Introduction and Background

- Bioretention cells are a stormwater management BMP that promotes the infiltration and treatment of runoff on site using natural vegetative and soil processes (Fig. 1).
- While bioretention has been shown effective at the removal of heavy metals, sediments, pathogens, and hydrocarbons from stormwater, nutrient (Nitrogen and Phosphorus) treatment has varied in success (Davis et al. 2009).
- Two critical design components of bioretention that can influence the treatment of nutrients are the selection of vegetation and organic soil amendments. Compost and other organic soil amendments can leach excess nutrients causing a total net export in bioretention effluent (Mullane et al. 2015), while the presence of vegetation may influence nutrient treatment trough plant uptake and complimentary biological processes (Lucas and Greenway 2008). The effects of the presence of each of these individually on stormwater treatment has so far been unstudied in any bioretention field experiment.

- **Objective:** Determine the extent to which the presence of compost or vegetation in bioretention cells affect the treatment of nutrients and total suspended solids from mixed urban/agricultural runoff.

Experimental Design and Methods

In June 2016, three large, unlined bioretention cells were installed to treat stormwater runoff from 13,662 m² of the UVM Miller Research Complex, a mixed urban/institutional and agricultural watershed. In this system, influent runoff is split equally among the cells and allowed to percolate through layers of peastone, sand, and gravel before being discharged through underdrain pipes (Fig. 2). Each cell has a unique treatment designed to isolate the effects of compost and vegetation on pollutant removal. Water samples were taken at discrete times during a storm event from the inflow and separate outflows and analyzed for concentrations of Total Suspended Solids (TSS) and nutrient species. Total stormwater flow and volume was recorded every storm event and factored by pollutant concentrations measurements to obtain a measure of mass. Storm Event Mean Concentrations (EMC) are calculated by total pollutant mass divided by total stormwater volume.

Preliminary Results

**Event Mean Concentrations**

- Nitrogen
- Phosphorus
- TSS

![Diagram of bioretention cell](image1)

**Citations**

- Prince George’s County. 2010. Bioretention Manual. PGC, Maryland. Department of Environmental Resources, Environmental Services Division, Landover, MD.

University of Vermont Miller Research Center Bioretention Cells

- **C+V+**
- **C+V-**
- **C-**
- **V+**
- **V-**

**Figure 1:** Diagram of a typical bioretention cell. Runoff is channeled into a depression in the ground filled with high permeability gravel and sandy loam soil and planted with a variety of vegetation. Infiltration is regulated through a split-flow system, allowing the cell to be subdivided into separate treatment areas.Stormwater is treated by infiltration, sedimentation, adsorption, plant uptake, and microbial decomposition. Treated effluent is either infiltrated and infiltrate pipes underdrains are discharged by an underdrain pipe (PGC). Bioretention Manual.

**Figure 2:** Stormwater Flow (1) and Vertical Profile (2) of Miller Research Center Bioretention Cells. Stormwater is first channeled into gravel swales to settle solids, and then onto a three-way splitting structure where influent water samples are taken. It then spreads across the surface of the cells and percolates through 15 cm of peastone, a 76 cm layer of sand, another 15 cm layer of peastone, and 30 cm of gravel before exiting through a perforated underdrain. In two cells, Switchgrass (Panicum virgatum) planted at a density of one per 0.9 m², and in one cell a 7.5 cm layer of compost was added in lieu of one of the top perforated layers. Composted treatments are experimentally paired to test the significant effect of compost (brown) and vegetation (green) on stormwater treatment.