



Living Water – Opportunities for restoration: Hikurangi Floodplain



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Summary

Project and Client

- Landcare Research was contracted by the Department of Conservation, on behalf of the Fonterra–Department of Conservation Living Water Programme, to identify and prioritise opportunities for biodiversity restoration on the floodplain of the Hikurangi Catchment.

Objectives

- Identify and prioritise opportunities for restoration.
- Identify priority sites, actions, goals and monitoring requirements.
- Present preliminary results at a workshop for farmers, hapū, and key stakeholders.

Methods

- Information on the biodiversity values of the Hikurangi floodplain was collated to identify gaps in knowledge and the priority natural areas that required additional field survey.
- Field reconnaissance surveys were undertaken in the natural areas to provide information on flora and vegetation, significance, threats, and management recommendations.
- A peat core from Otakairangi Swamp was analysed for plant macrofossils to confirm (or not) historical presence of *Sporadanthus ferrugineus*, now locally extinct from Northland.

Results

- Detailed descriptions of 16 remnants, assessed as having significant natural values, were provided. This included important populations of the threatened species, *Hebe* aff. *bishopiana* Hikurangi Swamp at one new site, and *Pittosporum obcordatum* at two new sites.
- Representative plot data, species lists, descriptions, and nutrient data provide baselines for monitoring changes in biodiversity and ecological condition.
- Six major threats are impacting on biodiversity values: hydrological modification, domestic stock damage, weed invasion, feral animal damage, habitat loss, and nutrient enrichment.
- *Sporadanthus ferrugineus* was confirmed as being historically present at Otakairangi Swamp.
- The preliminary results and recommendations were well received at the stakeholder workshop held on 5 June 2015.

Conclusions

- The Hikurangi floodplain is an important biodiversity hotspot, however urgent management and restoration is required to reverse the on-going gradual and insidious decline of biodiversity. Twelve key recommendations and opportunities for restoration to improve biodiversity outcomes have been presented for consideration and consultation with local farmers, hapū, and key stakeholders.

Recommendations and opportunities for restoration

- All the recommendations listed below, apart from ‘11: Restore Otakairangi Swamp’, apply to at least some remnants on private land, and all except perhaps ‘2: Prevent stock access’ and ‘5: Prevent habitat loss’ are currently relevant to public conservation land.
 1. **Review hydrological options** Consult Whangarei District Council, farmers and other stakeholders to review options to reduce the ecological impacts of the current hydrological regime, especially at the most important sites. Raise and manage water tables where possible by blocking drains, installing weirs, shallowing drains and keeping water tables high in summer.
 2. **Prevent stock access** Ensure remnants are fully fenced and stock-proof.
 3. **Control troublesome weeds** Focus on control of transformer weed species, e.g. tradescantia, privet, royal fern. Consider use of biocontrol agents, e.g. for tradescantia.
 4. **Control pests** Establish integrated control programmes for the major predators and browsers, e.g. possum, rats, mustelids and hares.
 5. **Prevent habitat loss** Increase awareness of biodiversity values, engage farmer environmental ‘champions’, and assist with fencing, weed control, and restoration plantings.
 6. **Minimise nutrient inputs** Use robust farm management practices, construct sediment traps, minimise bank erosion, and publicise best practice.
 7. **Expand remnant size and connectivity** Increase remnant viability by expanding remnant size, connecting with nearby remnants, creating corridors, linking with riparian plantings, and supplementing with restoration plantings.
 8. **Support existing restoration projects** Maintain and supplement restoration and monitoring programmes currently underway, e.g. herbaceous plantings within stop banks, threatened species management, black mudfish and longfin eel monitoring programmes.
 9. **Increase knowledge of important species distributions** Survey potential habitat for threatened/at risk/uncommon species by concentrating on natural areas around newly discovered populations, e.g. search for *Hebe* aff. *bishopiana* along the full range of river bank habitat associated with the Waiotu River (Waiotu Natural Area), and for *Pittosporum obcordatum* in semi-open forest and shrubland near the confluence of Whakapara and Waiotu Rivers.

10. **Increase important species populations** Supplement existing populations and establish new populations of threatened, at risk, uncommon and missing species. Where possible, involve landowners, land managers, students, hapū, marae, whanau, community groups, and members of the public in restoration and propagation programmes.
11. **Restore Otakairangi Swamp** Develop a restoration plan for re-establishing locally extirpated populations of *Sporadanthus ferrugineus* and its invertebrate commensal *Houdinia flexilissima*, and restore peat-forming processes in both Otakairangi Swamp and a showcase population that will be accessible to the public.
12. **Control and manage tradescantia** Develop a field experiment for the long-term control and management of tradescantia to increase biodiversity benefits, and establish the experiment in a range of forest remnants on both private and public conservation lands.
13. Suggested priority rankings of natural areas for biodiversity restoration have been provided. Although all natural areas are considered of high priority because of the magnitude of loss, those considered of immediate priority are Forsythe Meander, Heaton Road, Otakairangi Swamp (high), Otonga, Riponui Road, Waiotu, Wairua River, Wairua River South Whakapara North, Whakapara South (high), and Whakapara West (high).

1 Introduction

The Living Water Programme is a 10-year partnership between Fonterra and the Department of Conservation aimed at improving waterways, natural habitats, and ecosystems in priority dairy farming catchments.

Five catchments have been selected for initial investment: Kaipara Harbour, Miranda (Firth of Thames), Waikato Peat Lakes, Te Waihora-Lake Ellesmere, and Awarua-Waituna.

Living Water in the Kaipara Harbour is initially focussing on the Hikurangi Catchment in the upper part of the overall Kaipara Harbour Catchment, where the low-lying floodplain is subject to frequent flooding.

An annual operational plan was developed for Kaipara Harbour – Hikurangi Catchment for 2014/15 (Fonterra & Department of Conservation 2014). One of the agreed milestones for 2014/2015 was scoping opportunities for biodiversity restoration on the Hikurangi floodplain. The milestone incorporates both western science and mātauranga Māori pathways, which were to be developed as separate projects.

Landcare Research was contracted by the Department of Conservation to design and prioritise restoration opportunities on the Hikurangi floodplain from a western science perspective. These results are intended to complement the cultural priorities identified in a proposed separate mātauranga Māori report in order to achieve the aim of integrated catchment management (yet to be actioned).

2 Background

The Hikurangi floodplain is a highly modified landscape, with most of the area developed for agriculture, particularly dairy farming. Because the low-lying land was historically highly prone to flooding, the rivers have been channelized, straightened and stop-banked (Hikurangi Swamp Scheme, fully operational c.1970), preventing spillage of water except in extreme weather events.

The significant natural areas left are typically small, isolated and fragmented (Manning 2001). The most significant natural areas remaining on the floodplain are the Wairua River Government Purpose Wildlife Management Reserve (GPWMR: 157.5 ha) and the Otakairangi Swamp GPWMR: 266 ha), both public conservation lands administered by the Department of Conservation.

While there is a good understanding of species diversity, threatened species and their management within Wairua River GPWMR (e.g. Ritchie 2005; Townsend 2012, 2013, 2014), this is not the case for elsewhere. A more detailed ecological survey is needed to understand the current condition of other significant natural areas on the Hikurangi floodplain, the species they support, and the major threats.

There is also limited understanding of how the Hikurangi Swamp Scheme, with its highly modified hydrological regimes, impacts on ecological values and sustainability of the natural areas within the floodplain.

The scope of this project includes any action in the upper Wairua River catchment and upstream and downstream of and within the Hikurangi floodplain that would

- Enhance or restore, or
- Lead to sustainable management of the natural biodiversity, function or ecosystem services of the Hikurangi floodplain.

3 Objectives

The main aim is to design and prioritise restoration opportunities for sustainable management of the natural biodiversity, function or ecosystem services of the Hikurangi floodplain. The specific objectives are:

- Identify and prioritise opportunities for restoration
- Identify priority sites, actions, goals, and monitoring requirements
- Present preliminary results at a workshop for local farmers, hapū, and key stakeholders

4 Methods

4.1 Inventory

Information on the current physical and biodiversity values of the Hikurangi floodplain relevant to Living Water objectives and outcomes (Fonterra & Department of Conservation 2014) was collated to assess the gaps that required additional field survey. The main sources were the Hikurangi Catchment Living Water baseline report of Price and Dean (2014), the Protected Natural Area Programme (PNAP) survey of Manning (2001), internal Department of Conservation reports, e.g. Townsend (2012, 2013, 2014), and expert local knowledge, particularly from L. Forester (Northland Regional Council), and W. Holland and A. Townsend (Department of Conservation).

Spatial Data was supplied by the Department of Conservation in the ESRI Shapefile format. This included the Hikurangi Floodplain boundary, Public Conservation Land administered by the Department of Conservation, PNAP Significant Natural Area sites, and Department of Conservation Ecological Management Units. Aerial photography was sourced via Land Information New Zealand (LINZ) (Land Information New Zealand 2004, 2006) from the Northland 0.75 m and 1.0 m Rural Aerial Photos (2004 and 2006 respectively), released under a Creative Commons license <http://data.linz.govt.nz/license/attribution-3-0-new-zealand/>.

Maps of historic and current wetland type and extent were produced using the Freshwater Systems of New Zealand (FENZ) database (Ausseil et al. 2008; Leathwick et al. 2010) to understand historic and current patterns, and to inform priorities for protection and restoration.

4.2 Field Survey

Twenty-one sites were assessed as having natural values based on the PNAP (Manning 2001) and local knowledge (Table 1). Several Significant Natural Area sites from Manning (2001) have since been cleared and developed. Of the 21 assessed sites, one had already been surveyed by Townsend (2014) and permission for access was not granted for two sites on private land. The remaining 18 sites were surveyed between November 2014 and February 2015, however two were rejected as having minimal/no natural values left. The surveys of the individual sites are in Appendix 1.

Table 1 Hikurangi Floodplain sites surveyed

Status	Site	Tenure	Location	Area ha
Current survey	1 Borrow Cut	Public Conservation Land	E1713002 N6060092	c. 2.0
	2 Forsythe Meander	Public Conservation Land	E1710970 N6063327	c. 13.0
	3 Heaton Road	Private Land	E1708941 N6060153	c. 2.0
	4 Hikurangi Bush QEII	Queen Elizabeth II NT Coven	E1716141 N6058980	1.7
	5 Jordan Valley Road	Public Conservation Land	E1713113 N6058646	c. 4.0
	6 Matarau Island	Public Conservation Land	E1709281 N6056840	3.0
	7 Otakairangi North	Private Land	E1705802 N6060876	c. 5.0
	8 Otakairangi Swamp	Public Conservation Land	E1706257 N6060150	*315.0
	9 Otonga	Private Land	E 1717251 N6065023	c. 3.0
	10 Riponui Road	Private Land	E1703284 N6061971	c. 3.0
	11 Waiotu	Private Land	E1711295 N6067838	c. 15.0
	12 Wairua River	Public Conservation Land	E17062576 N060150	*181.7
	13 Wairua River South	Private Land	E1709542 N6056979	c. 1.5
	14 Whakapara North	Private Land	E1713678 N6065311	c. 3.0
	15 Whakapara South	Private Land	E1717952 N6064412	c. 10.0
	16 Whakapara West	Private Land	E1711541 N6064979	c. 8.0
Surveyed by DOC	17 Jordan Valley Fonterra Farm	Private Land	E1713967 N6058049	5.1
Rejected sites	18 Apotu Swamp Shrubland	Private Land	E1713763 N605667	0.0
	19 Wairua River Oxbow	Public Conservation Land	E1712250 N6061965	0.0
Access not granted	20 Hikurangi Swamp Remnant	Private Land	E1714250 N6061670	c. 16.0
	21 Jordan Valley Forest Remnants	Private Land	E1714059 N6058071	c. 3.5
* includes adjoining natural areas				

At each of the 16 accepted sites (Figure 1) a reconnaissance survey was conducted to determine the habitats and ecosystems present, collate species lists, identify threats, and provide recommendations for management. Representative plots were established in the main vegetation types to provide quantitative data on vegetation structure and composition, to assess current patterns, and to provide baselines for future monitoring.

Wetlands dominated by herbaceous plants were sampled using the national wetland monitoring protocol, which is based on sampling vegetation, nutrients, and water in 4-m² plots (Clarkson et al. 2004). Forest remnants were sampled using non-bounded plots ('non area') of c. 300–400m², in areas of relatively homogeneous vegetation and physiography. A flexible plot size and shape were used, as these were more suited to the small, irregular shaped remnants typical of the floodplain.

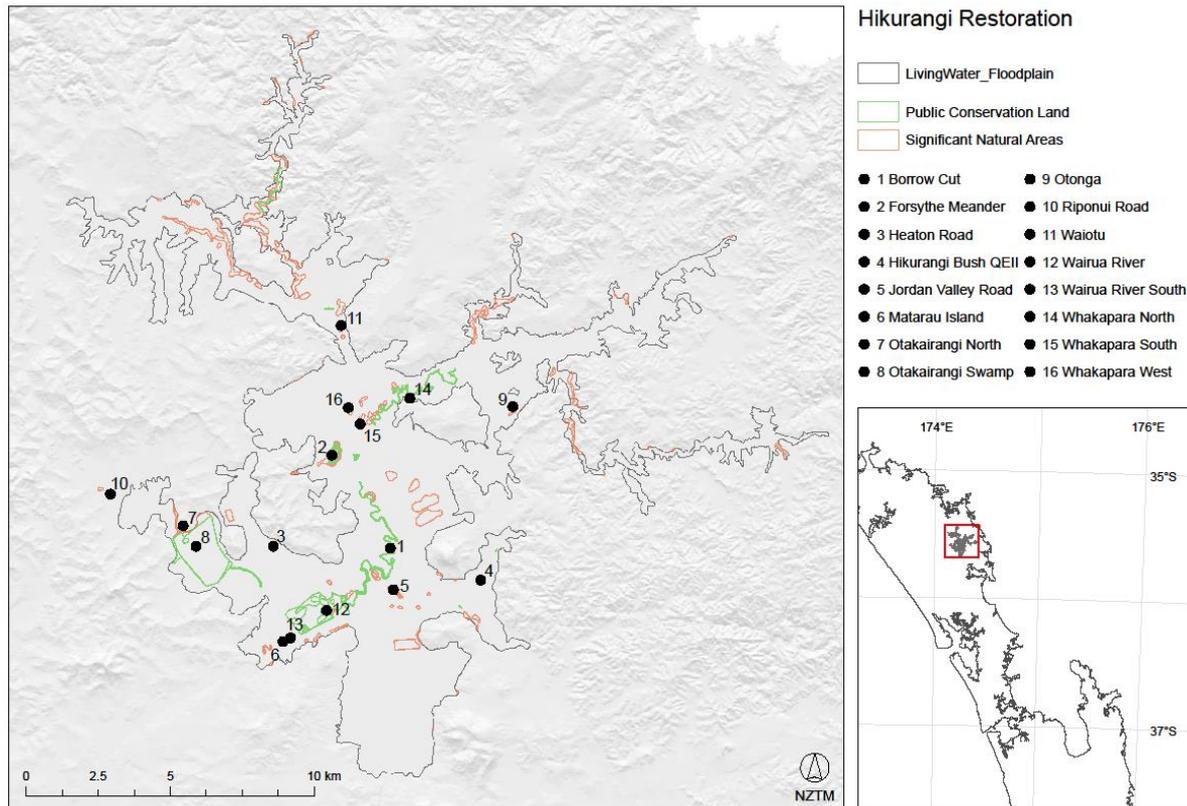


Figure 1 Location of Hikurangi Floodplain sites surveyed.

4.3 Peat macrofossil analysis

A peat core using a Russian D-section peat sampler (Jowsey 1966) was obtained from near the middle of Otakairangi Swamp (Plot OTW10) for analysis of plant macrofossils (by Aline Homes, Victoria University of Wellington), to determine whether *Sporadanthus ferrugineus* was originally present. *Sporadanthus ferrugineus* is an endemic peat-forming restiad (family Restionaceae) that historically dominated raised bogs throughout northern North Island but now occurs naturally at only three sites in the Waikato. Previous analyses of pollen in peat cores at Otakairangi Swamp (Newnham 1992) were unable to distinguish between the closely related restiad species *Empodisma robustum* (recorded as *E. minus* in Newnham 1992) and *S. ferrugineus*.

The historic presence of *S. ferrugineus* could guide potential restoration projects on re-establishing *S. ferrugineus* populations in areas on the Hikurangi floodplain having suitable environmental conditions.

5 Results

5.1 Wetland historic and current extent

5.1.1 Wetland types

Historically, the Hikurangi floodplain was essentially one big wetland (see Appendix 2), with the main wetland types being marsh, swamp, fen, bog, and gumland (Fig. 2; Ausseil et al 2008, Leathwick et al. 2010). While there is little doubt the dominant ecosystem by far was wetland, the wetland type classification probably requires some refinement, particularly with regard to gumland.

Gumland sites have been mapped along the boundaries between the hills and the floodplain and may be an artefact of displacement of the GIS overlay on the map. This is because gumlands are *Leptospermum scoparium*-dominated heathlands and are more likely to occur on infertile impervious soils of the surrounding hillsides, rather than on the more fertile floodplain soils (Clarkson et al. 2011). As a result, gumlands are not considered further in this report.

Refinement and ground-truthing are also recommended for the bog wetland type, which has probably been under-estimated. A survey of New Zealand peat resources, Davoren (1978), identified extensive areas of deep peat (bog) in and near the current-day Otakairangi Swamp GPWMR, which appear to have been misclassified in FENZ.

5.1.2 Wetland patterns

In early European settlement times, marshes dominated along the rivers and main streams (Fig. 2) reflecting the dynamic and fluctuating wet and dry regimes associated with periodic flooding. Moving away from the rivers where the influence of river flooding is less, swamps became dominant. These occurred on the more poorly-drained back swamps and flood plains characterised by higher and more permanent water tables. Still further away from the rivers and on less disturbed sites, fens developed. With the progression of time and with accumulation of peat, the fen surface rose above the influence of surface water to eventually become a rain-fed raised bog (Clarkson 2002).

A comparison of historical and current wetland data shows only 3.5% of wetland area remains (Fig. 3, Table 2). Although refinement at the wetland type level is desirable, the high level proportion and patterns of wetland loss should not change significantly. The statistics show the magnitude of the loss on the Hikurangi floodplain (>96%) greatly exceeds the New Zealand-wide total of 90% loss (Ausseil et al. 2008).

The two largest remaining wetlands are Otakairangi Swamp (west) and Wairua River (east). Although both are mapped as swamps in Ausseil (2008), peat depth, plant composition, and environmental conditions (Davoren 1978, Newnham 1992, this study) indicate that Otakairangi Swamp should be reclassified as a bog, with fen margins. In addition, since 2008 (the current wetland baselines in Fig. 3 and Table 2), the 3.06-ha fen remnant immediately north of Otakairangi Swamp has been developed.

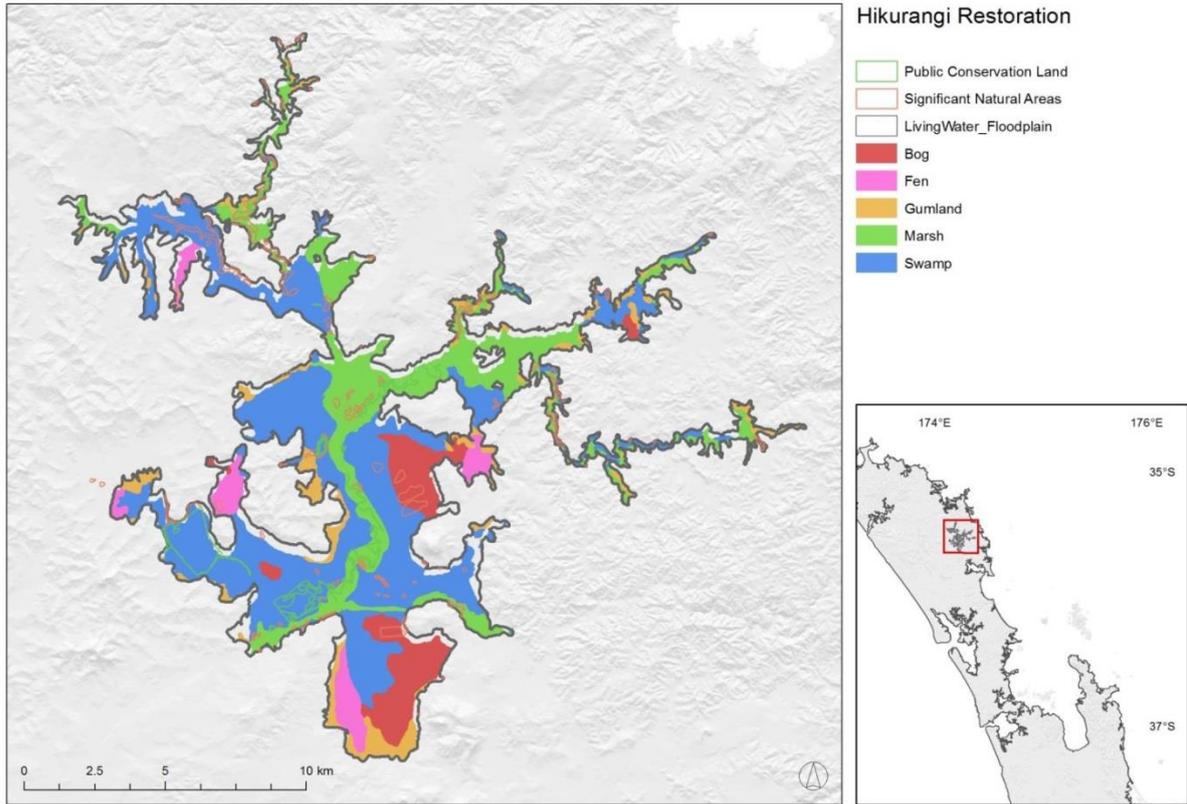


Figure 2 Historic extent of wetlands according to wetland type on the Hikurangi floodplain.

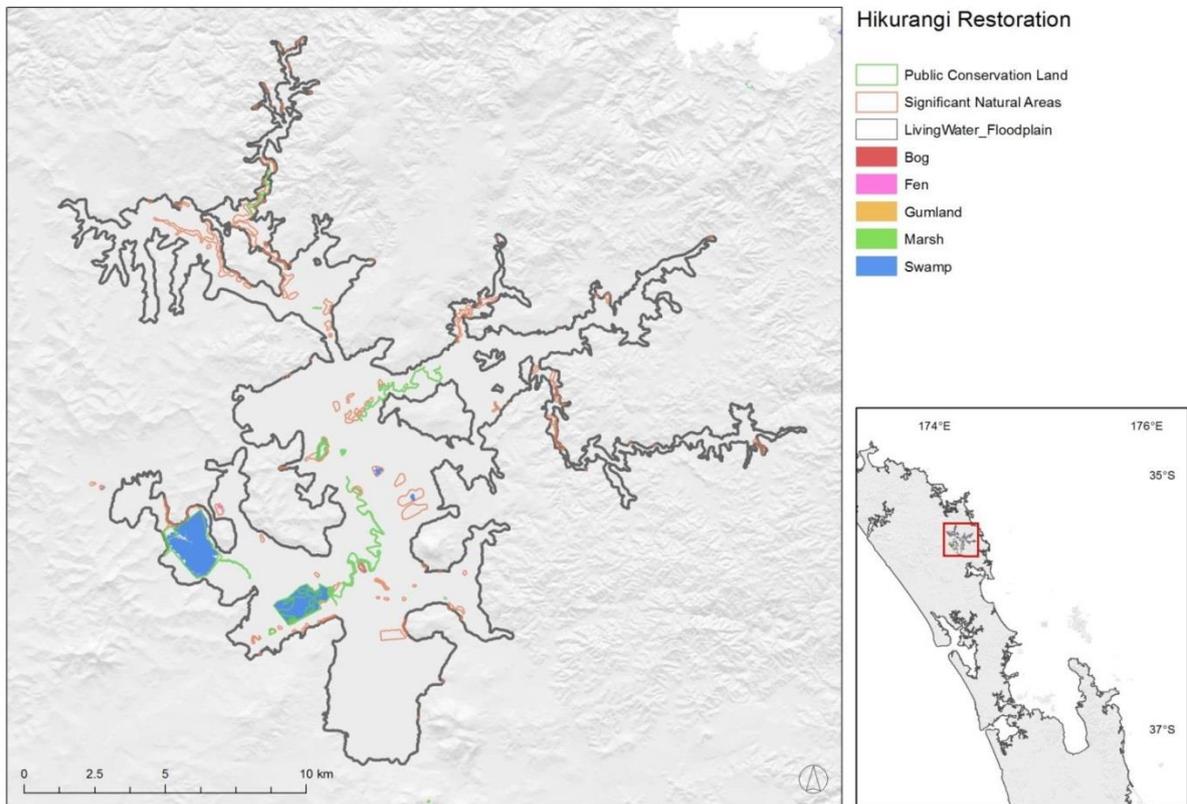


Figure 3 Current extent of wetlands according to wetland type on the Hikurangi floodplain.

Table 2 Historic and current areas of wetland by type on the Hikurangi floodplain; *= now developed

Wetland type	Historic (1840)		Current (2008)		Proportion Remaining %
	Frequency	Area ha	Frequency	Area ha	
Bog	8	1254.43	0	0	0
Fen	6	659.43	1*	3.06*	0.5*
Gumland	56	1123.47	0	0.00	0
Marsh	18	3469.41	15	15.01	0.4
Swamp	65	5674.77	21	403.93	7.1
Total	153	12 181.51	37	421.99	3.5

5.2 Main ecosystem types

The main ecosystem types and habitats in the natural areas (full descriptions in Appendix 1) are:

- forest
- river banks
- swamp
- fen
- bog

Forest ecosystems originally developed as extensive marsh and swamp forests but the remnants have been considerably modified hydrologically, causing a shift to drier conditions overall. The better drained sites are characterised by totara (*Podocarpus totara*) and the more poorly drained areas by kahikatea (*Dacrydium dacrydioides*). Occasional matai (*Prumnopitys taxifolia*), white maire (*Nestegis lanceolata*), black maire (uncommon; *Nestegis cunninghamii*), rimu (*Dacrydium cupressinum*), titoki (*Alectryon excelsus*), and taraire (*Beilschmiedia tarairi*) are also present. Closer to the rivers on hydrologically disturbed terraces and floodplains, the canopy is more open and with a greater mixture of species, including lowland ribbonwood (*Plagianthus regius*), kōwhai (*Sophora microphylla*), kānuka (*Kunzea robusta*), kawaka (*Libocedrus plumosa*), white maire, mānuka, and small trees and shrubs.

River banks are mostly dominated by exotic herbs and shrubs; however, a few areas of note had *Hebe* aff. *bishopiana* Hikurangi Swamp, a small indigenous turf association, and regenerating *Pittosporum obcordatum* (see section 5.3 below).

Herbaceous swamps are typified by Wairua River GPWMR, in overall very good condition. Other small swamps on the Hikurangi floodplain, e.g. artificial oxbows and cut-off channels are more degraded, being dominated by exotic herbs and grasses. However, an important population of regionally uncommon burr reed (*Sparganium subglobosum*) was recorded at the Wairua River South oxbow, close to Wairua River GPWMR.

Fens and bogs have all been developed apart from Otakairangi Swamp. This includes the 3.06-ha of fen immediately north of Otakairangi Swamp that was present in 2008 (Ausseil et al. 2008; Table 2). The central, least modified parts of Otakairangi Swamp are characterised by bog vegetation of *Machaerina teretifolia*, *Gleichenia dicarpa*, short-statured mānuka (<1 m) with local patches of *Empodisma robustum*.

5.3 Threatened land environments

The natural areas surveyed on the Hikurangi floodplain encompass three nationally threatened land environments (Cieraad et al. 2015). These are Category 1: <10% indigenous cover left); Category 2: 10–20% indigenous cover left; and Category 4: >30% left and <10% protected (Table 3). Category 1 is the most common (82.3% of total area), comprising the central and southern floodplain forest, swamp, fen and bog remnants, Category 2 (12.4%) consists of the river bank and northern floodplain remnants, and Category 4 (5.3%) comprises hill country (mostly Otakairangi North). The areas are approximate because of the variable accuracy of the remnant polygons, and scale issues as a result of LENZ being derived at a national scale and excluding water bodies. However, because 99.1% of the Hikurangi floodplain can be classified as threatened environments, all remnants with indigenous cover are very important as representative examples of lowland floodplain forest ecosystems, now uncommon in the region and throughout New Zealand.

Table 3 Area of natural areas in LENZ level IV threatened land environment categories

Natural Area	Category 1 ha	Category 2 ha	Category 4 ha	Total ha
Borrow Cut	0.0	7.1	0.0	7.1
Forsythe Meander	18.3	0.0	0.0	18.3
Heaton Road	2.2	0.0	0.3	2.4
Hikurangi Bush QEII	1.5	0.0	0.0	1.5
Jordan Valley Road	3.5	0.0	0.0	3.5
Matarau Island	0.0	2.1	0.0	2.1
Otakairangi North	0.0	0.0	27.9	27.9
Otakairangi Swamp	265.6	0.0	0.3	265.9
Otonga	0.0	3.4	0.0	3.4
Riponui Road	3.7	0.0	0.0	3.7
Waiotu	0.0	14.4	0.0	14.4
Wairua River	146.8	6.6	0.0	153.3
Wairua River South	0.0	1.1	0.0	1.1
Whakapara North	0.0	2.6	0.0	2.6
Whakapara South	0.0	21.0	0.0	21.0
Whakapara West	0.0	8.5	0.0	8.5
Grand Total	441.4	66.8	28.5	536.7
Proportion of Area %	82.3	12.4	5.3	

5.4 Threatened plant species

Two nationally threatened species (de Lange et al. 2013) grow on the Hikurangi floodplain (Table 4). The shrub *Hebe* aff. *bishopiana* (Hikurangi Swamp) has the highest threat category, being classified as Nationally Critical on the basis of having <250 mature individuals and being sparse in distribution. The second threatened species is the small tree *Pittosporum obcordatum*, which is classified as Nationally Vulnerable because its population has been estimated at only 1000–5000 mature individuals, and is in partial decline.

One new site for the nationally critical shrub, *Hebe* aff. *bishopiana* Hikurangi Swamp, was discovered during the survey. At least eight adult plants were noted scattered on steep banks along a c. 1 km stretch of the Waiotu River at Waiotu Natural Area. A thorough search for this species along the full range of river bank habitat both within and adjacent to the natural area is recommended.

Two new sites for *Pittosporum obcordatum* were found: Whakapara South and Whakapara West. These sites are several kilometres north of currently known sites centered on Wairua River GPWMR. At both sites, substantial populations were found, i.e. at least 50 and 90 individuals respectively, including occasional seedlings and saplings. A reconnaissance of similar sites near the confluence of the Whakapara and Waiotu Rivers is recommended as the habitat there appears suitable for *P. obcordatum*.

Five nationally At Risk species are present on the Hikurangi floodplain (Table 4): *Geranium solanderi* (At Risk – Declining), the rasp ferns, *Doodia squarrosa*, (syn. *Blechnum zeelandicum*; At Risk – Naturally Uncommon) and *Doodia mollis* (syn. *Blechnum molle*: At Risk – Naturally Uncommon), a leafy liverwort, *Cololejeuna falcidentata* (At Risk – Naturally Uncommon; recorded by Glenny et al. 2009) and kawaka (At Risk – Naturally Uncommon).

Twenty regionally uncommon species were recorded on the Hikurangi floodplain (Table 4). Regionally uncommon species were based on a working list of regionally significant species (Forester et al. 2006), and refined by A. Townsend, L. Forester, and W. Holland. Nearly all sites had regionally uncommon species and/or nationally threatened and uncommon species, a likely consequence of the extensive loss of floodplain habitat in Northland and nationally.

Table 4 Threatened, at risk and regionally uncommon species found on the Hikurangi floodplain

Species	Common name	Classification
<i>Hebe</i> aff. <i>bishopiana</i> Hikurangi Swamp	Swamp hebe	Nationally Critical
<i>Pittosporum obcordatum</i>	Heart-leaved kohuhu	Nationally Vulnerable
<i>Geranium solanderi</i>	Solander's geranium	At Risk–Declining
<i>Cololejeuna falcidentata</i> (Glenny et al 2009)	Leafy liverwort	At Risk–Naturally Uncommon
<i>Doodia squarrosa</i> (<i>Blechnum zeelandicum</i>)	Rasp fern	At Risk–Naturally Uncommon
<i>Doodia mollis</i> (<i>Blechnum molle</i>)	Rasp fern	At Risk–Naturally Uncommon
<i>Libocedrus plumosa</i>	Kawaka, NZ cedar	At Risk–Naturally Uncommon
<i>Carex gaudichaudiana</i>		Regionally Uncommon
<i>Carex subdola</i>		Regionally Uncommon
<i>Coprosma propinqua</i> var. <i>propinqua</i>	Mingimingi	Regionally Uncommon
<i>Coprosma parviflora</i>	Leafy coprosma	Regionally Uncommon
<i>Coprosma rigida</i>		Regionally Uncommon
<i>Coprosma rotundifolia</i>		Regionally Uncommon
<i>Coprosma tenuicaulis</i>	Swamp coprosma	Regionally Uncommon
<i>Drosera binata</i>	Forked sundew	Regionally Uncommon
<i>Empodisma robustum</i>	Wire rush	Regionally Uncommon
<i>Myrsine divaricata</i>	Weeping mapou	Regionally Uncommon
<i>Neomyrtus pedunculata</i>	Rohutu	Regionally Uncommon
<i>Nestegis cunninghamii</i>	Black maire	Regionally Uncommon
<i>Pennantia corymbosa</i>	Kaikomako	Regionally Uncommon
<i>Plagianthus regius</i> subsp. <i>regius</i>	Lowland ribbonwood	Regionally Uncommon
<i>Prumnopitys taxifolia</i>	Matai, black pine	Regionally Uncommon
<i>Rubus schmidelioides</i> var. <i>schmidelioides</i>	Tataramoa	Regionally Uncommon
<i>Sophora microphylla</i>	Kōwhai	Regionally Uncommon
<i>Sparganium subglobosum</i>	Burr reed, Maru	Regionally Uncommon
<i>Sphagnum cristatum</i>	Sphagnum	Regionally Uncommon
<i>Viola lyalli</i>	NZ native violet	Regionally Uncommon

5.5 Threatened animal species

The Hikurangi floodplain is home to several threatened bird and fish species, which have been covered in detail elsewhere, e.g. Manning (2001), Price and Dean (2014) and references therein. These include the Threatened species: Australasian bittern (*Botaurus poiciloptilus*) and the At Risk species: banded rail (*Gallirallus philippensis assimilis*); North Island fernbird (*Bowdleria punctata vealeae*); spotless crake (*Porzana tabuensis tabuensis*); black mudfish (*Neochanna diversus*); and longfin eel (*Anguilla dieffenbachii*). Although other threatened, at

risk, and uncommon species have been recorded in the wider catchment, their distributions on the floodplain are not well known and require further survey (Price & Dean 2014).

Threatened and uncommon fauna noted during the survey were recorded on the individual plot sheets. These included Australasian bittern at Borrow Cut, and North Island fernbird and black mudfish at Otakairangi Swamp GPWMR and Wairua River GPWMR.

An interesting find was the native orb weaver spider (*Backobourkia brounii*) on a mānuka shrub at Otakairangi Swamp GPWMR near Plot OTW10. This is New Zealand's largest orb web spider and a new invertebrate record for the Hikurangi floodplain. The spider is not commonly collected with only a few specimens lodged in the New Zealand Arthropod Collection (G. Hall, Landcare Research, pers. comm., 2015). Although not listed as threatened, it is probably under threat of becoming locally uncommon because of the extensive loss of wetland habitat in the region.

5.6 Threats

Threats to the biodiversity values have been identified on a site by site basis and outlined in the individual remnant reports (Appendix 1). The major threats are summarised in Table 5. While all of the six threats listed apply to at least some remnants on private land (PRIV), four of the threats are also relevant to Public Conservation Land (PCL).

Table 5 Major threats and impacts on biodiversity values of Hikurangi floodplain remnants

Threat	Causative factor	Impacts/ Visual clues
Hydrological regime changes (PRIV, PCL)	Manmade structures, e.g. drains, stop banks, channelization, artificial oxbows & ponds, pumping stations, channels	Modifications to natural fluctuations, e.g. increased or decreased flooding, more stable water tables Lowered (or sometimes raised) water tables Drying out from drainage Increase in dryland plants
Domestic stock damage (PRIV)	Stock access to remnants via unfenced/poorly fenced remnants, or across temporarily dried out water bodies in times of drought	Browsing, trampling, pugging, bank erosion, increased sediment levels, & other physical damage. Loss of ground cover and understorey species and structure. Forest canopy collapse. Contributes to nutrient enrichment and increased bacterial levels of waterways, and weed invasion
Exotic plant invasion (PRIV, PCL)	Establishment, spread and dominance of undesirable invasive plants	Outcompete and displace native plants Can become overwhelmingly dominant and lower species diversity
Introduced feral animal damage (PRIV, PCL)	Feral animal browsing and predation of native fauna	Browsing &/or bark damage (possum, hares, rabbits) Seed predation (rats and mice) Substrate disturbance (pigs) Predation/ decreased numbers of native fauna (possums, rats, mustelids, introduced fish, cats, dogs)
Habitat loss (PRIV)	Vegetation clearance, fragmentation, development, fire, and other habitat loss	Small, fragmented remnants, and reduction in size over time Edge effects, e.g. loss of trees at edges. Lack of buffer zones Fencelines too close to or encroaching into remnants
Nutrient enrichment (PRIV, PCL)	Agriculturally-derived nutrient inputs, erosion, sedimentation, fire-derived nutrient inputs	Eutrophic water bodies including decreased water quality and clarity. Influx of weeds, often leading to less diverse and more productive communities.

5.7 General restoration opportunities

Opportunities for enhancement of biodiversity should focus on restoring representative examples of the full range of natural ecosystems and habitats that originally characterised the Hikurangi floodplain environment. Comparison of current wetland extent and type with historic baselines (Fig. 3, Table 2) indicate that all wetland types are poorly represented (<4% remaining) particularly bog, fen and marsh types. Therefore all remnants on the floodplain could be considered significant, and protection and restoration of as many as possible will help redress the biodiversity losses.

Recommendations for management and restoration to improve biodiversity outcomes have been provided for each site in Appendix 1. These are summarised in Table 6, together with applicability to remnants on private land (PRIV) and Public Conservation Land (PCL).

Table 6 Recommendations for improvement of biodiversity values of Hikurangi floodplain remnants

Recommendation	Management actions
Review hydrological options to reduce ecological impacts of the current hydrological regime (PRIV, PCL)	<p>Review hydrological options, in consultation with WDC, farmers and other stakeholders, to reduce the ecological impacts of the current hydrological regime, especially at the most important sites.</p> <p>Options include raising water tables by blocking drains, installing weirs or bunds, making drains shallower, and keeping water tables high in summer. Consider drains oriented at right angles to remnant margin rather than around perimeter.</p> <p>Restoring the natural fluctuations of the river-influenced hydrological regime is limited by the highly engineered Hikurangi Swamp Scheme.</p>
Prevent domestic stock access (PRIV)	<p>Ensure remnants are fully fenced and stock proof. Use of temporary (e.g. electric) fences may be needed around dried out or shallow water bodies in times of drought to prevent temporary access into remnants.</p>
Control of troublesome exotic plants (PRIV, PCL)	<p>Focus on control of troublesome transformer species, e.g. Chinese privet, shining privet, tradescantia, royal fern, and willow. Follow weed control immediately with native restoration plantings.</p> <p>Consider the use of biocontrol agents, e.g. tradescantia biocontrol beetles.</p>
Control of pests (PRIV, PCL)	<p>Establish integrated pest animal control programmes to control at least the major pest browsers and predators, e.g. possum, rats, mustelids, feral cats</p>
Prevent habitat loss (PRIV)	<p>Mechanisms to prevent further habitat loss include education of the value of biodiversity and associated ecosystem services, having farming ‘champions’ to showcase good environmental practice, assistance with fencing, weed control, and restoration plantings</p> <p>Propagate threatened/uncommon/missing species to supplement existing populations and establish new populations in suitable habitats</p>
Minimise nutrient enrichment (PRIV, PCL)	<p>Avoid or minimise nutrient inputs by using robust farm management practices, e.g. fertiliser application rates and timings, utilisation and restoration of wetlands (those boggy patches at the back of the farm) to remove nutrients before they enter waterways, constructing of sediment traps, minimising bank erosion, publicising best practice..</p>

General principles, additional to the recommendations and management actions listed in Table 6, to be considered for restoration of remnants, include expanding remnant size, connecting to nearby remnants to form corridors, particularly around water ways, linking up with riparian plantings, make them as wide as possible, and supplementing with restoration plantings. These considerations are particularly relevant to remnants that are fragmented and irregular in shape. Current restoration projects and plantings supported by Department of Conservation and Northland Regional Council, e.g. planting ‘bendy’ plants within the stop banks, threatened species management and monitoring, and other restoration projects, should be maintained and expanded where possible.

To help achieve improved outcomes for biodiversity, local landowners, land managers, schools, tertiary students, marae groups, whanau, hapū, community groups, and members of the public should be involved in the restoration and propagation programmes. In addition, hapū aspirations for restoration of cultural and other resources, e.g. flax, rongoa, weaving materials, tuna habitat, would help guide restoration priorities and sites. Cultural priorities will be detailed in a separate, proposed report as outlined in the introduction section.

5.8 Restoration priorities

Suggested priorities for restoration (immediate, future, high, low) by site, based on the nature and immediacy of threat to biodiversity values, are summarised in Table 7. For example, private land remnants with threatened plant populations were considered of immediate and mostly high priority. The table also lists the top priority management action for each site, however, this should be considered alongside other management recommendations listed in the schedule of natural areas (Appendix 1). For example, although fencing and/or stock-proofing of some remnants is a top priority, removing the disturbance regime may lead to rapid expansion of troublesome weeds, particularly tradescantia.

Table 7 Restoration priorities for natural areas on the Hikurangi floodplain

Natural Area	Land Status	Priority Rank	Priority Management Action
Borrow Cut	PCL	Future	Threatened plant management
Forsythe Meander	PCL/Private	Immediate	Ensure fences are stockproof
Heaton Road	Private	Immediate	Ensure fences are stockproof
Hikurangi Bush QEII	Private	Future	Control tradescantia
Jordan Valley Road	PCL	Future	Control privet
Matarau Island	PCL	Future	Threatened plant management
Otakairangi North	Private	Future: low	General maintenance
Otakairangi Swamp	PCL	Immediate: high	Bog restoration: see below
Otonga	Private	Immediate	Control tradescantia
Riponui Road	Private	Immediate	Ensure fences are stockproof
Waiotu	Private	Immediate	Ensure fences are stockproof
Wairua River	PCL	Immediate	Threatened plant management
Wairua River South	Private	Immediate	Fence off remnants
Whakapara North	Private	Immediate	Ensure fences are stockproof
Whakapara South	Private	Immediate: high	Control tradescantia
Whakapara West	Private	Immediate: high	Ensure fences are stockproof

Two specific projects have been identified for consideration as priorities. These are restoration of Otakairangi Swamp peat bog and developing best practice management techniques for control of tradescantia.

5.8.1 Restoration of Otakairangi Swamp

Otakairangi Swamp, although modified through drainage and burning, is the only bog remaining in the Hikurangi catchment. It was formerly a late successional *Sporadanthus ferrugineus* raised bog, which is now a threatened bog ecosystem with only three sites left in New Zealand, all in Waikato. *Sporadanthus* is an important peat-former (along with *Empodisma robustum*, which is presently scarce at Otakairangi Swamp) but is now locally extinct in Northland. It is highly susceptible to fire (Clarkson 1997) and was likely extirpated

from the site by an increased fire regime associated with post-European settlement land clearance phase.

Sporadanthus ferrugineus can be re-established at Otakairangi Swamp by raising the water table and re-introducing the plant and its commensal invertebrate *Houdinia flexilissima* from Waikato sources, e.g. Gamman peat mine site. The introductions will be underpinned by strong science and successful re-establishments of the populations at sites where they once occurred in the Waikato (e.g. Peters & Clarkson 2009; Clarkson et al. 2013; Watts et al. 2013). For example, preliminary data from this survey and species-environment models (Clarkson et al. 2004) suggest that local conditions (nutrients, pH, peat depth, etc.) in central parts of Otakairangi Swamp are suitable for *Sporadanthus* re-establishment.

The outcome will be a restored peat bog remnant representative of a threatened bog type once common in the region, in which key peat-forming species have been re-introduced, and peat-forming processes have re-established. The new populations of *Sporadanthus ferrugineus* and *Houdinia flexilissima*, both classified as At Risk – Relict, will provide a more sustainable future nationally for these species, as well as helping reverse post-European biodiversity decline on the Hikurangi floodplain.

Additionally, as part of the project, a small population of *S. ferrugineus* (and *H. flexilissima*) should be established in a publically accessible location. This will provide a showcase example of the bog type, which together with information panels, including interpretation of the bog history and links to the Otakairangi bog restoration project, would be important for public education and awareness. In both cases (Otakairangi bog restoration and showcase population), restoration plans will need to be developed in consultation with major stakeholders and hapū.

5.8.2 Tradescantia control

The Hikurangi floodplain contains many swamp and marsh forest remnants on private production land, and several on public conservation land. These fragments have been modified by three major regime shifts, which impact on biodiversity. First there has been an invasion by the weed *Tradescantia fluminensis*, which is self-propagating and prevents native seedling recovery.

Second, increased fencing of fragments has reduced or removed stock browsing, which, under most circumstances, would improve forest tree species recruitment. However, under the invaded regime, complete absence of stock browsing facilitates rampant growth of tradescantia. For example at Otonga Natural Area, two adjacent fenced remnants with different browsing regimes (one with occasional stock access, one with none) had significantly different vegetation covers and composition. The first remnant had a tradescantia cover of 30% and a groundcover species richness of 22 (Plot ONA2), whereas the stock-excluded remnant had 99% tradescantia cover and a total of only 4 species in the groundcover (Plot ONA1).

Third, the flooding regime has been altered by the installation of stop banks in the Hikurangi Swamp Scheme (fully operational c. 1970), and regular flooding formerly maintained the semi-open canopy favoured by the threatened vegetation types and species.

Each of these regime shifts may be addressed in a restoration experiment involving treatments of manual clearing (to emulate hydrological regime disturbance), specific browsing regimes, and introduction of a biological control agent, e.g. the stem-boring beetle *Lema basicostata*, against tradescantia. This approach will allow determination of the effectiveness of each (or combinations) of these interventions for breaking negative feedbacks, thus providing best practice management approaches for slowing or reversing the decline in natural habitat remnants.

A suitable restoration experiment needs to be designed and established following engagement and consultation with landowners, hapū, and other stakeholders. The field experiment will involve various treatments undertaken in a range of remnants on both privately-owned and public conservation lands.

5.9 Monitoring

Monitoring of ecological condition and trend is important for detecting and quantifying changes to assess the effectiveness of restoration efforts. It is also important for detecting negative changes so remedial action can be taken at the earliest opportunity. There are several tools and frameworks that are available for monitoring changes in a range of ecosystems, e.g. DOC monitoring toolbox <http://www.doc.govt.nz/get-involved/run-a-project/our-procedures-and-sops/biodiversity-inventory-and-monitoring>, forest monitoring and assessment kit (FORMAK) <http://www.formak.co.nz/webfolder.html>, regional council monitoring framework (Lee & Allen 2011), Wetland Condition Index (Clarkson et al. 2004), and wetland monitoring and assessment kit (WETMAK) <http://www.landcare.org.nz/wetmak>. Recommendations for monitoring, particularly for aquatic habitats, have also been presented in Price and Dean (2014).

Different restoration projects should incorporate specific monitoring approaches relevant to the ecosystem and aims of the project. Some simple indicators that should be considered for all projects include changes in remnant area, proportion of native versus exotic vegetation cover, native species richness, presence, and abundance of undesirable species, presence, abundance and condition of desirable/threatened species, and damage by domestic stock.

The data provided in the forest and wetland plots, species lists, and descriptions (Appendix 1) provide baselines for monitoring future changes.

The tradescantia experiment will have specific monitoring requirements, e.g. plant and invertebrate species responses to the different treatments, which should be incorporated into the restoration plan. Similarly, the Otakairangi Swamp project will have wetland-based monitoring requirements, e.g. WCI, nutrients, hydrology, wetland functioning, *Sporadanthus ferrugineus* and *Houdinia flexilissima* population monitoring, which should also be included in the restoration plan.

5.10 Workshop

A workshop for farmers, hapū, and key stakeholders was held on 5 June 2015 to brief participants about the project and to provide feedback on first impressions and to raise any concerns and questions. The project's recommendations and opportunities were well received (W. Holland, pers. comm., 2015); however, it was noted that although more than 30 stakeholders were present, very few local farmers were able to attend.

6 Conclusions

The Hikurangi floodplain is an important biodiversity hotspot, containing many threatened ecosystems, species, and habitats. However, urgent management and restoration is required to reverse the on-going gradual and insidious decline of biodiversity that has been occurring over many years. Significantly improved outcomes for diversity will require consultation and development of partnerships with local landowners, hapū, and other key stakeholders.

7 Recommendations

The following recommendations are summarised from the overall report, the individual natural area reports, and the restoration programmes and activities currently underway on the floodplain. The main recommendations are:

1. **Review hydrological options to reduce ecological impacts of the current hydrological regime** Consult Whangarei District Council, farmers and other stakeholders to review options. Raise and manage water tables where possible by blocking drains, installing weirs, shallowing drains and keeping water tables high in summer.
2. **Prevent stock access** Ensure remnants are fully fenced and stock-proof
3. **Control troublesome weeds** Focus on control of transformer weed species, e.g. tradescantia, privet, royal fern. Consider use of biocontrol agents, e.g. for tradescantia
4. **Control pests** Establish integrated control programmes for the major predators and browsers, e.g. possum, rats, mustelids
5. **Prevent habitat loss** Increase awareness of biodiversity values, engage farmer environmental 'champions', and assist with fencing, weed control, and restoration plantings
6. **Minimise nutrient inputs** Use robust farm management practices, construct sediment traps, minimise bank erosion, and publicise best practice.
7. **Expand remnant size and connectivity** Increase remnant viability by expanding remnant size, connecting with nearby remnants, creating corridors, linking with riparian plantings, and supplementing with restoration plantings.
8. **Support existing restoration projects** Maintain and supplement restoration and monitoring programmes currently underway, e.g. herbaceous plantings within stop

banks, other restoration projects, threatened species management, black mudfish and long fin eel monitoring programmes.

9. **Increase knowledge of important species distributions** Survey potential habitat for threatened/at risk/uncommon species by concentrating on areas around newly discovered populations, e.g. search for *Hebe* aff. *bishopiana* along the full range of river bank habitat associated with the Waiotu River (Waiotu Natural Area), and for *Pittosporum obcordatum* in semi-open forest and shrubland near the confluence of Whakapara and Waiotu Rivers.
10. **Increase important species populations** Supplement existing populations and establish new populations of threatened, at risk, uncommon and missing species. Where possible, involve landowners, land managers, students, hapū, marae, whanau, community groups, and members of the public in restoration and propagation programmes.
11. **Restore Otakairangi Swamp** Develop a restoration plan for re-establishing locally extirpated populations of *Sporadanthus ferrugineus* and its invertebrate commensal *Houdinia flexilissima*, and restore peat-forming processes, in both Otakairangi Swamp, and in a showcase population that will be accessible to the public.
12. **Control and manage tradescantia** Develop a field experiment for the long term control and management of tradescantia to increase biodiversity benefits, and establish the experiment in a range of forest remnants on both private and public conservation lands.

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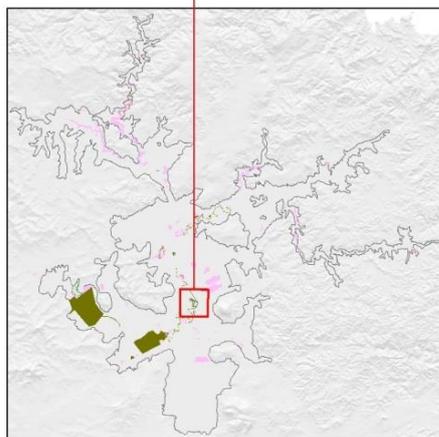
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Appendix 1 – Schedule of natural areas

1. BORROW CUT



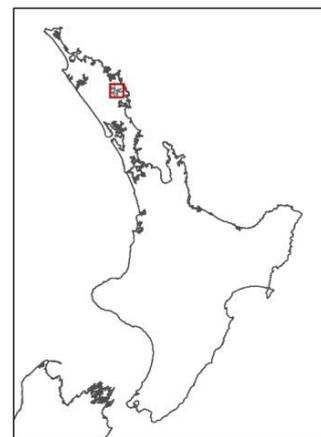
Legend

-  Public Conservation Land
-  Significant Natural Area
-  Additional Natural Area

Plots

-  Wetland, Protected
-  Wetland, Private Land
-  Non Area, Protected
-  Non Area, Private Land

Hikurangi Restoration



Location:

A relatively small remnant (c. 7.1 ha) located on the banks of a cut-off channel of the Wairua River, adjacent to the Tanekaha pumping station. It is Public Conservation Land designated as a marginal strip, which is managed by Whangarei District Council and leased to Northland Fish & Game. The Borrow Cut wetland is mainly excavated wetlands and ponds on the floodplain and an oxbow on the western side of the stop bank. It is referred to as the Tanekaha Pumping Station site in Townsend (2012). This survey concentrated on the 1–2 ha of natural habitat along and adjacent to the banks of the river channel.

Coordinates: E1713002 N6060092 (Plot BCNA1)

Vegetation Types:

- *Calystegia sepium*-*Cyperus ustulatus* vineland
- Kānuka-kahikatea-totara/mānuka-*Coprosma propinqua*-cabbage tree shrubland, including some planted shrubland
- *Eleocharis acuta*/*Altenanthera nahui*-*Centella uniflora*-*Viola lyalli* turf (very small areas on lower terrace by channel)
- Exotic herbfield and grassland (including rank pasture)
- Exotic aquatic herbfield (associated with excavated wetlands)
- Open water

Description:

Shrubby, patchy vegetation of mainly kānuka, mānuka, *Coprosma propinqua*, cabbage tree, kōwhai, *Myrsine divaricata*, Chinese privet, and blackberry, overtopped by scattered trees of totara and kahikatea, line the banks of the river channel. Species in the understorey and groundcover layers include *Coprosma pariviflora*, *Cyperus ustulatus*, *Calystegia sepium*, *Carex virgata*, and several exotic herbs and grasses such as tradescantia, *Galium palustre* and *Persicaria strigosa*.

Restoration plantings are being undertaken in the south-west corner, where a nationally important population of the threatened shrub, *Hebe* aff. *bishopiana* (Hikurangi Swamp), occurs (Townsend 2012). Occasional spraying and mulching of pest plants also occurs in this area.

The vegetation on the top of the terrace/floodplain is mainly exotic herbfield and grassland, and common species merges into the created pond/ aquatic habitats, also dominated by exotics. Common species include parrot's feather, *Potamogeton ochreatus*, *Egeria densa*, alligator weed, and pasture herbs and grasses.

Very small turf patches occur at the bottom of the terrace near the channel water's edge on the south-west corner. Several low herbaceous species are present such as *Altenanthera nahui*, *Centella uniflora*, *Viola lyalli*, *Hydrocotyle novae-zelandiae*, and *Dichondra repens*.

Significance:

The remnant is important because it contains a nationally important population of the threatened species, *Hebe* aff. *bishopiana* Hikurangi Swamp (nationally critical). Townsend

(2012) states that this site is one of only three sites nationally where the population can be considered “abundant” (the other sites are Wairua River GPWMR, and Matarau Island Scenic Reserve). It also has two adults of another threatened shrub, *Pittosporum obcordatum*, classified as nationally vulnerable. A larger population of *Pittosporum* comprising several adults and abundant seedlings (at the base of a female plant) occurs nearby, around the ox-bow created by the construction of the stop bank in the western half of the Tanekaha Pumping Station site.

The nationally At Risk – Naturally Uncommon herb *Geranium solanderi* was also recorded. Regionally significant species present include *Myrsine divaricata*, *Coprosma propinqua*, *Coprosma rigida*, *Coprosma parviflora*, *Viola lyalli*, and *Carex gaudichaudiana*.

The Threatened Australasian bittern (*Botaurus poiciloptilus*) was observed at the site, and the At Risk – Declining longfin eel (*Anguilla dieffenbachi*) is likely to be present.

Borrow Cut is the only New Zealand locality for the cress *Rorippa laciniata*, a new addition to the New Zealand flora (de Lange et al. 2009).

The remnant is classified as a Category 2 threatened land environment, which has 10–20% indigenous cover remaining (Cieraad et al. 2015).

Threats:

- Competition from invasive weeds, e.g. tradescantia, Chinese privet, blackberry. There is also a suite of aquatic weeds in wetter habitats; however, these habitats are mostly induced, and control of these invasives may be not be a priority if conservation values there are considered of lower significance.
- Competition from increased shading in threatened plant habitats associated with growth, development and canopy closure of surrounding vegetation. Both the *Pittosporum* and *Hebe* prefer more open, disturbed habitats, typical of banks and backswamps of rivers and streams. Historically, on the Hikurangi floodplain, these habitats were subject to regular disturbance caused by dynamic hydrological regimes associated with flooding of the Wairua River and its tributaries. Hydrological regimes have been substantially altered by river straightening, stop banks, and land drainage, so the more stable, drier overall conditions favour greater vegetation growth, thus promoting shading of lower layers. Increases in nutrients, derived from agriculture and better drained soils, may cause dense sward formation in ground cover vegetation, which also inhibits seedling recruitment.

Recommendations:

- Monitoring of invasive plant impacts and undertaking weed control if required, particularly around threatened plant populations.
- Monitoring of adverse changes in threatened plant habitat, e.g. too much shading or groundcover layer becoming too dense for successful seedling establishment. If this occurs, manual clearing of vegetation (native and exotic) may be required.
- Compile an inventory of threatened and regionally significant fauna species to inform restoration activities.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET

Site name: Borrow Cut **Date:** 28-Nov-14 **Plot no:** 1 (BCNA1)
Altitude: 95 m a.s.l. **GPS E:** 1713002 **N:** 6060092
Recorder: BRC, LF, SB, FG, NP **Veg structure:** Vineland
Composition¹: Calystegia – Cyperus **Canopy Mean hgt:** 0.8 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Calystegia sepium</i> *	40	1.9				<i>Cyperus ustulatus</i>	3	
<i>Cyperus ustulatus</i>	30	0.8				<i>Galium palustre</i> *	3	
<i>Cordyline australis</i>	5	5.9				<i>Coprosma propinqua</i>	2	
<i>Galium palustre</i> *	5					<i>Oenanthe pimpinelloides</i> *	2	
<i>Muehlenbeckia australis</i>	4	3.3				<i>Calystegia sepium</i> *	1	
<i>Hebe aff. bishopiana</i>	3	2.8				<i>Carex virgata</i>	0.5	
<i>Carex longii</i> *	2					<i>Lotus pedunculatus</i> *	0.5	
<i>Coprosma propinqua</i>	2	2.6				<i>Persicaria strigosa</i> *	0.5	
<i>Coprosma rigida</i>	2					<i>Sonchus oleraceus</i> *	0.5	
<i>Alopecurus geniculatus</i> *	1					<i>Tradescantia fluminensis</i> *	0.5	
<i>Carex virgata</i>	1					<i>Watsonia</i> sp.	0.5	
<i>Cyperus eragrostis</i> *	1							
<i>Lotus pedunculatus</i> *	1							
<i>Oenanthe pimpinelloides</i> *	1							
<i>Rubus fruticosus</i> *	1							
<i>Persicaria strigosa</i> *	0.5							

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: On lower terrace and bank by channel.

BORROW CUT PLANT SPECIES LIST

Species	CommonName	Status
<i>Adiantum hispidulum</i>	Rosy maidenhair	Non-endemic
<i>Alopecurus geniculatus</i> *	Kneed foxtail	Exotic
<i>Alternanthera nahui</i>		Non-endemic
<i>Alternanthera philoxeroides</i> *	Alligator weed	Exotic
<i>Anagallis arvensis</i> *	Blue pimpernel	Exotic
<i>Anthoxanthum odoratum</i> *	Sweet vernal	Exotic
<i>Bidens frondosa</i> *	Beggars' ticks	Exotic
<i>Blechnum membranaceum</i>		Endemic
<i>Blechnum novae-zelandiae</i>	Horokio	Endemic

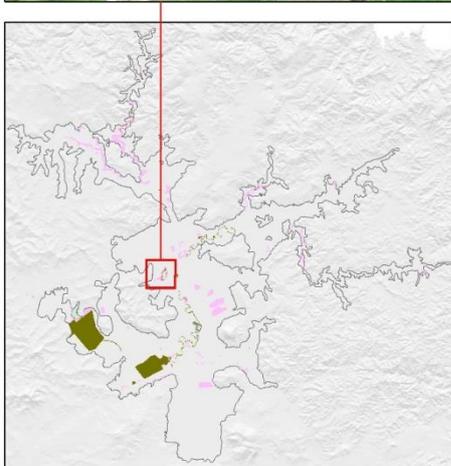
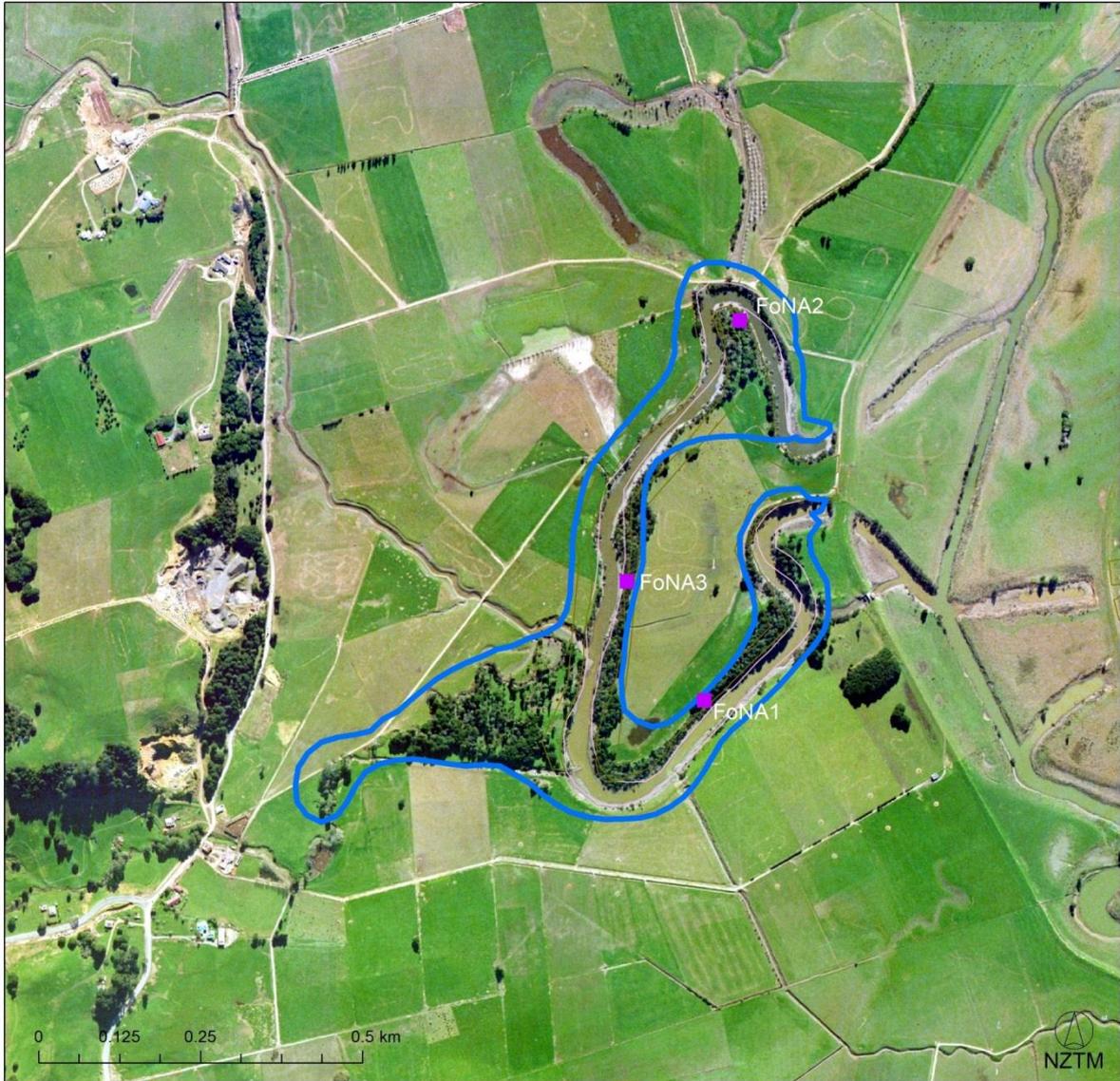
<i>Calystegia sepium*</i>	Akapōhue	Exotic
<i>Cardamine debilis</i>	New Zealand bitter cress	Endemic
<i>Carex gaudichaudiana</i>		Non-endemic
<i>Carex lessoniana</i>	Cutty grass	Endemic
<i>Carex longii*</i>		Exotic
<i>Carex ovalis*</i>	Oval sedge	Exotic
<i>Carex</i> sp.		
<i>Carex virgata</i>	Swamp sedge	Endemic
<i>Centella uniflora</i>	Centella	Non-endemic
<i>Conyza albida*</i>	Broad-leaved fleabane	Exotic
<i>Coprosma ×cunninghamii</i>		Endemic
<i>Coprosma parviflora</i>	Leafy coprosma	Endemic
<i>Coprosma propinqua</i>	Miki, Mingimingi	Endemic
<i>Coprosma rigida</i>		Endemic
<i>Cordyline australis</i>	Cabbage tree	Endemic
<i>Crepis capillaris*</i>	Smooth hawksbeard	Exotic
<i>Cyperus eragrostis*</i>	Puketangata	Exotic
<i>Cyperus ustulatus</i>	Coastal cutty grass	Endemic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Deparia petersenii</i>	Japanese lady fern	Indigenous
<i>Dichondra repens</i>	Creeping dichondra	Non-endemic
<i>Doodia australis (Blechnum parrisiae)</i>		Indigenous
<i>Egeria densa*</i>	Dense waterweed	Exotic
<i>Eleocharis acuta</i>	Club rush	Non-endemic
<i>Euonymus japonicus*</i>	Japanese spindle tree	Exotic
<i>Galium palustre*</i>	Marsh bedstraw	Exotic
<i>Geranium robertianum*</i>	Herb Robert	Exotic
<i>Geranium solanderi</i>	Matua-kūmara	Non-endemic
<i>Haloragis erecta</i>	Shrubby haloragis	Endemic
<i>Hebe</i> aff. <i>bishopiana</i>		Endemic
<i>Hedycarya arborea</i>	Pigeonwood, Kaiwhiri	Endemic
<i>Histiopteris incisa</i>	Histiopteris	Non-endemic
<i>Holcus lanatus*</i>	Yorkshire fog	Exotic
<i>Hydrocotyle novae-zeelandiae</i>		Endemic
<i>Juncus dichotomus*</i>		Exotic

<i>Juncus sarophorus</i>	Leafless rush	Non-endemic
<i>Juncus usitatus</i>	Common rush	Non-endemic
<i>Kunzea robusta (K. ericoides)</i>	Kānuka	Endemic
<i>Lachnagrostis filiformis</i>	New Zealand wind grass	Non-endemic
<i>Lactuca serriola*</i>	Prickly lettuce	Exotic
<i>Lastreopsis glabella</i>	Smooth shield fern	Endemic
<i>Leontodon taraxacoides*</i>	Hairy hawkbit	Exotic
<i>Leptospermum scoparium</i>	Mānuka	Non-endemic
<i>Leucopogon fasciculatus</i>	Hukihukiraho	Endemic
<i>Ligustrum sinense*</i>	Chinese privet	Exotic
<i>Lonicera japonica*</i>	Japanese honeysuckle	Exotic
<i>Lotus pedunculatus*</i>	Lotus	Exotic
<i>Ludwigia palustris*</i>	Water purslane	Exotic
<i>Melicytus micranthus</i>	Manakura	Endemic
<i>Microlaena stipoides</i>	Meadow rice grass	Non-endemic
<i>Microsorium pustulatum</i>		Indigenous
<i>Muehlenbeckia australis</i>	Large-leaved muehlenbeckia	Non-endemic
<i>Myriophyllum aquaticum*</i>	Brazilian water milfoil	Exotic
<i>Myriophyllum propinquum</i>	Common water milfoil	Non-endemic
<i>Myrsine divaricata</i>	Weeping mapou	Endemic
<i>Nitella cristata</i>		
<i>Oenanthe pimpinelloides*</i>	Parsley dropwort	Exotic
<i>Ottelia ovalifolia*</i>	Swamp lily	Exotic
<i>Oxalis exilis</i>	Creeping oxalis	Non-endemic
<i>Parsonsia heterophylla</i>	Akakaikiore	Endemic
<i>Pennisetum clandestinum*</i>	Kikuyu grass	Exotic
<i>Persicaria decipiens</i>		Non-endemic
<i>Persicaria strigosa*</i>		Exotic
<i>Phormium tenax</i>	Flax	Endemic
<i>Phytolacca octandra*</i>	Dyeberry	Exotic
<i>Pittosporum obcordatum</i>	Heart-leaved kohukohu	Endemic
<i>Plantago lanceolata*</i>	English plantain	Exotic
<i>Podocarpus totara</i>	Totara	Endemic
<i>Potamogeton ochreatus</i>	Blunt pondweed	Non-endemic
<i>Prunus campanulata*</i>	Bell-flowered cherry	Exotic

<i>Pteris tremula</i>	Australian bracken	Indigenous
<i>Quercus palustris</i> *	Pin oak	Exotic
<i>Ranunculus repens</i> *	Creeping buttercup	Exotic
<i>Rorippa laciniata</i> (de Lange et al. 2009)	Cress	Non-endemic
<i>Rubus cissoides</i>	Bush lawyer	Endemic
<i>Rubus fruticosus</i> *	Blackberry	Exotic
<i>Rumex obtusifolius</i> *	Broad-leaved dock	Exotic
<i>Schoenus maschalinus</i>	Dwarf bog rush	Non-endemic
<i>Senecio bipinnatisectus</i> *	Australian fireweed	Exotic
<i>Solanum nodiflorum</i>		Non-endemic
<i>Sonchus asper</i> *	Kautara	Exotic
<i>Sonchus oleraceus</i> *	Common sow thistle	Exotic
<i>Sophora microphylla</i>	Kōwhai	Endemic
<i>Tradescantia fluminensis</i> *	Tradescantia, Wandering Jew	Exotic
<i>Ulex europaeus</i> *	Gorse	Exotic
<i>Verbena bonariensis</i> *	Purple-top	Exotic
<i>Viola lyallii</i>	Hāka	Endemic
<i>Watsonia meriana</i> .*	Watsonia	Exotic
<i>Weinmannia silvicola</i>	Tawhero	Endemic

2. FORSYTHE MEANDER

Forsythe Meander



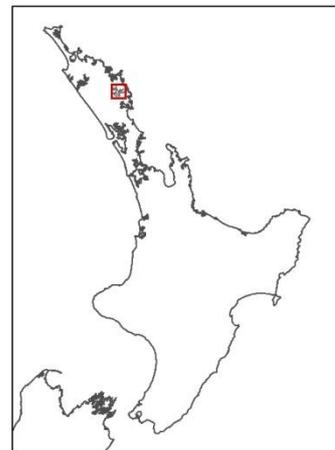
Legend

- Public Conservation Land
- Significant Natural Area
- Additional Natural Area

Plots

- Wetland, Protected
- Wetland, Private Land
- Non Area, Protected
- Non Area, Private Land

Hikurangi Restoration



Location:

This is a ribbon-shaped remnant (c. 18.3 ha) lining the banks of a small oxbow, which was formed as a result of straightening and stop-banking of the Wairua River (Hikurangi Swamp Scheme). The oxbow is fed by small streams but is essentially cut-off from the influence of the Wairua River. The remnant is Public Conservation Land, which on the south-western corner adjoins a slightly larger pocket of forest on private land (included in total area).

Coordinates: E1710970 N6063327 (Plot FONA3)

Vegetation Types:

- Totara forest
- Kānuka treeland

Description:

The remnant comprises a narrow strip of riparian forest and treeland lining the banks of the oxbow, particularly on the true left side. Totara is the dominant species; however, the canopy is typically uneven and is made up of a variety of species. These include lowland ribbonwood, kōwhai, kānuka, mānuka, kahikatea, *Coprosma areolata*, Chinese privet, *Melicope simplex*, *Melicytus micranthus*, and kawaka. White maire is also present, including one large individual with a diameter of 1.18 m.

The understorey consists of most of the above-listed species, along with pigeonwood, *Coprosma rigida*, and *Solanum pseudocapsicum*. The invasive weed, tradescantia is by far the most dominant groundcover; however, occasional seedlings of native trees and shrubs are scattered throughout, along with exotic species such as Chinese privet, and pasture herbs and grasses.

Significance:

The riparian forest remnant is important for protecting the oxbow from sediment and nutrient inputs through stabilising the banks and attenuating agriculturally derived nutrients. It has a relatively large number of species for its size, including one nationally at risk species, kawaka (on the northern alluvial terrace; Plot FONA2), and several regionally uncommon species, e.g, *Myrsine divaricata*, *Melicytus micranthus*, *Coprosma propinqua*, *Coprosma rigida*, *Coprosma parviflora*, *Coprosma rotundifolia*, *Carex subdola*, and kōwhai.

The remnant is classified as a Category 1 threatened land environment, which has <10% indigenous cover remaining (Cieraad et al. 2015).

Threats:

- Stock access and erosion. The forest remnant is protected by a fence but this is not entirely stockproof. Stock can access the remnant through gaps underneath the fence wires where they span small erosion gullies. Several areas of soil erosion were noted, and some fences had been compromised by bank collapse where set-backs are not wide enough.

- Fragmentation and reduction in size of the remnant. Loss of trees on the margins has occurred over the past decade or so (see Manning 2001) and several recently dead trees (including one white maire) were noted. These were mostly outside of the fence and thus have been exposed to damage by cattle
- Several invasive weed species are present, particularly tradescantia, Chinese privet, *Solanum pseudocapsicum*. Alligator weed and parrot’s feather were growing in the shallow water on the forest–oxbow margins.

Recommendations:

- Ensure fences are stockproof on the pasture/remnant boundary.
- Increase set-back widths between the pasture and the remnant, and plant up areas to improve riparian function and minimise erosion.
- Survey adjoining remnant on private land (unable to be accessed at time of visit) and assess combined restoration potential.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET

Site name: Forsythe Meander **Date:** 25-Nov-14 **Plot no:** 1 (FONA1)
Altitude: 95 m a.s.l. **GPS E:** 1711089 **N:** 6063142
Recorder: BRC, SB, LF, FC **Veg structure:** Forest **Composition¹:** Totara
Canopy Mean hgt: 14 m

Canopy (bird’s eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Podocarpus totara</i>	70	15	<i>Coprosma areolata</i>	10	5	<i>Tradescantia fluminensis</i> *	92	
<i>Plagianthus regius</i>	15	12	<i>Melicope simplex</i>	3	5	<i>Bidens frondosa</i> *	0.5	
<i>Ligustrum sinense</i> *	8	8	<i>Coprosma propinqua</i>	1		<i>Gladiolus dalenii</i> *	0.5	
<i>Coprosma areolata</i>	7	8	<i>Ligustrum sinense</i> *	1	5	<i>Ligustrum sinense</i> *	0.5	
<i>Sophora microphylla</i>	7	10	<i>Solanum pseudocapsicum</i> *	1	0.7	<i>Melicytus micranthus</i>	0.5	
			<i>Melicytus micranthus</i>	0.5		<i>Muehlenbeckia australis</i>	0.5	
			<i>Myrsine divaricata</i>	0.5		<i>Myrsine divaricata</i>	0.5	
			<i>Pyrrosia eleagnifolia</i>	0.5		<i>Oenanthe pimpinelloides</i> *	0.5	
			<i>Rubus australis</i>	0.5		<i>Plagianthus regius</i>	0.5	
			<i>Streblus heterophyllus</i>	0.5	5	<i>Podocarpus totara</i>	0.5	

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: On edge of paddock – alluvial flat going down to oxbow.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET**Site name:** Forsythe Meander**Date:** 25-Nov-14**Plot no:** 2 (FONA2)**Altitude:** 95 m a.s.l.**GPS E:** 1710970**N:** 6063327**Recorder:** BRC, SB, LF, FC**Veg structure:** Forest**Composition¹:** Kānuka**Canopy Mean hgt:** 10 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Kunzea robusta</i>	45	12	<i>Coprosma areolata</i>	10	8	<i>Tradescantia fluminensis*</i>	80	
<i>Podocarpus totara</i>	15	15	<i>Hedycarya arborea</i>	10		<i>Kunzea robusta</i>	45	12
<i>Sophora microphylla</i>	7	11	<i>Melicope simplex</i>	10	8	<i>Podocarpus totara</i>	15	15
<i>Melicope simplex</i>	5	8	<i>Libocedrus plumosa</i>	3	7.2	<i>Sophora microphylla</i>	7	11
<i>Plagianthus regius</i>	5	11	<i>Podocarpus totara</i>	1		<i>Melicope simplex</i>	5	8
<i>Coprosma areolata</i>	2	8	<i>Muehlenbeckia australis</i>	0.5		<i>Plagianthus regius</i>	5	11
<i>Hedycarya arborea</i>	2	8	<i>Parsonsia heterophylla</i>	0.5		<i>Coprosma areolata</i>	2	8
<i>Libocedrus plumosa</i>	2	5.8	<i>Pyrrhosia eleagnifolia</i>	0.5		<i>Hedycarya arborea</i>	2	8
			<i>Ripogonum scandens</i>	0.5		<i>Libocedrus plumosa</i>	2	5.8
			<i>Rubus schmidelioides</i>	0.5		<i>Coprosma areolata</i>	0.5	
			<i>Solanum pseudocapsicum*</i>	0.5		<i>Galium aparine*</i>	0.5	
						<i>Holcus lanatus*</i>	0.5	
						<i>Muehlenbeckia australis</i>	0.5	

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: goldfinch, fantail, house sparrow, harrier. Privet nearby, grazed, uneven canopy – cattle damage. Dead white maire outside fence.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET

Site name: Forsythe Meander **Date:** 25-Nov-14 **Plot no:** 3 (FONA3)
Altitude: 90 m a.s.l. **GPS E:** 1710970 **N:** 6063327
Recorder: BRC, SB, LF, FC **Veg structure:** Treeland **Composition¹:** Kānuka
Canopy Mean hgt: 6 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Ligustrum sinense</i> *	8	5	<i>Leptospermum scoparium</i>	5		<i>Tradescantia fluminensis</i> *	60	
<i>Melicytus micranthus</i>	8	4.5	<i>Ligustrum sinense</i> *	20		<i>Holcus lanatus</i> *	5	
<i>Tradescantia fluminensis</i> *	7	0.2	<i>Coprosma propinqua</i>	2		<i>Microlaena stipoides</i>	2	
<i>Kunzea robusta</i>	60	8	<i>Muehlenbeckia australis</i>	2		<i>Carex lambertiana</i>	0.5	
<i>Leptospermum scoparium</i>	15	6	<i>Melicytus micranthus</i>	15		<i>Carex virgata</i>	0.5	
			<i>Solanum pseudocapsicum</i> *	10		<i>Dacrycarpus dacrydioides</i>	0.5	
			<i>Coprosma rigida</i>	0.5		<i>Haloragis erecta</i>	0.5	
						<i>Juncus distegus</i>	0.5	
						<i>Ligustrum sinense</i> *	0.5	
						<i>Muehlenbeckia australis</i>	0.5	
						<i>Oenanthe pimpinelloides</i> *	0.5	

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: Fantail. Grazed

FORSYTHE MEANDER PLANT SPECIES LIST

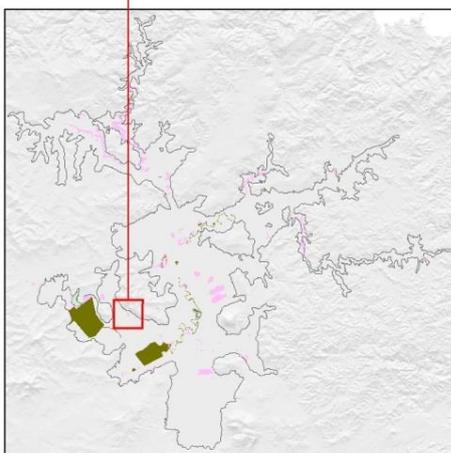
Species	CommonName	Status
<i>Alopecurus geniculatus</i> *	kneed foxtail	Exotic
<i>Alternanthera philoxeroides</i> *	Alligator weed	Exotic
<i>Anthoxanthum odoratum</i> *	sweet vernal	Exotic
<i>Bidens frondosa</i> *	Beggars' ticks	Exotic
<i>Bromus sp.</i> *	Brome	Exotic
<i>Bromus willdenowii</i> *	prairie grass	Exotic
<i>Calystegia sepium</i> *	Akapōhue	Exotic
<i>Cardamine debilis</i>	New Zealand bitter cress	Endemic
<i>Carex demissa</i> *	European yellow sedge	Exotic
<i>Carex lambertiana</i>		Endemic
<i>Carex ovalis</i> *	Oval sedge	Exotic
<i>Carex sp.</i>		

<i>Carex subdola</i>		Endemic
<i>Carex virgata</i>	Swamp sedge	Endemic
<i>CollospERMUM hastatum</i>	Kahakaha	Endemic
<i>Coprosma x cunninghamii</i>		Endemic
<i>Coprosma areolata</i>	Aruhe	Endemic
<i>Coprosma parviflora</i>	Leafy coprosma	Endemic
<i>Coprosma propinqua</i>	Miki, Mingimingi	Endemic
<i>Coprosma rhamnoides</i>		Endemic
<i>Coprosma rigida</i>		Endemic
<i>Coprosma rotundifolia</i>	Round-leaved coprosma	Endemic
<i>Cordyline australis</i>	Cabbage tree	Endemic
<i>Cortaderia selloana*</i>	Pampas grass	Exotic
<i>Corynocarpus laevigatus</i>	Karaka	Endemic
<i>Cynodon dactylon*</i>	Bermuda grass	Exotic
<i>Cyperus eragrostis*</i>	Puketangata	Exotic
<i>Cyperus ustulatus</i>	Coastal cutty grass	Endemic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Dactylis glomerata*</i>	cocksfoot	Exotic
<i>Dichondra repens</i>	Creeping dichondra	Non-endemic
<i>Doodia media</i>	Pukupuku	Non-endemic
<i>Eleocharis acuta</i>		Non-endemic
<i>Galium aparine*</i>	Cleavers	Exotic
<i>Gladiolus dalenii*</i>	Gladiolus	Exotic
<i>Haloragis erecta</i>	Shrubby haloragis	Endemic
<i>Hedycarya arborea</i>	Pigeonwood, Kaiwhiri	Endemic
<i>Holcus lanatus*</i>	Yorkshire fog	Exotic
<i>Juncus distegus</i>	Leafless rush	Endemic
<i>Juncus edgariae</i>		Endemic
<i>Kunzea robusta (K. ericoides)</i>	Kānuka	Endemic
<i>Lapsana communis*</i>	nipplewort	Exotic
<i>Leptospermum scoparium</i>	Mānuka	Non-endemic
<i>Libocedrus plumosa</i>	Kawaka, Cedar (NZ)	Endemic
<i>Ligustrum sinense*</i>	Chinese privet	Exotic
<i>Melicope simplex</i>	Poataniwha	Endemic
<i>Melicytus micranthus</i>	Manakura	Endemic
<i>Melicytus ramiflorus</i>	Hinahina	Non-endemic
<i>Microlaena stipoides</i>	Meadow rice grass	Non-endemic
<i>Muehlenbeckia australis</i>	Large-leaved muehlenbeckia	Non-endemic
<i>Myosotis laxa</i> subsp. <i>caespitosa*</i>	Water forget-me-not	Exotic
<i>Myriophyllum aquaticum*</i>	Brazilian water milfoil	Exotic
<i>Myrsine divaricata</i>	Weeping mapou	Endemic
<i>Nestegis lanceolata</i>	White maire	Endemic
<i>Oenanthe pimpinelloides*</i>	Parsley dropwort	Exotic

<i>Oplismenus imbecillis</i>		Non-endemic
<i>Oxalis exilis</i>	Creeping oxalis	Non-endemic
<i>Parsonsia heterophylla</i>	Akakaikiore	Endemic
<i>Passiflora tetrandra</i>	Aka	Endemic
<i>Pennisetum clandestinum</i> *	kikuyu grass	Exotic
<i>Persicaria hydropiper</i> *		Exotic
<i>Phormium tenax</i>	Flax, Harakeke	Endemic
<i>Plagianthus regius</i>	Lowland ribbonwood, Manatu	Endemic
<i>Plantago lanceolata</i> *	English plantain	Exotic
<i>Podocarpus totara</i>	Totara, Amoka	Endemic
<i>Polygonum strigosum</i> *		Exotic
<i>Prumnopitys taxifolia</i>	Black pine	Endemic
<i>Pyrrosia eleagnifolia</i>	Leather-leaf fern	Endemic
<i>Ripogonum scandens</i>	Akapirita	Endemic
<i>Rubus australis</i>	Bush lawyer	Endemic
<i>Rubus fruticosus</i> *	Blackberry	Exotic
<i>Rubus schmidelioides</i>	Bush lawyer	Endemic
<i>Rumex sp.</i> *	Dock	Exotic
<i>Rumex acetosa</i> *	Common sorrel	Exotic
<i>Senecio bipinnatisectus</i> *	Australian fireweed	Exotic
<i>Solanum nodiflorum</i>		Non-endemic
<i>Solanum pseudocapsicum</i> *	Christmas cherry	Exotic
<i>Sonchus oleraceus</i> *	Common sow thistle	Exotic
<i>Sophora microphylla</i>	Kōwhai	Endemic
<i>Streblus heterophyllus</i>	Ewekuri	Endemic
<i>Tradescantia fluminensis</i> *	Tradescantia, Wandering Jew	Exotic
<i>Ulex europaeus</i> *	Gorse	Exotic
<i>Zantedeschia aethiopica</i> *	Arum lily	Exotic

3. HEATON ROAD

Heaton Road



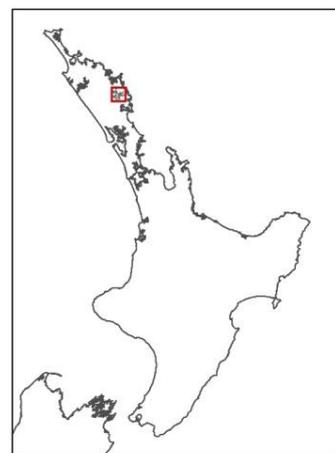
Legend

- Public Conservation Land
- Significant Natural Area
- Additional Natural Area

Plots

- Wetland, Protected
- Wetland, Private Land
- Non Area, Protected
- Non Area, Private Land

Hikurangi Restoration



Location:

A small patch of forest (c. 2.4 ha) on the floodplain immediately west of Heaton Road, about 3 km south of the Heaton Road – Riponui Road intersection.

Coordinates: E1708941 N6060153 (Plot HRNA1)

Vegetation Types:

- Totara-kahikatea-titoki forest

Description:

The forest remnant is dominated by totara, kahikatea (particularly common on the western margin), with titoki, tawa and taraire locally common. Although the canopy is quite diverse and intact, the understorey is very sparse, with few shrubs, saplings and seedlings present. The ground cover comprises locally common native grasses (*Microleana stipoides* and *Oplismenus imbecillus*), but a wide range of exotic species are also present. The remnant is fenced; however, the current vegetation composition and structure indicate that stock have regular access. No *Tradescantia fluminensis* (a troublesome weed) was recorded.

Significance:

The remnant is a representative example of the lowland floodplain forest ecosystem, now uncommon in the region and throughout New Zealand. It contains a good variety of forest canopy species, including species not typical in the other floodplain remnants surveyed, e.g. tawa, taraire, titoki, and kohekohe. The tree species composition indicates affinities with the adjacent hillslope forest (east of Heaton Road). Two threatened species were also recorded, the small rasp ferns, *Doodia squarrosa* (synonym: *Blechnum zeelandicum*) and *Doodia mollis* (syn: *Blechnum molle*), both classified as At Risk – Nationally Uncommon.

The remnant is classified as mainly threatened land environment Category 1 (2.2 ha), which has <10% indigenous cover remaining, with a minor amount to the north (<0.3 ha) of Category 4 (>30% indigenous cover and <10% protected) (Cieraad et al. 2015).

Threats:

- The main threat is cattle access into the remnant, which has resulted in the sparse understorey layers and lack of regeneration of trees and shrubs.
- A few weed species are present, which have the potential to degrade the remnants, in particular Chinese privet. In the long term, the lack of canopy recruitment (seedlings, saplings, and small trees) will lead to canopy collapse and degradation of the remnant.

Recommendations:

- Ensure fences are stockproof and keep stock out of remnant. Because the canopy is still essentially intact, regeneration of replacement species should be relatively rapid.
- Control of Chinese privet. Control of other weeds if they start spreading.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET**Site name:** Heaton Road**Date:** 19-Feb-15**Plot no:** 1 (HRNA1)**Altitude:** 98 m a.s.l.**GPS E:** 1708941**N:** 6060153**Recorder:** BC, KH, SB, FG**Veg structure:** Forest**Composition¹:** totara-kahikatea-titoki**Canopy Mean hgt:** 22 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Podocarpus totara</i>	40	22	<i>Beilschmiedia tarairi</i>	20	9.5	<i>Podocarpus totara</i>	40	22
<i>Dacrycarpus dacrydioides</i>	25	25	<i>Podocarpus totara</i>	16	8.5	<i>Dacrycarpus dacrydioides</i>	25	25
<i>Alectryon excelsus</i>	20	21	<i>Pyrrosia eleagnifolia</i>	1	21	<i>Alectryon excelsus</i>	20	21
<i>Beilschmiedia tarairi</i>	12	21	<i>Collospermum hastatum</i>	<1	8	<i>Beilschmiedia tarairi</i>	12	21
<i>Beilschmiedia tawa</i>	3	21				<i>Beilschmiedia tawa</i>	3	21

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: Outside part – west is kahikatea. Kereru and uleodon (vagrant) spider recorded.

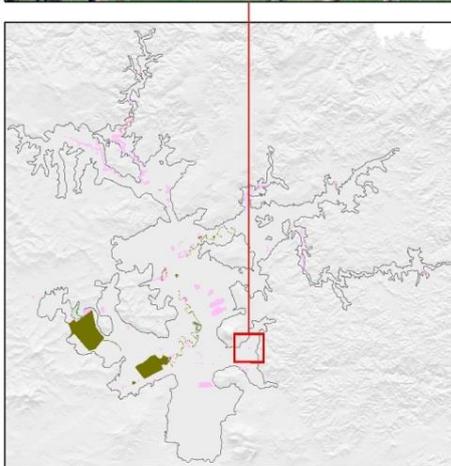
HEATON ROAD PLANT SPECIES LIST

Species	CommonName	Status
<i>Agrostis stolonifera</i> *	Creeping bent	Exotic
<i>Alectryon excelsus</i>	Titoki, New Zealand oak	Endemic
<i>Beilschmiedia tarairi</i>	Taraire	Endemic
<i>Beilschmiedia tawa</i>	Tawa	Endemic
<i>Berberis glaucocarpa</i> *	Barberry	Exotic
<i>Bidens frondosa</i> *	Beggars' ticks	Exotic
<i>Blechnum novae-zelandiae</i>	Horokio	Endemic
<i>Callitriche muelleri</i>	Starwort	Non-endemic
<i>Carex lambertiana</i>		Endemic
<i>Cirsium vulgare</i> *	Boar thistle	Exotic
<i>Collospermum hastatum</i>	Kahakaha	Endemic
<i>Coprosma rhamnoides</i>		Endemic
<i>Coprosma spathulata</i>		Endemic
<i>Cordyline australis</i>	Cabbage tree	Endemic
<i>Cyathea dealbata</i>	Ponga, Silver fern	Endemic
<i>Cyperus eragrostis</i> *	Puketangata	Exotic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Dactylis glomerata</i> *	Cocksfoot	Exotic
<i>Deparia petersenii</i>	Japanese lady fern	Indigenous
<i>Diplazium australe</i>		Indigenous

<i>Doodia australis</i> (<i>Blechnum parrisiae</i>)		Indigenous
<i>Doodia mollis</i> (<i>Blechnum molle</i>)	Mokimoki	Indigenous
<i>Doodia squarrosa</i> (<i>Blechnum zeelandicum</i>)		Indigenous
<i>Dysoxylum spectabile</i>	Kohekohe	Endemic
<i>Euphorbia peplus</i> *	Kaikaiatua	Exotic
<i>Galium palustre</i> *	Marsh bedstraw	Exotic
<i>Glyceria maxima</i> *	Reed sweetgrass	Exotic
<i>Isolepis habra</i>		Non-endemic
<i>Isolepis sepulcralis</i> *		Exotic
<i>Juncus tenuis</i> *	Track rush	Exotic
<i>Lapsana communis</i> *	Nipplewort	Exotic
<i>Lastreopsis glabella</i>	Smooth shield fern	Endemic
<i>Ligustrum sinense</i> *	Chinese privet	Exotic
<i>Mentha pulegium</i> *	European pennyroyal mint	Exotic
<i>Microlaena stipoides</i>	Meadow rice grass	Non-endemic
<i>Muehlenbeckia australis</i>	Large-leaved muehlenbeckia	Non-endemic
<i>Myrsine australis</i>	Māpau, red matipo	Endemic
<i>Oenanthe pimpinelloides</i> *	Parsley dropwort	Exotic
<i>Oplismenus imbecillis</i>		Non-endemic
<i>Oxalis exilis</i>	Creeping oxalis	Non-endemic
<i>Parsonsia heterophylla</i>	New Zealand jasmine	Endemic
<i>Persicaria hydropiper</i> *		Exotic
<i>Podocarpus totara</i>	Totara	Endemic
<i>Prunella vulgaris</i> *	Self-heal	Exotic
<i>Pyrrhosia eleagnifolia</i>	Leather-leaf fern	Endemic
<i>Ranunculus repens</i> *	Creeping buttercup	Exotic
<i>Rumex conglomeratus</i> *	Clustered dock	Exotic
<i>Senecio bipinnatisectus</i> *	Australian fireweed	Exotic
<i>Senecio jacobaea</i> *	Ragwort	Exotic
<i>Solanum nigrum</i> *	Black nightshade	Exotic
<i>Solanum nodiflorum</i>		Non-endemic
<i>Streblus heterophyllus</i>	Small-leaved milk tree, Turepo	Endemic
<i>Trifolium repens</i> *	White clover	Exotic
<i>Usnea</i> sp.	Lichen	Non-endemic
<i>Vulpia</i> sp.*		Exotic

4. HIKURANGI BUSH QEII

Hikurangi Bush QEII



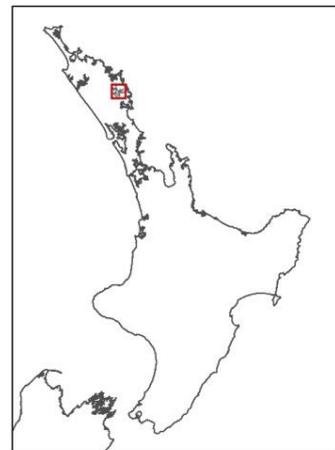
Legend

- Public Conservation Land
- Significant Natural Area
- Additional Natural Area

Plots

- Wetland, Protected
- Wetland, Private Land
- Non Area, Protected
- Non Area, Private Land

Hikurangi Restoration



Location:

A small forested remnant (1.5 ha) located on floodplain near the corner between Jordan Valley Road and State Highway 1, and bounded to the north by Mangawhero Stream. The site is protected by a Queen Elizabeth II National Trust Covenant and owned by Fonterra.

Coordinates: E1716141 N6058980 (Plot HikNA1)

Vegetation Types:

- Totara forest
- Kahikatea–totara (eastern margin)

Description:

The remnant comprises tall forest (up to 24 m in height) dominated by totara, with kahikatea becoming prominent towards the eastern margin. Other tree species included rimu, titoki, taraire, pukatea, kānuka, and *Ackama rosifolia* (one unthrifty individual on southern margin). The understorey consists of species more typical of hillslope (rather than flood plain) forests, e.g. hangehange, karaka, māpau, kawakawa, kohuhu, karamu, mamaku, silver fern, puriri (naturalised), and *Coprosma rhamnoides*. Tradescantia was the overwhelmingly dominant species in the ground cover, often attaining more than 90% cover in most places. Because of this, very few other species were present apart from occasional seedlings of kahikatea, māpau, mahoe, taraire, and titoki, and a few individuals of shining spleenwort and *Diplazium australe*. There have been several attempts at clearing the tradescantia in the past (but unfruitful; N. Pullman, pers. comm.) resulting in slightly more open areas where the main regeneration of native species has occurred.

Restoration plantings of native species have been undertaken around the margins to protect the remnant from edge effects and increase its viability.

Significance:

The remnant is a representative example of mature podocarp-dominated lowland floodplain forest which is now uncommon in the region and throughout New Zealand. It also provides a riparian buffer, albeit small, between the developed agricultural land to the east and south, and the Mangawhero Stream.

The leafy liverwort *Cololejeunea falcidentata* which is ranked as At Risk – Naturally Uncommon (Glenny et al. 2011) has been recorded on totara in this site (P.J. de Lange, pers. comm. to A.J. Townsend, 2014).

Manning (2001) recorded pokaka (*Elaeocarpus hookerianus*), a regionally uncommon species, in the canopy during the PNAP survey, but this species was not seen during our visit.

The remnant is classified as a Category 1 threatened land environment, which has <10% indigenous cover remaining (Cieraad et al. 2015).

Threats:

- The dominance of the invasive herb, *Tradescantia*, in the ground cover is preventing seedling recruitment and outcompeting ferns and other species on the forest floor.

Recommendations:

- Continue to investigate methods to control *Tradescantia*, e.g. herbicide, manual, bio-control.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET**Site name:** Hikurangi Bush QEII **Date:** 28-Nov-14**Plot no:** 1 (HIK1)**Altitude:** 122 m a.s.l.**GPS E:** 1716141**N:** 6058980**Recorder:** BRC, LF, NB, SB, FG **Veg structure:** Forest**Composition¹:** Totara**Canopy Mean hgt:** 22 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Podocarpus totara</i>	90	22	<i>Geniostoma ligustrifolium</i>	40	4.5	<i>Tradescantia fluminensis*</i>	90	
<i>Dacrycarpus dacrydioides</i>	10	24	<i>Macropiper excelsum</i>	7	4.5	<i>Alectryon excelsus</i>	1	
			<i>Myrsine australis</i>	5	4.2	<i>Asplenium oblongifolium</i>	0.5	
			<i>Corynocarpus laevigatus</i>	4	6.1	<i>Beilschmiedia tarairi</i>	0.5	
			<i>Cyathea medullaris</i>	3	5.5	<i>Coprosma rhamnoides</i>	0.5	
			<i>Melicytus macrophyllus</i>	2	2.9	<i>Dacrycarpus dacrydioides</i>	0.5	
			<i>Coprosma robusta</i>	1	4	<i>Macropiper excelsum</i>	0.5	
			<i>Melicytus ramiflorus</i>	1	6	<i>Melicytus ramiflorus</i>	0.5	
			<i>Pittosporum tenuifolium</i>	1	5.1	<i>Myrsine australis</i>	0.5	
			<i>Alectryon excelsus</i>	0.5	1.2	<i>Pyrrhosia eleagnifolia</i>	0.5	
			<i>Cordyline australis</i>	0.5	5			
			<i>Cyathea dealbata</i>	0.5	1.3			

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: Seedlings in understorey in previously cleared areas, e.g. fern grove. Many attempts at clearing *Tradescantia* but it is still abundant.

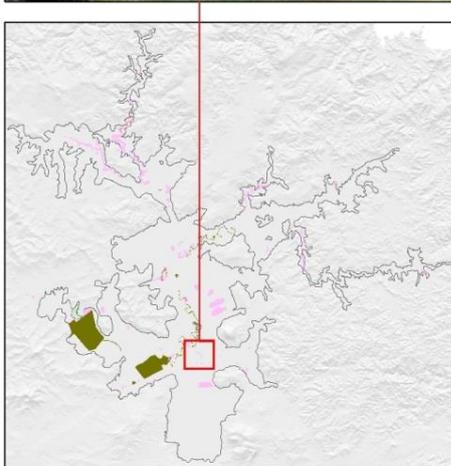
HIKURANGI BUSH QEII PLANT SPECIES LIST

Species	CommonName	Status
<i>Ackama rosifolia</i>	Makamaka	Endemic
<i>Alectryon excelsus</i>	Titoki, New Zealand oak	Endemic
<i>Allium triquetrum</i> *	Onion weed	Exotic
<i>Asplenium oblongifolium</i>	Shining spleenwort	Endemic
<i>Beilschmiedia tarairi</i>	Tarairi	Endemic
<i>Cololejeunea falcidentata</i> (Glenny et al. 2011)	Leafy liverwort	Endemic
<i>Collospermum hastatum</i>	Kahakaha	Endemic
<i>Coprosma arborea</i>	Mamangi	Endemic
<i>Coprosma rhamnoides</i>		Endemic
<i>Coprosma robusta</i>	Glossy karamu	Endemic
<i>Cordyline australis</i>	Cabbage tree	Endemic
<i>Corynocarpus laevigatus</i>	Karaka	Endemic
<i>Crocsmia ×crocsmiiflora</i> *	Montbretia	Exotic
<i>Cyathea dealbata</i>	Silver fern, Kaponga	Endemic
<i>Cyathea medullaris</i>	Black mamaku	Non-endemic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Dacrydium cupressinum</i>	Rimu	Endemic
<i>Dactylis glomerata</i> *	Cocksfoot	Exotic
<i>Delairea odorata</i> *	German ivy	Exotic
<i>Diplazium australe</i>		Non-endemic
<i>Doodia media</i> subsp. <i>australis</i> (<i>Blechnum parrisiae</i>)	Rasp fern	Non-endemic
<i>Ehrharta erecta</i>	Veldt grass	Exotic
<i>Galium aparine</i> *	Cleavers	Exotic
<i>Geniostoma ligustrifolium</i>	Hangehange	Non-endemic
<i>Kunzea robusta</i> (<i>K.ericoides</i>)	Kānuka	Endemic
<i>Hoheria populnea</i>	Lacebark	Endemic
<i>Lastreopsis glabella</i>	Smooth shield fern	Endemic
<i>Laurelia novae-zelandiae</i>	Pukatea	Endemic
<i>Macropiper excelsum</i>	Kawakawa	Endemic
<i>Ligustrum lucidum</i> *	Broadleaf privet	Exotic
<i>Ligustrum sinense</i> *	Chinese privet	Exotic
<i>Melicytus macrophyllus</i>	Large-leaved mahoe	Endemic
<i>Melicytus ramiflorus</i>	Mahoe, Hinahina	Non-endemic
<i>Muehlenbeckia complexa</i>	Small-leaved pohuehue	Non-endemic
<i>Myriophyllum propinquum</i>	Common water milfoil	Endemic

<i>Myrsine australis</i>	Māpau, Red matipo	Endemic
<i>Oenanthe pimpinelloides</i> *	Parsley dropwort	Exotic
<i>Oplismenus hirtellus</i> subsp. <i>imbecillus</i>		Non-endemic
<i>Pittosporum tenuifolium</i>	Kohuhu, Black matipo	Endemic
<i>Podocarpus totara</i>	Totara	Endemic
<i>Prunus campanulata</i> *	Taiwan cherry	Exotic
<i>Pseudopanax</i> sp. <i>Cultivar</i>		(Endemic)
<i>Pyrrhosia eleagnifolia</i>	Leather-leaf fern	Endemic
<i>Rhopalostylis sapida</i>	Nikau	Endemic
<i>Solanum mauritianum</i> *	Flannel leaf	Exotic
<i>Tradescantia fluminensis</i> *	Tradescantia, Wandering Jew	Exotic
<i>Vitex lucens</i>	Puriri	Endemic
<i>Zantedeschia aethiopica</i> cv. Green Goddess*	Green goddess	Exotic
Planted Native Species (additional to above)		
<i>Griselinia lucida</i>	Puka	Endemic
<i>Knightia excelsa</i>	Rewarewa	Endemic
<i>Phormium tenax</i>	Harakeke, NZ flax	Endemic

5. JORDAN VALLEY ROAD

Jordan Valley Road



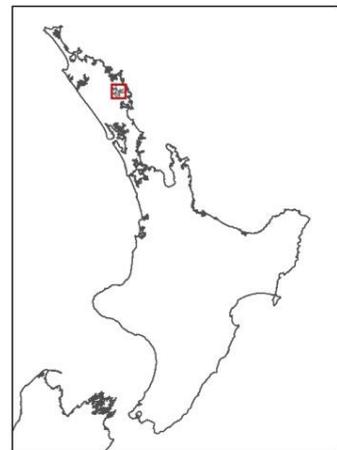
Legend

- Public Conservation Land
- Significant Natural Area
- Additional Natural Area

Plots

- Wetland, Protected
- Wetland, Private Land
- Non Area, Protected
- Non Area, Private Land

Hikurangi Restoration



Location:

Remnant is a narrow swampy strip (c. 3.5 ha) of Public Conservation Land, c. 0.5 km long, lining both sides of Jordan Valley Road, and administered by the Whangarei District Council.

Coordinates: E1713113 N6058646 (Plot JVNA3)

Vegetation Types:

- Chinese privet scrub
- *Carex*-reed sweetgrass-*Baumea articulata*-*Cyperus ustulatus* sedgeland (only minor pockets in poorly-drained areas)

Description:

Uneven canopied scrub, up to c. 5 m high, cover the wetlands, channels and associated low banks along the road sides. Chinese privet is the overwhelmingly dominant species, with canopy associates of cabbage tree and *Coprosma propinqua*, and scattered emergent totara up to 10 m in height. In areas where the canopy is taller, an understorey has developed, consisting of *Melicytus micranthus*, *Coprosma propinqua*, *Coprosma rhamnoides*, and Chinese privet. Ground cover species include *Carex maorica*, *Carex virgata*, *Hydrocotyle pterocarpa*, Chinese privet, and reed sweet grass, and other exotic herbs and grasses.

In more open, wetter areas, minor pockets of herbaceous species occur, including *Carex subdola*, *Baumea articulata*, *Cyperus ustulatus*, *Persicaria hydropiper*, reed sweet grass, and harakeke.

Significance:

Although dominated by the invasive exotic shrub, Chinese privet, the remnant contains wetland habitat for the threatened black mudfish (*Neochanna diversus*) and several regionally uncommon plant species including *Coprosma propinqua*, *Coprosma rotundifolia*, *Coprosma rigida*, *Carex subdola*, *Myrsine divaricata*, and *Melicytus micranthus*. Manning (2001) recorded *Juncus holoschoenus* var. *holoschoenus*, a threatened species during the PNAP survey, but this species was not seen during our visit.

The remnant has potential for restoration and increasing the conservation benefits for the floodplain, although significant effort would be required to control the Chinese privet, which is shade tolerant and regenerating vigorously.

The remnant is classified as a Category 1 threatened land environment, which has <10% indigenous cover remaining (Cieraad et al. 2015).

Threats:

- The dominance of Chinese privet in all vegetation tiers is retarding re-establishment and dominance of native communities.
- Several other potentially troublesome invasive species are present, including blackberry, Japanese honeysuckle, pampas, gorse, and parrot's feather.

- Stock access through insecure fences (only in a few places as most fences were in good condition) and probably through occasional ‘farming the long acre’ north of the road in the eastern sector.

Recommendations:

- Control of Chinese privet, as much as is practicable, depending on conservation priorities. Some areas along the roadside ditches had been recently sprayed for Chinese privet.
- Surveillance of other potentially troublesome weeds.
- Ensure fences are secure and stock excluded from the remnant.

WETLAND PLOT SHEET

Wetland name: Jordan Valley Road **Date:** 25-Nov-14 **Plot no:** 1 (JWV1)
Plot size (2 × 2 m default): 2x2 **Altitude:** 98 m a.s.l. **GPS/GR:** 1713014 6058666
Field leader: BRC **Structure:** Scrub
Composition: *Ligustrum sinense*

Canopy (bird’s eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Ligustrum sinense</i> *	92	4.7				<i>Carex lessoniana</i>	40	0.95
<i>Coprosma propinqua</i>	8	3.7				<i>Carex maorica</i>	3	0.75
<i>Coprosma rotundifolia</i>	0.5	3				<i>Hydrocotyle pterocarpa</i>	0.5	0.05
						<i>Ligustrum sinense</i> *	0.5	0.05
						<i>Myriophyllum aquaticum</i> *	0.5	0.1

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Callitriche stagnalis**, *Carex virgata*, *Eleocharis acuta*, *Galium palustre**, *Glyceria maxima**, *Ludwigia palustris**, *Oplismenus imbecillus*, *Persicaria hydropiper**, *Polygonum strigosum**, *Ranunculus amphitrichus*, *Rubus fruticosus**

Comments: Greenfinch, lycosid spider. Mean canopy height = 4 m

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	92	1	
Understorey: % cover introduced spp ³	1	4	
Total species: % number introduced spp	37.5	3	
Total species: overall stress/dieback	NA	5	
Total /20	NA	13	

²5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements: T = 15.9°C

Water table cm	-12	Water conductivity uS (if present)	227
Water pH (if present)	4.64	Von Post peat decomposition index	na

Soil core laboratory analysis (2 soil core subsamples):

Water content % dry weight	359	Total C %	23.42
Bulk Density T/m ³	0.209	Total N %	1.90
pH	4.77	Total P %	0.186
Conductivity uS	0.30	Total K %	0.535

Foliage laboratory analysis (leaf/culm sample of dominant canopy species):

Species	<i>Ligustrum sinense</i>	%C: 49.2	%N: 1.49	%P: 0.128	%K:0.69
	<i>Carex lessoniana</i>	%C: 48.5	%N: 1.74	%P: 0.171	%K:1.93

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET**Site name:** Jordan Valley Road **Date:** 27-Nov-14 **Plot no:** 2 (JVNA2)**Altitude:** 95 m a.s.l.**GPS E:** 1713310**N:** 6058489**Recorder:** BRC, LF, FG, SB**Veg structure:** Scrub**Composition¹:** *Ligustrum sinense* **Canopy Mean hgt:** 3 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Ligustrum sinense</i> *	95	3.5				<i>Lonicera japonica</i> *	30	
<i>Lonicera japonica</i> *	5	3.5				<i>Ligustrum sinense</i> *	10	
<i>Rubus fruticosus</i> *	0.5	1				<i>Carex ovalis</i> *	5	
						<i>Oenanthe pimpinelloides</i> *	2	
						<i>Ranunculus repens</i> *	0.5	
						<i>Rubus fruticosus</i> *	0.5	
						<i>Schedonorus arundinaceus</i> *	0.5	

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by ***Comments:** Bronze beetle, passionvine hopper.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET

Site name: Jordan Valley Road **Date:** 27-Nov-14 **Plot no:** 3 (JVNA3)

Altitude: 95 m a.s.l. **GPS E:** 1713113 **N:** 6058646

Recorder: BRC, LF, FG, SB **Veg structure:** Scrub

Composition¹: Totara/*Ligustrum sinense* **Canopy Mean hgt:** 5 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Ligustrum sinense</i> *	90	5.3	<i>Melicytus micranthus</i>	2	0.85	<i>Ligustrum sinense</i> *	25	
<i>Podocarpus totara</i>	10	7	<i>Coprosma ×cunninghamii</i>	1	1.2	<i>Carex virgata</i>	0.5	
			<i>Coprosma propinqua</i>	1	1	<i>Coprosma propinqua</i>	0.5	
			<i>Coprosma rhamnoides</i>	1	1	<i>Cordyline australis</i>	0.5	
			<i>Ligustrum sinense</i>	1		<i>Dactylis glomerata</i> *	0.5	
			<i>Coprosma parviflora</i>	0.5	0.6	<i>Doodia australis</i>	0.5	
			<i>Podocarpus totara</i>		3.7	<i>Pittosporum crassifolium</i>	0.5	
						<i>Oenanthe pimpinelloides</i> *	0.5	
						<i>Leontodon sp.</i>	0.5	
						<i>Podocarpus totara</i>	0.5	
						<i>Rubus australis</i>	0.5	

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: Mostly exotics but with some native species regeneration

JORDAN VALLEY ROAD PLANT SPECIES LIST

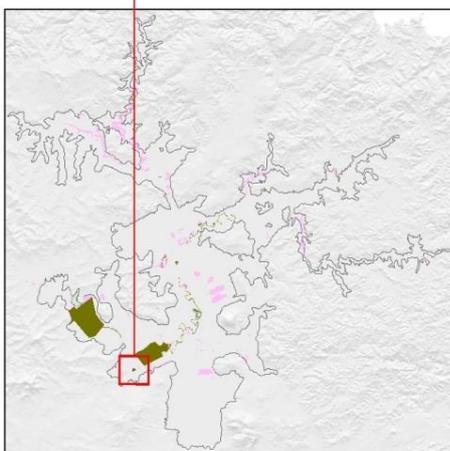
Species	CommonName	Status
<i>Agapanthus orientalis</i> *	Agapanthus	Exotic
<i>Alopecurus geniculatus</i> *	Kneed foxtail	Exotic
<i>Anthoxanthum odoratum</i> *	Sweet vernal	Exotic
<i>Baumea articulata</i>	Jointed baumea	Non-endemic
<i>Briza minima</i> *	Small quaking grass	Exotic
<i>Bromus willdenowii</i> *	Prairie grass	Exotic
<i>Callitriche stagnalis</i> *	Starwort	Exotic
<i>Calystegia sepium</i> *	Akapōhue, Calystegia	Exotic
<i>Carex lessoniana</i>	Cutty grass	Endemic
<i>Carex longii</i> *		Exotic
<i>Carex maorica</i>		Endemic

<i>Carex ovalis</i> *	Oval sedge	Exotic
<i>Carex subdola</i>		Endemic
<i>Carex virgata</i>	Swamp sedge	Endemic
<i>Centella uniflora</i>	Centella	Non-endemic
<i>Coprosma ×cunninghamii</i>		Endemic
<i>Coprosma areolata</i>	Aruhe	Endemic
<i>Coprosma parviflora</i>	Leafy coprosma	Endemic
<i>Coprosma propinqua</i>	Miki, Mingimingi	Endemic
<i>Coprosma rhamnoides</i>		Endemic
<i>Coprosma rigida</i>		Endemic
<i>Coprosma rotundifolia</i>	Round-leaved coprosma	Endemic
<i>Cordyline australis</i>	Cabbage tree	Endemic
<i>Cortaderia selloana</i> *	Pampas grass	Exotic
<i>Cyperus eragrostis</i> *	Puketangata	Exotic
<i>Cyperus ustulatus</i>	Coastal cutty grass	Endemic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Dactylis glomerata</i> *	Cocksfoot	Exotic
<i>Doodia australis (Blechnum parrisiae)</i>		Indigenous
<i>Eleocharis acuta</i>	Club rush	Non-endemic
<i>Eleocharis sphacelata</i>	Bamboo spike sedge	Endemic
<i>Epilobium ciliatum</i> *	Tall willowherb	Exotic
<i>Galium aparine</i> *	Cleavers	Exotic
<i>Galium palustre</i> *	Marsh bedstraw	Exotic
<i>Geranium dissectum</i> *	Cut-leaved cranesbill	Exotic
<i>Geranium robertianum</i> *	Herb Robert	Exotic
<i>Glyceria maxima</i> *	Reed sweetgrass	Exotic
<i>Hydrocotyle pterocarpa</i>		Non-endemic
<i>Hypochaeris radicata</i> *	Catsear	Exotic
<i>Juncus edgariae</i>		Endemic
<i>Juncus prismatocarpus</i>	Angled-fruit rush	Non-endemic
<i>Kunzea robusta (K. ericoides)</i>	Kānuka	Endemic
<i>Landoltia punctata</i> *	Purple-backed duckweed	Exotic
<i>Leontodon taraxacoides</i> *	Hairy hawkbit	Exotic
<i>Leptospermum scoparium</i>	Mānuka	Non-endemic
<i>Leycesteria formosa</i> *		Exotic
<i>Ligustrum sinense</i> *	Chinese privet	Exotic
<i>Lonicera japonica</i> *	Japanese honeysuckle	Exotic
<i>Lotus pedunculatus</i> *	Lotus	Exotic

<i>Lotus suaveolens</i> *	Hairy birdsfoot trefoil	Exotic
<i>Ludwigia palustris</i> *	Water purslane	Exotic
<i>Malus xdomestica</i> *	Apple	Exotic
<i>Melicytus micranthus</i>	Manakura, Small-leaved mahoe	Endemic
<i>Microtis unifolia</i>	Common onion orchid	Endemic
<i>Muehlenbeckia complexa</i>	Pöhue	Non-endemic
<i>Myriophyllum aquaticum</i> *	Parrot's feather	Exotic
<i>Myrsine divaricata</i>	Weeping mapou	Endemic
<i>Oenanthe pimpinelloides</i> *	Parsley dropwort	Exotic
<i>Oplismenus hirtellus subsp imbecillus.</i>		
<i>Paspalum urvillei</i> *	Vasey grass	Exotic
<i>Persicaria hydropiper</i> *		Exotic
<i>Persicaria strigosa</i> *		Exotic
<i>Phormium tenax</i>	Flax	Endemic
<i>Pittosporum crassifolium</i>	Karo	Endemic
<i>Podocarpus totara</i>	Totara, Amoka	Endemic
<i>Polygonum strigosum</i> *		Exotic
<i>Pteridium esculentum</i>	Bracken	Non-endemic
<i>Ranunculus amphitrichus</i>	Waoriki	Non-endemic
<i>Ranunculus repens</i> *	Creeping buttercup	Exotic
<i>Raphanus</i> sp.		
<i>Rosa rubiginosa</i> *	sweet briar	Exotic
<i>Rubus australis</i>	Bush lawyer	Endemic
<i>Rubus fruticosus</i> *	Blackberry	Exotic
<i>Rumex obtusifolius</i> *	Broad-leaved dock	Exotic
<i>Schedonorus arundinaceus</i> *	Tall fescue	Exotic
<i>Sonchus oleraceus</i> *	Common sow thistle	Exotic
<i>Thelymitra pauciflora</i>	Sun orchid	Non-endemic
<i>Ulex europaeus</i> *	Gorse	Exotic
<i>Vinca major</i> *	Blue periwinkle	Exotic
<i>Vulpia</i> sp.*.		Exotic
<i>Watsonia meriana</i> *	Watsonia	Exotic

6. MATARAU ISLAND SCENIC RESERVE

Matarau Island



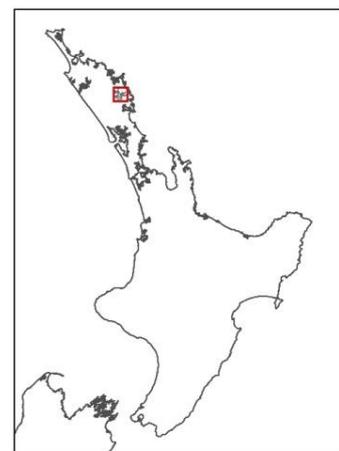
Legend

- Public Conservation Land
- Significant Natural Area
- Additional Natural Area

Plots

- Wetland, Protected
- Wetland, Private Land
- Non Area, Protected
- Non Area, Private Land

Hikurangi Restoration



Location:

The scenic reserve comprises a small ‘island’ remnant (c. 2.1 ha) situated between a small oxbow and the stop bank on true right bank of Wairua River, immediately south of Wairua River South Natural Area, and about 0.5 km south of Wairua River Government Purpose Wildlife Management Reserve. The remnant also includes the wetlands within the oxbow, and associated vegetation on oxbow banks

Coordinates: E1709281 N6056840 (Plot MINA1)

Vegetation Types:

- Totara forest
- Herbaceous wetland (not sampled)

Description:

The remnant was not sampled in detail because the reserve managed for threatened species, along with the nearby Wairua River GPWMR, and detailed information is already available, e.g. Manning (2001), Townsend (2012), AJ Townsend (unpublished data).

The forest is dominated by totara, with occasional kahikatea and kānuka, and infrequent white maire, karaka, and pigeonwood. A variety of small trees and shrubs form a diverse understory. Species include pigeonwood, *Coprosma areolata*, *Melicytus micranthus*, māpau, kānuka, totara, and kohuhu. The ground cover is relatively sparse but is also diverse. Common species include the native grasses, *Oplimenus imbecillus* and *Microleana stipoides*, ferns such as *Doodia mollis* and *Pellaea rotundifolia*, the sedge *Carex lambertiana*, and a large variety of tree and shrub seedlings. The forest is in very good condition, as the remnant is managed for the threatened species, *Hebe* aff. *bishopiana* Hikurangi Swamp and *Pittosporum obcordatum*, and stock are excluded

Significance:

The scenic reserve contains important populations of the threatened species, *Hebe* aff. *bishopiana* Hikurangi Swamp (nationally critical), *Pittosporum obcordatum* (nationally vulnerable) and *Doodia mollis* (syn. *Blechnum molle*) (at risk – naturally uncommon). Two regionally uncommon species, *Myrsine divaricata* and *Melicytus micranthus*, are also present.

The remnant is classified as a Category 2 threatened land environment, which has 10–20% indigenous cover remaining (Cieraad et al. 2015).

Threats:

- Increasingly shaded conditions caused by dense canopy and understory layers may negatively affect threatened shrubs, especially the shorter-lived *Hebe*, as these species prefer more open conditions.
- Weeds, e.g. Chinese privet and tradescantia, although currently under control, are a potential threat to long term viability of the remnant.

Recommendations:

- New plantings of threatened species should be targeted at more open, marginal sites.
- Continue to maintain a weed management programme

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET**Site name:** Matarau Island**Date:** 27-Nov-14**Plot no:** 1 (MINA1)**Altitude:** 95 m a.s.l.**GPS E:** 1709281**N:** 6056840**Recorder:** BRC, FG, LF, SB**Veg structure:** Forest**Composition¹:** Totara**Canopy Mean hgt:** 15 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Podocarpus totara</i>	90	17	<i>Coprosma areolata</i>	15	1.4	<i>Oplismenus imbecillis</i>	8	
<i>Dacrycarpus dacrydioides</i>	5	11	<i>Hedycarya arborea</i>	12	2.7	<i>Ligustrum sinense*</i>	2	
<i>Kunzea robusta</i>	5	12	<i>Podocarpus totara</i>	8	7.5	<i>Carex lambertiana</i>	1	
<i>Passiflora tetrandra</i>	0.5		<i>Melicytus micranthus</i>	5	4.3	<i>Microlaena stipoides</i>	1	
			<i>Kunzea robusta</i>	2	1.3 5	<i>Agrostis capillaris*</i>	0.5	
			<i>Myrsine australis</i>	2	6.5	<i>Corynocarpus laevigatus</i>	0.5	
			<i>Pittosporum tenuifolium</i>	1	1.5	<i>Dacrycarpus dacrydioides</i>	0.5	
			<i>Coprosma x cunninghamii</i>	0.5	1.5	<i>Dianella nigra</i>	0.5	
			<i>Cordyline australis</i>	0.5	1.3	<i>Doodia mollis</i>	0.5	
			<i>Haloragis erecta</i>	0.5	0.7 5	<i>Galium aparine*</i>	0.5	
			<i>Hebe aff. bishopiana</i>	0.5	2.3	<i>Haloragis erecta</i>	0.5	
			<i>Melicytus ramiflorus</i>	0.5	4	<i>Hedycarya arborea</i>	0.5	
			<i>Muehlenbeckia australis</i>	0.5		<i>Hydrocotyle moschata</i>	0.5	
			<i>Myrsine divaricata</i>	0.5	1.8	<i>Lotus pedunculatus*</i>	0.5	
			<i>Nestegis lanceolata</i>	0.5	1.5	<i>Microsorium pustulatum</i>	0.5	
			<i>Passiflora tetrandra</i>	0.5		<i>Muehlenbeckia australis</i>	0.5	
			<i>Ripogonum scandens</i>	0.5		<i>Passiflora tetrandra</i>	0.5	
			<i>Pyrrhosia eleagnifolia</i>			<i>Pellaea rotundifolia</i>	0.5	
						<i>Rhopalostylis sapida</i>	0.5	

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

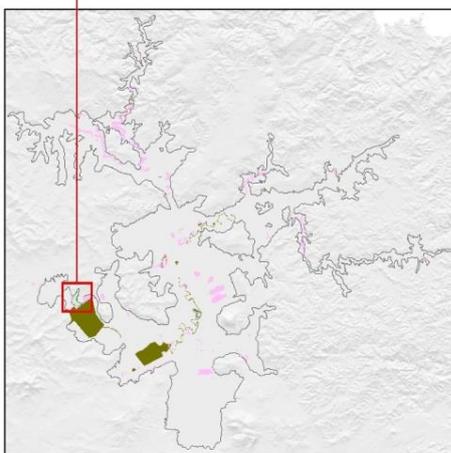
Comments: Fantail and chaffinch.

MATARAU ISLAND PLANT SPECIES LIST

Species	CommonName	Status
<i>Agrostis capillaris</i> *	Bent grass	Exotic
<i>Carex lambertiana</i>		Endemic
<i>Coprosma ×cunninghamii</i>		Endemic
<i>Coprosma areolata</i>	Aruhe	Endemic
<i>Cordyline australis</i>	Cabbage tree	Endemic
<i>Corynocarpus laevigatus</i>	Karaka	Endemic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Dianella nigra</i>	blue-berry	Endemic
<i>Doodia mollis</i> (<i>Blechnum molle</i>)	Mokimoki	Indigenous
<i>Galium aparine</i> *	Cleavers	Exotic
<i>Haloragis erecta</i>	Shrubby haloragis	Endemic
<i>Hebe aff. bishopiana</i>		Endemic
<i>Hedycarya arborea</i>	Kaiwhiri	Endemic
<i>Hydrocotyle moschata</i>	Hairy pennywort	Endemic
<i>Kunzea robusta</i> (<i>K. ericoides</i>)	Kānuka	Endemic
<i>Ligustrum sinense</i> *	Chinese privet	Exotic
<i>Lotus pedunculatus</i> *	Lotus	Exotic
<i>Melicytus micranthus</i>	Manakura	Endemic
<i>Melicytus ramiflorus</i>	Hinahina, mahoe	Non-endemic
<i>Microlaena stipoides</i>	Meadow rice grass	Non-endemic
<i>Microsorium pustulatum</i>		Indigenous
<i>Muehlenbeckia australis</i>	Large-leaved muehlenbeckia	Non-endemic
<i>Myrsine australis</i>	Māpau, Red matipo, mapou	Endemic
<i>Myrsine divaricata</i>	Weeping mapou	Endemic
<i>Nestegis lanceolata</i>	White maire	Endemic
<i>Oplismenus imbecillis</i>		Non-endemic
<i>Passiflora tetrandra</i>	Aka	Endemic
<i>Pellaea rotundifolia</i>	Button fern	Indigenous
<i>Pittosporum tenuifolium</i>	Black matipo, kohuhu	Endemic
<i>Podocarpus totara</i>	Totara	Endemic
<i>Pyrrhosia eleagnifolia</i>	Leather-leaf fern	Endemic
<i>Rhopalostylis sapida</i>	Feather duster palm	Endemic
<i>Ripogonum scandens</i>	Akapirita	Endemic

7. OTAKAIRANGI NORTH

Otakairangi North



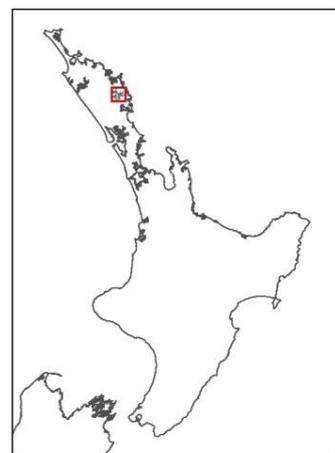
Legend

- Public Conservation Land
- Significant Natural Area
- Additional Natural Area

Plots

- Wetland, Protected
- Wetland, Private Land
- Non Area, Protected
- Non Area, Private Land

Hikurangi Restoration



Location:

Regenerating forest remnant (c.27.9 ha) on hillslopes adjoining the northern sector of Otakairangi Swamp Government Purpose Reserve. Only that part of the remnant facing Otakairangi Swamp (i.e. southern slopes) was surveyed.

Coordinates: E1705802 N6060876 (Plot ONNA1)

Vegetation Types:

- Totara/silver fern treeland
- Regenerating forest and scrub types including totara-kahikatea/mamaku-silverfern treeland, bracken-gorse/*Gahnia setifolia* fernland, and gorse shrubland.

Description:

Remnant comprises a mosaic of secondary forest and scrub ranging from early successional vegetation types dominated by bracken, gorse, silver fern, mamaku, *Myrsine australis*, *Gahnia setifolia*, and mingimingi to young stands of forest trees, particularly totara and kahikatea. The canopy of the forested patches is typically low and uneven, with emergent trees up to 12 m in height. The understorey consists of silver fern, *Myrsine australis*, hangehange, *Coprosma rhamnoides*, mingimingi, and totara, and others species characteristic of hillslope forest. The ground cover is relatively sparse and includes *Blechnum novae-zelandiae*, *Uncinia uncinata*, *Microlaena stipoides* and seedlings of trees and shrubs growing in the vicinity. Several dead mamaku were noted and a few cabbage trees showed symptoms of cabbage tree dieback.

Significance:

Although this remnant is on hillslope, not on the Hikurangi floodplain, it provides an important buffer and catchment to the northern part of Otakairangi Swamp Government Purpose Reserve. One regionally uncommon species, *Coprosma tenuicaulis* was recorded.

The remnant is classified as a Category 4 threatened land environment, which has >30% indigenous cover remaining and <10% protected (Cieraad et al. 2015).

Threats:

- Introduced mammals, eg pigs, possums. Signs of browsing observed.
- There are a few invasive weeds, e.g. gorse, however much of this is in the process of being shaded out by forest development.
- Fire, particularly in times of drought.

Recommendations:

- General maintenance, e.g. prevent cattle access (fences were not checked), keep introduced animal numbers low, avoid fires.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET**Site name:** Otakairangi North**Date:** 20-Feb-15**Plot no:** 1 (ONNA1)**Altitude:** 140 m a.s.l.**GPS E:** 1705802**N:** 6060876**Recorder:** BRC, LF, SB, KH**Veg structure:** Treeland**Composition¹:** PODtot / CYAdea**Canopy Mean hgt:** 9 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Podocarpus totara</i>	45	11	<i>Leucopogon fasciculatus</i>	7	1.6	<i>Blechnum novae-zelandiae</i>	3	
<i>Cyathea dealbata</i>	43	6	<i>Podocarpus totara</i>	5	3	<i>Uncinia uncinata</i>	3	
<i>Dacrycarpus dacrydioides</i>	5	10	<i>Cyathea dealbata</i>	20	4	<i>Ageratina riparia</i> *	1	
<i>Myrsine australis</i>	5	5.5	<i>Dicksonia squarrosa</i>	2	3.5	<i>Geniostoma rupestre</i>	1	
<i>Carpodetus serratus</i>	2	7	<i>Geniostoma rupestre</i>	14	3	<i>Microlaena stipoides</i>	1	
<i>Ulex europaeus</i> *	<1	4	<i>Myrsine australis</i>	14	5	<i>Myrsine australis</i>	1	
			<i>Cordyline australis</i>	1	4.5	<i>Carpodetus serratus</i>	<1	
			<i>Asplenium flaccidum</i>	<1	0.7	<i>Coprosma rhamnoides</i>	<1	
			<i>Melicytus ramiflorus</i>	<1	2.1	<i>Dacrycarpus dacrydioides</i>	<1	
			<i>Microsorium pustulatum</i>	<1	5	<i>Gahnia setifolia</i>	<1	
			<i>Pyrrosia eleagnifolia</i>	<1	9	<i>Leucopogon fasciculatus</i>	<1	
						<i>Ludwigia palustris</i> *	<1	
						<i>Oplismenus imbecillis</i>	<1	
						<i>Pyrrosia eleagnifolia</i>	<1	
						<i>Ulex europaeus</i> *	<1	
						<i>Uncinia banksii</i>	<1	

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

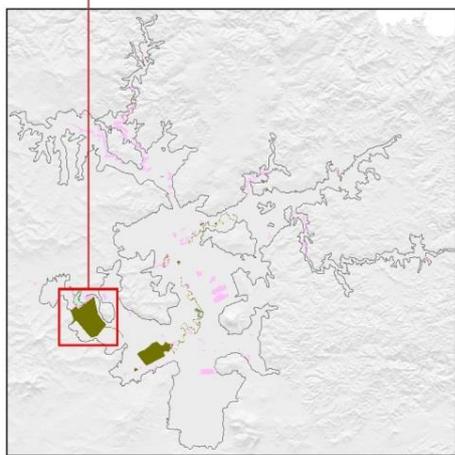
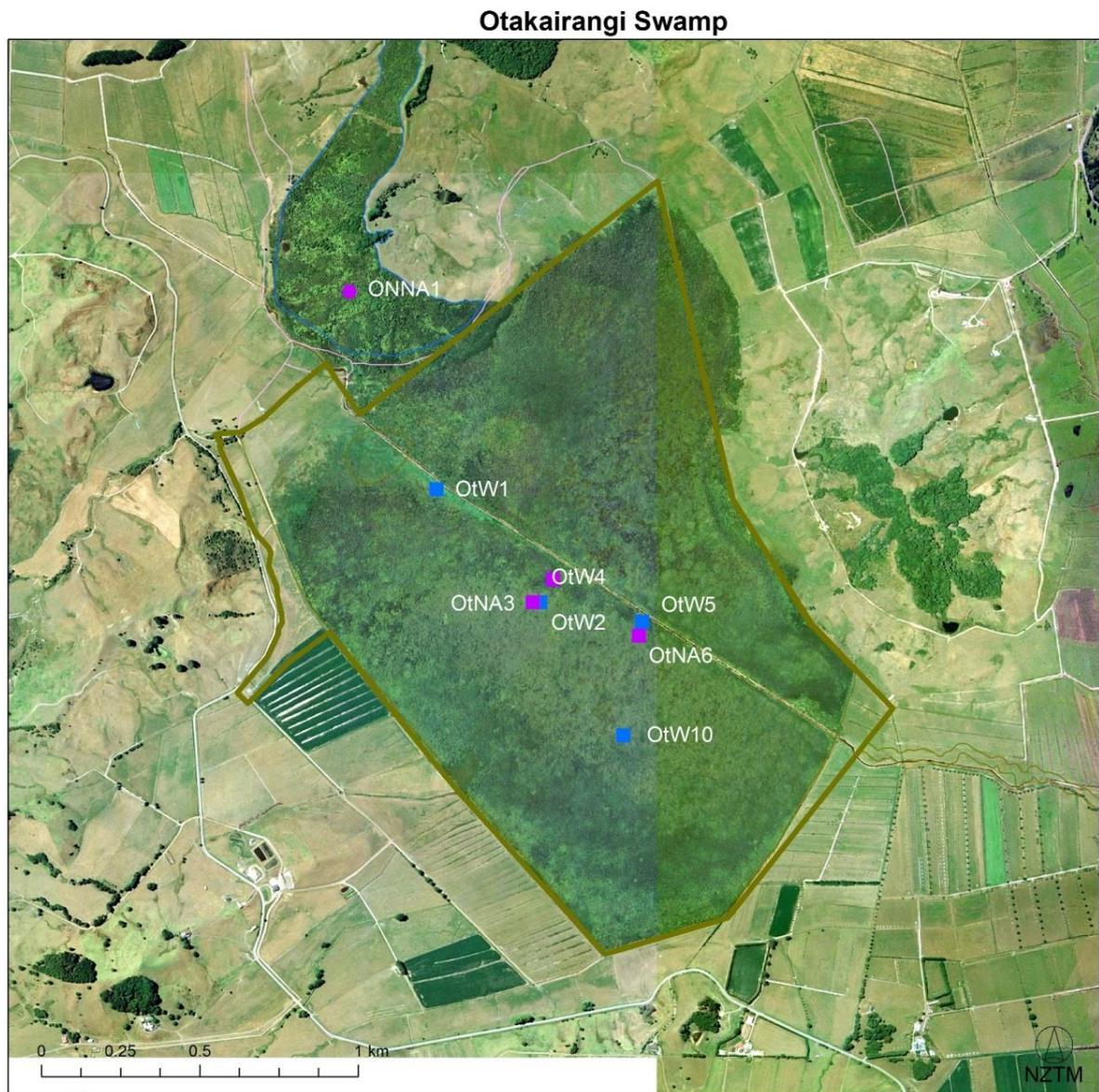
Comments: dead mamaku – cabbage tree dieback disease. Threats – pigs, fire risk, possum, etc., few weeds, patches of gorse but mostly being shaded out

OTAKAIRANGI NORTH PLANT SPECIES LIST

Species	CommonName	Status
<i>Ageratina riparia</i> *	Mist flower	Exotic
<i>Asplenium flaccidum</i>	Drooping spleenwort	Non-endemic
<i>Blechnum novae-zelandiae</i>	Horokio	Endemic
<i>Calystegia sepium</i> *	Akapōhue	Exotic
<i>Carex lessoniana</i>	Cutty grass	Endemic
<i>Carex ovalis</i> *	Oval sedge	Exotic
<i>Carpodetus serratus</i>	Marbleleaf, Putaputaweta	Endemic
<i>Centella uniflora</i>	Centella	Non-endemic
<i>Conyza canadensis</i> *	Canadian fleabane	Exotic
<i>Coprosma arborea</i>	Mamangi	Endemic
<i>Coprosma areolata</i>	Thin-leaved coprosma	Endemic
<i>Coprosma rhamnoides</i>		Endemic
<i>Coprosma robusta</i>	Glossy karamu	Endemic
<i>Coprosma tenuicaulis</i>	Hukihuki	Endemic
<i>Cordyline australis</i>	Cabbage tree	Endemic
<i>Cortaderia selloana</i> *	Pampas grass	Exotic
<i>Cyathea cunninghamii</i>	Gully tree fern	Indigenous
<i>Cyathea dealbata</i>	Ponga, Silver fern	Endemic
<i>Cyathea medullaris</i>	Black mamaku, Mamaku	Non-endemic
<i>Cyperus eragrostis</i> *	Puketangata	Exotic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Deparia petersenii</i>	Japanese lady fern	Indigenous
<i>Dianella haemata</i>		Endemic
<i>Dicksonia squarrosa</i>	Wheki, Rough tree fern	Endemic
<i>Diplazium australe</i>		Indigenous
<i>Doodia australis (Blechnum parrisiae)</i>		Indigenous
<i>Erechtites valerianifolia</i> *	Brazilian fireweed	Exotic
<i>Gahnia setifolia</i>	Māpere	Endemic
<i>Geniostoma rupestre</i>	Hangehange	Non-endemic
<i>Gonocarpus incanus</i>	Piripiri	Endemic
<i>Holcus lanatus</i> *	Yorkshire fog	Exotic
<i>Juncus edgariae</i>		Endemic
<i>Knightia excelsa</i>	New Zealand honeysuckle, Rewarewa	Endemic
<i>Kunzea robusta (K. ericoides)</i>	Kānuka	Endemic
<i>Leptospermum scoparium</i>	Mānuka	Non-endemic

<i>Leucopogon fasciculatus</i>	Mingimingi	Endemic
<i>Lotus pedunculatus</i>	Lotus	Exotic
<i>Ludwigia palustris</i> *	Water purslane	Exotic
<i>Lycopodium deuterodensum</i>	Puakarimu	Non-endemic
<i>Machaerina sp.</i>		
<i>Melicytus ramiflorus</i>	Mahoe, Whiteywood	Non-endemic
<i>Microlaena stipoides</i>	Meadow rice grass	Non-endemic
<i>Microsorium pustulatum</i>		Indigenous
<i>Myrsine australis</i>	Māpau, Red matipo	Endemic
<i>Nertera dichondrifolia</i>		Endemic
<i>Oenanthe pimpinelloides</i> *	Parsley dropwort	Exotic
<i>Oplismenus imbecillis</i>		Non-endemic
<i>Paesia scaberula</i>	Lace fern	Endemic
<i>Persicaria decipiens</i>		Non-endemic
<i>Persicaria hydropiper</i> *		Exotic
<i>Persicaria maculosa</i> *		Exotic
<i>Phormium tenax</i>	Flax, Harekeke	Endemic
<i>Pinus pinaster</i> *	Cluster pine	Exotic
<i>Podocarpus totara</i>	Totara	Endemic
<i>Pteridium esculentum</i>	Bracken	Non-endemic
<i>Pyrrhosia eleagnifolia</i>	Leather-leaf fern	Endemic
<i>Ranunculus repens</i> *	Creeping buttercup	Exotic
<i>Schedonorus arundinaceus</i> *	Tall fescue	Exotic
<i>Schefflera digitata</i>	Pate, Seven-finger	Endemic
<i>Schoenus maschalinus</i>	Dwarf bog rush	Non-endemic
<i>Schoenus pauciflorus</i>	Bog rush	Endemic
<i>Schoenus tendo</i>	Wīwī	Endemic
<i>Tmesipteris lanceolata</i>		Indigenous
<i>Tradescantia fluminensis</i> *	Tradescantia, Wandering Jew	Exotic
<i>Typha orientalis</i>	Raupo	Non-endemic
<i>Ulex europaeus</i> *	Gorse	Exotic
<i>Uncinia banksii</i>		Endemic
<i>Uncinia uncinata</i>	Dense sedge, Hookgrass	Non-endemic
<i>Weinmannia silvicola</i>	Tawhero	Endemic

8. OTAKAIRANGI SWAMP GOVERNMENT PURPOSE WILDLIFE MANAGEMENT RESERVE



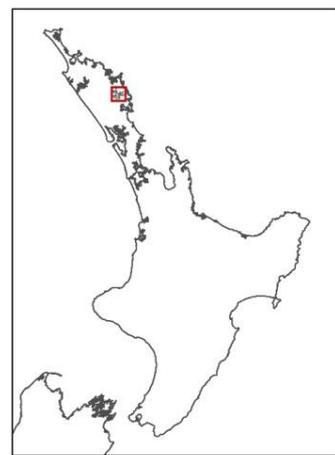
Legend

- Public Conservation Land
- Significant Natural Area
- Additional Natural Area

Plots

- Wetland, Protected
- Wetland, Private Land
- Non Area, Protected
- Non Area, Private Land

Hikurangi Restoration



Location:

A large peat bog remnant on the western part of the Hikurangi floodplain bounded to the north by regenerating scrub and forest on hillslope (Otakairangi North Natural Area). It is the largest natural area on the floodplain, totalling c. 265.9 ha and protected as GPWMR. A small portion extends onto private land on the north-east boundary (not included in the total area).

Coordinates: E1706257 N6060150

Vegetation Types:

- Mānuka shrubland
- Tangle fern fernland, mānuka/tangle fern fernland, mānuka/tangle fern-wire rush fernland
- Wire rush restiadland
- *Machaerina teretifolia*/tangle fern sedgeland
- Harakeke flaxland (along drain and northern pockets)
- Raupo reedland (very small area at northern margin)
- Blackberry scrub (margins)
- *Calystegia*-reed sweet grass vineland (alongside drain)

Description:

The peat bog is bisected by a deep drain ('Otakairangi Stream'), which runs in a NW to SE direction through the middle of the remnant. The main vegetation type is tall mānuka shrubland over a dense understorey of tangle fern. The central, less modified parts away from the drain have open patches and mosaics of peatland vegetation, including wire rush (*Empodisma robustum*), tangle fern, *Machaerina teretifolia*, and *Schoenus brevifolius*. These areas have the deepest peats (up to 5.3 m; Plot OTW5) and the lowest nutrient levels. Moving away from the central cores, harakeke becomes prominent along with swamp coprosma (*Coprosma tenuicaulis*), *Machaerina rubiginosa*, *Blechnum minus*, *Tetraria capillaris*, *Carex maorica*, and *C. lessoniana*. Along the drain and remnant margins, exotic species dominate, including blackberry, reed sweetgrass, Yorkshire fog, tall fescue, cocksfoot, and many other pasture weeds and grasses. *Calystegia sepium* (alongside drain), raupo (in wetter pockets), harakeke, wheki, and mamaku are also common near the margins.

Significance:

Otakairangi Swamp, albeit modified, is the only remnant of a raised bog type that once covered large areas of the Hikurangi floodplain (Davoren 1978). Macrofossil analysis of peat cores collected from Plots OTW5 and OTW10 showed the peat-forming species, *Sporadanthus ferrugineus*, was historically present (A. Homes, University of Victoria, pers. comm, 2015); however, the species is fire-sensitive (Clarkson 1997) and was probably removed by regular fires during the European settlement phase. There is potential to re-establish *Sporadanthus ferrugineus* and its invertebrate commensal 'Fred the Thread' (*Houdinia flexilissima*) (both threatened species) at Otakairangi Swamp, based on current work in the Waikato (Peters & Clarkson 2009:

<http://www.landcare.org.nz/files/file/317/recreating-restiad-wetlands.pdf>) so the original

peat-forming processes can be resumed. This would make Otakairangi Swamp the only site in Northland to have an example of the naturally rare ecosystem *Sporadanthus* domed bog <http://www.landcareresearch.co.nz/publications/factsheets/rare-ecosystems/wetlands/domed-bogs>.

The bog provides habitat for a large number of threatened animal species. Those recorded during the survey were North Island fernbird and black mudfish, and Manning (2001) lists Australasian bittern, spotless crane and tuna. In addition, the large native orb weaver spider (*Backobourkia brounii*) was recorded (near Plot OTW10), a new record for the Hikurangi floodplain, and under threat of becoming locally extirpated because of the extensive loss of wetland habitat in the region.

Five regionally uncommon plant species were recorded in the remnant, *Empodisma robustum*, *Coprosma rigida*, *C. tenuicaulis*, *Drosera binata*, and *Sphagnum cristatum*. In addition, besides *E. robustum*, *D. binata*, and *S. cristatum*, the fen/bog species, *Tetraria capillaris*, *Thelymitra cyanea*, and *Gleichenia dicarpa* were not recorded elsewhere on the floodplain.

The remnant is classified (c.265.6 ha) as a Category 1 threatened land environment, which has <10% indigenous cover remaining, apart from c.0.3 ha in Category 4 (>30% indigenous cover remaining and <10% protected) (Cieraad et al. 2015).

Threats:

- Ongoing lowering of water tables caused by the deep central drain (down to the mineral subsurface layers) and perimeter drains.
- A few individuals of the introduced royal fern *Osmunda regalis* have established and were marked with a GPS for later control.
- Other potentially troublesome weeds such as Chinese privet, reed sweet grass, blackberry and parrot's feather are mainly in modified peripheral areas.
- Fire, particularly in dry periods, is a potential threat to the sustainability of the peat bog and will release the carbon (stored as peat) into the atmosphere. The peat forming species, wire rush and *Sporadanthus ferrugineus* (if re-established) are particularly susceptible to being killed by fire.

Recommendations:

- Raise water tables, e.g. by installing weirs, or bunds, in the central drain and marginal drains. This will slow the rate of peat decomposition and peat shrinkage, enhance habitat for oligotrophic peatland plants, and minimise damage caused by fire.
- Eradicate royal fern while numbers are still low, as it is a major weed in peatlands elsewhere, e.g. Waikato region.
- Re-establish *Sporadanthus ferrugineus* sourced from the Waikato in the centre of Otakairangi Swamp. This will involve an investigation to determine the most suitable site in terms of vegetation, peat nutrients and peat depths, for growth of *Sporadanthus*, based on species-environmental models developed in Clarkson (2004).

- Establish and showcase a population of *Sporadanthus* and ‘Fred the Thread’ at an accessible site on the floodplain, together with interpretation, for public information and education.

WETLAND PLOT SHEET

Wetland name: Otakairangi Swamp **Date:** 26-Nov-14 **Plot no:** 1 (OTW1)
Plot size (2 × 2 m default): 2x2 **Altitude:** 98 m a.s.l. **GPS/GR:** 1706076 6060247
Field leader: BRC, SB, FG, LF **Structure:** Vineland
Composition: Calystegia-reed sweetgrass

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Calystegia sepium</i>	50	0.3						
<i>Glyceria maxima</i> *	25	0.35						
<i>Ranunculus repens</i> *	15	0.27						
<i>Agrostis stolonifera</i> *	5	0.17						
<i>Lotus pedunculatus</i> *	3	0.2						
<i>Galium aparine</i> *	1	0.32						
<i>Sonchus oleraceus</i> *	1	0.19						

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Juncus sarophorus*, *Galium palustre**

Comments: Native yellow vegetable bug. *Helix aspersa**. Mean canopy height 0.3. Peat 0–50 cm H8–H7, >–50 cm H5. Peat depth 3.43 m – clay bottom.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	50	2	
Understorey: % cover introduced spp ³	0	5	
Total species: % number introduced spp	86	1	
Total species: overall stress/dieback	NA	5	
Total /20	NA	13	

²5=0%: none, 4=1–24%: very low, 3=25–49%: low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements:

Water table cm	<–60	Water conductivity uS (if present)	
Water pH (if present)		Von Post peat decomposition index	8

Soil core laboratory analysis (2 soil core subsamples):

Water content % dry weight	202	Total C %	18.64
Bulk Density T/m ³	0.301	Total N %	1.38
pH	4.49	Total P %	0.112
Conductivity uS	0.50	Total K %	0.521

Foliage laboratory analysis (leaf/culm sample of dominant canopy species):

Species	%C	%N	%P	%K
<i>Calystegia sepium</i>	47.9	4.21	0.414	2.4

WETLAND PLOT SHEET

Wetland name: Otakairangi Swamp **Date:** 26-Nov-14 **Plot no:** 2 (OTW2)
Plot size (2 × 2 m default): 2x2 **Altitude:** 100 m a.s.l. **GPS/GR:** 1706404 6059889
Field leader: BRC, SB, FG, LF **Structure:** Restiadland **Composition:** Wirerush

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Empodisma robustum</i>	80	1						
<i>Gleichenia dicarpa</i>	14	0.97						
<i>Machaerina teretifolia</i>	6	1.51						
<i>Blechnum minus</i>	0.5	0.3						

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Blechnum minus*, *Coprosma tenuicaulis*, *Leptospermum scoparium*, *Phormium tenax*, *Schoenus brevifolius*, *Tetraria capillaris*

Comments: Understorey too dense for ground cover species. Mean canopy height 1 m. Peat 5.3 m deep. Cluster roots forming, dark paper wasps nearby.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp ³	0	5	
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	NA	5	
Total /20	NA	20	

²5=0%: none, 4=1–24%: very low, 3=25–49%: low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements: T = 13.5°C

Water table cm	-16	Water conductivity uS (if present)	112.6
Water pH (if present)	4.8	Von Post peat decomposition index	3

Soil core laboratory analysis (2 soil core subsamples):

Water content % dry weight	746	Total C %	35.93
Bulk Density T/m ³	0.086	Total N %	1.18
pH	4.39	Total P %	0.068
Conductivity uS	1.38	Total K %	0.367

Foliage laboratory analysis (leaf/culm sample of dominant canopy species):

Species	%C	%N	%P	%K
<i>Empodisma robustum</i>	48.9	1.05	0.049	2.121
<i>Leptospermum scoparium</i>	53.5	1.61	0.116	0.578

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET**Site name:** Otakairangi Swamp**Date:** 26-Nov-14**Plot no:** 3 (OTNA3)**Altitude:** 100 m a.s.l.**GPS E:** 1706380**N:** 6059889**Recorder:** BRC, LF, SB, FC**Veg structure:** Fernland**Composition¹:** *Gleichenia dicarpa***Canopy Mean hgt:** 0.65 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Gleichenia dicarpa</i>	85	0.9				<i>Bryophyta sp.</i>	1	
<i>Machaerina teretifolia</i>	10	1.56				<i>Campylopus sp.</i>	1	
<i>Leptospermum scoparium</i>	3	2.5				<i>Dianella haemata</i>	0.5	
<i>Blechnum minus</i>	0.5	0.7				<i>Hypochaeris radicata*</i>	0.5	
<i>Coprosma tenuicaulis</i>	0.5	1.6						
<i>Phormium tenax</i>	0.5	2						
<i>Tetraria capillaris</i>	0.5	0.92						
<i>Usnea sp.</i>	0.5							
<i>Bryophyta sp.</i>								
<i>Campylopus sp.</i>								

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by ***Comments:** Peat depth 5.3 m. Fern bird, cicada. Dense understory. *Empodisma robustum* plot nearby (Plot OTW2). Very dense understorey.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET

Site name: Otakairangi Swamp **Date:** 26-Nov-14 **Plot no:** 4 (OTW4)
Altitude: 97 m a.s.l. **GPS E:** 1706444 **N:** 6059961
Recorder: BRC, LF, SB, FC **Veg structure:** Fernland
Composition¹: *Gleichenia dicarpa* - *Machaerina rubiginosa* **Canopy Mean hgt:** 2.3 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Gleichenia dicarpa</i>	40	1.7	<i>Coprosma tenuicaulis</i>	2				
<i>Machaerina rubiginosa</i>	35	2.3	<i>Blechnum minus</i>	0.5				
<i>Coprosma tenuicaulis</i>	10	2.3	<i>Coprosma ×cunninghamii</i>	0.5				
<i>Leptospermum scoparium</i>	8	4.5						
<i>Phormium tenax</i>	6	2.2						
<i>Coprosma ×cunninghamii</i>	0.5	1.7						
<i>Glyceria maxima</i> *	0.5							
<i>Rubus</i> ×sp.	0.5							

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: Emergent mānuka over fernland – dying and not regenerating. Moribund. Peat depth 2.95 m. Understorey very dense.

WETLAND PLOT SHEET

Wetland name: Otakairangi Swamp **Date:** 26-Nov-14 **Plot no:** 5 (OTW5)
Plot size (×2 × 2 m default): 2x2 **Altitude:** 96 m a.s.l. **GPS/GR:** 1713014 6058666
Field leader: BRC, SB, FG, LF **Structure:** Fernland
Composition: Mānuka/ tanglefern-wirerush

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Gleichenia dicarpa</i>	45	1.6	<i>Gleichenia dicarpa</i>	45				
<i>Empodisma robustum</i>	30	1.5	<i>Empodisma robustum</i>	30				
<i>Leptospermum scoparium</i>	25	4.8						

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type:

Comments: No groundcover species as understorey too dense. Mean canopy height, near ditch = 1.7 m. Female *Empodisma*. Mānuka cover. Peat depth 3.3 m.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp3	1	4	
Total species: % number introduced spp	25	3	
Total species: overall stress/dieback	NA	5	
Total /20	NA	17	

²5=0%: none, 4=1–24%: very low, 3=25–49%: low, 2=50–75%: medium, 1=76–99%: high, 0=100%: v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements: T = 14°C

Water table cm	–19	Water conductivity uS (if present)	72.3
Water pH (if present)	4.52	Von Post peat decomposition index	9

Soil core laboratory analysis (2 soil core subsamples):

Water content % dry weight	739	Total C %	35.51
Bulk Density T/m ³	0.103	Total N %	1.52
pH	4.26	Total P %	0.065
Conductivity uS	0.58	Total K %	0.249

Foliage laboratory analysis (leaf/culm sample of dominant canopy species):

Species	%C	%N	%P	%K
<i>Empodisma robustum</i>	48.7	1.28	0.061	1.128
<i>Gleichenia dicarpa</i>	50.2	1.30	0.068	1.181
<i>Leptospermum scoparium</i>	53.8	1.30	0.062	0.32

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET

Site name: Otakairangi Swamp **Date:** 26-Nov-14 **Plot no:** 6 (OTNA6)
Altitude: 96 m a.s.l. **GPS E:** 1706716 **N:** 6059782
Recorder: BRC, LF **Veg structure:** Fernland
Composition¹: *Gleichenia dicarpa* **Canopy Mean hgt:** 0.75 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Gleichenia dicarpa</i>	80	0.8						
<i>Machaerina teretifolia</i>	10	1.3						
<i>Schoenus brevifolius</i>	8	1.4 5						
<i>Leptospermum scoparium</i>	2	3.5						
<i>Phormium tenax</i>	0.5	1.5						

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: Dense vegetation – no groundcover species recorded. Peat depth 3.3 m. Fernbird. Nearby *Coprosma tenuicaulis* & *Machaerina rubiginosa*. Sparse mānuka not regenerating very much. Near Plot OT5. Water pH = 4.5.

WETLAND PLOT SHEET

Wetland name: Otakairangi Swamp **Date:** 21-Feb-15 **Plot no:** 10 (OTW10)
Plot size (2 × 2 m default): 2×2 **Altitude:** 98 m a.s.l. **GPS/GR:** 1706666 6059465
Field leader: BRC, SB **Structure:** Sedgeland **Composition:** MACter/GLEdic

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Machaerina teretifolia</i>	55	120						
<i>Gleichenia dicarpa</i>	30	0.75						
<i>Schoenus brevifolius</i>	15	0.9						
<i>Drosera binata</i>	0.01	0.5						
<i>Leptospermum scoparium</i>	0.01	0.8						

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Phormium tenax*

Comments: Very dry. Peat depth 2.9 m. Nearby veg = (mānuka)/MACter - *Gleichenia* - (*Schoenus*) (*Empodisma robustum*) patches, occasional *Phormium*. Fernbird nearby, *Dolomedes minor* (nurseryweb spider), harrier, swallow, *Backobourkia brounii* (orbweaver spider).

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp ³	0	5	
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	NA	5	
Total /20	NA	20	

²5=0%: none, 4=1–24%: very low, 3=25–49%: low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements: T = 16.8 °C

Water table cm	–23	Water conductivity uS (if present)	78.6
Water pH (if present)	4.49	Von Post peat decomposition index	8

Soil core laboratory analysis (2 soil core subsamples):

Water content % dry weight	554	Total C %	37.81
Bulk Density T/m ³	0.090	Total N %	1.62
pH	4.06	Total P %	0.042
Conductivity uS	0.53	Total K %	0.166

Foliage laboratory analysis (leaf/culm sample of dominant canopy species):

Species	%C	%N	%P	%K
<i>Leptospermum scoparium</i>	53.0	1.22	0.050	0.37
<i>Machaerina teretifolia</i>	48.0	0.92	0.031	0.59

OTAKAIRANGI SWAMP GPWMR PLANT SPECIES LIST

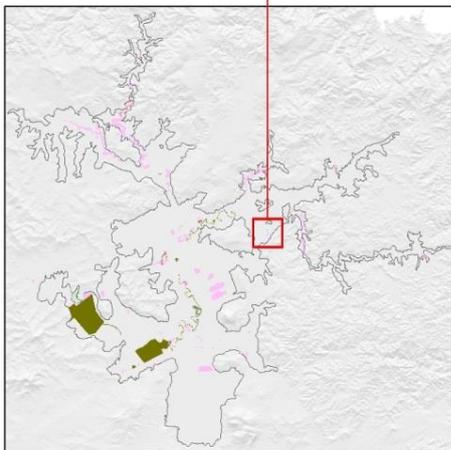
Species	CommonName	Status
<i>Agrostis stolonifera</i> *	Creeping bent	Exotic
<i>Alopecurus geniculatus</i> *	Kneed foxtail	Exotic
<i>Blechnum minus</i>	Swamp kiokio	Non-endemic
<i>Callitriche muelleri</i>	Mueller's starwort	Endemic
<i>Callitriche stagnalis</i> *	Starwort	Exotic
<i>Calystegia sepium</i> *	Akapōhue	Exotic
<i>Campylopus introflexus</i>	Moss	Non-endemic
<i>Cardamine debilis</i>	New Zealand bitter cress	Endemic
<i>Carex maorica</i>		Endemic
<i>Carex ovalis</i> *		Exotic
<i>Carex secta</i>	Makura	Endemic

<i>Conyza albida</i> *	Broad-leaved fleabane	Exotic
<i>Coprosma ×cunninghamii</i>		Endemic
<i>Coprosma propinqua</i>	Miki, Mingimingi	Endemic
<i>Coprosma rigida</i>		Endemic
<i>Coprosma robusta</i>	Glossy karamu	Endemic
<i>Coprosma tenuicaulis</i>	Hukihuki	Endemic
<i>Cyperus eragrostis</i> *	Umbrella sedge	Exotic
<i>Dactylis glomerata</i> *	Cocksfoot	Exotic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Deparia petersenii</i>	Japanese lady fern	Indigenous
<i>Dianella haemata</i>		Endemic
<i>Dicksonia squarrosa</i>	Atewheki	Endemic
<i>Drosera binata</i>	Forked sundew	Non-endemic
<i>Empodisma robustum</i>	Wire rush	Endemic
<i>Galium aparine</i> *	Cleavers	Exotic
<i>Galium palustre</i> *	Marsh bedstraw	Exotic
<i>Gleichenia dicarpa</i>	Tangle fern	Non-endemic
<i>Glyceria maxima</i> *	Reed sweetgrass	Exotic
<i>Haloragis erecta</i>	Shrubby haloragis	Endemic
<i>Holcus lanatus</i> *	Yorkshire fog	Exotic
<i>Hydrocotyle novae-zeelandiae</i>		Endemic
<i>Hypochoeris radicata</i> *	Catsear	Exotic
<i>Isachne globosa</i>	Swamp millet	Non-endemic
<i>Isolepis habra</i>		Non-endemic
<i>Isolepis prolifera</i>	Three-square	Non-endemic
<i>Juncus antarcticus</i>	Dwarf rush	Non-endemic
<i>Juncus pallidus</i>	Giant rush	Non-endemic
<i>Juncus procerus</i> *		Exotic
<i>Juncus sarophorus</i>	Leafless rush	Non-endemic
<i>Leptospermum scoparium</i>	Mānuka	Non-endemic
<i>Lotus pedunculatus</i> *	Lotus	Exotic
<i>Ludwigia palustris</i> *	Water purslane	Exotic
<i>Machaerina rubiginosa</i>	Common twig rush	Non-endemic
<i>Machaerina teretifolia</i>		Non-endemic
<i>Myosotis laxa</i> subsp. <i>caespitosa</i> *	Water forget-me-not	Exotic
<i>Osmunda regalis</i> *	Royal fern	Exotic
<i>Paspalum vaginatum</i> *	Saltwater paspalum	Exotic
<i>Persicaria maculosa</i> *		Exotic

<i>Phormium tenax</i>	Flax	Endemic
<i>Polycarpon tetraphyllum</i> *	Allseed	Exotic
<i>Polygonum strigosum</i> *		Exotic
<i>Potamogeton crispus</i> *	Curled pondweed	Exotic
<i>Potamogeton ochreatus</i>	Blunt pondweed	Non-endemic
<i>Ranunculus repens</i> *	Creeping buttercup	Exotic
<i>Rubus fruticosus</i> agg.*	Blackberry	Exotic
<i>Rubus</i> xsp.*		Exotic
<i>Schedonorus arundinaceus</i> *	Tall fescue	Exotic
<i>Schoenus brevifolius</i>		Non-endemic
<i>Sonchus oleraceus</i> *	Common sow thistle	Exotic
<i>Sphagnum cristatum</i>		Non-endemic
<i>Tetraria capillaris</i>		Non-endemic
<i>Thelymitra cyanea</i>	Striped sun orchid	Non-endemic
<i>Tradescantia fluminensis</i> *	Tradescantia, Wandering Jew	Exotic
<i>Typha orientalis</i>	Raupo	Non-endemic
<i>Usnea</i> sp	Lichen	Non-endemic

9. OTONGA

Otonga



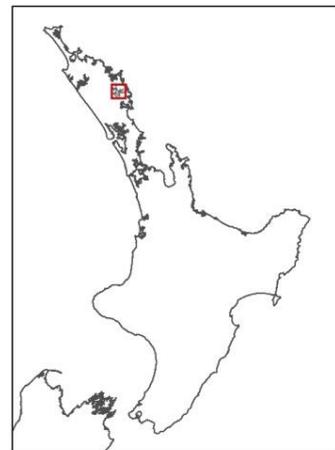
Legend

-  Public Conservation Land
-  Significant Natural Area
-  Additional Natural Area

Plots

-  Wetland, Protected
-  Wetland, Private Land
-  Non Area, Protected
-  Non Area, Private Land

Hikurangi Restoration



Location:

Several small forest remnants totalling c. 3.4 ha on the Hikurangi floodplain, immediately north of Whananaki North Road, c. 1 km north-east of Otonga township.

Coordinates: E 1717251 N6065023 (Plot ONA1); E1717273 N6064877 (Plot ONA2)

Vegetation Types:

- Kahikatea forest

Description:

The two largest remnants (see plot sheets) were dominated by kahikatea up to 30 m tall, with totara a minor associate. Several young totara and kahikatea typically form a subcanopy layer 10–20 m in height. Some of the tall young kahikatea in remnant 1 (Plot ONA1), are in the process of thinning out. Shrub and small trees in the understorey include *Myrsine australis*, cabbage tree, Chinese privet, *Solanum pseudocapsicum*, and hawthorn. Remnant 2 (Plot ONA2) is fenced but has had relatively recent occasional access by stock (B. Cutforth, pers. comm), and has a variety of exotic and native herbs, sedges, ferns and regenerating woody species in the ground cover. Remnant 2 was fenced 7–8 years and stock have been excluded; however, the ground is covered by a dense layer, up to 1 m thick, of *Tradescantia fluminensis*, and very few other species were recorded. A very small wetland is included in remnant 2; this comprises *Eleocharis acuta*, duckweed, and exotic herbs.

At least two other smaller kahikatea forest remnants occur on the same property, north of the remnants; these have been fenced and restoration plantings, e.g. harakeke, cabbage tree, undertaken (viewed from outside).

Significance:

The remnants are representative examples of the lowland floodplain forest ecosystem, now uncommon in the region and throughout New Zealand. It was interesting to compare the two remnants with different scenarios, i.e. low ground cover biodiversity (with dense *Tradescantia fluminensis* carpet) and higher ground cover biodiversity (without dense *Tradescantia fluminensis* carpet) to develop management approaches for the Hikurangi floodplain remnants.

Regionally uncommon species recorded in the remnant include *Coprosma parviflora* and *Coprosma rigida*.

The remnant is classified as a Category 2 threatened land environment, which has 10–20% indigenous cover remaining (Cieraad et al. 2015).

Threats:

- *Tradescantia fluminensis* is smothering ground cover species and likely preventing the regeneration of native species.
- Some other weed species are potentially troublesome, especially Chinese privet

Recommendations:

- Control/management of *Tradescantia fluminensis*. Work is currently underway (Landcare Research/DOC/Fonterra) to assess management options, e.g. occasional light grazing, and/or introduction of *Tradescantia fluminensis* biocontrol beetles.
- Control of Chinese privet.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET

Site name: Otonga

Date: 19-Feb-15

Plot no: 1 (ONA1)

Altitude: 98 m a.s.l.

GPS E: 1717215

N: 6065023

Recorder: BRC, LF, SB, KH

Veg structure: Forest

Composition¹: kahikatea

Canopy Mean hgt: 25 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Dacrycarpus dacrydioides</i>	95	30	<i>Ligustrum sinense</i> *	9	3	<i>Tradescantia fluminensis</i> *	99	1
<i>Podocarpus totara</i>	5	24	<i>Solanum pseudocapsicum</i> *	5	1.2	<i>Microlaena stipoides</i>	5	
			<i>Dacrycarpus dacrydioides</i>	20	16	<i>Carex dissita</i>	<1	
			<i>Podocarpus totara</i>	12	9	<i>Pennisetum clandestinum</i> *	<1	
			<i>Pyrrosia eleagnifolia</i>	1	20			
			<i>Phytolacca octandra</i> *	<1	1.2			
			<i>Ripogonum scandens</i>	<1	9			

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: Tall thin kahikatea, young ones in understory are in process of thinning. Fenced 7-8 years but very species poor in ground cover and dense tradescantia - compared to plot 2.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET

Site name: Otonga

Date: 19-Feb-15

Plot no: 2 (ONA2)

Altitude: 98 m a.s.l.

GPS E: 1717273

N: 6064877

Recorder: BRC, LF, SB, KH

Veg structure: Forest

Composition¹: kahikatea

Canopy Mean hgt: 20 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Dacrycarpus dacrydioides</i>	95	20	<i>Dacrycarpus dacrydioides</i>	9	15	<i>Prunella vulgaris</i> *	4	
<i>Podocarpus totara</i>	4	12	<i>Crataegus monogyna</i> *	6	5	<i>Microlaena stipoides</i>	30	
<i>Muehlenbeckia australis</i>	2	18	<i>Solanum pseudocapsicum</i> *	5	1.6	<i>Tradescantia fluminensis</i> *	30	
			<i>Cordyline australis</i>	4	8	<i>Fragaria vesca</i> *	3	
			<i>Podocarpus totara</i>	30	9	<i>Oenanthe pimpinelloides</i> *	2	
			<i>Metrosideros diffusa</i>	2	8.5	<i>Carex lambertiana</i>	18	
			<i>Ligustrum sinense</i> *	1	1	<i>Leucobryum</i>	1	
			<i>Myrsine divaricata</i>	1	1.5	<i>Alectryon excelsus</i>	<1	
			<i>Pittosporum tenuifolium</i>	1	2.5	<i>Asplenium polyodon</i>	<1	
			<i>Pyrrosia eleagnifolia</i>	1	18	<i>Carex virgata</i>	<1	
			<i>Coprosma rhamnoides</i>	<1	1.1	<i>Dacrycarpus dacrydioides</i>	<1	
			<i>Coprosma rigida</i>	<1	1	<i>Doodia australis</i>	<1	
			<i>Coprosma robusta</i>	<1	2	<i>Ehrharta erecta</i> *	<1	
			<i>Leucopogon fasciculatus</i>	<1	0.5	<i>Galium palustre</i> *	<1	
			<i>Parsonsia heterophylla</i>	<1	18	<i>Lapsana communis</i> *	<1	
			<i>Prunus sp.</i>	<1	1.4	<i>Microsorium scandens</i>	<1	
						<i>Muehlenbeckia australis</i>	<1	
						<i>Phyllocladus trichomanoides</i>	<1	
						<i>Rubus fruticosus</i> *	<1	
						<i>Rumex conglomeratus</i> *	<1	
						<i>Taraxacum officinale</i> *	<1	
						<i>Zantedeschia aethiopica</i> *	<1	

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: Less tradescantia than Plot 1; higher species diversity in ground cover.

OTONGA PLANT SPECIES LIST

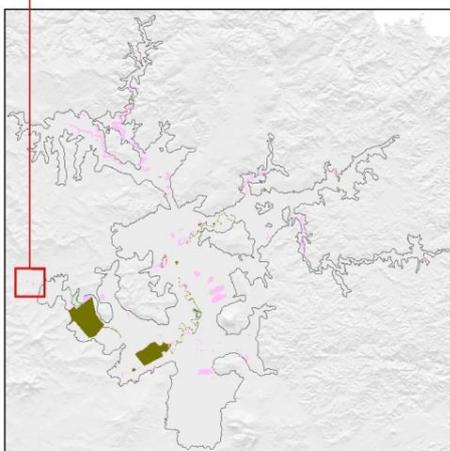
Species	CommonName	Status
<i>Alectryon excelsus</i>	New Zealand oak, Titoki	Endemic
<i>Asplenium polyodon</i>	Peretao	Non-endemic
<i>Bromus willdenowii</i> *	Prairie grass	Exotic
<i>Calystegia sepium</i> *	Akapōhue	Exotic
<i>Carex dissita</i>		Endemic
<i>Carex lambertiana</i>		Endemic
<i>Carex ovalis</i> *	Oval sedge	Exotic
<i>Carex virgata</i>		Endemic
<i>Carex vulpinoidea</i> *	Fox sedge	Exotic
<i>Centella uniflora</i>	Centella	Non-endemic
<i>Cirsium vulgare</i> *	Boar thistle	Exotic
<i>Coprosma ×cunninghamii</i>		Endemic
<i>Coprosma areolata</i>	Thin-leaved coprosma	Endemic
<i>Coprosma parviflora</i>	Leafy coprosma	Endemic
<i>Coprosma rhamnoides</i>		Endemic
<i>Coprosma rigida</i>		Endemic
<i>Coprosma robusta</i>	Glossy karamu	Endemic
<i>Cordyline australis</i>	Cabbage tree	Endemic
<i>Cotoneaster glaucophyllus</i> *	Cotoneaster	Exotic
<i>Crataegus monogyna</i> *	Hawthorn	Exotic
<i>Cyathea dealbata</i>	Ponga, Silver fern	Endemic
<i>Cyperus eragrostis</i> *	Puketangata	Exotic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Dacrydium cupressinum</i>	Rimu	Endemic
<i>Deparia petersenii</i>	Japanese lady fern	Indigenous
<i>Dicksonia squarrosa</i>	Wheki, Rough tree fern	Endemic
<i>Diplazium australe</i>		Indigenous
<i>Doodia australis (Blechnum parrisiae)</i>		Indigenous
<i>Ehrharta erecta</i> *	Veldt grass	Exotic
<i>Eleocharis acuta</i>	Club rush	Non-endemic
<i>Fragaria vesca</i> *	Alpine strawberry	Exotic
<i>Galium palustre</i> *	Marsh bedstraw	Exotic
<i>Glyceria maxima</i> *	Reed sweetgrass	Exotic
<i>Hoheria populnea</i>	Hoheria, Lacebark	Endemic
<i>Holcus lanatus</i> *	Yorkshire fog	Exotic

<i>Hypochaeris radicata</i> *	Catsear	Exotic
<i>Juncus edgariae</i>		Endemic
<i>Juncus effusus</i> *	Common rush	Exotic
<i>Lapsana communis</i> *	Nipplewort	Exotic
<i>Lemna disperma</i>	Duckweed	Non-endemic
<i>Leucobryum candidum</i>	Moss	Non-endemic
<i>Leucopogon fasciculatus</i>	Mingimingi	Endemic
<i>Ligustrum lucidum</i> *	Broadleaf privet	Exotic
<i>Ligustrum sinense</i> *	Chinese privet	Exotic
<i>Ludwigia palustris</i> *	Water purslane	Exotic
<i>Melicytus ramiflorus</i>	Mahoe, Whiteywood	Non-endemic
<i>Mentha pulegium</i> *	European pennyroyal mint	Exotic
<i>Mentha spicata</i> *	Mint	Exotic
<i>Metrosideros diffusa</i>	White rātā, Climbing rātā	Endemic
<i>Microlaena stipoides</i>	Meadow rice grass	Non-endemic
<i>Microsorium scandens</i>		Indigenous
<i>Mimulus guttatus</i> *	Monkey musk	Exotic
<i>Muehlenbeckia australis</i>	Large-leaved muehlenbeckia	Non-endemic
<i>Myosotis arvensis</i> *	Field forget-me-not	Exotic
<i>Myrsine australis</i>	Māpau, Red matipo	Endemic
<i>Myrsine divaricata</i>	Weeping mapou	Endemic
<i>Oenanthe pimpinelloides</i> *	Parsley dropwort	Exotic
<i>Parsonsia heterophylla</i>	Akakaikiore	Endemic
<i>Paspalum dilatatum</i> *	paspalum	Exotic
<i>Paspalum distichum</i> *	Mercer grass	Exotic
<i>Pennisetum clandestinum</i> *	Kikuyu grass	Exotic
<i>Persicaria decipiens</i>		Non-endemic
<i>Persicaria strigosa</i> *		Exotic
<i>Phyllocladus trichomanoides</i>	Celery pine, Tanekaha	Endemic
<i>Phytolacca octandra</i> *	Dyeberry	Exotic
<i>Pittosporum tenuifolium</i>	Black matipo	Endemic
<i>Plagianthus regius</i>	Manatu, Lowland ribbonwood	Endemic
<i>Podocarpus totara</i>	Totara	Endemic
<i>Polygonum sp.*</i>		Exotic
<i>Prunella vulgaris</i> *	Self-heal	Exotic
<i>Prunus sp.*</i>	Cherry	Exotic
<i>Pyrrosia eleagnifolia</i>	Leather-leaf fern	Endemic
<i>Ranunculus flammula</i> *	Spearwort	Exotic

<i>Ranunculus repens</i> *	Creeping buttercup	Exotic
<i>Rhopalostylis sapida</i>	Nikau	Endemic
<i>Ripogonum scandens</i>	Supplejack	Endemic
<i>Rubus australis</i>	Bush lawyer	Endemic
<i>Rubus fruticosus</i> *	Blackberry	Exotic
<i>Rumex conglomeratus</i> *	Clustered dock	Exotic
<i>Rumex obtusifolius</i> *	Broad-leaved dock	Exotic
<i>Senecio bipinnatisectus</i> *	Australian fireweed	Exotic
<i>Solanum nigrum</i> *	Black nightshade	Exotic
<i>Solanum pseudocapsicum</i> *	Christmas cherry	Exotic
<i>Sonchus oleraceus</i> *	Common sow thistle	Exotic
<i>Taraxacum officinale</i> *	Dandelion	Exotic
<i>Tradescantia fluminensis</i> *	Tradescantia, wandering Jew	Exotic
<i>Trifolium repens</i> *	White clover	Exotic
<i>Ulex europaeus</i> *	Gorse	Exotic
<i>Zantedeschia aethiopica</i> cv. Green Goddess*	Green goddess	Exotic

10. RIPONU ROAD

Riponui Road



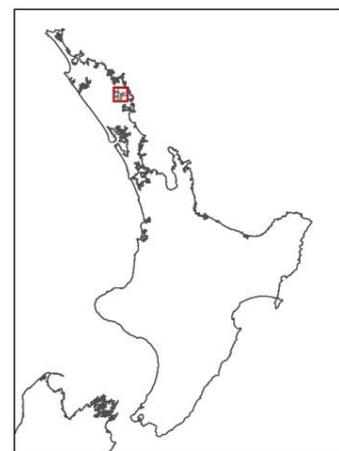
Legend

- Public Conservation Land
- Significant Natural Area
- Additional Natural Area

Plots

- Wetland, Protected
- Wetland, Private Land
- Non Area, Protected
- Non Area, Private Land

Hikurangi Restoration



Location: Small scattered forest remnants totalling c.3.7 ha on the Hikurangi floodplain immediately east of the junction of Riponui and Otakairangi Roads.

Coordinates: E1703284 N6061971 (RipNA1)

Vegetation Types:

- Kahikatea forest
- Totara–kahikatea forest

Description:

The eastern remnant (Plot RipRA1) is dominated by kahikatea up to 25 m tall, with occasional pukatea and totara. The understorey is relatively sparse, and typically comprises frequent *Solanum pseudocapsicum* and occasional totara, Chinese privet, *Coprosma areolata*, and barberry. Exotic herbs and grasses dominate the groundcover, with *Tradescantia fluminensis* locally abundant. Native ground cover species are sparse and included *Microlaena stipoides*, *Carex virgata*, *Carex lambertiana*, *Adiantum hispidulum*, *Deparia petersenii*, and kahikatea seedlings. The remnant is not securely fenced and cattle have had recent access as evidenced by several cow pats scattered throughout.

Totara dominates the canopy in the western remnant (adjacent to the race) with associates of kahikatea (common) and titoki (infrequent). The trees here are more scattered, with evidence of past logging of totara. The understorey and ground cover layers are similar to the eastern remnant although more stock damage is evident and rank pasture species are common.

Significance:

The remnants are representative examples of lowland floodplain forest ecosystems, now uncommon in the region and throughout New Zealand.

The nationally at risk – naturally uncommon herb *Geranium solanderi* was recorded in the remnant, along with the regionally uncommon tree, matai.

The remnant is classified as a Category 1 threatened land environment, which has <10% indigenous cover remaining (Cieraad et al. 2015).

Threats:

- Cattle browsing and trampling
- Hares, possums and other mammalian pests
- Weeds, e.g. *Tradescantia fluminensis*, *Solanum pseudocapsicum*, Chinese privet, broadleaf privet.

Recommendations:

- Stockproof fences around remnants
- Consider pest control where necessary
- Control of troublesome weeds, particularly Chinese privet, broadleaf privet and *Tradescantia fluminensis*.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET**Site name:** Riponui Road**Date:** 17-Feb-15**Plot no:** 1 (RipNA1)**Altitude:** 109 m a.s.l.**GPS E:** 1703284**N:** 6061971**Recorder:** BRC**Veg structure:** Forest**Composition¹:** kahikatea**Canopy Mean hgt:** 22 m (–25 m)

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Dacrycarpus dacrydioides</i>	98	25	<i>Solanum pseudocapsicum</i> *	20	1.5	<i>Dactylis glomerata</i> *	6	
<i>Laurelia novae-zelandiae</i>	2	18	<i>Podocarpus totara</i>	2	4	<i>Microlaena stipoides</i>	5	0.3
			<i>Ligustrum sinense</i> *	1	3	<i>Tradescantia fluminensis</i> *	30	
			<i>Berberis glaucocarpa</i> *	<1	2	<i>Carex virgata</i>	3	
			<i>Coprosma areolata</i>	<1	2.5	<i>Cyperus eragrostis</i> *	2	
			<i>Hedycarya arborea</i>	<1	6	<i>Solanum pseudocapsicum</i> *	15	0.5
			<i>Pyrrosia eleagnifolia</i>	<1	4	<i>Oplismenus imbecillis</i>	1	
						<i>Adiantum hispidulum</i>	<1	
						<i>Berberis glaucocarpa</i> *	<1	
						<i>Carex lambertiana</i>	<1	
						<i>Dacrycarpus dacrydioides</i>	<1	
						<i>Deparia petersenii</i>	<1	
						<i>Galium aparine</i> *	<1	
						<i>Ludwigia palustris</i> *	<1	
						<i>Muehlenbeckia australis</i>	<1	
						<i>Phytolacca octandra</i> *	<1	
						<i>Solanum nigrum</i> *	<1	

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: Cattle dung in remnant. Needs fencing, weed control. Drainage, hares, pests, logging of totara.

Other remnant = totara (70%) - kahikatea (25%) - titoki (5%). Scattered trees, logged totara, some with branches trimmed. Understory and ground cover similar. Animal access.

Streams have interesting ferns on bank sides.

Less tradescantia in totara, probably due to grazing.

RIPONUI ROAD PLANT SPECIES LIST

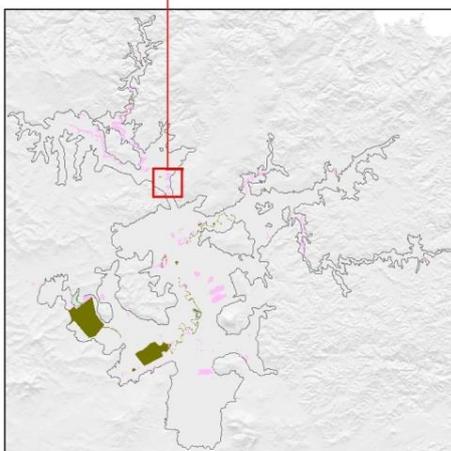
Species	CommonName	Status
<i>Adiantum hispidulum</i>	Rosy maidenhair	Non-endemic
<i>Ageratina riparia</i> *	Mist flower	Exotic
<i>Alectryon excelsus</i>	New Zealand oak, Titoki	Endemic
<i>Alternanthera nahui</i>		Non-endemic
<i>Anagallis arvensis</i> *	Blue pimpernel	Exotic
<i>Berberis glaucocarpa</i> *	Barberry	Exotic
<i>Bidens frondosa</i> *	Beggars' ticks	Exotic
<i>Blechnum chambersii</i>	Lance fern	Non-endemic
<i>Blechnum minus</i>	Swamp kiokio	Non-endemic
<i>Blechnum nigrum</i>	Black hard fern	Indigenous
<i>Calystegia sepium</i> *	Akapōhue	Exotic
<i>Carex lambertiana</i>		Endemic
<i>Carex ovalis</i> *	Oval sedge	Exotic
<i>Carex virgata</i>		Endemic
<i>Cirsium vulgare</i> *	Boar thistle	Exotic
<i>Collospermum hastatum</i>	Kahakaha	Endemic
<i>Conyza sumatrensis</i> *	Broad-leaved fleabane	Exotic
<i>Coprosma areolata</i>	Thin-leaved coprosma	Endemic
<i>Coprosma rhamnoides</i>		Endemic
<i>Cordyline australis</i>	Cabbage tree	Endemic
<i>Cyperus eragrostis</i> *	Puketangata	Exotic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Dacrydium cupressinum</i>	Rimu	Endemic
<i>Dactylis glomerata</i> *	Cocksfoot	Exotic
<i>Deparia petersenii</i>	Japanese lady fern	Indigenous
<i>Diplazium australe</i>		Indigenous
<i>Doodia australis (Blechnum parrisiae)</i>		Indigenous
<i>Drymoanthus adversus</i>		Endemic
<i>Fragaria vesca</i> *	Alpine strawberry	Exotic
<i>Galium aparine</i> *	Cleavers	Exotic
<i>Galium divaricatum</i> *	Slender bedstraw	Exotic
<i>Geranium solanderi</i>	Matua-kūmara	Non-endemic
<i>Glyceria maxima</i> *	Reed sweetgrass	Exotic
<i>Haloragis erecta</i>	Shrubby haloragis	Endemic
<i>Hedera helix</i> *	English ivy	Exotic

<i>Hedycarya arborea</i>	Pigeon wood, Porokaiwhiri	Endemic
<i>Hypolepis ambigua</i>		Endemic
<i>Isolepis sepulcralis</i> *		Exotic
<i>Juglans ailantifolia</i> *	Japanese walnut	Exotic
<i>Juncus effusus</i> *	Common rush	Exotic
<i>Juncus tenuis</i> *	Track rush	Exotic
<i>Knightia excelsa</i>	Rewarewa	Endemic
<i>Landoltia punctata</i> *	Purple-backed duckweed	Exotic
<i>Lapsana communis</i> *	Nipplewort	Exotic
<i>Lastreopsis glabella</i>	Smooth shield fern	Endemic
<i>Lastreopsis hispida</i>	Hairy fern	Non-endemic
<i>Laurelia novae-zelandiae</i>	Pukatea	Endemic
<i>Ligustrum lucidum</i> *	Broadleaf privet	Exotic
<i>Ligustrum sinense</i> *	Chinese privet	Exotic
<i>Lotus corniculatus</i> *	Lotus	Exotic
<i>Ludwigia palustris</i> *	Water purslane	Exotic
<i>Melicytus ramiflorus</i>	Mahoe, Whiteywood	Non-endemic
<i>Mentha pulegium</i> *	European pennyroyal mint	Exotic
<i>Metrosideros perforata</i>	White rātā, Akatea	Endemic
<i>Microlaena stipoides</i>	Meadow rice grass	Non-endemic
<i>Muehlenbeckia australis</i>	Large-leaved muehlenbeckia	Non-endemic
<i>Myosotis laxa</i> subsp. <i>caespitosa</i> *	Water forget-me-not	Exotic
<i>Myrsine australis</i>	Māpau, Red Matipo	Endemic
<i>Nasturtium officinale</i> *	Watercress	Exotic
<i>Nestegis lanceolata</i>	White maire	Endemic
<i>Oenanthe pimpinelloides</i> *	Parsley dropwort	Exotic
<i>Oplismenus imbecillis</i>		Non-endemic
<i>Paspalum distichum</i> *	Mercer grass	Exotic
<i>Pennisetum clandestinum</i> *	Kikuyu grass	Exotic
<i>Persicaria hydropiper</i> *		Exotic
<i>Persicaria maculosa</i> *		Exotic
<i>Phytolacca octandra</i> *	Dyeberry	Exotic
<i>Pinus radiata</i> *	Monterey pine	Exotic
<i>Plantago lanceolata</i> *	English plantain	Exotic
<i>Podocarpus totara</i>	Totara	Endemic
<i>Populus sp.</i> *	Aspen	Exotic
<i>Prumnopitys taxifolia</i>	Matai, Black pine	Endemic
<i>Pteris tremula</i>	Bracken	Indigenous

<i>Pyrrosia eleagnifolia</i>	Leather-leaf fern	Endemic
<i>Rubus cissoides</i>	Bush lawyer	Endemic
<i>Rumex</i> sp.*	Dock	Exotic
<i>Rumex conglomeratus</i> *	clustered dock	Exotic
<i>Schedonorus arundinaceus</i> *	Tall fescue	Exotic
<i>Schoenus maschalinus</i>	Dwarf bog rush	Non-endemic
<i>Scrophularia</i>	Figwort	
<i>Senecio jacobaea</i> *	Ragwort	Exotic
<i>Sison amomum</i> *	Stone parsley	Exotic
<i>Solanum nigrum</i> *	Black nightshade	Exotic
<i>Solanum pseudocapsicum</i> *	Christmas cherry	Exotic
<i>Sonchus oleraceus</i> *	Common sow thistle	Exotic
<i>Tradescantia fluminensis</i> *	Tradescantia, Wandering Jew	Exotic

11. WAIOTU

Waiotu



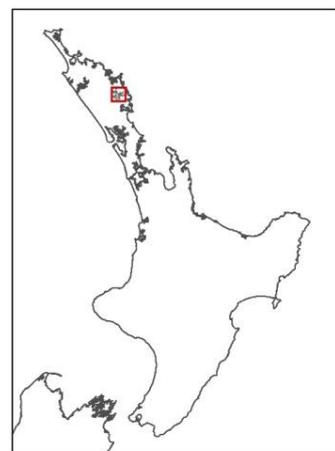
Legend

- Public Conservation Land
- Significant Natural Area
- Additional Natural Area

Plots

- Wetland, Protected
- Wetland, Private Land
- Non Area, Protected
- Non Area, Private Land

Hikurangi Restoration



Location:

Several forest remnants totalling c.14.4 ha along the banks and adjoining floodplain of the Waiotu River.

Coordinates: E1711295 N6067838 (Plot WaiNA1)

Vegetation Types:

- Totara-matai forest (Plot WaiNA1)
- Totara forest
- River banks – mostly exotic dominated

Description:

The remnants are dominated by totara up to 22 m tall, with a variety of canopy associates, e.g. matai (common), lowland ribbonwood (particularly in open areas), kōwhai, kahikatea, white maire, black maire, kānuka, and taraire. Understorey species include *Melicytus micranthus*, *Streblus heterophylla*, *Coprosma rhamnoides*, *Coprosma rotundifolia*, *Melicope simplex*, mahoe, and kawakawa. The ground cover comprises the exotic herbs, *Tradescantia fluminensis* (locally abundant) and *Selaginella kraussiana*, the native grasses *Microlaena stipoides* and *Oplismenus imbecillus*, and occasional seedlings of the trees and shrubs mentioned above.

The remnants are mostly fenced, although some of the fences are in poor condition, and one remnant on the eastern side of the Waiotu River has been intensively grazed.

Several individuals of *Hebe* aff. *bishopiana* Hikurangi Swamp were noted growing on the banks of the Waiotu River.

Significance:

The remnants are representative examples of lowland floodplain forest ecosystems, now uncommon in the region and throughout New Zealand.

The presence of *Hebe* aff. *bishopiana* Hikurangi Swamp (swamp hebe) is notable as it is a threatened species, being classified as Nationally Critical. Two additional threatened species were also recorded, the small rasp ferns, *Doodia squarrosa* (synonym: *Blechnum zeelandicum*) and *Doodia mollis* (syn: *Blechnum molle*), both classified as At Risk – Nationally Uncommon.

Regionally uncommon species recorded in the remnant include black maire, matai, lowland ribbonwood, *Myrsine divaricata*, *Coprosma parviflora*, *Coprosma propinqua*, *Coprosma rotundifolia*, and kaikomako.

The remnants are particularly important in the Hikurangi floodplain because of the relatively large total area, diversity of species, and they incorporate both sides of the river, including the banks, which provide habitat for *Hebe* aff. *bishopiana* Hikurangi Swamp.

Waiotu is classified as threatened land environment Category 2, which has 10–20% indigenous cover remaining (Cieraad et al. 2015).

Threats:

- Stock access
- Weeds, e.g. *Tradescantia fluminensis*, Chinese privet, broadleaf privet.

Recommendations:

- Ensure remnant fences are stockproof.
- Control of weeds if necessary.
- Collect seeds and cuttings of *Hebe* aff. *bishopiana* Hikurangi Swamp for propagation and planting along the river banks on the property (and elsewhere in the district) to increase populations of this threatened species.
- Some weed control is recommended along parts of the river banks covered in exotic species.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET

Site name: Waiotu

Date: 12-Feb-15

Plot no: 1 (WaiNA1)

Altitude: 99 m a.s.l.

GPS E: 1711295

N: 6067838

Recorder: BRC

Veg structure: Forest

Composition¹: totara–matai

Canopy Mean hgt: 21 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Podocarpus totara</i>	50	22	<i>Streblus heterophyllus</i>	5	9	<i>Tradescantia fluminensis</i> *	65	
<i>Prumnopitys taxifolia</i>	30	21	<i>Melicytus ramiflorus</i>	4	4	<i>Selaginella kraussiana</i> *	20	
<i>Plagianthus regius</i>	10	20	<i>Coprosma rhamnoides</i>	2	0.9	<i>Oplismenus imbecillis</i>	2	
<i>Sophora microphylla</i>	7	20	<i>Dacrycarpus dacrydioides</i>	2	7	<i>Microlaena stipoides</i>	10	
<i>Dacrycarpus dacrydioides</i>	3	22	<i>Melicytus micranthus</i>	10	1.5	<i>Arthropteris tenella</i>	1	
			<i>Coprosma rotundifolia</i>	1	3	<i>Doodia australis</i>	1	
			<i>Myrsine australis</i>	1	7	<i>Adiantum raddianum</i> *	<1	
			<i>Arthropteris tenella</i>	<1	2	<i>Beilschmiedia tarairi</i>	<1	
			<i>Coprosma parviflora</i>	<1	0.5	<i>Carex lambertiana</i>	<1	
			<i>Kunzea robusta</i>	<1	0.7	<i>Coprosma arborea</i>	<1	
			<i>Ligustrum lucidum</i> *	<1	1	<i>Corynocarpus laevigatus</i>	<1	
			<i>Macropiper excelsum</i>	<1	0.5	<i>Doodia squarrosa</i>	<1	
			<i>Melicope simplex</i>	<1	1.2	<i>Hedycarya arborea</i>	<1	
						<i>Lonicera japonica</i> *	<1	
						<i>Macropiper excelsum</i>	<1	
						<i>Microsorium pustulatum</i>	<1	
						<i>Nestegis cunninghamii</i>	<1	
						<i>Sophora microphylla</i>	<1	
						<i>Vitex lucens</i>	<1	

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: Drying out, weeds, some fences getting old and in need of repair.

Birds observed: kingfisher, grey warbler, fantail, tui, pukeko, silvereeye.

WAIOTU PLANT SPECIES LIST

Species	CommonName	Status
<i>Adiantum diaphanum</i>	Small maidenhair	Non-endemic
<i>Adiantum hispidulum</i>	Rosy maidenhair	Non-endemic
<i>Adiantum raddianum</i> *	Delta maidenhair fern	Exotic
<i>Ageratina adenophora</i> *	Catspaw	Exotic
<i>Ageratina riparia</i> *	Mist flower	Exotic
<i>Agrostis stolonifera</i> *	Creeping bent	Exotic
<i>Alectryon excelsus</i>	New Zealand oak, Titoki	Endemic
<i>Alopecurus geniculatus</i> *	Kneed foxtail	Exotic
<i>Alternanthera nahui</i>		Non-endemic
<i>Amaranthus retroflexus</i> *	Redroot	Exotic
<i>Arthropteris tenella</i>	Jointed fern	Indigenous
<i>Asplenium flaccidum</i>	Drooping spleenwort	Non-endemic
<i>Asplenium polyodon</i>	Peretao	Non-endemic
<i>Aster subulatus</i> *	Bushy starwort	Exotic
<i>Banksia integrifolia</i> *	Coastal banksia	Exotic
<i>Beilschmiedia tarairi</i>	Taraire	Endemic
<i>Bidens frondosa</i> *	Beggars' ticks	Exotic
<i>Blechnum novae-zelandiae</i>	Horokio	Endemic
<i>Calystegia sepium</i> *	Akapōhue	Exotic
<i>Calystegia tuguriorum</i>	Climbing convolvulus	Non-endemic
<i>Carex lambertiana</i>		Endemic
<i>Carex virgata</i>		Endemic
<i>Collosporum hastatum</i>	Kahakaha	Endemic
<i>Coprosma ×cunninghamii</i>		Endemic
<i>Coprosma arborea</i>	Mamangi	Endemic
<i>Coprosma areolata</i>	Thin-leaved coprosma	Endemic
<i>Coprosma parviflora</i>	Leafy coprosma	Endemic
<i>Coprosma propinqua</i>	Mingimingi	Endemic
<i>Coprosma rhamnoides</i>		Endemic
<i>Coprosma robusta</i>	Glossy karamu	Endemic
<i>Coprosma rotundifolia</i>	Round-leaved coprosma	Endemic
<i>Coprosma spathulata</i>		Endemic

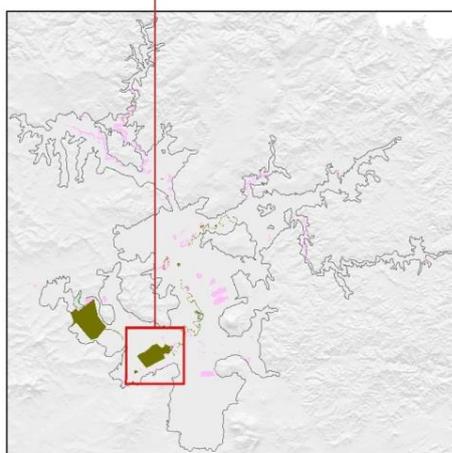
<i>Cordyline australis</i>	Cabbage tree	Endemic
<i>Cortaderia selloana</i> *	Pampas grass	Exotic
<i>Corynocarpus laevigatus</i>	Karaka	Endemic
<i>Crocosmia xrococsmiiflora</i> *	Montbretia	Exotic
<i>Cyathea dealbata</i>	Ponga, Silver fern	Endemic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Dacrydium cupressinum</i>	Rimu	Endemic
<i>Dactylis glomerata</i> *	Cocksfoot	Exotic
<i>Deparia petersenii</i>	Japanese lady fern	Indigenous
<i>Dicksonia squarrosa</i>	Wheki, Rough tree fern	Endemic
<i>Diplazium australe</i>		Indigenous
<i>Doodia australis (Blechnum parrisiae)</i>		Indigenous
<i>Doodia mollis (Blechnum molle)</i>	Mokimoki	Indigenous
<i>Doodia squarrosa (Blechnum zeelandicum)</i>		Indigenous
<i>Drymoanthus adversus</i>		Endemic
<i>Dysoxylum spectabile</i>	Kohekohe	Endemic
<i>Earina mucronata</i>	Bamboo orchid (NZ)	Endemic
<i>Epilobium brunnescens</i>	Creeping willowherb	Endemic
<i>Epilobium nerteroides</i>		Endemic
<i>Galium divaricatum</i> *	Slender bedstraw	Exotic
<i>Galium palustre</i> *	Marsh bedstraw	Exotic
<i>Galium propinquum</i>	Māwe	Non-endemic
<i>Gamochaeta coarctata</i> *		Exotic
<i>Geniostoma rupestre</i>	Hangehange	Non-endemic
<i>Haloragis erecta</i>	Shrubby haloragis	Endemic
<i>Hebe aff. bishopiana</i>		Endemic
<i>Hedycarya arborea</i>	Kaiwhiri	Endemic
<i>Hoheria populnea</i>	Hohere, Lacebark	Endemic
<i>Holcus lanatus</i> *	Yorkshire fog	Exotic
<i>Hypochaeris radicata</i> *	Catsear	Exotic
<i>Juglans ailantifolia</i> *	Japanese walnut	Exotic
<i>Juncus distegus</i>	Leafless rush	Endemic
<i>Juncus edgariae</i>		Endemic
<i>Juncus sarophorus</i>	Leafless rush	Non-endemic
<i>Juncus usitatus</i>	Common rush	Non-endemic
<i>Knightia excelsa</i>	New Zealand honeysuckle, Rewarewa	Endemic
<i>Kunzea robusta (K. ericoides)</i>	Kānuka	Endemic
<i>Landoltia punctata</i> *	Purple-backed duckweed	Exotic

<i>Lapsana communis</i> *	Nipplewort	Exotic
<i>Lastreopsis glabella</i>	Smooth shield fern	Endemic
<i>Laurelia novae-zelandiae</i>	Pukatea	Endemic
<i>Leptospermum scoparium</i>	Mānuka	Non-endemic
<i>Ligustrum lucidum</i> *	Broadleaf privet	Exotic
<i>Ligustrum sinense</i> *	Chinese privet	Exotic
<i>Lonicera japonica</i> *	Japanese honeysuckle	Exotic
<i>Lophomyrtus bullata</i>	New Zealand myrtle, Ramarama	Endemic
<i>Lotus pedunculatus</i> *	Lotus	Exotic
<i>Ludwigia palustris</i> *	Water purslane	Exotic
<i>Macropiper excelsum</i>	Kawakawa, Pepper tree	Endemic
<i>Melicope simplex</i>	Poataniwha	Endemic
<i>Melicytus micranthus</i>	Manakura, Swamp mahoe	Endemic
<i>Melicytus ramiflorus</i>	Mahoe, Whiteywood	Non-endemic
<i>Mentha pulegium</i> *	European pennyroyal mint	Exotic
<i>Metrosideros diffusa</i>	White rātā, Climbing rātā	Endemic
<i>Microlaena stipoides</i>	Meadow rice grass	Non-endemic
<i>Microsorium pustulatum</i>		Indigenous
<i>Muehlenbeckia australis</i>	Large-leaved muehlenbeckia	Non-endemic
<i>Myriophyllum aquaticum</i> *	Brazilian water milfoil	Exotic
<i>Myrsine australis</i>	Māpau, Red matipo	Endemic
<i>Myrsine divaricata</i>	Weeping mapou	Endemic
<i>Nestegis cunninghamii</i>	Black maire	Endemic
<i>Nestegis lanceolata</i>	White maire	Endemic
<i>Oenanthe pimpinelloides</i> *	Parsley dropwort	Exotic
<i>Oplismenus imbecillis</i>		Non-endemic
<i>Parsonsia heterophylla</i>	New Zealand Jasmine	Endemic
<i>Paspalum urvillei</i> *	Vasey grass	Exotic
<i>Pennantia corymbosa</i>	Kaikomako	Endemic
<i>Pennisetum clandestinum</i> *	Kikuyu grass	Exotic
<i>Persicaria decipiens</i>		Non-endemic
<i>Persicaria hydropiper</i> *		Exotic
<i>Persicaria maculosa</i> *		Exotic
<i>Persicaria strigosa</i> *		Exotic
<i>Phormium tenax</i>	Flax, Harakeke	Endemic
<i>Pittosporum tenuifolium</i>	Black matipo	Endemic
<i>Plagianthus regius</i>	Manatu, Lowland ribbonwood	Endemic
<i>Plantago lanceolata</i> *	English plantain	Exotic

<i>Podocarpus totara</i>	Totara	Endemic
<i>Prumnopitys taxifolia</i>	Matai, Black pine	Endemic
<i>Prunus</i> sp.	Cherry	
<i>Pyrrosia eleagnifolia</i>	Leather-leaf fern	Endemic
<i>Quercus ellipsoidalis</i>	Northern pin oak	
<i>Ranunculus repens</i> *	Creeping buttercup	Exotic
<i>Ranunculus sceleratus</i> *	Celery-leaved buttercup	Exotic
<i>Ranunculus trichophyllus</i> *	Water buttercup	Exotic
<i>Ripogonum scandens</i>	Supplejack	Endemic
<i>Rorippa amphibia</i> *	Marsh yellow cress	Exotic
<i>Rubus cissoides</i>	Bush lawyer	Endemic
<i>Rubus fruticosus</i> *	Blackberry	Exotic
<i>Rumex crispus</i> *	Curled dock	Exotic
<i>Salix fragilis</i> *	Crack willow	Exotic
<i>Schoenoplectus tabernaemontani</i>	Lake clubrush	Non-endemic
<i>Schoenus maschalinus</i>	Dwarf bog rush	Non-endemic
<i>Selaginella kraussiana</i> *	African clubmoss	Exotic
<i>Senecio bipinnatisectus</i> *	Australian fireweed	Exotic
<i>Senecio esleri</i>		Endemic
<i>Senecio minimus</i>	Fireweed	Non-endemic
<i>Solanum mauritianum</i> *	Flannel leaf	Exotic
<i>Solanum pseudocapsicum</i> *	Christmas cherry	Exotic
<i>Sophora microphylla</i>	Kōwhai	Endemic
<i>Streblus heterophyllus</i>	Small-leaved milk tree, Turepo	Endemic
<i>Tradescantia fluminensis</i> *	Tradescantia, Wandering Jew	Exotic
<i>Verbena bonariensis</i> *	Purple-top	Exotic
<i>Vitex lucens</i>	Puriri	Endemic
<i>Vitis vinifera</i> *	Grape	Exotic

12. WAIRUA RIVER WILDLIFE MANAGEMENT RESERVE

Wairua River



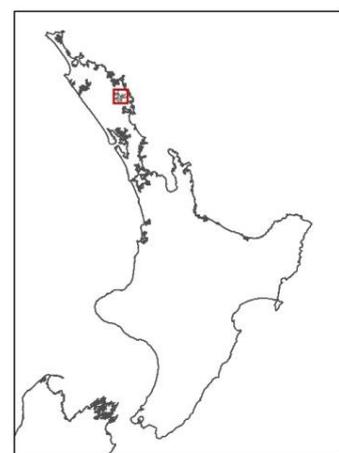
Legend

- Public Conservation Land
- Significant Natural Area
- Additional Natural Area

Plots

- Wetland, Protected
- Wetland, Private Land
- Non Area, Protected
- Non Area, Private Land

Hikurangi Restoration



Location:

A large swamp remnant located on the true right bank of the Wairua River comprising alluvial floodplain and small oxbows. The oxbows were formed as a result of straightening and stop-banking of the Wairua River in the 1970s (Hikurangi Swamp Scheme). The remnant is the second largest on the Hikurangi floodplain, totalling c.153.3 ha.

Coordinates: E1710785 N6057931

Vegetation Types:

Detailed information is already available for this important reserve, e.g. Manning (2001), Townsend (2012, 2013), A.J. Townsend (unpublished data), therefore only a cursory survey was undertaken.

The main vegetation types observed in the areas we visited are:

- Mānuka scrub and shrubland
- *Carex subdola* sedgeland, *Carex gaudichaudiana* sedgeland,
- *Eleocharis acuta/Sphagnum falcatulum* mossland
- Open water

A map and inventory of the vegetation types are provided by Townsend (2013). These include Forest, scrub, shrubland, sedgeland, reedland, rushland, grassland, herbfield and aquatic herbfield.

Description:

The reserve is dominated by mānuka scrub and shrubland, usually with a variety of woody swamp and semi-swamp species such as *Coprosma tenuicaulis*, *C. rigida*, *C. propinqua*, *C. rotundifolia*, *Myrsine divaricata*, *Melicytus micranthus*, cabbage tree, lowland ribbonwood, and kānuka.

Areas of higher water tables have herbaceous wetland vegetation, with local patches of *Carex subdola*, *C. gaudichaudiana*, *Sphagnum falcatulum*, *Eleocharis acuta*, *Isolepis prolifera*, and burr reed. Exotic species are common in these wetter areas, including *Persicaria strigosa*, *Ranunculus flammula*, *Carex ovalis*, reed sweet grass, parrot's feather, *Bidens frondosa*, *Ranunculus repens*, *Lotus pedunculatus*, and other pasture herbs and gasses.

The reserve overall is in good condition; however, large patches of dense tradescantia is locally common in the drier scrub and shrubland areas, including in habitats of the threatened *Pittosporum obcordatum*.

Significance:

The remnant is a representative example of a relatively unmodified and large swamp ecosystem which is now extremely uncommon locally, regionally, and nationally. Although the hydrology has been modified – stop banks have altered the hydrological regime by minimising flooding from the Wairua River and increasing water storage from feeder

waterways, and surrounding land has been drained – the water tables are relatively high overall and marsh and swamp hydrological conditions prevail.

The wildlife management reserve is a biodiversity hotspot, containing nationally important populations of the threatened species, *Hebe* aff. *bishopiana* Hikurangi Swamp (nationally critical) and *Pittosporum obcordatum* (nationally vulnerable). Other threatened and at risk species present include rough rasp fern (*Doodia squarrosa*) (syn. *Blechnum zeelandicum*; at risk – naturally uncommon), *Hypolepis dicksonioides* (at risk – naturally uncommon), Australasian bittern (*Botaurus poiciloptilus*), marsh crake (*Porzana pusilla*), black mudfish (*Neochanna diversus*), longfin eel (*Anguilla dieffenbachi*), fernbird, banded rail, and Australasian shoveller (Manning 2001; Townsend 2012, 2013).

Several regionally uncommon species are also present, including *Carex gaudichaudiana*, *Myrsine divaricata*, burr reed, *Coprosma parviflora*, *Coprosma propinqua*, *Coprosma tenuicaulis*, *Coprosma rotundifolia*, *Coprosma rigida*, *Carex subdola*, and lowland ribbonwood.

Wairua River is classified mainly (146.8 ha) as threatened land environment Category 1, which has <10% indigenous cover remaining, with smaller river bank areas (totalling 6.6 ha) of Category 2 (10–20% indigenous cover left) (Cieraad et al. 2015).

Threats:

- Invasive weeds, particularly tradescantia (common), which can dominate the canopy, and Chinese privet (mainly on margins), which can dominate the understorey/ground cover layers. Other troublesome exotics that are present include alligator weed, reed sweetgrass, oxygen weed, parrot's feather, *Carex ovalis*, and blackberry.
- Ongoing modifications to hydrological regime and earthworks associated with resource consents. Changes in water tables and increased nutrient and sediment levels can potentially impact threatened and significant species, and overall functioning of the wetland ecosystem, and favour exotic species (see Townsend 2013).

Recommendations:

- Continue to target troublesome weeds, particularly in high priority areas, e.g. threatened species habitats. The potential use of biocontrol agents for controlling tradescantia, a major understorey invasive in the drier *Pittosporum obcordatum* habitat, should be considered.
- Monitor effects of water regime changes on important wetland species, communities and functioning, and manage or alter where necessary.

WETLAND PLOT SHEET

Wetland name: Wairua River **Date:** 27-Nov-14 **Plot no:** 1 (WRW1)
Plot size (2 × 2 m default): 2x2 **Altitude:** 98 m a.s.l. **GPS/GR:** 1710785 6057931
Field leader: BRC, LF, SB, FG **Structure:** mossland
Composition: *Eleocharis acuta*/Sphagnum

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Sphagnum falcatulum</i>	50	0.2				<i>Sphagnum falcatulum</i>	10	
<i>Eleocharis acuta</i>	20	0.7				<i>Persicaria strigosa</i> *	2	
<i>Sparganium subglobosum</i>	9	0.7				<i>Bidens frondosa</i> *	0.5	
<i>Persicaria strigosa</i> *	8	0.4				<i>Lotus pedunculatus</i> *	0.5	
<i>Bidens frondosa</i> *	5	0.35						
<i>Isolepis prolifera</i>	5	0.54						
<i>Juncus articulatus</i> *	0.5	0.15						

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Mānuka, *Myriophyllum propinquum*

Comments: Mean canopy height = 0.4 m

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	13.5	4	
Understorey: % cover introduced spp ³	3	4	
Total species: % number introduced spp	60	2	
Total species: overall stress/dieback	NA	5	
Total /20	NA	15	

²5=0%: none, 4=1–24%: very low, 3=25–49%: low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements: T = 21.2°C

Water table cm	–1	Water conductivity uS (if present)	111.2
Water pH (if present)	4.87	Von Post peat decomposition index	NA

Soil core laboratory analysis (2 soil core subsamples):

Water content % dry weight	431	Total C %	18.60
Bulk Density T/m ³	0.215	Total N %	1.30
pH	4.56	Total P %	0.123
Conductivity uS	0.27	Total K %	0.396

Foliage laboratory analysis (leaf/culm sample of dominant canopy species):

Species	%C	%N	%P	%K
<i>Eleocharis acuta</i>	46.4	1.52	0.135	1.16
<i>Leptospermum scoparium</i>	53.2	1.38	0.094	0.36

WETLAND PLOT SHEET

Wetland name: Wairua River **Date:** 27-Nov-14 **Plot no:** 2 (WRW2)
Plot size (2 × 2 m default): 2x2 **Altitude:** 94 m a.s.l. **GPS/GR:** 1710288 6058137
Field leader: BRC, LF, FG, SB, K **Structure:** Sedgeland **Composition:** *Carex subdola*

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Carex subdola</i>	60	0.65				<i>Persicaria strigosa</i> *	1	
<i>Carex ovalis</i> *	8	0.45						
<i>Eleocharis acuta</i>	1	0.68						
<i>Persicaria strigosa</i> *	1	0.44						

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Alopecurus geniculatus**, *Juncus edgariae*, *Rubus fruticosus**, *Carex gaudichaudiana*

Comments: Swamp/marsh. Grey warbler, kingfisher, skylark, greenfinch, chaffinch, yellow hammer, silvereeye, fantail, house sparrow. Mean canopy height 0.6 m. Soil dark organic layer over black burnt layer over gravel over alluvial clay.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	9	4	
Understorey: % cover introduced spp ³	100	0	
Total species: % number introduced spp	50	2	
Total species: overall stress/dieback	NA	5	
Total /20	NA	11	

²5=0%: none, 4=1–24%: very low, 3=25–49%: low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements: T = 14.1

Water table cm	-12	Water conductivity uS (if present)	93.5
Water pH (if present)	4.95	Von Post peat decomposition index	NA

Soil core laboratory analysis (2 soil core subsamples):

Water content % dry weight	286	Total C %	19.75
Bulk Density T/m ³	0.233	Total N %	1.66
pH	4.70	Total P %	0.173
Conductivity uS	0.16	Total K %	0.406

Foliage laboratory analysis (leaf/culm sample of dominant canopy species):

Species	%C	%N	%P	%K
<i>Carex subdola</i>	46.8	1.96	0.129	0.92

WETLAND PLOT SHEET

Wetland name: Wairua River **Date:** 27-Nov-14 **Plot no:** 3 (WRW3)
Plot size (2 × 2 m default): 2x2 **Altitude:** 92 m a.s.l. **GPS/GR:** 1709839 6057363
Field leader: BRC, LF, SB, FG, KH **Structure:** Shrubland **Composition:** Mānuka

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Leptospermum scoparium</i>	75	5.5				<i>Carex subdola</i>	80	0.6
						<i>Eleocharis acuta</i>	5	0.65
						<i>Galium palustre</i> *	3	
						<i>Leptospermum scoparium</i>	1	
						<i>Coprosma rigida</i>	0.5	
						<i>Ranunculus flammula</i> *	0.5	
						<i>Persicaria strigosa</i> *	0.5	

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Bidens frondosa**, *Carex ovalis**, *Coprosma rigida*, *Cordyline australis*, *Glyceria maxima**, *Juncus edgariae*, *Juncus sarophorus*, mānuka

Comments: Canopy mean height 4.5 m. Pontodrillus earthworm. Pockets of mānuka/Carex nearby

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp ³	4	4	
Total species: % number introduced spp	38	3	
Total species: overall stress/dieback	NA	5	
Total /20	NA	17	

²5=0%: none, 4=1–24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements: T = 15.4°C

Water table cm	-15	Water conductivity uS (if present)	92.8
Water pH (if present)	4.89	Von Post peat decomposition index	

Soil core laboratory analysis (2 soil core subsamples):

Water content % dry weight	235	Total C %	18.24
Bulk Density T/m ³	0.260	Total N %	1.40
pH	4.52	Total P %	0.129
Conductivity uS	0.23	Total K %	0.449

Foliage laboratory analysis (leaf/culm sample of dominant canopy species):

Species	%C	%N	%P	%K
<i>Leptospermum scoparium</i>	52.7	1.37	0.083	0.37

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET

Site name: Wairua River

Date: 27-Nov-14

Plot no: 4 (WRNA4)

Altitude: 91 m a.s.l.

GPS E: 1709839

N: 6057356

Recorder: BRC, LF, SB, FG, KH **Veg structure:** Shrubland

Composition¹: mānuka/ *Carex subdola*

Canopy Mean hgt: 3 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	Hm
<i>Leptospermum scoparium</i>	60	5.5				<i>Carex subdola</i>	60	0.6
<i>Carex subdola</i>	30	0.95				<i>Carex ovalis</i> *	8	80
<i>Eleocharis acuta</i>	3	0.65				<i>Coprosma propinqua</i>	1	3.3
<i>Coprosma propinqua</i>	2	3.3				<i>Muehlenbeckia australis</i>	1	4.5
<i>Persicaria strigosa</i> *	0.8	0.6				<i>Persicaria strigosa</i> *	1	
<i>Carex ovalis</i> *	0.5					<i>Carex virgata</i>	0.5	0.6
<i>Glyceria maxima</i> *	0.5					<i>Coprosma rigida</i>	0.5	
<i>Juncus edgariae</i>	0.5	1.6				<i>Juncus edgariae</i>	0.5	1.25
Bare soil	5					<i>Lotus pedunculatus</i> *	0.5	4.5

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: Grey warbler

WAIRUA RIVER GPWMR PLANT SPECIES LIST

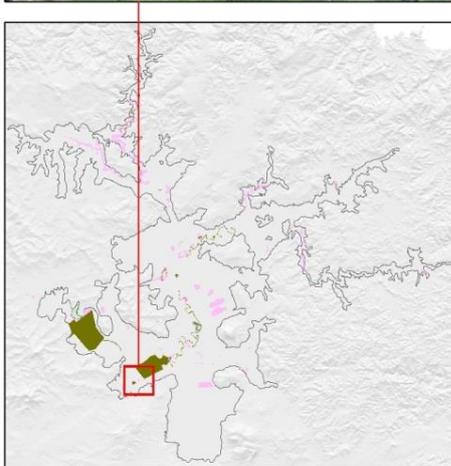
Species	CommonName	Status
<i>Alopecurus geniculatus</i> *	Kneed foxtail	Exotic
<i>Bidens frondosa</i> *	Beggars' ticks	Exotic
<i>Carex gaudichaudiana</i>		Non-endemic
<i>Carex ovalis</i> *	Oval sedge	Exotic
<i>Carex lessoniana</i>	Cutty grass	Endemic
<i>Carex maorica</i>		Endemic
<i>Carex subdola</i>		Endemic
<i>Carex virgata</i>	Swamp sedge	Endemic
<i>Coprosma propinqua</i>	Mingimingi, Miki	Endemic
<i>Coprosma rigida</i>		Endemic
<i>Coprosma tenuicaulis</i>	Hukihuki	Endemic
<i>Cordyline australis</i>	Cabbage tree	Endemic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Egeria densa</i> *	Egeria	Exotic
<i>Eleocharis acuta</i>	Club rush	Non-endemic
<i>Eleocharis sphacelata</i>	Bamboo spike sedge	Non-endemic
<i>Galium palustre</i> *	Marsh bedstraw	Exotic
<i>Glyceria maxima</i> *	Reed sweetgrass	Exotic
<i>Hebe aff. bishopiana</i>		Endemic
<i>Isolepis prolifera</i>		Non-endemic
<i>Juncus articulatus</i> *	Jointed rush	Exotic
<i>Juncus edgariae</i>		Endemic
<i>Juncus sarophorus</i>	Leafless rush	Non-endemic
<i>Kunzea robusta (K. ericoides)</i>	Kānuka	Endemic
<i>Leptospermum scoparium</i>	Mānuka	Non-endemic
<i>Lotus pedunculatus</i> *	Lotus	Exotic
<i>Machaerina articulata</i>		Non-endemic
<i>Muehlenbeckia australis</i>	Large-leaved muehlenbeckia	Non-endemic
<i>Myriophyllum aquaticum</i> *	Water milfoil	Exotic
<i>Myriophyllum propinquum</i>	Common water milfoil	Non-endemic
<i>Persicaria decipiens</i>		Non-endemic
<i>Persicaria strigosa</i> *		Exotic
<i>Pittosporum obcordatum</i>	Heart-leaved kohuhu	Endemic
<i>Pittosporum tenuifolium</i>	Kohuhu	Endemic
<i>Plagianthus regius</i> subsp. <i>regius</i>	Lowland ribbonwood	Endemic

<i>Podocarpus totara</i>	Totara	Endemic
<i>Prumnopitys taxifolia</i>	Matai, Black pine	Endemic
<i>Ranunculus flammula</i> *	Spearwort	Exotic
<i>Rubus fruticosus</i> *	Blackberry	Exotic
<i>Rubus schmidelioides</i> var. <i>schmidelioides</i>	Tataramoa	Endemic
<i>Schoenoplectus tabernaemontani</i>	Kuawa	Non-endemic
<i>Schoenus maschalinus</i>		Non-endemic
<i>Sophora microphylla</i>	Kōwhai	Endemic
<i>Sparganium subglobosum</i>	Burr-reed, Maru	Non-endemic
<i>Sphagnum falcatulum</i>		Non-endemic
<i>Tradescantia fluminensis</i> *	Tradescantia	Exotic

NB species list is limited to areas visited. For a more comprehensive list see Asquith (1996).

13. WAIRUA RIVER SOUTH

Wairua River South



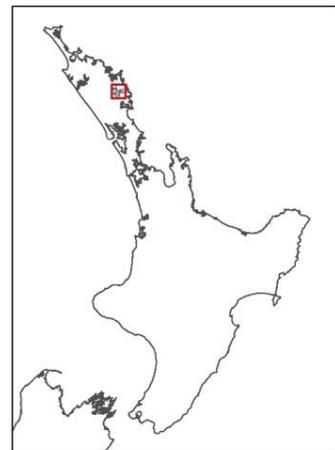
Legend

- Public Conservation Land
- Significant Natural Area
- Additional Natural Area

Plots

- Wetland, Protected
- Wetland, Private Land
- Non Area, Protected
- Non Area, Private Land

Hikurangi Restoration



Location:

Remnant (c. 1.1 ha) comprises an ‘island’ situated between a small artificial oxbow and the stop bank on true right bank of Wairua River, between Wairua River Wildlife Management Reserve and Matarau Island Scenic Reserve. The remnant also includes the wetlands within the oxbow, and associated vegetation on oxbow banks.

Coordinates: E1709542 N6056979 (Plot WRSNA1)

Vegetation Types:

- Kānuka/totara forest alongside oxbow (Plot WRSNA1)
- Totara treeland on floodplain terrace
- *Persicaria strigosa-Isolepis prolifera*-burr reed herbfield (Plot WRSW2)

Description:

This is a narrow strip of riparian forest fringing an oxbow (wetland) cut off by stopbank of the Wairua River, plus sparse forest and treeland covering the adjoining river terrace and oxbow banks. Kānuka is common along the oxbow banks, and totara is the main species on the terrace. Occasional kōwhai and large individuals of *Myrsine divaricata* and *Coprosma areolata* also occur in the canopy. Understorey shrubs include *Myrsine divaricata*, *Meliccytus micranthus*, and juvenile totara and kōwhai. The ground cover is sparse and locally dominated by *Microlaena stipoides*, and exotic herbs and grasses. No *Tradescantia fluminensis* (a troublesome weed) was recorded.

A small population of *Hebe* aff. *bishopiana* Hikurangi Swamp was growing on the banks of the oxbow by the farm culvert immediately west of Matarau Island Scenic Reserve. One plant was growing on the west side of the culvert, and 12 were noted on the east side. Other species present were occasional cabbage tree, totara, *Coprosma rotundifolia*, kānuka, mānuka, and the exotics, kikuyu, pampas and pine.

The oxbow wetland was a mosaic of open water, and patches of herbaceous terrestrial vegetation. Although much of the vegetation was exotic, patches of the native herb *Sparganium subglobosum* (burr reed) were prominent, particularly in the eastern sector (see wetland plot WRSW2).

Significance:

The remnants are representative examples of lowland floodplain forest, oxbow and wetland ecosystems, now uncommon in the region and throughout New Zealand.

The presence of *Hebe* aff. *bishopiana* Hikurangi Swamp is notable as it is a threatened species, being classified as Nationally Critical. Regionally uncommon species recorded in the remnant include *Sparganium subglobosum*, *Myrsine divaricata*, *Coprosma rigida*, *C. parviflora* and *C. rotundifolia*.

The remnants are classified as threatened land environment Category 2, which has 10–20% indigenous cover remaining (Cieraad et al. 2015).

Threats:

- The forest remnants are not fenced off, and are subject to cattle browsing and trampling.
- Although several potentially troublesome weed species were noted, e.g. Chinese privet, mercer grass, those in the forest remnants are probably currently being kept under control by stock browsing.
- The oxbow wetland has several invasive exotics such as alligator weed, reed sweet grass, and *Utricularia gibba*.

Recommendations:

- Fencing off remnants to exclude cattle, including the narrow strips of riparian forest on the opposite side of the oxbow.
- Control of existing Chinese privet. Ongoing surveillance of fenced areas to assess need for weed control.
- Assess the potential of the site for expansion/ establishment of populations of high priority threatened species: *Hebe* aff. *bishopiana* Hikurangi Swamp (small population already present in Wairua River South) and *Pittosporum obcordatum* (not recorded at the site but found in nearby Wairua River Government Purpose Wildlife Management Reserve and Matarau Island Scenic Reserve).

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET

Site name: Wairua River South **Date:** 20-Feb-15 **Plot no:** 1 (WRSNA1)
Altitude: 96 m a.s.l. **GPS E:** 1709542 **N:** 6056979
Recorder: BRC, LF, SB, FG, KH **Veg structure:** Forest **Composition¹:** kānuka/totara
Canopy Mean hgt: 15 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Kunzea robusta</i>	60	17	<i>Melicytus micranthus</i>	8	5	<i>Microlaena stipoides</i>	35	
<i>Podocarpus totara</i>	20	12	<i>Melicope simplex</i>	5	5	<i>Trifolium repens</i> *	2	
<i>Muehlenbeckia australis</i>	10	10	<i>Muehlenbeckia australis</i>	5	8	<i>Lapsana communis</i> *	1	
<i>Sophora microphylla</i>	8	12	<i>Myrsine divaricata</i>	40	7	<i>Melicytus micranthus</i>	1	
<i>Myrsine divaricata</i>	2	8	<i>Podocarpus totara</i>	30	7	<i>Muehlenbeckia australis</i>	1	
<i>Coprosma areolata</i>	1	7	<i>Coprosma areolata</i>	2	6	<i>Oenanthe pimpinelloides</i> *	1	
			<i>Sophora microphylla</i>	10	8	<i>Persicaria hydropiper</i> *	1	
			<i>Coprosma rigida</i>	1	4.5	<i>Solanum nigrum</i> *	1	
						<i>Anagallis arvensis</i> *	<1	
						<i>Cirsium vulgare</i> *	<1	
						<i>Conyza sumatrensis</i> *	<1	

						<i>Coprosma rhamnoides</i>	<1	
						<i>Cyperus eragrostis*</i>	<1	
						<i>Hypochaeris radicata*</i>	<1	
						<i>Mentha pulegium*</i>	<1	
						<i>Myrsine divaricata</i>	<1	
						<i>Oplismenus imbecillis</i>	<1	
						<i>Oxalis exilis</i>	<1	
						<i>Plantago lanceolata*</i>	<1	
						<i>Plantago major*</i>	<1	
						<i>Podocarpus totara</i>	<1	
						<i>Senecio jacobaea*</i>	<1	
						<i>Sophora microphylla</i>	<1	

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: Nearby is totara treeland.

Cattle browsing. *No tradescantia. Privet (LIGsin) – very few but present. Potential weed problem if fenced off. Needs fencing on opposite side. Potential for *Pittosporum obcordatum* and swamp hebe (*Hebe* aff. *bishopiana*) restoration.

WETLAND PLOT SHEET

Wetland name: Wairua River South **Date:** 20-Feb-15

Plot no: 2 (WRSW2)

Plot size (2 × 2 m default): 2x2 **Altitude:** 95 m a.s.l.

GPS/GR: 1709596 6057050

Field leader: BRC, LF, SB, FG, KH

Structure: Herbfield

Composition: *Persicaria-Isolepis-Sparganium*

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Persicaria strigosa*</i>	40	1				<i>Galium</i> sp.	8	
<i>Isolepis prolifera</i>	25	1				<i>Lemna disperma</i>	1	
<i>Sparganium subglobosum</i>	20	1.15				<i>Azolla pinnata*</i>	<1	
<i>Galium palustre*</i>	5	0.85				<i>Landoltia punctata*</i>	<1	
<i>Holcus lanatus*</i>	5	1.1						
<i>Myriophyllum aquaticum*</i>	5	1.8						
<i>Carex ovalis*</i>	2	0.85						
<i>Galium</i> sp.	1	0.9						
<i>Ludwigia palustris*</i>	1	0.8						
<i>Bidens frondosa*</i>	<1	1						
<i>Mentha pulegium*</i>	<1	0.7						

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: *Alternanthera philoxeroides**, *Glyceria maxima**, *Carex virgata*, *Utricularia gibba**, *Ludwigia palustris** *Carex maorica*

Comments: Patches of open water. *Sparganium subglobosum* regionally uncommon species.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	59	2	
Understorey: % cover introduced spp ³	1	4	
Total species: % number introduced spp	71	2	
Total species: overall stress/dieback	NA	5	
Total /20	NA	13	

²5=0%: none, 4=1–24%: very low, 3=25–49%: low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements: T =

Water table cm	+10	Water conductivity uS (if present)	63
Water pH (if present)	4.96	Von Post peat decomposition index	NA

Soil core laboratory analysis (2 soil core subsamples):

Too wet/ unable to be collected

Foliage laboratory analysis (leaf/culm sample of dominant canopy species):

Species	%C	%N	%P	%K
<i>Persicaria decipiens</i>	47.2	1.33	0.129	0.83
<i>Sparganium subglobosum</i>	46.9	2.23	0.224	1.27

WAIRUA RIVER SOUTH PLANT SPECIES LIST

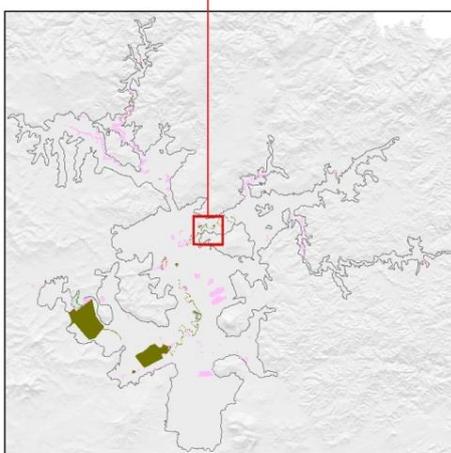
Species	CommonName	Status
<i>Agrostis capillaris</i> *	Bent grass	Exotic
<i>Agrostis stolonifera</i> *	creeping bent	Exotic
<i>Alisma plantago-aquatica</i> *	Water plantain	Exotic
<i>Alternanthera philoxeroides</i> *	Alligator weed	Exotic
<i>Anagallis arvensis</i> *	Blue pimpernel	Exotic
<i>Axonopus affinis</i> *		Exotic
<i>Azolla pinnata</i> *	Ferny azolla	Exotic
<i>Bidens frondosa</i> *	Beggars' ticks	Exotic
<i>Carex fascicularis</i>		Endemic
<i>Carex gaudichaudiana</i>		Non-endemic

<i>Carex maorica</i>		Endemic
<i>Carex ovalis</i> *	Oval sedge	Exotic
<i>Carex virgata</i>		Endemic
<i>Centella uniflora</i>	centella	Non-endemic
<i>Cirsium vulgare</i> *	Boar thistle	Exotic
<i>Conyza sumatrensis</i> *	Broad-leaved fleabane	Exotic
<i>Coprosma areolata</i>	Aruhe	Endemic
<i>Coprosma parviflora</i>	Leafy coprosma	Endemic
<i>Coprosma rhamnoides</i>		Endemic
<i>Coprosma rigida</i>		Endemic
<i>Coprosma rotundifolia</i>		Endemic
<i>Cordyline australis</i>	Cabbage tree	Endemic
<i>Cyperus brevifolius</i> *	Globe sedge	Exotic
<i>Cyperus eragrostis</i> *	Puketangata	Exotic
<i>Cyperus ustulatus</i>	Coastal cutty grass	Endemic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Dacrydium cupressinum</i>	Rimu	Endemic
<i>Doodia australis (Blechnum parrisiae)</i>		Indigenous
<i>Eleocharis acuta</i>	Club rush	Non-endemic
<i>Fragaria vesca</i> *	Alpine strawberry	Exotic
<i>Galium sp.*</i>	Bedstraw	Exotic
<i>Galium palustre</i> *	Marsh bedstraw	Exotic
<i>Galium propinquum</i>	Māwe	Non-endemic
<i>Glyceria maxima</i> *	Reed sweetgrass	Exotic
<i>Holcus lanatus</i> *	Yorkshire fog	Exotic
<i>Hypochaeris radicata</i> *	Catsear	Exotic
<i>Isolepis habra</i>		Non-endemic
<i>Isolepis prolifera</i>		Non-endemic
<i>Juncus acuminatus</i> *	Sharp-fruited rush	Exotic
<i>Juncus edgariae</i>		Endemic
<i>Juncus effusus</i> *	Common rush	Exotic
<i>Juncus microcephalus</i> *	South American rush	Exotic
<i>Juncus sarophorus</i>	Leafless rush	Non-endemic
<i>Juncus tenuis</i> *	Track rush	Exotic
<i>Juncus usitatus</i>	Common rush	Non-endemic
<i>Kunzea robusta (K. ericoides)</i>	Kānuka	Endemic
<i>Landoltia punctata</i> *	Purple-backed duckweed	Exotic
<i>Lapsana communis</i> *	Nipplewort	Exotic

<i>Lemna disperma</i>	Common duckweed	Non-endemic
<i>Leptospermum scoparium</i>	Mānuka	Non-endemic
<i>Ligustrum sinense*</i>	Chinese privet	Exotic
<i>Lotus corniculatus*</i>	Lotus	Exotic
<i>Ludwigia palustris*</i>	Water purslane	Exotic
<i>Melicope simplex</i>	Poataniwha	Endemic
<i>Melicytus micranthus</i>	Small-leaved mahoe	Endemic
<i>Mentha pulegium*</i>	European pennyroyal mint	Exotic
<i>Microlaena stipoides</i>	Meadow rice grass	Non-endemic
<i>Muehlenbeckia australis</i>	Large-leaved muehlenbeckia	Non-endemic
<i>Myriophyllum aquaticum*</i>	Brazilian water milfoil	Exotic
<i>Myrsine divaricata</i>	Weeping mapou	Endemic
<i>Nestegis lanceolata</i>	White maire	Endemic
<i>Oenanthe pimpinelloides*</i>	Parsley dropwort	Exotic
<i>Oplismenus imbecillis</i>		Non-endemic
<i>Oxalis exilis</i>	Creeping oxalis	Non-endemic
<i>Paspalum distichum*</i>	Mercer grass	Exotic
<i>Persicaria hydropiper*</i>		Exotic
<i>Persicaria strigosa*</i>		Exotic
<i>Phytolacca octandra*</i>	Dyeberry	Exotic
<i>Plantago lanceolata*</i>	English plantain	Exotic
<i>Plantago major*</i>	Broad-leaved plantain	Exotic
<i>Podocarpus totara</i>	Totara, Amoka	Endemic
<i>Prunella vulgaris*</i>	Self-heal	Exotic
<i>Pyrrhosia eleagnifolia</i>	Leather-leaf fern	Endemic
<i>Ripogonum scandens</i>	Akapirita, Supplejack	Endemic
<i>Rubus australis</i>	Bush lawyer	Endemic
<i>Rubus schmidelioides</i>	Bush lawyer	Endemic
<i>Senecio bipinnatisectus*</i>	Australian fireweed	Exotic
<i>Senecio jacobaea*</i>	Ragwort	Exotic
<i>Solanum nigrum*</i>	Black nightshade	Exotic
<i>Sophora microphylla</i>	Kōwhai	Endemic
<i>Sparganium subglobosum</i>	Bur-reed, Maru	Non-endemic
<i>Stellaria media*</i>	chickweed	Exotic
<i>Stenotaphrum secundatum*</i>	Buffalo grass	Exotic
<i>Streblus heterophyllus</i>	Ewekuri	Endemic
<i>Trifolium repens*</i>	White clover	Exotic
<i>Utricularia gibba*</i>		Exotic

14. WHAKAPARA NORTH

Whakapara North



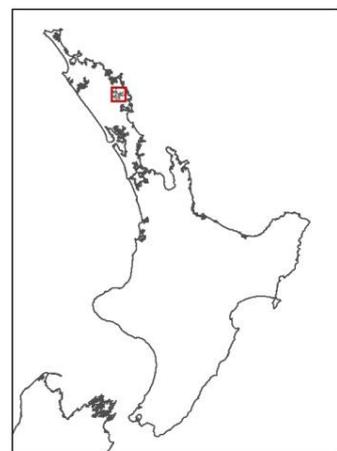
Legend

- Public Conservation Land
- Significant Natural Area
- Additional Natural Area

Plots

- Wetland, Protected
- Wetland, Private Land
- Non Area, Protected
- Non Area, Private Land

Hikurangi Restoration



Location:

An elongated remnant c.2.6 ha) on the Hikurangi floodplain comprising forest and a small wetland, situated between McLennan Road and the Whakapara River.

Coordinates: E1713678 N6065311 (Plot WNNA1, forest); E1713687 N6065384 (Plot WNW2, wetland);

Vegetation Types:

- Totara-kahikatea forest (Plot WNNA1)
- *Glyceria maxima* grassland (Plot WNW2)
- *Carex virgata*-*Juncus edgariae*-*Carex secta*/*Landoltia* sedgeland (not sampled)

Description:

The forest is dominated by totara, with frequent kahikatea, and occasional matai, pukatea, rimu, titoki, rewarewa, and lowland ribbonwood. Some of the totara has been logged in the past. A variety of shrubs and small trees make up the understorey, including *Melicytus micranthus*, *Coprosma areolata*, *C. arborea*, white maire, kōwhai, and *Myrsine australis*. The exotic invasive herb, *Tradescantia fluminensis* occurs locally in dense patches in the groundcover. Elsewhere, the native grass, *Microlaena stipoides*, is common, but otherwise groundcover is relatively sparse. Some recent cattle damage was evident, e.g. browsing of *Glyceria maxima* in the wetland, and trampling in other areas.

Significance:

The remnants are representative examples of lowland floodplain forest and wetland ecosystems, now uncommon in the region and throughout New Zealand. The forest remnant contained the small rasp fern, *Doodia mollis* (syn: *Blechnum molle*), a threatened species classified as At Risk – Nationally Uncommon. Regionally uncommon species recorded include matai, *Coprosma propinqua*, *Coprosma rigida*, *Coprosma tenuicaulis*, *Coprosma parviflora*, and *Myrsine divaricata*.

Whakapara North is classified as a Category 2 threatened land environment, which has 10–20% indigenous cover remaining (Cieraad et al. 2015).

Recommendations:

- Fencing of remnant to exclude cattle.
- Control of invasive weed species that have the potential to degrade biodiversity values, especially *Tradescantia fluminensis*, Chinese privet, and *Solanum pseudocapsicum*.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET

Site name: Whakapara North **Date:** 17-Feb-15 **Plot no:** 1 (WNN1)
Altitude: 100 m a.s.l. **GPS E:** 1713678 **N:** 6065311
Recorder: BRC SB, LF, AT, KH **Veg structure:** Forest **Composition¹:** totara-kahikatea
Canopy Mean hgt: 20 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Podocarpus totara</i>	40	20	<i>Podocarpus totara</i>	4	10	<i>Tradescantia fluminensis</i> *	25	
<i>Dacrycarpus dacrydioides</i>	35	22	<i>Coprosma areolata</i>	3	7	<i>Microlaena stipoides</i>	20	
<i>Prumnopitys taxifolia</i>	10	20	<i>Muehlenbeckia australis</i>	3		<i>Oplismenus imbecillis</i>	1	
<i>Dacrydium cupressinum</i>	5	18	<i>Plagianthus regius</i>	3	13	<i>Coprosma rhamnoides</i>	<1	
<i>Laurelia novae-zelandiae</i>	3	15	<i>Coprosma arborea</i>	2	5.5	<i>Dacrycarpus dacrydioides</i>	<1	
			<i>Melicytus micranthus</i>	16	4.5	<i>Doodia squarrosa</i>	<1	
			<i>Ligustrum sinense</i> *	1	4.3	<i>Lapsana communis</i> *	<1	
			<i>Melicope simplex</i>	1	3.5	<i>Melicytus micranthus</i>	<1	
			<i>Myrsine australis</i>	1	1.8	<i>Myrsine australis</i>	<1	
			<i>Nestegis lanceolata</i>	1	3	<i>Nestegis lanceolata</i>	<1	
			<i>Rubus cissoides</i>	1	7	<i>Persicaria hydropiper</i> *	<1	
			<i>Sophora microphylla</i>	1	7	<i>Plagianthus regius</i>	<1	
			<i>Coprosma rigida</i>	<1	3	<i>Solanum nigrum</i> *	<1	
			<i>Drymoanthus adversus</i>	<1		<i>Sonchus oleraceus</i> *	<1	
			<i>Pyrrosia eleagnifolia</i>	<1		<i>Cirsium vulgare</i> *		
			<i>Ripogonum scandens</i>	<1				
			<i>Solanum pseudocapsicum</i> *	<1	0.6			

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: cattle browse, stock damage, weeds (tradescantia). Grey warbler and fantail recorded. Rainbow skink.

WETLAND PLOT SHEET**Wetland name:** Whakapara North **Date:** 17-Feb-15**Plot no:** 2 (WNW2)**Plot size (2 × 2 m default):** 2×2 **Altitude:****GPS/GR:** 1713687 6065384**Field leader:** BRC, SB, LF, AT, KH**Structure:** Grassland**Composition:** *Glyceria maxima*

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Glyceria maxima</i> *	95	1				<i>Galium divaricatum</i> *	5	0.65
<i>Persicaria strigosa</i> *	5	0.8				<i>Persicaria strigosa</i> *	13	0.6
<i>Ludwigia palustris</i> *	0.01	0.65				<i>Bidens frondosa</i> *	<1	0.65
<i>Mentha pulegium</i> *	0.01	0.65				<i>Myriophyllum aquaticum</i> *	<1	0.1
<i>Plantago lanceolata</i> *	0.01	0.9						

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by ***Additional species in vicinity in same vegetation type:** *Holcus lanatus*, *Schedonorus arundinaceus***Comments:** Wetter central area = (CARsec, CARvir, JUNedg, LEPsco. *Glyceria* - grazed - stock cattle access, lots of weeds.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	100	0	
Understorey: % cover introduced spp ³	100	0	
Total species: % number introduced spp	100	0	
Total species: overall stress/dieback	NA	5	
Total /20	NA	5	

²5=0%: none, 4=1–24%: very low, 3=25–49%: low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high³Add subcanopy and groundcover % cover for introduced species**Field measurements:** T = 18.0 °C

Water table cm	+7	Water conductivity uS (if present)	120.7
Water pH (if present)	5.45	Von Post peat decomposition index	NA

Soil core laboratory analysis (2 soil core subsamples):

Water content % dry weight	184	Total C %	8.10
Bulk Density T/m ³	0.449	Total N %	0.61
pH	4.90	Total P %	0.093
Conductivity uS	0.13	Total K %	0.553

Foliage laboratory analysis (leaf/culm sample of dominant canopy species):

Species	%C	%N	%P	%K
<i>Glyceria maxima</i>	47.1	1.95	0.255	1.27

WHAKAPARA NORTH PLANT SPECIES LIST

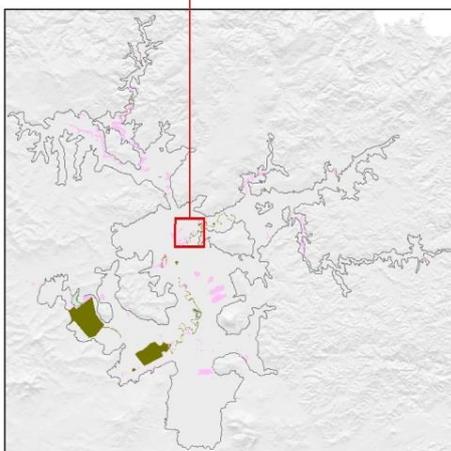
Species	CommonName	Status
<i>Agathis australis</i>	Kauri	Endemic
<i>Azolla pinnata</i> *	Ferny azolla	Exotic
<i>Bidens frondosa</i> *	Beggars' ticks	Exotic
<i>Blechnum minus</i>	Swamp kiokio	Non-endemic
<i>Carex lessoniana</i>	Cutty grass	Endemic
<i>Carex maorica</i>		Endemic
<i>Carex ovalis</i> *	Oval sedge	Exotic
<i>Carex secta</i>	Makura	Endemic
<i>Carex virgata</i>		Endemic
<i>Centella uniflora</i>	Centella	Non-endemic
<i>Cirsium vulgare</i> *	Boar thistle	Exotic
<i>Collospermum hastatum</i>	Kahakaha	Endemic
<i>Coprosma x cunninghamii</i>		Endemic
<i>Coprosma arborea</i>	Mamangi	Endemic
<i>Coprosma areolata</i>	Thin-leaved coprosma	Endemic
<i>Coprosma parviflora</i>	Leafy coprosma	Endemic
<i>Coprosma propinqua</i>	Mingimingi	Endemic
<i>Coprosma rhamnoides</i>		Endemic
<i>Coprosma rigida</i>		Endemic
<i>Coprosma tenuicaulis</i>	Hukihuki	Endemic
<i>Cordyline australis</i>	Cabbage tree	Endemic
<i>Cyperus eragrostis</i> *	Puketangata	Exotic
<i>Cyperus ustulatus</i>	Coastal cutty grass	Endemic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Dacrydium cupressinum</i>	Rimu	Endemic
<i>Dactylis glomerata</i> *	Cocksfoot	Exotic
<i>Deparia petersenii</i>	Japanese lady fern	Indigenous
<i>Dicksonia squarrosa</i>	Wheki, Rough tree fern	Endemic
<i>Diplazium australe</i>		Indigenous
<i>Doodia australis (Blechnum parrisiae)</i>		Indigenous

<i>Doodia mollis</i> (<i>Blechnum molle</i>)	Mokimoki	Indigenous
<i>Doodia squarrosa</i> (<i>Blechnum zeelandiae</i>)		Indigenous
<i>Drymoanthus adversus</i>		Endemic
<i>Galium divaricatum</i> *	Slender bedstraw	Exotic
<i>Glyceria maxima</i> *	Reed sweetgrass	Exotic
<i>Holcus lanatus</i> *	Yorkshire fog	Exotic
<i>Hydrocotyle sulcata</i>		Endemic
<i>Hypolepis distans</i>		Non-endemic
<i>Isachne globosa</i>	Swamp millet	Non-endemic
<i>Isolepis habra</i>		Non-endemic
<i>Isolepis sepulcralis</i> *		Exotic
<i>Juncus acuminatus</i> *	Sharp-fruited rush	Exotic
<i>Juncus edgariae</i>		Endemic
<i>Juncus effusus</i> *	Common rush	Exotic
<i>Kunzea robusta</i> (<i>K. ericoides</i>)	Kānuka	Endemic
<i>Lapsana communis</i> *	Nipplewort	Exotic
<i>Laurelia novae-zelandiae</i>	Pukatea	Endemic
<i>Leptospermum scoparium</i>	Mānuka	Non-endemic
<i>Ligustrum sinense</i> *	Chinese privet	Exotic
<i>Lotus pedunculatus</i> *	Lotus	Exotic
<i>Ludwigia palustris</i> *	Water purslane	Exotic
<i>Luzula</i> sp.	Woodrush	Non-endemic
<i>Luzula picta</i>		Endemic
<i>Machaerina rubiginosa</i>	Common twig rush	Non-endemic
<i>Machaerina tenax</i>		Endemic
<i>Melicope simplex</i>	Poataniwha	Endemic
<i>Melicytus micranthus</i>	Manakura, Swamp mahoe	Endemic
<i>Mentha pulegium</i> *	European pennyroyal mint	Exotic
<i>Metrosideros diffusa</i>	White rātā, Climbing rātā	Endemic
<i>Microlaena stipoides</i>	Meadow rice grass	Non-endemic
<i>Muehlenbeckia australis</i>	Large-leaved muehlenbeckia	Non-endemic
<i>Myosotis laxa</i> subsp. <i>caespitosa</i> *	Water forget-me-not	Exotic
<i>Myriophyllum aquaticum</i> *	Brazilian water milfoil	Exotic
<i>Myrsine australis</i>	Māpau, Red matipo	Endemic
<i>Myrsine divaricata</i>	Weeping mapou	Endemic
<i>Nasturtium officinale</i> *	Kōwhitiwhiti	Exotic
<i>Neomyrtus pedunculata</i>	Myrtle	Endemic
<i>Nestegis lanceolata</i>	White maire	Endemic

<i>Oenanthe pimpinelloides</i> *	Parsley dropwort	Exotic
<i>Oplismenus imbecillis</i>		Non-endemic
<i>Passiflora tetrandra</i>	Kohia, New Zealand passionfruit	Endemic
<i>Persicaria decipiens</i>		Non-endemic
<i>Persicaria hydropiper</i> *		Exotic
<i>Persicaria maculosa</i> *		Exotic
<i>Persicaria strigosa</i> *		Exotic
<i>Pittosporum tenuifolium</i>	Black matipo	Endemic
<i>Plagianthus regius</i>	Manatu, Lowland ribbonwood	Endemic
<i>Plantago lanceolata</i> *	English plantain	Exotic
<i>Podocarpus totara</i>	Totara	Endemic
<i>Prumnopitys taxifolia</i>	Matai, Black pine	Endemic
<i>Prunella vulgaris</i> *	Self-heal	Exotic
<i>Pyrrosia eleagnifolia</i>	Leather-leaf fern	Endemic
<i>Ranunculus repens</i> *	Creeping buttercup	Exotic
<i>Ripogonum scandens</i>	Supplejack	Endemic
<i>Rubus cissoides</i>	Bush lawyer	Endemic
<i>Rubus fruticosus</i> *	Blackberry	Exotic
<i>Rumex conglomeratus</i> *	Clustered dock	Exotic
<i>Schedonorus arundinaceus</i> *	Tall fescue	Exotic
<i>Senecio bipinnatisectus</i> *	Australian fireweed	Exotic
<i>Solanum nigrum</i> *	Black nightshade	Exotic
<i>Solanum pseudocapsicum</i> *	Christmas cherry	Exotic
<i>Sonchus oleraceus</i> *	Common sow thistle	Exotic
<i>Sophora microphylla</i>	Kōwhai	Endemic
<i>Streblus heterophyllus</i>	Small-leaved milk tree, Turepo	Endemic
<i>Tradescantia fluminensis</i> *	Tradescantia, Wandering Jew	Exotic
<i>Wolffia australiana</i>	Water meal	Non-endemic

15. WHAKAPARA SOUTH

Whakapara South



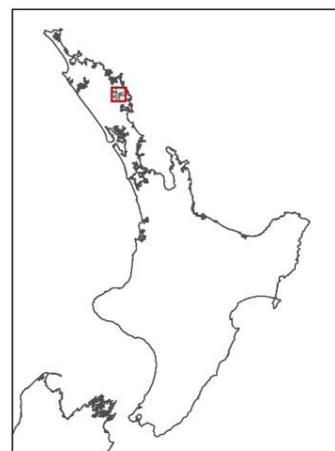
Legend

- Public Conservation Land
- Significant Natural Area
- Additional Natural Area

Plots

- Wetland, Protected
- Wetland, Private Land
- Non Area, Protected
- Non Area, Private Land

Hikurangi Restoration



Location:

Several small remnants totalling c.21 ha on the floodplain and around oxbows on the true right bank of the Whakapara River.

Coordinates: E1711952 N6064412 (Plot WSNA1)

Vegetation Types:

- Totara-matai forest (Plot WSNA1)
- Totara forest (Remnant north of sampled remnant)
- Matai-kahikatea forest (Forest lining oxbow east of sampled remnant)
- Carex sedgeland wetland (also exotic herbs and grasses)

Description:

The largest forest remnant (sampled) is dominated by totara up to 18 m tall, with canopy associates of matai (common), rimu, kōwhai, kānuka white maire, black maire, and kahikatea. Understorey species include *Coprosma areolata*, *Melicytus micranthus*, white maire, *Myrsine divaricata*, *Melicope simplex*, and *Pittosporum obcordatum*. More than 50 *Pittosporum obcordatum* individuals ranging from seedlings to adults, up to 4.5 m in height were noted (a few individuals were also found fringing the oxbow remnant to the east). Although the groundcover has localised dense patches of *Tradescantia fluminensis*, a wide variety of native species are present including *Microlaena stipoides*, *Oplismenus imbecillus*, *Arthropteris tenella*, *Pellaea rotundifolia*, and seedlings of trees and shrubs such as white maire, lowland ribbonwood, kānuka, and mahoe. The remnant is fenced and is grazed only very occasionally (G. Lindsay, pers. comm.), which appears to suit the open habitat requirements of *P. obcordatum*. An old bulldozer track runs through the middle of the remnant.

Significance:

The forest remnants are particularly notable as they had sizeable populations (at least 50 individuals in total) of the threatened species *Pittosporum obcordatum*, which is classified as Nationally Vulnerable. They also contained the two small rasp ferns, *Doodia squarrosa* (synonym: *Blechnum zeelandicum*) and *Doodia mollis* (syn: *Blechnum molle*), classified as At Risk – Nationally Uncommon. These remnants still have diverse species composition, including the regionally uncommon species, black maire, matai, *Coprosma rigida*, *Coprosma parviflora*, *Coprosma rotundifolia*, lowland ribbonwood, and kaikomako.

Whakapara South is classified as a Category 2 threatened land environment, which has 10–20% indigenous cover remaining (Cieraad et al. 2015).

Threats:

- Weeds, particularly *Tradescantia fluminensis*, Chinese privet.
- Increased intensity of grazing (current regime appears to be adequate for maintaining semi-open habitat favoured by *Pittosporum obcordatum*).

Recommendations:

- Control of troublesome weeds
- Protect and monitor *Pittosporum obcordatum* population. The seeds could be collected and propagated for distribution elsewhere on the property and on other suitable floodplain sites.
- Monitor cattle access and grazing regimes and check whether fences are stockproof.

WETLAND REPRESENTATIVE (NON_AREA) PLOT SHEET

Site name: Whakapara South

Date: 17-Feb-15

Plot no: 1 (WSNA1)

Altitude: 95 m a.s.l.

GPS E: 1711952

N: 6064412

Recorder: BRC

Veg structure: Forest

Composition¹: totara-matai

Canopy Mean hgt: 18 m

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H m	Species	%	H m	Species	%	H m
<i>Podocarpus totara</i>	60	18	<i>Melicytus micranthus</i>	8	5.5	<i>Oplismenus imbecillis</i>	8	
<i>Prumnopitys taxifolia</i>	30	17	<i>Coprosma areolata</i>	21	3	<i>Tradescantia fluminensis*</i>	40	
<i>Dacrydium cupressinum</i>	10	18	<i>Nestegis lanceolata</i>	20	12	<i>Microlaena stipoides</i>	10	
			<i>Pittosporum obcordatum</i>	1	1.7	<i>Arthropteris tenella</i>	1	
			<i>Muehlenbeckia australis</i>	0.1	1.5	<i>Aseuosmia quercifolia</i>	<1	
			<i>Clematis paniculata</i>	<1	0.5	<i>Bidens frondosa*</i>	<1	
			<i>Coprosma spathulata</i>	<1	0.7	<i>Coprosma spathulata</i>	<1	
			<i>Earina mucronata</i>	<1	15	<i>Dactylis glomerata*</i>	<1	
			<i>Melicope simplex</i>	<1	0.7	<i>Doodia squarrosa</i>	<1	
			<i>Myrsine divaricata</i>	<1	1	<i>Kunzea robusta</i>	<1	
			<i>Parsonsia heterophylla</i>	<1	1.1	<i>Lapsana communis*</i>	<1	
			<i>Sophora microphylla</i>	<1	0.8	<i>Ligustrum sinense*</i>	<1	
			<i>Streblus heterophyllus</i>	<1	1	<i>Melicytus ramiflorus</i>	<1	
						<i>Nestegis lanceolata</i>	<1	
						<i>Oenanthe pimpinelloides*</i>	<1	
						<i>Pellaea rotundifolia</i>	<1	
						<i>Plagianthus regius</i>	<1	
						<i>Plantago lanceolata*</i>	<1	
						<i>Senecio bipinnatisectus*</i>	<1	

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Comments: PITobc in plot. Heavy grazing in parts, weeds (tradescantia), needs fencing but also needs disturbance for PITobc. Past bulldozer track through middle.

WHAKAPARA SOUTH PLANT SPECIES LIST

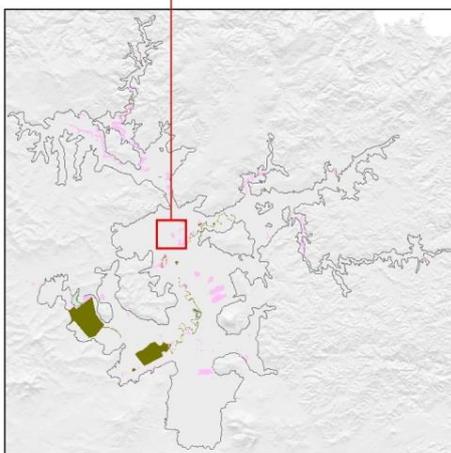
Species	CommonName	Status
<i>Agrostis capillaris</i> *	Bent grass	Exotic
<i>Alseuosmia quercifolia</i>		Endemic
<i>Alternanthera nahui</i>		Non-endemic
<i>Arthropteris tenella</i>	Jointed fern	Indigenous
<i>Bidens frondosa</i> *	Beggars' ticks	Exotic
<i>Carex gaudichaudiana</i>		Non-endemic
<i>Carex lambertiana</i>		Endemic
<i>Carex lessoniana</i>	Cutty grass	Endemic
<i>Carex ovalis</i> *	Oval sedge	Exotic
<i>Carex virgata</i>		Endemic
<i>Centella uniflora</i>	Centella	Non-endemic
<i>Clematis paniculata</i>	Pikiarero	Endemic
<i>Coprosma arborea</i>	Mamangi	Endemic
<i>Coprosma areolata</i>	Aruhe	Endemic
<i>Coprosma parviflora</i>	Leafy coprosma	Endemic
<i>Coprosma rhamnoides</i>		Endemic
<i>Coprosma rigida</i>		Endemic
<i>Coprosma rotundifolia</i>	Round-leaved coprosma	Endemic
<i>Coprosma spathulata</i>		Endemic
<i>Cordyline australis</i>	Cabbage tree	Endemic
<i>Corynocarpus laevigatus</i>	Karaka	Endemic
<i>Crococsmia xrococsmiiflora</i> *	Montbretia	Exotic
<i>Cyperus eragrostis</i> *	Puketangata	Exotic
<i>Cyperus ustulatus</i>	Coastal cutty grass	Endemic
<i>Dacrycarpus dacrydioides</i>	Kahikatea	Endemic
<i>Dacrydium cupressinum</i>	Rimu	Endemic
<i>Dactylis glomerata</i> *	Cocksfoot	Exotic
<i>Dichondra repens</i>	Creeping dichondra	Non-endemic
<i>Diplazium australe</i>		Indigenous
<i>Doodia australis (Blechnum parrisae)</i>		Indigenous
<i>Doodia mollis (Blechnum molle)</i>	Mokimoki	Indigenous
<i>Doodia squarrosa (Blechnum zeelandiae)</i>		Indigenous
<i>Earina mucronata</i>	Bamboo orchid (NZ)	Endemic
<i>Eleocharis sphacelata</i>	Bamboo spike sedge	Endemic
<i>Euphorbia peplus</i> *	Kaikaiatua	Exotic

<i>Fragaria vesca</i> *	Alpine strawberry	Exotic
<i>Galium aparine</i> *	Cleavers	Exotic
<i>Galium divaricatum</i> *	Slender bedstraw	Exotic
<i>Glyceria maxima</i> *	Reed sweetgrass	Exotic
<i>Gomphocarpus</i>		
<i>Haloragis erecta</i>	Shrubby haloragis	Endemic
<i>Jacobaea vulgaris</i> *		Exotic
<i>Juncus sarophorus</i>	Leafless rush	Non-endemic
<i>Juncus tenuis</i> *	Track rush	Exotic
<i>Juncus usitatus</i>	Common rush	Non-endemic
<i>Knightia excelsa</i>	New Zealand honeysuckle	Endemic
<i>Kunzea robusta (K. ericoides)</i>	Kānuka	Endemic
<i>Lapsana communis</i> *	Nipplewort	Exotic
<i>Lemna disperma</i>	Common duckweed	Non-endemic
<i>Leptospermum scoparium</i>	Mānuka	Non-endemic
<i>Ligustrum sinense</i> *	Chinese privet	Exotic
<i>Melicope simplex</i>	Poataniwha	Endemic
<i>Melicytus micranthus</i>	Manakura	Endemic
<i>Melicytus ramiflorus</i>	Hinahina	Non-endemic
<i>Microlaena stipoides</i>	Meadow rice grass	Non-endemic
<i>Microsorium pustulatum</i>		Indigenous
<i>Muehlenbeckia australis</i>	Large-leaved muehlenbeckia	Non-endemic
<i>Myriophyllum aquaticum</i> *	Brazilian water milfoil	Exotic
<i>Myrsine australis</i>	Māpau, red matipo	Endemic
<i>Myrsine divaricata</i>	Weeping mapou	Endemic
<i>Nestegis cunninghamii</i>	Black maire	Endemic
<i>Nestegis lanceolata</i>	White maire	Endemic
<i>Oenanthe pimpinelloides</i> *	Parsley dropwort	Exotic
<i>Oplismenus imbecillis</i>		Non-endemic
<i>Parsonsia heterophylla</i>	New Zealand jasmine	Endemic
<i>Paspalum dilatatum</i> *	Paspalum	Exotic
<i>Paspalum distichum</i> *	Mercer grass	Exotic
<i>Passiflora tetrandra</i>	Kohia, NZ passionfruit	Endemic
<i>Pellaea rotundifolia</i>	Button fern	Indigenous
<i>Pennantia corymbosa</i>	Kaikomako	Endemic
<i>Persicaria decipiens</i>		Non-endemic
<i>Persicaria hydropiper</i> *		Exotic
<i>Persicaria strigosa</i> *		Exotic

<i>Pittosporum obcordatum</i>	Heart-leaved kohukohu	Endemic
<i>Plagianthus regius</i>	Manatu, Lowland ribbonwood	Endemic
<i>Plantago lanceolata</i> *	English plantain	Exotic
<i>Podocarpus totara</i>	Totara	Endemic
<i>Prumnopitys taxifolia</i>	Matai, Black pine	Endemic
<i>Prunella vulgaris</i> *	Self-heal	Exotic
<i>Pyrrosia eleagnifolia</i>	Leather-leaf fern	Endemic
<i>Raukaua anomalus</i>		Endemic
<i>Ripogonum scandens</i>	Supplejack	Endemic
<i>Senecio bipinnatisectus</i> *	Australian fireweed	Exotic
<i>Sison amomum</i> *	Stone parsley	Exotic
<i>Solanum pseudocapsicum</i> *	Christmas cherry	Exotic
<i>Sonchus oleraceus</i> *	Common sow thistle	Exotic
<i>Sophora microphylla</i>	Kōwhai	Endemic
<i>Streblus heterophyllus</i>	Small-leaved milk tree, Turepo	Endemic
<i>Tradescantia fluminensis</i> *	Tradescantia, Wandering Jew	Exotic

16. WHAKAPARA WEST

Whakapara West



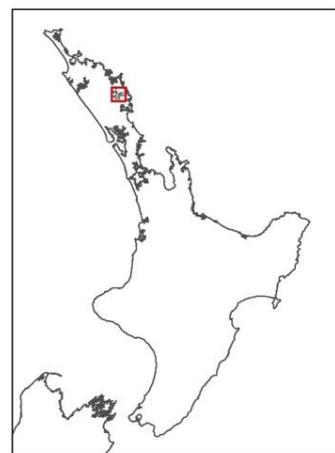
Legend

- Public Conservation Land
- Significant Natural Area
- Additional Natural Area

Plots

- Wetland, Protected
- Wetland, Private Land
- Non Area, Protected
- Non Area, Private Land

Hikurangi Restoration



Location:

Three small remnants (c. 8.5 ha in total) located on the true left bank of the Waiotu River, immediately north-west of Whakapara North Natural Area. One of the remnants is an ephemeral wetland (Remnant 1: centre), and the other two are riparian forest around oxbows (Remnants 2: west; and 3: east).

Coordinates: E1711541 N6064979

Altitude: 90 m a.s.l.

Description

The remnants were identified post-field survey as being likely habitat for the threatened plant *Pittosporum obcordatum*. They were visited on 10 April 2015 by Wendy Holland (DOC) and Lisa Forester (NRC), who provided the following descriptions.

Remnant 1:

Coordinates: E1711453 N6065187

Vegetation Type: Mercer grass grassland

Description: Ephemeral wetland surrounded by *Paspalum distichum*. Dried out at time of visit. Mostly dominated by exotic species, but some native wetland herbs present, e.g. *Alternanthera nahui*, *Myriophyllum propinquum*. No *Tradescantia fluminensis* recorded.

Remnant 2

Coordinates: E1711400 N6065122

Vegetation Type: Kānuka- lowland ribbonwood/mānuka forest

Description: Riparian forest oxbow remnant very open discontinuous canopy of mostly kānuka with some mānuka, *Plagianthus regius*, and the odd karaka, pigeonwood, kōwhai. *Pittosporum obcordatum* is a common feature of the open subcanopy. The understorey comprises occasional *Coprosma*, *Myrsine divaricata*. A large old growth black maire is a feature of this remnant. The groundcover is mostly pasture grasses with pockets of willow weed, and sedges and *Juncus*. The invasive exotic herb, *Tradescantia fluminensis*, common in many forest remnants on the Hikurangi floodplain, was absent. Circa 65 adult *Pittosporum obcordatum* found (mostly between 4 and 6 m; some up to 7 m; some healthy big specimens) plus 1 × 60-cm seedling. *Pittosporum obcordatum* specimen sent to Ewen Cameron - AK herbarium.

Remnant 3

Coordinates: E1711541 N6064979

Vegetation Composition: Kānuka- lowland ribbonwood/mānuka forest

Description: Riparian forest oxbow remnant very open, discontinuous canopy of mostly kānuka with some mānuka, *Plagianthus regius*; frequent *Pittosporum obcordatum* in

subcanopy. *Coprosma* in the subcanopy. Ground cover mostly pasture grasses with pockets of willow weed, and sedges, and *Juncus*. No *Tradescantia fluminensis*. Area of wetland dominated by *Persicaria strigosa*, and *Eleocharis sphacelata* and *E. acuta*. Circa 27 *Pittosporum obcordatum* found including saplings and adults.

Some vegetation clearance has occurred in the northern half of the remnant since 2004–2006, the dates of the underlying images.

Significance:

The remnants are representative examples of lowland floodplain forest, oxbow, and wetland ecosystems, now uncommon in the region and throughout New Zealand. The two forest patches were particularly notable as they had sizeable populations of the threatened species *Pittosporum obcordatum* (over 90 plants), which is classified as Nationally Vulnerable. They also contained the two small rasp ferns, *Doodia squarrosa* (synonym: *Blechnum zeelandicum*) and *Doodia mollis* (syn: *Blechnum molle*), classified as At Risk – Nationally Uncommon. These remnants still have diverse species composition, including the regionally uncommon species, black maire, matai, *Coprosma rigida*, *C. rotundifolia*, *C. tenuicaulis*, lowland ribbonwood, and *Rubus schmidelioides*.

Whakapara West is classified as a Category 2 threatened land environment, which has 10–20% indigenous cover remaining (Cieraad et al. 2015).

Threats:

- Remnants are not or poorly fenced and cattle appear to have regular access.
- Some vegetation has recently been cleared, burnt and sprayed.
- Vegetation (?dead) being pushed into the oxbow.
- Some clearance of wetland area.

Recommendations:

- Fencing of remnants to exclude cattle browsing and trampling.
- Increase the width of the riparian margins so they are more sustainable.

WHAKAPARA WEST PLANT SPECIES LIST

Species	CommonName	Remnant 1	Remnant 2	Remnant 3
<i>Alternanthera nahui</i>		Yes		
<i>Azolla pinnata</i> *	Ferny azolla		Yes	
<i>Bidens frondosa</i> *	Beggars' ticks			Yes
<i>Bidens pilosa</i> *			Yes	
<i>Carex ovalis</i> *	Oval sedge			Yes
<i>Carex virgata</i>			Yes	
<i>Centella uniflora</i>				Yes
<i>Conyza sumatrensis</i> *	Broad-leaved fleabane		Yes	Yes
<i>Conyza bonariensis</i> *	Wavy-leaved fleabane	Yes		
? <i>Coprosma parviflora</i>	Leafy coprosma			
<i>Coprosma propinqua</i>	Mingimingi, Miki		Yes	Yes
<i>Coprosma propinqua x robusta</i>			Yes	
<i>Coprosma rhamnoides</i>				Yes
<i>Coprosma rigida</i>			Yes	Yes
<i>Coprosma rotundifolia</i>	Round-leaved coprosma			Yes
<i>Coprosma tenuicaulis</i>	Hukihuki		Yes	Yes
<i>Corynocarpus laevigatus</i>	Karaka		Yes	
<i>Cyperus eragrostis</i> *				Yes
<i>Cyperus sp.</i> *		Yes		
<i>Cyperus ustulatus</i>			Yes	
<i>Dacrycarpus dacrydioides</i>	Kahikatea			Yes
<i>Digitaria sanguinalis</i> *	Summer grass	Yes		
<i>Doodia mollis (Blechnum molle)</i>	Mokimoki		Yes	
<i>Doodia squarrosa (Blechnum zealandicum)</i>			Yes	
<i>Egeria densa</i> *	Egeria		Yes	
<i>Eleocharis sphacelata</i>	Bamboo spike sedge		Yes	Yes
<i>Eleocharis acuta</i>				Yes
<i>Epilobium ciliatum</i> *		Yes		
<i>Erechtites valerianifolia</i> *			Yes	
<i>Euchiton japonicus</i>		Yes		
<i>Euchiton sp.</i> *		Yes		
<i>Galium palustre</i> *				
<i>Hedycarya arborea</i>	Pigeonwood		Yes	
<i>Hypochaeris radicata</i> *	Catsear	Yes		
<i>Isolepis prolifera</i>		Yes		

<i>Juncus acuminatus*</i>	Sharp-fruited rush	Yes	
<i>Juncus bufonis</i> var. <i>bufonius*</i>	Toad rush	Yes	
<i>Juncus dichotomus</i>			
<i>Juncus edgariae</i>			
<i>Juncus effusus*</i>			Yes
<i>Juncus</i> sp.		Yes	
<i>Juncus usitatus</i>		Yes	
<i>Kunzea robusta</i> (<i>K ericoides</i>)	Kānuka	Yes	Yes
<i>Leptospernum scoparium</i>	Mānuka	Yes	Yes
<i>Ligustrum sinense*</i>	Chinese privet	Yes	
<i>Lotus pedunculatus*</i>	Lotus	Yes	Yes
<i>Lotus suaveolens*</i>	Hairy birdsfoot trefoil		
<i>Ludwigia palustris*</i>	Water purslane	Yes	
<i>Melicope simplex</i>	Poataniwha		Yes
<i>Melicytus micranthus</i>	Manakura		Yes
<i>Melicytus ramiflorus</i>	Hinahina, Mahoe	Yes	
<i>Microlaena stipoides</i>		Yes	Yes
<i>Muehlenbeckia australis</i>	Large-leaved muehlenbeckia	Yes	
<i>Myriophyllum aquaticum*</i>	Brazilian water milfoil	Yes	
<i>Myriophyllum propinquum</i>		Yes	Yes
<i>Myrsine australis</i>	Māpau, red matipo	Yes	
<i>Myrsine divaricata</i>		Yes	
<i>Nestegis cunninghamii</i>	Black maire	Yes	
<i>Ottelia ovalifolia*</i>		Yes	
<i>Paspalum distichum*</i>	Mercer grass		Yes
<i>Persicaria decipiens</i>			Yes
<i>Persicaria hydropiper*</i>		Yes	Yes
<i>Persicaria strigosa*</i>			Yes
<i>Phytolacca octandra*</i>	Dyeberry	Yes	
<i>Pittosporum obcordatum</i>		Yes	Yes
<i>Plagianthus regius</i>	Lowland ribbonwood, Manatu	Yes	Yes
<i>Podocarpus totara</i>	Totara, Amoka	Yes	
<i>Portulaca oleracea*</i>	Purslane	Yes	
<i>Prumnopitys taxifolia</i>	Matai, Black pine	Yes	
<i>Pseudognaphalium luteo-album</i>	Yes		
<i>Pyrrosia eleagnifolia</i>	Leather-leaf fern	Yes	Yes
<i>Ranunculus flammula*</i>			Yes
<i>Ripogonum scandens</i>	Akapirita, Supplejack	Yes	

<i>Rubus australis</i>	Bush lawyer		Yes	
<i>Rubus fruticosus*</i>	Blackberry			Yes
<i>Rubus schmidelioides</i>				Yes
<i>Schoenus maschalinus</i>				
<i>Solanum nigrum*</i>	Black nightshade		Yes	
<i>Solanum pseudocapsicum*</i>	Christmas cherry			Yes
<i>Sonchus oleraceus*</i>	Common sow thistle	Yes		
<i>Sophora microphylla</i>	Kōwhai		Yes	Yes
<i>Streblus heterophyllus</i>	Ewekuri		Yes	Yes
<i>Trifolium repens*</i>	White clover	Yes		

* = Exotic

Appendix 2 – Understanding wetlands

In simple terms, a wetland is any area (including shallow water and land water margins) where water occurs at or near the ground surface for all or part of the year, and supports plants and animals adapted to living in the permanently or seasonally wet conditions.

Freshwater wetlands comprise a variety of classes or types based on distinctive combinations of water regime, nutrient status, pH, and substrate (Johnson & Gerbeaux 2004). The functional types most relevant to the Hikurangi floodplain are marsh, swamp, fen, and bog.

The marsh, swamp, fen, and bog types separate along environmental gradients of water supply, nutrient levels, pH, and substrate. The main environmental gradients are summarised in Table 8, which is based on Johnson & Gerbeaux (2004) and Clarkson & Peters (2010).

Table 8 Wetland type environmental characteristics

Wetland Type	Marsh	Swamp	Fen	Bog
Water Source	Surface & Groundwater	→	Groundwater	→ Rainfall
Water flow/fluctuation	High	→	Medium	→ Low
Nutrient availability	High	→	Medium	→ Low
pH	High/neutral	→	Medium	→ Low/acidic
Peat content	Low/none	→	Medium	→ High

Marshes have shallow surface water that fluctuates periodically to the extent that the surface can be dry underfoot. They typically have higher nutrient levels and mineral (non-peat) substrates and are often alongside rivers and other water bodies prone to flooding. At the opposite end of the spectrum, bogs are rain-fed and the water table is more stable, being retained close to the surface within a peat matrix, which is nutrient-poor and acidic. Fens and bogs are often collectively referred to as peatlands.

An easy way of distinguishing between marshes, swamps, fens, and bogs is based on the footwear needed to walk across them. Marshes may require wet (or dry) suits when water levels are high, yet sneakers would be fine most other times. Chest or thigh waders would be needed for swamps to cope with high overall water tables and areas of shallow water. ‘South Island’ knee length gumboots are mostly fine for fens, except for occasional pockets or channels of deeper water. Shorter red-band gumboots will keep your feet dry in bogs as the water is retained below the surface within the peat matrix, which, together with the vegetation, will support your weight.

Studies on wetland succession indicate that, in the absence of major disturbance, wetlands develop from marshes through swamps through fens to bogs over several thousand years (Clarkson et al. 2004). One of the oldest raised bogs is Otakairangi Swamp GPWMR, which has peat deposits dating back to c.30 000 years (Newnham 1992).