Supporting Information

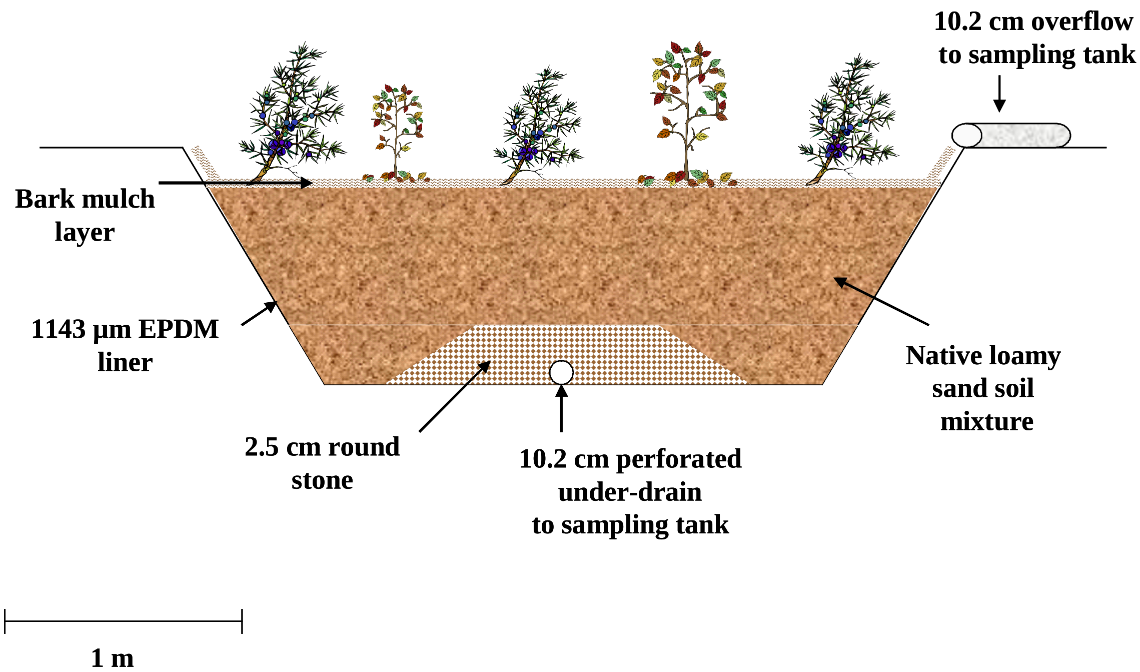

Figure 1. Cross-section of rain garden, Haddam, CT.

Table 1. Soil and mulch characteristics, Haddam, CT rain garden.

	Rain Garden No.		
	1	2	Mulch
Bulk Density (g/cc)	1.63	1.66	0.2
Organic Matter (% LOI)	1.6	1.9	-
CEC ($cmol_c$/kg)	16.8	22.7	166
pH	6.1	6.3	-
Sand (%)	84.4	83.6	-
Silt (%)	7.6	10.0	-
Clay (%)	8.0	6.4	-
Infiltration Capacity (cm/hr)	12.6	10.3	-

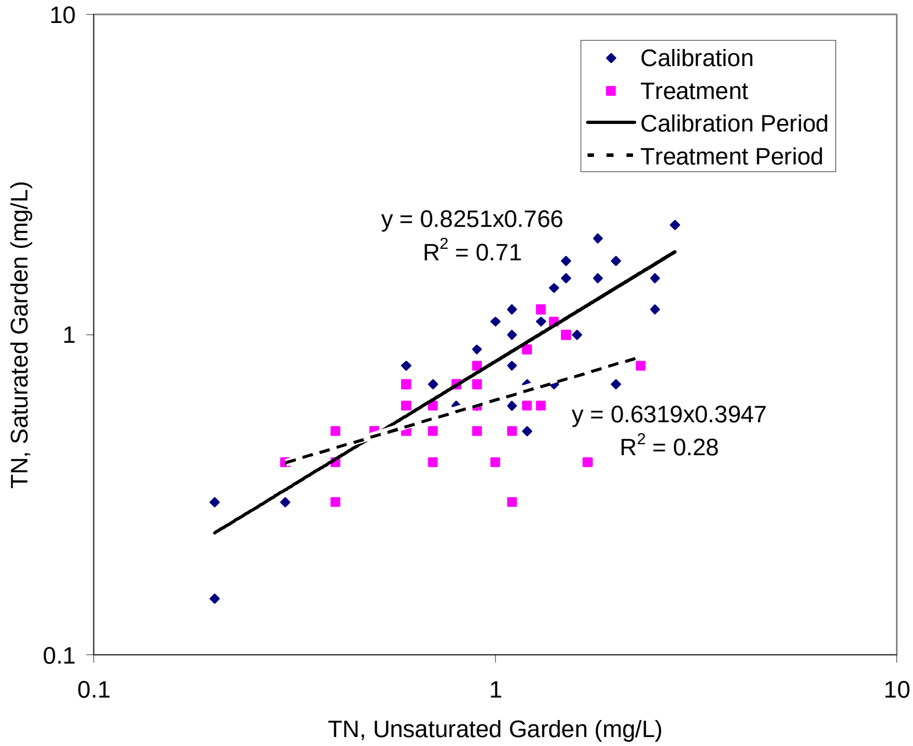

Figure 2. ANCOVA regression relationship for TN.

Temperature

ANOVA results showed that the average temperature difference between roof runoff and underdrain outflow was significantly larger (negative) in winter and fall as compared to summer months (Table 2). Interestingly, the difference was negative for all seasons. The lack of a cooling effect in the summer was surprising; increases in runoff temperature from paved surfaces have been found in another study (1). The temperature increase may be due to the relatively shallow (0.6 m) soil depth and the short retention of water in the system due to the high permeability of the soils. In addition, the pitched roof faces east, and may not have absorbed as much heat as if it had a southerly exposure.

Table 2. Seasonal water temperatures and average temperature difference (°C), Haddam, CT rain garden. Means followed by the same letter are not significantly different at p=0.05 using Duncan's MRT.

Season	Roof runoff	Underdrain outflow	Difference
		°C	
Fall	14.5	16.5	-2.2 b
Winter	4.6	7.0	-2.2 b
Spring	8.1	8.7	-0.6 ab
Summer	19.2	19.4	-0.2 a

Manganese

During the treatment period, dark staining was observed on the tipping bucket measuring outflow from the treatment garden, whereas no staining was noted on the bucket for the control garden. It was suspected that manganese (Mn) was being released from the system, so the last five months of samples were analyzed for Mn in addition to Cu, Pb and Zn. The geometric mean Mn concentration (n=5) in both precipitation and roof runoff was 4 $\mu g\ L^{-1}$. The Mn concentration in underdrain outflow from the control garden was 13 $\mu g\ L^{-1}$. The Mn concentration in underdrain outflow from the treatment garden was 270 $\mu g\ L^{-1}$, and significantly (p=0.001) higher than precipitation, roof runoff, and control garden underdrain outflow Mn concentrations. Initial soil concentrations of Mn were 331 and 213 $\mu g\ g^{-1}$ for the treatment garden and control garden, respectively. The reducing conditions noted in the treatment garden were likely the cause of the release of Mn. An increase in soluble Mn^{2+} due to reducing conditions has been documented (2,3). In the pH range from 5 to 7, the critical potential, or the point where there would be a marked transformation from reducible form of Mn to the water soluble plus exchangeable form, would be expected to occur in the range of 600 mv to 150 mv (2).

For the pH of the soils at the Haddam site (4), the critical potential would be around 200 mv. The saturated garden redox potential average during the treatment period was lower than this critical value, and the control garden average redox potential was higher than the critical value (see manuscript). Therefore, it is not surprising that Mn was converted to a more soluble form in the treatment garden. A rain garden with a saturated zone has the potential to release Mn to receiving waters if an underdrain is directly connected.

Despite the small percent uptake, Zn tissue concentrations in winterberry (*Ilex verticillata*) increased from 21 to 344 mg kg^{-1}. Percent increases of Zn in the two other plant species used were much lower. Phytoextraction of metals in plants has been defined as the uptake of metals from the soil and translocation into either aboveground or belowground plant tissue (5). Hyperaccumulation has been defined as the accumulation of a metal of more than 0.1% in dry plant tissue (6). An alternative criterion has been proposed to define hyperaccumulation as tissue concentrations greater than 10,000 mg kg^{-1} for Mn and Zn (7). Plant tissue Zn concentrations one to two orders of magnitude higher than those found in winterberry at the Haddam site have been reported (8). Belowground accumulation of Zn in winterberry was not measured at the Haddam site, however, aboveground accumulation of Zn in winterberry was 0.04% of dry plant tissue. Although winterberry does not appear to be hyperaccumulating Zn at the Haddam site, the results of this study suggest that its potential use in overall phytoremediation should be further investigated.

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