4.1 Understanding the values of zero-order streams and their importance in protecting downstream waterways

Summary

Zero-order streams (drainage lines) play a potentially vital role in providing ecosystem services such as filtration of runoff, retention of nutrients and other pollutants, and denitrification, thus reducing total nitrogen loads to waterways and the bays. Quantifying the performance of these services in both rural and urban landscapes is crutical to setting policies for protection and/or management of these parts of the landscape. In Year 1, we will (i) assess the effectiveness of treatment systems located within an ephemeral waterway/drainage line on rural land, and (ii) assess the potential for improving the nitrogen retention in urban riparian zones, through a biomimicry approach. The project will provide Melbourne Water with practical guidelines for managing drainage lines in rural and urban landscapes.

Research Theme

Flow and water quality management

Timing

2013-2016

Project Team

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Deliverables

- Commencement of Beenak monitorng, after installation of flow monitoring and diversion of upstream sediment basin
- Development of communications brief in consultation with all interested MW staff.
- 6 month review of monitoring outcomes
- Monitoring report for Beenak site
- Interim guidelines for selection and design of WSFD treatments
- Seminar describing performance of Beenak WSFD systems and implications for practice

Background

Headwater streams play a vital role in minimising pollutant transport through catchments, retaining sediments, and in particular, acting to facilitate denitrification (Alexander, et al., 2000; McClain, et al., 2003). In rural areas, drainage lines are often 'ignored', either used as part of agricultural production, or used for traffic of agricultural machinery. In 2012, Melbourne Water's Rural Lands Program commenced a project investigating the potential to integrate a range of water quality and flow management techniques into rural lands. The first phase of this project identified a potential site at Beenak, which has since been equipped with a range of management practices, including a range of sediment basins, and a large densely vegetated broad swale which aims to loosely emulate the structure and function of the drainage line as it would have been prior to agricultural development.

In urban environments where stormwater pipes bypass the riparian zone, and stream incision further isolates the stream from the riparian zone, denitrification potential is likely to decrease (Groffman, et al., 2002). Given that many waterways and bays in Australia and throughout the world are threatened by eutrophication due to excessive nitrogen loads (Taylor, et al., 2005), such a deterioration in the nutrient retention and transformation capacity of riparian zones and waterways is of critical concern. In this component of the project, we therefore aim to compare the nitrogen transformation processes which occur in natural and urbanised (degraded) riparian zones, and to determine the effects of bio-engineering the riparian zone (using biofiltration-derived techniques) to restore lost denitrification capacity. We ask whether such a technique could be used to restore the critical role that headwater streams play in nutrient retention and protection of downstream waterways.

The overall aim of the project is to provide Melbourne Water with practical design guidelines

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for the management of rural and urban headwaters, to both improve their in-situ values and to increase their delivery of important ecosystem services such as pollutant retention and protection of larger downstream waterways.

Methods

Beenak: We have already worked with MW and landholder to design and construct pilot scale water sensitive farm design (WSFD) systems at Beenak. In 2013/14 we will conduct monitoring of the systems constructed at Beenak. A principal aim of this project is to compare zero-order "natural type" systems with more constructed systems (e.g. sediment basins) (see Figure 1).

We propose three types of measurement on this system: low flow water quality sampling, event water quality sampling, and continuous rainfall and flow measurement.
Low flow water quality sampling will be carried out manually at the upstream and downstream storages (sites WQ2 and WQ7) on approximately ten occasions over a twelve-month period. Samples will be analysed for TSS, TP, TN, COD, BOD, Cu, Zn, Hg, Pb, Cr, Cd, As, oils and greases (O&G). This will provide information on the specific contaminants typically present in the system.

Event water quality sampling will be carried out at seven locations along the watercourse (sites WQ1 to WQ7) using autosamplers triggered manually at the start of significant rain for approximately ten events over a twelve-month period. Samples will be analysed for TSS, TP, TN, COD, Cu, Zn, Hg, Pb, and O&G (subject to revision according to results of the low flow analysis). This will provide information on the performance of the individual treatments under high flow conditions.

Rainfall will be measured by a logging rain gauge installed on site. Flows will be obtained by the continuous measurement of water depth at site Flow1 upstream of the concrete culvert. This will assist with model calibration to the catchment, and provide information necessary to convert contaminant concentrations to loads.

Given the potential for herbicides and pesticides to be present on site (in particular due to the strawberry production upstream) , we will undertake an initial pilot investigation of sediments within the waterway on the site, as well as limited passive sampling. This pilot investigation will be undertaken within the first three months of the project. Results will be presented to Melbourne Water for consideration in terms of further pesticide and herbicide monitoring to be undertaken at the site.