From: Chris Tanner
Sent: Thursday, 6 September 2012 2:23 p.m.
To: Clive Howard-Williams
Subject: Lake Okaro Wetland

Hi Clive, Neil's final report attached. The wetland has consistently removed about 80% of the incoming nitrate-N load, 70-90% of TSS and around 1 log E. coli. Overall TN removal seems to have been more variable, likely due to differences in Org-N input and export. The wetland has generated some ammonium and DRP, but overall annual TP removal has ranged from 12-60%. It appears that performance has dropped off somewhat with maturation, but I think this may be largely due to variations in loading regime. We really need to look more closely at the implications of the results and what's behind them. I have a feeling that there has been a gradual loss of vegetated area in the wetlands –this would be worth assessing.

Cheers Chris

Highlights from Exec Summary shown below:

Period	Water quality variable							
	Total nitrogen				Total phosphorus			
	Mass load to wetland (kg)	Mass removed by wetland (kg)	Proportion of target retained (%)	Proportion of catchment export load retained (%)	Mass load to wetland (kg)	Mass removed by wetland (kg)	Proportion of target retained (%)	Proportion of catchment export load retained (%)
Target		348	-	-		16	-	-
2008	1444	597	171	41	504	302	1900	60
2009	876	146	42	17	251	56.8	355	23
2010	1250	149	42	12	249	30.5	190	12

For TN, wetland performance was exceptional in 2008, when more than 170% of the target mass was retained. Performance was more modest in 2009 and 2010, when 42% of the target was retained. The performance of the wetland is in part determined by the influent load – if the inflow load is large, the amount retained as proportion of the inflow appears large.

The wetland has consistently retained more TP than the target value. The performance of the wetland is in part determined by the influent load.

The proportion of target mass and catchment export mass retained within the wetland appears to have decreased over the assessment period. This apparent deterioration in performance is probably related to the smaller load of material exported from the catchment (because of the hydrological characteristics) and the impact of remedial actions undertaken in the upper catchment. The latter have probably reduced catchment exports (reducing the load entering the wetland), while wetland export has remained reasonably constant. The net effect is an apparent deterioration in performance.

The performance of the wetland is summarised in terms of annual attenuation of loads of a range of variables not identified in the Lake Okaro Action Plan below:

Assessment of wetland performance - measured attenuation of key forms of N and P.

Period	Water quality variable				
	Ammoniacal-N	Nitrate-N	Dissolved reactive	Suspended solids	*E. coli*

	phosphate									
	Mass (kg)	Prop. (%)[a]	Mass (kg)	Prop. (%)[a]	Mass (kg)	Prop. (%)[a]	Mass (t)	Prop. (%)[a]	(Log red.)	Prop. (%)[a]
2008	-4.7	-8	368.3	77	-12.8	-15	115.1	(87)	>1 log	92
2009	-39.2	-133	225	78	-6.8	-12	111.9	(88)	>1 log	96
2010	-28.9	-70	362.7	80	25.2	30	58.2	(71)	>1 log	89

Note:

[a] Prop. (%) is the proportion of inflow load retained by the wetland expressed as a percentage

The wetland is a net source of ammoniacal-N, but this is a relatively insignificant component of the nitrogen balance, and concentrations are generally low. The wetland retains a significant proportion of the inflowing nitrate-N load, following biogeochemical transformation involving denitrification. In two of the three years of assessment, the wetland was a net source of DRP, but in the third year it retained almost a third of the inflowing load.

Similar trends are evident for suspended solids loads as for TN and TP, with 71% to 88% removal rates. Variability in removal rates is largely related to the variability in inflow loads.

Attenuation of *E. coli* loads was reasonably constant (between 1 and 2 log units), and is influenced to some extent by the hydrological conditions.

In addition to reducing the mass of material leaving the wetland, biogeochemical transformations within the wetland considerably reduce the proportion of readily available nitrogen leaving the wetland. Up to about 40% of the nitrogen load entering the wetland is in soluble, bioavailable forms. This proportion is reduced to between 15% and 21% in the wetland outflow.

Evaluating wetland performance should take place over a sufficiently long period of time, allowing extreme conditions and events to be detected and placed in a longer-term context. The wetland is one of a series of restoration tools that have been applied in the Lake Okaro catchment. Determining the overall performance of the wetland requires consideration of the contributions of within catchment attenuation activities as well.

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