Evaluation of Climate Resilient Stormwater Management Practices for the Mid-Atlantic Region

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Problem Statement

Mid-Atlantic States are required to manage nonpoint source pollution. Bays, estuaries, rivers, and ponds are becoming eutrophic from excess nutrients, and the contribution from urban stormwater is growing. Further exacerbating this eutrophication are increases in rainfall intensities, droughts, and severe storm events associated with a changing climate. Current stormwater management technologies will be inadequate to deal with these changes unless design specifications are updated.

Urban stormwater examples in Maryland

Proposed Approach

- Conduct a literature review of the current science related to designs for enhanced nitrogen removal in bioretention, designs for climate resilience, and costs associated with enhanced resilient designs.
- Develop design standards and specifications for bioretention systems modified for climate resiliency and enhanced nitrogen removal.
- Conduct a design workshop for the proper use of the design standards and specifications.
- Produce and implement a survey to document the attitude toward altered or enhanced systems and identify barriers to implementing advanced nitrogen removing systems.

What We Accomplished

Assembled a list of relevant research and design manuals on current and established science for infiltration and nitrogen removal in urban bioretention and rain gardens, and drafted a Design Manual for climate resilient specifications for urban bioretention systems:

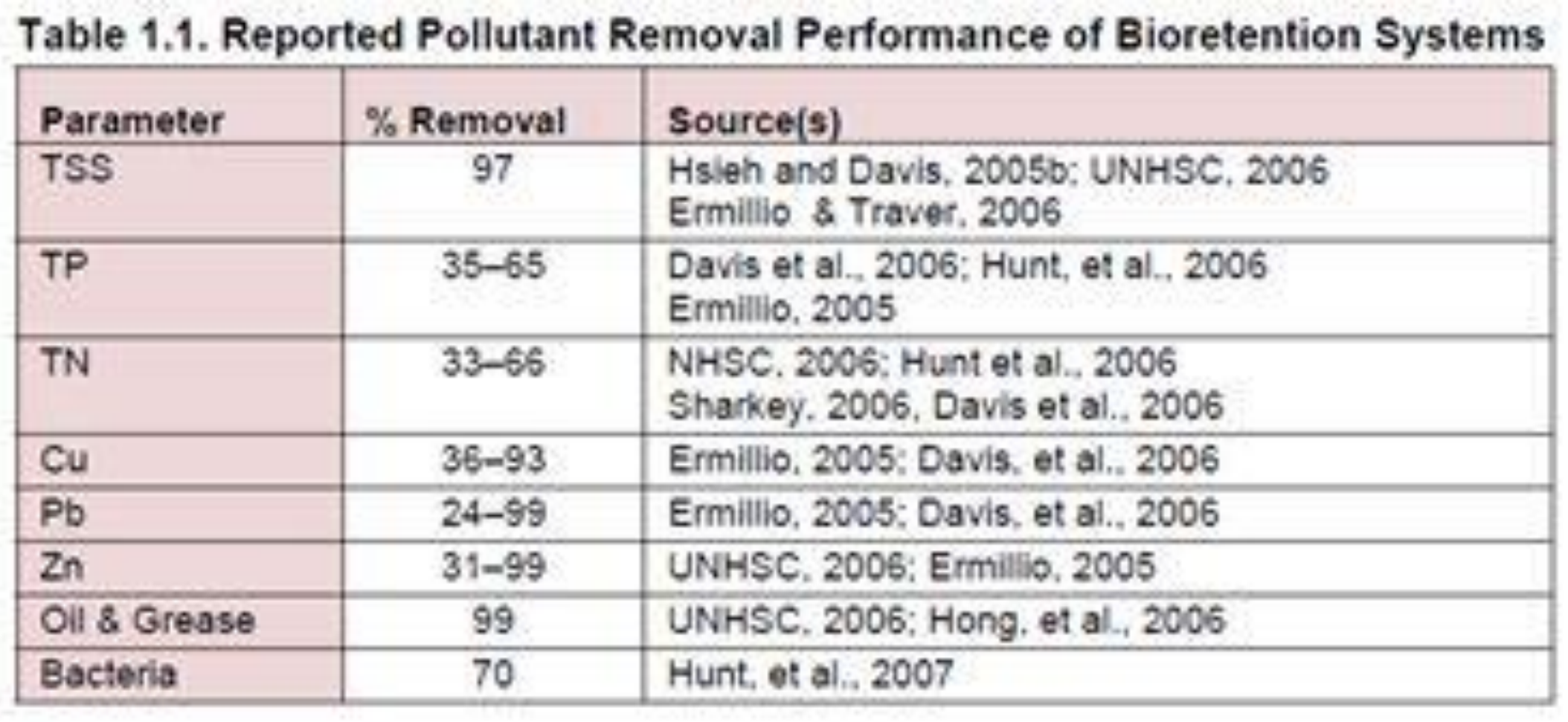

Table 1.1. Reported Pollutant Removal Performance of Bioretention Systems

Parameter	% Removal	Source(s)
TSS	97	Hsieh and Davis, 2005b; UNHSC, 2006 Ermillio & Traver, 2006
TP	35–65	Davis et al., 2006; Hunt, et al., 2006 Ermillio, 2005
TN	33–66	NHSC, 2006; Hunt et al., 2006 Sharkey, 2006, Davis et al., 2006
Cu	36–93	Ermillio, 2005; Davis, et al., 2006
Pb	24–99	Ermillio, 2005; Davis, et al., 2006
Zn	31–99	UNHSC, 2006; Ermillio, 2005
Oil & Grease	99	UNHSC, 2006; Hong, et al., 2006
Bacteria	70	Hunt, et al., 2007

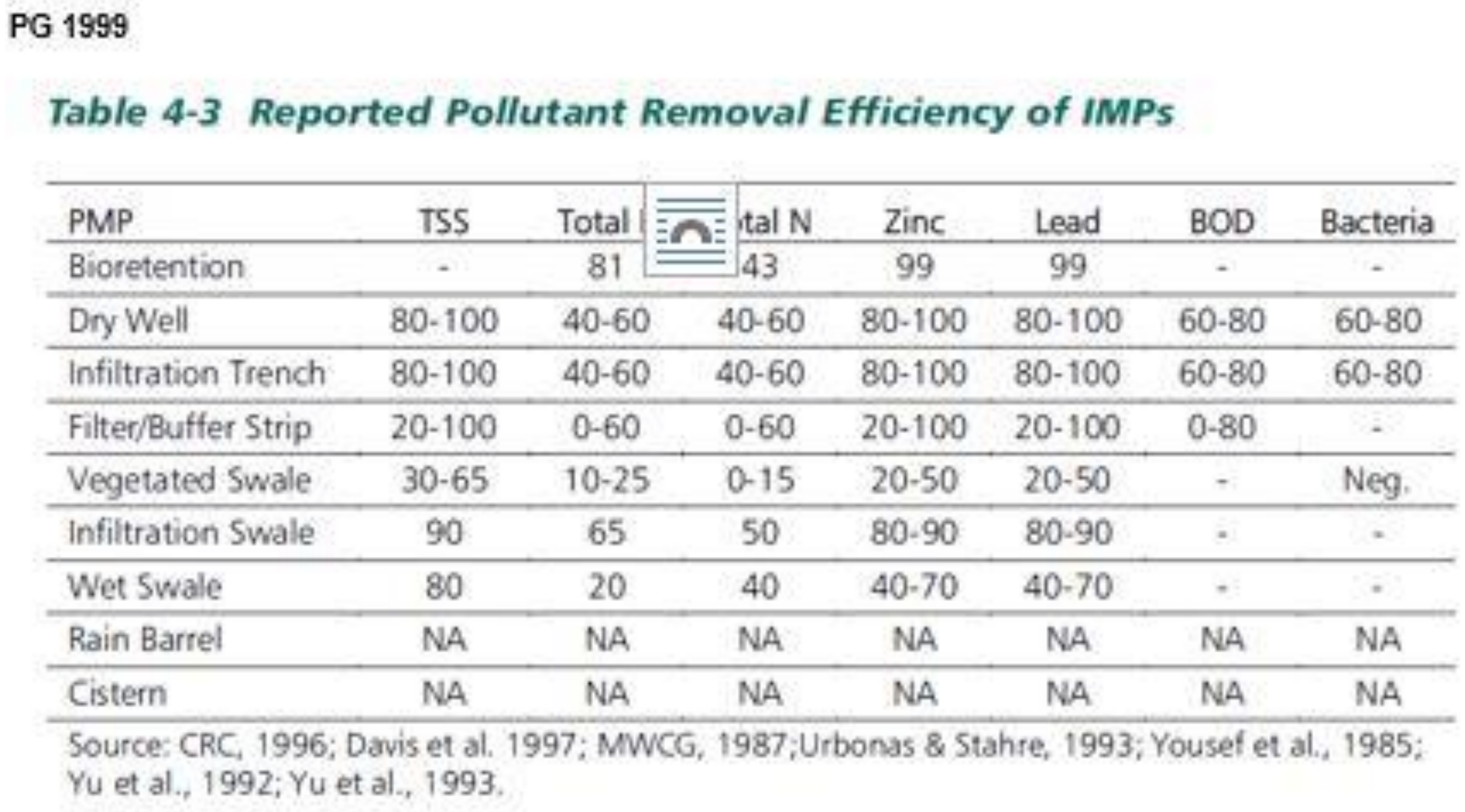

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Table 4-3 Reported Pollutant Removal Efficiency of IMPs

PMP	TSS	Total	tal N	Zinc	Lead	BOD	Bacteria
Bioretention	-	81	43	99	99	-	-
Dry Well	80-100	40-60	40-60	80-100	80-100	60-80	60-80
Infiltration Trench	80-100	40-60	40-60	80-100	80-100	60-80	60-80
Filter/Buffer Strip	20-100	0-60	0-60	20-100	20-100	0-80	-
Vegetated Swale	30-65	10-25	0-15	20-50	20-50	-	Neg.
Infiltration Swale	90	65	50	80-90	80-90	-	-
Wet Swale	80	20	40	40-70	40-70	-	-
Rain Barrel	NA	NA	NA	NA	NA	NA	NA
Cistern	NA	NA	NA	NA	NA	NA	NA

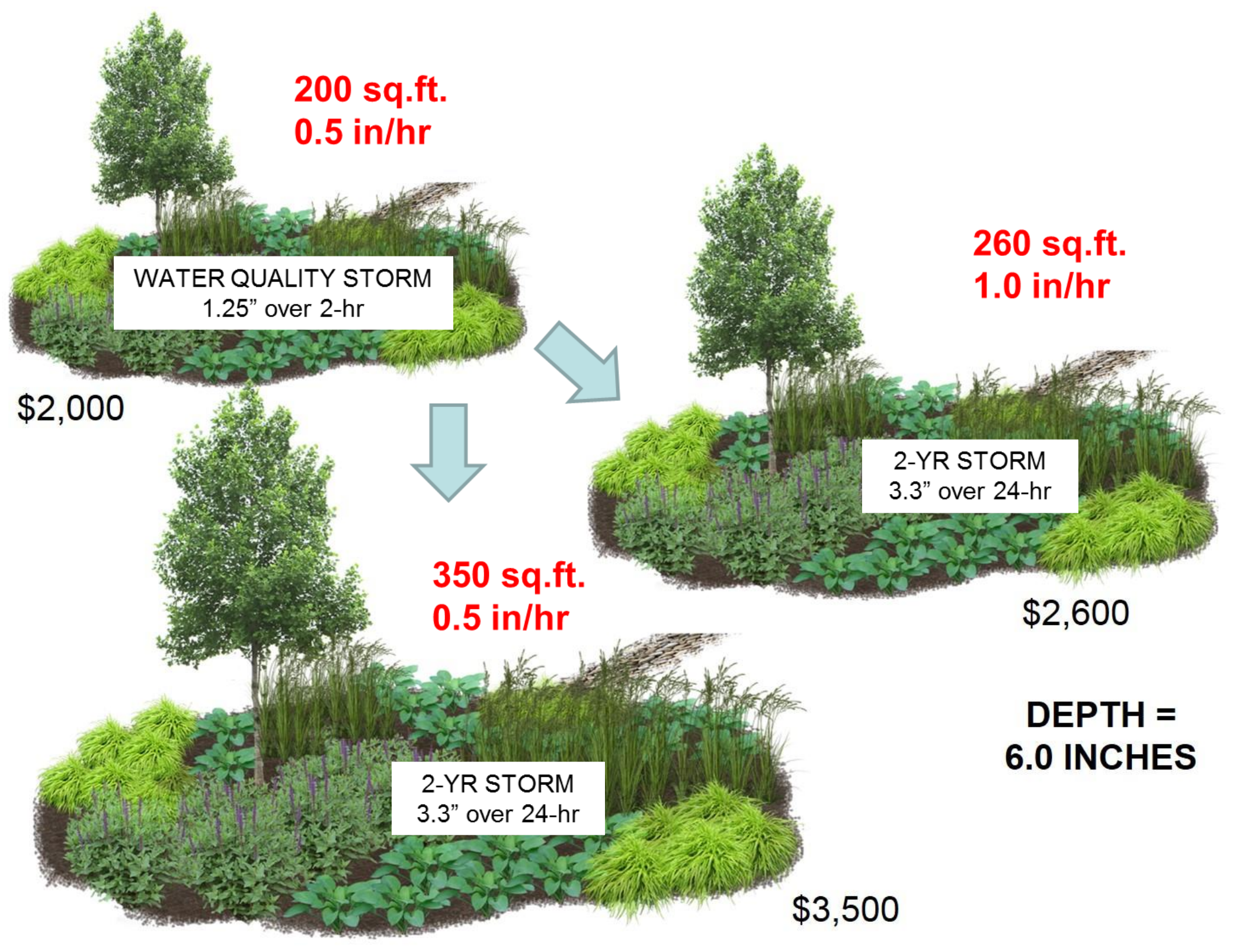
Source: CRC, 1996; Davis et al. 1997; MWCG, 1987;Urbonas & Stahre, 1993; Yousef et al., 1985; Yu et al., 1992; Yu et al., 1993.

Conducted research on potential design changes to enhance denitrification:

Rutgers University and NJ Sea Grant Consortium rain garden research plot

Preliminary Findings

- Removal of nitrogen, phosphorus, and sediment from effluent was dependent on a number of factors, some of which were mutually exclusive:
  - increasing the infiltration rate can help improve phosphorus removal but hinder nitrogen removal.
- Impacts from climate change are still difficult to predict at the scale of localized practices, due to a lack of downscaled data.
- Changes in distribution and intensity of precipitation are important design considerations for managing nutrient pollution.
- No studies were found that did not use an underdrain in the practice, thus none of the studies could provide efficiency estimates for rain gardens (only bioretention).



Example of modifying the garden design to accommodate a higher volume 2-year storm (treating 3.3” over 24 hrs instead of 1.25” in the same time period). Graphic and research by Christopher Obropta, Ph.D., P.E.

What’s Next?

- Technical memorandum with a summary of results from the literature review
- Fact sheet/design manual for mid-Atlantic states
- Workshop to introduce design standards and survey participants about ease of use and cost feasibility

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