DIVERSIFIED SPECIES TECHNICAL NOTE

Number: DSTN-028
Date: November 2012

Riparian Restoration, Pukahukiwi Kaokaoroa Trust

Summary

The Rotorua Lakes region contains a number of significant lakes requiring remedial action to improve water quality, habitat and cultural value. Scion has been collaborating with Ngāti Pikiao and Ngāti Te Takinga to develop a model sustainably productive riparian restoration site on the northern edge of Lake Rotoiti as part of the FFR Diversified Species programme. A one-hectare riparian site dominated by willows was identified to establish a trial. A survey has been completed and provides a baseline description of the characteristics of the restoration site and vegetation cover.

Plots placed along transects were used to describe site characteristics and vegetation cover. The central zone of the restoration area is dominated by wet floodplain where the predominant canopy is willow. Most of the drier levee and part of the embankment along the roadside are dominated by native shrub hardwood species. Besides willow and native regeneration, significant exotic weed species also occur throughout the site.

The trial will evaluate a range of treatment options that test the effectiveness of willow removal methods for enhancing establishment of native species on the restoration area. As the willows are removed there is also scope for planting selected sites with a range of indigenous species to supplement natural regeneration and to provide a long-term sustainable resource for the harvesting of wood and fibre, and to enhance sediment trapping along lake and road margins, and reduce bank erosion.

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Introduction

The Rotorua Lakes region contains a number of lakes requiring remedial action to improve water quality, habitat and cultural value. Lake margins are commonly owned and managed by Māori. Scion has been collaborating with Ngāti Pikiao and Ngāti Te Takinga to develop a model sustainably productive riparian restoration site on the northern edge of Lake Rotoiti adjacent to the Ohau Channel and Te Takinga Marae.

Survey of Iwi and Landowners

In a partnership among Scion, Future Forests Research (FFR) and Ngā Pae O Te Māramatanga (New Zealand's Māori Centre of Research Excellence), Anastasia Rickard carried out a survey with iwi, landowners and interested parties to highlight the main issues and to determine their support for proposed restoration plans for the riparian area[1]. The survey found that iwi are supportive of restoration plans, and highlighted a number of issues including:

- Ongoing consultation between Ngāti Pikiao, Ngāti Te Takinga and Scion and their full involvement will be beneficial for all parties;
- Support for restoration of the sites using native species, building on what is already there, and planting natives to reduce erosion and filter lake water;
- Support for eradication of willow;
- Control of pest animals such as possums to reduce damage to native plant species;
- Improved access for the benefit of the community and visitors, especially as it is a high-profile location;
- Involvement of the local community and youth groups in the restoration project;
- Provision for long-term maintenance and productive harvesting of plant materials; and
- Respect for culturally sensitive areas at the site.

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Selection of Site

In consultation with Ngāti Pikiao and Ngāti Te Takinga, an approximately one-hectare site was identified for establishment of a restoration trial. The site is located immediately adjacent to the boat ramp and car park at the northern end of Lake Rotoiti where the diversion wall for water from the Ohau channel has been erected.

Methods

A field-based assessment of the site characteristics and vegetation cover of the riparian area was carried out in December 2010 and January 2011. A report was completed by Anastasia Rickard for Ngā Pae O Te Māramatanga[2]. The main objective was to provide a baseline description of the characteristics of the restoration site and vegetation cover, including exotics and native plant species, before restoration activities are initiated.

Six parallel transects 20 metres apart were demarcated from the road edge to the lake margin within the trial area. Ten-metre diameter circular plots were placed at 10-metre intervals along each transect. A total of 59 plots were established. Topography was assessed for each plot into one of five broad units:

1. Bank (B) – adjacent to road, well drained and possibly modified with fill.
2. Toeslope (Ts) – base of bank flaring out into a flood plain.
3. Floodplain (Fp) – permanently or periodically wet or flooded hollows and depressions behind a levee or bank.
4. Levee (L) – flat, slightly elevated, alluvial plain, occasionally flooded during high lake levels.
5. Lake edge (LE).

Vegetation cover was assessed using standardised reconnaissance methods[3]. Vegetation cover of dominant trees in each plot and the vegetation in height tiers were included in the assessment. There were six tier classes as follows:

1. T1 (Tier 1) – emergent species and mean top height
2. T2 – species >12 m high and mean top height
3. T3 – species 5 – 12 m high
4. T4 – species 2 – 5 m high
5. T5 – species 30 cm – 2 m high
6. T6 – species <30 cm high

For each plot, a percentage cover score was determined by species within each tier into one of seven cover classes using the methods of Mueller–Dombois and Ellenberg[4]. These cover scores were:

1. < 1% cover
2. 1 – 5%
3. 6 – 25%
4. 26 – 50%
5. 51 – 75%
6. 76 – 95%
7. > 95%

The site and vegetation cover data were analysed using SAS version 9.2 statistical analysis software. The relative importance of each species in each plot was obtained by summing their cover scores across all height tiers. Species were ranked based on their summed cover score. The growth behaviour of the important species (mean cover scores >5) was determined by plotting their mean cover score against height tier.

Plots were classified into vegetation types based on summed cover scores. In most cases, vegetation classes were easily defined using either the species with the highest cover score, or the species with the highest and second highest scores. To simplify this classification process, the two willow species in the wetland (grey willow - *Salix cinerea*; crack willow – *S. fragilis*) were grouped together, as were the native shrub hardwood species other than the two most common. In most cases, plots could be readily classified into vegetation classes using this method. In six plots where tree ferns ranked highest based on summed cover score, the highest tree or shrub species was used to classify the vegetation. There were also one or

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two plots where an under storey species ranked highest, but again the major canopy species was used for classifying these plots.

Maps were prepared showing the vegetation classification, topographical unit and the percentage water covering each plot. The composition of each vegetation class and of the topographical units was shown by tabulating the mean summed cover score of the 20 most important species for each vegetation class or topographical unit. Ground cover categories and canopy cover and mean top height were compared across topographical units and vegetation classes using analysis of variance and the least significant difference test.

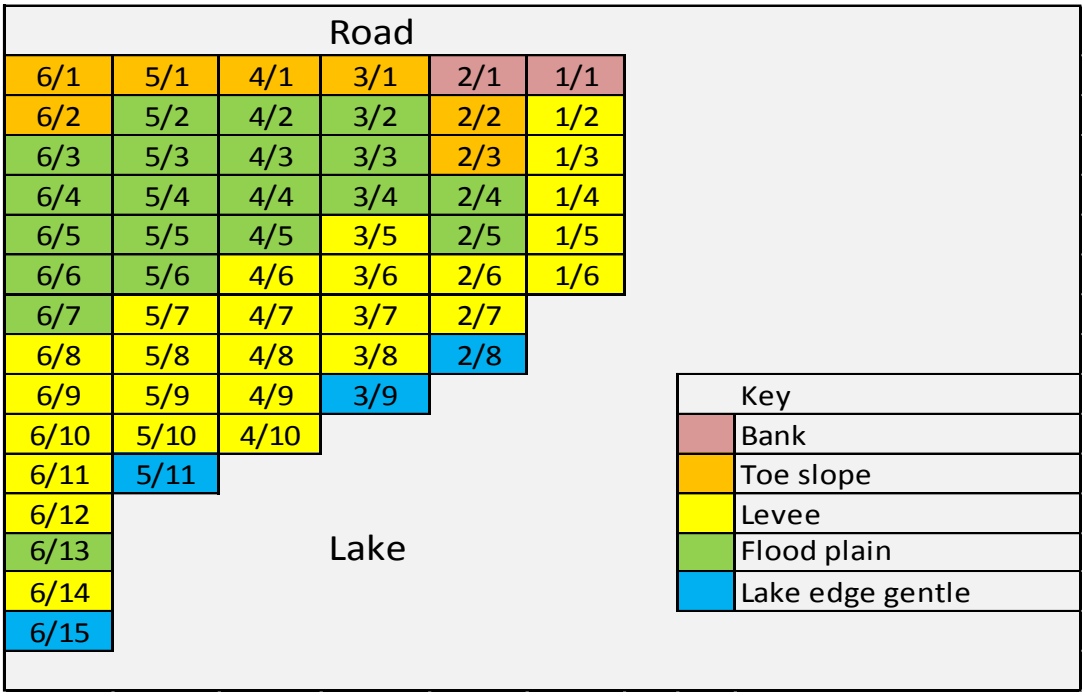

Figure 1: Map of the study area based on the 59 plots established along 6 transect showing the topographical unit of each plot, Lake Rotoiti restoration site.

Results

Topography

A map of the study area showing the Topographical Unit of each plot is given in Figure 1. Levee and Floodplain are the most dominant topographical units forming a diagonal band stretching from the boat ramp on the eastern side to the western edge of the restoration site. As expected, the plots along the road are recorded as Bank and Toe slope and the few Lake Edge plots are located along the lake margin of most transects.

Hydrology

The water cover as recorded during the ground cover assessment of each plot is shown in Figure 2. The high concentrations of water are located in the centre of the site and along the lake edge. The higher levels of water throughout the site tended to correlate with the Floodplain Topographical Unit (Figure 1).

Vegetation Type

A list of exotic and native plant species recorded during the survey of vegetation in the Lake

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Rotoiti restoration site is in Appendix 1. Dominance of key species assessed in the vegetation survey was used to determine five vegetation types based on mean cover scores. The five vegetation types were:

1. MELRAM – *Melicytus ramiflorus* (mahoe)
2. MELRAM/SHRUB – mahoe/native shrub hardwood species
3. SALSPP – includes both grey willow (SALCIN) and crack willow (SALFRA)
4. SALSPP/COPTEN – both willow species/*Coprosma tenuifolia* (huki huki)
5. SALSPP/ MELRAM – both willow species/mahoe.

The five major vegetation types for each plot are shown in Figure 3. Willow is the main vegetation type occupying the wetter Levee and Floodplain. The three vegetation types either dominated by or with a high proportion of mahoe (MELRAM) are located around the drier landward edges of the restoration site, i.e. plots identified as Bank or Toe slope (Figure 1).

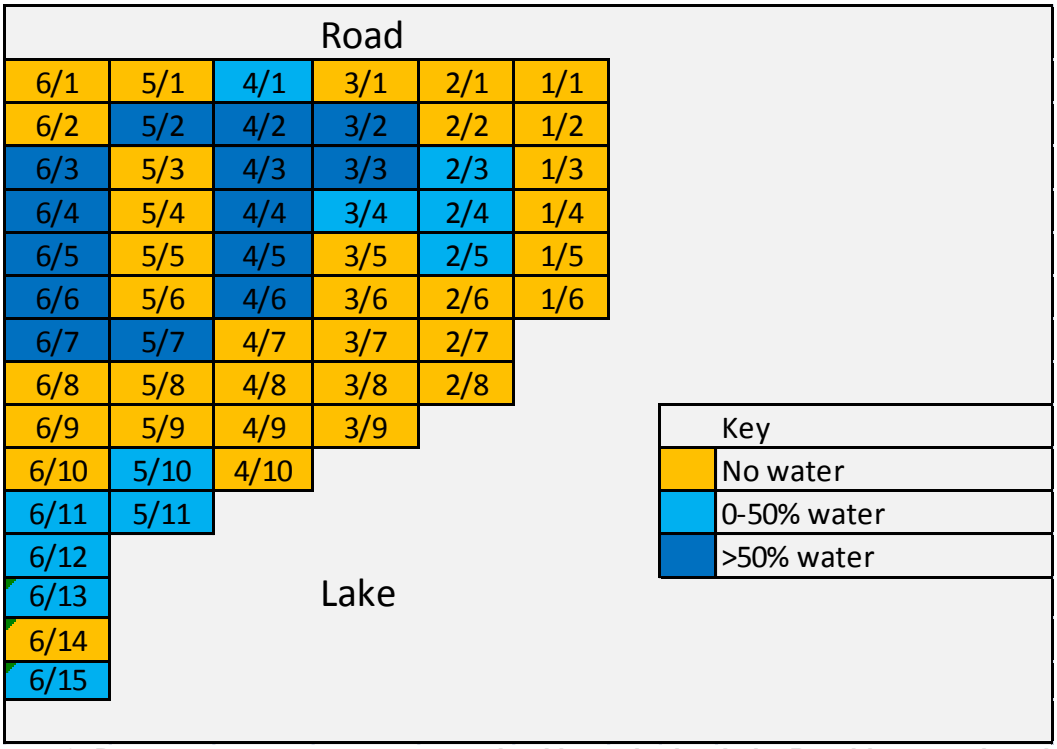

Figure 2: Percentage water cover categorised in each plot, Lake Rotoiti restoration site.

Vegetation by Tiers

Exotic Vegetation - The mean cover score over a range of height tiers of the most predominant exotic species within the restoration site is shown (Figure 4). Grey willow (SALCIN) is the most common exotic species - with the highest mean cover score across all height tiers while crack willow (SALFRA) has a minor presence. English ivy (HEDHEL) and to a lesser extent blackberry (RUBFRU) were the most predominant exotic species in height tiers <0.3m and 0.3-2m. Alder (ALNGLU) and gorse (ULEEUR) have only a minor presence.

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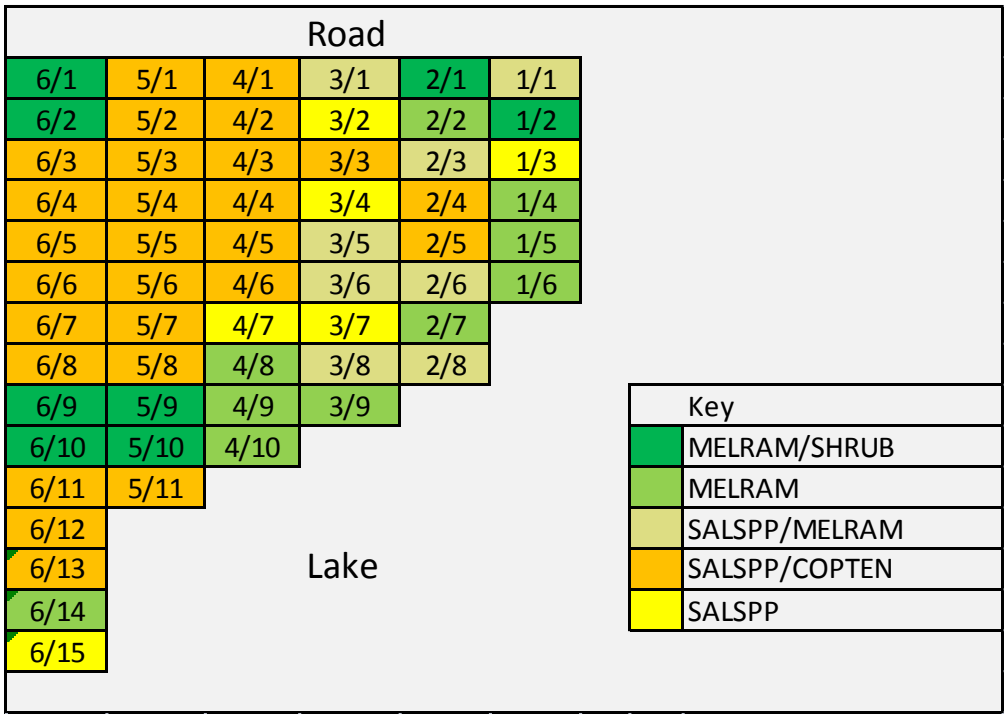

Figure 3: Layout of the five vegetation types determined for each plot, Lake Rotoiti restoration area. Species codes are: MELRAM = *Melicytus ramiflorus* (mahoe); SALSPP = *Salix* species (willow); COPTEN = *Coprosma tenuifolia* (huki huki).

***NativeVvegetation* -** The mean cover score of the six predominant native species across height tiers is given in Figure 5. Huki huki (COPTEN) dominates the tiers up to 5 m, mahoe (MELRAM) continues to be present in the 5-12 m tier. Huki huki is often the major under storey species to grey willow (SALCIN) which dominates most of the site. Tree ferns (TREEFN) are also significant in lower tiers but only up to the 2-5 m tier. The ground cover tier <0.3 m is dominated by kiokio (BLENOV) and the native sedge *Carex maorica* (CARMAO).

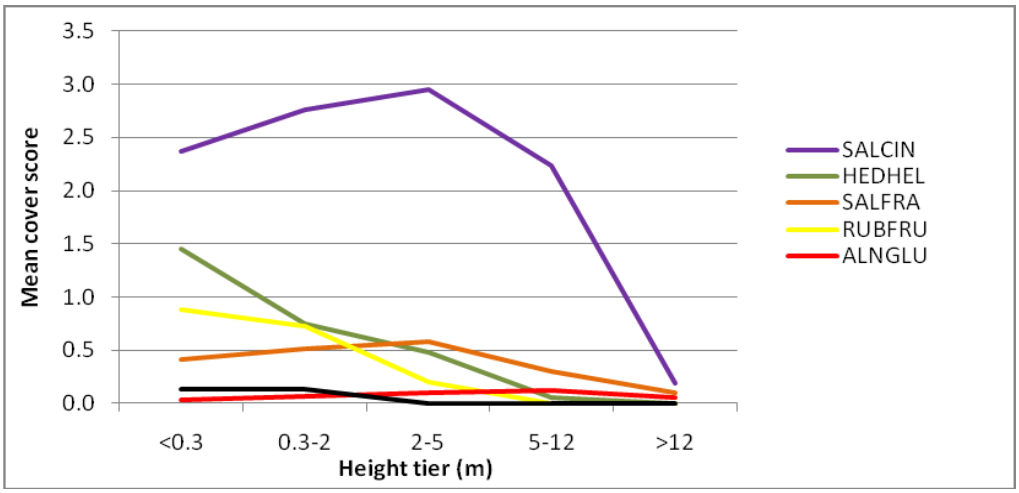

Figure 4: Mean cover score by height tier of major exotic species, Lake Rotoiti Restoration area. Species codes are: SALCIN = *Salix cinerea* (grey willow); HEDHEL = *Hedera helix* (ivy); SALFRA = *Salix fragilis* (crack willow); RUBFRU = *Rubus fruticosus* (blackberry); ALNGLU = *Alnus glutinosa* (alder).

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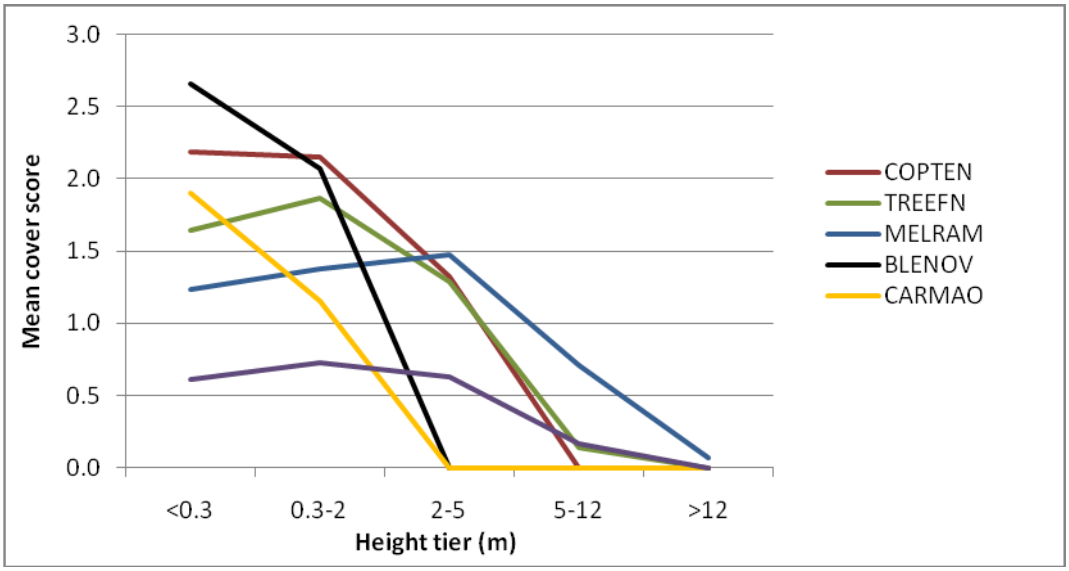

Figure 5: Mean cover score by height tier of major native species, Lake Rotoiti Restoration area. Species codes are: COPTEN = *Coprosma tenuifolia* (huki huki); TREEFN = treeferns; MELRAM = *Melicytus ramiflorus* (mahoe); BLENOV = *Blechnum novae-zelandiae* (kiokio); CARMAO = *Carex maorica* (Maori sedge).

Discussion

The 59 plots used to provide a baseline of site and vegetation cover clearly show associations between topography, soil/hydrology type and vegetation types throughout the riparian area. The central zone of the restoration area surveyed is dominated by floodplain (Figure 1), where the majority of wet sites occur (Figure 2) and which are dominated by willow species (Figure 3), especially grey willow. Most of the drier levee and part of bank sites along the roadside are dominated by native shrub hardwood species, but gorse and blackberry are present and likely to be spreading.

Grey willow is the dominant canopy tree at this site, especially in the higher tiers, often exceeding 5 m in height (Figure 4). In contrast, the only other exotics of any significance (and then only in the lower tiers) are blackberry and ivy which tend to be localised ground covers. The native shrubs or small trees including mahoe, huki huki and kawakawa are common in lower tiers (Figure 5) as an understorey to willows, especially where willows are not dense. If willows are carefully removed in areas of native understorey species, there is likely to be effective regeneration of a native forest cover dominated by the species already present.

Further Work

There is excellent scope for progressively removing the willow that dominates most of the restoration area at this site. Much of the area, particularly the drier sites, has a vigorous understorey, often dominated by native shrub and young tree species. The method of willow removal will be critical to determining successful conversion of these areas to natives. Options for removing willows include poisoning in various forms and physical removal of trees[5]. Stem poisoning has been a preferred method used in some willow-dominated wetland conversion programmes. Poisoned trees gradually disintegrate to allow regenerating understorey natives to develop. This avoids regeneration of willow from broken and fallen twigs associated with attempted cutting of live trees and removal.

Proposed treatment options for removal of willows at the riparian area at Lake Rotoiti include:

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- **Control –** leave willows for the duration of the trial;
- **Maximum control –** drill/poison the willow and spray or cut all problem weeds such as blackberry, ivy, etc, thereby assisting native regeneration; and
- **Minimum control –** drill/poison all crack willow and at least the female grey willow.

The presence of vigorous weed species such as blackberry, ivy, and to a lesser extent gorse, is problematic. Any restoration plans will need to ensure that as willows are removed, these invasive weeds are controlled as sites are opened up.

The drier sites in the restoration area where there is abundant native regeneration are likely to provide the best opportunities for replacement of native forest cover as willows are removed. Other than mangeao, there were no other high-forest native tree species present in the restoration area. It is not known whether natural regeneration of native tree species from forest remnants along nearby edges of the both Lake Rotorua and Lake Rotoiti will occur after the willows are removed, but this will be monitored.

It is therefore proposed to plant sites as the willows are removed to supplement any natural regeneration and to provide a long-term sustainable resource for the harvesting of wood and fibre. The ephemeral wet areas could be planted with kahikatea. Small groups of other podocarps such as totara, matai and miro could be tested on drier sites. Native tree hardwoods such as pukatea (*Lauraelia novae-zealandiae*) and pokaka (*Elaeocarpus hookerianus*) could also be tested by planting in small groups on both drier and wetter sites. The wet sites can be lanted with harakeke and ti kouka (*Cordyline australis*).

Acknowledgements

Heidi Dungey and Greg Steward provided ongoing support and advice, Elizabeth Miller assisted with plant identification, Mark Miller and Kane Fleet carried out the vegetation assessment and Mark Kimberley the data analysis. Scion and Ngā Pae O Te Māramatanga funded the internship of Anastasia as part of the Future Forest Research Diverse Species Programme. James Rickard and other members of her whanau provided insightful contributions and support to Anastasia throughout the project.

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Appendix 1: Species list of exotic and native plant species recorded during the vegetation survey in the Lake Rotoiti Restoration Site.

SPECIES CODE	BOTANICAL NAME	COMMON NAME	MAORI NAME
SALCIN	*Salix cinerea*	Grey willow	
COPTEN	*Coprosma tenuicaulis*	Swamp coprosma	Huki Huki
MELRAM	*Melicytus ramiflorus*	Whitey wood	Mahoe
BLENOV	*Blechnum novae-zelandiae*	Palm leaf fern	Kiokio
CARMAO	*Carex maorica*	Maori Sedge	
HEDHEL	*Hedera helix*	Ivy	
HEDARB	*Hedycarya arborea*	Pigeon wood	Porokaiwhiri
MACEXC	*Macropiper excelsum* subsp. *excelsum*	Pepper tree	Kawakawa
COPROB	*Coprosma robusta*	Glossy karamu	Karamu
SALFRA	*Salix fragilis*	Crack willow	
RUBFRU	*Rubus fruticosus*	Blackberry	
PYRELE	*Pyrrosia eleagnifolia*	Leather - leaf fern	Ota
PSEARB	*Pseudopanax arboreus*	Five finger	Whauwhaupaku
MUEAUS	*Muehlenbeckia australis*	Large - leaved muehlenbeckia	Pohuehue
ARISER	*Aristotelia serrata*	Wineberry	Makomako
ELEACU	*Eleocharis acuta*	Sharp spike sedge	Utu Utu
GENLIG	*Geniostoma ligustrifolium*	Maori privet	Hange hange
MICPUS	*Microsorum pustulatum* subsp. *pustulatum*	Hounds tongue	Kowaowao
HYDMAC	*Hydrangea macrophylla*	Hydrangea	
LITCAL	*Litsea calicaris*		Mangeao
LEPSCO	*Leptospermum scoparium*	Tea tree	Manuka
COPGRA	*Coprosma grandifolia*	Evergreen	Kanono
ALNGLU	*Alnus glutinosa*	Alder	
UNCUNC	*Uncinia uncinata*	Hook grass	Tataraheke
ULEEUR	*Ulex europaeus*	Gorse	
CATSEP	*Catystegia sepium* subsp. *roseata*	Hedge bindweed	
CYADEA	*Cyathea dealbata*	Silver fern	Ponga
LIGSIN	*Ligustrum sinense*	Chinese privet	
LONJAP	*Lonicera japonica*	Japanese honeysuckle	
DICSQU	*Dicksonia squarrosa*	Rough tree fern	Wheki
HEDGAR	*Hedychium gardnerianium*	Kahili ginger	
CROCRO	*Crocosmia crocosmiiflora*	Crocosmia	
FUCTRI	*Fuchsia triphylla*	Honeysuckle Fuchsia	
BUDDAV	*Buddleja davidii*	Summer lilac	
CAMSPP	*Camellia* sp.	Camellia	
CORAUS	*Cordyline australis*	Cabbage tree	Ti kouka
PHOTEN	*Phormium tenax*	New Zealand Flax	Harakeke
CORFUL	*Cortaderia fulvida*	Cutty grass	Toe toe/Kakaho
CYAMED	*Cyathea medullaris*	Black tree fern	Mamaku
BRAREP	*Brachyglottis repanda*	Bushman's friend	Rangiora
PTYACI	*Ptychomnion aciculare*	Pipe cleaner moss	
ASPFLA	*Asplenium flaccidum*	Hanging spleenwort	Makawe
PERDEC	*Pericaria decipiens*	Willow weed	Tutuanawi
DIPAUS	*Diplazium australe*	Austra Lady Fern	
PHYOCT	*Phytolacca octandra*	Ink weed	

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