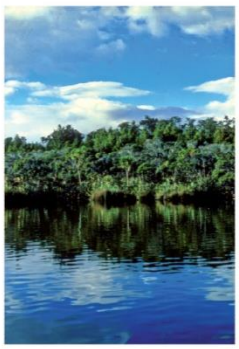

Ngarara Farms Waimeha Neighbourhood Development Area – vegetation assessment of environmental effects

Landcare Research
Manaaki Whenua

Ngarara Farms Waimeha Neighbourhood Development Area – vegetation assessment of environmental effects

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Contents

Executive Summary

The proposed Waimeha Neighbourhood Development Area (NDA) of the Ngarara Farms residential development and the adjacent Kawakahia Wetland were assessed by Landcare Research for Maypole Environmental Limited. A field visit to the site was undertaken on 21–22 July 2014. Objectives were to assess the current state of the vegetation and the likely environmental effects of residential development on current vegetation, and to suggest measures to mitigate these effects. The condition of all affected plant communities previously identified and mapped was assessed. Predominant plant species were recorded, along with threatened native species and invasive weed species. The condition of vegetation associations dominated by native species was noted, and mapped boundaries between associations were checked for correctness. The ecological values of the vegetation associations and likely environmental effects of residential development on current vegetation were assessed. Measures to mitigate these effects were outlined.

The portion of Kawakahia Wetland adjacent to the proposed Waimeha NDA comprises a mosaic of (*Carex geminata*) sedgeland, raupo (*Typha orientalis*) reedland, and harakeke (*Phormium tenax*) flaxland, with intervening low sand ridges with mesic vegetation dominated by woody species such as māhoe (*Melicytus ramiflorus*) and mingimingi (*Coprosma propinqua*). Regionally rare bog nertera (*Nertera scapanioides*), dwarf musk (*Mazus novaezeelandiae* ssp. *novaezeelandiae*) and sand pimelea (*Pimelea* sp. aff. *arenaria*) have been recorded previously in or near the wetland, but were not recorded on this visit. All vegetation associations appear to be in healthy condition, with stock exclusion by fencing, no evidence of possum browsing, overwhelming dominance by indigenous species, and evidence (bait stations) of ongoing pest control.

Six vegetation associations are directly affected by the development proposal, five of them dominated by exotic species (pasture, wet weedy pasture, gorse scrub, pine plantation, old-growth exotic treeland), and one (māhoe scrub) dominated solely by native species in which regionally sparse gully fern (*Cyathea cunninghamii*) occurs. Māhoe scrub appears to be in healthy condition, with stock exclusion by fencing, no evidence of possum browsing, overwhelming dominance by indigenous species, and evidence of ongoing pest control. Several invasive weed species – boxthorn (*Lycium ferocissimum*), gorse (*Ulex europaeus*), blackberry (*Rubus fruticosus*), radiata pine (*Pinus radiata*), barberry (*Berberis glaucocarpa*), khasia berry (*Cotoneaster simonsii*), climbing asparagus (*Asparagus scandens*), ivy (*Hedera helix*) and wandering willy (*Tradescantia fluminensis*) – are locally present in these associations.

As the largest wetland left in freehold tenure in the lower North Island, Kawakahia Wetland has outstanding ecological value. It is essentially intact and at least partly buffered by regenerating native forest. Although a regionally and nationally common vegetation association and of small extent, the māhoe scrub in the proposed Waimeha NDA has high value because of its role as a buffer for part of Kawakahia Wetland, and therefore should be protected.

With no significant ecological value, clearance of most existing vegetation (the exotic communities) on the proposed Waimeha NDA will have minimal environmental impacts. Although the māhoe scrub bordering Kawakahia Wetland should be retained for its buffering function, as a common species of young secondary vegetation with a fast growth rate and high coppicing ability, māhoe has relatively high resilience to perturbation. Thus māhoe

scrub is unlikely to deteriorate from some degree of encroachment by clearance, and has the ability to recover and quickly re-form a new edge. Clearance of any māhoe scrub infringes the relevant District Plan, but this may be mitigated by augmenting the buffer, where inadequate or non-existent, by fascined mānuka.

Significant risks of ecological degradation (e.g. increased sedimentation, increased weed invasion, damage by humans entering wetland) are posed by the proposed Waimeha NDA to Kawakahia Wetland. These can be mitigated largely or completely by a buffer zone, commonly advocated as a management tool to reduce land-use impacts on natural landscape features, including wetlands. Further desirable mitigation includes implementation of best-practice erosion and sediment control measures, removal of weeds remaining after development, choice of amenity species to avoid the introduction of known environmental weeds, and ongoing weed and pest control.

Ngarara has evidently had a long history of use for agriculture, and the only primary vegetation associations surviving are those in the Kawakahia Wetland. The only other association dominated by native species is māhoe scrub, a young (probably less than 30 years) secondary association that will succeed to taller native forest in the foreseeable future if weeds and pests are controlled. Despite its relative floristic paucity, typical of young secondary vegetation, it nevertheless provides an invaluable buffer for the southern and southwestern edges of Kawakahia Wetland and is therefore of high ecological importance. The remaining vegetation associations are all dominated heavily by exotic species and despite the inevitable presence of some native plant species, have no significant ecological value. Apart from nationally common but regionally sparse gully fern in māhoe scrub, no threatened species were recorded, only common widespread native plant species, as is usual in highly modified landscapes with a long history of human occupation.

We recommend that:

- the existing Kawakahia Wetland māhoe scrub buffer zone be augmented by supplementary establishment of mānuka scrub by fascining;
- populations of invasive weeds surviving after site development be removed;
- ongoing and weed and pest (rodent, mustelid, possum, wild cat) control are highly desirable for maintaining the integrity of existing natural vegetation and wildlife of the Kawakahia Wetland and the existing vegetated buffer and in allowing further natural successional development of the māhoe scrub and proposed fascined mānuka scrub toward the projected mature kohekohe coastal forest. Any pest control plan should be created with the input of Greater Wellington Regional Council (GWRC) and the landowner, who have an ongoing pest control programme in the wetland;
- species for amenity/public planting be selected so as to avoid the introduction of environmental weeds; and
- the implementation of best-practice erosion and sediment control measures to prevent increased sedimentation of Kawakahia Wetland, both during and after development

Summary

Project and Client

- The current state of the vegetation was assessed in the proposed Waimeha Neighbourhood of the Ngarara Farms residential development by Landcare Research for Maypole Environmental Limited.

Objectives

- To assess the current state of the environment in the proposed Waimeha NDA of the Ngarara Farms residential development.
- To assess the environmental effects on current vegetation of the proposed Waimeha NDA.
- To suggest measures to mitigate these effects.

Methods

- A field visit was made to the proposed Waimeha Neighbourhood on 21 and 22 July 2014 to assess all previously identified and mapped affected plant communities.
- Predominant plant species were recorded, along with threatened native species and invasive weed species.
- Condition of associations dominated by native species was noted.
- Previously mapped boundaries between associations were checked for correctness.
- Ecological values of the associations were assessed.
- Likely environmental effects on current vegetation were assessed.
- Measures to mitigate these effects were suggested.

Results

- The portion of Kawakahia Wetland adjacent to the proposed Waimeha NDA comprises a mosaic of *Carex geminata* sedgeland, raupo (*Typha orientalis*) reedland, and harakeke (*Phormium tenax*) flaxland, with intervening low sand ridges with mesic vegetation dominated by woody species such as māhoe (*Melicytus ramiflorus*) and mingimingi (*Coprosma propinqua*). Regionally rare bog nertera (*Nertera scapanioides*), dwarf musk (*Mazus novaezeelandiae* ssp. *novaezeelandiae*), and sand pimelea (*Pimelea* sp. aff. *arenaria*) have been recorded in or near the wetland but were not recorded on this visit. For dwarf musk, this could be affected by time of year and others could have been affected by encroachment of exotic species. All native-dominated associations appear to be in healthy condition, with stock excluded by fencing, no evidence of possum browsing, overwhelming dominance by indigenous species, and evidence (bait stations) of ongoing pest control.

- Six other vegetation associations are directly affected by the proposal, five of them dominated almost wholly by exotic species (pasture, wet weedy pasture, gorse scrub, pine plantation, old-growth exotic treeland), and one (māhoe scrub) dominated solely by native species in which regionally sparse gully fern (*Cyathea cunninghamii*) occurs. Māhoe scrub appears to be in healthy condition, with stock excluded by fencing, no evidence of possum browsing, overwhelming dominance by indigenous species, and evidence of ongoing pest control.
- Several invasive weed species – boxthorn (*Lycium ferocissimum*), gorse (*Ulex europaeus*), blackberry (*Rubus fruticosus*), radiata pine (*Pinus radiata*), barberry (*Berberis glaucocarpa*), khasia berry (*Cotoneaster simonsii*), climbing asparagus (*Asparagus scandens*), ivy (*Hedera helix*), and wandering willy (*Tradescantia fluminensis*) – are locally present in these associations.
- As the largest wetland left in freehold tenure in the lower North Island, Kawakahia Wetland has outstanding ecological value. It is essentially intact and at least partly buffered by regenerating native forest. Although a regionally and nationally common vegetation association, and of small extent, the māhoe scrub between the Waimeha NDA and the wetland has high importance because of its role as a buffer and natural adjunct for part of Kawakahia Wetland, and therefore should be protected.
- With no significant ecological value in the proposed Waimeha NDA footprint, clearance of most existing vegetation there will have negligible ecological impact. Although as much as possible of the māhoe scrub bordering Kawakahia Wetland should be retained for its buffering function, as a common species of young secondary vegetation with a fast growth rate and high coppicing ability, māhoe has relatively high resilience to perturbation. Thus māhoe scrub is unlikely to deteriorate from some degree of encroachment by clearance, and has the ability to relatively quickly re-form a new edge.
- Clearance of any māhoe scrub that is between the Waimeha NDA and the Kawakahia Wetland infringes the relevant District Plan, but this may be mitigated – in terms of creating native-dominated shrubland – by augmenting the buffer, where inadequate or non-existent, by fascined mānuka.
- Significant risks of ecological degradation (especially increased sedimentation and increased weed invasion) are posed by the proposed Waimeha NDA to Kawakahia Wetland
- These effects can be mitigated largely or completely by a buffer zone, commonly advocated as a management tool to reduce land use impacts on natural landscape features, including wetlands.
- Further mitigation measures include implementation of best-practice erosion and sediment control measures, during and after development works, removal of weeds remaining after development, choice of amenity species to avoid the introduction of known environmental weeds, and ongoing weed and pest control (which should take into account GWRC's current ongoing pest control programme).

Conclusions

- Ngarara has evidently had a long history of use for agriculture, and the only primary vegetation associations surviving are those in the Kawakahia Wetland. The only other

association dominated by native species is māhoe scrub, a young (probably less than 30 years) secondary association that will succeed to taller native forest in the foreseeable future if weeds and pests are controlled. Despite its relative floristic paucity (typical of young secondary vegetation), it nevertheless provides an invaluable buffer and natural adjunct for the southern and southwestern edges of Kawakahia Wetland and is therefore of high ecological value. The remaining vegetation associations are all dominated by exotic species and despite the inevitable presence of some native plant species, have no significant ecological value. Apart from nationally common but regionally sparse gully fern in māhoe scrub, no threatened species were recorded, only common widespread native plant species, as is usual in highly modified landscapes with a long history of human occupation.

Recommendations

- Augmenting the existing Kawakahia Wetland māhoe scrub buffer zone where non-existent or inadequate by supplementary establishment of mānuka scrub by fascining.
- Populations of invasive weeds surviving after site development should be removed.
- Ongoing weed and pest (rodent, possum) control are highly desirable in maintaining the integrity of existing natural vegetation of Kawakahia Wetland and its existing vegetated buffer and in allowing further natural successional development of the māhoe scrub and proposed fascined mānuka scrub to kohekohe forest. Any pest control plan should be created in consultation with GWRC and the landowner, who have an ongoing pest control programme in the wetland.
- Species for public/amenity planting should be selected so as to avoid the introduction of known environmental weeds to the Waimeha NDA.
- Best-practice erosion and sediment control measures (i.e. sediment fences, temporary detention ponds, bunds, dams, hydroseeding, immediate revegetation of bare earth, use of geotextile to reduce erosion) to prevent fine sediment entering Kawakahia Wetland.

1 Introduction

Landcare Research was contracted by EOS Ecology on behalf of Maypole Environmental Limited to undertake an assessment of the effects of the Waimeha Neighbourhood Development Area (NDA) development on vegetation to inform local and regional consent applications. A separate report covers the effect on aquatic ecological values (James 2014).

2 Background

The Waimeha NDA is the first stage of Ngarara, a greenfield urban development between Waikanae and Waikanae Beach on the Kapiti Coast. The Waimeha NDA is bordered by the Mackays Crossing to Pekapeka (M2PP) extension of SH1 to the southeast (currently under construction), Te Moana Road to the southwest, Waikanae Golf Course to the east, and the Kawakahia Wetland to the north (Fig. 1). Ngarara has been planned over the last several years, including the undertaking of the various assessments necessary to obtain a District Plan change, which was granted. This included an ecological assessment (Boffa Miskell 2008) and a baseline freshwater ecological and water quality investigation (Sinclair Knight Merz 2008), both completed in 2008. Since the plan change was granted, the New Zealand Transport Agency (NZTA) has successfully obtained the approvals and land required to construct the M2PP, which crosses the original Ngarara development area, including the Waimeha NDA. With the M2PP construction currently underway, the design of a revised Waimeha NDA covering a reduced area is proceeding.

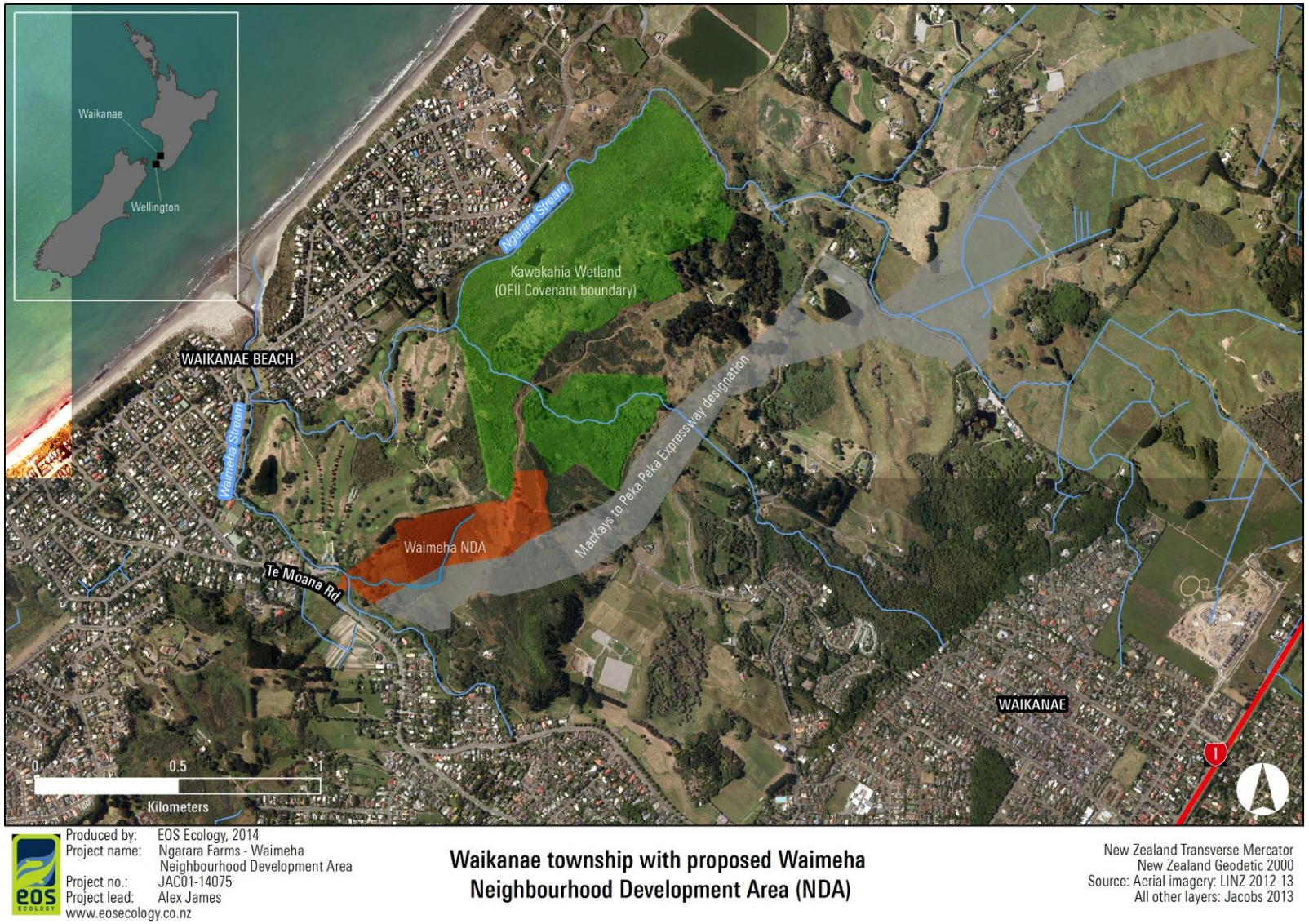

Figure 1 Location of the proposed Waimeha Neighbourhood Development Area.

3 Objectives

- To assess the current state of the environment in the proposed Waimeha NDA and adjacent Kawakahia Wetland of the Ngarara Farms residential development.
- To assess the environmental effects of the proposed development on current vegetation of the proposed Waimeha NDA and adjacent Kawakahia Wetland.
- To suggest measures to mitigate these effects.

4 Methods

A literature review was conducted of previous botanical studies in the district. A field visit was made to the proposed Waimeha NDA and adjacent Kawakahia Wetland on 21 and 22 July 2014 and all affected plant communities previously identified and mapped in 2007 (Boffa Miskell 2008). Predominant plant species were recorded, along with threatened native species and invasive weed species. Condition of associations dominated by native species was noted. Mapped boundaries between associations were checked for correctness.

5 Planning Classification/Legislative Drivers

5.1 Resource Management Act 1991

Section 5 of the RMA 1991 states the purpose of the Act is the sustainable management of natural and physical resources, with sustainable management meaning:

> *'managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while:*
>
> *(a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
>
> *(b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and*
>
> *(c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.'*

Under Section 6 the following matters are of national importance:

> *'(a) the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:*
>
> *(b) the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna'*

The relevant other matters (Section 7) that must be given regard to are:

'(c) the maintenance and enhancement of amenity values;

(d) intrinsic values of ecosystems;

(e) maintenance and enhancement of the quality of the environment'

5.2 Regional Policy Statement and Regional Plan

The Greater Wellington Regional Council's (GWRC) Regional Policy Statement (RPS) identifies Waimeha Stream and all tributaries as being a significant indigenous ecosystem (GWRC 2013). The Kawakahia Wetland is directly connected to the Ngarara Stream, a major tributary of the Waimeha Stream. Therefore, Policy 43 (protecting aquatic ecological function of water bodies – consideration) of the RPS, is relevant to parts of this wetland, including its vegetation:

'When considering an application for a resource consent, notice of requirement, or a change, variation or review of a district or regional plan, particular regard shall be given to:

(a) maintaining or enhancing the functioning of ecosystems in the water body;

(b) maintaining or enhancing the ecological functions of riparian margins;

(c) minimising the effect of the proposal on groundwater recharge areas that are connected to surface water bodies;

(d) maintaining or enhancing the amenity and recreational values of rivers and lakes, including those with significant values listed in Table 15 of Appendix 1;

(e) protecting the significant indigenous ecosystems and habitats with significant indigenous biodiversity values of rivers and lakes, including those listed in Table 16 of Appendix 1;

(f) maintaining natural flow regimes required to support aquatic ecosystem health;

(g) maintaining fish passage;

(h) protecting and reinstating riparian habitat, in particular riparian habitat that is important for fish spawning;

(i) discouraging stock access to rivers, lakes and wetlands; and

(j) discouraging the removal or destruction of indigenous wetland plants in wetlands.'

Kawakahia Wetland is identified in Appendix 2 of the Regional Freshwater Plan as a wetland with a 'high degree of natural character' where the 'surface water is to be managed for aquatic ecosystem purposes' (GWRC 2012). This wetland is considered by the GWRC to be a 'Key Native Ecosystem' and as such undergoes active management of pest plants and animals in conjunction with the landowner. It is also protected by a Queen Elizabeth II National Trust covenant (Ngarara Covenant 5/07/240A).

5.3 District Plan

The Kapiti Coast District Council (KCDC) District Plan Heritage Register classifies Kawakahia Wetland K066 as an 'Ecological Site of Regional Significance (areas of significant indigenous vegetation and significant habitat of indigenous flora)' (KCDC 1999). It is also considered to be an 'outstanding landscape' (KCDC 1999). The Commissioners of the Environment Court in their Plan Change (2009) stated (paragraph 239) that *'a 50-m buffer be provided for all areas identified as ecological sites and as having high ecological constraints by the applicant and a 20 m buffer for all other ecological sites on site'*.

5.4 Regional Soil Plan

The Greater Wellington Regional Soil Plan (GWRC 2000) states in its Objectives and Policies:

'To ensure that territorial authorities adopt subdivision provisions in their district plans, and include conditions on subdivision consents, to avoid, remedy or mitigate adverse effects of soil disturbance and vegetation clearance, including any adverse effects on water quality or soil conservation, where those effects are associated with the subdivision of land.'

6 Results

6.1 State of the Existing Environment

6.1.1 Wetland vegetation

The portion of Kawakahia Wetland adjacent to the proposed Waimeha NDA comprises a complex mosaic of wetland associations dominated variously by native species (Figs 2, 3, 4):

Carex geminata s.l. sedgeland (Carex wetland: Boffa Miskell 2008),

Raupo (*Typha orientalis*) reedland (Raupo wetland: Boffa Miskell 2008), and

Harakeke (*Phormium tenax*) flaxland (Flax wetland: Boffa Miskell 2008),

with intervening low sand ridges supporting mesic vegetation dominated by woody species such as māhoe (*Melicytus ramiflorus*) and mingimingi (*Coprosma propinqua*) (Wetland with mixed vegetation: Boffa Miskell 2008).

A range of native trees (e.g. tī kōuka (*Cordyline australis*)), shrubs (e.g. swamp coprosma (*Coprosma tenuicaulis*), mingimingi), tall tussocks (e.g. toetoe (*Austroderia toetoe*) and kauri grass (*Gahnia xanthocarpa*)), lianes (e.g. pohuehue (*Muehlenbeckia complexa*)), and sedges (e.g. *Machaerina tenax*) are also present, along with numerous adventive herbaceous species (e.g. lotus (*Lotus pedunculatus*)) typical of wet ground.

All associations appear to be in healthy condition, with stock excluded by fencing, no evidence of possum browsing, overwhelming dominance by indigenous species, and evidence (bait stations) of ongoing pest control.

Regionally rare (Data deficient: Sawyer 2010) bog nertera (*Nertera scapanioides*) has been recorded from Kawakahia Wetland in the past but given the highly eutrophic nature of the wetland, this typical species of oligotrophic mires is likely to be very rare in it. It was not seen on this visit. Dwarf musk (*Mazus novaezeelandiae* ssp. *novaezeelandiae*) (Serious decline: Sawyer 2010) and sand pimelea (*Pimelea* sp. aff. *arenaria*) (Serious decline: Sawyer 2010) have been recorded within the vicinity of Kawakahia Wetland (Boffa Miskell 2008), but were not recorded in the portion within the proposed Waimeha Neighbourhood on this visit. The former could be less visible at the time of year of the survey.

Figure 2 Southern end of Kawakahia Wetland showing *Carex geminata* sedgeland (foreground), toetoe and raupo reedland (middle distance), and harakeke flaxland (distance), with a patch of mānuka scrub (centre) and low ridges supporting mixed wetland vegetation.

Figure 3 Southern end of Kawakahia Wetland with māhoe scrub beyond it. Regionally rare gully fern in māhoe scrub in wetland fringe vegetation in the centre.

Figure 4 Kawakahia Wetland with *Carex geminata* sedgeland in the foreground, and harakeke flaxland in the centre. Tī kōuka on the left and toetoe on the left and right.

6.1.2 Wetland fringe vegetation

Fringing vegetation consists of short secondary scrub and forest dominated heavily by māhoe (Fig. 5), with a limited range of other woody and herbaceous species (see māhoe scrub description below). Boundaries between vegetation associations are narrow and clearly defined (discrete) where micro-topographic boundaries are sharp (as where the wetland abuts a steep dune slope), and poorly defined (merging) where micro-topographic boundaries are wider and blurred (as where the wetland abuts a gentle dune slope). Where boundaries are poorly defined, ecotonal associations with elements of both mesic (e.g. māhoe) and wetland (e.g. *Carex geminata*) associations occur.

Figure 5 Māhoe scrub fringing Kawakahia Wetland at its southern end.

6.1.3 Māhoe scrub

Short secondary scrub and forest dominated heavily by māhoe, with a limited range of other native tree (kahikatea (*Dacrycarpus dacrydioides*), lancewood (*Pseudopanax crassifolius*), coastal fivefinger (*Pseudopanax lessonii*) of garden origin, karo (*Pittosporum crassifolium*) of garden origin, tī kōuka, lancewood × coastal fivefinger hybrids)), tree ferns (mamaku (*Cyathea medullaris*), ponga (*C. dealbata*), whekī (*Dicksonia squarrosa*)), shrubs (hangehange (*Geniostoma ligustrifolium*), kawakawa (*Macropiper excelsum*), taupata (*Coprosma repens*)) and ground ferns (shining spleenwort (*Asplenium oblongifolium*), hen and chickens (*A. bulbiferum*), *A. flaccidum*, sickle fern (*A. polyodon*), *A. hookerianum*, *Hypolepis ambigua*, hound's tongue (*Microsorum pustulatum*), common shieldfern (*Polystichum wawranum*)) species (Fig. 6). Mānuka (*Leptospermum scoparium*), mingimingi, and coastal tree daisy (*Olearia solandri*) are present in places on the margins.

Dead and dying gorse (*Ulex europaeus*), mānuka and blackberry (*Rubus fruticosus*) – being shaded out by taller vegetation – are widely present, and the association appears to have developed through them. Occasional kohekohe (*Dysoxylum spectabile*) seedlings in the understorey (Fig. 7) indicate that succession to taller forest of longer-lived species will occur in the foreseeable future if weeds and pests are controlled.

This association appears to be in healthy condition, with stock exclusion by fencing, no evidence of possum browsing, overwhelming dominance by indigenous species, and evidence of ongoing pest control (bait stations).

Regionally sparse (Sawyer 2010) gully fern (*Cyathea cunninghamii*) occurs in this association.

The invasive exotic climbing asparagus (*Asparagus scandens*) is locally present. Although gorse and blackberry are still present, they have been and are being overtopped and ousted by taller-growing native trees.

Figure 6 Interior of māhoe scrub in wetland fringe vegetation showing dense even-aged canopy and sparse understory and ground layers due to restricted light.

Figure 7 Kohekohe seedling in the understorey of māhoe scrub in wetland fringe vegetation, foreshadowing eventual transition to taller coastal forest of longer-lived species.

6.1.4 Vegetation of the proposed Waimeha NDA

Six vegetation associations were mapped (Fig. 8) and summarised by Boffa Miskell (2008). The mapped boundaries were found generally still to be correct in July 2014 although some of the pasture area had been colonised by gorse scrub over this time.

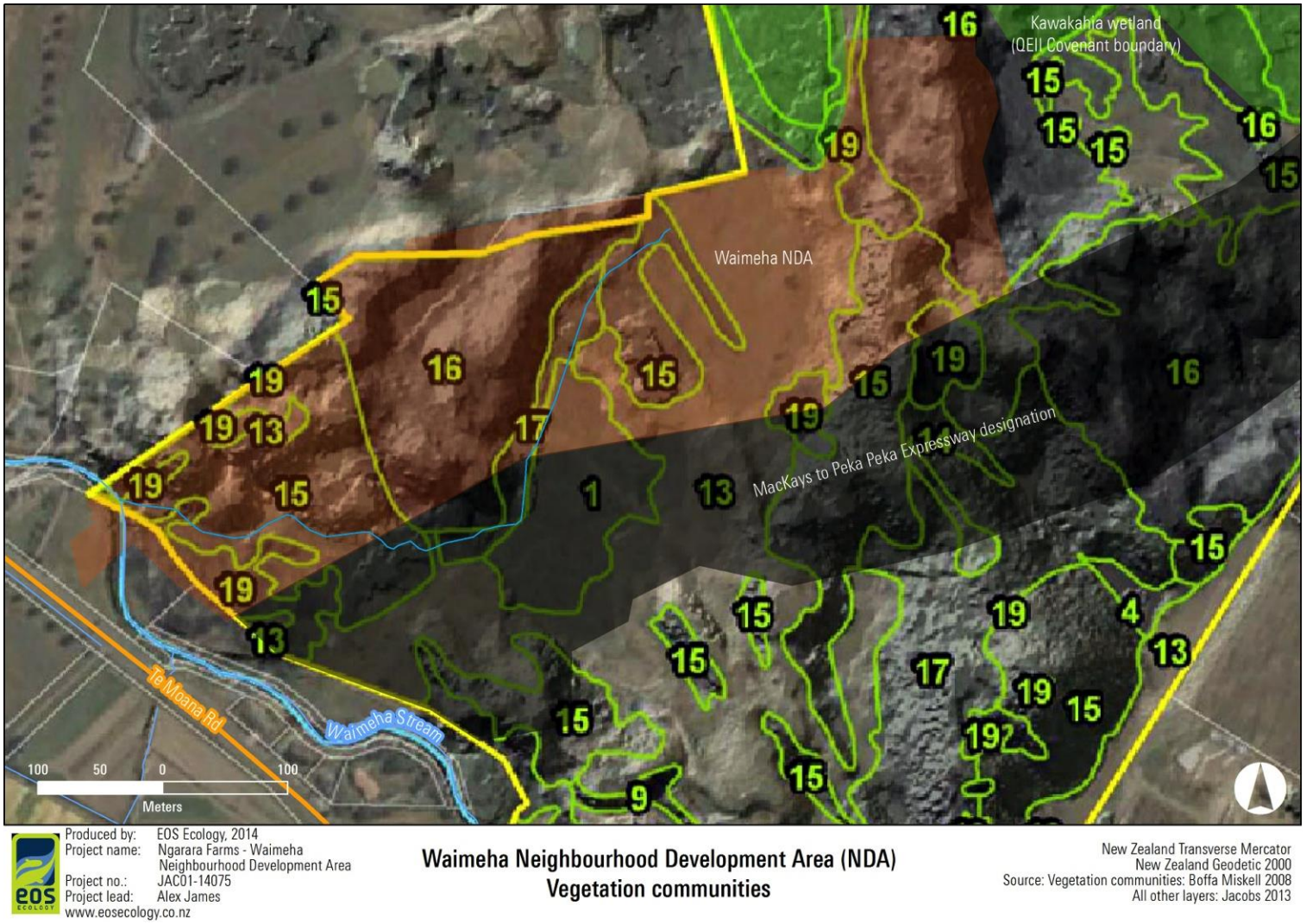

Figure 8 Vegetation associations of the proposed Waimeha NDA as mapped by Boffa Miskell (2008). Vegetation community codes: 1–Wet weedy pasture; 13–Pasture; 15–Gorse scrub; 16–Pine plantation; 17–Māhoe scrub; and 19–Old growth exotic treeland.

6.1.5 Pasture (Boffa Miskell 2008 vegetation community code 13)

Comprising almost entirely exotic pasture grasses and herbs, with very occasional native rushes and scramblers (e.g. knobby clubrush (*Ficinia nodosa*), *Juncus sarophorus*, pohuehue). Where no longer grazed, bracken (*Pteridium esculentum*) is establishing in places.

No threatened native species were recorded. Invasive exotic boxthorn (*Lycium ferocissimum*), gorse, and blackberry are locally present.

6.1.6 Wet weedy pasture (Boffa Miskell 2008 vegetation community code 1)

Comprising largely exotic pasture grasses and herbs. Native (especially *Juncus sarophorus*) and adventive (especially soft rush (*J. effusus*)) rushes are common. Where no longer grazed, native *Carex geminata* is establishing in places.

No threatened native species were recorded.

6.1.7 Gorse scrub (Boffa Miskell 2008 vegetation community code 15)

Comprising dense gorse with some intervening patches of exotic pasture. Occasional native trees (especially māhoe) and rushes (e.g. knobby clubrush, *Juncus sarophorus*) are present (Fig. 9).

No threatened native species were recorded.

Invasive exotic radiata pine (*Pinus radiata*), barberry (*Berberis glaucocarpa*), and khasia berry (*Cotoneaster simonsii*) are locally present.

Figure 9 Gorse scrub at the southern end of proposed Waimeha NDA, with occasional regenerating māhoe. Old-growth exotic treeland (*Eucalyptus* sp. and radiata pine) on the horizon.

6.1.8 Māhoe scrub (Boffa Miskell 2008 vegetation community code 17)

This is contiguous with the māhoe scrub described in Wetland fringe vegetation above.

6.1.9 Pine plantation (Boffa Miskell 2008 vegetation community code 16)

Radiata pine plantation with a sparse māhoe subcanopy in places, occasional native shrubs (e.g. kawakawa, thick-leaved coprosma (*Coprosma crassifolia*)) in the understorey and native ferns (especially sickle fern and hound's tongue) in the ground layer (Fig. 10). There are local fringes of native trees (especially māhoe) and tree ferns (especially mamaku).

Figure 10 Interior of pine plantation showing sparse māhoe subcanopy and native ferns in the ground layer.

No threatened native species were recorded.

The exotic invasive climbing asparagus is present in places.

6.1.10 Old-growth exotic treeland (Boffa Miskell 2008 vegetation community code 19)

Heavily dominated by planted exotics, this comprises a variety of exotic conifers (e.g. Monterey cypress (*Cupressus macrocarpa*) and broadleaved (especially *Eucalyptus* species) trees. Seedlings of some native tree species (e.g. kohekohe, karaka (*Corynocarpus laevigatus*)) are present in places.

No threatened native species were recorded.

Invasive exotic ivy (*Hedera helix*) and wandering willy (*Tradescantia fluminensis*) are locally present.

6.2 Assessment of Values

Section 6 of the RMA requires that significant habitats of indigenous fauna be protected. Significant habitats can be defined in a number of ways, including sites (vegetation/land systems) of recognised ecological significance, significant habitat for indigenous fauna, and species of ecological significance.

6.2.1 Sites of recognised ecological significance

As the largest wetland left in freehold tenure in the lower North Island (Boffa Miskell 2008) and the largest dune swale wetland remaining in the Foxton Ecological District, Kawakahia Wetland has outstanding ecological value. It is essentially intact and at least partly buffered by regenerating native forest. Kawakahia Wetland is directly connected to the Ngarara Stream, a major tributary of the Waimeha Stream which – along with its tribtuaries – is identified in the RPS as a significant indigenous ecosystem (GWRC 2013).

Kawakahia Wetland is identified in Appendix 2 of the Regional Freshwater Plan as a wetland with a 'high degree of natural character' where the 'surface water is to be managed for aquatic ecosystem purposes' (GWRC 2012). This wetland is considered by the GWRC to be a 'Key Native Ecosystem' and as such undergoes active management of pest plants and animals in conjunction with the landowner. It is also protected by a Queen Elizabeth II National Trust covenant (Ngarara Covenant 5/07/240A).

The Kapiti Coast District Council (KCDC) District Plan heritage register classifies Kawakahia Wetland as an 'Ecological Site (areas of significant indigenous vegetation and significant habitat of indigenous flora)' (KCDC 1999). It is also considered to be an 'outstanding landscape' (KCDC 1999).

There are no sites of recognised ecological significance in the Waimeha NDA itself.

Although a regionally and nationally common vegetation association, and of relatively small extent, the māhoe scrub adjacent to the proposed Waimeha NDA that borders the Kawakahia Wetland has high value because of its role as a buffer for part of the wetland, and therefore as much as possible should be retained.

6.2.2 Species of ecological significance

Regionally rare bog nertera, dwarf musk and sand pimelea have been recorded in or near wetland, but were not recorded on this visit. Regionally rare gully fern was recorded on this visit in the māhoe scrub bordering the wetland.

6.3 Assessment of Environmental Effects

The potential effects of development of the Waimeha NDA on vegetation can be split into two distinct components:

- Construction effects: relate primarily to the clearance of vegetation and earthworks required to create the form and infrastructure required by an urban development. Potential effects are destruction of ecological significant native vegetation and the discharge of contaminants (especially fine sediment and machinery-related hydrocarbons) to the surrounding environment (e.g. the adjacent Kawakahia Wetland).
- Operational/Post-construction effects: relate to the ongoing effects of the proposed Waimeha NDA once it is constructed and operating. Potential effects include the discharge of stormwater contaminants (e.g. fine sediment, heavy metals, and hydrocarbons), increased fire risk, and increased risk of weed incursion into the Kawakahia Wetland.

The level of environmental effect was considered in the context of the RMA using the continuum below, obtained from the Quality Planning website (www.qualityplanning.org.nz):

- Nil effects – No effects at all.
- Less than minor adverse effects – Adverse effects that are discernable day-to-day effects, but too small to adversely affect other persons.
- Minor adverse effects – Adverse effects that are noticeable but will not cause any significant adverse impacts.
- More than minor adverse Effects – Adverse effects that are noticeable that may cause an adverse impact but could be potentially mitigated or remedied.
- Significant adverse effects that could be remedied or mitigated – An effect that is noticeable and will have a serious adverse impact on the environment but could potentially be mitigated or remedied.
- Unacceptable adverse effects – extensive adverse effects that cannot be avoided, remedied or mitigated.

6.3.1 Construction effects

Vegetation Clearance

Design Overview

Construction within the Waimeha NDA will initially require the clearance of existing vegetation.

Potential Effects

This construction will unavoidably result in the clearance of vegetation. With no significant ecological value in the development footprint, clearance of most existing vegetation on the proposed Waimeha NDA will have minimal environmental impacts. Although as much as possible of the māhoe scrub bordering the southern and southeastern edge of Kawakahia Wetland should be retained for its intrinsic values and wetland buffering function, as a common species of young secondary vegetation with a fast growth rate and high coppicing ability, māhoe has relatively high resilience to perturbation. Thus māhoe scrub is unlikely to deteriorate from some degree of encroachment by clearance, and has the ability to recover and quickly re-form a new edge.

The relevant District Plan (Kapiti Coast District Council 1999) restricts the clearance of naturally occurring indigenous vegetation to:

- 'the removal of trees <4 m high or which have a trunk circumference <95 cm measured at 1.4 m above the ground.' The māhoe scrub bordering Kawakahia Wetland fulfils the second criterion (all trunk diameters <95 cm at 1.4 m), so can be cleared.
- 'Modification of vegetation is not permitted where it:
    - forms a contiguous area >100 m^2'. The area of māhoe scrub greatly exceeds 100 m², which precludes clearance of any of it;
    - 'is within 20 m of a waterbody'. Parts of the Kawakahia Wetland certainly meet the RMA definition of waterbody.
    - 'is nationally or regionally rare or threatened'. Māhoe scrub is not nationally or regionally rare or threatened.

Mitigation Required

Any clearance of māhoe scrub that is unavoidable may be mitigated by augmenting the existing māhoe scrub buffer, where inadequate or non-existent, by establishing mānuka scrub by fascining (see Recommendations below).

Conclusion

As the majority of the vegetation within the Waimeha NDA (development footprint) is of no particular ecological value, its clearance will have nil adverse effects.

Earthworks

Design Overview

Construction within the Waimeha NDA will involve earthworks using a variety of heavy machinery. The dunes will require re-shaping to create appropriate slopes for the roads and residential lots and the installation of utilities will require trenching throughout the NDA.

Potential Effects

Discharge of fine sediment that may enter adjacent environments (e.g. Kawakahia Wetland) where it may smother and kill vegetation. Burial of aerial plant components kills most species, and many are also susceptible to death from burial of root systems. There is also a loss of coastal landforms/soil complexes which themselves are becoming a rare element in the landscape. There is some literature on the importance of retaining soil reserves as baselines.

Mitigation Required

Throughout the project area, best-practice erosion and sediment control measures (i.e. sediment fences, temporary detention ponds, bunds, dams, hydroseeding, immediate revegetation of bare earth, use of geotextile to reduce erosion) to prevent fine sediment entering Kawakahia Wetland are a necessity. An erosion and sediment control plan (for both during and following development) will need to be consistent with the GWRC guidelines (GWRC 2006), and submitted to the consent authority.

Conclusion

Provided appropriate erosion and sediment controls are utilised, earthwork will have less than minor adverse effects.

6.3.2 Operational effects

Weed Invasion

Design Overview

Urban development within the Waimeha NDA will involve development of public and private gardens, all relatively close to Kawakahia Wetland.

Potential Effects

A major concern is increased proximity to seed sources of weeds (Timmins & Williams 1991) and consequent weed invasion through both accidental dispersal by natural vectors (e.g. wind, birds) and deliberate dumping of garden waste, a common source of environmental weeds such as wandering willy.

Mitigation Required

Buffer zone

Weed invasion can be mitigated to some extent by a buffer zone, commonly advocated as a management tool to reduce land-use impacts on natural landscape features, including

wetlands. They are usually vegetated and provide a physical barrier between the land use activity and the wetland. The current and potential future ecological functions of the buffer zone around the Kawakahia Wetland include providing a barrier to the invasion of some weedy plant species and providing a physical barrier to humans who may enter the wetland area, trampling plants and inadvertently introducing weeds.

There is no definitive minimum or ideal buffer width, although it is generally accepted that the wider the better and that any buffer is better than no buffer. Selected guidelines from New Zealand and overseas are summarised in Table 1.

Table 1 Summary of selected wetland buffer guidelines

Source	Targeted land use	Location	Recommended widths
Ausable Bayfield Conservation Authority (ABCA)	Agriculture	Canada	20–200 m Slopes >5% then buffer should exceed 20 m Large wetlands (>10 hectares) with high wildlife values require buffers >200 m
Jones, Edmunds & Associates (2000)	Any including urban	St Johns County, Florida, USA	300 ft (91.44 m) to protect a viably functioning wetland ecosystem. 75 ft (22.86 m) if advanced stormwater treatment is undertaken or it can be confirmed that reduced distance will adequately protect any listed species (if present)
McElfish et al. (2008)	Any including urban	USA	30–>100 ft (9.1–>30.5 m) for sediment and phosphorus removal 100–>160 ft (30.5–>48.77 m) for nitrogen removal 100–>300 ft (30.5–>91.44 m) for wildlife protection (depending on species and habitat characteristics)
Parkyn et al. (2000)	Any including urban	Auckland, New Zealand	10 m could be used as a general guideline for minimum buffer width that is sustainable for native vegetation 10–20 m should meet most of the aquatic functions provided by riparian vegetation
Palone & Todd (1998)	Any including urban	Chesapeake Bay, USA	Buffers <50 ft (15.24 m) have proven increasingly difficult to manage as effective filters. 50–100 ft (15.24–30.5 m) for adequate sediment and phosphorus removal 100–300 ft (30.5–91.44 m) for wildlife protection 35–90 ft (10.67–27.43 m) for nitrogen removal

Reeves et al. (2006)	Urban and rural	New Zealand	Densely planted buffers with widths of 15 m or greater provide the best environment for reducing weedy ground cover 15 m or more is the optimum width for buffers
Auckland Regional Council (2001)	Any including urban	Auckland, New Zealand	A buffer width of more than 10 m (15 m preferred) of a range of riparian vegetation will achieve most of the identified aquatic benefits A 10-m minimum buffer width is therefore recommended as a general guideline

While buffer width has a major effect on its effectiveness in protecting the wetland, adequate width is also crucial to successful establishment of a sustainable, self-perpetuating zone of native vegetation that is resistant to the invasion of exotic weeds. Vegetated buffer strips nearly always have an abrupt outer edge and as such are subjected to edge effects, which is the change in plant and animal community structure across habitat boundaries that results from changing environmental conditions across them (especially microclimatic). Virtually all studies on edge effects have been conducted on forest edges. The rate at which microclimatic effects of edges dissipate within forest depends on the variable being measured but some, for example soil temperature and light levels, dissipate by about 10 m (Davies-Colley et al. 2000). Others, such as wind speed and air temperature, persist for considerably greater distances. Typically, there is a rapid decline in edge effects – both in microclimatic variables and vegetation response – over the first 10–20 m of forest, but these persist at reduced levels over much longer distances (Young & Mitchell 1994). These edge effects often provide conditions ideal for exotic plant species that are not desirable in a buffer around a highly valued environment such as the Kawakahia Wetland (e.g. blackberry, pasture grasses, gorse, ivy). Therefore, narrow buffers may be affected by edge effects for their entire width and require ongoing weed management. From an ecological point of view, it is therefore crucial to maximise the width of the vegetated native buffer.

A sustainable, self-perpetuating buffer dominated by native vegetation that will minimise edge effects on the vegetation of Kawakahia Wetland is required. An effective buffer already exists along much of the Kawakahia Wetland– Waimeha NDA boundary in the māhoe scrub, a young secondary community dominated by native species that will succeed over time to taller, multi-layered native forest dominated by kohekohe, provided that weeds and pests are controlled. The 20-m minimum width buffer outlined in rule D11.2.3 of the KCDC District Plan is a reasonable distance based on the high ecological values of the environment being protected. Although as much as possible of it should be retained, māhoe – a common species of young secondary vegetation with a fast growth rate and high coppicing ability – has relatively high resilience to perturbation. Thus māhoe scrub is unlikely to deteriorate from some degree of encroachment by clearance if some is unavoidable, and has the ability to recover and quickly re-form a new edge. However, where there is currently a sparsely vegetated buffer dominated by pasture grasses, a narrower buffer of no less than 15 m would be acceptable provided:

- an effective buffer of native shrubs/trees were established quickly

- the length of 15 m wide buffer were minimised and all opportunities were taken elsewhere to increase buffer width beyond the 20 m minimum
- the overall average buffer width of the Kawakahia Wetland – Waimeha NDA were no less than 20 m (i.e. parts of the buffer will need to be greater than 20 m in other sections).

In sparsely vegetated areas, we suggest the exposed wetland edge be 'sealed' with a strip of dense mānuka scrub, which can easily be created by fascining (laying cut capsule-bearing mānuka slash on the ground). Fascining mānuka (Fig. 11) is a fast revegetation technique commonly used for bare ground (Porteous 1993). Pasture would need probably to be herbicided first to ensure good germination. The mānuka scrub created by fascining would provide a fast-growing dense native buffer, which would quickly and effectively fulfil the necessary ecological functions, thus mitigating to a large extent any limitations of a relatively narrow buffer zone. This buffer would initially last for 40–50 years (Burrows 1973) and be replaced naturally over time by other shrub and tree species present at the site. Eventually, successional pathways in it and the existing māhoe scrub buffer would converge, creating a uniform multi-layered native forest buffer. The alternative is mass planting containerised stock of either mānuka alone or a representative range of shrub species already present at the site (e.g. mānuka, mingimingi, lancewood, hangehange, kawakawa, and taupata), a more expensive technique which would take longer to fulfil the ecological functions required of buffers.

Figure 11 An example of fascining mānuka on recently bared surfaces. Mānuka seeds will quickly germinate and form a dense thicket, thereby stabilising the bare slope.

Appropriate amenity species

Species for public/amenity planting should be selected so as to avoid the introduction of known environmental weeds (Howell 2008) to the Waimeha NDA.

Weed control

Populations of invasive weeds surviving after site development shall be removed. Ongoing weed and pest control within the Kawakahia Wetland and its buffer zone is highly desirable to maintain the integrity of the wetland and its buffer zone.

Conclusion

Weed invasion has the potential to have more than minor adverse effects on Kawakahia Wetland. However this can be minimised provided the mitigation measures suggested above are utilised.

Human Disturbance

Design Overview

Urban development within the Waimeha NDA will mean that what was previously private land with limited access will become fully accessible by the public.

Potential Effects

Increased human entry into Kawakahia Wetland brings with it the inevitability of trampling damage to vegetation and increased risk of accidental weed invasion on footwear, clothing, and by food disposal. Fire danger will also be increased. Most of the wetland vegetation associations are not particularly flammable, and nor is māhoe scrub (NWH Mason, pers. com.), so increased fire risk is not a particular concern.

Mitigation Required

Human disturbance can be mitigated to some extent by a buffer zone, commonly advocated as a management tool to reduce land use impacts on natural landscape features, including wetlands (see Mitigation under Weed Invasion above). The fascined mānuka scrub in particular will provide an effective barrier to human entry. Dense plantings of harakeke/flax – and vines can also form effective barriers to humans.

Conclusion

Provided the mitigation measures suggested above are utilised, human disturbance will have less than minor adverse effects.

7 Discussion and conclusions

Like the adjacent northern Horowhenua (Duguid 1990), with its accessibility and easy topography, the southern Horowhenua has a long history of human settlement and impact. Ngarara has evidently had a long history of use for agriculture, and the only primary vegetation associations surviving are those in the Kawakahia Wetland. The only other association dominated by native species is māhoe scrub, a young (probably less than 30 years) secondary association that will succeed to taller native forest in the foreseeable future if weeds and pests are controlled. Despite its relative floristic paucity, typical of young secondary vegetation, it nevertheless provides an invaluable buffer for the southern and southwestern edges of Kawakahia Wetland and is therefore of high ecological importance. It also enhances the range of ecological communities present. The remaining vegetation associations are all dominated heavily by exotic species and despite the inevitable presence of some native plant species, have no significant ecological value. Apart from nationally common, but regionally sparse, gully fern in māhoe scrub, no threatened species were recorded, only common widespread native plant species, as is usual in highly modified landscapes with a long history of human occupation. A few rare forbs, previously reported, were not observed in the recent survey.

8 Recommendations

8.1 Opportunities for Ecological Improvement

Although much of the affected edge of Kawakahia Wetland is already effectively buffered by māhoe scrub, in some places only an inadequate (i.e. too narrow) buffer exists or none at all (exotic pasture). Here, we suggest that the exposed wetland edge be ‘sealed’ with a strip of dense mānuka scrub, which can easily be created by fascining (laying cut capsule-bearing mānuka slash on the ground). Fascining mānuka is a fast revegetation technique commonly used for bare ground (Porteous 1993). Pasture would need probably to be herbicided first to ensure good germination. The mānuka scrub created by fascining would provide a fast-growing dense native buffer, which would quickly and effectively fulfil all the ecological functions required of buffers, thus mitigating to a large extent any limitations of a relatively narrow buffer zone. This buffer would initially last for 40–50 years (Burrows 1973) and be replaced naturally over time by other shrub and tree species present at the site. Eventually, successional pathways in it and the existing māhoe scrub buffer would converge, creating a uniform multi-layered native forest buffer. The alternative is mass planting containerised stock of either mānuka alone or a representative range of shrub species already present at the site (e.g. mānuka, mingimingi, lancewood, hangehange, kawakawa, and taupata), a more expensive technique which would take longer to fulfil the ecological functions required of buffers.

8.2 Monitoring and Maintenance

Ongoing weed and pest control are highly desirable, both in maintaining the integrity of existing natural vegetation adjacent the proposed Waimeha NDA (Kawakahia Wetland and fringing māhoe scrub) and in allowing further natural successional development of the māhoe

scrub and proposed fascined mānuka scrub to kohekohe forest. The wetland is part of GWRC's Key Native Ecosystem programme and as such is already subjected to a pest control progamme in conjunction with the landowner. Any additional pest control should be developed in consultation with GWRC and the landowner to ensure consistency and efficiency.

8.3 Mitigation Summary

- Augmenting the existing Kawakahia Wetland māhoe scrub buffer zone by supplementary establishment of mānuka scrub by fascining.
- Populations of invasive weeds surviving after site development should be removed.
- Ongoing weed and pest (rodent, mustelid, possum, wild cat) control within Kawakahia Wetland and its buffer zone. Any pest control plan should be created in consultation with GWRC, who has an ongoing pest control programme in the wetland.
- Species for public/amenity planting should be selected so as to avoid the introduction of known environmental weeds to the Waimeha NDA.
- Best-practice erosion and sediment control measures (i.e. sediment fences, temporary detention ponds, bunds, dams, hydroseeding, immediate revegetation of bare earth, use of geotextile to reduce erosion), during and after development, to prevent fine sediment entering adjacent Kawakahia Wetland.

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