Kaiwaiwai Constructed Wetland and water quality – June 2015

Introduction

A wetland has been constructed at Kaiwaiwai Farm adjacent to a remnant Kahikatea stand which is being restored. Earthworks have transformed a traditionally wet 0.75 ha of pasture to a wetland with about 0.5 ha of open water. The balance of the area is planted banks. A portion of the flow from a drain to the north of the wetland has been redirected to provide a permanent and controlled flow of water which can range from 1 to 10 litres per second. Aquatic plants including raupo (*Typha orientalis*), Lake clubrush (*Scoenoplectus tabernaemontanii*) and a Cutty grass (*Carex geminata*) have been planted in the wetland which is designed for a water depth of 300mm.

Design

The design is unique in that the area actually comprises of three separate wetlands providing a serpentine flow path of water down 6m wide bays. These bays run back and forth across the area to slow down water flow, maximise residence time and water treatment. The wetland is well vegetated to give good dispersion and even flow through the majority of wetland and minimise channelisation or dead-zones. After passing through the wetland the treated water will re-join the original drain. The area is fenced to exclude livestock. A special feature of this project is the restoration and protection of a large Kahikatea and Totara which was overgrown with blackberry. Figure 1 shows the layout of the wetland.

Function

Wetland areas are useful in helping restore water quality as they are the kidneys of the landscape. They provide an efficient system to remove contaminants from drainage water, particularly nitrate through denitrification and allow time for any sediment to settle out. Contaminants such as nitrogen and phosphorus enter waterways through groundwater, surface runoff and direct application. Left unchecked these nutrients feed algal growth which degrades water quality. In a wetland anaerobic bacteria in the sediment convert the nitrate-nitrogen in the water to nitrogen gas which is then released into the atmosphere. This is known as denitrification.

Results

Monthly water sampling has been carried out at Kaiwaiwai. **Error! Reference source not found.** shows that significant quantities of nitrate in the drainage water entering the wetland is being removed. It will be interesting to see if this rate of removal also occurs in the winter as temperature and denitrification rate decrease. Total Nitrogen and Dissolved Reactive Phosphate have also been reduced while E. coli. (*Escherichia coli*) showed marked increases in the outflow as compared with inflow, most likely due to increase in water temperature in the wetland relative to the drain given the relatively shallow and open slower moving water of the wetland and increased birdlife. The wetland will take one to two years to become fully established. It is expected the wetland will maintain itself with wetland plants growing and dying in an annual cycle. Organic matter will accumulate in the base of the wetland and continually convert nitrate to nitrogen gas. Overseer estimates that 273 kg N will be removed each year in this way. At a cost of $55,000 this equates to $201/kg N which is comparable with other methods of reducing farm nutrient losses.

Table 1 Comparison of the quality of water entering and leaving the Kaiwaiwai Wetland

Date	05 Feb 2015		10 Mar 2015		15 Apr 2015		07 May 2015	
Flow (L/s)	3		10		10		10	
	In	Out	In	Out	In	Out	In	Out
Total N (g/m^3)	1.49	1.2	1.2	0.45	4.1	2.8	2.5	1.63
Nitrate-N (g/m^3)	0.86	<0.02	0.81	<0.02	3.6	1.88	2.1	0.76
DRP# (g/m^3)	0.063	0.024	0.048	0.022	0.025	0.016	0.027	0.063
E. coli cfu/100ml	6	20	33	360	110	1300	81	700

DRP = Dissolved Reactive Phosphate

E. coli (*Escherichia coli*)

Eels and koura and most likely other fish can be found in the drain at the exit of the wetland. A fish pass is planned so that bird life and frogs in the wetland will have new neighbours.

Figure 1 Map showing location remnant bush and design of wetland with entry and exit points.