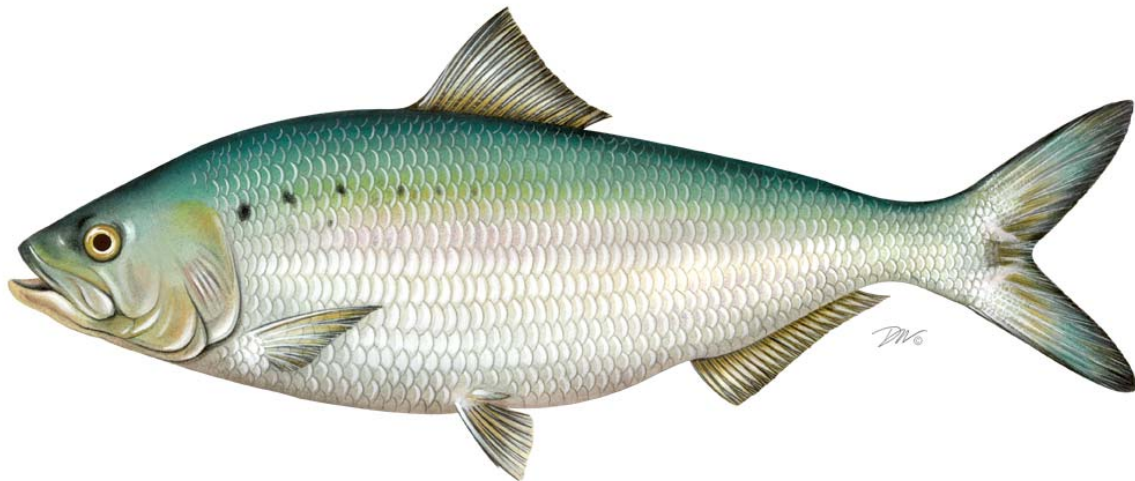


Massachusetts Division of Marine Fisheries
American Shad Habitat Plan for
Massachusetts Coastal Rivers



Submitted to the Atlantic States Marine Fisheries Commission as a requirement of Amendment 3 to the Interstate Management Plan for Shad and River Herring

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Massachusetts Division of Marine Fisheries -- January 2014

American shad spawning runs in Massachusetts occur in two large rivers bordering multiple jurisdictions and six moderate sized coastal rivers. The Connecticut River and Merrimack rivers have relatively large runs of American shad that support recreational fisheries and are managed by multi-jurisdiction management plans (CRASC 1992; and MRTC 1997). The American shad habitat plans for the Connecticut River (CRASC *in Prep.*) and Merrimack River (MRTC 2010) are reported independently from this report. The other coastal rivers with known spawning runs present are (with major drainage area in parentheses): Palmer River (Narragansett Bay), Jones River (South Shore), North River (South Shore), South River (South Shore), Neponset River (Boston Harbor), and Charles River (Boston Harbor). The principal threat identified for most shad runs in Massachusetts is **Barriers to Migration**. However, significant questions about the status of potential threats and issues such as water withdrawals and water quality impairment exist and require further investigation. This habitat plan will report on the Palmer River and Charles River because among the six coastal runs they have been identified as restoration priorities by the MA Division of Marine Fisheries (*Marine Fisheries*). The Taunton River is included for future monitoring because a historical shad run and fishery were present, but the current population status is unknown. Updated versions of this plan will add other rivers as needed.

A synopsis of investigations on American shad spawning habitat requirements (Greene et al. 2009) reveals that although consensus is lacking, shad generally spawn well upstream of the tidal interface at mid-river runs in relatively shallow depths (< 4 m) with more apparent selection to moderate to high water velocity (0.3 to 0.9 m/s) than to a specific substrate type.

Palmer River

Watershed Information: The Palmer River, located in Bristol County, MA, originates in the wetlands of northern Rehoboth (Figure 1) and flows south for approximately 17 river miles (rm) through Swansea to its confluence with the Barrington River and discharges to Narragansett Bay in RI. Two impoundments created by dams are located along the course of the river: Shad Factory Pond and Perryville Pond. The former is a shallow 38 acre pond formed by an 8 ft dam last rebuilt in 1912. The dam is located at 7.7 rm with a drainage area of 27.5 mi². Shad are known to spawn along an unknown proportion of the upper end of the river below the dam. Upstream of the dam, there is 6.5 rm of potential spawning habitat before reaching the impassible Perryville Dam at rm 14.2. The habitat upstream of the Perryville Dam (Perryville Pond; 3.3 acres) has not been assessed, but is thought to have low potential for American shad with some potential for other diadromous species. The watershed, which also supports spring spawning runs of white perch and river herring, was documented in the 1970s as having spawning rainbow smelt and sea lamprey. The Palmer River presently has the last remaining recreational fishery for American shad in MA south of Cape Cod.

American Shad Status: No current population data are available. Fishery resource surveys were conducted by *Marine Fisheries* and the MA Division of Fish and Wildlife (*MassWildlife*) from 1968 to 1971 and by *Marine Fisheries* in 1993. Water quality and creel information were collected in these surveys. Creel survey results are summarized in Table 1. In addition, shad were transplanted by *Marine Fisheries* personnel from the Palmer River into the Mattapoissett River in 1968 (N = 78) and in 1969 (N = 80). Anecdotal reports suggest that recreational angling for shad continues in the Palmer River, although at low levels of catch and effort. Population monitoring and habitat assessment were considered when a fish ladder was reconstructed at Shad Factory Pond in 2007; however, this work has not been done.

Fish Ladder Specifications: A concrete weir and pool fish ladder was installed in 2007 by the Town of Rehoboth, Save the Bay and several funding partners. The fish ladder was designed by the U.S. Fish and Wildlife Service (USFWS) and the project received technical assistance from the MA Office of Fishing and Boating Access and *Marine Fisheries*. The fish ladder is approximately 320 ft. in length with 19 weirs and 16 ft x 3 ft pools. No aspect of fish passage for shad has been assessed at this location. The Perryville Dam in Rehoboth has no fishway and obstructs passage to unassessed habitat (Reback et al. 2004).

Table 1. Summary of Palmer River shad creel surveys conducted between 1968 – 1971 and 1993.

Date	1968	1969	1970	1971	1993
No. Anglers	333	657	413	419	72
Total Catch	148	174	82	120	41
Hours Fished	660	1500	1297	915	108
Catch/Hour	0.22	0.12	0.06	0.13	0.38

Regulatory Authority: The owner of the dam is responsible for repairing, operating, and maintaining the fish passage facilities as prescribed in M.G.L. Chapter 130 §19. Fish passage at the Shad Factory Pond fish ladder has been historically managed cooperatively by the Town of Rehoboth and the dam owner, the Bristol County Water Authority of Bristol, RI. Wetlands habitat and water quality protections are provided by M.G.L. Chapter 131 §40 and Commonwealth of Massachusetts Regulations 10.00 and administered by the Massachusetts Department of Environmental Protection (*MassDEP*).

Water Withdrawal Permissions: The Bristol County Water Authority maintains a water withdrawal registration (No. 4-26-247.05) issued by *MassDEP* in the Narragansett Bay and Mt. Hope Bay Shore river basins to withdraw 2.7 million gallons per day (MGD) from three surface water sources (Swansea Reservoir, Shad Factory Reservoir and Anawan Reservoir) for public water supply. Monthly withdrawal records are required for annual submission to *MassDEP*.

Water Discharge Data: None currently. The West Branch of the Palmer River had a gauge station (No. 01109200, drainage area 4.35 mi²) operating during 1962-1974. The monthly mean discharge in May for this period was 9.8 cfs; however, the short duration of the data series and long distance between the West Branch gauge location and Shad Factory Pond limit the data utility.

Water Quality Monitoring: *MassDEP* assesses waterbodies by comparing water quality to Surface Water Quality Standards (SWQC), indentifying threats to habitats and recommending remedial actions (*MassDEP* 2007). The Narragansett Bay watershed was last assessed during 2004-2008 (*MassDEP* 2009); however, the Palmer River segment was listed as "Not Assessed" for its capacity to support aquatic life.

Recommended action:

Currently, *Marine Fisheries* does not have an ongoing project or imminent plans to initiate an assessment of the Palmer River shad run. *Marine Fisheries* expects that a habitat assessment would be useful for this watershed and potentially transferable to other Massachusetts watersheds with small, poorly documented shad runs; however, the funding to undertake this effort is not presently available. We **recommend** the following actions for the Palmer River: (1) assessment of the amount and suitability of Palmer River habitat for shad spawning and rearing, (2) census counts of shad and river herring passing upstream into Shad Factory Pond, (3) passage efficiency at the Shad Factory Dam fishway and (4) the feasibility of fish passage improvements at the Perryville Dam.

Agency or Agencies with Regulatory Authority: *MarineFisheries* -- coastal waters diadromous fish, *MassWildlife* -- inland waters diadromous fish, and *MassDEP* -- wetlands and water quality protection.

Action actively being addressed by agency: The only action taken to date has been the preparation of an Operations and Maintenance Plan for the Shad Factory Dam fishway. A draft was sent to the dam owner in 2011 requesting comments. The dam owner has not responded to the inquiry to date.

Initial Habitat Goal: Conduct the shad spawning habitat assessment for the Palmer River upstream and downstream of Shad Factory Pond and assess species presence. If suitable upstream conditions are found, seek funding for passage efficiency studies at Shad Factory Pond and fish passage feasibility studies at Perryville Dam.

Timeline for achieving goals/targets: None established. *MarineFisheries* will seek funding in 2014.

Possible metrics to evaluate progress: (1) comparison of water quality parameters to *MassDEP* criteria (SWQC) for supporting aquatic life; (2) census counts of shad and river herring into Shad Factory Pond using a locking box trap installed at the fish ladder exit; (3) passage efficiency evaluation using PIT tag study; (4) discharge range that provides suitable water depth and velocity in fishway and water depth and velocity at river habitats.

Estimated costs: A cost estimate has not been developed yet. The primary cost item for the Initial Habitat Goal would be two short-term technicians.

Potential setbacks/areas of concern: The watershed is part of an active water supply. The municipal needs for water compete directly with water needs for aquatic life, but the effects are unknown.

Other organizations: The Town of Rehoboth has expressed an interest in shad restoration in the Palmer River. The Bristol County Water Authority has an interest and responsibility to allow diadromous fish passage at Shad Factory Pond.

Charles River

Watershed Information: The Charles River is a relatively large coastal river in Massachusetts that provides habitat for diadromous fish for nearly 80 mi as it flows to Boston Harbor (Figure 2) and borders the lands of 24 towns and cities. The drainage area of the watershed is approximately 311 mi². There are eight dams that fragment diadromous fish habitat in the Charles River. The upper two dams have no passageways and the lower six have passageways with unknown efficiency for passing American shad.

American Shad Status: Belding (1921) refers to the Charles River as one of the first rivers in Massachusetts to lose its shad and alewife fisheries due to pollution and dams. Reback and DiCarlo (1972) state that shad were not present in the Charles River at the time of their 1960s survey of anadromous fish; however, they note the high restoration potential and interest of *MarineFisheries* to pursue shad restoration. A river assessment was conducted by *MarineFisheries* in the late 1960s to determine the available potential spawning habitat. A total of 61 mi with suitable spawning habitat was documented and plans were launched to begin stocking fertilized shad eggs in 1971. Intensive stocking of shad eggs occurred through much of the 1970s and sporadic stocking of mature adult shad continued from 1978 to 1992. The results of the stocking effort were not evaluated, although returning adult shad were captured in low numbers while collecting river herring for stocking below the Watertown Dam during the 1990s and 2000s (Reback et al. 2005). Shad stocking efforts were renewed in 2006 to apply improved culture techniques and oxytetracycline (OTC) marking to evaluate restoration responses.

Ongoing Shad Monitoring: Starting in 2006, a cooperative effort between *Marine Fisheries* and the USFWS, has stocked an average of 3 million OTC-marked larvae in potential nursery habitat upstream of the Moody Street Dam (4th barrier). Gravid American shad were collected from the Merrimack River and cultured to fry stage at the USFWS Attleboro hatchery. For the past 3 years the two agencies have electrofished downstream of the Watertown Dam (2nd barrier) in order to provide information on the status of the shad run and restoration contributions. During 2012, weekly, spawning run electrofishing trips yielded a total of 30 adult shad. The otoliths of each adult were removed and examined for an OTC mark and were aged along with scales from each fish. Of the 30 adults retained, 25 were an age (3-6) that could have originated from the restoration efforts. Of those 25 fish, 15 possessed an OTC mark. It is unknown whether non-marked fish are the result of straying, hatchery product that lost or failed to incorporate an OTC mark, or remnant of a natural population. Since the resumption of stocking in 2006 a limited effort has been made to identify if a remnant spawning run existed. This assessment operated the Denil fishway at the Watertown Dam as a fish trap.

When the trap was operated, adult shad were prevented from passing through the upstream exit by way of tightly spaced vertical bars. The trapping approach had limitations, but did document the presence of low numbers of adult shad. In 2013, *Marine Fisheries* replaced this trap methodology with a video monitoring system. Video review is not complete at this time, but to date over 250,000 river herring and 36 adult shad have been observed passing through the fishway. In 2013 only 21 adult American shad were captured while electrofishing, meaning the number of shad successfully utilizing the fishway exceeded the number sampled below and supports the possibility of natural reproduction occurring in the watershed. The stocking efforts in 2013 included the release of double OTC marked fry to assist with the evaluation of stocking and marking techniques.

Fish Ladder Specifications: Detailed specifications on the Charles River fishways are provided in Reback et al. (2005). The first barrier in Boston Harbor is the Charles River Locks, built for navigation and flood control. A locking protocol is used to pass migrating fish at this location with specific timing provisions for the shad migration. The 2nd, 4th, 5th and 6th dams have large width Denil fishways designed by the USFWS to pass river herring and shad. The 3rd barrier has been partially breached to allow fish passage. The uppermost dams, the Metropolitan Circular Dam at 20.0 rm and the Silk Mill Dam at 20.2 rm have no fishways. At present, shad have access to approximately 20 rm of potentially suitable habitat.

Regulatory Authority: The owner of the dam is responsible for repairing, operating, and maintaining the fish passage facilities as prescribed in M.G.L. Chapter 130 §19. Seven of the eight dams on the Charles River are owned by the Massachusetts Department of Conservation and Recreation. The Silk Mill Dam is privately owned. Wetlands habitat and water quality protections are provided by M.G.L. Chapter 131 §40 and Commonwealth of Massachusetts Regulations 10.00 and administered by the Massachusetts Department of Environmental Protection (*MassDEP*).

Water Withdrawal Permissions: With a large urban watershed that connects many towns, the Charles River is subject to complex water management. Communities in the metropolitan Boston area (inside Route 128) receive water from the Massachusetts Water Resources Authority's Quabbin Reservoir. Communities outside of Route 128 are allowed under 14 MA Water Management Act permits to withdraw water from groundwater wells and reservoirs.

Water Discharge Data: The importance of the Charles River for water resource management is reflected by the presence of 18 USGS stream flow gauges in the watershed. The Waltham stream flow gauge station (No. 01104500, 12.2 rm, 251 mi² drainage area) is on the main stem Charles River and is most proximate to the fishways. The average monthly discharge at the Waltham gauge station is 615 cfs for April and 370 cfs for May from the time series record of 1931-2012.

Water Quality Monitoring: *MassDEP* assesses waterbodies by comparing water quality to Surface Water Quality Standards, identifying threats to habitats and recommending remedial actions (*MassDEP* 2007). The Charles River watershed was last assessed during 2002-2006 (*MassDEP* 2008); with a large percentage of the potential shad habitat listed as *Impaired* due to several stressors including low dissolved oxygen, high nutrients, and invasive plant growth.

Recommended action:

The current efforts being undertaken by *Marine Fisheries* have been outlined above. Stocking and monitoring efforts will continue through at least 2015. *Marine Fisheries* expects that a habitat survey and assessment would be useful for this watershed and potentially transferable to other watersheds in Massachusetts, but the funding to undertake this effort is not presently available. We **recommend** the following actions for the Charles River: (1) assessment of the amount and suitability of Charles River habitat for shad spawning and rearing; (2) passage efficiency at the Watertown Dam fishway; (3) evaluate the feasibility of providing fish passage at the two upstream impassible dams; and (4) evaluate the feasibility of fish passage improvements through removal of the Watertown Dam.

Agency or Agencies with Regulatory Authority: *Marine Fisheries* -- coastal waters diadromous fish, *MassWildlife* -- inland waters diadromous fish, and *MassDEP* -- wetlands and water quality protection.

Action actively being addressed by agency: *Marine Fisheries* is currently monitoring passage at the first fishway to measure potential for natural reproduction. We are also facilitating dialogue between citizen's groups and other state agencies to increase access to upstream habitat in the system through fish passage improvements.

Initial Habitat Goal: Conduct shad spawning habitat assessment for the Charles River upstream and downstream of the Watertown Dam. If suitable conditions are found, seek funding for passage efficiency studies at the Watertown Dam and next two dams upstream.

Timeline for achieving goals/targets: None established. *Marine Fisheries* will seek funding in 2014.

Possible metrics to evaluate progress: (1) comparison of water quality parameters to *MassDEP* criteria (SWQC) for supporting aquatic life; (2) passage efficiency evaluation using PIT tag study; and (3) discharge range that provides suitable water depth and velocity in fishway and water depth and velocity at river habitats.

Estimated costs: A cost estimate has not been developed.

Potential setbacks/areas of concern: The watershed is part of a heavily urbanized area with documented surface water quality and stormwater impairments. Invasive species are also of concern, as many lentic areas in the watershed are heavily impacted by water chestnut.

Other organizations: *Marine Fisheries* conducts most field work in cooperation with the USFWS. The Charles River Watershed Association is also engaged in fish habitat restoration as well as the greater betterment of the Charles River.

Taunton River

Watershed Information: The Taunton River is the largest river in southeastern Massachusetts and has no barriers that impede American shad passage along the 38.5 km main stem. The Taunton River includes a large drainage area (approximately 562 mi²) that is supported by numerous significant tributaries. The Taunton River, which is formed by the confluence of the Matfield and Town rivers in Bridgewater, passes the borders of more than 10 towns before reaching the tidal Mount Hope Bay which connects to Narragansett Bay (Figure 1). The watershed has a legacy of industrial pollution, yet is unique in Massachusetts with no dams along its entire main stem.

American Shad Status: Belding's (1921) anadromous fish survey of the early 20th century recognized historical shad runs in the Taunton River that were rendered commercially extinct due to industrial pollution. Unlike most coastal rivers in Massachusetts, obstructions were not a problem for migratory fish in the main stem Taunton River. The next anadromous fish survey in the 1960s (Reback and DiCarlo, 1972) also cited pollution as the primary driver of low shad numbers in the Taunton system as opposed to dams. During this survey, additional work was done to identify shad habitat in the Taunton River. *Marine Fisheries* surveyed the stream substrate from the Berkley Bridge in Dighton to the Jenkins Leatherboard Company dam in Bridgewater. The Berkley Bridge was the lower limit of salt water intrusion. They documented 28 km of potential spawning habitat in this stretch and highlighted the promising outlook for shad restoration. They also named the Segreganset River and Nemasket River as Taunton River tributaries with shad present. Reback and DiCarlo (1972) noted a shad stocking project in 1969 that transferred shad eggs from Connecticut River adults to the Nemasket River. The most recent MA DMF anadromous fish survey (Reback et al. 2004) echoes the potential for shad restoration in the Taunton River but recognized that shad stocking in the 1960s and 1970s with eggs and adults from the Connecticut River produced little evidence of success. Presently, the status of shad in the Taunton River watershed is unknown with some anecdotal reports of finding individual adult shad in the last decade. For the Taunton River, the principal threat and cause of low populations is not Barriers to Migration and has not been identified.

Fish Ladder Specifications: No fishways in main stem Taunton River.

Regulatory Authority: In the absence of dams and fishways, the principal regulatory authority related to American shad is found with the state regulations of the *Marine Fisheries* (coastal) and *MassWildlife* (inland). Wetlands habitat and water quality protections are provided by M.G.L. Chapter 131 §40 and Commonwealth of Massachusetts Regulations 10.00 and administered by *MassDEP*.

Water Withdrawal Permissions: Three facilities have MA Water Management Act permits with authorized surface and groundwater withdrawals totaling 3.27 million gallons per day (MGD). Of these three facilities, the largest withdrawal at 3.03 MGD is for a municipal public water source.

Water Discharge Data: The main stem Taunton River has a USGS stream flow gauge in Bridgewater (No. 01108000, 261 mi² drainage area). The average monthly discharge at the Bridgewater gauge station is 886 cfs for April and 558 cfs for May from the time series record of 1929-2012.

Water Quality Monitoring: *MassDEP* assesses waterbodies by comparing water quality to Surface Water Quality Standards, identifying threats to habitats and recommending remedial actions (*MassDEP* 2007). The Taunton River watershed was last assessed during 2004 (Rojko et al. 2005); with most of the potential main stem shad habitat listed as *Suitable* to support aquatic life or "Not Assessed".

Recommended action:

Of the three coastal rivers in the current plan, the least information is known on the status of and threats to American shad in the Taunton River. *Marine Fisheries* seeks more information on the presence of shad in the Taunton River, the status of potential shad habitat, and the influence of potential threats such as historical and present pollutant loading, and water quality impairment. We expect that a habitat survey and assessment would be useful for this watershed and potentially transferable to other watersheds in Massachusetts, but the funding to undertake this effort is not presently available. We **recommend** the following actions for the Taunton River: (1) assessment of the amount and suitability of Taunton River habitat for shad spawning and rearing; and (2) monitoring to confirm the presence of a shad spawning run.

Agency or Agencies with Regulatory Authority: *Marine Fisheries* -- coastal waters diadromous fish, *MassWildlife* -- inland waters diadromous fish, and *MassDEP* -- wetlands and water quality protection.

Action actively being addressed by agency: None.

Initial Habitat Goal: Conduct both recommended actions.

Timeline for achieving goals/targets: None established.

Possible metrics to evaluate progress: (1) comparison of water quality parameters to State criteria for supporting aquatic life; and (2) discharge range that provides suitable water depth and velocity at river habitats.

Estimated costs: A cost estimate has not been developed. The Taunton River watershed is in close proximity to the Palmer River. Technicians deployed to assess the Palmer River habitat could conduct the Taunton River assessment concurrently on a similar schedule.

Potential setbacks/areas of concern: The watershed is part of an active water supply and urbanized area with documented surface water quality and stormwater impairments. The municipal needs for water compete directly with water needs for aquatic life, but the effects are unknown.

Other organizations: No active projects are underway on American shad in the Taunton River. Several towns have active river herring wardens that would likely take an interest and perhaps participate in future shad monitoring and restoration efforts as would the Nature Conservancy and the Taunton River Watershed Alliance, active non-profit groups that works to improve the aquatic resources of the Taunton River.

Related Activities

Two ongoing *Marine Fisheries* projects related to diadromous fish could benefit the interest of improving our knowledge of American shad habitat in the future. A GIS datalayer of diadromous fish habitat has been developed in cooperation with the Massachusetts Department of Transportation to provide tools for transportation and diadromous fish restoration planning. The statewide datalayer presently contains presence/absence and time-of-year entries for all diadromous fish and specific habitat locations for river herring and rainbow smelt. This datalayer can be improved in the future by adding shad habitat data. Secondly, *Marine Fisheries* conducts habitat assessments for rainbow smelt and river herring to under a Quality Assurance Program Plan (QAPP) that relates habitat and water quality conditions to aquatic life and species life history thresholds (Chase 2010). The QAPP can be updated in the future to include shad habitat assessments.

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Figure 1. Palmer River and Taunton River in the Narragansett Bay Watershed. The green dots are dams that are passable to migratory fish and the red dots are impassible dams.

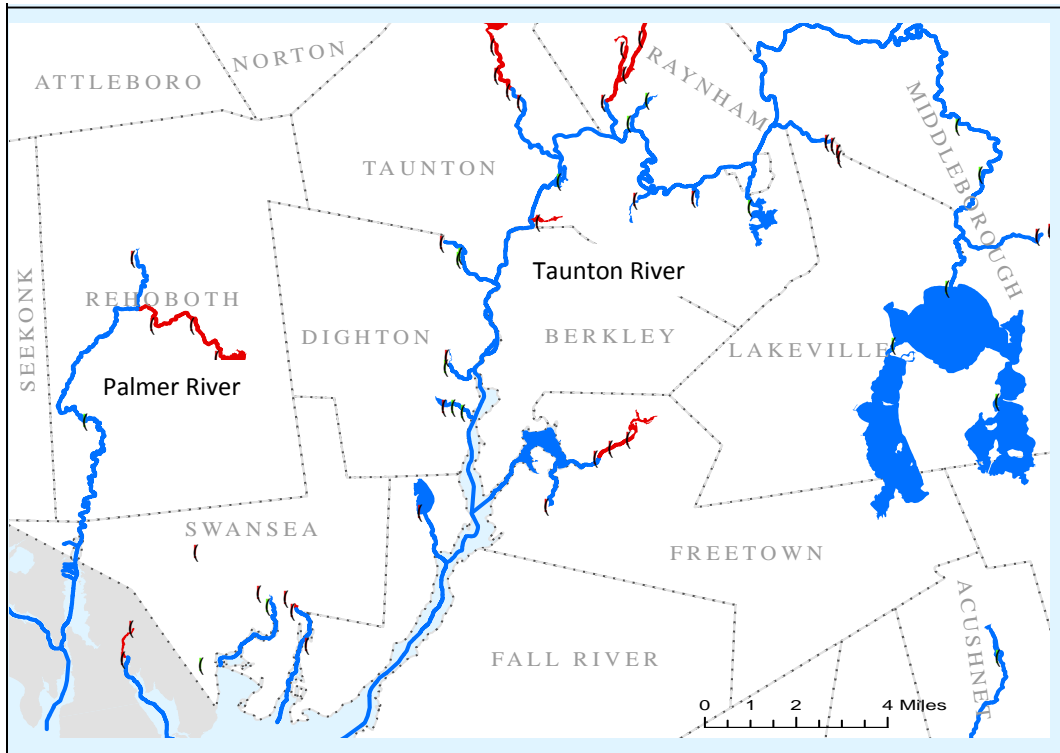


Figure 2. Charles River in the Boston Harbor Watershed. The green dots are dams that are passable to migratory fish and the red dots are impassible dams.

