Pahiatua WWTP Wetland

Proposed Pahiatua Wastewater Treatment System Wetland Design

Draft for Comment

Pahiatua WWTP Upgrade

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Draft for Comment

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1 Introduction

A constructed wetland system has been proposed to manage the discharge from the Pahiatua Wastewater Treatment Plant (WWTP) before it flows into the Mangatainoka River. The wetland has been proposed to serve two functions:

i. To "polish" the quality of the discharge by removing a portion of the residual nitrogen and to reduce the concentration of living faecal bacteria in the discharge, and
ii. Address cultural issues related to the disposal of human wastewater (and in particular Policy 5-11 in the Horizons Regional Plan).

Nutrient treatment wetlands require different conditions to wetlands built primarily for biodiversity purposes in order to extract nitrogen and faecal bacteria most effectively. In particular they need to be shallow, fully open to sunlight, have a full cover of wetland sedges, rushes and reeds, and be designed so that water remains in the wetland for as long as possible. They should not have areas of open and deep water, trees and shrubs that provide shade to the main wetland area are not desirable, and conditions that encourage large numbers of water birds to inhabit the wetland are not ideal.

For these reasons, it is proposed that the wetland system for the Pahiatua WWTP discharge should comprise of two sections, constructed in series: a nutrient treatment section at the upstream end followed by a more diverse wetland downstream that can have and promote elements of indigenous biodiversity to a greater degree.

Following the adjournment of the Pahiatua WWTP hearing, consultation meetings were held with representatives of Rangitane o Tamaki nui a Rua Inc. and Kahungunu ki Tamaki nui-a-rua on 10th July 2017 with Roger MacGibbon (Opus) and Dave Watson (Tararua District Council). During these meeting the functional differences between a nutrient treatment wetland and a biodiversity wetland were discussed with the parties present. It is understood that there is a preference for the wetland not to be fully impermeable. This report has been prepared for circulation and comment prior to being finalised and presented to the hearing panel by 10th August 2017.

2 Pahiatua WWTP Wetland Design

A two stage wetland is proposed for the Pahiatua WWTP site (Figure 2).

2.1 Nutrient treatment wetland

2.1.1 Specifications

The upper portion, shown in blue in Figure 2, is the nutrient treatment section. To optimise nitrogen removal (by a bacterial process called denitrification) and to enhance faecal bacteria mortality, this section of wetland has the following design requirements:

1. Flat bottomed with a mean water depth of 300mm, a maximum water depth of 500mm and have water cover over the entire wetland base when it is full. Most indigenous

wetland plants cannot survive in greater than 500mm depths for other than short periods.

2. Have a width to length ratio of between 1:3 and 1:5 to optimise water spread and reduce the likelihood of channelization.
3. Retain 95% of the maximum discharge flow rate within the wetland for at least 24 hours and the median flow rate for several days. For Pahiatua this means that the treatment wetland area must not be less than 0.5 ha in size.
4. Have plant cover of natives sedges, rushes and reeds over the entire wetland surface so that no areas of open water exist when the plants have reached mature size.
5. The wetted area must remain fully open to sunlight, ie. not be shaded to any great extent.

2.1.2 Construction

The upper wetland area at the Pahiatua WWTP site is sufficiently large to accommodate a wetland of at least 0.5 ha in size and suitably level to ensure water passes slowly through the wetland. This wetland will need to be excavated by a digger, with the topsoil stripped back and stockpiled and then laid back down on the base of the wetland after excavation to create a substrate for planting. Small earth bunds will be constructed around the wetland edge to prevent stormwater / surface runoff entering the wetland.

Excavation will need to be guided by laser technology to ensure the bottom of the wetland is sufficiently level to enable a thin veneer of water to spread evenly across the wetland, and to create a gradual gradient that ensures that water does not move through the wetland too quickly. If the fall from the top to the bottom of the treatment wetland is greater than 500 mm then one or more weirs will need to be constructed across the wetland at intervals to prevent the water running to the downstream end and pooling at depths greater than 500mm. Each weir should be built with a reinforced spillway set at between 300 and 500mm above the wetland base (see example in Figure 1).

Figure 1: Newly constructed treatment wetland with weirs and spillways to slow down the flow of water and prevent depths greater than 500mm.

It will be necessary to line the treatment wetland with clay to reduce the rate of downward percolation of discharge through into the groundwater. The intention of the clay lining will be to slow down but not eliminate the downward movement of water. Complete impermeability is not desirable because much of the denitrifying activity occurs in the organic soil layer in the wetland; consequently, discharge passing through a partially permeable lining is likely to have a lower nitrogen content than water leaving the wetland where the liner is completely impermeable.

2.1.3 Planting

There are only a small number of species suitable for planting in a treatment wetland. Species planted must be tolerant of constant emersion in water; capable of withstanding frosts; able to tolerate low oxygen soil conditions; and grass- or sedge-like to serve as a filter to water flow. The following species are recommended for the Pahiatua treatment wetland:

- *Carex secta* (purei / pukio)
- *Carex geminata* (rautahi)
- *Cyperus ustulatus* (giant umbrella sedge)
- *Juncus pallidus* (giant rush)
- *Juncus edgariae* (wiwi)
- *Schoenoplectus tabernaemontani* (kuawa)
- *Eleocharis sphacelata* (kutakuta)

2.2 Biodiversity wetland

2.2.1 Specifications

The proposed location for the biodiversity wetland is shown in light green in Figure 2. The site is a natural depression that was probably a wetland or stream at some stage in the past. It is proposed that this area receives the water from the treatment wetland above after which it will flow out through a culvert or outlet structure to be built through the existing bunds that separate this area from the Mangatainoka River. The site is very suitable for the creation of a wetland and wetland margin forest and will add considerable biodiversity value to the area. It will connect well with the Mangatainoka River which serves as an important dispersal corridor for many native animal species. There is good potential to plant a diversity of native plant species in this zone including less common species that may have been of cultural significance to iwi in the past.

The area proposed for the biodiversity wetland is currently grazed and does not hold water for long however with a constant flow from the WWTP and the close proximity of the water table beneath the soil surface it is expected that wetland-like conditions will develop and on occasions surface water can be expected to accumulate. This is especially likely if the outlet culvert / structure to the river is perched above the wetland base.

2.2.2 Construction

Because the shape and nature of this area is already suitable as a wetland, little in the way of earthworks will be necessary. The only significant earthworks required will be to create two bunds (shown as purple-coloured areas in Figure 2) to prevent wetland water leaving down lateral drains, the removal of the willow trees growing down in the wetland base, construction of the culvert or

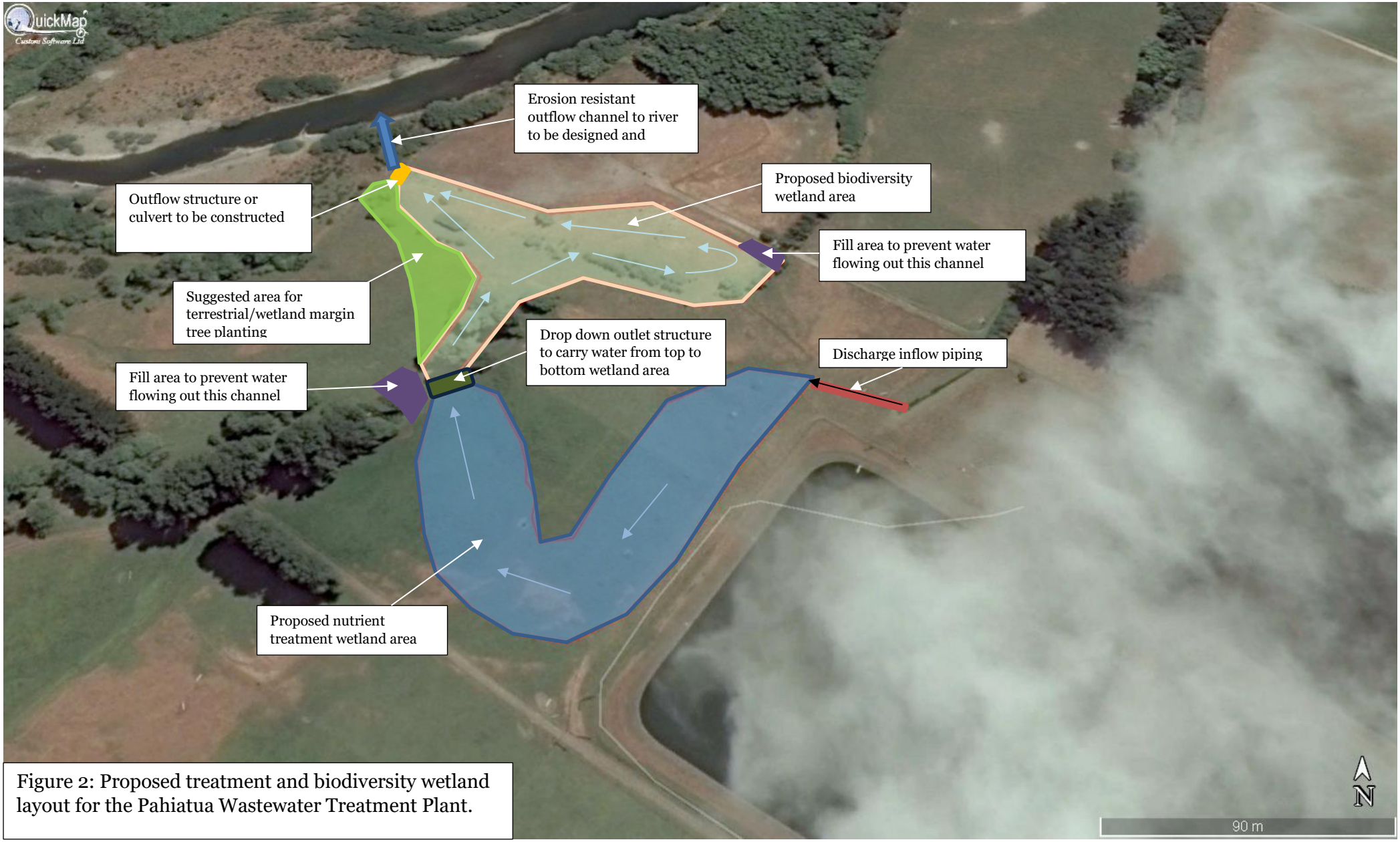

Figure 2: Proposed treatment and biodiversity wetland layout for the Pahiatua Wastewater Treatment Plant.

weir structure at the outlet, and construction of a similar erosion-resistant structure to carry water from the top wetland to the lower one.

No clay lining will be applied to this wetland and as a result water will percolate down through the wetland soil and into the water table. This is of no concern because the quality of water leaving the upper treatment wetland will be high. Furthermore, the sedge – rush vegetation in the base of the biodiversity wetland will add organic matter to the soil and gradually reduce its permeability.

The wetland area will need to permanently fenced from livestock.

2.2.3 Planting

It is proposed that the lower, wetter channel area of this wetland is planted in some of the same sedge and rush species as those planted in the top treatment wetland. This is to allow further nutrient treatment to occur (and to ensure that additional nutrients aren't added due to an excess

of decomposing woody vegetation entering the system). However, the slightly elevated areas alongside the deeper channel are suitable for wetland margin and riparian plant species that like to be in moist soil or have their roots reaching into the water table. Provided they are planted on the south side of the deepest section of wetland any wetland tree and shrub species can be established without threatening to shade the sedge and rush areas. The intention in this area will be to create a variety of habitats suitable for wetland and river margin bird species and shaded water margin habitat suitable for tuna (eel).

The wetland / wetland margin area, as drawn in Figure 2, is approximately 0.6 ha in size.

An additional 0.2 ha area has been proposed for planting on the southern side of the biodiversity wetland (bright green in Figure 1). This area is slightly elevated and is likely to stay above water level and will be suitable for more terrestrial tree and shrub plantings as would once have occurred along riparian margins. This area will support birds and invertebrates that use river corridors for dispersal and nesting.

The following plant species are suggested for the biodiversity wetland:

A. Wettest areas and flow channel

- Purei / pukio *Carex secta*
- Rautahi *Carex geminata*
- Giant umbrella sedge *Cyperus ustulatus*
- Giant rush *Juncus pallidus*
- Wiwi *Juncus edgariae*
- Raupo *Typha orientalis* Deepest downstream areas only

B. Elevated margins that are water covered periodically

- Harakeke / flax *Phormium tenax*
- Ti kouka *Cordyline australis*
- Mingimingi *Coprosma propinqua*
- Toetoe *Austroderia fulvida*
- Swamp sedge *Carex virgata*
- Purei / pukio *Carex secta*

- Kahikatea *Dacrycarpus dacrydioides*

C. Damp margins where tree root system can reach the water table

- Karamu *Coprosma robusta*
- Koromiko *Hebe stricta*
- Manuka *Leptospermum scoparium*
- Ti kouka *Cordyline australis*
- Harakeke *Phormium tenax*
- Ribbonwood *Plagianthus regius*
- Mahoe *Melicytus ramiflorus*
- Twiggy daisy *Olearia virgata*
- Kahikatea *Dacrycarpus dacydioides*
- Pukatea *Laurelia novae-zelandiae*
- Maire tawake *Syzygium maire*

D. Elevated terrestrial margins

- Totara *Podocarpus totara*
- Kohuhu *Pittosporum tenuifolium*
- Kanuka *Kunzea ericoides*
- Five finger *Pseudopanax arboreus*
- Karamu *Coprosma robusta*
- Long-leaved lacebark *Hoheria sexstylosa*
- Lemonwood *Pittosporum eugenioides*
- Kowhai *Sophora tetraptera*
- Pigeonwood *Hedycarya arborea*

3 Planting and maintenance

3.1 Treatment wetland

The upper water treatment wetland will need to be constructed and fully planted in one operation so that there is no risk of sediment loss down into the Mangatainoka. Ideally, the wetland should be planted when the re-laid soil is damp but before the WWTP discharge is redirected into the wetland. The best time to plant is in spring at the start of the growing season. Once planted the volume of discharge redirected through the wetland should be gradually increased over several weeks until the wetland is fully saturated. This approach provides time for the nursery-raised seedlings to adapt to increasingly saturated growing conditions rather than having to tolerate fully saturated soils from the start.

Plants should be planted in the wetland at a rate of 2 plants per square metre (equates to 0.7m spacings between plants), and the entire base of the wetland should be planted (ie. no unplanted open water areas).

Blanking (ie. replacement of plants that die) will be necessary to fill all gaps. Weeds, especially willow seedlings, will also need to be controlled on an annual basis until full canopy cover is

achieved (up to 5 years following planting). This is best done manually because native sedges are particularly vulnerable to herbicides.

All of the sedges, rushes and reeds planted in the treatment wetland will need to be heavily topped every 5 or so years. This is to ensure the plants retain their vigour. Without a hard trim sedges, rushes and reeds tend to lose vigour and shed more leaf matter than they grow. This can result in a net addition of nitrogen and phosphorus rather than extraction.

3.2 Biodiversity wetland

The biodiversity wetland can be planted in stages or all at once. It would be advisable to plant the sedges and rushes for the lowest channel section of this wetland at the same time as the planting of the treatment wetland so that they benefit from the gradual increase in WWTP discharge passing through the wetland.

Plants around the margins of the wetland area should be planted a 1.5m spacings whereas those sedges and rushes in the wettest part of this wetland should be planted at 1m spacings.

Weed control maintenance and blanking of any gaps will be necessary for at least 3 years and probably up to 5, until a vegetative canopy is formed.

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