Research on Stormwater Nitrogen & Phosphorus Removal to Meet TMDLs in Prince George's County, MD

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Project Needs

- The WIP-II mandates will cost the County approximately $800,000,000 to implement.
- The pollutant removal efficiencies for LID practices are high; but the unit costs (per impervious area) are also very high.
- The County needs to find LID designs that are cost-effective.

Project Objectives

- Evaluate Media (sand, top soil & organic matter) and Configurations to enhanced N & P Removal from Urban runoff
- Increase infiltration rate of media so the facilities can treat more impervious areas
  - Reduce unit cost
  - But, keep high pollutant removal efficiencies

- P: Enhanced Adsorption (media materials)
- N: Media & Configurations for Denitrification for better N removal
- Overall: Treat more impervious acres

Project Approaches/Scope of Work

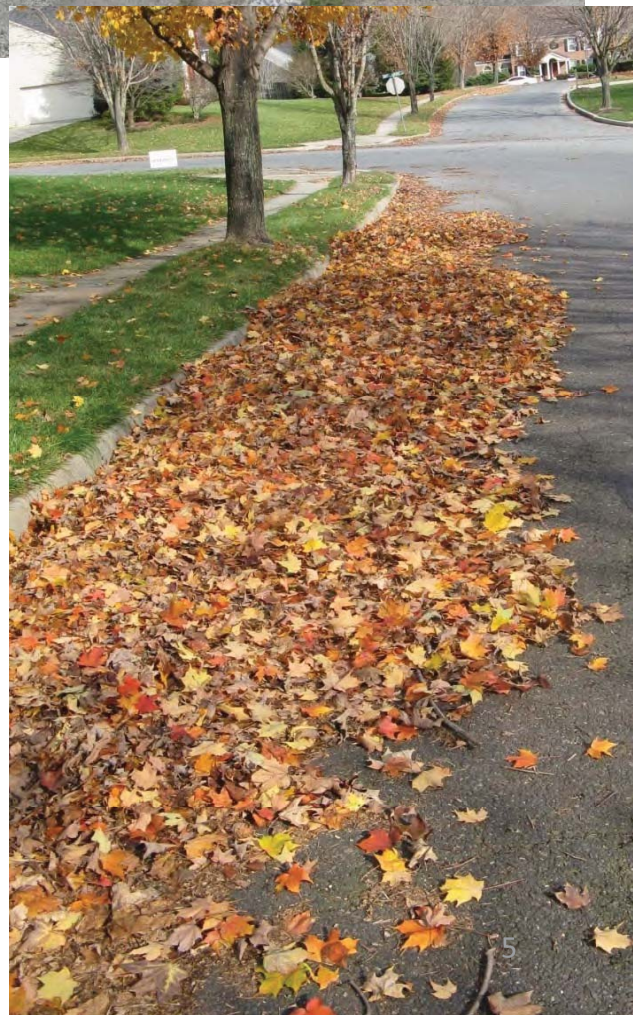
- Focus on Bioretention and Sand Filters
- Detailed Literature Searches
- Laboratory Studies to Optimize Media, Conditions, & Configurations
- Conduct monitoring of Field Verification Facilities
- Open Communication with Regulatory Agencies (EPA and MDE)

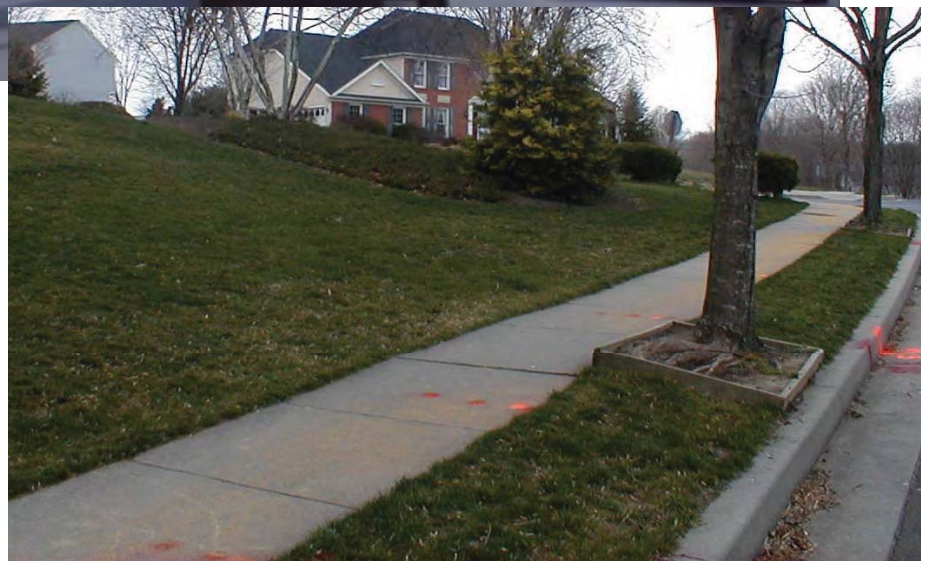
Understanding Sources of N & P

Typical Urban Concentration:

TN: 2.28 mg/l

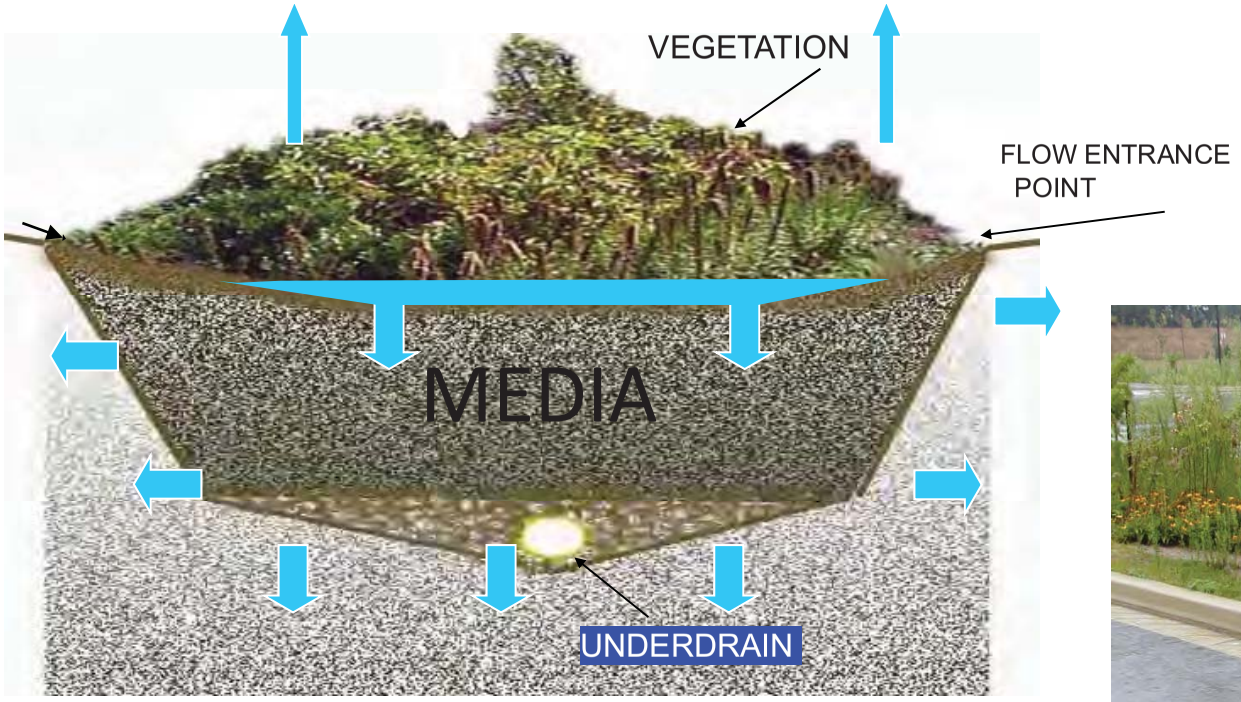
TP: 0.33 mg/l





Understanding Bioretention

Hydrology: Pooling, Infiltration, & Evapotranspiration



Quality:

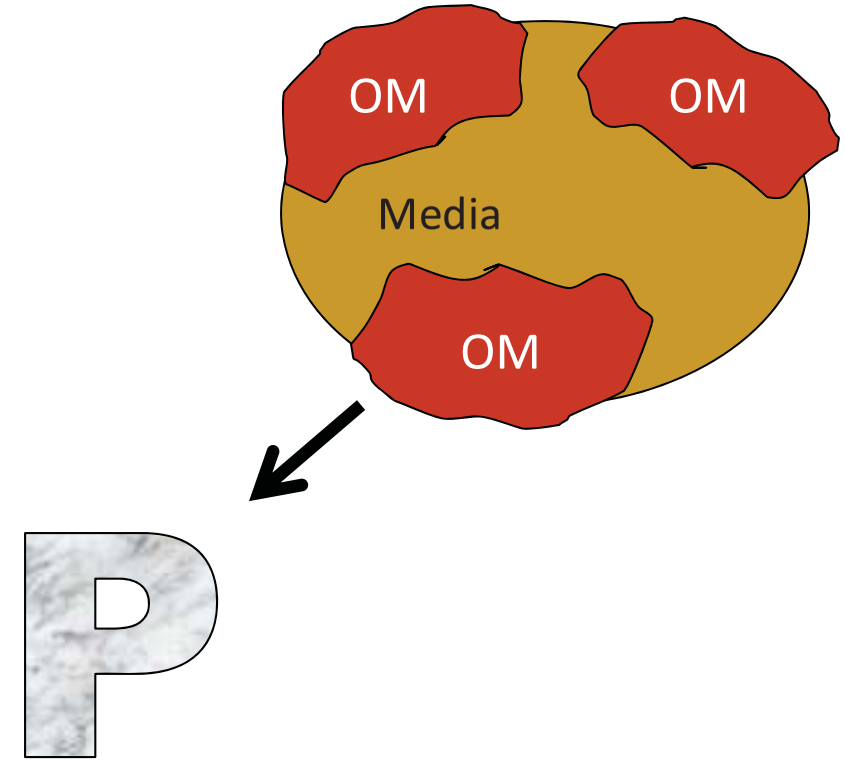
Filtration,
Adsorption,
Biodegradation

MEDIA: Sand, Soil, Organic Matter

Organic Matter in Media

Organic Matter may leach P

- **Compost**
- **Mulch**
- **Peat**
- **Other?**



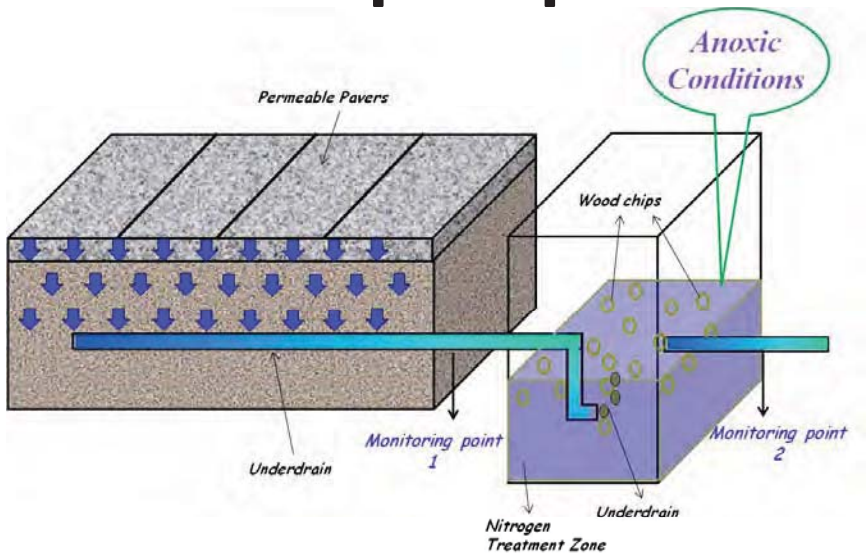
The Entire Research Project will Proceed in Three Phases

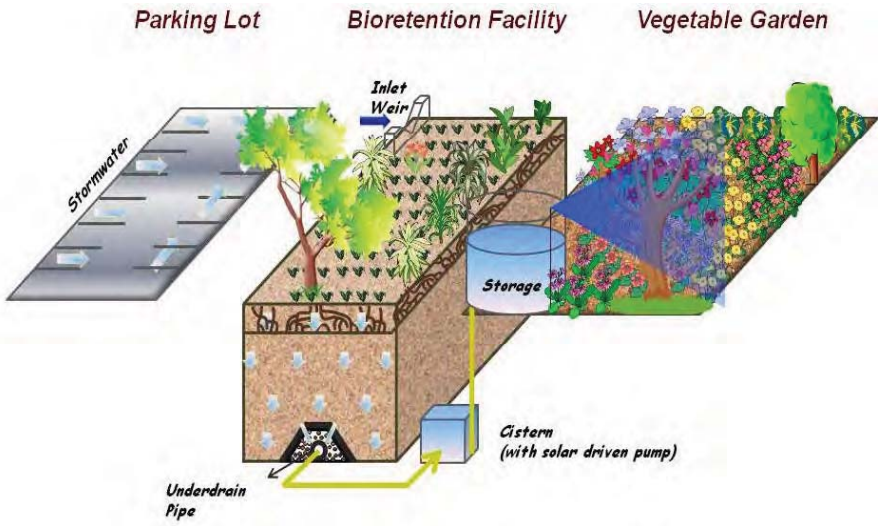
On-going NFWF Research Project Phase I

- Contract between the County and the University of Maryland
- Funded by the County and an EPA grant through the National Fish and Wildlife Foundation (NFWF) – 50/50
- Enhance Bioretention Phosphorus removal efficiency using recycling materials in media

Project Components

1. **Bioretention retrofit for enhanced phosphorus removal:** Monitoring stage
2. **Permeable pavers/ porous concrete parking area for enhanced nitrogen removal:** under construction
3. **Bioretention with a Sump Pump and Cistern to collect Treated Runoff Discharge:** Permit stage





Completed Laboratory Project

Total Input P to Columns over a 6 months period (~10 exp.): 111 mg

Output P from Traditional Bioretention Media: 190 mg

Output P from Amended Bioretention Media: 13 mg

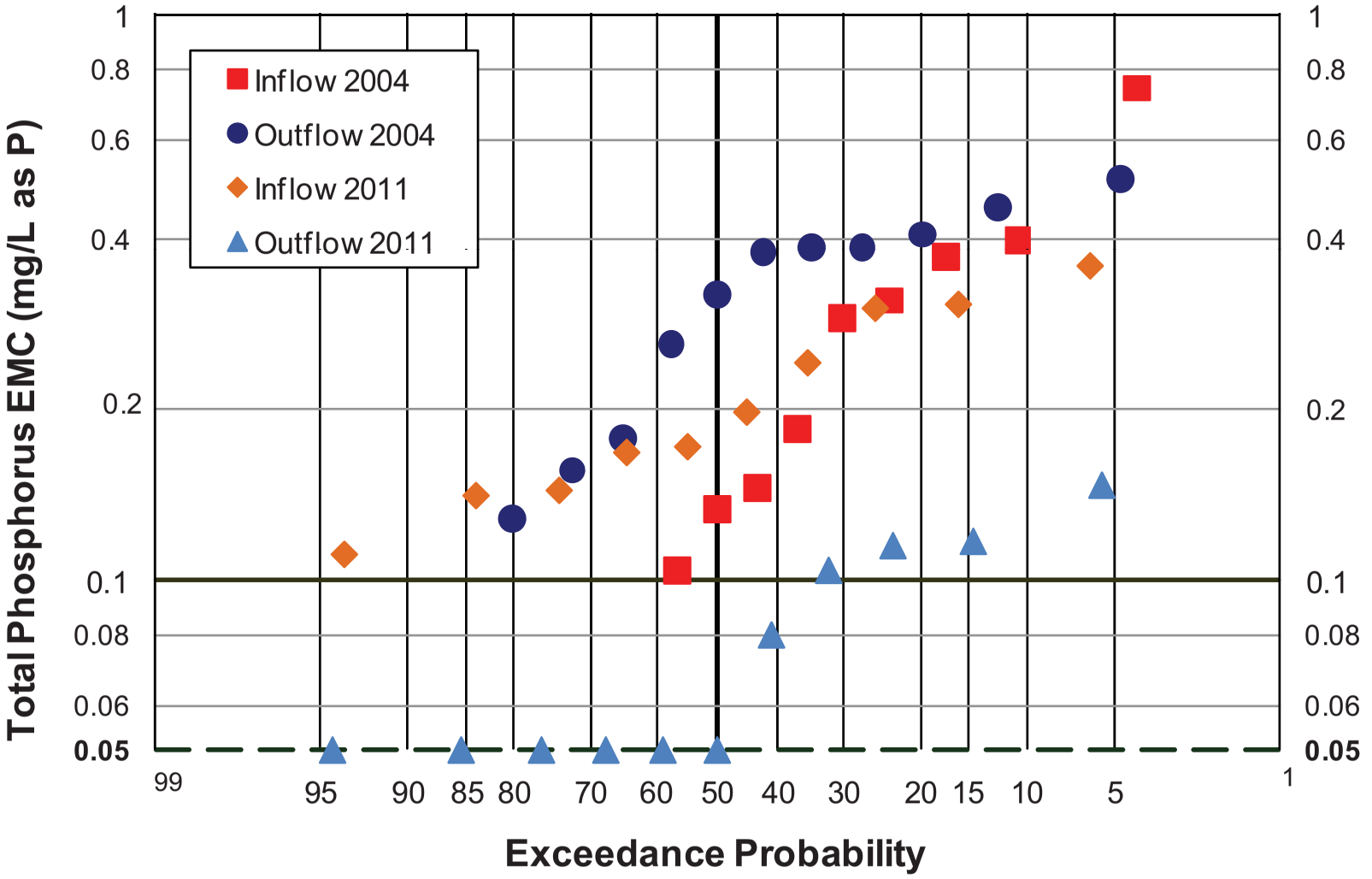
O'Neill & Davis, J. Env. Engg 2012

UMD Enhanced P Bioretention

Field Research Status

- Construction was completed in April 2011
- It has been in the full monitoring phase since May 2011
- Approximately 25 storm events have been Monitored to-date
- Monitoring data are being complied and Evaluated

Preliminary Results: Exceedance Probability for TP



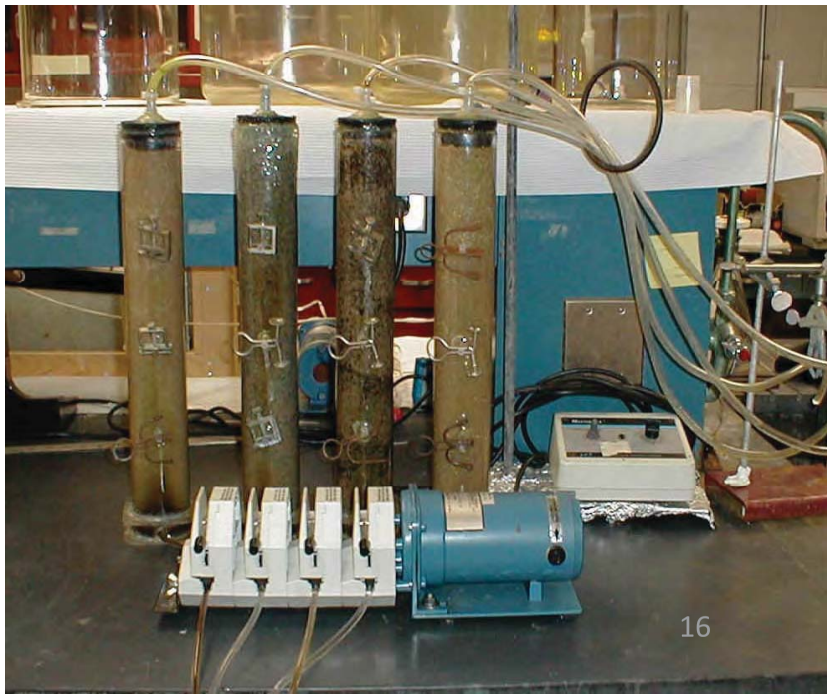
Liu, in progress; 2004 Data from Li & Davis, J. Env. Eng. 2009

This Research Result is *particularly* important to the County Because

TOTAL reductions—current to 2025	TN reduction	TP reduction
County impervious	45,992	8,593
Muni. impervious	10,914	2,053
Total impervious	**56,906**	**10,646**
County pervious	89,309	6,988
Muni. pervious	11,079	870
Total pervious	**100,388**	**7,859**
TOTAL LOAD REDUCTION (current to 2025)	**157,294 (88% of goal)**	**18,504 (57% of goal)**
Target (100% of load reduction goal)	**178,421**	**32,240**

Phase II, Phosphorus (P) Tasks

- Continue Phase I tasks to evaluate Al & Fe amendments on P uptake
- Find sources of Al & Fe amendments for use
- Optimize with flow rates and vegetation
- Field Studies



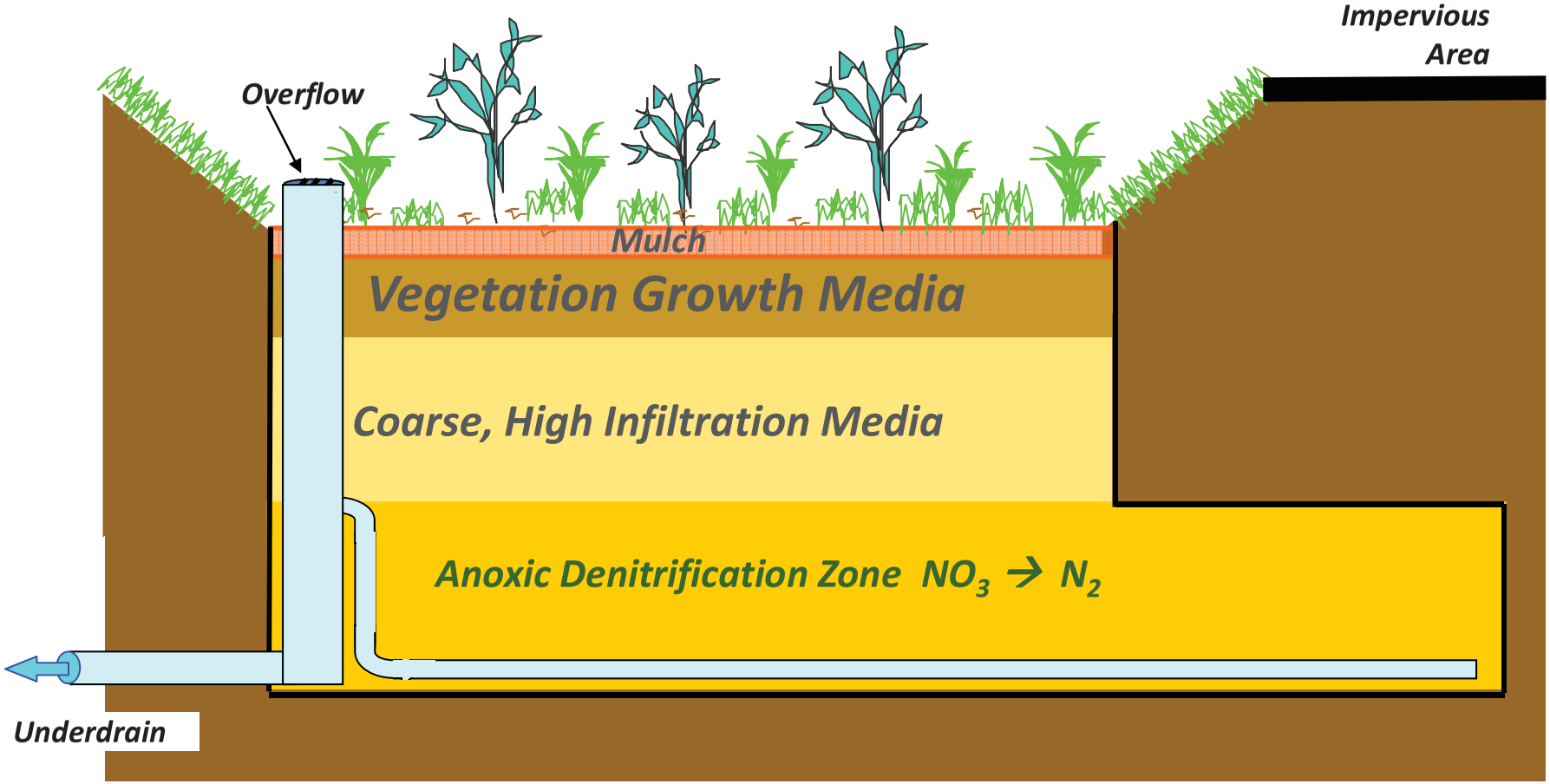
Phase II, Nitrogen (N) Tasks

- Evaluate media system for better TN removal efficiency
- Evaluate configurations for denitrification
- Evaluate media for denitrification
- Field Studies

Example Design Option:

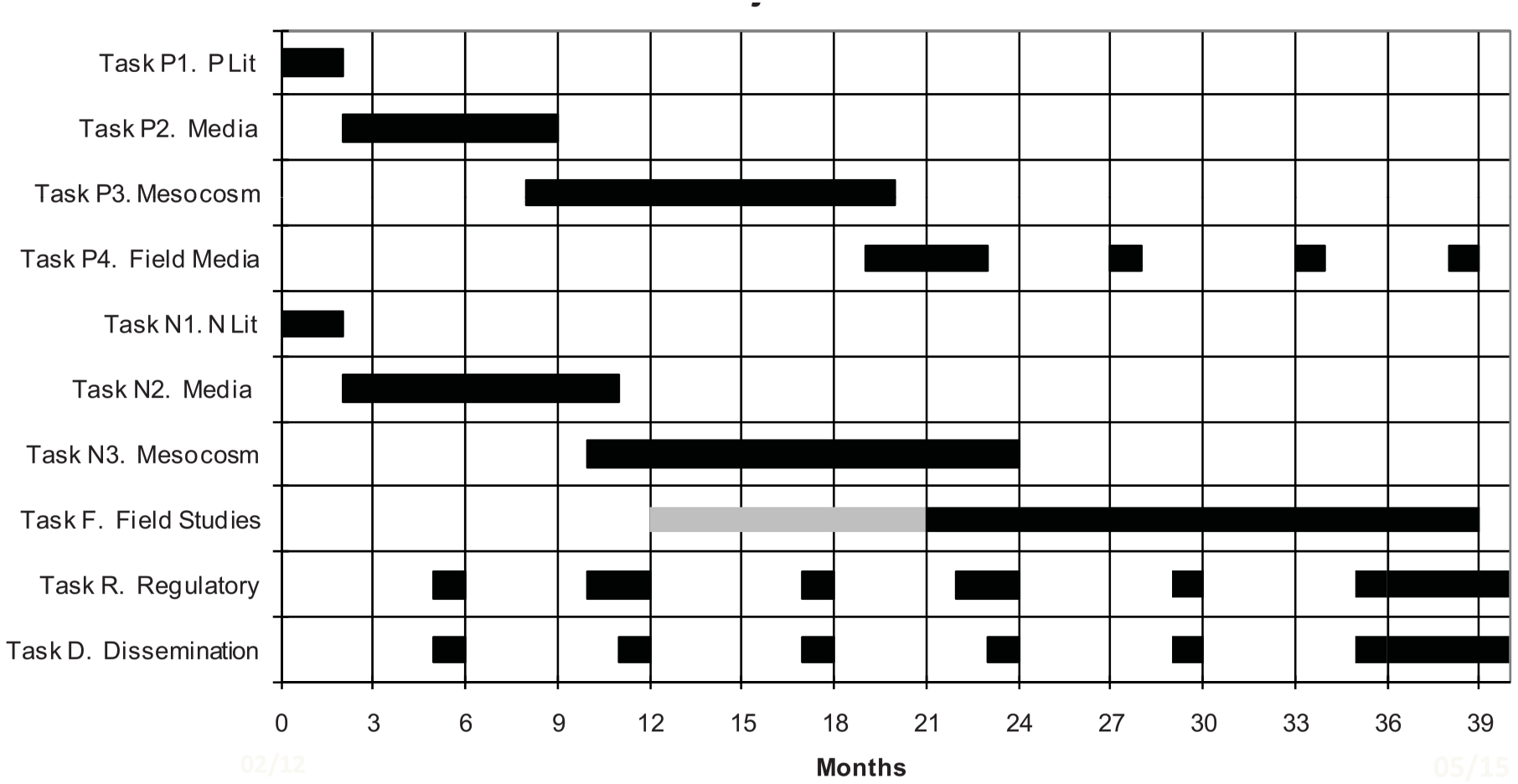
Layered Bioretention

With high infiltration media and deep denitrification



Kim , Seagran, Davis, Water Environ. Res. 2003

Project Schedule



Additional Research Works
Phase III

- More testing and Monitoring efforts
- Construct & monitor a field LID facility each in Prince George's County and Montgomery County in the Anacostia River watershed to incorporate the research recommendations.
- N & P Credits for leaf collection.
- Optimal Design with limit site spaces.

NFWF Grant Application

- **Partner with Montgomery County to submit a grant application package to NFWF for a total project of ~ $1,200,000 to cover both Phase II and Phase III efforts**
- **Need a support letter from the Anacostia Watershed Restoration Partnership**

Questions and Answers