

Watershed Management and Modeling as Tools in the Restoration of Pearly Pond, Rindge NH

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Pearly Pond Management Planning Project



Funded by NHDES Watershed
Assistance Program

Matching provided by:

- Franklin Pierce
- Pearly Pond Assocn
- Town of Rindge

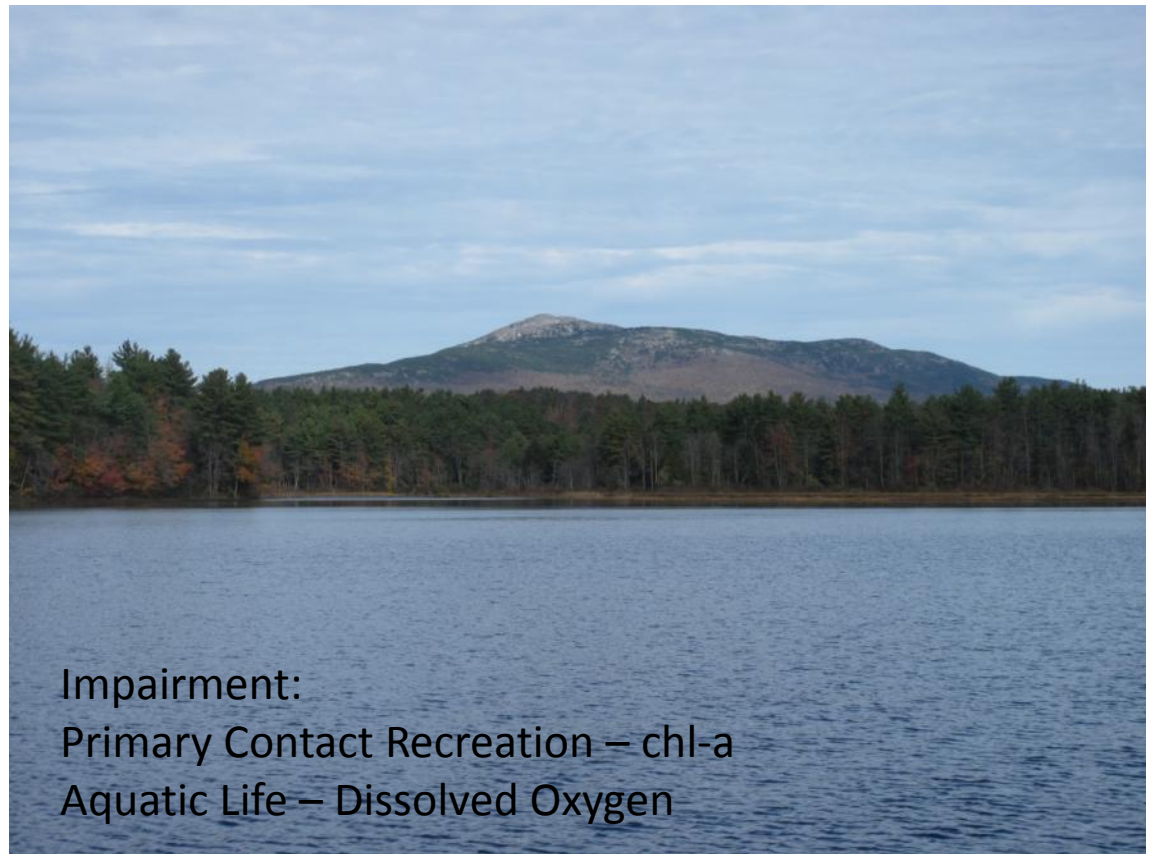
Technical Assistance:

- Comprehensive
Environmental, Inc.

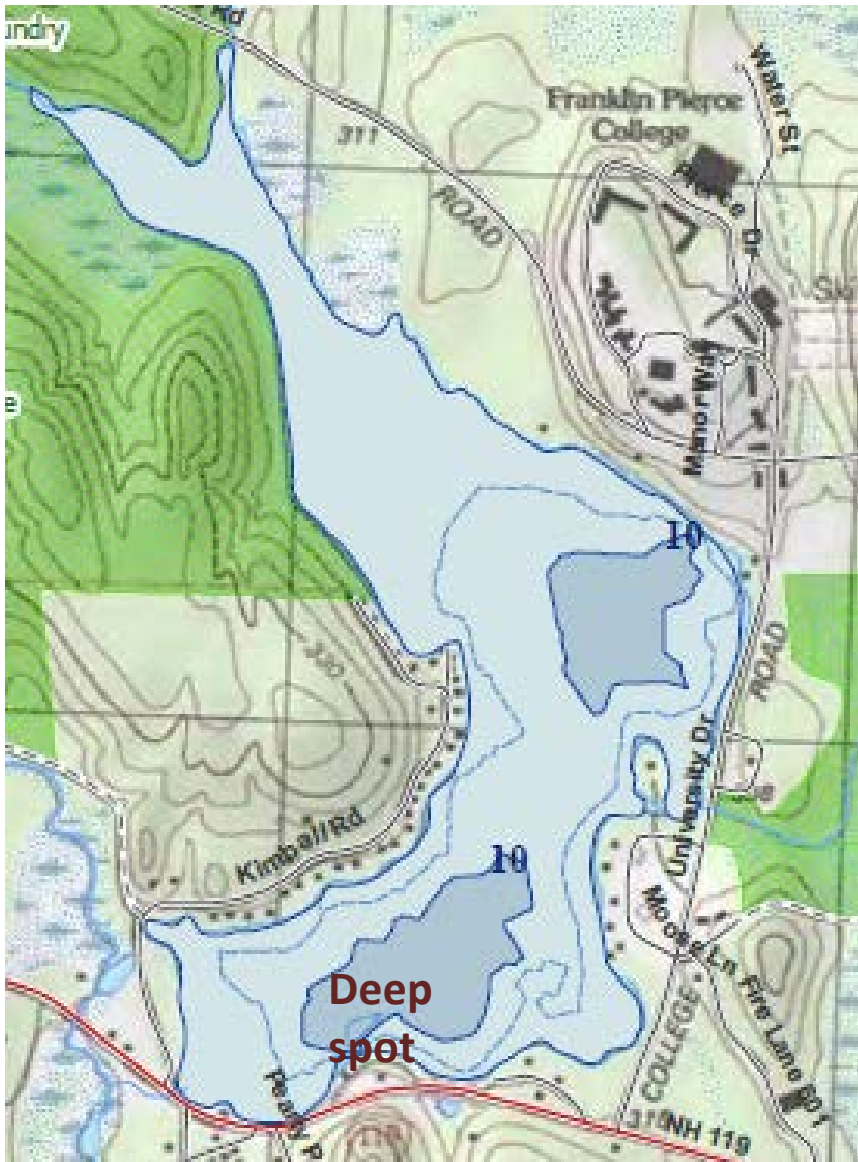


Project Overview

Pearly Pond, Rindge NH

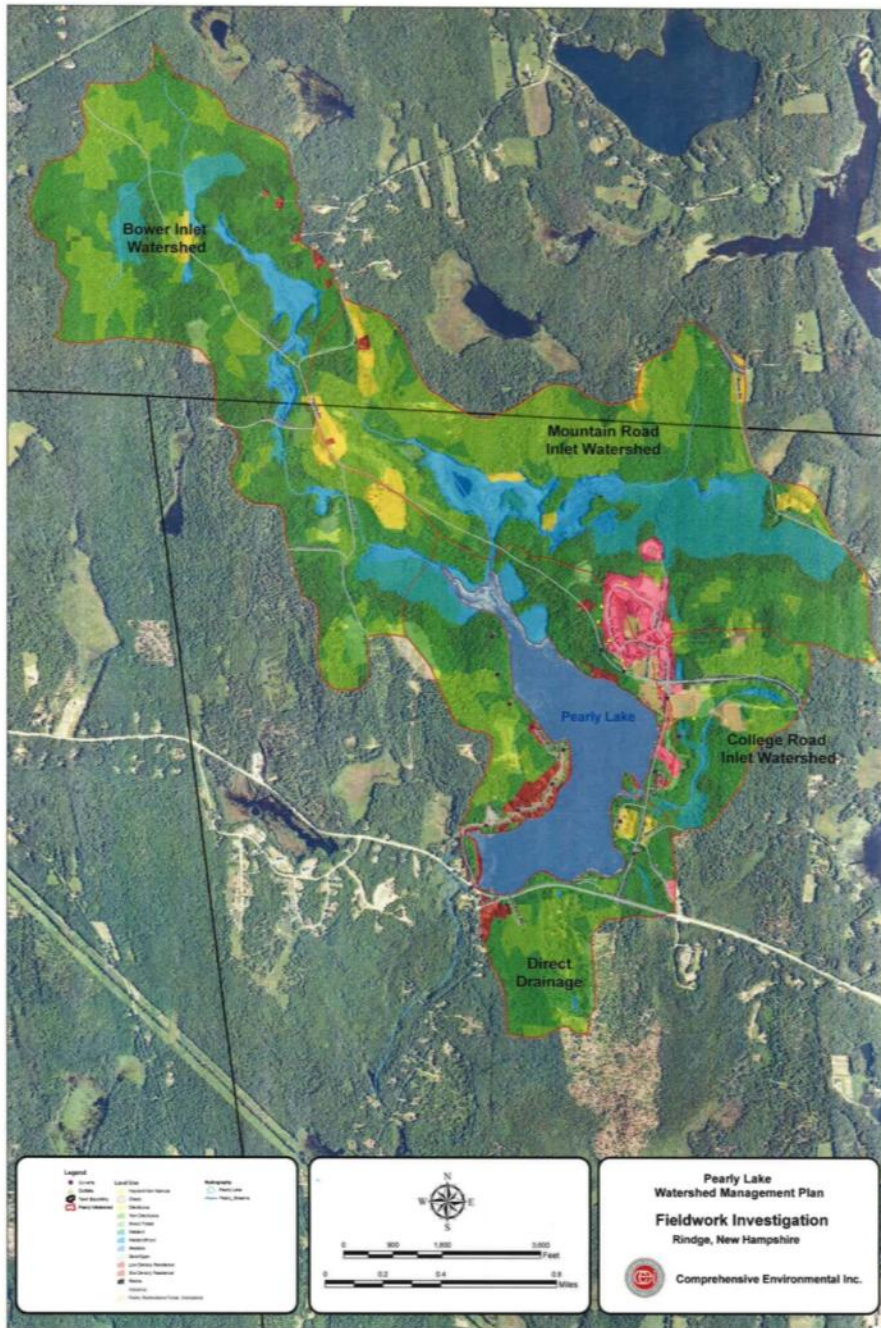


Impairment:
Primary Contact Recreation – chl-a
Aquatic Life – Dissolved Oxygen



Pearly Pond

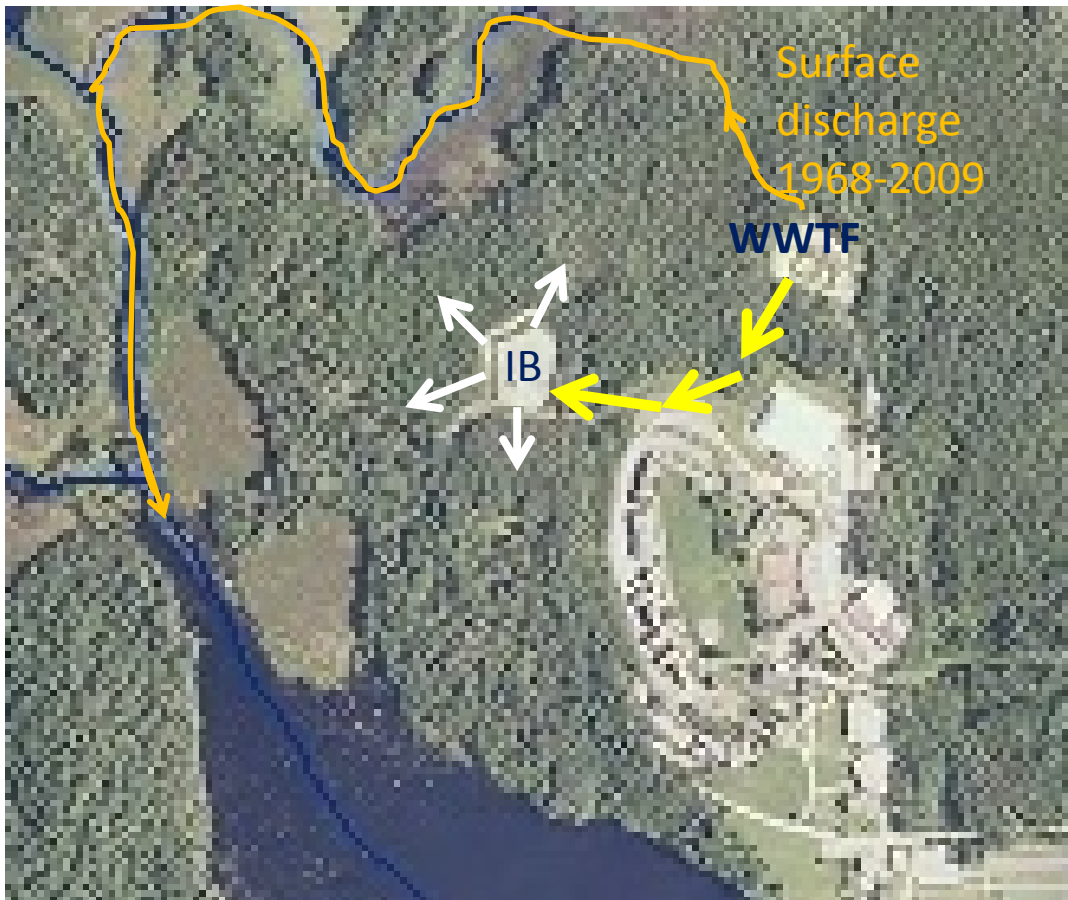
- 191 acres (78 ha)
- Shallow: 1.6 m avg
3.4 m deepest
- Flushing rate: 4.7x/yr
- Warm water fishery
- Invasive variable milfoil



Watershed

- 2126 acres (861 ha)
- Little development:
 - Franklin Pierce
 - 53 residences
- Major nutrient sources:
 - Past: FPU WWTF
 - Septic systems
 - Runoff
 - Geese

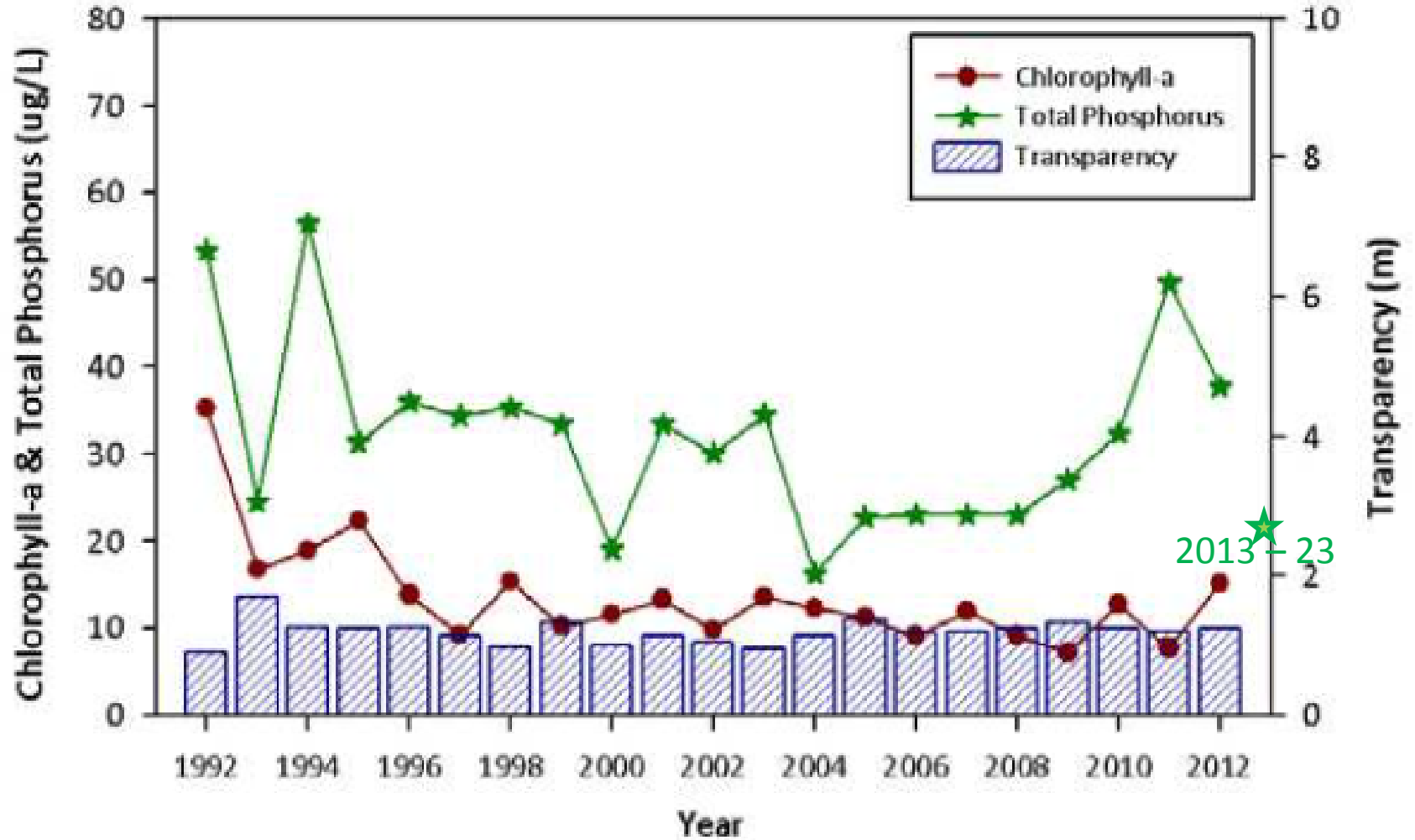
Wastewater treatment Facility (WWTF)



IB=Infiltration beds



Historical Deep Spot Chlorophyll-a, Epilimnetic Total Phosphorus & Transparency Data



Project Goals

1. Reduce phosphorus levels to the level that would eliminate harmful algae blooms
2. Use model to identify sources, possible solutions
3. Work with stakeholders to write management plan



Where is the P coming from?



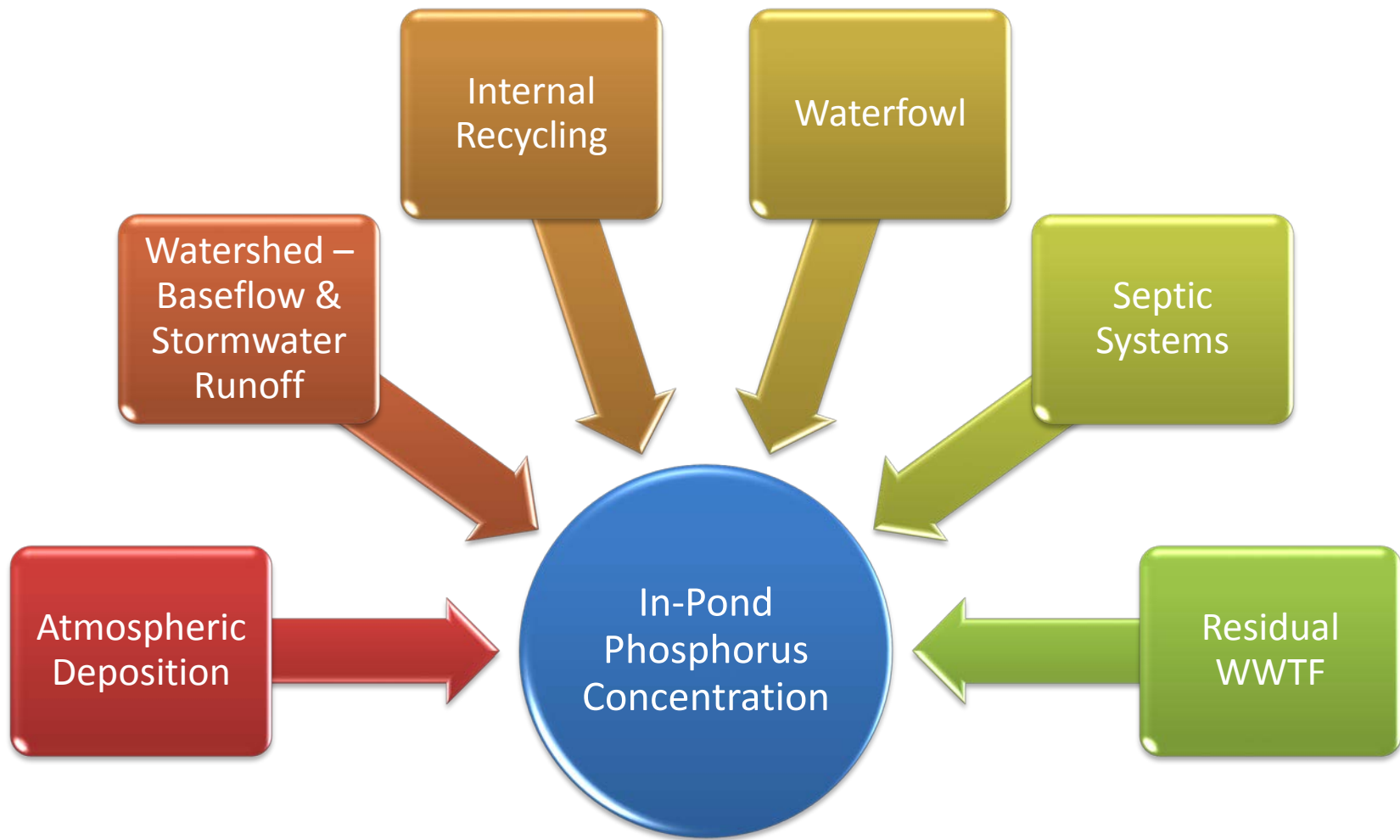
I didn't do
it!
I was
FRAMED!

Model Overview

- ENSR-LRM Model – Land-use export coefficient model
- Land use, septic system data collected via surveys, ground-truthing, landowner contact
- Inputs predict phosphorus load, water load, and phosphorus concentrations in streams and pond
- Calibrated to 2009-2014 water quality data
- 2009 marks end of WWTF discharge to wetlands – redirected to rapid infiltration basins (RIBs)



Model Overview



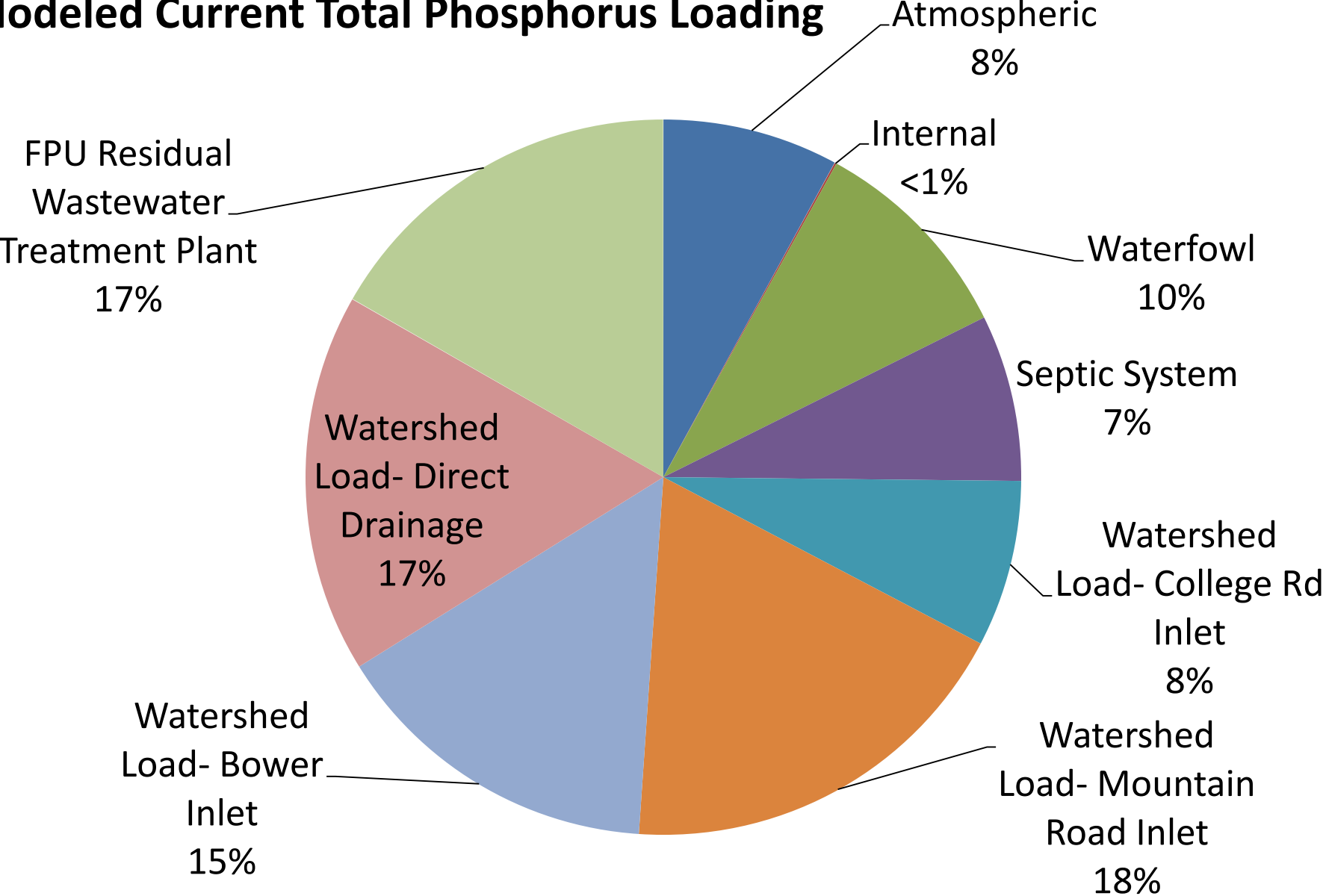
Model Results

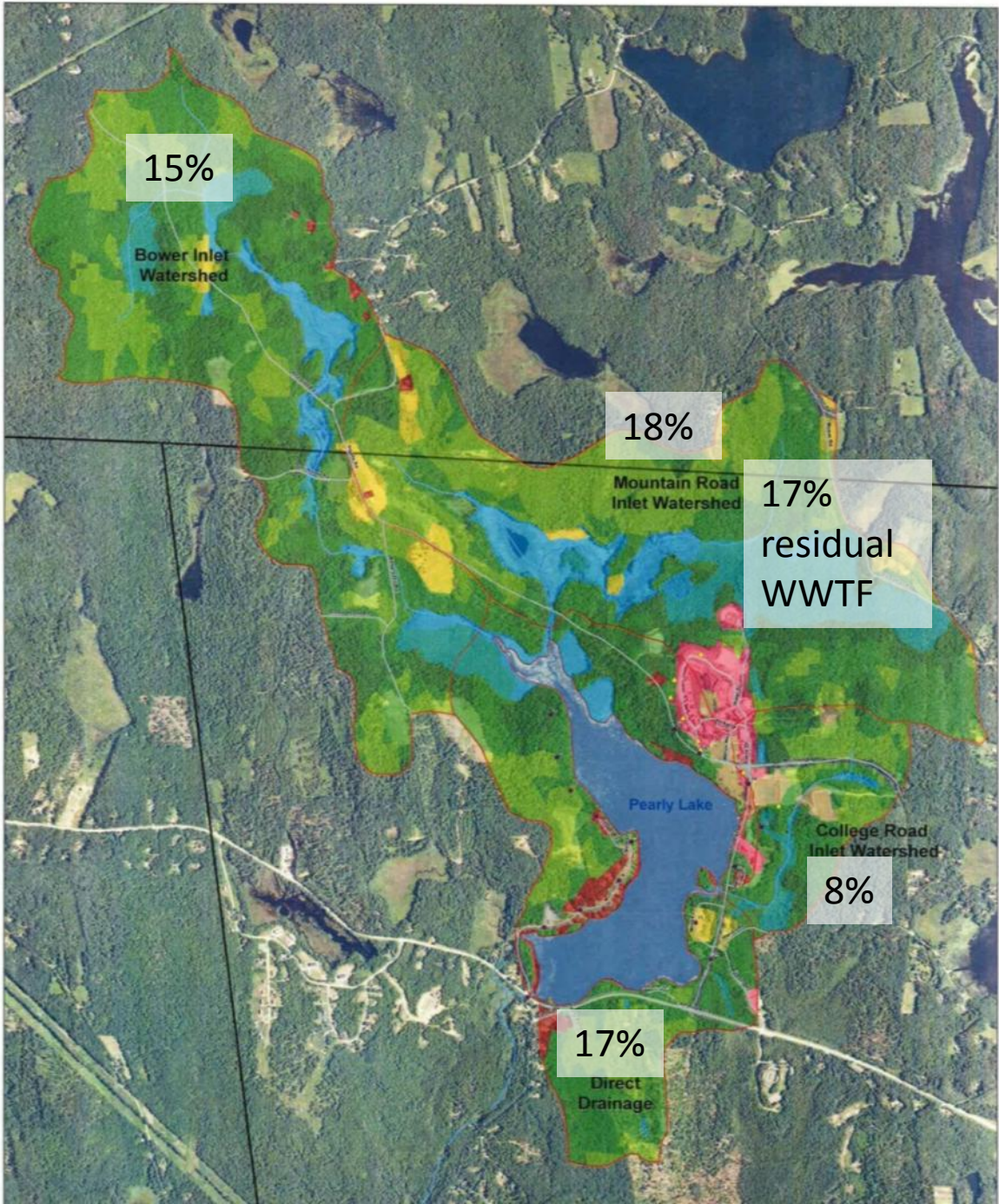
Unique to Pearly Pond

- WQ indicates high background phosphorus in baseflow
- Residual phosphorus load from historic WWTF discharge to wetlands
- Stormwater surface runoff and NPS pollution contributes 40-50% of the total phosphorus load



Modeled Current Total Phosphorus Loading





15%

Bower Inlet Watershed

18%

Mountain Road Inlet Watershed

17% residual WWTF

College Road Inlet Watershed

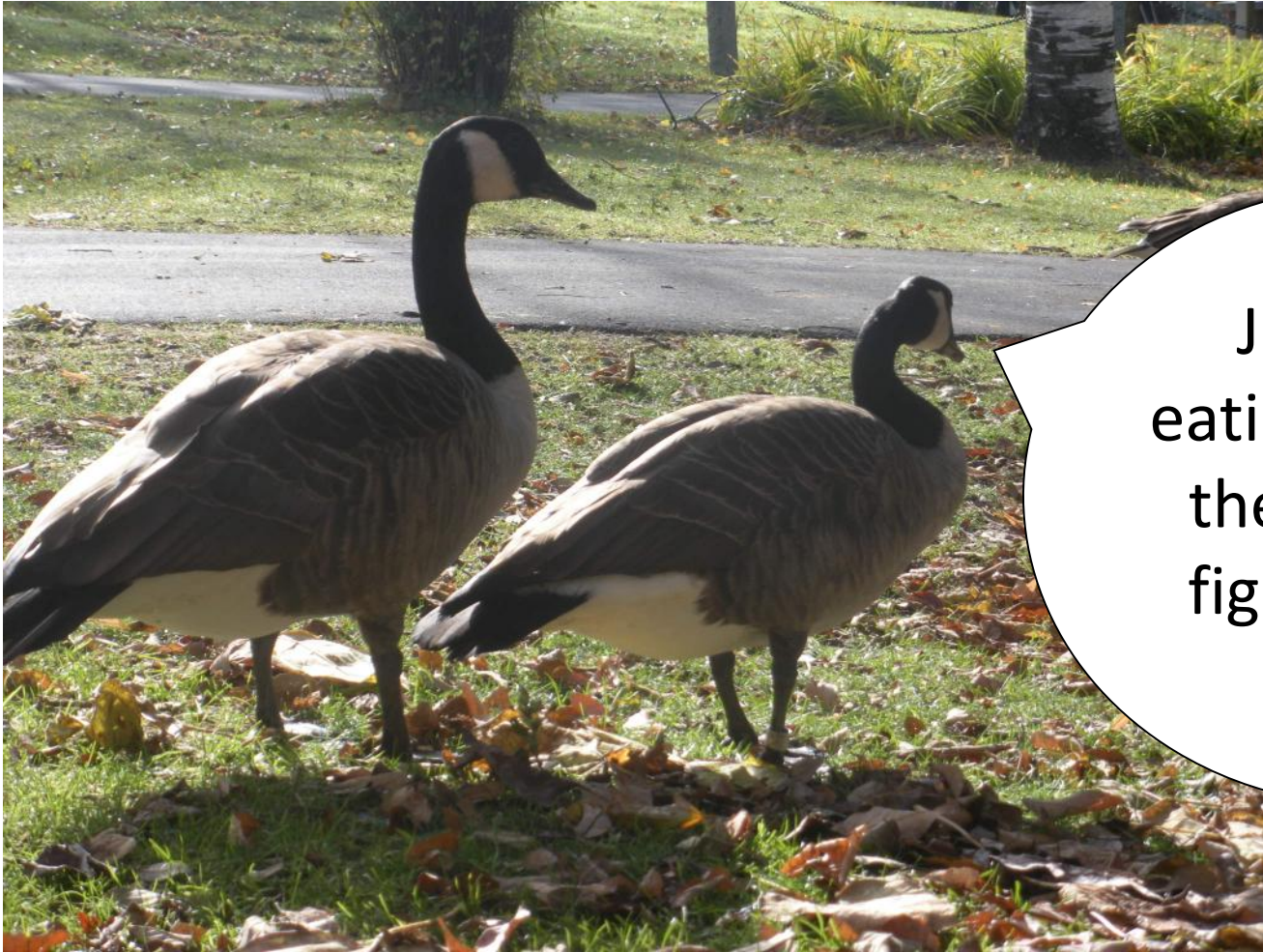
8%

17%

Direct Drainage

Pearly Lake

What should we do?



Just keep eating, Marvin, they'll never figure it out!

Potential Restoration Steps

- Non-structural BMPs
 - Ordinance review & updates
 - Shoreline survey & public education
 - Reduce phosphorus loads by adjusting behaviors within the watershed and along shoreline of the lake



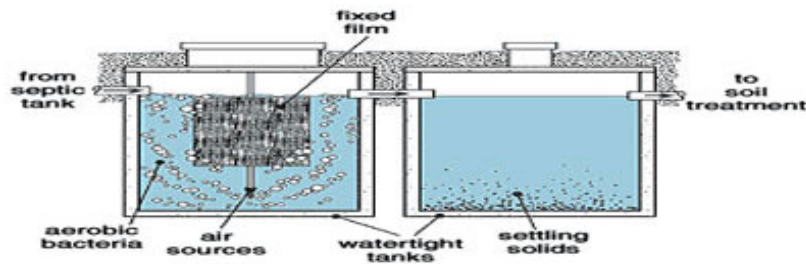
Potential Restoration Steps

- Structural BMPs
 - Wastewater Improvements (3-5%)
 - Wetland Improvements (12-14%)
 - Stormwater BMPs (45-50%)



Wastewater Improvements

- Reduce septic inputs to lake (sewering \$\$\$)
- Reduced flows – reduce I&I and water consumption
- Nutrient source reduction
- Increase storage and minimize shock loading
- Increase phosphorus removal and retention time at plant
 - Chemical / biological additives
 - RBC function (run in series)
- Improve the function of the RIBs
 - Rotation of bed loading & contact time
 - Bind phosphorus (iron enhancement)

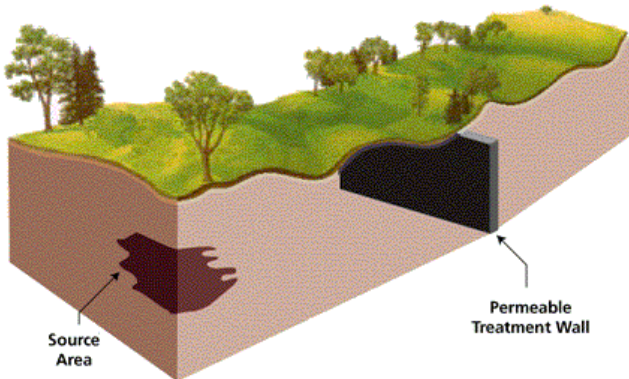


SEQUENCING BATCH REACTORS



Wetland Improvements

- Wetland Restoration
 - Dredge
 - Harvest & re-vegetate
- Chemical Treatment / Phosphorus Binding
- Floating Treatment Wetlands
- Reactive Barrier Walls



Treatment Islands



Mechanical Methods

Stormwater BMP Evaluation

Field Work Plan & Site Selection

- 1) Visited all Roadway Crossings with Tributaries
- 2) Reviewed Roadways and Drainage
- 3) Visited Sites with watershed residents and Steering Committee
- 4) Investigated FPU Campus Drainage



Stormwater BMP Evaluation

Field Work Plan & BMP Rational

Evaluated the Sites for a number of factors and identified potential Best Management Practices (BMPs):

Site Matrix & Field Notes

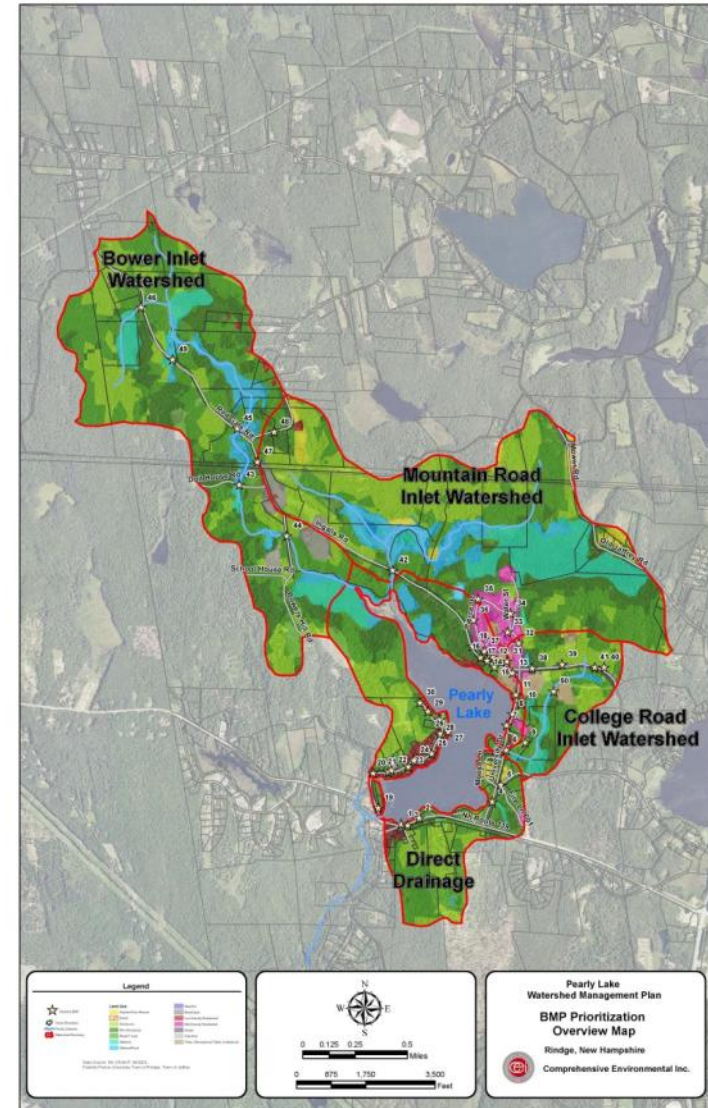
Site Location & Type
 Apparent Issues
 Pollutant Sources
 Potential Impacts
 Site Constraints
 Property Owner
 Accessibility
 Potential BMPs
 Maintenance

Potential Type of BMP	Accessibility	Sediment Accumulation	Deposits	Drainage Structural or Culvert Condition	Erodibility	Vegetation	Direct Runoff to Waterbody	Proximity to Waterbody	Constraints
<input type="checkbox"/> Bioretention Area <input type="checkbox"/> Plunge Pool <input type="checkbox"/> Treatment Swale <input type="checkbox"/> Infiltration Trench / Basin <input type="checkbox"/> Wet Pond / Constructed Wetlands <input type="checkbox"/> Filter Strip <input type="checkbox"/> Leaching Cbs / Sub-Chambers	<input type="checkbox"/> Easy <input type="checkbox"/> Moderate <input type="checkbox"/> Difficult	<input type="checkbox"/> None <input type="checkbox"/> Slight build up <input type="checkbox"/> Heavy build up Approx. Depth _____ Inches	<input type="checkbox"/> None <input type="checkbox"/> Grease/Oil <input type="checkbox"/> Grass Clippings <input type="checkbox"/> Compost <input type="checkbox"/> Trash/Debris <input type="checkbox"/> Algae/ Blooms <input type="checkbox"/> Other*	Circle One or both: Drainage Structure / Pipe <input type="checkbox"/> N/A <input type="checkbox"/> Good <input type="checkbox"/> Corroded <input type="checkbox"/> Cracked <input type="checkbox"/> Exposed Steel <input type="checkbox"/> Other*	<input type="checkbox"/> N/A <input type="checkbox"/> None <input type="checkbox"/> Channeling <input type="checkbox"/> Depressions <input type="checkbox"/> Bank Erosion <input type="checkbox"/> Displaced Riprap <input type="checkbox"/> Other*	<input type="checkbox"/> N/A <input type="checkbox"/> No Distress <input type="checkbox"/> Distressed <input type="checkbox"/> Sparse <input type="checkbox"/> Undesirable Woody <input type="checkbox"/> Invasive Plants	<input type="checkbox"/> None <input type="checkbox"/> At Crossing <input type="checkbox"/> Overland Flow <input type="checkbox"/> Drainage Outfall	Approx. Distance: _____ Feet Name of Waterbody: _____	Available Space: <input type="checkbox"/> Yes <input type="checkbox"/> No Slope: <input type="checkbox"/> Slight <input type="checkbox"/> Moderate <input type="checkbox"/> Steep Obstructions: <input type="checkbox"/> Trees <input type="checkbox"/> Boulders <input type="checkbox"/> Other*
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Stormwater BMP Evaluation

Findings

- **100** Areas of concern and
- **50** Potential BMP sites identified:
 - ✓ **11** Roadway / Stream Crossing Sites
 - ✓ **22** Roadway Drainage Sites
 - ✓ **4** Lake Front Sites
 - ✓ **10** Parking Lot Sites
 - ✓ **3** Individual Property Sites



Stormwater BMP Evaluation

Potential BMP Sites – Roadway Drainage



Paved Roads



Gravel Roads



Stormwater BMP Evaluation

Potential BMP Sites – Minimal buffers along Lake Front



Rt 119 – State Highway



University Drive

Stormwater BMP Evaluation

Potential BMP Sites – Parking Lots



Stormwater BMP Evaluation

Potential BMP Sites – Culverts & Stream restoration



Bank Erosion



Drainage at Culvert Crossings



Stormwater BMP Evaluation

Potential BMP Sites – Erosion Repairs



At Drainage Outfalls



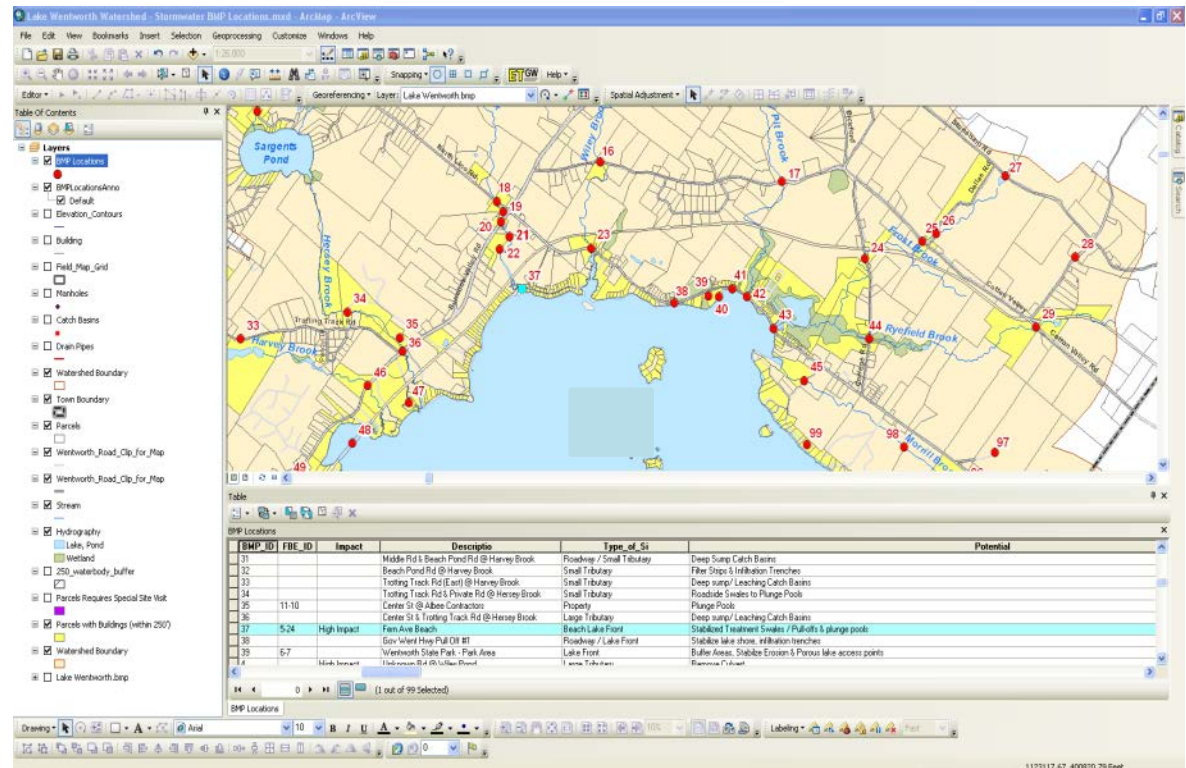
Along Shoreline

Stormwater BMP Evaluation

Two Tiered Ranking Process:

The intent is to use preliminary model results to prioritize hot spots and then rank those sites based on a more refined cost and pollutant removal estimate.

- 1st round ranked 50 sites down to the top 30
- 2nd round ranked the top 30 sites down to the final 4-6 BMP Sites.



Stormwater BMP Evaluation

1st Ranking Process

– General Criteria to Identify Potential Impacts & Feasibility

- Size & Type of Impairment
- Surrounding Land Use
- Proximity to the Waterbody
- Site Constraints (access, land ownership, ledge, high GW, etc.)
- Permitting Concerns
- Ease of Construction / Maintenance

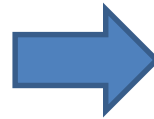


Stormwater BMP Evaluation

2nd Ranking Process:

Ranking Criteria (top 30 sites):

- BMP Drainage Area
- Percent Impervious
- Land Use Types
- Pollutant Removal
- BMP Cost
- BMP Maintenance Cost



\$ per pound of
pollutant
removed

On average over a 10 year period
~ \$2,500 - \$5,000 per pound



**Selected BMPs = Most
Cost Effective**

Stormwater BMP Improvements

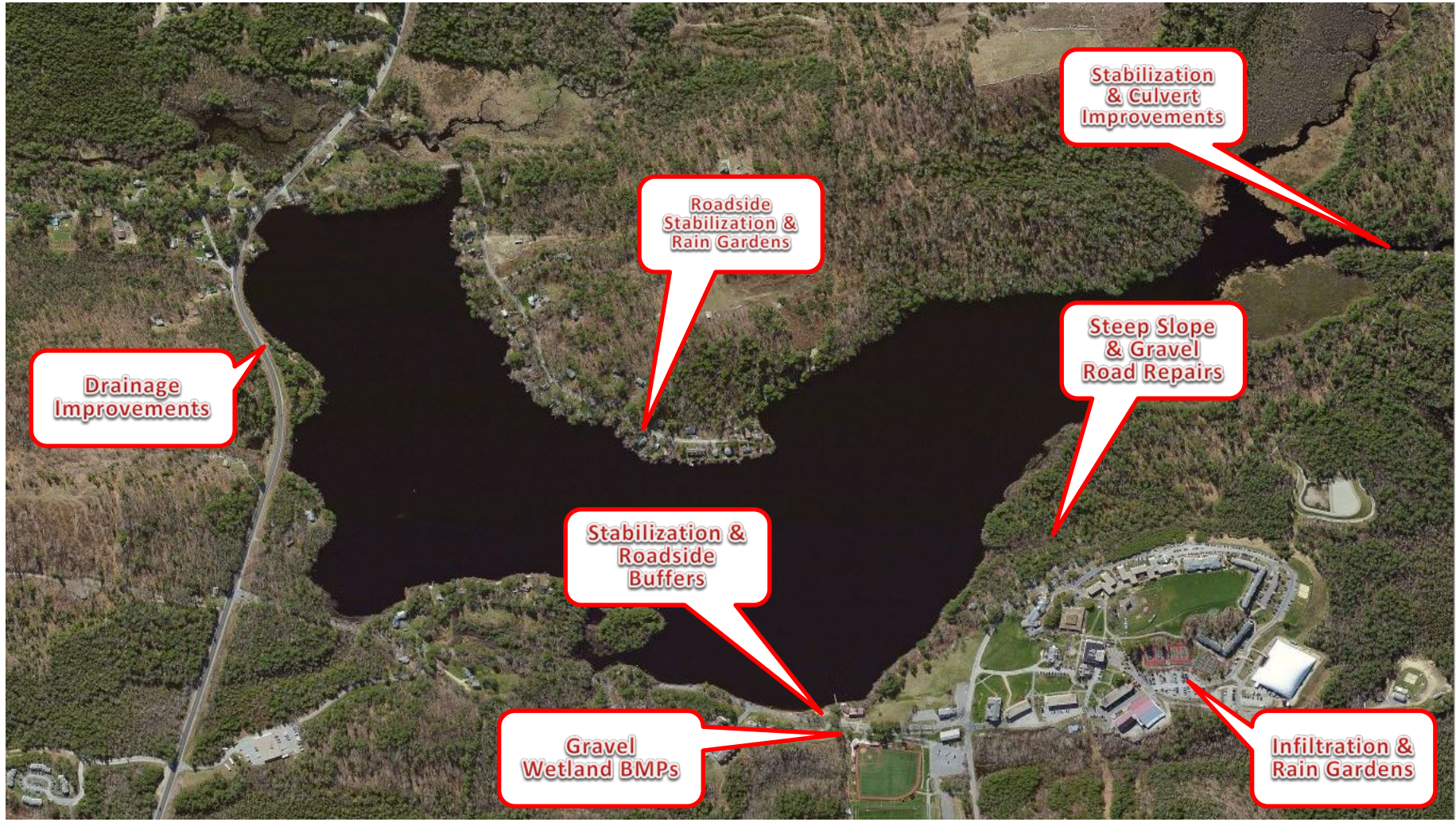
TABLE 5.0 - TOP 6 STORMWATER BMP OPTIONS

Rank	BMP Map ID	BMP Description / Type	Location	BMP Type	Total Costs w/ Contingency (\$)	Total Cost Grant Request (60%) (\$)	Total Cost Grant Match (40%) (\$)	Total 10 yr Costs (\$)	BMP Type	BMP Efficiency (%)	Total TP Loading (lb/yr)	TP Annual Removal (lb/yr)	TP 10 Yr Removal (lb/yr)	10 Year Cost / lb TP (\$/lb)
1	11	Drainage Improvements, CB to bioretention areas and gravel wetlands, install infiltration strip & stabilization to beach area	University Drive / Beach Area & Fields	Gravel Wetland / Vegetated Buffers	\$265,200	\$159,120	\$63,648	\$271,200	Gravel Wetland / Vegetated Buffers	65%	15.71	10.21	102.14	\$2,655
2	37	Infiltration BMPs / Raingardens throughout FPU parking lots	Franklin Pierce Drive / Community Center Parking	Small Bioretention / Small Infiltration	\$158,800	\$95,280	\$57,168	\$164,800	Small Bioretention / Small Infiltration	65%	6.59	4.29	42.86	\$3,845
3	3	Bioretention / Treatment BMPs along Rt. 119	NH Route 119 / Highway Drainage	Large Bioretention	\$95,200	\$57,120	\$34,272	\$101,200	Large Bioretention	65%	3.64	2.37	23.66	\$4,277
4	20	BMP wetpond, bioretention system, roadway structures drainage and piping	Kimball Road / Sharp Curve	Wet Pond / Small Bioretention	\$66,400	\$39,840	\$23,904	\$71,400	Wet Pond / Small Bioretention	65%	2.41	1.57	15.68	\$4,553
5	33	New CBs, new drainage diversions & infiltration BMPs throughout FPU parking lots and buildings	Franklin Pierce Drive / FPU Library & Courts	Large Infiltration	\$125,300	\$75,180	\$45,108	\$131,300	Large Infiltration	65%	4.43	2.88	28.81	\$4,557
6	12	Raingarden at FPU Community Center	Franklin Pierce Drive / Community Center	Small Bioretention	\$30,800	\$18,480	\$11,088	\$35,800	Small Bioretention	65%	1.20	0.78	7.77	\$4,607
Totals - Top 6					\$741,700	\$445,020	\$235,188	\$775,700			33.99	22.09	220.93	



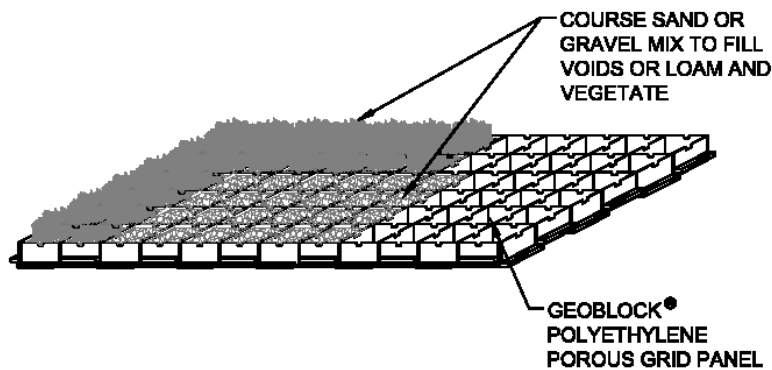
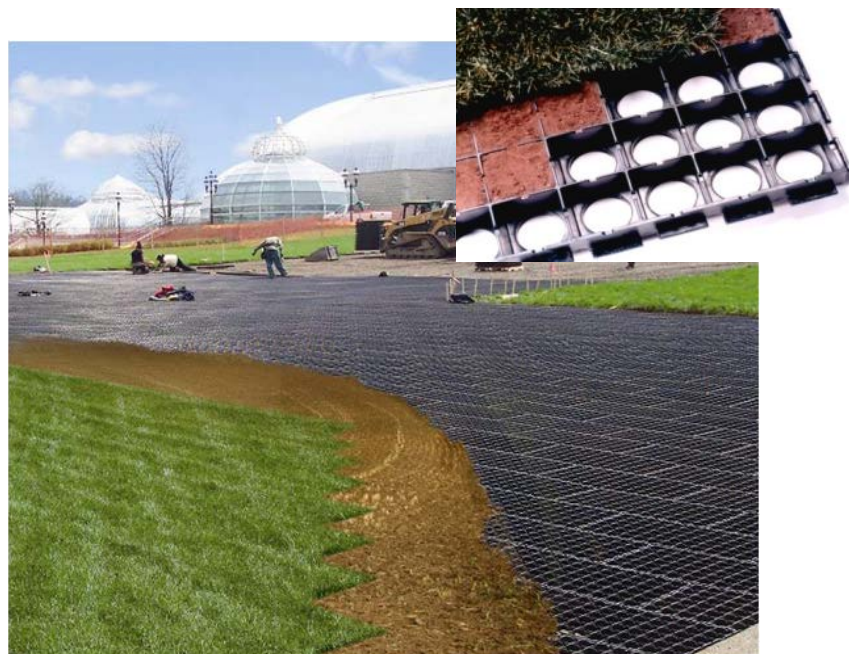
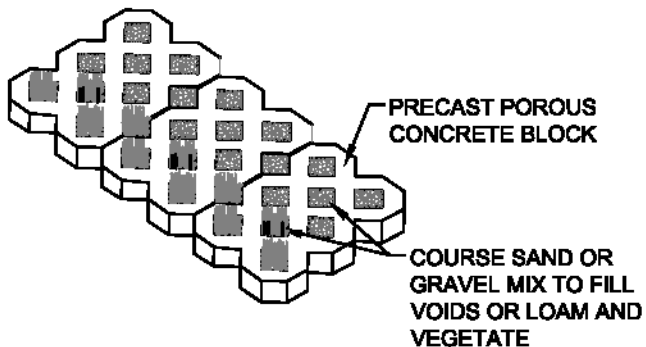
Stormwater BMP Improvements

Potential BMP Locations



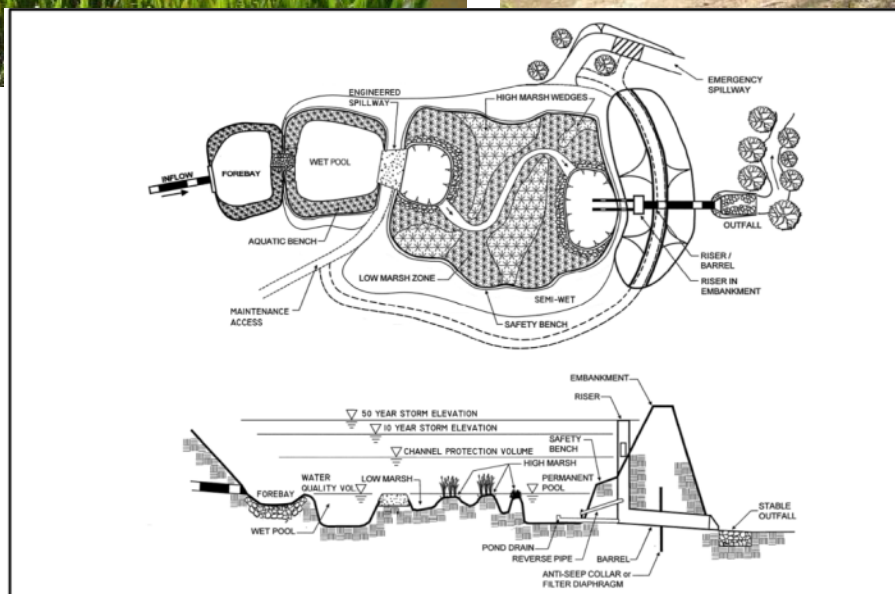
Stormwater BMP Improvements

Beach Areas & Access Points – Site Stabilization & Porous Materials



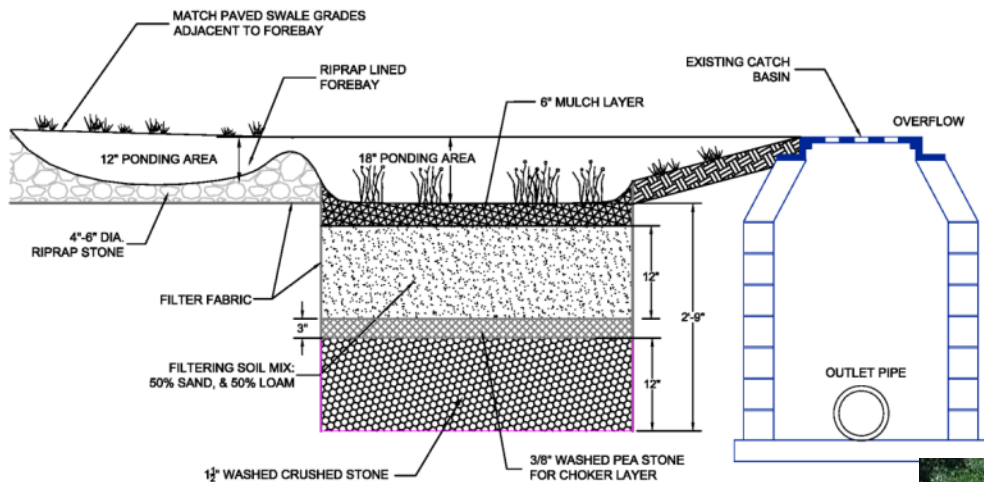
Stormwater BMP Improvements

Treatment Ponds – Constructed Wetlands & Infiltration Ponds



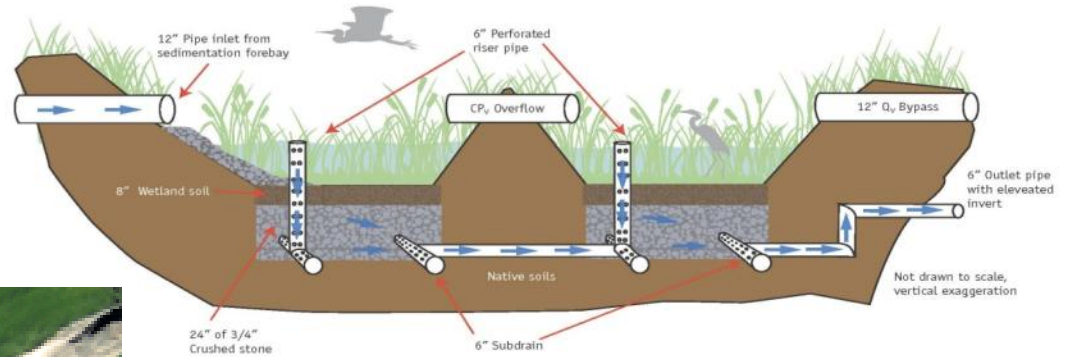
Stormwater BMP Improvements

Bioretention & Rain Gardens



Stormwater BMP Improvements

Gravel Wetlands



Questions?

We're baaaack!!!

