DRAFT

Watershed Restoration Plan for Pearly Pond, Rindge NH

November 12, 2014

NH Dept. of Environmental Services
Pearly Pond Management Advisory Council
Town of Rindge
Franklin Pierce University
Comprehensive Environmental Inc.

Pearly Pond, Rindge NH

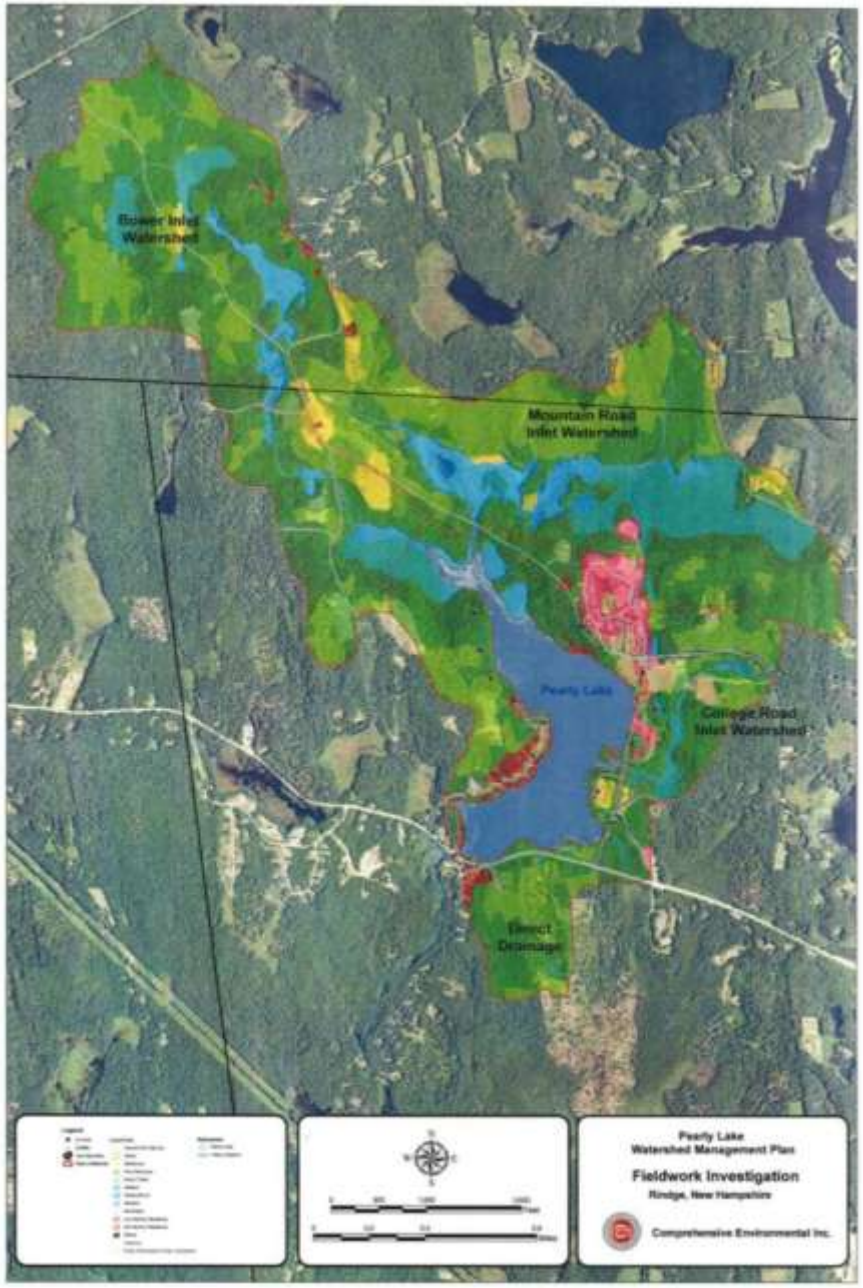
"Impaired" Status declared by DES because:

- •High chlorophyll-a – pigment found in algae, indicator of algal biomass
- •Low Dissolved Oxygen (DO) – Excess algae leads to low DO

Underlying cause: Too much phosphorus→too much algae!

Pearly Pond

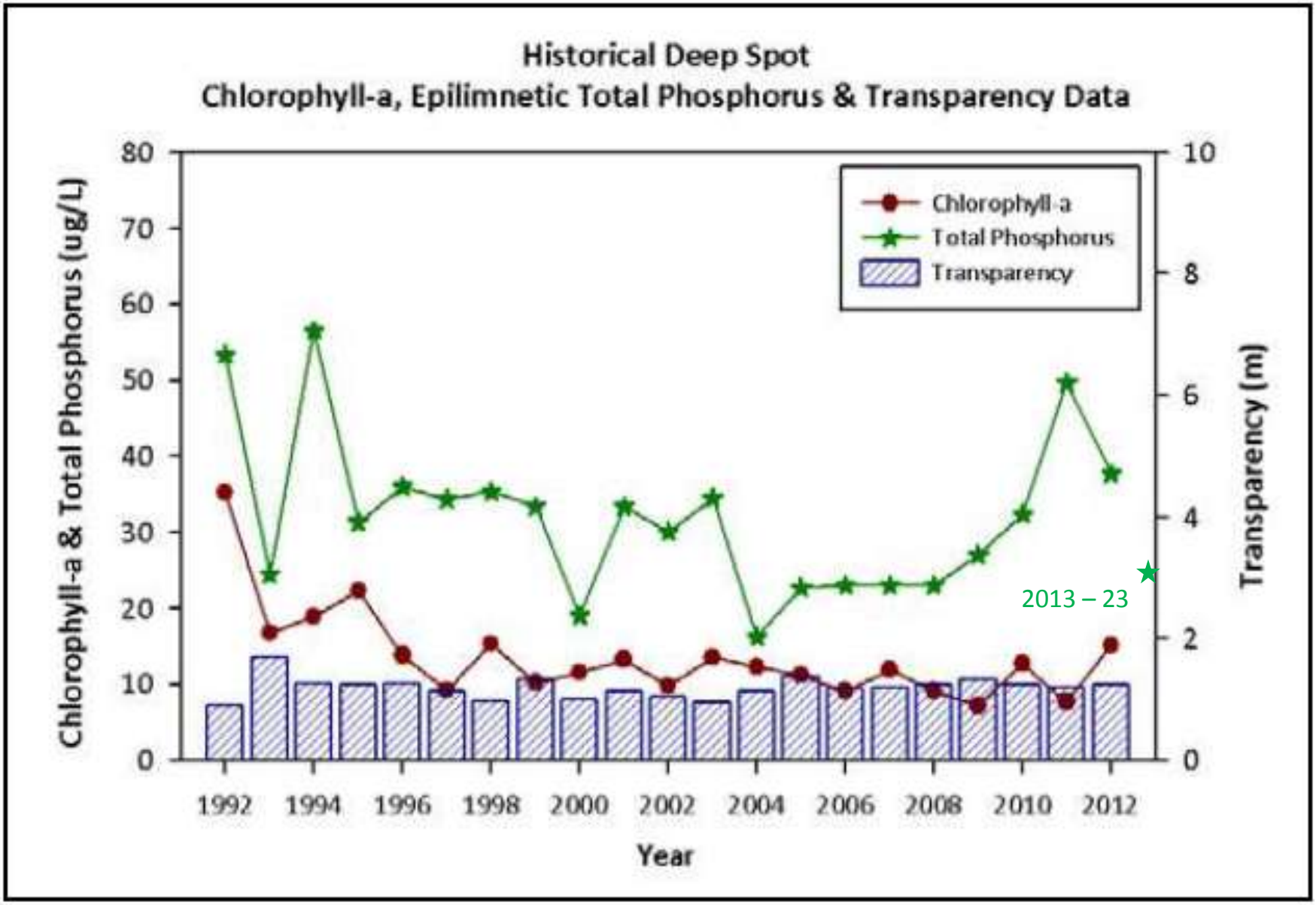
- 191 acres (78 ha)
- Shallow: 1.6 m avg
  3.4 m deepest
- Flushing rate: 4.3x/yr
- Warm water fishery
- Invasive variable milfoil



Watershed

- 2,126 acres (861 ha)
- Little development:
  - Franklin Pierce
  - Limited residential
  - ~ 180 acres developed
- Major nutrient sources:
  - Past: FPU WWTF
  - Stormwater Runoff
  - Septic systems
  - Geese

Data show that phosphorus is not decreasing as fast as we'd like



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 to prioritize solutions

When plan is done: Submit grant to put the plan into action!

Model Overview

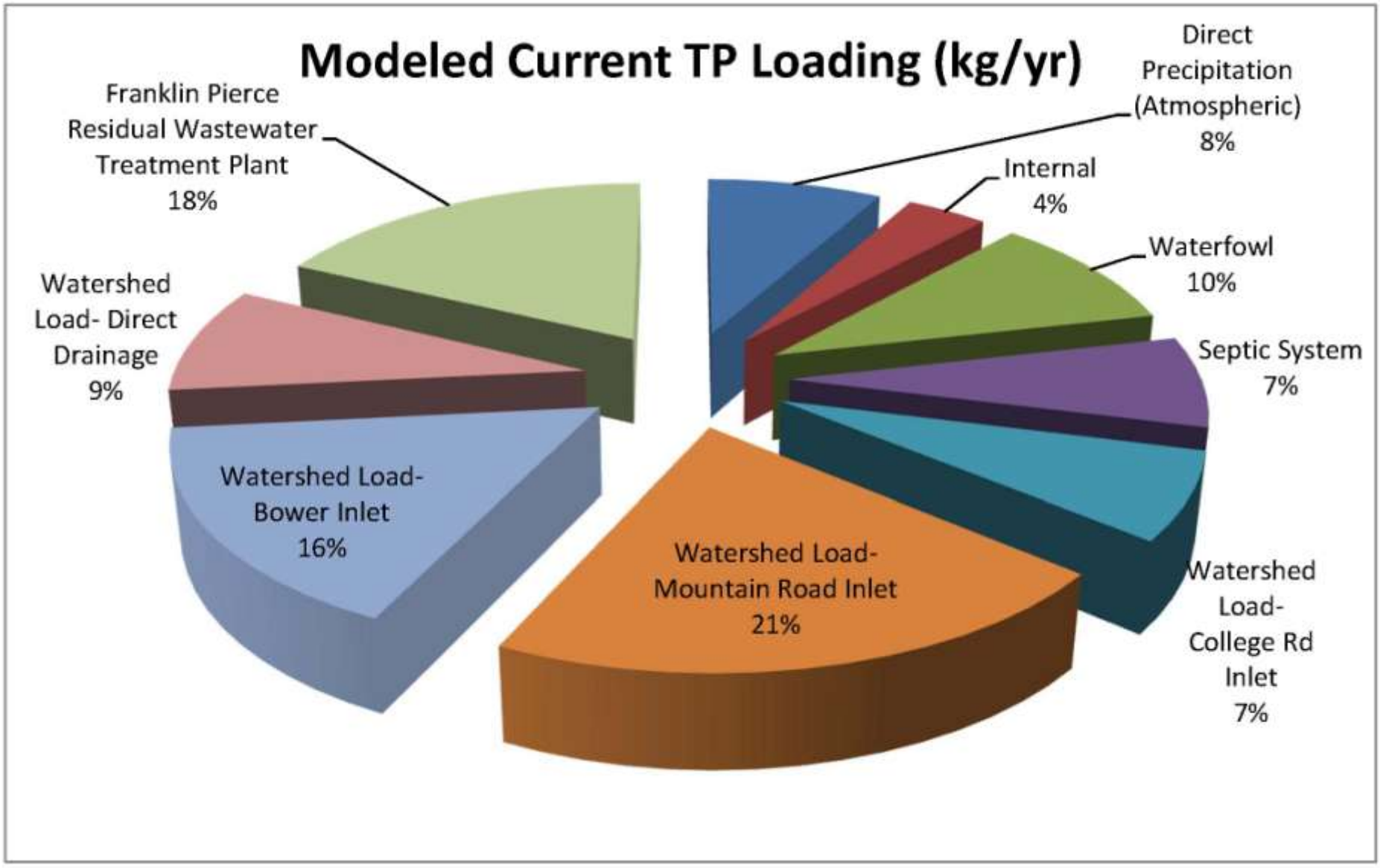
- ENSR-LRM Model – Land-use export coefficient model
- Land use, septic system data collected via maps, surveys, ground-truthing, landowner contact
- Inputs predict phosphorus load, water load, and phosphorus concentrations in streams and pond
- Calibrated to 2009-2013 water quality data
- 2009 marks 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 45% of the total phosphorus load
- Estimated loading of 240 kg/yr of phosphorus to the lake (Approx. eight 5 gallon buckets)


Modeled Current TP Loading (kg/yr)
Franklin Pierce Residual Wastewater Treatment Plant 18%
Direct Precipitation (Atmospheric) 8%
Internal 4%
Waterfowl 10%
Septic System 7%
Watershed Load- College Rd Inlet 7%
Watershed Load- Mountain Road Inlet 21%
Watershed Load- Bower Inlet 16%
Watershed Load- Direct Drainage 9%

Water Quality Goal: 17 ppb

- Based on high phosphorus levels in Bower Inlet (pristine subwatershed), background TP in-pond anticipated to be 17 ppb.
- To reduce TP levels to 13 ppb, would require reducing natural inputs of TP, and would cost more than $2.6 million to reduce.
- According to the NHDES 2009 report, there are unimpaired lakes that have TP levels as high as 27.5 ppb, and 25% of the unimpaired lakes are higher than 11.0 ppb.
- Pearly Pond appears to be naturally somewhat eutrophic, and may be one of those lakes which can achieve unimpaired status and avoid harmful algae blooms with a TP level as high as 17 ppb.

Further Studies

- Investigate impact of internal TP loading
  - Fall and winter sampling
- Investigate natural background TP loading
  - Long-term monitoring – tributaries, groundwater, wetlands, soils

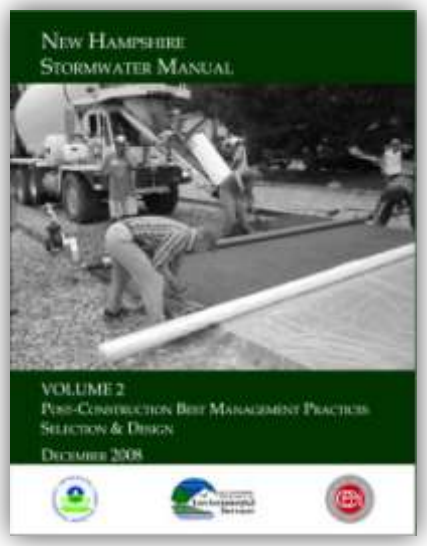
Potential Restoration BMPs

- Non-structural BMPs
  - Ordinance updates
  - Public education – build on survey
- Structural BMPs
  - Wastewater, Septic, Waterfowl, Stormwater, etc.

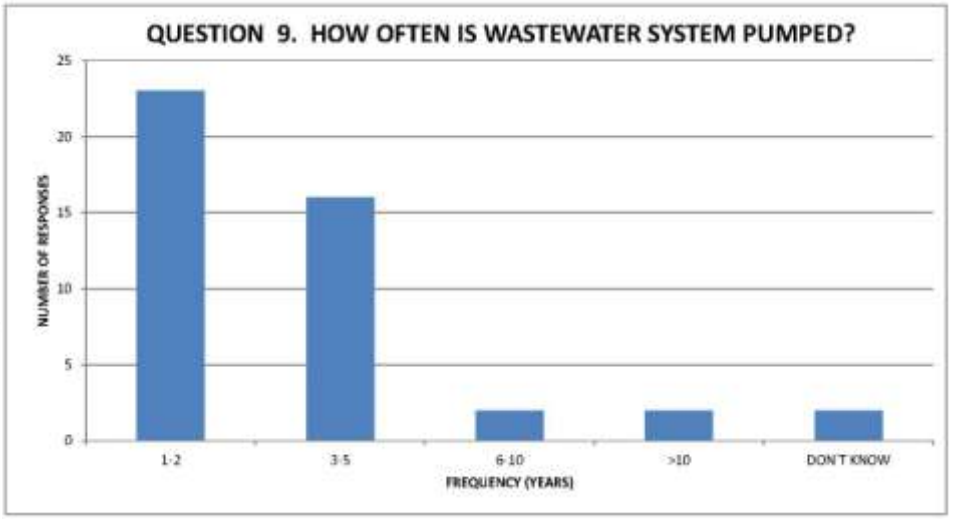
http://www.bing.com/maps

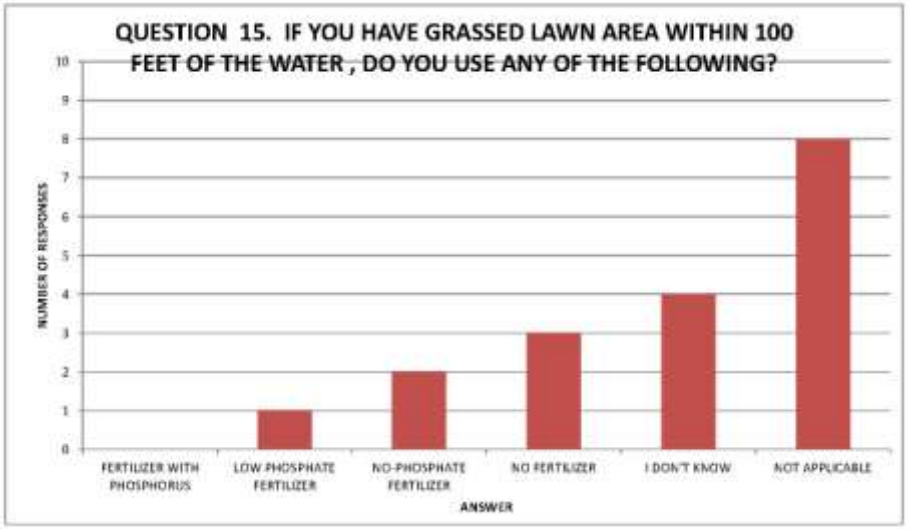
Ordinance Updates

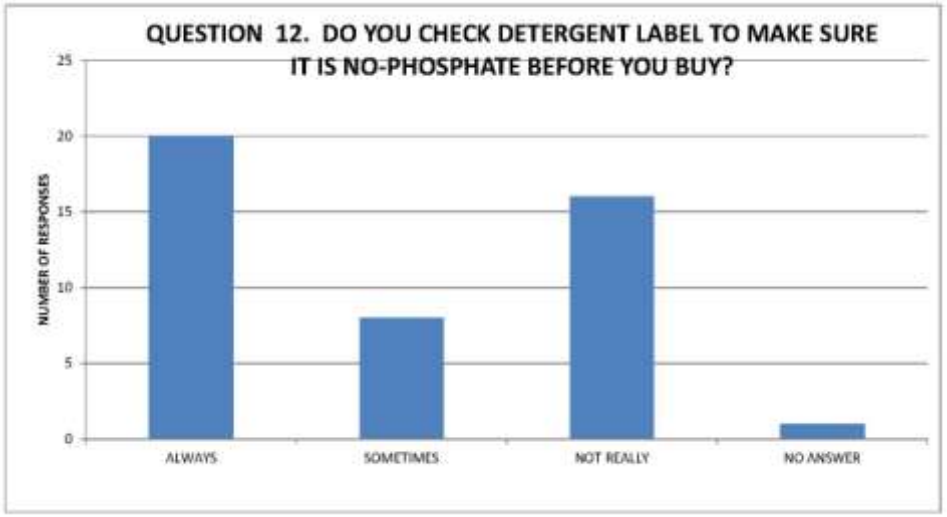
- Control phosphorus loads from future development
- Potential for 458 kg/yr of “P” under build-out conditions (218 kg increase)
- Consider no phosphorus export from future development – antidegradation
- At a minimum – meet requirements of Alteration of Terrain regulations



Public Education – Resident Survey





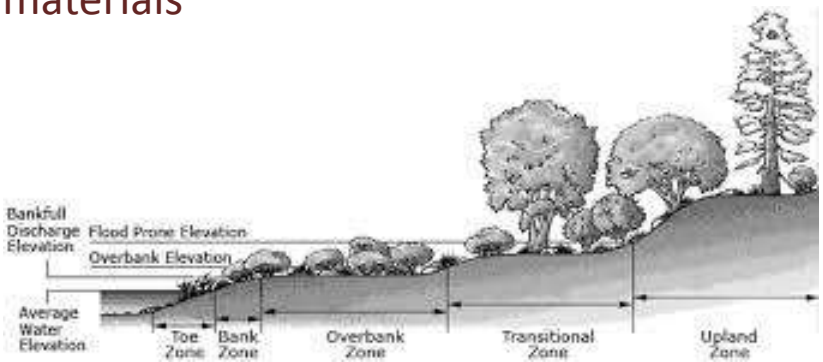


Public Education

- Educate and involve homeowners within the watershed and along shoreline of the lake
  - Lawn and yard care
  - Phosphorus products
  - Septic maintenance
  - Pet waste
  - Waterfowl
- Based on Survey Results

Public Education

- Develop an outreach campaign to promote the use of vegetated buffers and proper yard maintenance:
  - Control leaf litter;
  - Provide treatment of runoff from yard into lake;
  - Provide aesthetically pleasing features;
  - Promote community assistance for installations;
  - Leverage educational efforts and installations to obtain DES funds for materials



Structural Best Management Practices (BMPs)

- Waterfowl Controls (10%)
- Septic System Maintenance / Repairs (7%)
- Wastewater Improvements
- Wetland Improvements (18%)
- Stormwater BMPs (45%)

http://www.bing.com/maps

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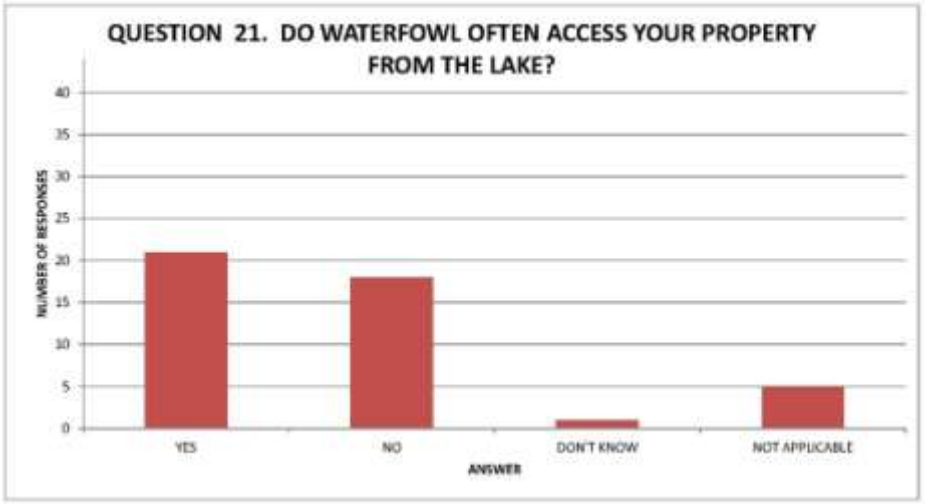
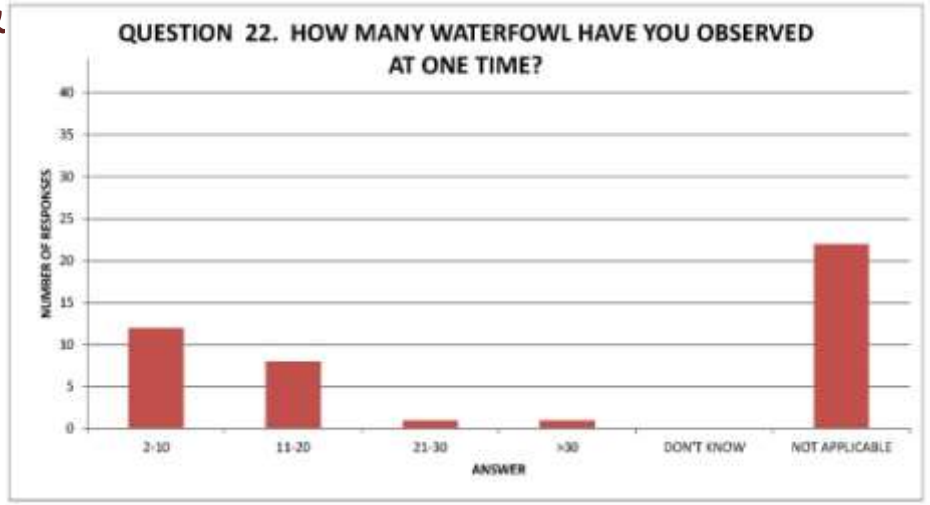
Waterfowl

- **Phosphorus load – ~23 kg/yr**
- Detailed studies would be required to track patterns and locate nesting areas
- Minimize human / bird interaction
- Minimize access to shorelines & lawn areas (short grass)

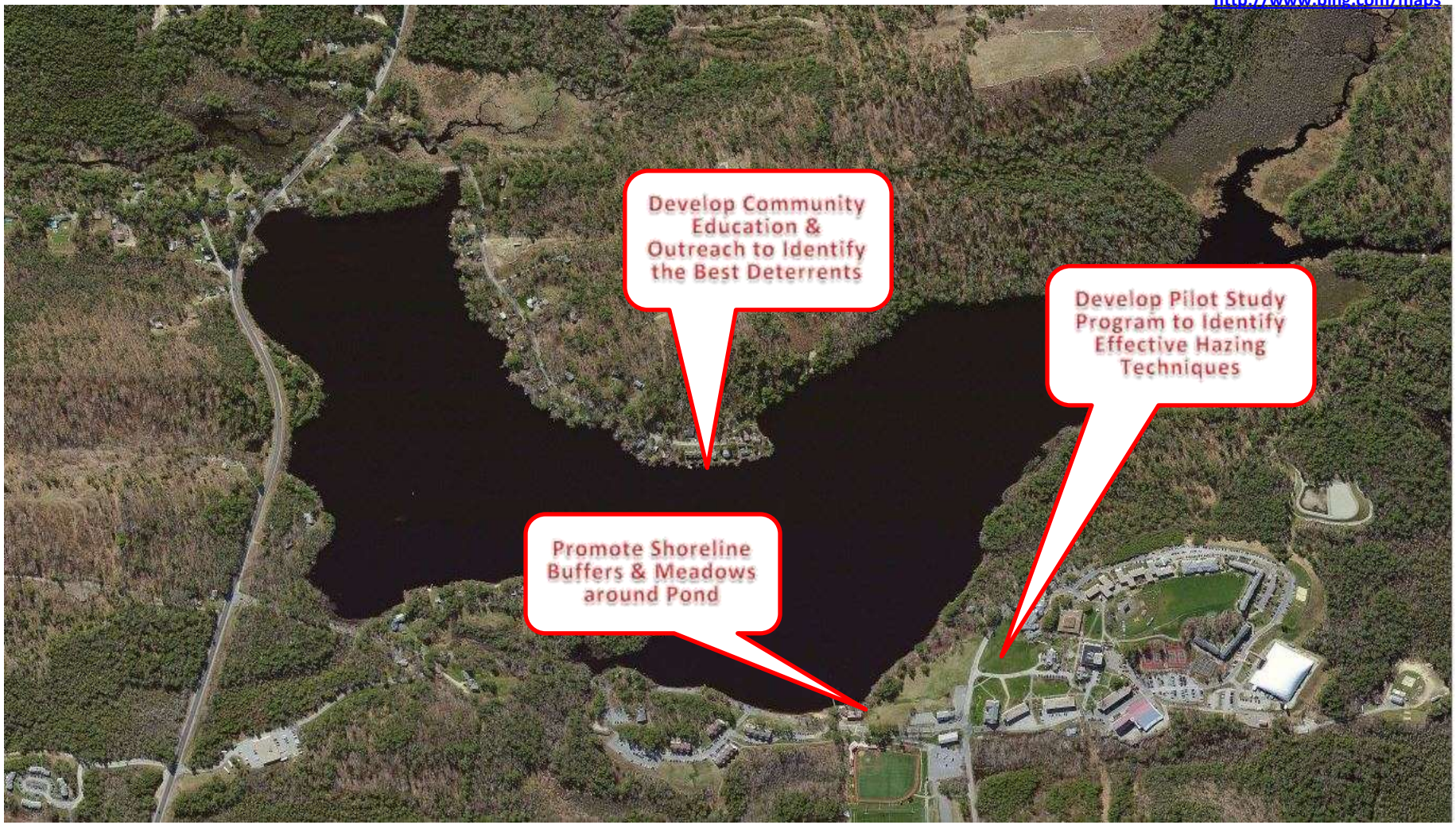




Waterfowl

Potential BMP Locations

http://www.bing.com/maps



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Waterfowl

- Outreach Program to identify deterrents
  - Vegetated buffers
  - Perched beaches
  - Other deterrents

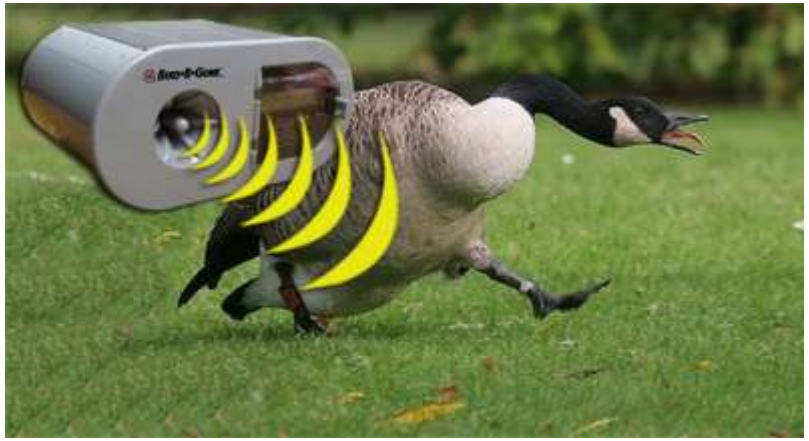
Goose Fence

http://www. blog.lakefairlee.org/

http://www.docksource.com/

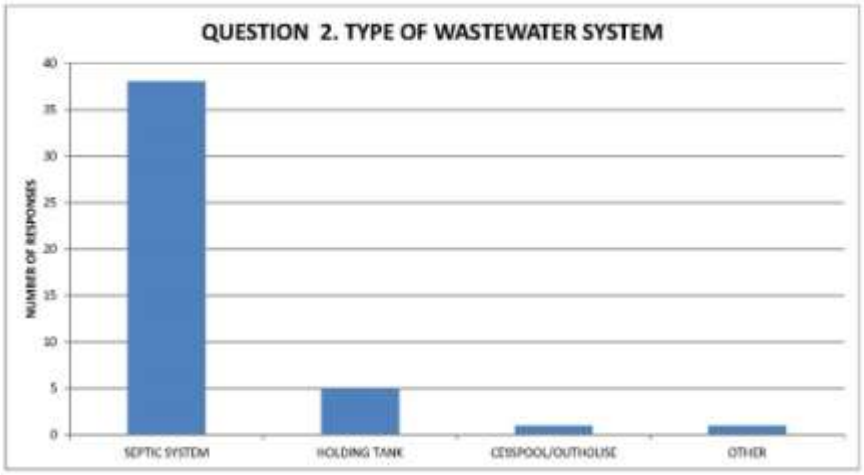
Waterfowl

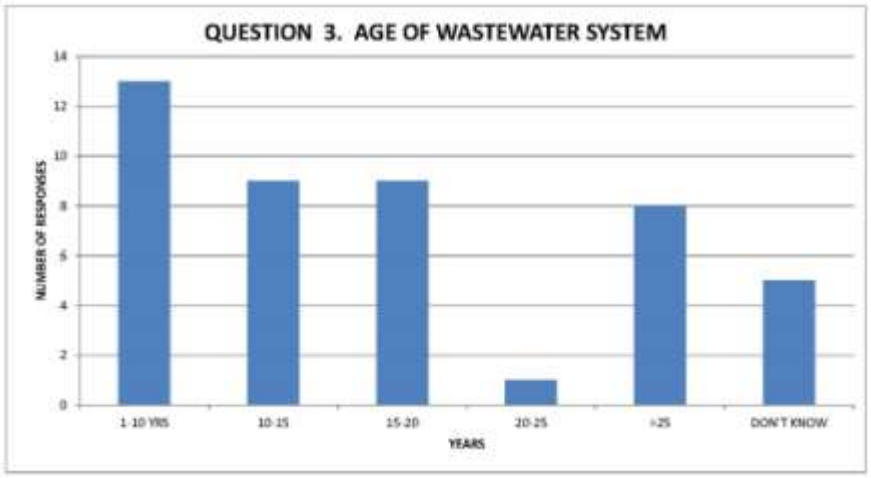
- Campus Pilot Study Program to identify hazing / scaring techniques
  - Border Collies
  - Coyote effigies
  - Drones
  - Distress Calls



Septic Systems

- **Phosphorus load – ~18 kg/yr**
- In 5 years time approximately 50% of the systems surveyed would be 25 years or older
- Septic system maintenance
- Repairs & replacement – can be very expensive ($5,000 - $20,000)





Septic System BMP Improvements

Potential BMP Locations

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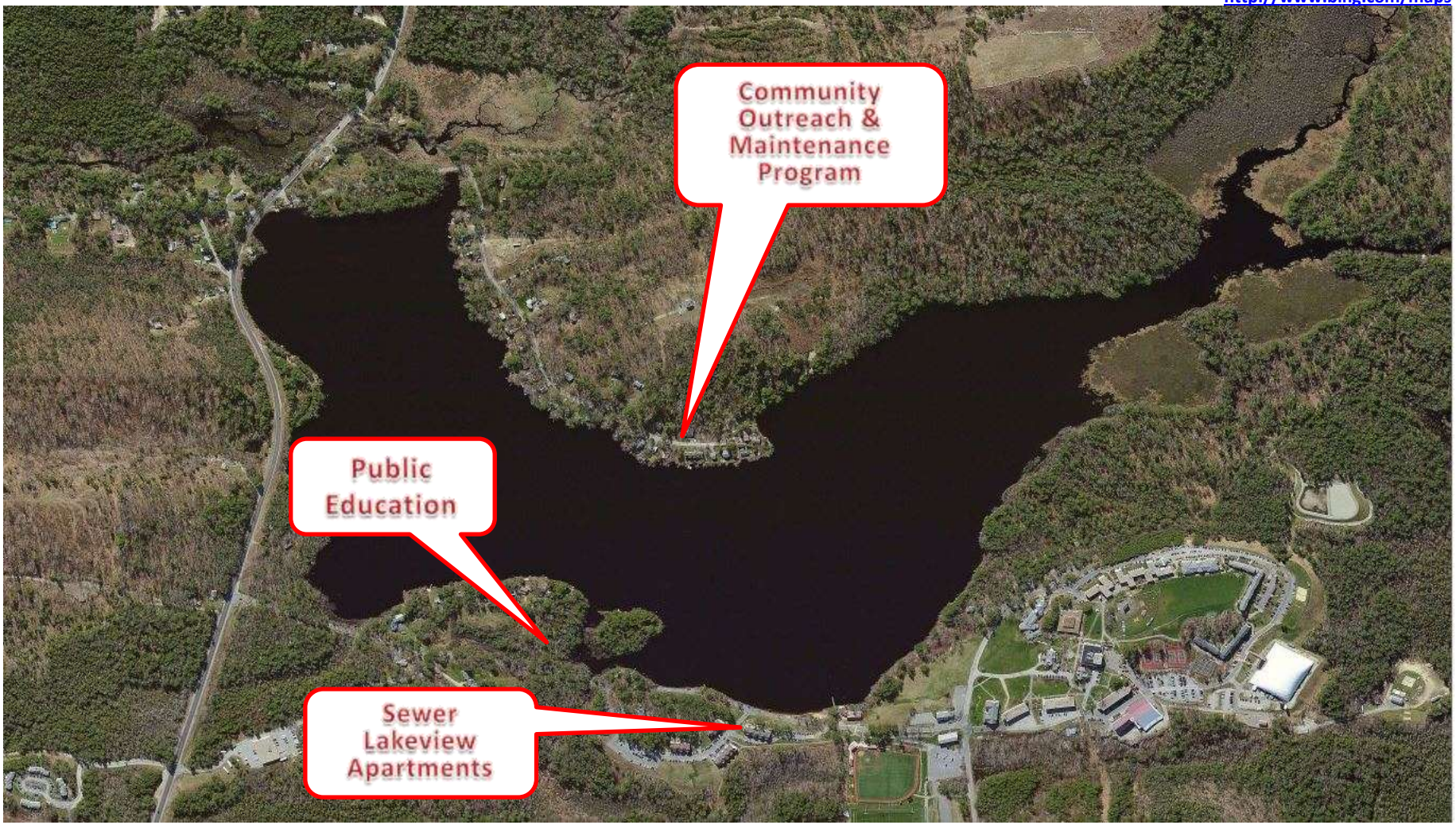

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Septic Systems

- Septic System Maintenance Outreach Program
  - **Potential phosphorus load – 5-6 kg/yr**
  - Septic system maintenance – ($250 - $500 per household biannually)
  - Explore options to obtain a lower bulk rate for the community
  - Maintenance, repairs & replacement – should be tracked & credited if completed

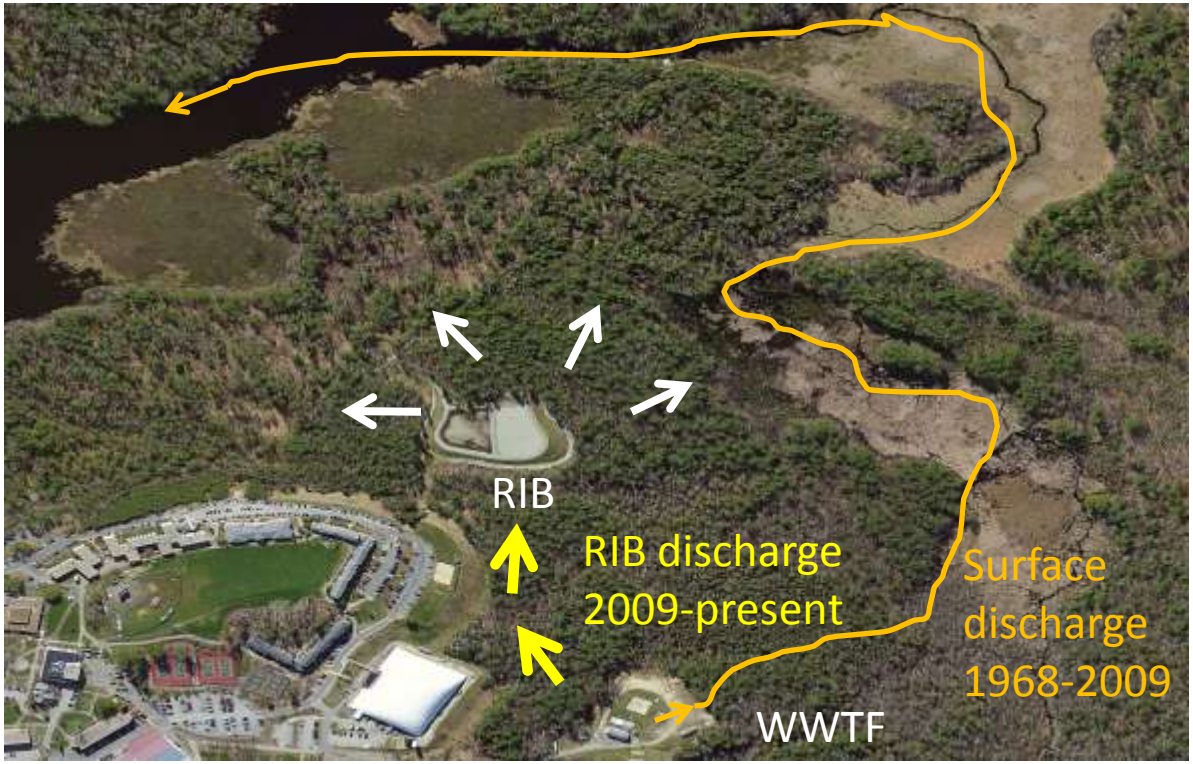
Septic Systems

- Sewering Lakeview Apartments
  - **Phosphorus load – 12 kg/yr** (~65% of septic load)
  - Sewering – can be expensive but may not be cost effective for all areas
  - Cost effective for Lakeview (estimated 10,000 gpd usage & higher loading)
  - Utilize existing infrastructure
  - Could help wastewater system run more effectively

Wastewater

- Phosphorus loads from RIBs – ~11 – 14 kg/yr
- Historic Phosphorus load - ~ 43 kg/yr

Wastewater treatment facility (WWTF)



https://www.bing.com/maps/

RIB=Rapid Infiltration Beds

Wastewater

Potential BMP Locations

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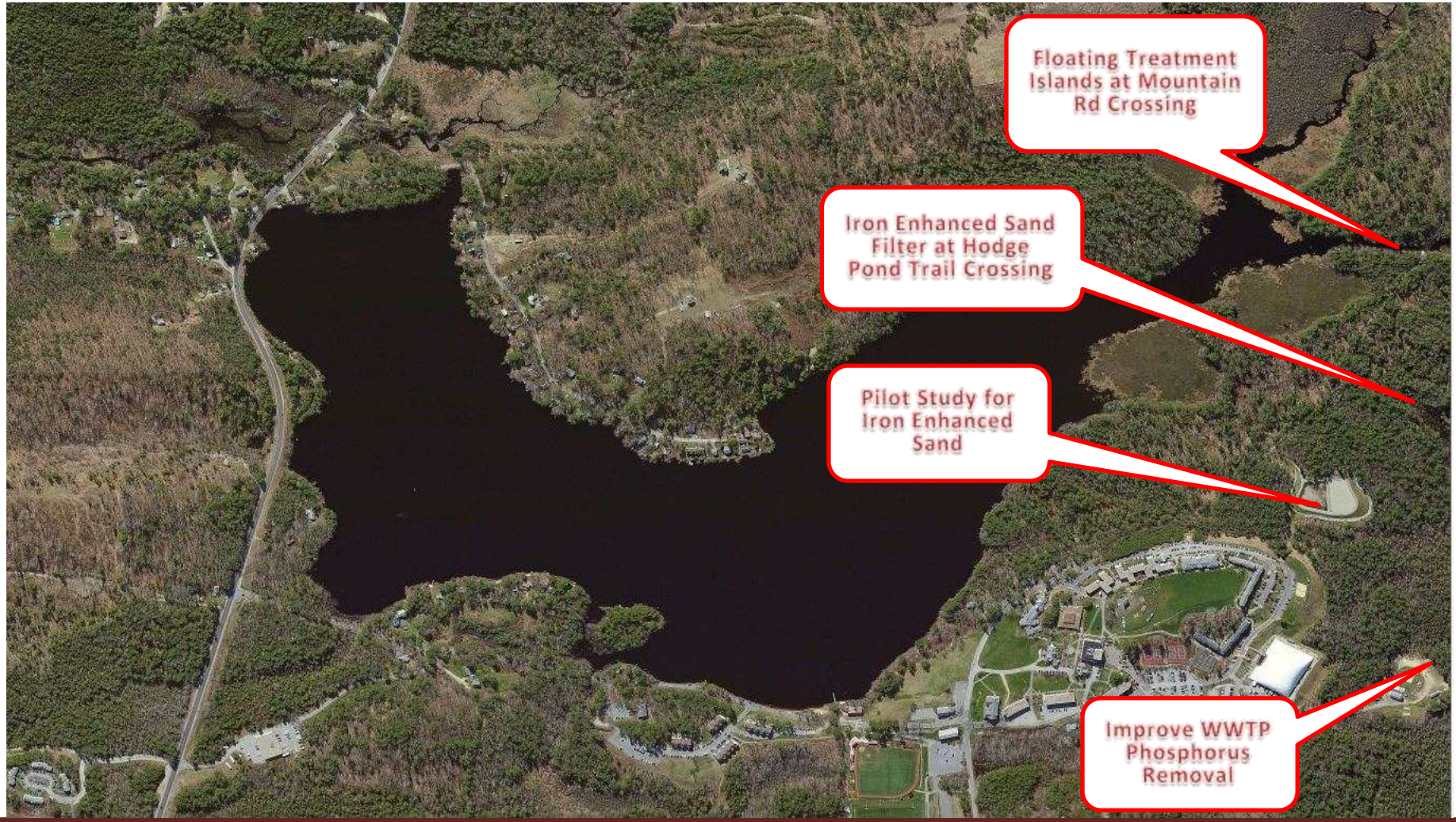

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Wastewater

- **Phosphorus loads from WWTP – ~11 – 14 kg/yr**
  - Increase phosphorus removal at plant
  - Chemical / biological additives for the RBCs
    - Additional Aluminum Sulfate (flocculent)
    - Additional Sodium Hydroxide (pH controls)
  - Adjustments made to chemical feed system
  - Compatible with current plant operation & permits

http://www.fresh-culture.com/equipment.htm

http://portfolio.htp.bcit.ca/A00747714/novatec_13abcd/solutions_MWT.html

Wastewater

- Improve the “P” removal of the RIBs
  - Rotation of bed loading & contact time
  - Bind phosphorus (iron enhancement)
  - Relatively inexpensive option
  - Compatible with on-going RIB maintenance

http://www.first4magnets.com/

http://www.bing.com/maps

Wetland Treatment

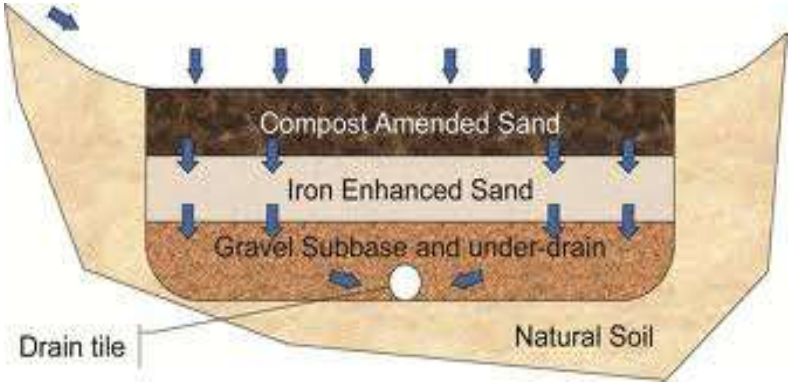
- **Phosphorus loads from wetland – ~43kg/yr**
- Floating Treatment Wetlands
  - Inexpensive to construct and install
  - Requires removal during winter months
  - Require minimum depth of water
  - Maintenance would include replacement of dead vegetation

Treatment Islands

http://www.wastewateralternatives.com/#/biohaven-floating-islands

Wetland Treatment

- Iron Enhanced Sand Filter
  - Supplemental to floating wetlands
  - Similar process to RIBs
  - Would require retrofit to existing trail crossing
  - Requires less water depths than floating islands



Iron Enhanced Sand Filter

http://stormwater.safl.umn.edu/

Stormwater BMP Evaluation

Phosphorus is carried to the lake via stormwater runoff ~ 105 kg/yr

- Fertilizers
- Erosion
- Roadways / parking areas

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

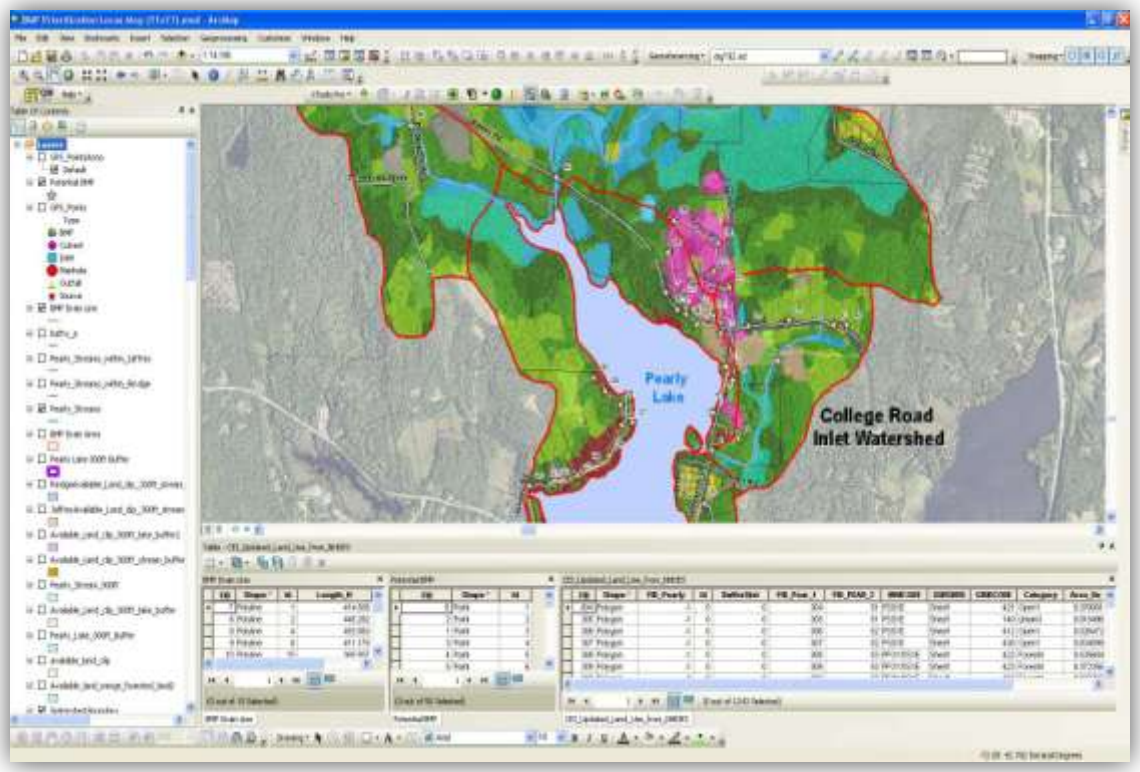
Stormwater BMP Evaluation

Two Tiered Ranking Process:

Use 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
  - Used general criteria to identify potential impacts & feasibility
  - Numerical ranking

- 2nd round ranked the top 30 sites down to the final 5-10 potential BMP Sites.
  - Pollutant Removal
  - BMP & Maintenance Costs
  - 10 year period
  - Cost per pound (or kg) of pollutant removed



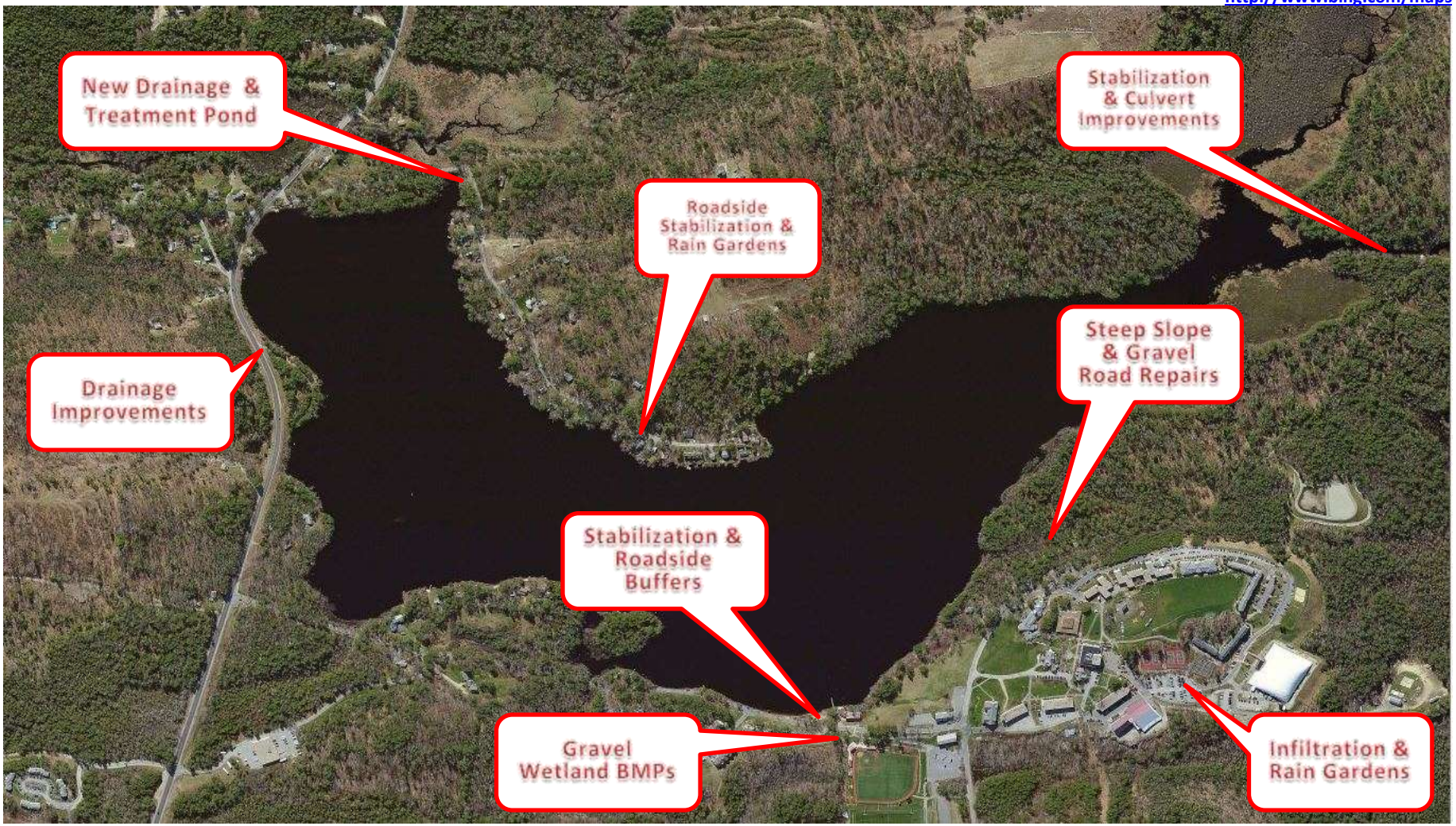
Stormwater BMP Evaluation

- Ranking Results
  - Stormwater BMPs could treat approx. 120 acres of the 185 developed acres (~6% of entire watershed)
  - Top 10 BMPs could reduce “P” by 15-20 kg per year (2/3 of 5 gallon bucket)
  - 20 kg of “P” is ~ 20% of the annual “P” loading attributed to stormwater runoff (105 kg /yr)
  - Stormwater maintenance & public education can help

Stormwater BMP Improvements

Potential BMP Locations

http://www.bing.com/maps



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Option 1 – FPU Campus - Boat House & Fields

Install gravel wetland cells on either side of access pathway connected by cross culvert. Install underground drainage piping as needed to divert drainage to gravel wetlands from roadways / parking areas and ball fields. Design treatment areas to overflow to existing outfall by connecting gravel wetland piping to existing drainage piping. Stabilize a portion of gravel parking area at the boat house with porous pavers and/or porous pavement systems (Geoblock®). Prevent beach erosion by installing curbing / landscaping berms to capture and infiltrate sheet runoff prior to reaching beach area. Provide educational kiosk.

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Option 2 – FPU Campus – East Parking Areas

Install tree box filters or infiltration dividers throughout large parking areas on the east side of FPU campus. Install infiltration beds or large rain gardens adjacent to tennis courts to handle runoff from nearby paved parking areas and ball fields. Install underground drainage piping as needed to divert drainage to treatment areas. Design treatment areas to overflow to existing outfalls by connecting to existing drainage piping.

Option 3 - Kimball Rd – Beach Access

Install several rain gardens at Beach access. Use existing drainage system to connect rain garden overflows to outlet piping. Install rain gardens on both sides of Kimball Road and adjacent to the beach area / existing drainage outfall. Stabilize a small section of beach access with porous pavers and/or porous pavement systems (Geoblock®). Provide overflow system for porous pavement to prevent runoff from flowing over beach area. Connect overflow to existing drainage system.

Option 4 - Kimball Rd – Sharp Corner

Install new curbing and divert flows to small treatment areas on either side of sharp curve via curb cuts. Install up-gradient catch basins and drainage piping as needed to divert drainage to a wetpond located on Town owned property. Up-gradient catch basins will reduce the amount of runoff reaching the "low spot" on the sharp curve. Re-grade sections of roadway as needed to divert runoff to treatment areas. Install roadside vegetated buffers along the lakeside shoulder and create one stabilized pathway for snow mobiles to access the lake from the roadway.

Option 5 – FPU Campus – West Parking Areas & Roadway

Install a series of curb-cuts and "bump-outs" to direct runoff to rain gardens / infiltration areas on main section of roadway. Place "bump-outs" in specific areas to promote traffic calming for busy sections of roadway and areas of heavy pedestrian traffic. Along steep sections of roadway, install infiltration swales reinforced with rounded riprap or river stone. Install checkdams to reduce runoff velocities and promote infiltration. Connect overflows for drainage system to existing drainage. Install larger rain garden / infiltration pond at the base of the steep roadway section and re-direct existing drainage outfall into treatment area.

Option 6 – FPU Campus – Community Center

Install rain gardens at FPU community center to handle runoff from adjacent walkways and paths. Convert a section of existing drainage swale adjacent to Mountain Road to an infiltration swale by installing sub-surface crushed stone beds and riprap checkdams. Install infiltration beds/gardens around Community Center and connect existing roof leaders to infiltration beds for irrigation of vegetation.

Option 7 – Route 119 – Existing drainage swales and paved outfalls

Install plunge pools / sediment traps on lakeside shoulder (westbound) of Route 119. Plunge pools will be installed where surface runoff from roadway drains onto existing paved swales. Plunge pools to be installed at locations that can be easily maintained from the roadway shoulder and without interference with existing guardrail infrastructure. Retrofit existing drainage swale along eastbound shoulder of Route 119 by installing bio-retention or gravel treatment swale. Install rock check dams to reduce velocities and promote subsurface flows.

Option 8 – Mountain Rd – Gravel Road Drainage & Erosion

Re-grade and stabilize steep gravel roadway sections. Re-grade and reinforce drainage swales with stabilization materials and check dams to reduce runoff velocities and prevent erosion. In some very steep areas install riprap swales with reinforced shoulders. On flatter sections of roadway install vegetated swales reinforced with turf blankets. Install plunge pools and gabion level spreaders at existing outfalls to prevent erosion on steep slopes. Stabilize sections of upper roadway embankments and eroded drainage channels with bio-engineered slope treatment.

Option 9 – Mountain / Ingalls Rd – Culvert Crossing & Drainage

Improve grading on roadway. Stabilize existing drainage swales with turf reinforcement / vegetation and install checkdams. Install series of small drainage crossings with plunge pools and infiltration areas along steep portions of roadway. Improve drainage around culvert crossing and stabilize side slopes with wing-walls and riprap drainage swales. Install level spreader and treatment BMPs near culvert if permissible by NHDES.

Option 10 - Kimball Rd – Gravel Turn-around

Re-grade and stabilize steep gravel roadway section of private road. Install drainage swales with check dams to reduce runoff velocities. Install underground piping and drainage structures as needed to reduce puddles and erosion at turn-around. Direct new drainage system to small wetpond and/or gravel treatment system prior to discharge into existing drainage outfall piping.

Questions?

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