REPORT

Woodville Wastewater Treatment Plant - Proposed Wetland Concept

Information in support of the AEE

Prepared for

Tararua District Council

Prepared by

Tonkin & Taylor Ltd

Date

August 2018

Job Number

1005792.0000

Exceptional thinking together

www.tonkintaylor.co.nz

Document Control

Title: Woodville Wastewater Treatment Plant - Proposed Wetland Concept, Information in support of the AEE					
Date	Version	Description	Prepared by:	Reviewed by:	Authorised by:
27/8/2018	Final	Report	R MacGibbon	T Bryce	T Bryce

Distribution:

Tararua District Council copies

Tonkin & Taylor Ltd (FILE) 1 copy

Table of contents

1 Introduction

This report has been compiled as supporting information for the “Consent Application Woodville WWTP” and the accompanying Assessment of Environmental Effects (WSP Opus August 2018).

Tararua District Council proposes to install a constructed wetland at the Woodville Waste Water Treatment Plant (WWTP). The wetland has been proposed to serve two functions:

i To “polish” the quality of the discharge to the Mangaatua Stream by removing a portion of the residual soluble nitrogen in the discharge, and

ii Potentially address cultural issues related to the disposal of human wastewater (and in particular Policy 5-11 in the Horizons Regional Plan).

Constructed wetlands of different designs can be effective at reducing soluble nitrogen loads by activating different elements of the nitrogen cycle. However, wetlands cannot perform the treatment functions of a wastewater treatment plant and will only be of value in a polishing role if the WWTP is performing to accepted standards.

2 Wetland types

2.1 Vertical Flow wetlands

Wetlands can reduce both ammoniacal-N and nitrate concentrations but not in the same section of wetland. In Vertical Flow Wetlands (VF wetlands) the discharge applied to the wetland surface percolates down through the substrate where it is collected and piped out (Figure 1). This type of wetland is effective at converting ammonium to nitrate and nitrite (nitrification) and requires a well oxygenated (aerobic) substrate to function well. The expected ammoniacal-N conversion performance range of VF wetlands is between 30% and 75% of the ammoniacal-N entering the wetland with the better aerated wetlands typically converting greater than 50% (Eawag, 2018; Tilley, et al 2014). These wetlands can also reduce suspended solids and bacterial concentrations.

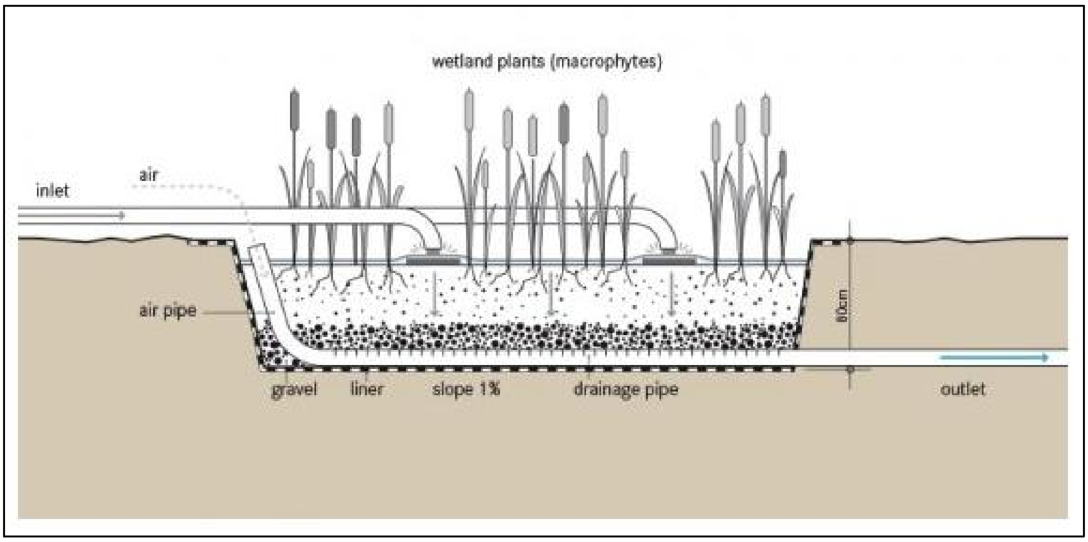


Figure 1: Diagrammatic representation of a Vertical Flow constructed wetland (source Eawag et al 2018).

VF wetland conversion of ammoniacal-N is optimised when the discharge is applied in pulses rather than continuously. Pulsing increases the draw-down of oxygen into the substrate which in turn improves nitrification efficiency. Consequently, multiple parallel VF bays are recommended to enable each to receive the discharge in pulses without affecting the rate of outflow from the WWTP. The principal determinant of the size of a VF wetland is the capacity to allow peak flows to pass through the wetland without the need for bypass channels. The rate of flow through a VF wetland can be affected by gravel particle size. Initial calculations for the Woodville WWTP using recommended gravel grades suggest that the VF wetland can be accommodated in an area of less than 1 ha.

2.2 Surface Flow wetlands

Surface Flow wetlands (SF wetlands) can be very effective at converting nitrate to nitrogen gas and water (denitrification). To function optimally this wetland type needs a constant supply of organic material (provided by planted wetland reeds and sedges) and low oxygen (anoxic) conditions (Figure 2). The low oxygen conditions are created by prolonged water/discharge retention times; the longer the water remains in the wetland the greater the amount of nitrate removed. Water retention of at least 24 hours is the minimum performance target. SF constructed wetlands can remove between 30% and over 95% of nitrate (Tanner et al. 2010; Louise Cook, pers comm). The expected nitrate extraction performance range of wetlands retaining water for between 2 and 4 days, which is likely to be achievable at the two possible Woodville WWTP wetland sites, is between 50% and 75%. The percentage extraction does not change with increased nitrate concentration, which makes SF wetlands very useful where nitrate levels are high and/or variable.

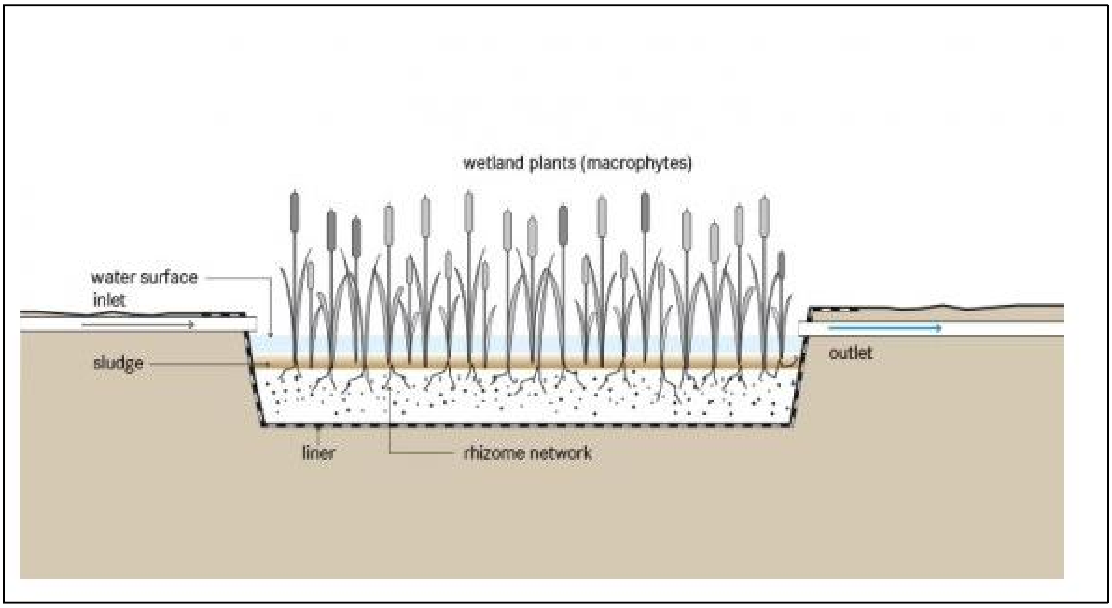


Figure 2: Diagrammatic representation of a Surface Flow constructed wetland.

SF wetlands have 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 (up to 1:10 is acceptable in some parts of the wetland).
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 Woodville this means that the SF wetland area must not be less than 1.0 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 sedge/rush/reed vegetation must remain fully open to sunlight, ie. should not be shaded to any great extent.

VF and SF wetlands work best in series (with the VF wetland up-stream of the SF wetland) when the WWTP discharge has concentrations of ammoniacal-N that require management. SF wetlands only are necessary where ammoniacal-N levels are low or negligible but nitrate concentrations are at levels requiring management. While not high enough to cause water quality problems in the Mangaatua Stream (Greer et al 2018) the Woodville WWTP discharge quality data suggests that moderate ammoniacal-N concentrations flow out of the WWTP ponds. A VF wetland can be effective at reducing ammoniacal-N concentrations to low levels.

A graphic representation of what the wetlands can achieve can be viewed in Appendix 1.

2.3 Woodville WWTP proposal

Both VF and SF wetland bays are proposed for the Woodville WWTP plant because of the moderate ammonium-N concentrations in the discharge. An additional biodiversity wetland bay will be added downstream of the SF wetland bays if room permits. A minimum “wet” wetland area of 2ha is likely to be necessary plus additional elevated wetland margin land to allow for maintenance access.

Two potential wetland sites are currently under consideration, both of which have the potential to accommodate VF and SF wetland bays in series (Figure 3). A decision as to which site will be utilised will depend on negotiations with landowners and selection of a suitable discharge outlet location to the Mangaatua Stream.

From a practical wetland performance perspective site 1 has more space than site 2 to design and install a wetland that suits the needs of the WWTP. There is also room to make provision for increased discharge volume if that should ever be necessary in the future. The layout of site 1 will also allow one or more vertical flow beds to be taken offline for maintenance from time to time whereas at site 2 this will be less likely.

The major issue to be considered at site 1 is where the outlet from the wetland to the river will be positioned. The preference would be to run the outflow through the fenced off wet area of the neighbouring property to the west with the outflow entering the river about 160m further downstream.

Figure 3: Location of the two wetland site options (white arrows show possible locations for the wetland discharge to the Mangaatua Stream)

3 References

Eawag (Swiss Federal Institute of Aquatic Science and Technology); Stauffer, B. and Spuhler, D. 2018. Vertical Flow CW. https://www.sswm.info/node/8261

Hudson, N. and Nagels N. 2011. *Assessing the performance of the Lake Okaro constructed wetland.* Prepared for the Pastoral 21 consortium under contract to AgResearch Limited and for the Bay of Plenty Regional Council. NIWA Client Report HAM2011-120.

Tanner, C.C. and Kloosterman, V.C. 2007. *Guidelines for Constructed Wetland Treatment of Farm Dairy Wastewaters in New Zealand*. NIWA Science and Technology Series No 48.

Tanner, C.C.; Sukias, J.P.S.; Yates, C.R. 2010. *New Zealand guidelines: Constructed wetland treatment of tile drainage*. NIWA Information Series No. 75. National Institute of Water & Atmospheric Research Ltd.

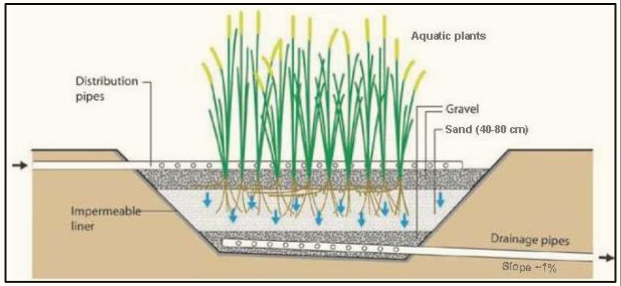
Tilley, E., Ulrich, L., Luethi, C., Reymond, P. Zurbruegg, C. 2014. Compendium of Sanitation Systems and Technologies. 2nd Revided Edition. Duebendorf, Switzerland: Swiss Federal Institute of Aquatic Science and Technology (Eawag).

Tonkin & Taylor Ltd

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
....	....
Roger MacGibbon	Tony Bryce
Principal Environmental Consultant	Project Director

Appendix A: Proposed three bay wetland system to meet cultural, water quality and biodiversity objectives

PROPOSED THREE BAY WETLAND SYSTEM TO MEET CULTURAL, WATER QUALITY AND BIODIVERSITY OBJECTIVES



Wetland Bay 1: Vertical flow wetland

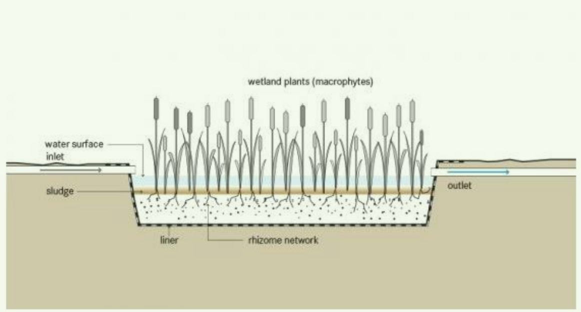
- Receives discharge from the oxidation ponds.
- Wastewater must pass down through the sand and gravel substrate before it can leave this wetland.
- The wetland is lined to prevent any water loss.
- Very effective at converting ammonium (NH_4) to nitrate (NO_3).
- Percolating wastewater is oxygenated.
- Acts as a filter to bacteria
- Will filter out P that is bound to sediment particles.
- Plants will take up N and P but must be harvested to remove the nutrients.

Discharge inflow from wastewater treatment plant

Flow from Bay 1 to Bay 2

Wetland Bay 2: Surface flow wetland

- Receives water from the vertical flow wetland.
- Wetland is fully covered in native rushes and sedges
- Water flows slowly through the wetland with average retention time of 2 to 4 days.



- Very effective at converting nitrate to nitrogen and oxygen gas.
- Low permeability at the top end, moderate permeability at the downstream end.
- Low oxygen condition to encourage denitrifying bacteria.
- Bacteria killed by exposure to sunlight.
- Plants will take up N and P but must be harvested to remove nutrients from the system.

Flow from Bay 2 to Bay 3

Wetland Bay 3: Biodiversity wetland

- Receives water from the surface flow wetland.
- Constructed with a mix of open water, rush and sedge areas and wetland margin trees and shrubs.
- This wetland should be unlined to allow slow natural percolation into groundwater.
- Designed as habitat for wetland birds, fish (including tuna) and invertebrates.
- Natural recycling of organic nutrients will occur here with natural biochemical processes reactivated.
- There may be some increase in organic N and P due to decomposition of vegetation, and bacteria due to birdlife.

Percolation to groundwater

Outflow to stream

www.tonkintaylor.co.nz