

The Living Lab Wetland Project

Pioneering Ecological Engineering for Schools



Introduction

Mass Audubon's Long Pasture Wildlife Sanctuary in Barnstable, MA, is seeking school participation in our *Living Lab Wetland Project* to design and build wetlands on school grounds for education and conservation. Mass Audubon works to protect the nature Massachusetts for people and wildlife. A primary goal of our work is to actively engage the public in our conservation, education, and advocacy work.

Long Pasture, in partnership with Tom Biebighauser of Wetland Restoration and Training LLC and several government agencies and nonprofit organizations, has been advocating for wetland conservation on Cape Cod by creating or restoring wetlands at schools, town-owned conservation land, and Mass Audubon wildlife sanctuaries. The partnership has created a total of 21 wetlands on Cape Cod to date.

Approximately 1,700 students at seven Cape Cod schools have created "Living Lab" wetlands on their campuses for educational and conservation purposes between 2016 and 2018. To maximize the learning potential of this project, Long Pasture has provided concurrent and ongoing training and educational programming to many of these students including hands-on activities and in-class lessons focused on science, technology, engineering, and mathematics (STEM). [Listen to a radio interview](#) on *The Point with Mindy Todd*, airing on WCAI (NPR) describing the project along with testimonials from teachers, and project partners.

Through years of practice and refinement, we now have the technology to bring naturally appearing and functioning wetlands to schools. The addition of a Living Lab wetland on school campuses provides students with unparalleled learning opportunities to investigate rare wetland dependent flora, fauna, and soils, and contribute to the ongoing work in wetland restoration ecology and ecological engineering being carried out by Long Pasture. The wetlands are designed to be

maintenance free, replenish groundwater, and increase opportunities for viewing wildlife. The wetlands can be established at a low cost, and require little, if any maintenance.



Purpose and Need

Wetlands are considered to be the most biologically diverse of all ecosystems. Forty-three percent of all species listed as threatened or endangered in the United States by the U.S. Fish and Wildlife Service depend on wetlands for their survival. Experts report that less than one-half of the wetlands in the contiguous 48 United States remain. Over 28 percent of the wetlands in Massachusetts were lost to drainage from the 1780s to 1980s.¹

Long Pasture has chosen to concentrate our wetland creation and restoration efforts on schools through our *Living Lab Wetland Project*. By bringing the "lab" to the school through wetland creation, we make outdoor learning accessible, and more feasible than bussing to off campus study sites. Public school campuses were often created on or adjacent to what were once considered "valueless wetlands," and it is not difficult to find appropriate open space to restore wetlands at schools.

The project partnership involves both teachers and students in the step-by-step process of planning, creating, and then studying the wetland on school grounds. By actively participating in the creation of a wetland, students will gain a sense of investment and ownership in the project and receive valuable practical experience in real life ecological engineering. Ecological engineering is the design of sustainable ecosystems that integrate human society with its natural environment for the benefit of both.

Once created, the Living Lab wetland will serve as an ongoing study site. The interactive, experiential learning opportunities at the wetland site can reinforce in-class learning of core science, technology, engineering, and math concepts that are embedded into federal and state learning standards. Long Pasture teacher naturalists offer place-based learning approaches to schools, integrating the Next Generation Science Standards (NGSS) and MA Science, Technology, and Engineering Standards. These standards promote real world science learning by complementing core concepts about how the world works with active investigations to increase and provide a context for understanding.

¹ Dahl, T.E. 1990. Wetlands losses in the United States 1780's to 1980's. U.S. Department of Interior, Fish and Wildlife Service, Washington, D.C. 21pp.

Mass Audubon Partnership Opportunities

Mass Audubon's Long Pasture Wildlife Sanctuary in Barnstable is inviting schools across Massachusetts to participate in our *Living Lab Wetland Project*.

Mass Audubon offers the following activities as part of this project:

Creation of a Living Lab Wetland on Campus.

Students and teachers would participate in the design and construction of the wetland, utilizing science engineering and math STEM components. The creation takes one day to complete and requires the use of an excavator. The construction will be led by Tom Biebighauser of Wetland Restoration and Training LLC and Ian Ives of Mass Audubon.

Prior to the creation of the wetland, students would be introduced to the project and wetland ecology through an in school presentation provided by Mass Audubon. By creating a Living Lab, students will:

- Determine soil texture using a soil auger and the ribbon test
- Determine elevation of groundwater using a soil auger
- Measuring slope using a laser level and a clinometer
- Measuring distance using a range finder and an imperial and metric tape measure
- Using laser level to record elevations
- Learning how to mark circles, ovals, rectangles, and irregular shapes on the ground using survey equipment
- Identification and control of nonnative invasive plants
- Planting and seeding of native plants for pollinators
- Use *Best Management Practices* to control soil erosion
- Loosening compacted soils for plant growth and water percolation using shovels and rakes
- Learning when soil compaction is good and when it is bad



Additional Education Programing

Mass Audubon can offer educational programming to students before and after construction centered around conservation biology, field biology techniques, vernal pool ecology, and vernal pool certification for a reasonable price.

Wildlife and Water Quality Monitoring

- Amphibian, avian, invertebrate, botanical water quality monitoring for multiple grade levels after the wetlands are built.
- Pitfall trapping, aquatic traps and dip netting for surveying invertebrate and amphibian use of wetlands
- Audio and video monitoring and egg mass surveys to census amphibian reproductive activity
- Wetland plant surveying using quadrats
- Cover-board monitoring in surrounding uplands
- Water monitoring using water testing equipment
- Vernal Pool Certification

Environmental Benefits

Schools can expect the creation of a Living Lab on their property to provide the following environmental benefits:

- Restoring less productive land to a more productive state as a functioning vernal pool
- Increasing biodiversity (amphibian, avian, invertebrate, and more)
- Providing habitat for target species (spotted salamander, wood frog, bats)
- Resiliency by cleaning run-off, reducing flooding, and recharging groundwater
- Establish a living classroom for education and basis for citizen science

Curriculum-based Educational Opportunities for all Grade Levels

Mass Audubon Long Pasture has developed lesson plans for Elementary, Middle, and High School students.

At the Elementary Level, this can include:

- **Bat Roosting Boxes:** Two rocket style bat roosting boxes placed near the wetland to improve educational opportunities relating to these often misunderstood mammals. The boxes may be mounted on 2-inch diameter steel pipes for longevity. The rocket bat box design is very successful. Materials cost approximately \$100.00/box.
- **Nest boxes:** Building and placing nest boxes for cavity-nesting birds would improve wildlife viewing and educational opportunities around the school. Six or more boxes may be built and with materials costing around \$5.00/box.
- **Track Station:** Students can discover what wildlife species visit wetlands by examining tracks left on a tracking station. A tracking station is like a small sandbox, only it is built level with the elevation of surrounding ground.

Middle and High School-level lesson plans could focus on:

- Identifying the species of aquatic animals best suited to colonize new ponds and those that are most poorly suited.

- Discovering if natural communities tend to exist in equilibrium or do they tend to change over time.
- Finding out how the creation or manipulation of natural habitat can be used for conservation purposes.

Estimated Cost per School Wetland

- Excavator, fuel, operator, and support truck = \$800.00
- Aquatic-safe liner (40 x 40-feet) & 2 matching 8 oz. geo-textile pads & shipping = \$2,559
- Spikes and washers: \$1.10 each x 75 = \$82.00
- Straw: \$10.00 per bale x 12 bales = \$120.00
- Wheat seed: \$15.00 per bag x 1-bag = \$15.00
- 35hours of project consultation, educational programming, as well as construction day supervision and training by Mass Audubon (Ian Ives), includes all salary & travel = \$1,700
- 2 days of project supervision and training by Tom Biebighauser, includes all salary & travel @ \$750 per day = \$2,906

Total = \$8,182

For more information on the *Living Lab Wetland Project*, contact Ian Ives - Long Pasture Wildlife Sanctuary Director at:

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Key Staff:

- Ian Ives, *Long Pasture Wildlife Sanctuary Director*, has a strong background in local wetland conservation and vernal pool protection and currently leading the Eastern Spadefoot Toad Restoration Project, and has overseen 10 wetland restoration projects and five wetland professional workshops.
- Tom Biebighauser, a *Wildlife Biologist and Wetland Ecologist*, has restored over 1,800 wetlands in 22 U.S. states, Canada, and New Zealand. With 34-year career with the U.S. Forest Service, Tom has designed and built wetlands at over 200 schools and universities. Tom is currently the President of Wetland Restoration and Training LLC.
- Liz Packard, *Long Pasture Wildlife Sanctuary School Program Coordinator*, holds a M.A. in Sustainability and Environmental Management, oversees five part time teacher naturalists and designs and teaches K-12 school curriculum for 21 school programs across Cape Cod.

PHOTOS OF *LIVING LABS* CREATED ON CAPE COD



Liner Wetland 1 year after creation at Mass Audubon's Ashumet Holly Wildlife Sanctuary in Falmouth.



A liner wetland at Falmouth Academy in Falmouth filled with rainwater two weeks after creation.



A liner wetland at Falmouth High School in Falmouth one year after creation.



Seventh grade students at the Lawrence Middle School in Falmouth place the liner into the dug wetland depression.



Falmouth Public School students studying their new *Living Lab* on campus.