Vermont Bioengineering Projects
Restoring Living Shorelands
NALMS 2019
By Amy Picotte, Vermont Shorelands Program
2011 Lake Champlain Floods
Cleared Shores Cause Bank Failure

Two adjacent properties on Malletts Bay, Lake Champlain

Photos by Britt Hazelton
Live Staking on Lake Champlain
North West Regional Planning Commission
Lake Champlain Basin Program and VTDEC Lakes and Ponds Program

Project Designed by Lamoureux and Dickerson Engineers, Essex, VT
Vermont Ranked Worse than the Nation for Degraded Shallow Water Habitat Caused by Shoreland Development

<table>
<thead>
<tr>
<th>Lakeshore Disturbance</th>
<th>Vermont</th>
<th>NAP Ecoregion</th>
<th>Nation</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>18%</td>
<td>15%</td>
<td>17%</td>
</tr>
<tr>
<td>Good</td>
<td>11%</td>
<td>42%</td>
<td>35%</td>
</tr>
<tr>
<td>Fair</td>
<td>43%</td>
<td></td>
<td>48%</td>
</tr>
<tr>
<td>Poor</td>
<td>71%</td>
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Percentage of Lakes

EPA - 2007 National Lakes Assessment
The 2014 Shoreland Protection Act

- Regulatory Permits for New Impervious Surface and Clearing
- The Voluntary Natural Shoreland Erosion Control Certification Program

This

Not That
Vermont Natural Shoreland Erosion Control Certification
Modelled after National Leaders and Experts in Bioengineering
Assessment of Five Bioengineering Installation Projects

- Fiber Coir Rolls
  - Lake Iroquois
  - Island Pond (also Lift System)

- Encapsulated Soil Lifts
  - Lake Bomoseen
  - Lake Raponda

- Live Crib Wall
  - Waterbury Reservoir
2015 Lake Iroquois – Fiber Coir Rolls

VTDEC Facilities Engineering
Brian Majka, GEI Consulting from Michigan Led Training
Plant Results

- 18% Increase in Plant Species
- Didn’t Fence First Year
- Site Stabilized

Top Growing Species
- Silky Dogwood
- Red Maple
- Redosier Dogwood
- Willows

Poorer Performing Species
- Elderberry

2015 Lake Iroquois – Fiber Coir Roll

<table>
<thead>
<tr>
<th>Species</th>
<th>% Survival</th>
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<tbody>
<tr>
<td>Silky Dogwood</td>
<td>129</td>
</tr>
<tr>
<td>Red Maple</td>
<td>120</td>
</tr>
<tr>
<td>Red Osier Dogwood</td>
<td>120</td>
</tr>
<tr>
<td>Shrub Willow</td>
<td>100</td>
</tr>
<tr>
<td>Black chokeberry</td>
<td>100</td>
</tr>
<tr>
<td>Winterberry</td>
<td>100</td>
</tr>
<tr>
<td>Arrowwood viburnum</td>
<td>100</td>
</tr>
<tr>
<td>Nannyberry viburnum</td>
<td>100</td>
</tr>
<tr>
<td>Cranberry viburnum</td>
<td>80</td>
</tr>
<tr>
<td>Red oak</td>
<td>67</td>
</tr>
<tr>
<td>Elderberry</td>
<td>40</td>
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</table>
2017 Island Pond
Encapsulated Soil Lifts and Fiber Coir Rolls

[Map of Vermont showing the location of Island Pond]

[Photos of Island Pond's shoreline and vegetation]

[Path along the shore with foliage]

[Map showing the location of Island Pond]

[Path along the shore with foliage]

[Map showing the location of Island Pond]

[Path along the shore with foliage]
Plant Results

- 25% Decrease in Plant Species
- Sandy Soils Susceptible to Ice Push
- Fencing Removed then Replaced
- Project Stable

Top Growing Species
Arrowood Viburnum
Low Grow Fragrant Sumac

Poorer Performing Species
Herbaceous plants have been slower growing

2017 Island Pond – Fiber Coir and Lift System

- 100% Survival
- 97% Survival
- 88% Survival
- 67% Survival
- 60% Survival

% Survival

Fiber Coir Roll & Encapsulated Soil Lifts

Arrowwood Viburnum Fragrant Sumac Sweet Fern Nannyberry Viburnum Black Cokeberry
2017 Lake Bomoseen - Encapsulated Soil Lifts
Lake Bomoseen – Encapsulated Soil Lifts

August 2017

June 2019

Sept 2019
Lake Bomoseen

Top Tier
- % Gain in stem count:
  - Cranberry viburnum
  - Nannyberry
  - Redosier Dogwood
  - Arrowwood
  - Silky Dogwood
  - Elderberry

Middle Tier
- Cranberry viburnum
- Nannyberry
- Redosier Dogwood
- Arrowwood
- Silky Dogwood
- Elderberry

Bottom Tier
- Cranberry viburnum
- Nannyberry
- Redosier Dogwood
- Arrowwood
- Silky Dogwood
- Elderberry
Lake Bomoseen
Natural Plant Mortality and Cultural Plant Mortality
Plant Results

- 15% Decrease in Plant Species
- Beaver and People Damages
- Japanese Knotweed Introduction
- Project Stable

Top Growing Species
- Elderberry
- Silky Dogwood
- Nannyberry Viburnum

Poorer Performing Species
- Willow

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2017 Lake Bomoseen-Encapsulated Soil Lifts

- % Survival
- No Change

- Common elderberry: 133%
- Silky dogwood: 89%
- Nannyberry viburnum: 87%
- Arrowwood viburnum: 85%
- Red Osier dogwood: 80%
- Cranberry viburnum: 78%
- Willow spp.: 54%
2018 Lake Raponda – Encapsulated Soil Lifts
Natural Shoreland Erosion Control - Partners Training
Plant Results

- 18% Decrease in Plant Species
- Delayed Fencing
- Project Stable

Top Growing Species
Black Chokeberry
Redosier Dogwood
Steeplebush

Poorer Performing Species
Nannyberry Viburnum (did well at Bomo site)

2018 Lake Raponda - Encapsulated Soil Lifts

- % Survival

- Black chokeberry: 107
- Red osier dogwood: 97
- Steeplebush: 93
- American cranberry: 88
- Willow spp: 72
- Nannyberry viburnum: 70
2018 Waterbury Reservoir - Live Crib Wall

FASTEN 8X8 W/ 12" TIMBER LOCK SCREWS OR EQUAL

BACKFILL W/ NATIVE SOIL
NO STONES LARGER THAN 6"

PREPARE RAMP TO FINISH GRADE

NATIVE PLANTINGS

EXISTING TOP OF BANK

TIMBER CRIB
6"x6"

STAIRS
4"x4"

TIMBER CRIB
4"x8"

PIN 1ST 8X8 LIT W/#4 REBAR
EA #4 REBAR IS 4" LONG

SCALE: 1" = 2'
Live Crib Wall at Waterbury Reservoir

2018 – Just Installed
Live Crib Wall at Waterbury Reservoir

2019 – one year later
Plant Results

- 30% Decrease in Plant Species
- Reservoir Level Changes
- Popular Backcountry Site Hard to Water Regularly
- No Fencing Used
- Site Stabilized

2018 Waterbury Reservoir - Live Crib Wall Plant Survival

- Black Chokeberry: 107
- Arrowwood Viburnum: 100
- Silky Dogwood: 72
- American Cranberry: 93
- Nannyberry Viburnum: 72
- Elderberry: 28
- Maple Leaf Steeplebush Viburnum: 0

Percent Change in Stem Count

- 0% No Change

Note: The graph shows the survival percentages of different species at the Waterbury Reservoir.
LESSONS LEARNED from Vermont Bioengineering
Are These Nature-Based Solutions to Restore Living Shorelands Working?

Mallards on Lake Raponda

Mergansers on Maidstone Lake by Rebecca Scott
Average distance wind can travel (km) over water to the site weighted by direction of the fastest 5-second wind gust (daily) in February to May of 2019

Effective Fetch:
- 2017 Lake Bomoseen
- 2017 Island Pond
- 2018 Waterbury Reservoir

Percent Change in Stem Count:
- 2015 Lake Iroquois: 18% Plant Increase Softscape
- 2018 Lake Raponda: 19% Plant Mortality Softscape
- 2018 Waterbury Reservoir: 30% Plant Mortality Live Crib Wall

ALL SITES STABLE!
Summary - Lessons Learned

✓ Plan for 20% Plant Mortality
✓ Plan for Replacement Plantings
✓ Simplify Planting Selections
✓ Use Clean Soils
✓ Use Wildflower Seed
✓ Signage Is Important
✓ Install Temporary Fencing (Sand Fence)
✓ Use Biodegradable Jute ECB Instead of Geotextiles

Illustration by Sarah Drew
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