Filter Media and Ameliorant Details

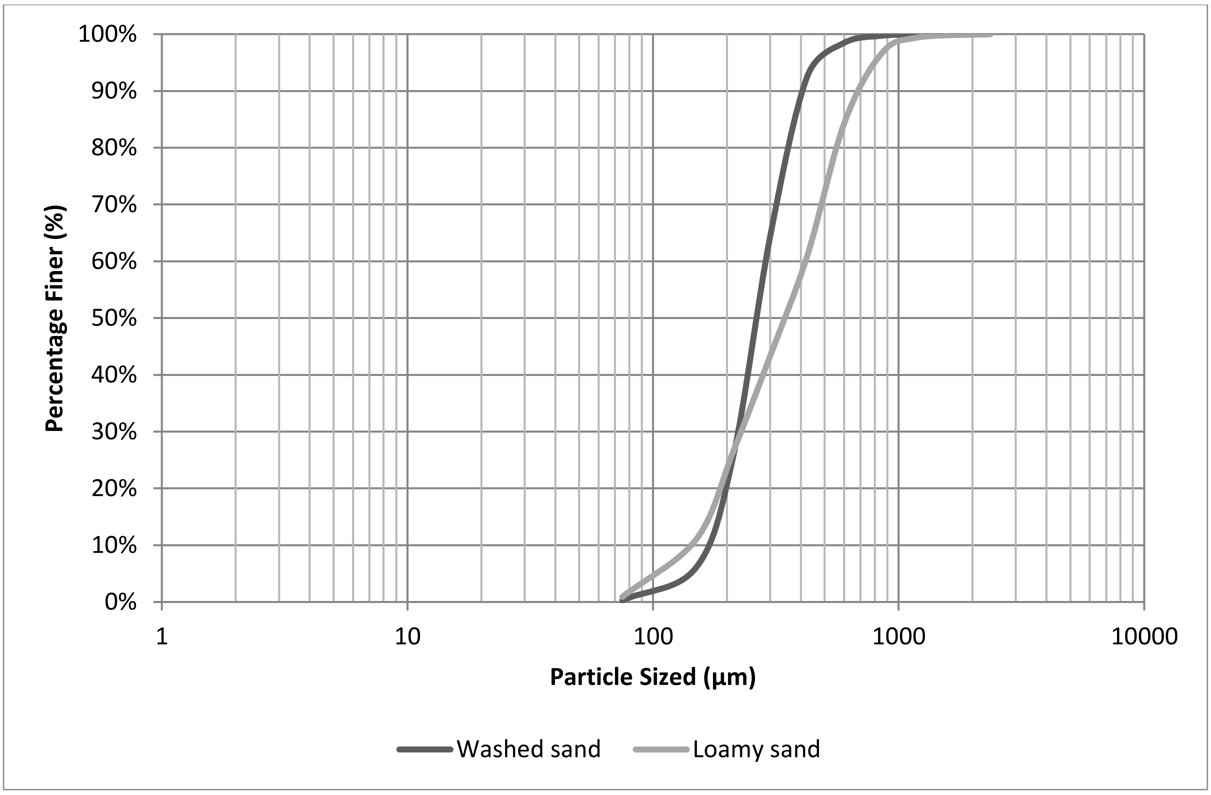

Figure S.1: Particle size distribution of two filter media types tested

Table S.1: Filter media composition

Soil property	Filter media	
	Washed sand	Loamy sand
pH	6.33	6.33
TOC %	<0.10	0.25
TOM % (as ashed free dried mass)	0.11	0.47
TP (mg/g)	<0.01	0.01
TN (mg/g)	0.03	0.11

The top 100 mm of the filter media layer in each column was mixed with 37 g of ameliorant made as per the recipe shown in Table S.2.

Table S.2: Ameliorant Mixture (Adopted from Bratieres et al. (2010))

Name	Quantity Kg/100 m^2 filter area
Granulated poultry manure fines	50
Superphosphate	2
Magnesium Sulphate	3
Potassium Sulphate	2
Trace Element Mix	1
Fertilizer NPK (16.4.14)	4
Lime	20
Total	82

Biofilter Vegetation

Table S.3: Biofilter vegetation Details

Name	Short description	Plant during experimental period	Extent of roots after 2 years of operation
Carex appressa	Also known as tall sedge. The most commonly used and recommended biofilter plant species in Australia. Consist of an extensive root system with very fine roots.		
Leptospermum continentale	A small shrub species known as tea tree. Consist of an extensive root system with very fine roots.		
Palmetto buffalo grass	A lawn grass species. Known to have relatively deep roots, however, the root structure is not extensive as the other two species tested.		

Tracer Test

The objective of the KCl tracer test was to estimate the submerged zone (SZ) pore volume. SZ pore volume was then used to differentiate old SZ water from the from the freshly treated stormwater in the biofilter outflow. Furthermore, the porosity of the SZ media was also derived using the tracer test results. It should be noted that the tracer test was conducted only on three replicates of each un-vegetated columns (WS and LS) to avoid any unnecessary impacts on plants and plant-associated microbes due to the introduction of high salt concentration. Nevertheless, SZ of both vegetated and un-vegetated columns had the similar media layers, as such it was assumed that the results from un-vegetated columns apply to vegetated columns.

Dechlorinated tap water (using 0.83 mg/L $Na_2S_2O_3$) was used as the blank solution. Then 0.96 g/L KCL was added to the blank solution to prepare the salt solution with a target electrical conductivity of 2000 µS/cm. Each column was dosed with 26 L of salt solution, and the total outflow was collected into a series of 500 mL samples. Each outflow sample was analyzed for electrical conductivity. It should be noted that at the end of tracer test, each biofilter column was flushed with another 26 L blank solution, but this flushing caused a significant release of fine particles from the filter media (data not shown). As such, all six un-vegetated columns used for the tracer test were emptied and re-packed. These columns were subjected to accelerated dosing to receive the same amount of water as the rest of the columns to achieve the same level of hydraulic compaction.

The electrical conductivity of each outflow sample (C_{out}) was normalised to the measured electrical conductivity (C_{in}). The results of the tracer test are shown in Figure S1. It was assumed that the old SZ water was fully displaced when a sudden increase in the initial steady normalised outflow concentration (C_{out}/C_{in}) was observed. The sudden increase in C_{out}/C_{in} was observed when C_{out}/C_{in} reached approximately 0.1, and the cumulative outflow volume reached approximately 10-L. Therefore, the pore volume retained of the SZ was estimated to be 10-L, and the porosity was estimated to be 0.5.

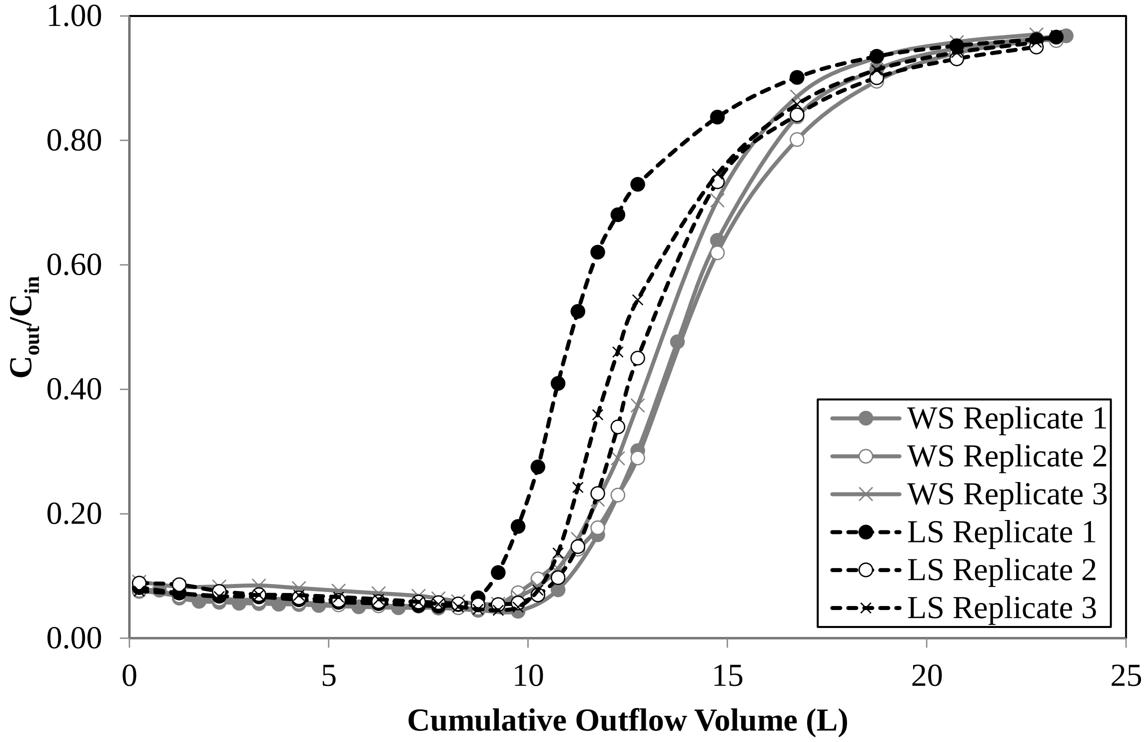

Figure S.2: Change of outflow KCl concentration (normalised to the inflow concentration) with cumulative outflow during the tracer test trail in three replicates of WS and LS un-vegetated columns.

Table S.4: Target and measured semi-synthetic stormwater pollutant concentrations

	Inflow Concentration		
Stormwater pollutant	Unit	Target (Duncan 1999; Taylor et al. 2005; NHMRC 2009)	Measured Geometric mean *(Geometric standard deviation)*
E. coli	MPN/100mL	5.9×10^4	2.8×10^4 *(4.16)*
Total suspended solids	mg/L	100	86 *(1.44)*
Total phosphorus	mg/L	0.35	0.42 *(1.18)*
Total nitrogen	mg/L	2.2	2.92 *(1.17)*
Cadmium	mg/L	0.0045	0.0081 *(1.40)*
Chromium	mg/L	0.025	0.054 *(1.58)*
Copper	mg/L	0.05	0.08 *(1.36)*
Lead	mg/L	0.14	0.27 *(1.47)*
Manganese	mg/L	0.23	0.19 *(1.11)*
Nickel	mg/L	0.031	0.05 *(1.30)*
Zinc	mg/L	0.25	0.26 *(1.18)*

MPN – Most Probable Number; Total suspended solids, total nitrogen, total phosphorus and heavy metal concentrations were measured using standard methods ((APHA/AWWA/WPCF 2005; Hsomi and Sudo 1986) and ICP-MS (for metals))

Table S.5: Performance in each individual sampling round

Sampling round	Date	Antecedent dry days	Inflow volume (L)	Inflow *E. coli* concentration (MPN/100 mL)*	Outflow *E. coli* concentration (MPN/100 mL) Geometric mean *(Geometric standard deviation)*					Infiltration rate (mm/h) Geometric mean *(Geometric standard deviation)*				
					WS	**LS**	**CA**	**LC**	**PB**	**WS**	**LS**	**CA**	**LC**	**PB**
1	2/11/2012	2	20	18560	994 *(1.79)*	1317 *(1.15)*	265 *(1.32)*	425 *(1.65)*	522 *(1.55)*	298 *(1.12)*	187 *(1.30)*	262 *(1.09)*	272 *(1.05)*	292 *(1.11)*
2	16/11/2012	3	20	9160	538 *(1.56)*	867 *(1.24)*	263 *(1.25)*	355 *(1.69)*	279 *(1.70)*	333 *(1.03)*	235 *(1.22)*	286 *(1.06)*	295 *(1.07)*	311 *(1.08)*
3[(a)]	27/11/2012	4	**40**	23010	626 *(1.87)*	1621 *(1.16)*	630 *(1.28)*	1108 *(1.51)*	1045 *(1.24)*	337 *(1.05)*	205 *(1.12)*	291 *(1.05)*	282 *(1.14)*	318 *(1.08)*
4	4/12/2012	4	20	25900	549 *(1.31)*	1320 *(1.32)*	442 *(1.27)*	634 *(1.91)*	747 *(1.58)*	259 *(1.12)*	168 *(1.08)*	250 *(1.06)*	210 *(1.51)*	252 *(1.09)*
5	11/12/2012	7	20	20420	380 *(1.53)*	837 *(1.13)*	258 *(1.28)*	413 *(1.37)*	458 *(1.42)*	262 *(1.26)*	185 *(1.07)*	256 *(1.06)*	253 *(1.31)*	274 *(1.22)*
6 [(d)]	29/01/2013	3	20	132420	3155	1283	383	1872	3027	91	123	53	146	126

					(1.52)	*(2.18)*	*(3.99)*	*(1.74)*	*(.145)*	*(2.00)*	*(1.48)*	*(1.48)*	*(1.33)*	*(1.19)*
7 [b, d]	12/02/2012	13	20	104090	1682	2569	3058	4724	2696	337	209	200	253	228
					(1.80)	*(1.44)*	*(1.22)*	*(2.08)*	*(1.54)*	*(1.07)*	*(1.16)*	*(1.21)*	*(1.01)*	*(1.26)*
8 [a]	19/02/2013	4	**40**	22030	1365	1237	840	1673	986	251	182	133	214	180
					(1.21)	*(1.29)*	*(1.30)*	*(1.29)*	*(1.22)*	*(1.10)*	*(1.15)*	*(1.30)*	*(1.14)*	*(1.19)*
9	26/02/2013	2	20	62680	2306	2040	1199	2447	2606	212	179	80	134	147
					(1.40)	*(1.25)*	*(1.49)*	*(1.13)*	*(1.540*	*(1.11)*	*(1.06)*	*(1.49)*	*(1.29)*	*(1.26)*
10 [d]	25/03/2013	29	20	26850	199	155	10279	17131	1247	314	173	243	235	346
					(1.51)	*(1.41)*	*(3.67)*	*(1.25)*	*(1.15)*	*(1.15)*	*(1.23)*	*(1.09)*	*(1.13)*	*(1.10)*
11 [d]	12/04/2013	3	20	21980	1115	892	883	1043	1945	206	167	79	107	217
					(1.33)	*(1.18)*	*(1.60)*	*(1.20)*	*(1.21)*	*(1.42)*	*(1.11)*	*(1.34)*	*(2.04)*	*(1.26)*
12 [b, d]	24/05/2013	42	20	17930	1029	734	6808	5325	1789	237	114	205	178	177
					(1.34)	*(1.33)*	*(1.26)*	*(1.48)*	*(1.49)*	*(1.36)*	*(1.18)*	*(1.03)*	*(1.38)*	*(1.60)*
13 [a]	4/06/2013	3	**40**	18030	1508	628	419	378	1189	193	130	63	92	178
					(1.24)	*(1.20)*	*(1.47)*	*(2.65)*	*(1.39)*	*(1.15)*	*(1.07)*	*(1.40)*	*(2.06)*	*(1.16)*
14 [c]	18/06/2013	4	20	12160	302	77	60	68	620	60	52	26	32	54
					(1.70)	*(2.98)*	*(1.55)*	*(5.22)*	*(1.19)*	*(1.64)*	*(1.63)*	*(1.26)*	*(2.15)*	*(2.47)*

15 [c, e]	19/06/2013	1	20	190	194 *(1.72)*	65 *(2.31)*	52 *(1.99)*	38 *(2.30)*	500 *(1.04)*	47 *(1.65)*	51 *(1.56)*	23 *(1.32)*	27 *(1.94)*	37 *(2.29)*
16 [c]	28/06/2013	3	20	12160	210 *(2.13)*	36 *(3.27)*	30 *(2.55)*	28 *(4.83)*	531 *(1.32)*	56 *(1.90)*	42 *(1.70)*	17 *(1.10)*	24 *(2.05)*	69 *(1.50)*

*Notes: *: Inflow E. coli concentration is rounded for significant digits; (a): High inflow volume events simulating 1 in 3 months ARI events. Three replicates each from WS and LC configurations were tested for other indicators in addition to E. coli; (b): dry weather events; (c); Outflow valves were restricted in three replicates from each configuration to one target infiltration rate (d): Discrete outflow samples were collected for two replicates in WS, CA, LC and PB configurations; (e): No raw sewage was added to inflow mix.*

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