

Project Final Report

Lake Shirley
Low Impact Development Project
05-10/319

Dates: 2006 – 2009

Town of Lunenburg

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PREPARED FOR:

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF RESOURCE PROTECTION

AND

US ENVIRONMENTAL PROTECTION AGENCY
REGION 1

MASSACHUSETTS EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS
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DEPARTMENT OF ENVIRONMENTAL PROTECTION
Laurie Burt, Commissioner

BUREAU OF RESOURCE PROTECTION
Glenn Haas, Acting Assistant Commissioner

DIVISION OF MUNICIPAL SERVICES
Steven J. McCurdy, Director

DIVISION OF WATERSHED MANAGEMENT

Glenn Haas, Director

A. Project Snapshot

Project Number and Title: Lake Shirley Low Impact Development Project, #05-10/319

A1. Project start date: 2006

A2. Date closed: June 30, 2009

A3. Basin and HUC 12 subwatershed: Nashua River

A4. Segment and/or waterbody number(s): Lake Shirley (MA81122_2008)

A5. Status of waterbody: Category 5 (noxious aquatic plants, turbidity, exotic species)

A6. Priority Pollutant(s) targeted: Sediment, nutrients and invasive weeds

A7. Estimated Annual Pollutant removal: No specific pollutant removal quantification was possible with this project. However, the Town of Lunenburg has adopted DEP's requirement that new development achieve an 80% TSS removal rate. Various types of Low Impact Development (LID) controls were included in the demonstration projects and are described in the LID Guidebook that was prepared for the town.

A8. BMPs installed, number and type: This project involved the installation of a total of five LID projects around Lake Shirley. It also included the following:

- permitting of these LID demonstration projects
- permitting of a drawdown program and a hydroraking program
- conducting annual vegetation surveys of Lake Shirley
- development of a LID Guidebook for the Town of Lunenburg
- development of educational newsletters on LID demonstration projects
- presentations on LID demonstration projects

Descriptive Project Summary

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 05-10/319

PROJECT TITLE: Lake Shirley Low Impact Development Project

NPS CATEGORY: Section 319

INVESTIGATOR: Lake Shirley Improvement Corporation and Town of Lunenburg

LOCATION: Lunenburg, MA

TARGETED POLLUTANTS: Sediment and Nutrient Loading

DESCRIPTION: Lake Shirley is a 354-acre lake located within the Nashua River watershed in Lunenburg and Shirley, MA. Lake Shirley is an important ecological and recreational resource for the Town of Lunenburg and surrounding communities. The lake is on the Massachusetts Year 2002 Integrated List of Waters for impairments by noxious aquatic plants, turbidity, and exotic species. The Lake Shirley Improvement Corporation (LSIC) and the Town of Lunenburg have led an ongoing effort to assess and provide long-term solutions to the water quality and nuisance plant problems in the lake.

DEP issued a 319 Grant to the Town of Lunenburg in 2006 to conduct this Low Impact Development Project (#05-10/319). The Town of Lunenburg contracted with Geosyntec consultants in July 2006 to provide environmental consulting services in support of that grant.

Each element of the 319 project was designed to mitigate the identified impairments in Lake Shirley as identified in the four major project goals as follows:

1. Reduce sediment and nutrient loading to Lake Shirley by installing a variety of Low Impact Development (LID) stormwater management controls throughout the watershed
2. Conduct a lake-level drawdown for nuisance plant control
3. Develop a LID Guidebook for the Town of Lunenburg
4. Provide public education outreach to watershed residents

Tasks performed under the grant to achieve those goals include the following:

1. Implemented LID Controls at five locations around Lake Shirley
2. Continued a lake-level drawdown program for nuisance plant control
3. Developed a LID Guidebook for the Town of Lunenburg
4. Conducted a public education and outreach program
5. Conducted an aquatic vegetation survey program

The project has successfully demonstrated the value of LID controls to achieve sediment and nutrient removal along the shoreline of Lake Shirley and influent streams.

PROJECT COST: \$167,961.76

FUNDING: By US/EPA \$ 67,802.41
By Grantee \$100,159.35 (includes in-kind matches)

PROJECT COMPLETE

DURATION: 2006 – 2009

C. BMPs:

Low Impact Stormwater Controls

C1. Type of BMP: Constructed Wetland Restoration/ Enhancement at 76/84 Sunset Lane, Lunenburg

C2. Date of implementation: Completed construction during the second week of November 2008

C3. Size of treatment area: 23 acres

C4. Area land use: Low density residential, forest, wetland

C5. Pollutant load removed: 304 lbs total suspended sediment/year; 1.65 lbs total phosphorus/year

C6. Method of pollutant load removal determination: Simple Method to estimate pollutant loading using event mean concentration data from the National Storm Water Quality Database and removal efficiencies from the Massachusetts Storm Water Policy Handbook



A degraded wetland area adjacent to a Lake Shirley tributary was restored with biodegradable coir fiber logs and plantings. Over time, the sinuous flow path will become densely vegetated to provide improved pollutant filtering and attenuation.

D. Lessons Learned

Geosyntec developed an engineering design for a wetland restoration/enhancement at an unnamed tributary to Lake Shirley adjacent to 76 and 84 Sunset Lane.

This project involved creation of a sinuous flow path for the channel using coir fiber logs and live stake plantings. The design was intended to promote vegetative filtering and nutrient uptake by establishment of a dense shrub and herbaceous plant growth in the area just upstream of the tributary's confluence with Lake Shirley.

E. Attachments

Map: See attached map of Lake Shirley Best Management Practices (BMPs)

Deliverable: See LID Guidebook for the Town of Lunenburg

C. BMPs

Low Impact Stormwater Controls (continued)

- C1. Type of BMP: Create Raingarden to Control Stormwater Runoff – 398 Sunset Lane, Lunenburg
- C2. Date of implementation: Constructed in July 2007 to replace a direct pipe discharge to Lake Shirley
- C3. Size of treatment area: 0.09 acres
- C4. Area land use: Suburban residential
- C5. Pollutant load removed: 52 lbs total suspended sediment/year; 0.13 lbs total phosphorus/year
- C6. Method of pollutant load removal determination: Simple Method to estimate pollutant loading using event mean concentration data from the National Storm Water Quality Database and removal efficiencies from the Massachusetts Storm Water Policy Handbook

D. Lessons Learned

With proper design, small areas immediately adjacent to receiving waters can be effectively used to reduce sediment and nutrient loading through infiltration and vegetative uptake.

E. Attachments

Map: See attached map of Lake Shirley Best Management Practices (BMPs)

Deliverable: See LID Guidebook for the Town of Lunenburg



To eliminate a direct stormwater pipe discharge and reduce pollutant loading to Lake Shirley, a raingarden was installed to infiltrate and treat stormwater at the southern end of Sunset Lane.

C. BMPs

Low Impact Stormwater Controls (continued)

- C1. Type of BMP: Install Vegetative Buffer along 400 feet of shoreline - Oakes Landing, Shirley
- C2. Date of implementation: fall 2008
- C3. Size of treatment area: 0.2 acres
- C4. Area land use: Suburban residential
- C5. Pollutant load removed: 3 lbs total suspended sediment/year; 0.02 lbs total phosphorus/year
- C6. Method of pollutant load removal determination: Simple Method to estimate pollutant loading using event mean concentration data from the National Storm Water Quality Database and removal efficiencies from the Massachusetts Storm Water Policy Handbook.

D. Lessons Learned

Geosyntec designed a shrub buffer for 800 linear feet of shoreline associated with the Oakes Landing development. Due to several homeowners opting out of the project, the actual length of the buffer constructed in October 2008 was a total of 400 linear feet of shoreline as follows:

- Ohearn = 200 ft, R. Marchetti = 100 ft, and B. Marchetti = 100 ft

E. Attachments

Map: See attached map of Lake Shirley Best Management Practices (BMPs)

Deliverable: See LID Guidebook for the Town of Lunenburg



In 2008, a 400-foot shrub buffer was installed along the shoreline of Lake Shirley at the Oakes Landing subdivision. The buffer included 274 native shrub plantings, soil amendments and mulch.

C. BMPs

Low Impact Stormwater Controls (continued)

- C1. Type of BMP: Create a Raingarden and Vegetated Water Quality Swale - 53 Pearl Street, Lunenburg
- C2. Date of implementation: fall 2008
- C3. Size of treatment area: 0.05 acres
- C4. Area land use: Suburban residential
- C5. Pollutant load removed: 29 lbs total suspended sediment/year; 0.07 lbs total phosphorus/year
- C6. Method of pollutant load removal determination: Simple Method to estimate pollutant loading using event mean concentration data from the National Storm Water Quality Database and removal efficiencies from the Massachusetts Storm Water Policy Handbook.

D. Lessons Learned

Geosyntec designed a raingarden and vegetated water quality swale to treat runoff discharging to the lake from Pearl Street.

E. Attachments

Map: See attached map of Lake Shirley Best Management Practices (BMPs)

Deliverable: See LID Guidebook for the Town of Lunenburg



A vegetated swale was constructed at 53 Pearl Street in Lunenburg to filter and treat stormwater flows that periodically flooded and created erosion on the property. The swale included soil amendments to improve infiltration, shrub and herbaceous plantings, and a stabilized rock outlet to Lake Shirley.

C. BMPs

Low Impact Stormwater Controls (continued)

- C1. Type of BMP: Install a sediment forebay, channel stabilization and constructed wetland - 833 Flat Hill Road, Lunenburg
- C2. Date of implementation: fall 2008
- C3. Size of treatment area: 40.5 acres
- C4. Area land use: Suburban residential
- C5. Pollutant load removed: 493 lbs total suspended sediment/year; 2.79 lbs total phosphorus/year
- C6. Method of pollutant load removal determination: Simple Method to estimate pollutant loading using event mean concentration data from the National Storm Water Quality Database and removal efficiencies from the Massachusetts Storm Water Policy Handbook.

D. Lessons Learned

Direct discharges of sediment/pollutants to Lake Shirley have been reduced by stabilization of actively eroding channel sections and creation of a sediment forebay designed with a stabilized maintenance access for use by the homeowner.

E. Attachments

Map: See attached map of Lake Shirley Best Management Practices (BMPs)

Deliverable: See LID Guidebook for the Town of Lunenburg



View upstream (towards Flat Hill Road) of newly constructed sediment forebay and stabilized channel section at 833 Flat Hill Road.

C. BMPs

Lake Vegetation Management

- C1. Type of BMP: Lake Drawdown, Wetland Permitting and Vegetation Surveys
- C2. Date of implementation: Wetland Permitting was performed with the Lunenburg and Shirley Conservation Commissions to gain approval of the LID lake demonstration projects, the hydroraking programs and the yearly drawdown. For the duration of the contract, Lake Drawdown was conducted each winter and Vegetation Surveys were conducted each year in the late summer near height of growing season.
- C3. Size of treatment area: Entire lake ~ 354 acres
- C4. Area land use: The Lake Shirley shoreline is primarily year-round residential homes with a few seasonal lake homes still present. The lake is divided into three primary basins by several glacial eskers which cross the lake in north-south orientation. These eskers are long linear landforms with steep-sides and composed of coarse-grained sand and boulder cobbles deposited by melt water streams when this area was glaciated during the Pleistocene. Due to the steep narrow topography of these landforms, they are mostly undeveloped and covered primarily with pine vegetation. The shallow nature of the lake with much of the lake less than 10 feet deep, with the exception of a few deep basins, tends to make the lake susceptible to overgrowth by invasive weeds, especially Eurasian milfoil.
- C5. Pollutant load removed: Drawdown is intended to kill invasive vegetation which tends to grow in shallow areas of the lake. These shallow areas are exposed and the freeze/thaw exposure to these exposed lake bottoms tends to stress vegetation regrowth when the lake is later flooded in the spring.
- C6. Method of pollutant load removal determination: Invasive vegetation removal promotes healthier natural vegetation. Invasive species, such as Eurasian milfoil tend to outcompete native species. Success was determined by vegetation survey methodology.

D. Lessons Learned

Drawdown was found to be an effective technique at helping to control/ manage invasive vegetation dominance when used in conjunction with other lake management practices.

E. Attachments

Map: See attached map of Lake Shirley Best Management Practices (BMPs)

Deliverable: See LID Guidebook for the Town of Lunenburg

C. BMPs

Low Impact Development (LID) Guidebook and Public Education

- C1. Type of BMP: LID Guidebook for Town of Lunenburg and LSIC Newsletters and Annual Meetings
- C2. Date of implementation: LID information on Lake Shirley demonstration projects was included in semi-annual LSIC Newsletters and in Powerpoint presentations given at LSIC Annual Meetings during the course of the contract. The LID Guidebook for the Town of Lunenburg was completed during the summer of 2009.
- C3. Size of treatment area: All of Lake Shirley (~ 354 acres) benefits from the LID demonstration projects. The LID Guidebook provides useful information on best stormwater management practices for town boards and the public for the entire Town of Lunenburg.
- C4. Area land use: The shoreline of Lake Shirley is primarily year-round residential homes with a few seasonal lake homes still present. The Town of Lunenburg has a mix of suburban to rural land use with much of the town still in agricultural use with several large farms.
- C5. Pollutant load removed: The LID Guidebook is intended to illustrate Low Impact Development techniques that homeowners and developers can implement to meet the town's stormwater bylaw and Conservation Commission requirements.
- C6. Method of pollutant load removal determination: DEP has developed a stormwater BMP website which provides pollutant load removal estimated for the various types of LIDs that were included in the guidebook.

D. Lessons Learned

The Guidebook describes LID approaches which provide less costly, smaller-scale stormwater approaches that can be readily implemented by homeowners and smaller developers who tend to dominate the type of development that the Town of Lunenburg will likely continue to experience as the town grows.

LID demonstration projects that were constructed under this grant were featured in the Guidebook. These were augmented with other examples from local lakes based on Geosyntec's experience and practice.

E. Attachments

Deliverable: See LID Guidebook for the Town of Lunenburg

