

Massachusetts Department of Fish and Game

Division of Ecological Restoration

Invested in Nature and Community

Bridges and Culverts: Repair, Replace, Reconstruct

Timothy Chorey

Stream Continuity Specialist
Timothy.Chorey@state.ma.us

Kristen Ferry

Restoration Specialist/Continuity Program Manager
Kristen.Ferry@state.ma.us



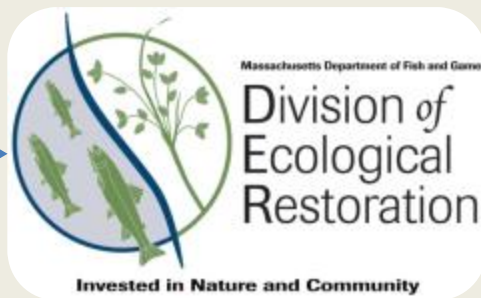


Stream Continuity Program

Est. 2014



Westfield Brook – Windsor, MA (DER)



Stream Continuity Program

Est. 2014

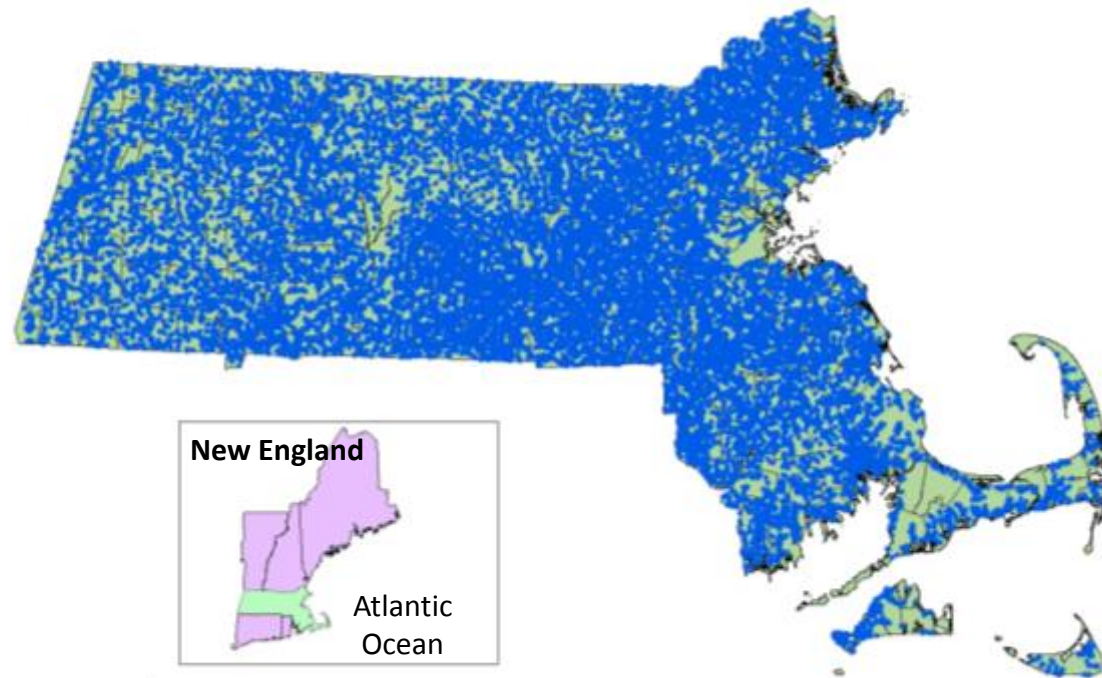


Westfield Brook – Windsor, MA (DER)

Program Goal
**Increase town's
ability to replace
culverts**

Massachusetts Situation

- 351 Municipalities
- 30,000 culverts
- Mostly town owned, maintained & managed
- The majority block fish and animal passage
- Aging and degraded infrastructure



● Road-stream crossing

Massachusetts Situation

MA Stream Crossing Standards promulgated into regulations

- MA Wetland Protection Act – 2014
- MA Army Corp of Engineers – 2005



Massachusetts Stream Crossing Standards or Aquatic Organism Passage (AOP)

0.82 Openness ratio

Large span, 1.2x bankfull width

Open arch



2 feet
Embedment

Natural
substrate

Banks, dry
passage

Comparable depth and
velocity, up & downstream

Paul Nguyen

Roadway History

A MANUAL
OF
THE PRINCIPLES AND PRACTICE
OF
ROAD-MAKING:
COMPREHENDING
THE LOCATION, CONSTRUCTION, AND IMPROVEMENT
OF
ROADS,
(COMMON, MACADAM, PAVED, PLANK, ETC.)
AND
RAIL-ROADS.

BY
W. M. GILLESPIE, A. M., C. E.
PROFESSOR OF CIVIL ENGINEERING IN UNION COLLEGE.

SIXTH EDITION, WITH ADDITIONS.

"Every judicious improvement in the establishment of roads and bridges
increases the value of land, enhances the price of commodities, and augments
the public wealth."
DR. WERT CLINTON.

NEW YORK
PUBLISHED BY A. S. BARNES & CO.
51 JOHN STREET.

1853.

178

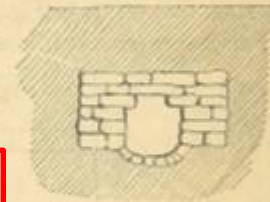
THE CONSTRUCTION OF ROADS.

CULVERTS AND DRAINS.

These structures are necessary for carrying under a road the streams which it intersects. They are also needed to carry the waters of the ditches, from the upper side of a road, to that side on which lie the natural water-courses into which they must finally be discharged. Their simplest form consists of two walls of stone or brick, covered with slabs, and having a foundation, either of wood (if always wet) or of stone, laid in the form of an inverted arch, as shown in cross-section in Figure 97.

Their size must be proportioned to the greatest quantity of water which they can ever be required to pass, and should be at least 18 inches square, or large enough to admit a boy to enter to clean them out. Their bottoms should be inclined 1 in 120, or 1 inch in 10 feet. When the road

Fig. 97.



be at least 18 inches square,
or large enough to admit a boy
to enter to clean them out.

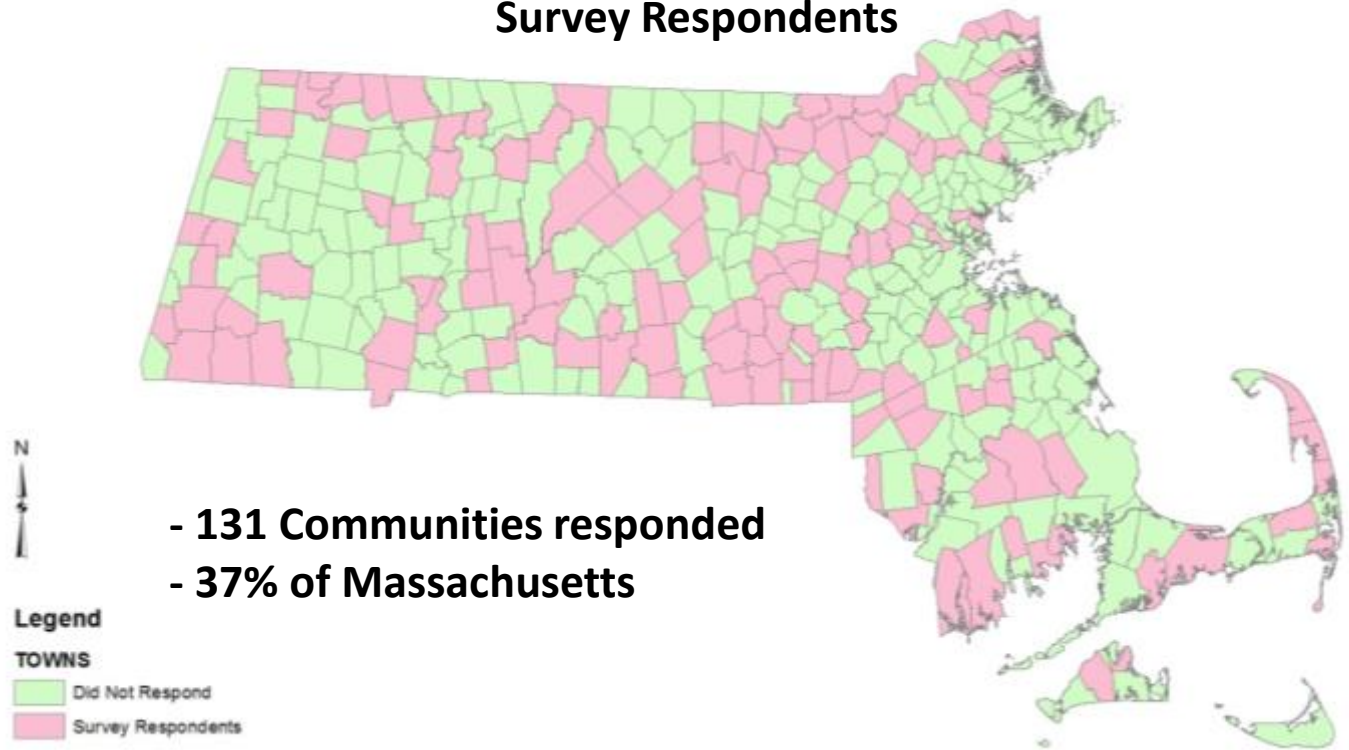
In districts where stone is scarce, a small culvert may

Identify the Problems

Conducted a state-wide
needs assessment.

**Status Quo &
Hurdles to Implementation**

Survey Respondents



What DER is doing:

1) Providing Technical Assistance



Getting in the River

Dighton, MA



Getting in the Culvert

Dighton, MA

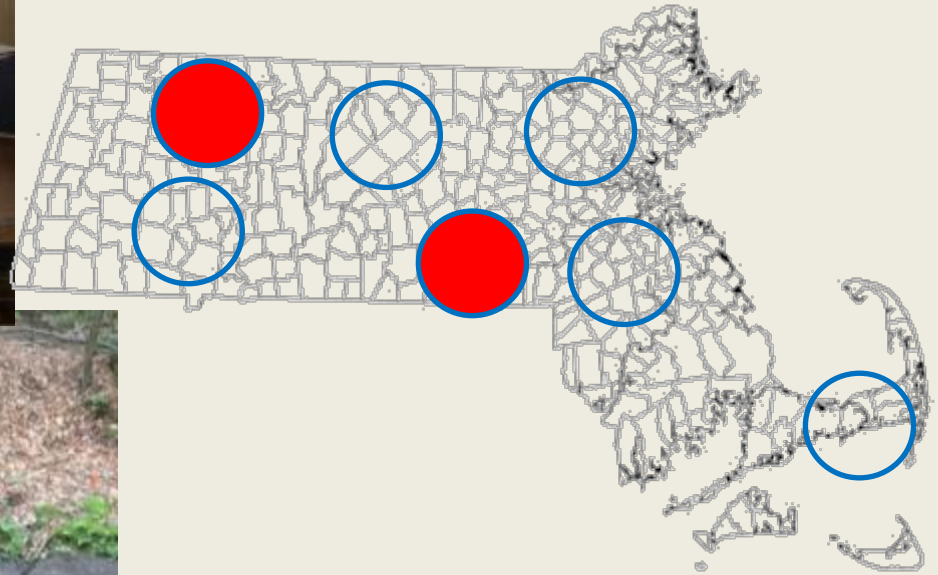
1) Providing Technical Assistance

West Tisbury
August to November 2016



What DER is doing:

2) Long Term Culvert Replacement Training Sites



Ashfield, MA



What DER is doing:

3) DER Statewide Funding Opportunities

- **Field Data Collection Grant (Long Term Training Site)**
 - 2 grants for \$25,000 (\$50K total)
 - Deadline January 27, 2017
- **Municipal Assistance Grant Program***
 - All Phases of Culvert Replacement
 - \$750,000 Total
 - Issued Mid-February 2017
 - Funds available for FY18 (July 2017)

*subject to state budget approval



Ashfield, MA

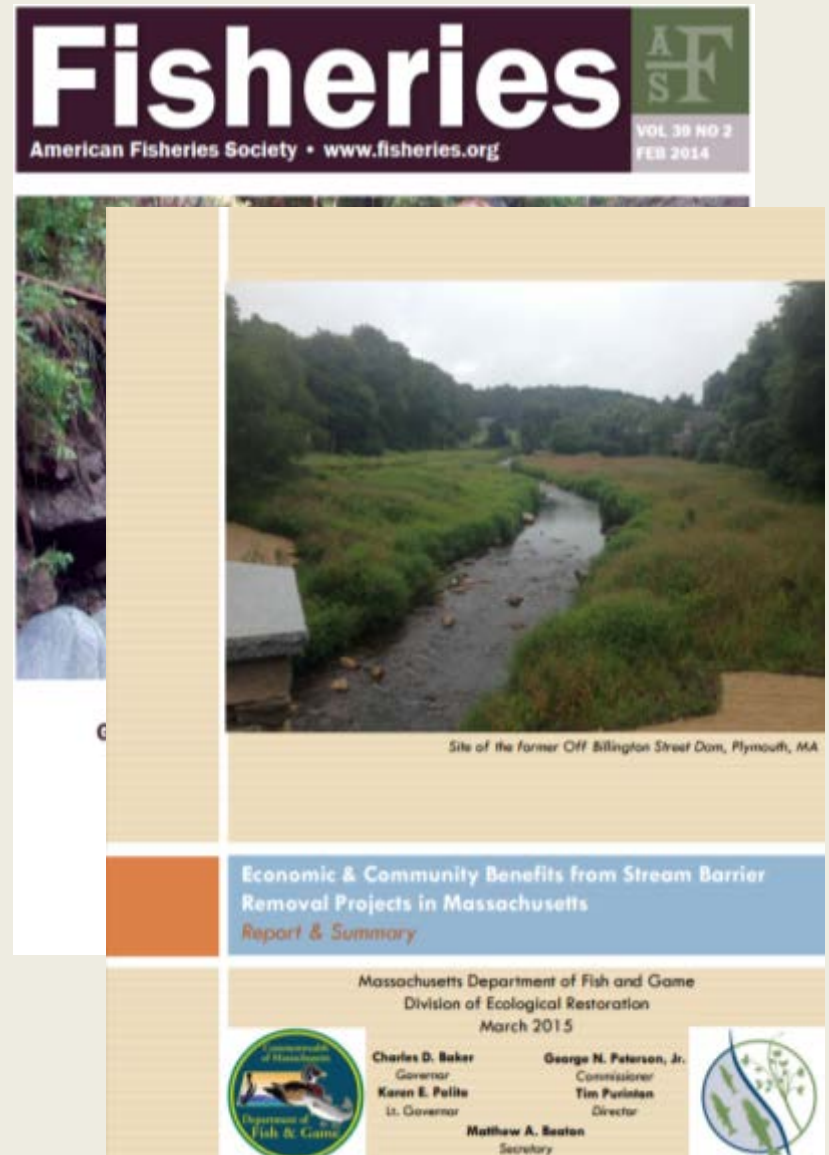
Long Term Cost Benefits

1. American Fisheries Society



Long Term Cost Benefits

1. American Fisheries Society
2. Division of Ecological Restoration



Long Term Cost Benefits

1. American Fisheries Society
2. Division of Ecological Restoration
3. National Cooperative Highway Research Program (NCHRP)
Project 25-25, Task 93.



Site of the former Off Billington Street Dam, Plymouth, MA



Ed Samanns, PWS, CE
Senior Program Manager

Gianfilippo Caselli,
DMA Economist

Division of
Ecological
Restoration



Louis Berger

**Long Term
Construction and
Maintenance Cost
Comparison for
Road Stream
Crossings:
Traditional
Hydraulic Design
vs. Aquatic
Organism
Passage Design**

**Economic & Community Benefits from Stream Barrier
Removal Projects in Massachusetts**
Report & Summary

Massachusetts Department of Fish and Game
Division of Ecological Restoration
March 2015



Charles D. Baker
Governor
Karen E. Polla
Lt. Governor

George N. Peterson, Jr.
Commissioner
Tim Purinton
Director

Matthew A. Beaton
Secretary



Long Term Cost Benefits

- American Fisheries Society

- Highlighted the impacts of culvert failures in VT after TS Irene



Take home message

- **True Cost =**
 - Replacement \$\$ +
 - Tourism \$\$ +
 - Disruption to commerce \$\$ +
 - Human Safety \$\$ +
 - Emergency Response \$\$...

RT 100 & RT 73, Rochester, VT



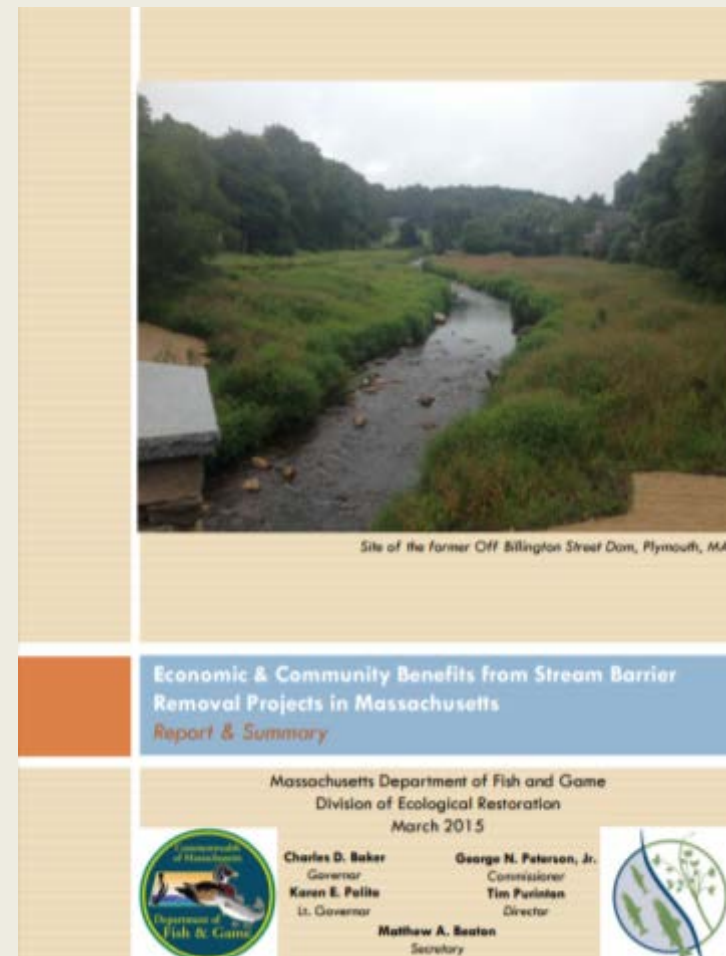
Long Term Cost Benefits

- Division of Ecological Restoration

- Compared 3 AOP Replacement to In-Kind Replacement over a 30 yrs.

Take home message

- Upfront cost was more, but
- Long Term cost was **38%** less expensive the in-kind replacement over 30.



Long Term Cost Benefits

- National Cooperative Highway Research Program (NCHRP) Project 25-25, Task 93

- Reviewed 94 AOP Crossings
- 8 different states
- Used several cost benefit models

Take home message

- AOP culverts were cost effective for:
 - **78%** of 3-sided box culverts
 - **82%** of 4-sided box culverts
 - **100%** of metal pipe culverts



Louis Berger

**Long Term
Construction and
Maintenance Cost
Comparison for
Road Stream
Crossings:
Traditional
Hydraulic Design
vs. Aquatic
Organism
Passage Design**

Long Term Cost Benefits

Summary

- The True Cost of failure is more than just the cost of a culvert.
- Upfront cost are higher for culverts meeting the Stream Crossing Standards
- Typically, culverts meeting the Stream Crossing Standards are cost effective over the life of the culvert, and have storm resilience and ecological benefits.

Roadway History

A MANUAL
OF
THE PRINCIPLES AND PRACTICE
OF
ROAD-MAKING:
COMPRISING
THE LOCATION, CONSTRUCTION, AND IMPROVEMENT
OF
ROADS,

COST AND REVENUE COMPARED.

65

5. WHAT ROADS OUGHT TO BE AS TO THEIR COST.

A *minimum* of expense is, of course, highly desirable ; but the road which is truly cheapest is not the one which has cost the least money, but the one which makes the most profitable returns in proportion to the amount which has been expended upon it.

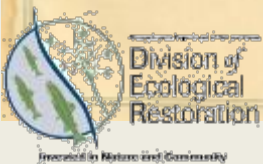
To lessen the cost of the construction of a road, while striving to attain the attributes which we have found to be desirable, we should endeavor to avoid the necessity of making high embankments, or deep excavations, or any rock-cuttings; the cuttings through the hills should just suf-

5. WHAT ROADS OUGHT TO BE AS TO THEIR COST.

A *minimum* of expense is, of course, highly desirable ; but the road which is truly cheapest is not the one which has cost the least money, but the one which makes the most profitable returns in proportion to the amount which has been expended upon it.

PUBLISHED BY A. S. BARNES & CO.
51 JOHN STREET.
1853.

improvement, and also of the annual saving of labor in the carriage of goods and passengers which its adoption will produce. If the latter exceed the interest of the for-



Stay Tuned...

Thank you!



Timothy Chorey

Stream Continuity Specialist

Timothy.Chorey@state.ma.us