

Project Final Report

Internal Phosphorus Load Inactivation for Lake Attitash  
18-01/319

2018-2020

City of Amesbury

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PREPARED FOR:

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION  
BUREAU OF WATER RESOURCES

AND

U.S. ENVIRONMENTAL PROTECTION AGENCY  
REGION 1

MASSACHUSETTS EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS  
Kathleen A. Theoharides, Secretary

DEPARTMENT OF ENVIRONMENTAL PROTECTION  
Martin Suuberg, Commissioner

BUREAU OF WATER RESOURCES  
Kathleen M. Baskin, Assistant Commissioner

WATERSHED PLANNING PROGRAM  
Laura J. Blake, Director



**A. Project Snapshot**

- A1. Project Start Date: April 12, 2018
- A2. Date Closed: September 30, 2020
- A3. Basin and HUC-12 watershed locations: Merrimack Basin  
HUC ID: 010700061404
- A4. Segment and waterbody information:
  - 1) Lake Attitash – MA84002
- A5. Status of waterbody:
  - 1) Category 5
- A6. Priority pollutants targeted:  
Phosphorus
- A7. Estimated annual pollutant removal, method of determination, and calculations with grant estimates from the application in brackets:  
Phosphorus: 81.9 kg/yr
- A8. BMPs installed, number and type:  
Aluminum sulfate/sodium aluminate treatment of Lake Attitash in 2019 and 2020.
  - a. 2019 Treatment – Approximately 195-acres were treated to achieve a dose of 40 g/m<sup>2</sup>
  - b. 2020 Treatment –Approximately 51.25-acres were treated to achieve a dose of 60 g/m<sup>2</sup>)

## **B. Descriptive Project Summary**

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION  
SECTION 319 NPS PROJECT 18-01/319

Project Title: Internal Phosphorus Load Inactivation for Lake Attitash  
NPS Category: Resource Restoration  
Investigator: City of Amesbury  
Location: Merrimac River Watershed

### Description:

Lake Attitash is a secondary drinking water supply that experiences frequent cyanobacteria or Harmful Algal Blooms (HABs) caused by excess phosphorus. The EPA, CDC, WHO and MADPH all agree that drinking water containing toxins from a HAB have adverse health risks including; liver, kidney and neurological damage. The MA DPH monitored the lake from 2009-2012 and issued more than a dozen health advisories during this period. Frequent blooms result from excess internal loading, and they threaten Amesbury's drinking water supply and the public. It is not possible to avoid having water from Lake Attitash being sent to Amesbury's drinking water intake during high flow conditions.

Efforts by EPA, MassDEP, Amesbury, Merrimac and the Lake Attitash Association (LAA) to lower inputs of nutrients have been implemented over the past 30 years. Large scale public education efforts have been implemented as part of these efforts and continue, and restrictive ordinances have been implemented to reduce phosphorus inputs to the lake. Agriculture was a major source of phosphorus loading in the past. Through the efforts of LAA and MADAR these inputs have been drastically reduced. The source of continued high levels of phosphorus has been identified as the lake sediment.

### Project Goals:

Sequester the phosphorus in the lake sediment over the 194 acres of Lake Attitash where anoxia occurs. Treatment of surficial sediment will lead to decreased cyanobacteria abundance, which in turn, will increase water clarity and deep water oxygen levels. Achieving this goal will reduce the risk to Amesbury's drinking water supply and the public encountering Lake Attitash.

Aluminum compounds will be applied to an area of 194 acres at a dose of at least 40 g/m<sup>2</sup>. The application of aluminum treatment will remove phosphorus from the water column. Treatments will be applied to the pond with application rates and timing to be determined following review by local and state government staff.

### Project Tasks:

- 1: Quality Assurance and Project Evaluation
- 2: Watershed Based Plan
- 3: Permitting
- 4: Aluminum Treatment
- 5: Outreach and Education
- 6: Reporting and Project Oversight

Project Cost: \$587,000

Funding: \$352,000 by the US EPA  
\$235,000 by the City of Amesbury and Project Partners

Duration: 2018 – 2020

**C. Project Finances**

Budget: See table below.

Total Project Cost = \$416,545.01

s.319 Grant Funds = \$249,470.44

Non-Federal Match = 167,074.57 (40%)

**Original Budget**

<b>Expense Items</b>	<b>s.319 Amount</b>	<b>Non-Federal Match</b>	<b>Total Amount</b>
<b>Salary - By Title and salary range:</b>			
Project Manager \$70/hour x 100 hours		\$7,000	\$7,000
City Engineer \$45/hour x 10 hours		\$ 450	\$ 450
LAA Volunteers \$24.14/hour x 150 hours		\$3,621	\$3,621
<b>Subtotal:</b>		<b>\$11,071</b>	<b>\$11,071</b>
<b>Subcontractual Services:</b>			
Permitting, Bidding & Mandated Monitoring (if required)		\$15,000	\$15,000
Phosphorous Inactivation Treatment	\$352,500	\$189,500	\$542,000
Reporting		\$10,000	\$10,000
Greenscapes		\$7,500	\$7,500
<b>Subtotal:</b>	<b>\$352,500</b>	<b>\$222,000</b>	<b>\$574,500</b>
<b>Other:</b>			
Notice of Intent mailings		\$ 1,000	\$ 1,000
Newspaper ads for permits		\$ 479	\$ 479
Miscellaneous supplies		\$ 200	\$ 200
<b>Subtotal:</b>		<b>\$ 1,679</b>	<b>\$ 1,679</b>
<b>Travel (\$.45/mile):</b>			
Mileage		\$ 250	\$ 250
<b>Subtotal</b>		<b>\$ 250</b>	<b>\$ 250</b>
<b>Totals:</b>	<b>\$352,500</b>	<b>\$235,000</b>	<b>\$587,500</b>
	<b>60%</b>	<b>40%</b>	<b>100%</b>

**Actual Budget**

<b>Expense Items</b>	<b>s.319 Amount</b>	<b>Non-Federal Match</b>	<b>Total Amount</b>
<b>Salary - By Title and salary range:</b>			
Project Manager \$70/hour		\$6,230	\$6,230
LAA Volunteers \$24.14/hour		\$8,321.98	\$8,321.98
<b>Subtotal:</b>		<b>\$14,551.98</b>	<b>\$14,551.98</b>
<b>Subcontractual Services:</b>			
Permitting, Bidding & Mandated Monitoring		\$51,615.87	\$51,615.87
Phosphorous Inactivation Treatment	\$249,470.44	\$83,842.38	\$333,312.82
Reporting		\$10,000	\$10,000
Greenscapes/Education/Outreach		\$6,824.46	\$6,824.46
<b>Subtotal:</b>	<b>\$249,470.44</b>	<b>\$152,282.71</b>	<b>\$152,282.71</b>
<b>Other:</b>			
Newspaper ads for permits		\$239.88	\$239.88
<b>Subtotal:</b>		<b>\$239.88</b>	<b>\$239.88</b>
<b>Totals:</b>	<b>\$249,470.44</b> <b>60%</b>	<b>\$167,074.57</b> <b>40%</b>	<b>\$416,545.01</b> <b>100%</b>

All tasks were completed within the original project final budget.

Match Documentation: Project match was met by in-kind (City of Amesbury and Lake Attitash Association) and paid services by the City of Amesbury.

**D. BMP**

**In-Lake Alum Treatment**

D1. Type of BMP: Internal phosphorus load inactivation through alum treatment which included the application of aluminum sulfate and sodium aluminate.

D2. Date of implementation:  
2019 Treatment – April 25<sup>th</sup> – May 16<sup>th</sup>  
2020 Treatment – June 8<sup>th</sup> – June 11<sup>th</sup>

D3. Size of treatment area (direct treatment area):  
2019 Treatment – 193.75-acres (40 g/m<sup>2</sup>)  
2020 Treatment – 51.25-acres (60 g/m<sup>2</sup>)

See treatment area map at the end of this Section.

D4. Area Land Use: See Watershed Land Use Table below.

Land Use	Area (acres)	% of Watershed
Forest	816.57	48.4
Water	376.55	22.3
Medium Density Residential	134.13	7.9
Agriculture	130.52	7.7
Low Density Residential	91.19	5.4
Open Land	61.53	3.6
High Density Residential	46.04	2.7
Industrial	17.83	1.1
Commercial	13.36	0.8
Highway	0.98	0.1

D5. Pollutant load removal:  
Phosphorus – 81.9 kg/yr (70% reduction of the 117 kg/yr internal phosphorus load)

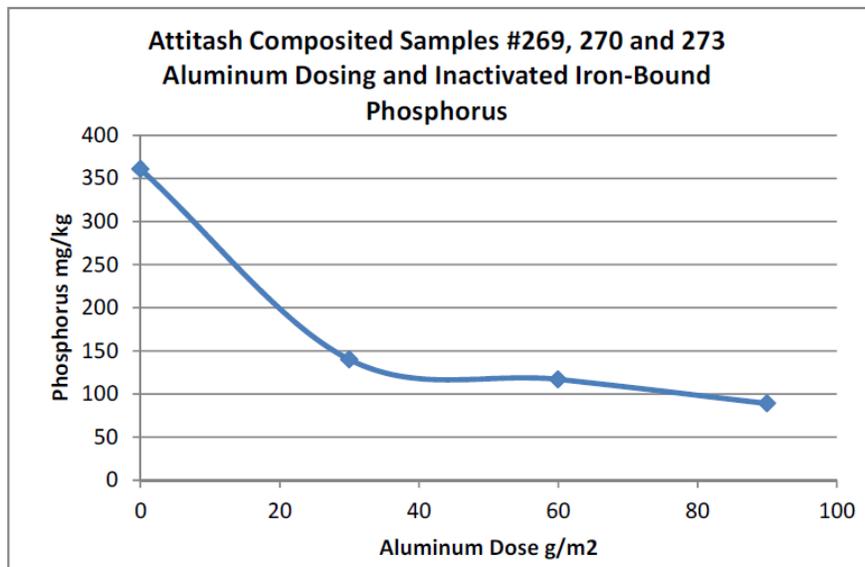
D6. Method of determination and calculations:  
A Watershed Based Plan (WBP) for Lake Attitash was prepared in 2017 to identify causes of impairments and pollutant sources to address phosphorus loading which lead to cyanobacteria blooms. The *Development of a Management Plan for Lake Attitash, Amesbury and Merrimac, Massachusetts* Report (WRS, 2016) served as the basis for the WBP and developed a nutrient budget for the lake where internal loading was identified as a leading cause for elevated phosphorus concentrations. The 2016 WRS report used a Lakes Loading Response Model (LLRM) to estimate minimum internal phosphorus loading at 117 kg/yr or 40% of the total loading with a total phosphorus load to the lake of 294.9 kg/yr. A summary of the model results from this report are provided below:

LOAD SUMMARY	Water	Phosphorus	Nitrogen
DIRECT LOADS TO LAKE	(CU.M/YR)	(KG/YR)	(KG/YR)
ATMOSPHERIC	1698372	29.0	943.5
INTERNAL	0	117.0	234.0
WATERFOWL	0	10.0	47.5
SEPTIC SYSTEM	0	0.0	0.0
WATERSHED LOAD	4633102	138.9	5087.9
TOTAL LOAD TO LAKE (Watershed + Direct Loads)	6331474	294.9	6313.0
TOTAL INPUT CONC. (MG/L)		0.047	0.997

The WBP water quality goal was to reduce the internal loading of this accumulated sediment by 70%, to return the lake to "normal" biological activity thereby eliminating harmful algal blooms and safer drinking water for Amesbury.

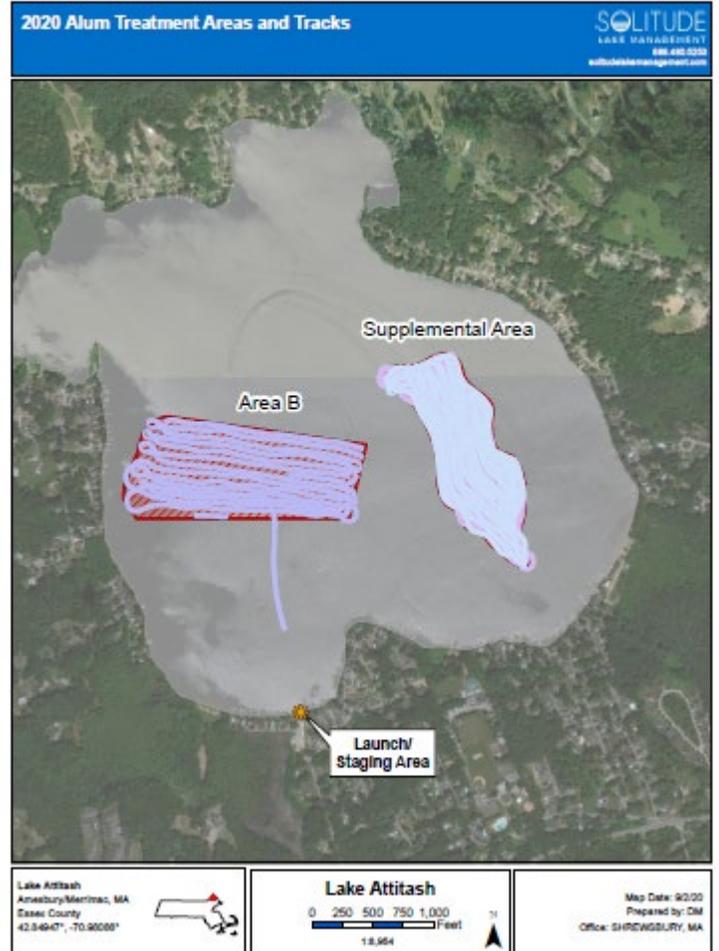
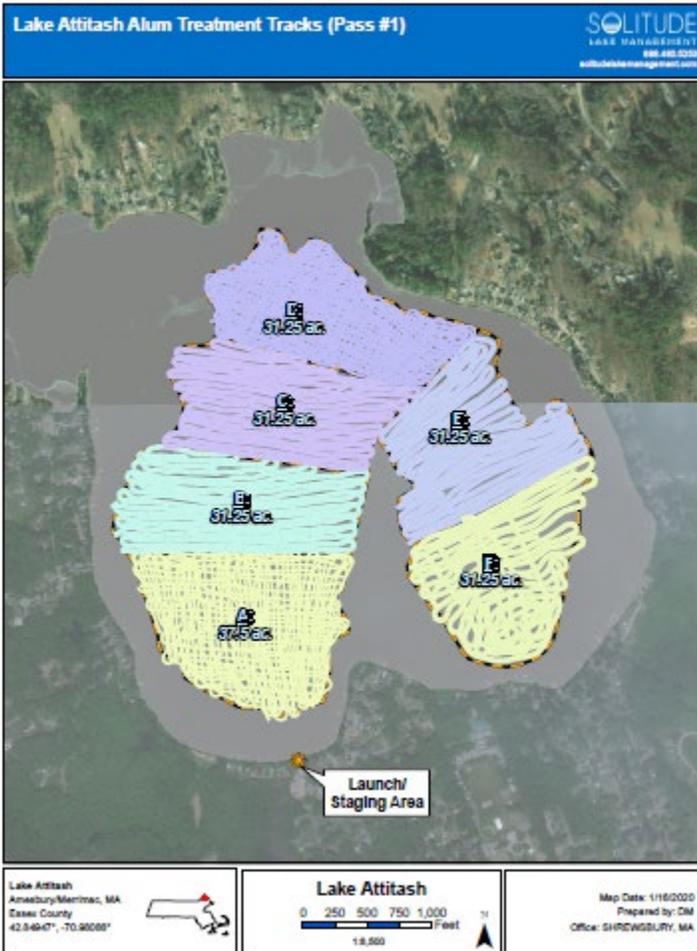
Alum treatment at Lake Attitash was the method used to treat the accumulation of phosphorus in the lake sediments. Based on extensive assessments to meet the water quality goal, the project specifications called for the application of liquid aluminum sulfate and sodium aluminate to achieve a dose of 40 g/m<sup>2</sup> of aluminum over approximately 195-acres of Lake Attitash in the spring of 2019. A follow-up treatment of 60 g/m<sup>2</sup> was applied to the deepest areas of the lake in the June of 2020.

Aluminum assays (shown below) on Lake Attitash sediment collected in 2016 indicate that the above recommended dose would yield an approximated 70% reduction in internal phosphorus load. Specifically, the aluminum assays depicted an approximate 70% reduction in the composite sample that best represents the treatment area.



Note: Lake Attitash sediment samples collected in 2016.

D7. Signed pollutant removal statement attached.



**E. Lesson Learned**

The 2019 treatment took longer than expected due to mechanical issues with the application vehicles. Since this wasn't anticipated it is recommended that treatment be planned around recreational uses of the waterbody with an additional time buffer in case additional days are required due to equipment malfunction or weather delays.

## **Appendix/Attachments**

### **Task 1 Deliverables - Quality Assurance and Project Evaluation**

- Modeled results of anticipated pollutant load reductions achieved by BMPs implemented under this project, produced by the project designer, engineer, or other qualified person.

*See Section D of this report and attached Lake Attitash Alum Treatment Final Completion Report and Addendum.*

- Documentation of the BMP implementation work. Information to be supplied for each BMP includes BMP type, date of completed installation, targeted pollutant(s), size of targeted treatment area, and site maps.

*See Section D of this report and attached Lake Attitash Alum Treatment Final Completion Report and Addendum.*

### **Task 2 Deliverables – Watershed Based Plan**

Watershed Based Plan for the Lake Attitash Watershed.

*See attached Lake Attitash Watershed Based Plan.*

### **Task 3 Deliverables - Permitting**

Approved Order of Conditions, Licenses to Apply Chemicals and additional permits as needed.

*The following permitting related documents are included:*

- Amesbury Order of Condition (DEP File #002-1204)
- Merrimac Order of Condition (DEP File #45-285)
- MassDEP License to Apply Chemicals (#WM04-000017)
- Treatment Plan, Health & Safety Plan, Spill Response Plan

### **Task 4 Deliverables – Aluminum Treatment**

Summarize and report on the results of the treatment and monitoring results (if required as part of permit conditions). Outline findings and the feasibility of possible improvements/modifications. Estimate amount of phosphorus removed from the water column and discuss any reduction in cyanobacteria related beach closures and water supply issues. Complete treatment and provide treatment report, detailing amounts applied, locations, treatment conditions, and initial results.

*See Section D and attached Lake Attitash Alum Treatment Final Completion Report and Addendum and attached ESS Water Quality Reports.*

*The City and watershed residents report improved water clarity and a reduction in algal bloom occurrence in both 2019 and 2020 (post application).*

## **Task 5. Deliverables – Public Education and Outreach**

- Provide a report summarizing outreach and education activities undertaken for this task, with copies of all education and outreach related materials and a report describing results, followup, and recommendations resulting from the task.

Education and outreach activities included the following:

- 3 LAA Annual Public Meetings
- 16 Watershed Newsletters
- Participation in Greenscapes Program for 2019 and 2020
- Storm Drain Stenciling Program

### LAA Annual Public Meetings

Annual Public meetings were held in person on 8/9/18, 8/15/19 and 8/11/2020 (via Zoom due to Covid-19 precautions).

- 2018 – 75 attendees
- 2019 – 70 attendees (See attached presentation)
- 2020 – 35 attendees via Zoom Meeting

See attached meeting presentations for 2018 (grant portion only), 2019 and 2020.

### Newsletters

All newsletters were emailed to watershed residents, posted on the LAA website and in some cases copies were brought door to door. East newsletter addressed one or more Lake Attitash nonpoint source issue

The following newsletters were developed (see attached):

- 5/30/18 Stormwater Newsletter #1
- 6/12/18 Pet Waste Newsletter #2
- 7/9/2018 Let's Get Serious Fertilizer Newsletter #3
- 8/15/2018 Buffer Gardens Newsletter #4
- 8/28/2018 Automobile / motor care newsletter #5
- 9/21/2018 Soil Erosion and Conservation Commission Newsletter #6
- 10/17/18 Clean Up Your Shoreline Newsletter #7
- 11/19/18 Yard Waste Newsletter #8
- 1/19/2019 New Years' Resolutions Newsletter #9
- 5/10/19 Alum Grant Newsletter #10
- 6/3/19 Shoreline Planting Newsletter #11
- 6/28/19 Trees Newsletter #12
- 1/11/20 Newsletter #13 Happy Fall Newsletter #13
- 2/12/20 Love your Lake Newsletter #14
- 5/1/20 Watershed Newsletter #15
- 6/5/20 Parting Shots Newsletter # 16

Painting storm drains/ Amesbury. High School Students / DPW template and paint.

## Greenscapes Program

The City of Amesbury participated in the Greenscapes North Shore Coalition in 2019 and 2020 which provided the following content:

### 2019

1. 5-year Public Education and Outreach Plan for Amesbury's MS4 Notice of Intent (NOI)
2. MS4 outreach and education to developers and residents on reducing stormwater runoff through green infrastructure
3. Outreach and education for residents, including a revised "Guide to Greenscaping" and pet waste and septic system messaging
4. Keeping Water Clean school program for up to 4 fifth grade classes in one school of your choosing.
5. Regional workshops on water quality and quantity issues
6. Greenscapes presentation
7. Greenscapes website and social media messaging ([www.greenscapes.org](http://www.greenscapes.org))
8. Additional copies of previous years' materials, if available, including the MS4 brochure

### 2020

1. MS4 outreach and education to residents, businesses, institutions, commercial and industrial facilities on reducing stormwater runoff through green infrastructure
2. Targeted outreach and education focusing on pet waste and bacteria reduction
3. "Keeping Water Clean" (KWC) school program
4. The NEW "Greenscapes Guide"
5. Regional workshops on water quality and quantity issues
6. Greenscapes presentation
7. Greenscapes website and social media messaging ([www.greenscapes.org](http://www.greenscapes.org))
8. Additional copies of previous years' materials, if available, including, 2018's MS4 brochure, 2019's Rain Garden Brochure and more

## Storm Drain Stenciling

Storm drain stenciling within the watershed took place on October 2019 by LAA volunteers and Amesbury High School students.

### **Task 6 Deliverables - Reporting and Project Oversight**

6a. Quarterly progress reports.

*All quarterly progress reports have been submitted to MassDEP.*

6b. Invoice, DM/WBE Reporting, and Match Certification.

*All invoice, DM/WBE Reporting, and Match Certification have been filed with MassDEP.*

*MassDEP issued a MBE waiver for the project on May 1, 2020.*

6c. Quarterly filing of forms.

*All quarterly forms have been filed with MassDEP.*

6d. Draft final report.

*The project draft final report has been submitted for review.*

6e. Two (2) complete hard copies of the final report and three CDs with electronic versions of the final report.

*Hard and electronic copies of the final report have been submitted to MassDEP.*

## POLLUTANT REMOVAL ESTIMATION STATEMENT

The pollutant removal estimations in this report were determined using the appropriate estimation model(s) and/or methods outlined in the May 2016 report *Development of a Management Plan for Lake Attitash, Amesbury and Merrimac, Massachusetts* by WRS. Documentation is kept on file by the grantee and is available for review by MassDEP/EPA.

A handwritten signature in black ink, appearing to read 'R Desmarais', with a long, sweeping underline that extends to the right.

Robert Desmarais, P.E.  
City of Amesbury  
Director of Public Works