

# Development of a test method for micro-bioretention devices & media

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## Introduction

Stormwater360 has been conducting tests to evaluate the performance of micro-bioretention media and devices made using locally available materials in New Zealand. In the process of evaluating different media, different regulatory guidelines and test methods were reviewed and trialled.

Micro-bioretention devices operate at a hydraulic conductivity of >2500 mm/hr which is considerably faster than conventional bioretention devices (typically 100-300 mm/hr), whilst maintaining similar levels of pollutant removal.

Using a review of US, Australian and New Zealand device assessment guidelines for bioretention treatment devices, available research literature, and our experience gained from trialling different test methods, a lab based column test method was advocated for the evaluation of micro-bioretention devices.

	Bioretention device (BMP database)	Micro-bioretention (SW360 tests)		FAWB mixture
	Field test	Field test	Lab test	Guidelines
Hydraulic conductivity (mm/hr)	100-300	>2500	2500	100-300
Suspended sediment (TSS)	55-88%	83-88%		90%
Nutrients				
- Phosphorus	-179 to -47%	9-70%	26-75%	80%
- Nitrogen	-7 to 33%	40%	42-48%	50%
Metals				
- Zinc	70-90%	48-79%	82-90%	90%
- Copper	43-53%	33-77%	74-83%	60%

Table 1: Pollutant removal rates of bioretention treatment devices

## Current regulatory guidelines

Regulatory guideline	Field or Laboratory testing
Washington State Department of Ecology (TAPE)	Field testing
New Jersey Technology Acceptance Reciprocity Partnership (TARP)	Field testing
NJDEP laboratory assessment of a Filtration Manufactured Treatment Device	Laboratory testing
Auckland Proprietary Devices Evaluation Protocol (PDEP)	Field or laboratory testing
Gold Coast City Council	Field or laboratory testing

Table 2: Types of testing required by US, AU & NZ regulatory bodies

## Key issues

At SW360 we are seeing a growing market for micro-bioretention treatment devices both locally and internationally. To meet this demand media blends made from locally sourced materials need to be developed. Agreement on a standardised test method would support the development and regulation of micro-bioretention media blends and devices.

- An ideal test method needs to:-
- produce results which measure real world performance,
  - produce results which are comparable with other scientific studies, and
  - be practical to conduct from a time and cost perspective.



Figure 1: Stormwater360 NZ laboratory column test setup

## Lessons learnt from micro-bioretention media evaluation at SW360

### Influent composition

The choice of influent has a large influence on removal performance. At SW360 we have experimented with using 100% synthetic influent and semi-synthetic influent (FAWB).

Using tap water spiked with dissolved Copper and dissolved Zinc, we obtained unrealistically high removal in four different media. 95-97% of Copper and 98-100% removal of Zinc.

A repeat of the column tests using semi-synthetic stormwater (real stormwater with key pollutant concentrations adjusted) produced results which were realistic.



Figure 2 & 3: TSS tests (left), Muffle furnace (right)

### Saturation & repetition

Tests conducted on dry and saturated media showed that measurements in saturated media were the most consistent for hydraulic conductivity. Continuous testing over a 5 week periods revealed that the rate changed significantly over the first few wetting cycles.

The graph below shows the saturated hydraulic conductivity of micro-bioretention media continually tested at SW360 laboratories over 5 weeks.

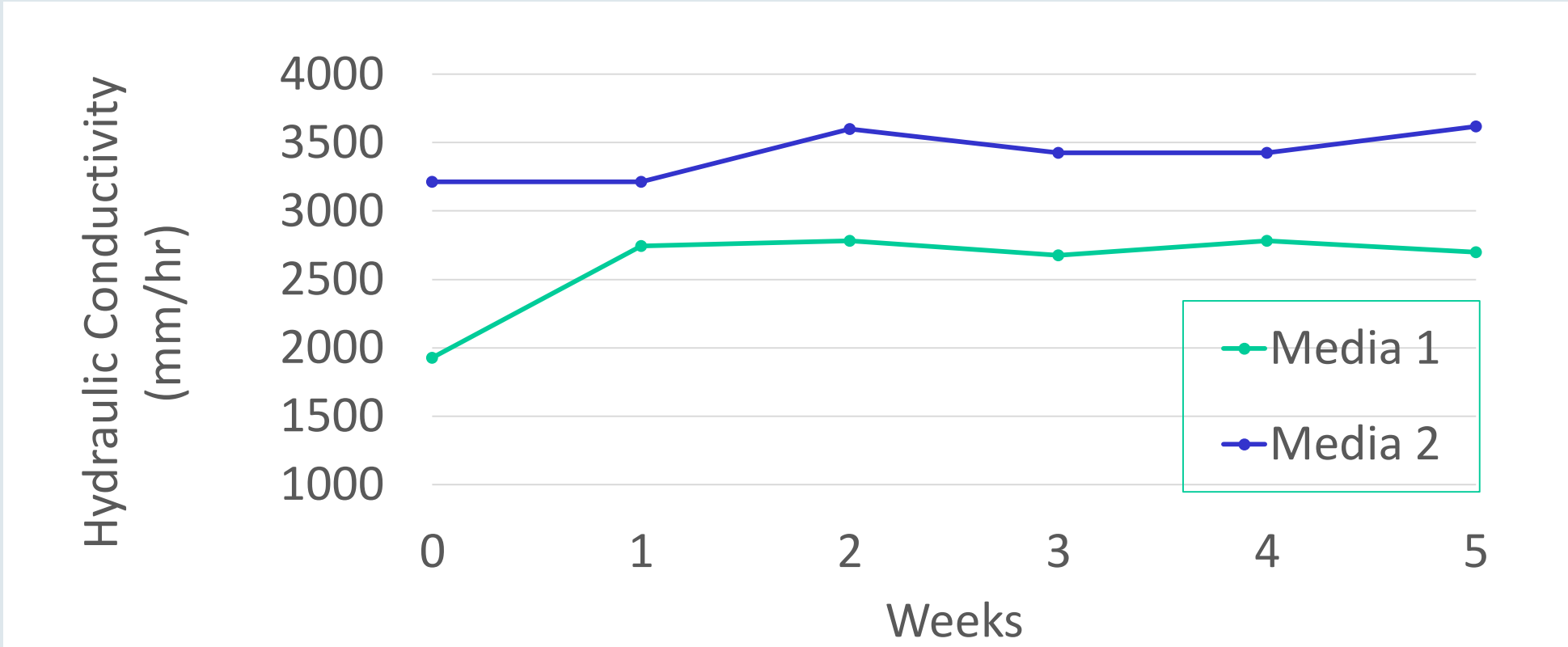


Figure 4: Hydraulic conductivity of media over 5 weeks

The media took 1-2 weeks before stabilising. Initial measurements were shown to underestimate the mature saturated hydraulic conductivity by 10-30%.

### Laboratory vs field testing

Field testing is expensive. Field testing can cost upwards of \$200,000 and take 6-24 months to complete. Even then the selection of site and site influent characteristics can have an undue influence on the removal performance observed. Due to practical issues, some regulatory bodies have allowed laboratory based performance assessment.

At SW360 we developed a laboratory based column test setup to test different micro-bioretention media. Laboratory based testing has shown to produce repeatable results and meaningful assessments of bio-retention media in a cost-effective and time efficient manner.



Figure 5 & 6: Micro bio-retention unit (left), and plant growth trials at SW360 premises (right)

## Conclusions

Laboratory based assessment of micro-bioretention devices is an appropriate approach to assess performance and has several advantages over field based assessment. Cost and time savings, and the greater control over test variables being the main advantages. With adequate consideration of the influent composition, test setup and duration of a test, the differences between laboratory and field test results can be minimised.