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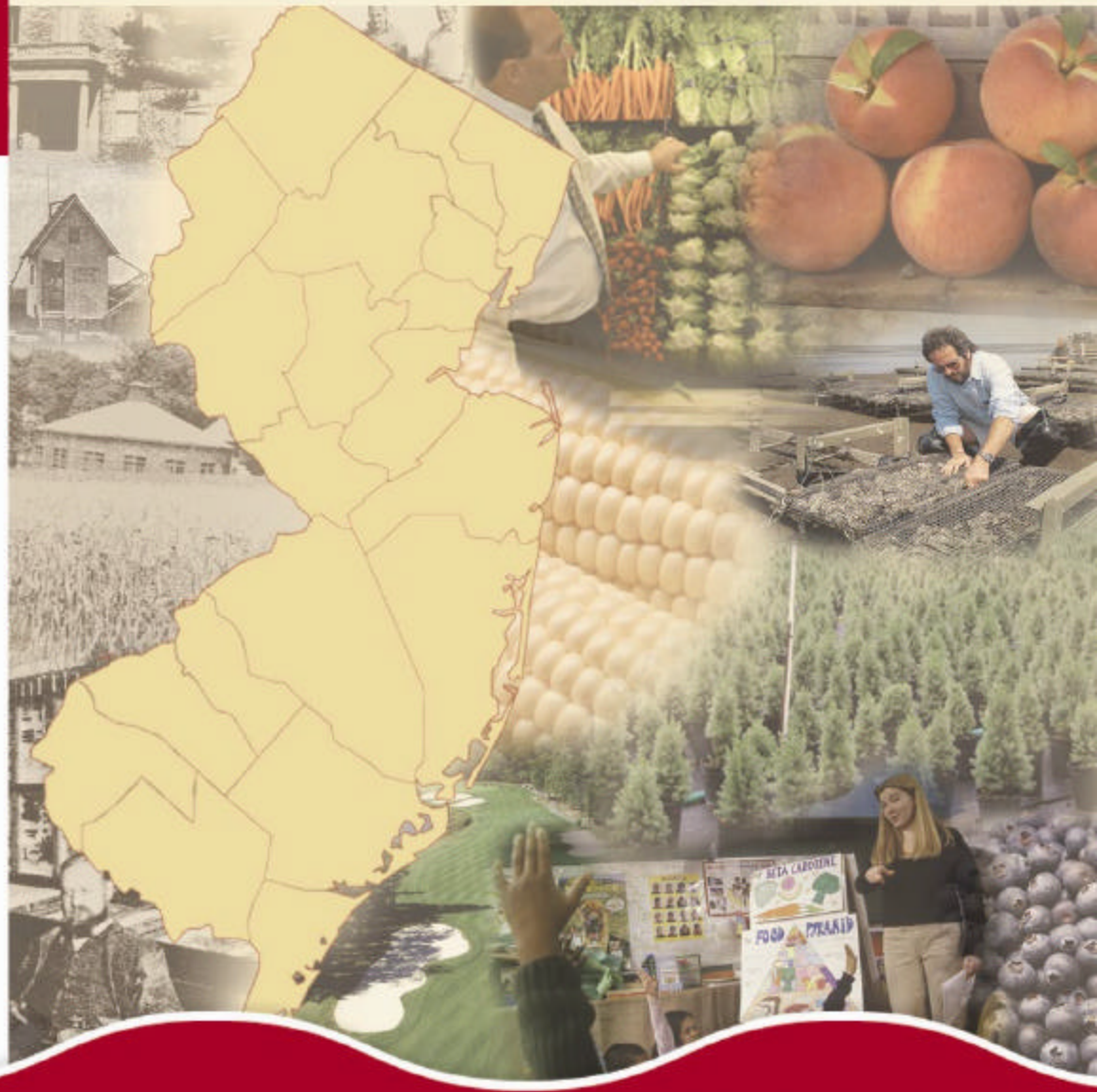

The Tailwater Recovery System as an Agricultural BMP – Improving Effectiveness and Other Lessons Learned

Presented by Katie Buckley
Rutgers Cooperative Research & Extension Water Resources Program

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Project Partners

- Rutgers Cooperative Research & Extension (RCRE) Water Resources Program
  - Katie Buckley, Program Associate
  - Christopher Obropta, Assistant Extension Specialist
- RCRE of Cumberland County
- Cumberland-Salem Soil Conservation District (SCD)
- Private Nursery Grower

Tailwater Recovery System Defined

- A planned irrigation system in which all facilities utilized for the collection, storage, and transportation of irrigation tailwater for reuse have been installed.
- Benefits of a tailwater recovery system:
  - conserve irrigation water supplies, especially in areas where groundwater supplies are overextended;
  - improve offsite water quality.

Tailwater Recovery System Defined (cont'd)

- Drawbacks:
  - Takes up space often in areas where production would continue.
  - Oil and gas are the source of energy to keep pumps operating.
  - Treatment of reuse water essential to keep disease from recycling through the crop. This can be a fine line, though, can be done.
  - May require maintenance.

Project Background

- **Nursery production is the fastest-growing agricultural industry in NJ**; NJ ranks 11th in the nation for number of nurseries.
- Our project lies within a 70-acre nursery production facility; < **20 acres runs off to the recovery pond**.
- Originally, the tailwater recovery system was built (to NRCS Design Standards) to save irrigation water due to increasing local irrigation demands.

Project Background (cont'd)

- Tailwater recovery system discharge was causing the instream water quality in the receiving waterbody to degrade (Chowdhury, 2004).
- The receiving waterbody, Harrow Run, is a tributary to the Cohansey River.
  - The Cohansey River is impaired for fecal coliform, phosphorus, and pH (NJDEP, 2004).
- The increase in instream total phosphorus resulted in a collaboration between the nursery grower, RCRE, and the SCD. It was decided that the tailwater system could discharge to a bioretention pond prior to discharge to stream.

Bioretention Pond Defined

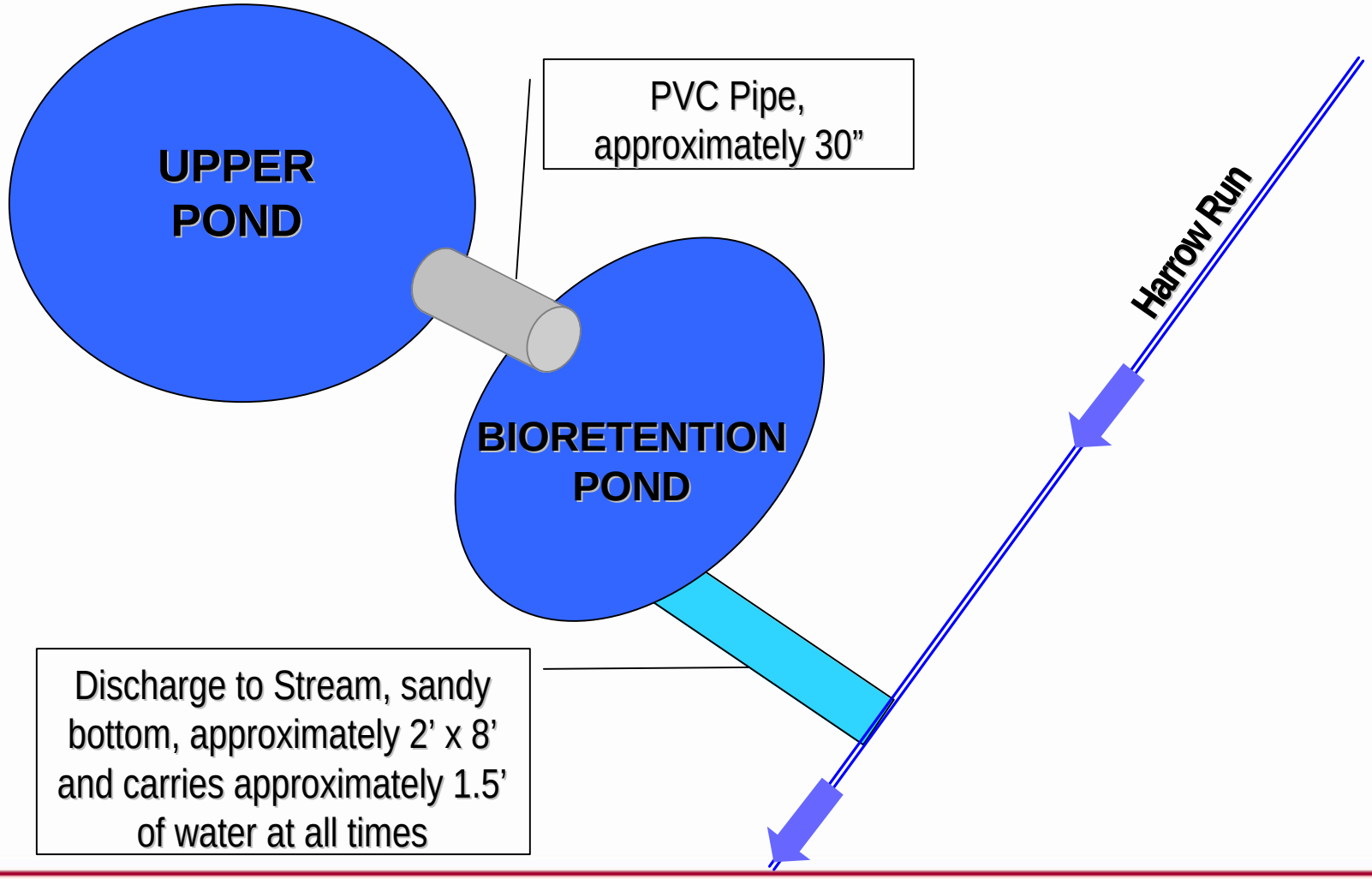
A "bioretention pond" is an engineered infiltration device providing physical, chemical, and biological treatment. This best management practice (BMP) may include pre-treatment area and flow regulation devices. The BMP is planted with diverse native materials.

The primary purpose of a bioretention facility is to enhance stormwater infiltration. Other important objectives include the removal of pollutants, reduction of peak flow runoff, preservation of base flow, and the reduction of thermal impacts, under certain scenarios.

This is the traditional definition and purpose.

- Bioretention pond area created is 7,500 sq. ft.
- Two plantings occurred, the first in November 2004 and second planting in June 2005.
- Monitoring began in March of 2005.

System Diagram



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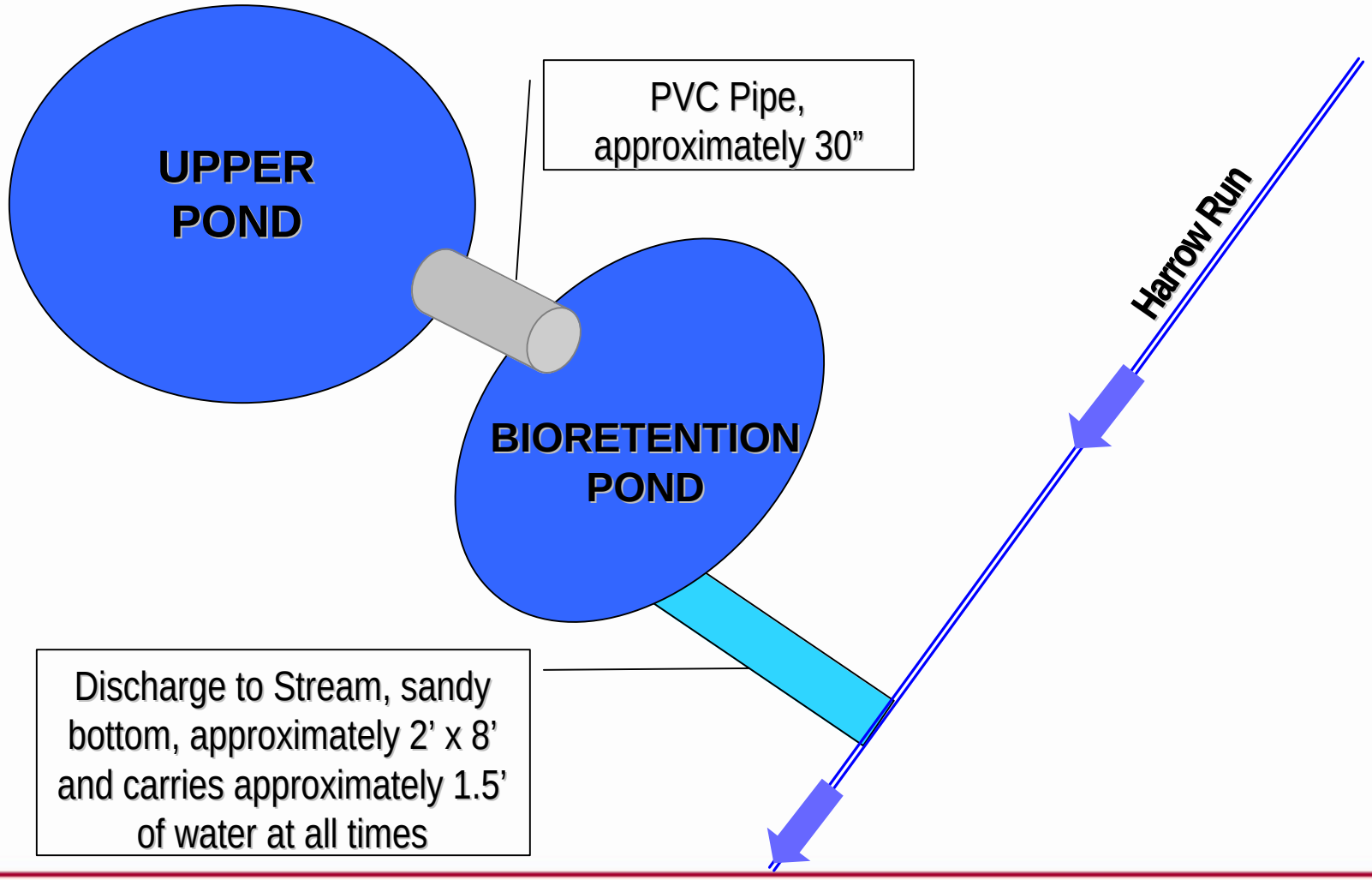

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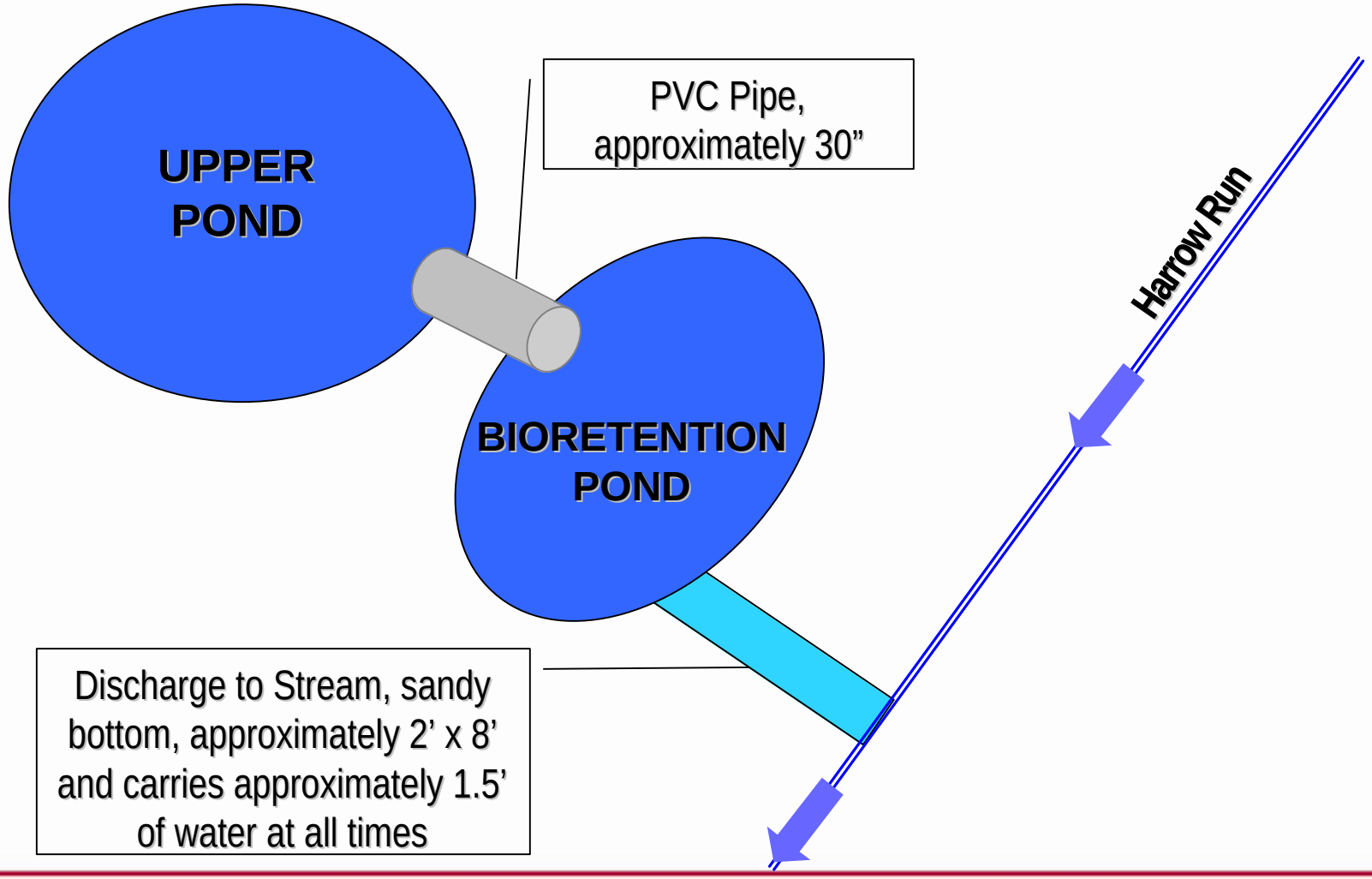

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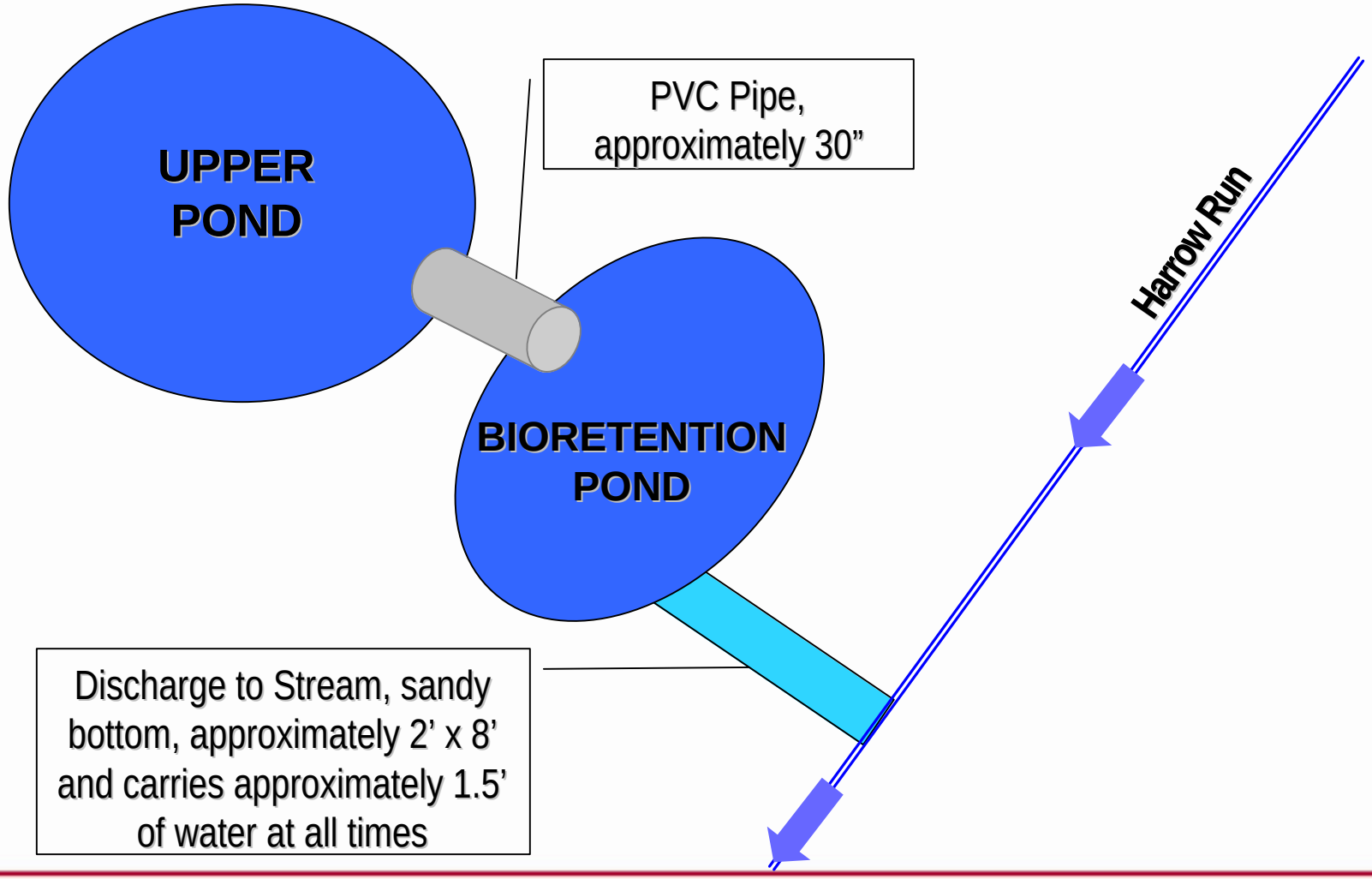

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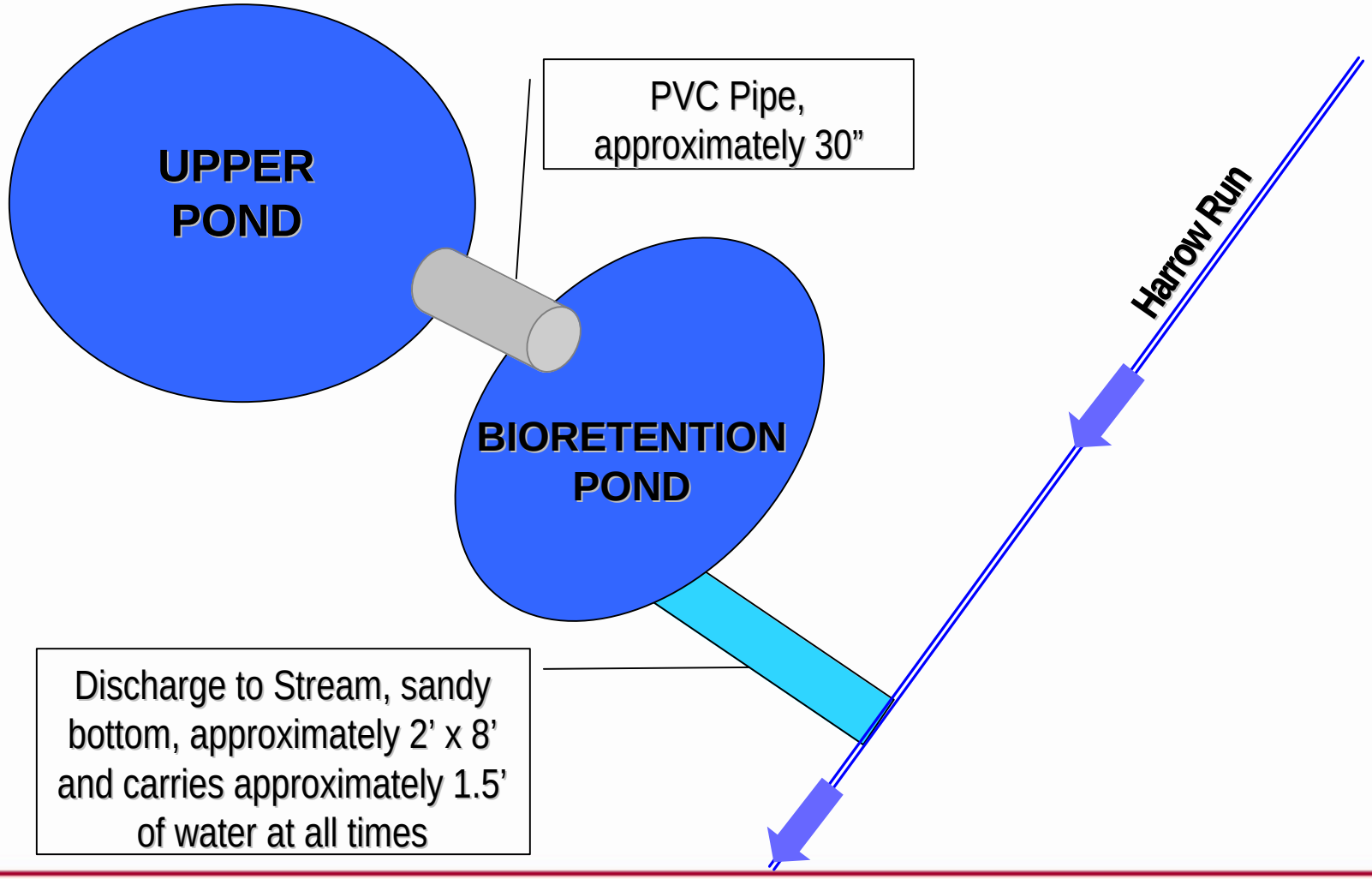


Settling Pond to Bioretention Pond

- Two plantings occurred with more than 5,000 native species installed (one plant per square foot).
- Hay was packed into mesh bags and hung across the pond for algae control.
- Erosion control matting used on banks.
- Native grass seed mix spread along shoreline, including fescues and ryegrass.

Native Plants Used

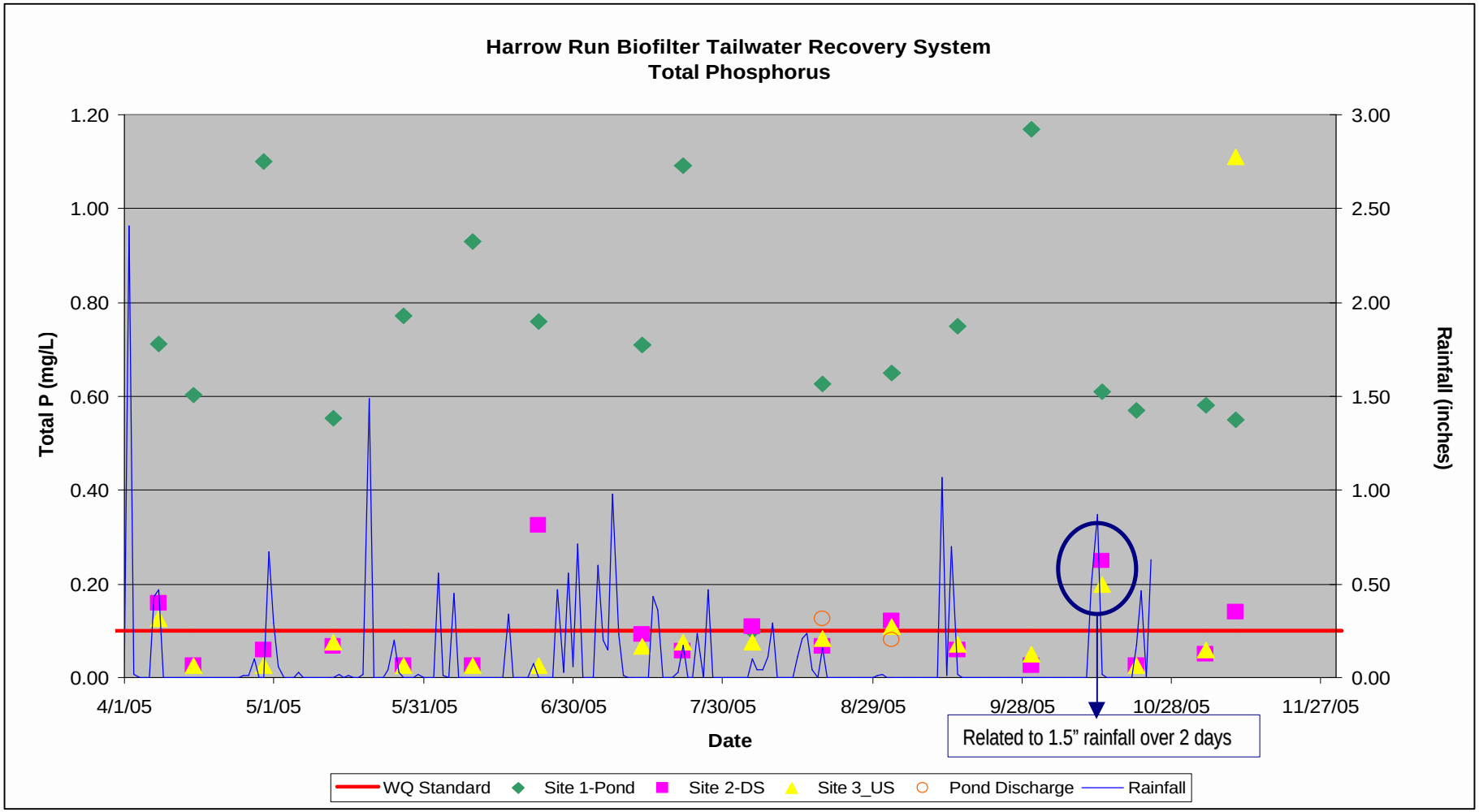
- Shrubs to improve bank stability and provide for shade over the lower pond:
  - Red-osier dogwood
  - Winterberry
- Submerged aquatic vegetation
  - Pond lily
  - Duck potato
  - Spatterdock
- Shoreline vegetation
  - Bur Reed and bulrush
  - Swamp Rose-Mallow (hibiscus)
  - Soft rush
  - Long hair sedge
  - Blue flag iris
  - Swamp milkweed
  - Cattails

The Sampling Program

- Bi-weekly sampling for a total of 1 year, independent of weather conditions; flow monitoring also conducted at each event
- 1 stormwater sample collected at each site per season
- In-situ temperature, pH, DO
- Phosphorus, total and dissolved
- Nitrate+Nitrite Nitrogen, Ammonia-Nitrogen, and TKN

Sampling Sites Chosen

Water Quality Results



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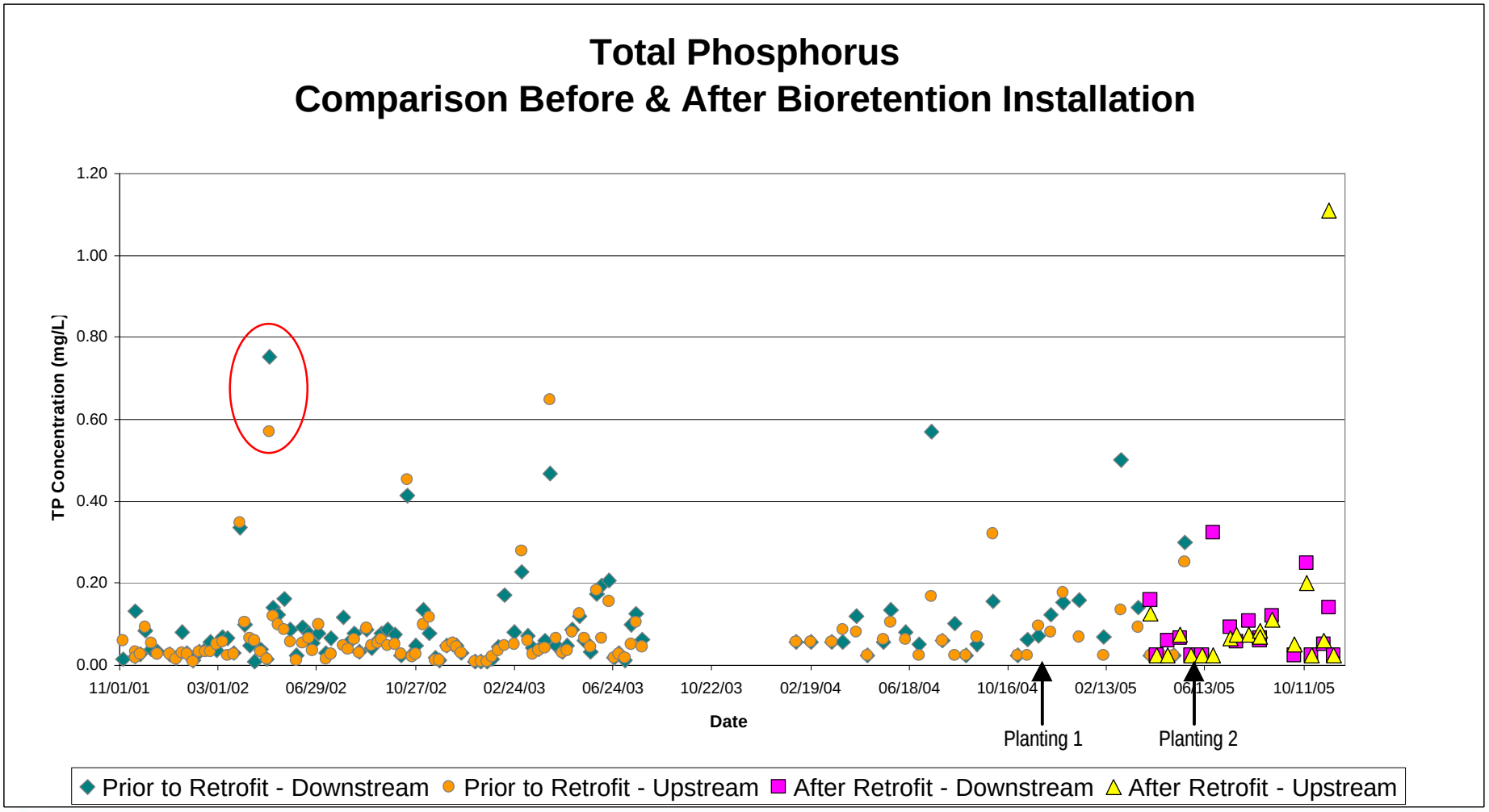
Water Quality Results (cont'd)

	Prior to Bioretention		After Bioretention	
	Upstream	***Downstream***	***Upstream***	***Downstream***
Years of Data Collection	2001-2005	2001-2005	2005	2005
Number of Samples	118	118	19	19
Minimum TP (mg/L)	0.008	0.008	0.025	0.025
Maximum TP (mg/L)	0.649	0.752	1.110	0.325
Mean TP (mg/L)	0.074	0.091	0.120	0.090

- Upstream TP concentrations have increased in recent years (+0.046 mg/L).
- Prior to bioretention installation, mean TP concentration **increased** downstream from upstream by 0.016 mg/L.
- After installation, mean TP concentration **decreased** by 0.030 mg/L.

Water Quality Results (cont'd)



What degree of pollution control does the BMP provide?

- Change in TP concentration upstream of system to downstream of discharge showed a **95% significance before and after the installation of the bioretention facility**.
- **TP load (lbs/ac/yr) decreases by 25%** as measured at the downstream location.
- The tailwater recovery system has continued to be used, **saving the nursery grower 7 million gallons** of water last year.

Lessons Learned

- Some factors have limited plant growth:
  - Extreme algae production
  - Extremes in pH (cattails were used for their tolerance in low pH waters)
- Wildlife: the muskrat
- The Harrow Run is a stream that is continuing to meander and evolve within its forested floodplain, and therefore, TSS is very high under background conditions.

Lessons Learned by Other Tailwater Users in NJ

- A constantly recirculating pond will have no algae issues (even over a 6-year period).
- Replenishment with groundwater during the day and into the night, keeps ponds clean and plentiful for next day's use.
  - Self-flushing sediment filters will decrease maintenance which would normally occur 1x per month.
- Maintenance and costs are minimal considerations when lack of available water supply limits nursery growth.

Lessons Learned by Other Tailwater Users in NJ (cont'd)

- Regular practice includes chlorinating reuse water prior to irrigation.
- Nursery growers reusing up to 100 million gallons per year, at a 50% reuse rate.
- A weir should be properly winged with riprap to prevent erosion of sediment alongside the grassed area of the pond.

Project Costs

- 60 samples analyzed for the parameters previously mentioned cost $4,600.
- Wetland plants cost $5,000.
- $4,500 for personnel, though much more time was spent on this project than originally anticipated.
- Tools were mostly available from previous restoration efforts.
- Students involved in the planting were paid hourly.

Contact Information

Katie Buckley

Program Associate

kbuckley@envsci.rutgers.edu

Tel: (732) 932-9011

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