 Eradicate boxthorn. Control marram on foredune and pampas and grey willow in the dune swale. Recommend to initiate management of regenerating dune forest option 2 (see transect 098).

From this transect until the causeway between transect 103 and 104 there will be significant changes occurring before the next monitor due to some areas being used for long-term debris disposal and the construction of sediment ponds. Management will be constrained by this project and the relevant consents that apply.

102 Eradicate boxthorn and agapanthus (*Agapanthus praecox*). Control marram on foredune, and pampas and brush wattle on the edge of the developed area. Also control kikuyu to prevent it encroaching onto the foredune.

103 Control marram on foredune. The area of gorse (*Ulex europaeus*) could be eradicated with low level of effort required. Control blackberry, boxthorn and Japanese honeysuckle (*Lonicera japonica*).

104 Control boxthorn and the area of gorse between the sea and wetland.

105 Control marram on foredune. Eradicate boxthorn. Control of blackberry and gorse would enhance the ecological values of the dunes.

106 Eradicate *Agarvae americana* and agapanthus that is present in patches on the established dune. Control of boxthorn and possibly of blackberry would add to the ecological values and quality of the dunes.

107 Control boxthorn.

108 Control marram and boxthorn.

109 Eradicate moth plant. Control boxthorn and gorse.

[1] Option 1: No Action. Option 2: Low Level Intervention. Option 3: More Intensive Intervention. See Appendix 3 for full descriptions for the proposed management actions.

110 Eradicate pampas. Control boxthorn, barberry (*Berberis glaucocarpa*).

111 Control boxthorn, barberry spindle tree (*Euonymus europaeus*) and evergreen buckthorn (R*hamnus alaternus*).

112 Control kikuyu to stop it spreading over the rest of the foredune. Control boxthorn.

113 Eradicate Japanese spindle tree (*Euonymus japonicus*). Control boxthorn.

114 Eradicate South African iceplant and swamp oak (*Casuarina glauca*). Control kikuyu to stop further spread into the dunes.

115 Eradicate marram. Control of gorse, boxthorn and pampas would greatly benefit the ecological values at this site.

116 Control gorse, pampas and marram.

117 Eradicate gazania (*Gazania linearis*). Control boxthorn.

118 Control boxthorn.

119 Control boxthorn.

120 Eradicate similax (*Asparagus asparagoides*). Control boxthorn.

121 Control boxthorn and blackberry.

122 Eradicate Phoenix palm (*Phoenix canariensis*). Control boxthorn.

123 Eradicate South African iceplant, boxthorn, banksia (*Banksia integrifolia*) and yucca (*Yucca gloriosa*). Norfolk Island pines (*Araucaria heterophylla*) could be replaced with a relevant native tree species. Control kikuyu to stop it from encroaching from the mown verge into the dune system.

124 Eradicate South African iceplant before it spreads over the whole foredune. Control boxthorn and pampas.

125 Eradicate similax. Control boxthorn and radiata pine (*Pinus radiata*) from the crest of the established foredune. Control hawthorn (*Crataegus monogyna*), Chinese privet (*Ligustrum sinense*) and tree privet (*Ligustrum lucidum*) from the treeland at southern end of the dunes. Control marram, Japanese honeysuckle and sweet briar (*Rosa rubiginosa*) throughout. There is a large vehicle access track to the beach from the foredune; this has resulted in increased erosion.

126 Eradicate similax. Control marram, boxthorn, kikuyu and gorse. Radiata pines could be removed from the area outside of the Urupa.

4.3 West End

131 Could control exotic grasses and replace with spinifex to re-establish and stabilise this narrow piece of dune. Eradicate South African iceplant, grey willow and cape daisy (*Arctotis stoechadifoilia*).

132 Eradicate South African iceplant, yucca, agapanthus, similax, dimorphotheca, montbretia (*Crocosmia x crocosmiiflora*) and buffalo grass (*Stenotaphrum secundatum*). Control of exotic grasses and replacement with spinifex would add ecological value and aid in stabilising this narrow piece of dune. Discourage dumping of garden waste by residents. Also discourage beach access via non formed tracks to reduce tracking and erosion.

4.4 Ōhope dunes

133 Eradicate South African iceplant, agapanthus, gazania, Japanese spindle tree, gorse, similax, dimorphotheca and watsonia (*Watsonia bulbillifera*). Control kikuyu. Discourage residents from planting garden species and the dumping of garden waste on the dunes.

134 Eradicate South African iceplant, yucca, gazania and succulents. Control kikuyu and sea couch (*Elytrigia pycnantha*). Discourage garden waste dumping and informal tracking.

135 Eradicate South African iceplant, agapanthus, yucca, *Acacia sophorae* and pampas. Control a number of garden escapees including; similax, gazania, montbretia, canna lily, Japanese spindle tree, cape daisy and climbing asparagus (*Asparagus scandens*). Control buffalo grass and sea couch. Discourage garden waste dumping on the dunes.

136 Eradicate *Acacia sophorae,* South African iceplant, yucca, Japanese spindle tree, dimorphotheca and red hot poker (*Kniphofa uvaria*). Control kikuyu from encroaching further into dunes from the mown road edge. Discourage garden waste dumping on the dunes.

137 Eradicate *Acacia sophorae,* South African iceplant, dimorphotheca, red hot poker, gazania, similax, montbretia, Japanese spindle tree and prickly pear (*Opuntia vulgaris*). Control buffalo grass. Discourage the dumping of garden waste that is leading to the establishment of pest plants.

138 Build a sand ladder where there is severe tracking and a blowout, also planting spinifex to reduce the erosion and helping to bind sand in this area. Eradicate *Acacia sophorae,* agapanthus, gorse, South African iceplant, canna lily, pampas, watsonia and dimorphotheca. Control blackberry.

139 Eradicate agapanthus, dimorphotheca, *Acacia sophorae*, South African ice plant, watsonia, Japanese spindle berry, moth plant, gazania, *Lilium formosum,* canna lily and blue morning glory (*Ipomoea indica*). Control brush wattle, berry, evergreen buckthorn, Chinese privet and giant reed (*Arundo donax*). Adjoining property owners need to be discouraged from the dumping of rubbish and garden waste onto the dunes.

An unofficial path leads to the beach, this has resulted in a large blowout. Installation of a sand ladder here for beach access would be beneficial.

4.5 Ōhope Spit

140 Eradicate moth plant and grey willow. Continue with pampas control and control blackberry. Dumping of household rubbish and encroachment of exotic gardens into the dunes need to be discouraged.

141 Eradicate moth plant and pampas. Control blackberry.

142 Eradicate yucca, pampas and South African iceplant. Control gorse and blackberry.

4.6 Ohiwa Spit

144 Eradicate pampas, yucca, Acacia sophorae, South African iceplant, agapanthus, dimorphotheca, watsonia, montbretia and tradescantia (Tradescantia fluminensis). Control gorse and gazania. Dumping of garden waste needs to be discouraged.

4.7 Whangakopikopiko Island

144.1 Eradicate pampas, yucca, Acacia sophorae, South African iceplant, agapanthus, dimorphotheca, watsonia, montbretia and tradescantia (Tradescantia fluminensis). Control gorse and gazania. Dumping of garden waste needs to be discouraged.

4.8 Bryans Beach

145 Eradicate *Acacia sophorae*, saltwater paspalum, boxthorn, hawthorn, pampas and Chinese privet. Control gorse and radiata pine.

146 Eradicate saltwater paspalum. Control, gorse, blackberry and montbretia. Predator control at this site would benefit nesting dotterels, if not already happening by DOC.

4.9 Waiōtahe Spit

147 Control gorse, blackberry and sweet briar.

4.10 Waiōtahe Beach

149 Control pampas and gorse.

150 Control gazania, gorse and dimorphotheca.

4.11 Waiōtahe Beach Middle

151 Eradicate agapanthus. Control of sweet briar and the narrow strip of exotic grasses to encourage native vegetation regeneration would be beneficial to the dunes.

4.12 Waioweka Estuary

152 Continue with boxthorn and gorse control. Control of exotic grasses would result in the natural regeneration of pohuehue (*Meuhlenbeckia complexa*).

153 Continue with Chinese privet and gorse control. Control boxthorn, similax, and blackberry.

4.13 Hikuwai Beach

154 Control boxthorn, pampas, gorse and similax.

155 Control boxthorn, blackberry, moth plant, pampas and similax.

156 Control boxthorn, buffalo grass, tradescantia and madeira vine (*Anredera cordifolia*). Also the control of kikuyu and sea couch to allow natural regeneration of pohuehue would add to the ecological value of the dunes. There is a large amount of rubbish dumped here (removal required). Due to the location (just outside town) and ease of access to the site, monitoring will be required.

4.14 Hikuwai Beach Middle

157 Control boxthorn, radiata pine, blackberry, succulents and ragwort (*Senecio jacobea)*. Control of kikuyu to stop further invasion into the dunes would be beneficial.

4.15 Tirohanga Dunes

This site was the only one noted to have the native herb *Euphorbia glauca* present.

158 There is a large amount of erosion occurring, with a steep drop from the crest of the dune to the beach. Planting of sand binding plants such as spinifex would help to stablise the dunes from further erosion.

Continue with existing control of boxthorn and Chinese privet. Control similax, woolly nightshade, hawthorn and blackberry.

159 There is a large amount of erosion occurring, with a steep drom (~10 m) from the crest of the dune to the beach. Planting of sand binding plants like spinifex would help to stablise the dunes from further erosion.

Control boxthorn and blackberry.

160 There is a large amount of erosion occurring, with a steep drop (~4 m) from the crest of the dune to the beach. Planting of sand binding plants such as spinifex would help to stabilise the dunes from further erosion.

Control boxthorn and blackberry.

161 Control boxthorn, gorse, pampas and blackberry. A well defined track leads down to the beach from the camping ground. A sand ladder here would aid in preventing further erosion. Control of Indian doab (*Cynodon dactylon*) on the camping ground side would help to prevent it encroaching further into the dunes.

The current restoration plantings occurring here are very effective.

162 Eradicate South African iceplant and marram. Control pampas, boxthorn, gorse, similax, agapanthus, montbretia and Japanese honeysuckle. Garden waste dumping by residents onto dunes needs to be discouraged.

There are a number of tracks and subsequently blowouts on the dune edge. Tracking from properties through dunes needs to be minimised. The installation of formed pathways and sand ladders would aid in reducing erosion. Continuation of the restoration plantings that are occurring in the back dunes onto the eroded face of the dune would be beneficial.

163 Eradicate South African iceplant. Continue with boxthorn and gorse control. Control similax, Chinese privet and blackberry. The edge of the foredune is eroded and would benefit form planting of sand binding plants like spinifex.

164 Continue with South African iceplant, boxthorn and gorse control. Control Chinese privet, similax and blackberry.

4.16 Tirohanga Pa

160 Only part of the transect bisects this small site. Control gorse and blackberry.

4.17 Omarumutu

165 Eradicate pampas and saltwater paspalum. Control gorse.

166 Control of sea couch would allow for natural regeneration by pohuehue. Control of ragwort and possibly lupin would enhance the quality of these dunes.

167 Eradicate South African iceplant, marram from the foredune and banksia from the rear dunes. Control gorse and Japanese honeysuckle. Planting of species, such as spinifex/pingao (*Desmoschoenus spiralis*) in the gaps would be beneficial.

4.18 Hawai

180 Control gorse, Japanese honeysuckle and blackberry. This transect has very coarse sand.

4.19 South of Taratuia Point

249 Control saltwater paspalum that dominates the established foredune and swale to stop it encroaching further on to the dunes. Eradicate boxthorn.

4.20 Tapuaeharuru

258 Eradicate *Acacia sophorae*, marram, pampas, crack willow (*Salix fragilis*) and kahili ginger (*Hedychium gardneriaum*). Removal of large radiata pine and silver poplar (*Populus alba*), and the subsequent control of seedlings would increase the ecological value of these dunes. Control blackberry, Japanese honeysuckle and canna lily.

4.21 Whangaparaoa Beach

263 Eradicate saltwater paspalum, pampas and crack willow. Control silver poplar and possibly blackberry.

264 Eradicate grey willow and saltwater paspalum. Control buffalo grass and blackberry.

265 Eradicate South African iceplant and saltwater paspalum. Control Japanese honeysuckle.

Part 5: High priority pest plant management actions

The recommendations for specific pest plant control made in Wildland Consultants 2008 (section 6) should also be considered, as they will apply to the entire Bay of Plenty region.

Pest plants identified in the Regional Pest Management Strategy and observed throughout the Bay of Plenty region include:

- Progressive control; boneseed (Chrysanthemoides monilifera), wild ginger, lantana (Lantana camara) and woolly nightshade.

- Boundary Control; gorse, blackberry and ragwort.

- Regional surveillance; moth plant, climbing asparagus, papmas (Cortaderia jubata & Cortaderia selloana), blue morning glory, tree privet, Chinese privet, Italian buckthorn, and green-goddess lily (Zantedeschia aethiopica).

These pest plants should be considered a priority for control throughout the dunes of the Bay of Plenty region. Other pest plant species that control should be under taken for include: Taiwan cherry (*Prunus campanulata*), Himalayan honeysuckle (*Leycesteria Formosa*) and swamp oak.

A large number of pest plants have become established in dune systems due to the dumping of garden waste. The investment of time to reduce the amount of garden waste dumping on the dunes would reduce pest plant invasions and subsequently pest plant control requirements.

Part 6: Discussion

In general the overall condition of the Ōtamarākau-Cape Runaway dunes is moderate to good.

There were visible differences observed between dune condition at sites in close proximity to urban areas, to those located at more remote locations. We observed a greater variety of weed species near urban areas (due to garden escapees and organic waste dumping), along with increased informal pedestrian and vehicle tracking. There was visibly lower erosion at sites where restoration planting had occurred. There are a number of profiles (e.g. Tirohanga Dunes) with large amounts of erosion that would greatly benefit from restoration planting.

Part 7: References

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Appendices

Appendix 1 – Plant names used in text

Latin Name	Common Name
Acacia sophorae	
Agapanthus praecox	agapanthus
Agarvae Americana	
Amaryllis belladonna	naked lady, belladonna lily
Ammophila arenaria	marram grass
Anredera cordifolia	Madeira vine
Araucaria heterophylla	Norfolk Island pines
Araujia sericifera	moth plant
Arctotis stoechadifoilia	cape daisy
Arundo donax	giant reed
Asparagus asparagoides	similax
Asparagus scandens	climbing asparagus
Banksia integrifolia	banksia
Berberis glaucocarpa	barberry
Canna indica	canna lily
Carprobrotus edulis	South African iceplant
Casuarina glauca	swamp oak
Chrysanthemoides monilifera	boneseed
Cirsium arvense	Californian thistle
Coprosma robusta	karamu
Coprosma repens	taupata
Cortaderia jubata	pampas
Cortaderia selloana	pampas
Crataegus monogyna	hawthorn
Crocosmia x crocosmiiflora	montbretia
Cynodon dactylon	Indian doab
Cyperus involucratus	umbrella sedge
Desmoschoenus spiralis	pingao
Elytrigia pycnantha	sea couch
Eucalyptus botryoides	eucalyptus trees
Euonymus europaeus	spindle tree
Euonymus japonicus	Japanese spindle tree
Gazania linearis	gazania
Hedychium gardneriaum	kahili ginger, wild ginger
Ipomoea indica	blue morning glory
Kniphofa uvaria	red hot poker

Lantana camara	lantana
Leycesteria formosa	Himalayan honeysuckle
Ligustrum lucidum	tree privet
Ligustrum sinense	Chinese privet
Lilium formosum	
Lonicera japonica	Japanese honeysuckle
Lupinus arboreus	lupin
Lycium ferocissimum	boxthorn
Macropiper excelsum	kawakawa
Metrosideros excelsa	pohutukawa
Meuhlenbeckia complexa	pohuehue
Opuntia vulgaris	prickly pear
Osteospermum fruticosum	dimorphotheca
Paraserianthes lophantha	brush wattle
Paspalum vaginatum	saltwater paspalum
Pennisetum clandestinum	kikuyu
Phoenix canariensis	phoenix palm
Pinus radiata	radiata pine
Pittosporum crassifolium	karo
Populus alba	silver poplar
Prunus campanulata	Taiwan cherry
Pseudopanax lessonii	houpara
R*hamnus alaternus*	evergreen buckthorn, Italian buckthorn
Rosa rubiginosa	sweet briar
Rubus fruticosus	blackberry
Salix cinerea	grey willow
Salix fragilis	crack willow
Senecio jacobea	ragwort
Solanum mauritianum	woolly nightshade
Spinifex sericeus	spinifex
Stenotaphrum secundatum	buffalo grass
Tradescantia fluminensis	tradescantia
Ulex europaeus	gorse
Watsonia bulbillifera	watsonia
Zantedeschia aethiopica	green-goddess lily, arum lily

Appendix 2 – Photographs of additional vegetation classes for the Bay of Plenty region

02.03 Eucalyptus treeland

02.05 Mixed exotic treeland

02.06 Mixed indigenous treeland

03.07 Pink bindweed vineland

05.08 Coastal kanuka shrubland

05.09 Saltmarsh ribbonwood shrubland

08.10 Indian doab grassland

08.11 Saltwater paspalum grassland

09.06 *Carex pumila* sedgeland

09.07 *Baumea articulata* sedgeland

10.02 Wiwi rushland

10.06 Agapanthus herbfield

Appendix 3 – Options for Management of Vegetation Succession for regenerating indigenous dune forest

Three options for the management of vegetation succession for regenerating indigenous dune forest – Matata, Bay of Plenty (Wildland Consultants 2007)

Option 1: No Action

- No control/removal of eucalyptus.
- Instigate monitoring to track changes over time.
- Future vegetation development would depend, in large part, on future changes (i.e. dieback) of the eucalyptus canopy, pest animal and weed abundance, and the extent of grazing.

Option 2: Low-Level Intervention

- Large eucalyptus trees would be left standing to provide some continuity of shelter, while trees smaller than 10cm dbh would be removed using a cut-and-swab method[2]. The tall eucalyptus trees would gradually die out of their own accord over a long period of time, however new eucalyptus seedlings and saplings would have to be weeded out regularly if this approach were adopted, be cause there would still be a seed source on site.
- Other pest plants at the site which would require specific management are brush wattle Japanese honey suckle, kikuyu, boxthorn and pampas. Eradication of small infestations would also be cost effective if done at this stage, and the highest priority would be to concentrate on those with the potential for rapid future expansion in this habitat (i.e. kahili ginger, similax, crack willow, grey willow, montbretia and naked lady), as well as agapanthus, arum lily and *Cyperus involucratus*.
- Gaps and edges could be planted with indigenous species such as houpara, kawakawa, karamu, taupata, karo and pohutukawa. The main purpose of the planting would be to provide a protective buffer against wind exposure, but also to out-compete pest plants invading the area. Plant stock would need to be source from the coastal bioclimatic zone of the Otanewainuku Ecological District (ideally from within the site), or from the coastal bioclimatic zone in the neighbouring Tauranga ED or Te Teko ED. Pest plants would need to be controlled until canopy closure. Suitable threatened species which occur in the coastal zone of the Otanewainuku ED could be planted (e.g. *Pimelea tomentosa)* or which occur in other comparable coastal dune environments in the eastern Bay of Plenty (c.f. Shaw 1997).
- Control rabbits, which are a threat to naturally occurring seedlings as well as new plantings.

[2] Small trees (less than 30cm dbh) of *Eucalyptus botryoides* are know to coppice vigorously from stumps in Australia (Hamilton 2000), they probably also have this ability in New Zealand. Effective control would therefore need to be either 'cut and swab' (using appropriate herbicide) or poison trees standing. Follow up control would also be required.

Option 3: More Intensive Intervention

- All eucalyptus trees below 10cm dbh would be removed, as described in the previous option. The killing of large eucalyptus while standing (via ring-barking or stem drilling/cutting and poisoning) would be broken into five sectors and stages. After the first sector of tall trees was killed there would need to be monitoring of the stand and comparison to the other areas where tall trees were not killed. If monitoring showed a favourable outcome in terms of indigenous species regeneration, further sectors could be killed in a stage-wise sequence. Visitors would need to be notified, using signage, and any risk to do with the railway or state highway would have to be minimised by considered felling of dead trees.
- Planting, pest plant control, and rabbit control would be required as for Option 2.