Monitoring Hydraulic Conductivity and Soil Contamination in Bioretention Systems in SEQ Constructed in 2006

Ms Nicole Ramilo[1]
[1]*BMT, Spring Hill, Australia*

Overview

Bioretention systems were first constructed in Australia circa 2001. Since this time, the science around their operation and our design of such systems and integration into the landscape has significantly improved. However, due to the relatively recent technology and expense of ongoing monitoring, limited data exists to demonstrate that laboratory results and guidelines are consistent with what is being observed in the field, and confirm that we are applying the science correctly.

This paper reviews monitoring results from a series of conventional (no saturated zone) bioretention systems constructed in 2006 (11+ years old) in a large car park at a commercial shopping centre at Noosaville, located on the Sunshine Coast in South East Queensland. The systems contain a number of now well-established trees (Broad-leaved paperbark Melaleuca quinquenervia), which have been controversial inclusions due to their perceived risk of underdrainage root intrusion.

Results of the monitoring indicate that trees in the systems have significantly increased infiltration rates in the filter media over time, and that there has been no significant accumulation of contaminants in the filter media. Furthermore, results indicate that tree root intrusion to subsurface drainage pipes is not an issue. This research supports the anticipated longevity of bioretention systems and shows that trees can be a valuable inclusion in bioretention systems, without compromising drainage over time.

Objectives

The objectives of this paper are to:

i. Demonstrate that trees, particularly Melaleuca quinquenervia, are valuable inclusions in bioretention systems
ii. Demonstrate that tree root intrusion to underdrainage pipes is not an issue in bioretention systems, even with no saturated zone (as recommended by the Bioretention Technical Design Guidelines (WBD 2014) when including trees)
iii. Demonstrate the longevity of bioretention filter media in the field (particularly from contamination and clogging), following 11+ years of operation in a commercial car park

Method

Root Intrusion:

To assess root intrusion and potential blockage of underdrainage pipes, a pipe camera was inserted into the underdrainage pipes of seven bioretention basins in 2018. Results were compared with other available

underdrainage pipe camera inspections at the same sites in 2012 in addition to other sites with and without trees (Dalrymple 2012, Water By Design 2011).

Hydraulic Conductivity:
In situ hydraulic conductivity testing of filter media in all 13 bioretention systems on site was undertaken in 2007, 2008, 2011 and 2018. Hydraulic conductivity was measured using a Guelph Permeameter (as specified in the stormwater management plan) until 2018, when the single ring infiltrometer under constant head method was used, in accordance with FAWB (2008) guidelines.

Soil Contamination:
Testing of filter media in five representative bioretention systems was undertaken in 2007, 2011 and 2018. Samples were tested for the following key contaminants in the top 400mm of soil (using NATA accredited laboratories):

- Heavy Metals
- PAHs, BTEX and Total Petroleum Hydrocarbons
- Organochlorine and Organophosphorus Pesticides

Results
Results of the investigations undertaken indicated:

- No significant root intrusion of underdrainage pipes from trees at Noosa Civic (to be confirmed with final pipe camera inspection 2018)
- Significantly increased hydraulic conductivity over time
- Concentrations of soil contaminants below ecological and human health investigation / screening levels for commercial sites. Furthermore, recorded concentrations of arsenic, cadmium, mercury, lead, soil hydrocarbon fractions and soil BTEX were below reporting limits at all sites in 2018.
- The greatest accumulation of contaminant in the filter media over time was zinc

Conclusions

- Trees (specifically Melaleuca quinquenervia) in bioretention systems do not cause significant root intrusion and blockage of underdrainage pipes
- Planting Melaleuca in bioretention systems may provide benefits for long term maintenance and possibly remediation of soil hydraulic conductivity.
- No significant accumulation of contaminants in bioretention filter media in the top 400mm of soil following 11+ years of operation, supporting the longevity of these systems in the field.