DAVIE LOVELL-SMITH

Whisper Creek Application
Appendix C: Ecological Assessment

ASSESSMENT OF ECOLOGICAL VALUES AND RESTORATION OPTIONS FOR WHISPER CREEK, SPENCERVILLE

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ASSESSMENT OF ECOLOGICAL VALUES AND RESTORATION OPTIONS FOR WHISPER CREEK, SPENCERVILLE

Contract Report No. 4462

3 November 2017

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. INTRODUCTION

Davie Lovell-Smith Ltd is acting for a developer, Ross Moffatt of LMM Investments 2012 Limited, who is undertaking a subdivision of up to 70 lots at Whisper Creek, Spencerville, Christchurch. The residential subdivision development will occupy the north-western area of the property. The remainder of the land will remain undeveloped, and there are opportunities for an extensive open space and lake or riparian plantings.

Wildland Consultants have been asked to provide an assessment of site values and to highlight opportunities for possible ecological restoration of the site.

2. METHODS

A site visit was undertaken on 16 October 2017 to assess the ecological values of the area and focused on indigenous plants, lizards, invertebrates and birds. Opportunities for ecological restoration of the area will be identified and detailed in a report along with the assessment of ecological values.

The drainage channels on this project site drain into the Styx River and so a search of the New Zealand Freshwater Fish Database (NZFFD) was carried out for the Styx River catchment on 16 October 2017. Visual assessment of various aerial photographs of the site and discussions with relevant people suggested that water is only seasonally present in the drainage channels at this site, and so a fish and macroinvertebrate survey was not undertaken at the site.

3. ECOLOGICAL CONTEXT

3.1 Site location

The site is located on Spencerville Road, Spencerville, Christchurch, and is the proposed subdivision of Lot 2 DP 5889 (Figure 1). The northern boundary of the property is Spencerville Road, and the south-eastern boundary is adjacent to the Styx River and Lower Styx Road. The area of the site is 10.991 hectares.

3.2 Low Plains Ecological District

The property is located in the Low Plains Ecological District, in the Canterbury Plains Ecological Region (McEwen 1987). Low Plains Ecological District comprises a large area of coalesced fans that occur north and south of Banks Peninsula and range from 0-300 metres above sea level. It extends from the Waipara River in the north to the Washdyke Creek in the south, and is also drained by many other rivers including the Waimakariri, Rakaia, Ashburton, and Rangitata.

Underlying geology of the Ecological District is mainly Pleistocene glacial outwash gravels and Holocene alluvial deposits. However, there are important areas of Holocene coastal swamp deposits near Tuahiwi/Ohoka, Marshlands, Doyleston, Longbeach, Seadown; significant areas of beach gravels from Christchurch to the

Figure 1: Location of the project area at Spencerville, Christchurch. The proposed subdivision occupies higher elevation parts of the site. Figure provided by Davie Lovell-Smith.

Waipara River and at Seadown in the south; extensive coastal sands from Christchurch to Waipara River; and minor areas of inland dunes centred on Halkett.

Soils on terraces and coalescing low angle fans are shallow, stony, and droughty with poorly-drained, gleyed, silty and clayey soils on lower parts of fans. Alluvial soils are present on river flats and low terraces, ranging from excessively drained stony sands to well drained deep silty soils. Excessively-drained sandy soils occur on both coastal and terrace dunes.

Climate is characterised by low rainfall (600-800 mm per annum), warm summers with hot foehn northwesterlies giving temperatures above 32°C, and cool winters with frequent frosts and occasional light snowfalls.

Former vegetation mainly comprised lowland short tussock grassland - matagouri (*Discaria toumatou*) shrubland with some floodplain forest; some podocarp-hardwood forest; extensive kānuka (*Kunzea robusta*) shrublands; extensive harakeke/lowland flax (*Phormium tenax*), sedge (*Carex* spp.), tī kōuka/cabbage tree (*Cordyline australis*) swamplands; dry riparian kōwhai (*Sophora microphylla*) - mixed hardwood woodland flanking major rivers; and elsewhere mixed short tussock and other indigenous grasses and herbs, and extensive shrubland dominated by matagouri, but with a diverse component of *Coprosma*, *Olearia*, *Carmichaelia*,

Corokia, *Rubus*, *Clematis*, and *Muehlenbeckia* shrub and liane species. The small-leaved shrub *Olearia adenocarpa* is endemic to the Canterbury Plains, but is now very localised and rare. Extensive cushionfields and herbfields are scattered over braided riverbeds and adjacent river terraces, dominated by various species of *Raoulia*, *Muehlenbeckia*, *Scleranthus*, *Rytidosperma*, and *Colobanthus*.

Most of the Ecological District is now farmed: intensive dairy, sheep, cattle, and crops, with some areas of exotic plantation forest, numerous small settlements, and the major urban centre of Christchurch. Indigenous forest remnants are still present at Riccarton and Arowhenua, and kānuka stands persist at Eyrewell and Bankside, but indigenous vegetation is much reduced in extent, and indigenous forest, and shrublands now comprise <0.1% landcover, and freshwater water and estuarine wetlands comprise <0.2% landcover, within the Ecological District (Landcover Database v4; Landcare Research 2014).

3.3 Threatened Environments Classification

The Threatened Environment Classification (TEC) is a source of national scale information on New Zealand's land environments (Cieraad *et al.* 2015). The Spencerville property is located entirely on Acutely Threatened land environments which have <10% indigenous vegetation cover remaining (Cieraad *et al.* 2015). This is the highest level of threat within the TEC system.

4. SITE DESCRIPTION

4.1 Site visit

A site visit was carried out in cool, damp weather on 16 October 2017. During the site visit vascular plant species, birds and lizards that were observed were recorded. General impacts of the proposal on ecological values (vegetation, birds and lizards) were assessed and potential opportunities for enhancing ecological values were identified.

4.2 Vegetation

4.2.1 Higher elevation area

The higher elevation area of the site has been proposed for the subdivision (Plate 1). This area comprises exotic vegetation and no indigenous species that would occur naturally in the area were observed. The main vegetation type comprises exotic pasture grasses and associated herbaceous weed species such as dandelion (*Taraxacum officinale*), narrow leaved plantain (*Plantago lanceolata*), creeping buttercup (*Ranunculus repens*), common storksbill (*Erodium cicutarium*), and mouse-eared chickweed (*Cerastium glomeratum*). Larger growing woody weeds include gorse (*Ulex europeaus*), blackberry (*Rubus fruticosus*), and elderberry (*Sambucus nigra*). Other exotic species are present and have been used as shelter belts and amenity plantings, and include pampas (*Cortaderia selloana*), grey willow (*Salix cinerea*), eucalypts (*Eucalyptus* species), and radiata pine (*Pinus radiata*). Tarata/lemonwood (*Pittosporum eugenioides*) is one of the few indigenous species planted in this area.

4.2.2 Lower elevation area

The lower elevation area of the site is not part of the proposed subdivision, and will be retained as productive land for farming (P. Harte, Davie Lovell-Smith Ltd, pers. comm.; Plates 1, 2). No indigenous plant species were observed in this area. The main vegetation type comprises exotic pastures grasses and associated annual and herbaceous weed species such as dandelion, narrow leaved plantain, creeping buttercup, common storksbill, shepherds purse (*Capsella bursa-pastoris*), and mouse-eared chickweed. There are scattered patches and some isolated individuals of gorse. Shelter belt plantings in this area comprise radiata pine, eucalypts and common alder (*Alnus glutinosa*). Annual nettle (*Urtica urens*) occurs on bare areas under some radiata pine shelterbelts. Two paddocks had been recently ploughed.

4.2.3 Drainage channels

Several drainage channels traverse lower elevation parts of the property, forming a network that channels water into the Styx River. The drainage channels are not permanently wet, as is evidenced by the type of vegetation present and comments from the local farmer, and mainly carry water during the winter months. On the banks of the drainage channels there are only occasional, scattered, rushes (*Juncus* spp.) and sedges (*Carex secta* and possibly *C. virgata*) (Plate 1), and for some stretches of the drainage channels these species are absent. Some common exotic plants that are usually indicative of the site being permanently wet were either absent (watercress, *Nasturtium microphylla* and *N. officinale*) or present in low numbers (floating sweet-grass, *Glyceria fluitans*). Several plants of common alder have self-seeded onto the banks of the main drainage channel from a tree planted in a nearby shelter belt, and there are occasional plants of grey willow. A large patch (c. 50 m long) of duckweed (*Lemna minor*) was present in one part of the main drainage channel (Plate 2).

Plate 1: Tussocks of *Carex* growing on the bank of a drainage channel, with part of a ploughed paddock showing in the background.

Plate 2: Duckweed (*Lemna minor*) growing on the surface of the water in a drainage channel, with the paddock comprising a dense sward of pasture grasses.

The drain that provides the outlet into the Styx River has a weir in its lower reaches, and above this it appeared to have become partially filled with silt from earthquake liquefaction, paddock runoff and other sediments. The purpose of the weir and how well the lower part of this drainage network is functioning needs to be further investigated. The farmer who is currently leasing the land commented that the drain probably needs to be cleaned out, to enable water flow.

4.3 Avifauna

Several bird species were observed during the site visit and these are listed in Table 1. Paradise shelducks were the only endemic species observed. However, a number of native species were also observed, including two pied stilt that were flying over the site. The presence of paradise shelducks, mallard ducks, Canada geese, and pūkeko is typical of damp sites within a greater wetland mosaic area.

Table 1: Bird species seen or heard during the Whisper Creek site visit.

Common Name	Scientific Name	Conservation Status*
Paradise shelduck	*Tadorna variegata*	Not Threatened (endemic)
Pied Stilt	*Himantopus himantopus*	Not Threatened (native)
Shining cuckoo	*Chrysococcyx lucidus*	Not Threatened (native)
Welcome swallow	*Hirundo neoxena*	Not Threatened (native)
Swamp harrier	*Circus approximans*	Not Threatened (native)
Spur-winged plover	*Vanellus miles*	Not Threatened (native)
Pūkeko	*Porphyrio melanotus*	Not Threatened (native)
Silvereye	*Zosterops lateralis*	Not Threatened (native)
Mallard duck	*Anas platyrhynchos*	Introduced and Naturalised
Eurasian skylark	*Alauda arvensis*	Introduced and Naturalised
European greenfinch	*Carduelis chloris*	Introduced and Naturalised
Yellowhammer	*Emberiza citrinella*	Introduced and Naturalised
Canada goose	*Branta canadensis*	Introduced and Naturalised

*Conservation status from Robertson *et al*. (2017).

4.4 Lizards

Underneath some old tyres amongst rank grass (Plate 3) two Canterbury grass skinks (*Oligosoma* aff. *polychroma* Clade 4; Plate 4) were observed. Canterbury grass skinks are classified as At Risk–Declining (Hitchmough *et al*. 2016).

Plate 3: Rank grass and old tyres where the Canterbury grass skinks were found.

Plate 4: Canterbury grass skink (*Oligosoma* aff. *polychroma* Clade 4).

4.5 Terrestrial invertebrates

Only two indigenous terrestrial invertebrates were observed during the site visit. A caterpillar of the yellow admiral butterfly (*Vanessa itea*) was found in its characteristic shelter on a patch of the introduced annual nettle on a fence line. This is a widespread lowland butterfly that lives in a wide variety of habitats from suburban gardens to montane indigenous shrubland. Under a pile of old tyres on a slightly elevated site near the entrance, an indigenous centipede was found. This find indicates that the project site, particularly this comparatively dry area, will be supporting a range of remnant indigenous invertebrates that have survived dramatic habitat modification.

Potentially important habitat for indigenous invertebrates was seen on the margins of drainage channels where indigenous sedges (*Carex secta* and *C. virgata*) were growing along with a *Juncus*. Pedestalled *C. secta* is particularly rich in a variety of indigenous insect species which feed on its foliage or on its persistent dead dry leaves. Many invertebrates live in the dry leaves, enabling them to remain well hidden from their predators. The *Juncus* will support the stem-boring larvae of the small brightly coloured day-flying moth *Glyphipterix iocheaera*, a widespread species on many *Juncus* species.

4.6 Freshwater fish and macroinvertebrates

Results of the NZFFD search show that ten indigenous and four introduced fish species have been recorded in the Styx River and its tributaries (Table 2). Several of these indigenous species are valued culturally, either as a food source (mahinga kai) and/or as a treasured species (taonga). Two of the introduced fish species, brown trout (*Salmo trutta*) and perch (*Perca fluviatilis*) are valued as sports fish. Rudd (*Scardinius erythrophthalmus*), is designated as a noxious species under the Freshwater Fisheries Regulations 1983.

Two indigenous macroinvertebrates have also been recorded in the Styx River and its tributaries (Table 2). Freshwater crayfish/kōura (*Paranephrops zealandicus*) is recorded in the NZFFD, and the indigenous freshwater mussel/kākahi (*Echyridella menziesii*) has been found by Council staff in the lower Styx River (Duncan Gray, Environment Canterbury and Greg Burrell, Christchurch City Council, pers. comm.). Both of these species are valued culturally as food sources (mahinga kai).

The range of species that have been recorded in this lowland catchment highlight the values of the Styx River and its tributaries. Although the drainage channels within the project site are manmade and only contain water on a seasonal basis, they are connected to the Styx River and so freshwater fauna could be moving in and out of them and/or be temporarily residing in them, subject to water presence. These waterways could therefore provide seasonal habitat and feeding opportunities for freshwater fauna, and could also provide refuge during times when the Styx River is in flood.

Table 2: Freshwater fish and macroinvertebrate species recorded in the Styx River catchment, with their current conservation status and cultural significance.

Common Name	Scientific Name	Conservation Status	Cultural significance[3]
Fish			
Longfin eel/tuna	*Anguilla dieffenbachi*	At Risk-Declining[1]	Mahinga kai
Shortfin eel/tuna	*Anguilla australis*	Not Threatened[1]	Mahinga kai
Yelloweye mullet/makawhiti	*Aldrichetta forsteri*	Not Threatened[1]	Mahinga kai
Black flounder/pātiki	*Rhombosolea retiaria*	Not Threatened[1]	Mahinga kai
Inanga	*Galaxias maculatus*	At Risk-Declining[1]	Mahinga kai
Lamprey/kanakana	*Geotria australis*	Threatened-Nationally Vulnerable[1]	Mahinga kai
Upland bully	*Gobiomorphus breviceps*	Not Threatened[1]	
Common bully	*Gobiomorphus cotidianus*	Not Threatened[1]	
Giant bully	*Gobiomorphus gobioides*	Not Threatened[1]	Taonga
Common smelt	*Retropinna retropinna*	Not Threatened[1]	Taonga
Brown trout	*Salmo trutta*	Introduced and Naturalised[1]	
Perch	*Perca fluviatilis*	Introduced and Naturalised[1]	
Goldfish	*Carassius auratus*	Introduced and Naturalised[1]	
Rudd	*Scardinius erythrophthalmus*	Introduced and Naturalised[1]	
Macroinvertebrates			
Freshwater mussel/kākahi	*Echyridella menziesii*	At Risk-Declining[2]	Mahinga kai
Freshwater crayfish/kōura	*Paranephrops zealandicus*	At Risk-Declining[2]	Mahinga kai

[1] Goodman *et al.* (2014).
[2] Grainger *et al.* (2014).
[3] Cultural significance indicates species traditionally collected as food (mahinga kai) or treasured species designated as taonga under the Ngai Tahu Claims Settlement Act 1998 (Schedule 98).

5. ECOLOGICAL RESTORATION OPPORTUNITIES

5.1 Overview

The site provides a number of opportunities for ecological restoration of indigenous vegetation, and by undertaking these the habitats of indigenous avifauna, lizards, terrestrial invertebrates, and freshwater fish and macroinvertebrates will be improved. As outlined in Section 3, several vegetation types would have historically been present in the area and these vegetation types provide context for the types of ecological restoration plantings that could be undertaken at this site.

Five main vegetation types have been identified that could be developed and these are described in Section 5.2. Opportunities for enhancing the habitats of indigenous fauna are described in Section 5.3. General restoration planting guidelines, including information on particular weed species that will require active control, are provided in

Section 5.4. Appendix 1 comprises a range of photographs taken at various other sites, that show the types of ecological restoration plantings that could be undertaken at this site.

5.2 Vegetation types

5.2.1 Dry shrubland

On the higher elevation area of the site, with droughty soils, species typical of drier habitats would have occurred. These include small-leaved shrubby species such as mānuka (*Leptospermum scoparium*), porcupine shrub (*Melicytus alpinus*), coprosma species including mikimiki (*Coprosma propinqua* var. *propinqua*), prostrate kowhai (*Sophora prostrata*), matagouri, native broom (*Carmichaelia australis*), kānuka, mingimingi (*Leptecophylla juniperina*) and pōhuehue (*Muehlenbeckia complexa*). Other species that also occur in dryland habitats of the Low Plains Ecological District, that were not recorded from the general area of the site but may have been present, include shrubby pōhuehue (*Muehlenbeckia astonii*) and shrubby riverbed daisy (*Olearia adenocarpa*). Silver tussock (*Poa cita*) and hard tussock (*Festuca novae-zelandiae*) would also be associated with this vegetation type.

5.2.2 Dry forest

In places with deeper soils and/or slightly more moisture, taller dry forest species would have occurred, including kōwhai, akeake (*Dodonea viscosa*), ngaio (*Myoporum laetum*), tī kōuka/cabbage tree, kānuka, kōhūhū (*Pittosporum tenuifolium*), karamū (*Coprosma robusta*), akiraho (*Olearia paniculata*), rohutu (*Lophomyrtus obcordata*), poroporo (*Solanum laciniatum*), and tauhinu (*Ozothamnus leptophyllus*), kāpuka (*Griselinia littoralis*), māhoe (*Melicytus ramiflorus*), tōtara (*Podocarpus totara* var. *totara*) and māpau (*Myrsine australis*).

This vegetation type would be suitable for planting on appropriate drier or free draining soils along the property boundary, and could provide shelter and privacy.

5.2.3 Wetland vegetation

Wetland plant species for areas that are periodically flooded, or for stormwater management ponds, need to be able to tolerate local environmental conditions, including climate and water depths. These plants need to be able to establish and spread readily to form a dense stable vegetation cover with reasonable resistance to weed invasion and grazing by water birds, and they should not be a significant weed risk elsewhere in the surrounding catchment or region. In the area that is likely to be permanently wet with standing water during the winter months, and periodically wet during the rest of the year, suitable species are pūrei (*Carex secta*), tall spike-rush (*Eleocharis sphacelata*), and lake clubrush (*Schoenoplectus tabernaemontani*). Raupō (*Typha orientalis*) can also be used, but would need to be carefully managed as it tends to produce large accumulations of decomposing litter, traps silt and other sediments, and it often grows vigorously in nutrient-rich situations, excluding other potentially more desirable species.

Plants that are suitable for marginal shallow-water and embankment areas surrounding constructed wetlands and stormwater management ponds need to be able to tolerate wet soils and periodic flooding. Species that can grow well in seasonally wet soil would include sedges, rushes and grasses such as marsh clubrush (*Bolboschoenus fluviatilis*), rautahi (*Carex geminata* and *C. lessoniana*), toetoe (*Austroderia richardii*

and *A. toetoe*), toetoe upokotangata/giant umbrella sedge (*Cyperus ustulatus*), sharp spike-rush (*Eleocharis acuta*) and leafless rushes (e.g., *Juncus edgariae*), as well as harakeke/lowland flax, the fern swamp kiokio (*Blechnum novae-zelandiae*), and the woody species karamū, mikimiki, tī kōuka/cabbage tree and kōhūhū.

5.2.4 Tall swamp forest

The feature of this vegetation type would be the tall forest tree kahikatea (*Dacrycarpus dacrydioides*) and other water-tolerant woody species such as mānatu (*Plagianthus regius* subsp. *regius*), narrow-leaved houhere/lacebark (*Hoheria angustifolia*), kōhūhū, weeping matipo (*Myrsine divaricata*), kāpuka, pūrei and harakeke/lowland flax. Consideration should be given to the planting of swamp forest vegetation in suitable wet, low lying sites.

This vegetation type would be suitable for planting on appropriate soils along the property boundary, and could provide shelter and privacy.

5.2.5 Drainage channel riparian zone vegetation

Existing vegetation alongside the drainage channels (the riparian zone) is mostly exotic grasses, with some annual and herbaceous weeds and a few scattered indigenous sedges and rushes. Riparian zone vegetation is important for the health of waterways, water quality and ecological functionality. The plants provide shading, nutrient and sediment filtering, and habitat and food sources.

To help improve water quality in the drainage channels and also the Styx River into which the channels flow, and to protect the banks of the drainage channels from erosion and stock damage, the main drainage channels on the property should be fenced and riparian plantings undertaken. Ideally, the fenced area and the plantings should be 5-10 metres wide on each embankment. On the steeper banks of the channel that are periodically flooded, plantings should comprise rautahi, toetoe, toetoe upokotangata, leafless rushes, harakeke/lowland flax, and swamp kiokio. On drier areas outside of the steep sided banks of the drainage channel the planting should include grasses such as silver tussock and toetoe, harakeke/lowland flax, and woody species such karamu, mikimiki, shrubby pōhuehue, pōhuehue, ti kōuka/cabbage tree, kōhūhū, tōtara, and mānatu. An important consideration in design of the planting is that it needs to allow excavator access to the drainage channels for periodic clearing of sediment, and this could be done by varying the plant species to provide varied width and height of the planted area.

5.3 Opportunities for enhancing habitats of indigenous fauna

5.3.1 Avifauna

The establishment of dry forest, tall swamp forest, and riparian vegetation will encourage the spread of endemic birds that are likely to be present in the surrounding area, onto the site. Examples of endemics birds that may spread onto the site include: bellbird (*Anthornis melanura*), grey warbler (*Gerygone igata*), New Zealand fantail (*Rhipidura fuliginosa*), and New Zealand pigeon/kereru (*Hemiphaga novaeseelandiae*).

The development of wetlands and the establishment of wetland vegetation could also encourage use of the site by other native wetland birds, including swamp bird species such as the Australasian bittern (*Botaurus poiciloptilus*, Threatened–Nationally Critical) and marsh crake (*Porzana pusilla*, At Risk–Declining). Bittern inhabit a number of wetland sites in the greater Christchurch area, including wetlands near the mouth of the Waimakariri River, Travis Wetland, and Te Waihora/Lake Ellesmere.

5.3.2 Lizards

The establishment of dry shrublands will provide more natural habitat for Canterbury grass skinks and other lizard species that may be present. The inclusion of fruit-bearing shrubs, such as porcupine shrub, mikimiki, and pōhuehue, and species that provide thick, tangled cover, such as silver tussock, hard tussock, toetoe, and harakeke/lowland flax in plantings is likely to be of benefit for lizards. Planting plans should consider linking habitats within the site`, to allow lizards to spread through the area.

The presence of Canterbury grass skinks at the site means that any development of the site that may disturb or kill some skinks will require a Wildlife Act (1953) permit. Successfully gaining a wildlife permit will require the preparation and submission of a Lizard Management Plan to the Department of Conservation. Granting of the wildlife permit may require such actions as live-capturing skinks and temporally removing them to a holding facility while restoration activities are undertaken.

5.3.3 Terrestrial invertebrates

Each of the vegetation types outlined in Section 5.2 support a characteristic suite of indigenous invertebrates that would have historically been present in this part of Canterbury.

Key plants for invertebrates in the Dry Shrubland include pōhuehue, river bed daisy, mānuka, mikimiki, matagouri, native broom, silver tussock and hard tussock. All these plants support a number of specialist insect species, with pōhuehue the most important. Pōhuehue foliage supports the larvae of three copper butterfly species, including the brightly-coloured Rauparaha's copper (*Lycaena rauparaha*) that was first discovered and described from nearby Kaiapoi, and twelve moths, including the dayflying *Morova subfasciata* whose larvae feed within Pōhuehue stems creating a distinctive swelling. The moths have diverse feeding strategies on this shrubby vine including leaf miners, and those that feed on its flowers and foliage. In addition to moths and butterflies, a range of other indigenous insects specialize on this hostplant, including two shield bugs, a cockroach, stick insect, lacewing and several beetles. Once this plant community is established many of the specialist insects will naturally spread into it from adjacent areas. An exception will be the specialist moths of the small-leaved *Olearia* species which can be manually translocated from the closest available source.

Key plants of the Dry Forest are kānuka, kōhūhū, tī kōuka/cabbage tree , poroporo, tauhinu and māhoe. All of these plant species support their own group of indigenous insects. For example, tī kōuka/cabbage tree supports the cabbage tree looper moth (*Epiphyrne verriculata*), in addition to other insects, including beetles, bugs and another two moths (one boring in its flower stems, the other rolling its leaf tips to create a home from which to feed on fresh foliage). In this part of Canterbury the

foliage of tauhinu is fed on exclusively by two moths. One is a large dark brown noctuid *Graphania homoscia*, whose striped larvae hide by day deep within the plant, and the other is the smaller leaf-rolling moth *Harmologa* "new species" lives in a silk joined leafy hideout high on the plant. Māhoe supports several conspicuous moths, including the bright green noctuid *Feredayia graminosa* whose larvae feed on its foliage at night.

Wetland vegetation is rich in associated insects with the pedestalled sedge *Carex secta*, other *Carex* species, kōhūhū and raupō being of particular significance. Kōhūhū supports several indigenous moths, including the large orange geometrid *Xyridacma ustaria* and stunning white depressarid *Nymphostola galactina*, both of which have cryptic larvae feed on its foliage. An undescribed leaf mining moth in the genus *Acropcercops* creates a silver sheen to the undersides of the leaves, as a result of its larval workings inside the leaves. The raupō specialist moth *Scieropepla typhicola* was first described from Christchurch, but it is a widespread moth of wetlands where its larvae feed within the seed heads of its host forming a characteristic fluffing of the otherwise uniformly smooth seed heads.

Most of the plant species of the proposed Tall Swamp Forest habitat support specialist insects, including several moths. Despite kahikatea being our tallest indigenous tree it supports just one small, colourful leaf-rolling moth *Pyrgotis arcuate*. Other proposed restoration plant species, such as mānatu, kōhūhū and kāpuka also have specialist moths that will naturally colonise the plantings once they are well established. Of note is the insect fauna of harakeke/lowland flax, with the flax-notching moth (*Tmetolophota steropastis*), flax window geometrid (*Orthoclydon praefectata*), and the seed-feeding *Stathmopoda holochra.*

5.3.4 Freshwater fish and macroinvertebrates

Manmade waterways, such as drainage channels, can provide vital habitat for freshwater fauna, particularly in many areas of lowland Canterbury where natural waterways and wetlands have been diverted and/or drained. Development of this site will provide opportunities to improve habitat in the manmade waterways, including existing drainage channels and any new stormwater management areas, by simple actions such as fencing them to prevent stock access, and installing native plants between the fences and the water's edge (in the riparian zone) to help provide habitat and prevent nutrients and sediment from reaching the waterways and the Styx River.

The noxious fish Rudd have very limited distribution in Canterbury and the South Island, and so it is important that their spread is not facilitated. They are present in the Styx River catchment and their preferred habitat is slow to non-flowing water. Once established they can be difficult to eradicate, so it will be important to prevent them establishing in the proposed stormwater management ponds. This could be done by installing weir-type structures at the pond outlets that are designed to prevent fish jumping or climbing over them.

5.4 Restoration planting guidelines

All restoration plantings of indigenous species will require an active management programme to ensure their successful establishment. Planting alongside the existing

drainage channels could be carried out immediately, but areas to establish the other vegetation types, such as Dry Shrubland or Wetland vegetation, will need to be investigated.

Restoration planting begins with planning what is to be planted when and where, and how it will be looked after. This includes selecting the right plant species for each vegetation type and eco-sourcing of plants; plants sourced from local seed are better adapted to local sites, and also protect the species genetics and hence ecological integrity. The main steps to plan for are: site preparation, planting, and ongoing plant maintenance.

Site preparation involves clearing rubbish and weeds to have a clean planting area, helping the plants to better establish. Plantings need to be undertaken with an appropriate grade of high quality plants, with each plant protected using a weed mat and plant guard. Weed mat, around the base of the plant, suppresses weed competition and also helps retention of soil moisture; the plant guard protects the plant from animal browse (e.g., pūkeko, rabbits, hares and possums) and herbicide spray damage. Ongoing plant maintenance involves a weed control programme for the first 3-5 years after planting, with possible plant replacement if any deaths have occurred. A weed control programme ensures the plants are not competing with weed species during their establishment (some weeds can totally smother plantings if left uncontrolled). Regular and strategic hand-weeding or spot-spraying with herbicide before the weed species become well-established is the most effective means of control. In some wetland sites, weed control can be facilitated by water frequency and depth (note that most herbicides cannot be used over, or in close proximity to, water).

Many common exotic pasture grasses and low growing herbaceous weeds (e.g., clover (*Trifolium* spp.), dandelion, catsear (*Hypochaeris radicata*), cleavers (*Galium aparine*), mouse-eared chickweed) will need to be controlled within the weed control programme. Common woody weed species to be controlled include: blackberry, hawthorn (*Cratageus monogyna*), elderberry, gorse, grey willow, common alder, and Scotch broom (*Cytisus scoparius*), with several of these being recorded from the area during the site visit. In wetland sites, there are other common weeds that may require control, particularly during plant establishment. These may include: yellow flag iris (*Iris pseudacorus*), purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis*), reed canary grass (*Phalaris arundinacea*), reed sweet grass (*Glyceria maxima*), arum lily (*Zantedeschia aethiopica*), and pendulous sedge (*Carex pendula*). Although none of these wetland species were observed at the site, they could occur there as they have all been recorded from the Christchurch area.

There are various useful publicly available restoration planting resources, such as the Living Streams handbook produced by Environment Canterbury (this is in three parts, and Part 3 (Planting and maintenance) would be particularly applicable) and the Department of Conservation website (http://www.doc.govt.nz/our-work/motukarara-conservation-nursery/native-plant-communities-of-the-canterbury-plains/).

6. CONCLUSIONS

The site currently has few natural ecological values, but has the potential to be improved in conjunction with the residential subdivision development. If the suggested restoration opportunities in Section 5 are adopted, these will improve the vegetation and this in turn will enhance the habitat for a great variety of indigenous fauna.

ACKNOWLEDGMENTS

We thank Patricia Harte, from Davie Lovell-Smith Ltd, for client liaison and for providing information on the project.

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PHOTOGRAPHS OF ECOLOGICAL RESTORATION PLANTINGS AT VARIOUS OTHER SITES

Plate 5: Sedges and rushes at the margin of a stormwater storage pond, with harakeke/lowland flax in the background.

Plate 6: Sedges and rushes at the margin of a stormwater storage pond, with raupō emerging along the left hand edge.

Plate 7: Sedges and rushes at the margin of a stormwater storage pond.

Plate 8: Dryland shrubby vegetation planted on a gravel bank. With the addition of the grasses, silver tussock and hard tussock, this would be ideal habitat for lizards.

Plate 9: Dryland shrubby vegetation planted on a gravel bank.

Plate 10: Dry forest species in a shelterbelt, including māpau, kōhūhū, akeake and karamū.

Plate 11: Dry forest species with a canopy of tī kōuka/cabbage tree and kowhai, and a well-developed understorey of small-leaved coprosma, harakeke/lowland flax, and grasses.

Plate 12: Forest and shrub species planted on a wetland site, with young kahikatea trees in the foreground.

Plate 13: Forest and shrub species planted on a wetland site.

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