

WHAT A DAM MESS

An analysis of potential dam removal projects in Massachusetts

Motivation:

The state of Massachusetts has over 2,500 dams that obstruct natural waterways. Only ten percent of these dams still provide valuable services to the state and its residents by generating hydroelectricity or creating reservoirs for drinking water and human recreation. The vast majority of these dams are relics from 18th and 19th Century factories and mills that dotted the Massachusetts countryside. Now, these dams restrict migratory fish travel, disrupt natural ecosystems, and pose major safety hazards after centuries of wear and tear have pushed hundreds of dams to the brink of collapse.

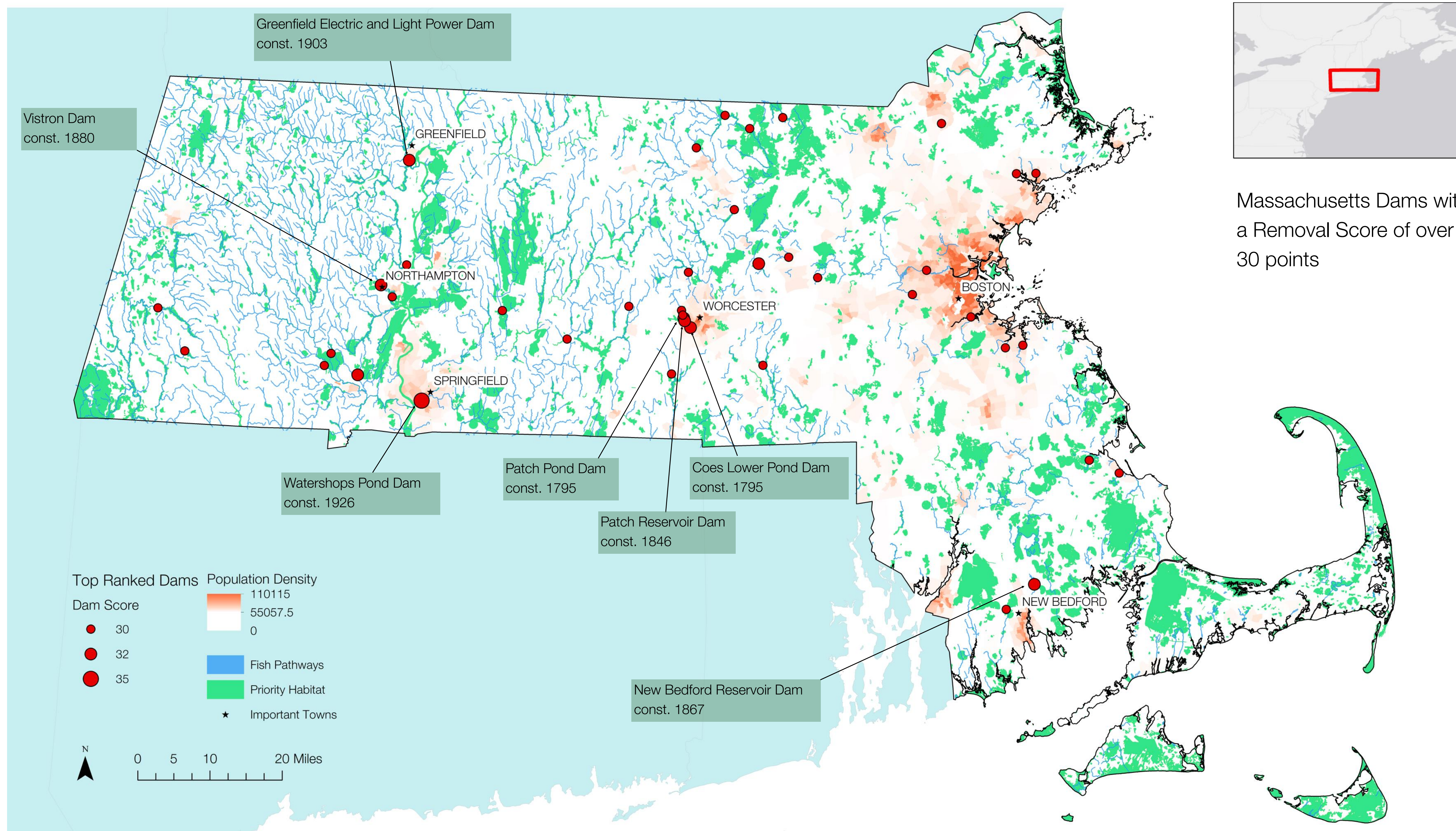
Many towns across the country have already removed obsolete dams. The goal of this project is to help towns and regulatory authorities to identify dams that should be removed to benefit the local environment and ensure the safety of community residents.

Methodology:

Six criteria were used to identify which dam removals would produce the greatest ecological and societal benefit.

- Current blockage of fish passageways
- Proximity to priority habitats for rare species
- Proximity to areas of high population density
- Proximity to Fishing and Boating Access Ramps
- Proximity to Drinking Water Reservoirs
- Dam Hazard Score

Five raster maps were created to analyze each of the criteria (Dam Hazard Score was included in the point data for each dam). The rasters were then reclassified and weighted to assign a series of values each map. Finally, the ArcMap tools “Extract Multi-Values to Points” and “Calculate Field” was used to assign each dam a removal score between 0 and 40 with a score of 40 meaning that the dam causes great environmental degradation and serious human risk.



Results:

Forty-one dams received scores of at least 30 points which should be further investigated for removal. These dams are spread out across the state with the highest density of dams centered in Central Massachusetts near Worcester. The large spatial distribution of high scoring dams was unexpected given the very low population density areas that some dams in Western and Northern Massachusetts fall into. However, in hindsight the high scores are understandable given the priority given to fish pathways and priority habitats for rare species in the field calculator. Overall, the project successfully identified dams across the state that pose environmental and human safety problems. Additional work should be done to determine if the identified dams can feasibly be removed including hydraulic analyses to determine the impact to the riverine environment and community surveys to determine if the public is in favor of the dam removal.

Conclusions:

Further research was done into the nine highest scoring dams to determine the feasibility of their removal by accounting for parameters that were not included in the GIS Program. Out of these nine dams, two dams provide important flood protection and one dam supports a large recreational pond. The remaining six dams are all over a century old and provide no current services to society. Policymakers and engineers should take action to remove these dams to reconnect fish habitat, ensure the safety of local residents, and to restore the beauty of nature.

Criteria Weighting

Criteria	Fish Pathways	Priority Habitat	Pop. Density	Hazard Score	Boat Use	Reservoir Use	Total
Range of Values	0 - 1	0 - 1	1 - 4	1 - 3	0 - 1	0 - 1	
Weight	10	5	2.5	3	3	3	
Final Range of Values	0 - 10	0 - 5	2.5 - 10	3 - 9	0 - 3	0 - 3	40

Limitations:

There were several limitations in the generation of this project. First, the Massachusetts inventory of dams’ dataset was used which contains 2,903 dams, however, there are estimates that there are hundreds more dams across the state that are only a few feet high. These dams are not inventoried but still pose an issue to fish passage. Additionally, the dam dataset does not provide information on whether dams are currently used for hydroelectricity generation or flood protection purposes

which led to the identification of some “useful” dams for removal. Another limitation occurred with the anadromous fish dataset. It only contained point data of where blockages occur on rivers with anadromous fish and did not contain a comprehensive list of coastal rivers that are home to anadromous fish. To fix this, a join was applied between all rivers and the anadromous fish points to create a dataset of rivers with anadromous fish presence. However, the final product included only upstream portions of some rivers, not the entire length, which skewed certain dam scores.

Cartographer: Rory Buckman

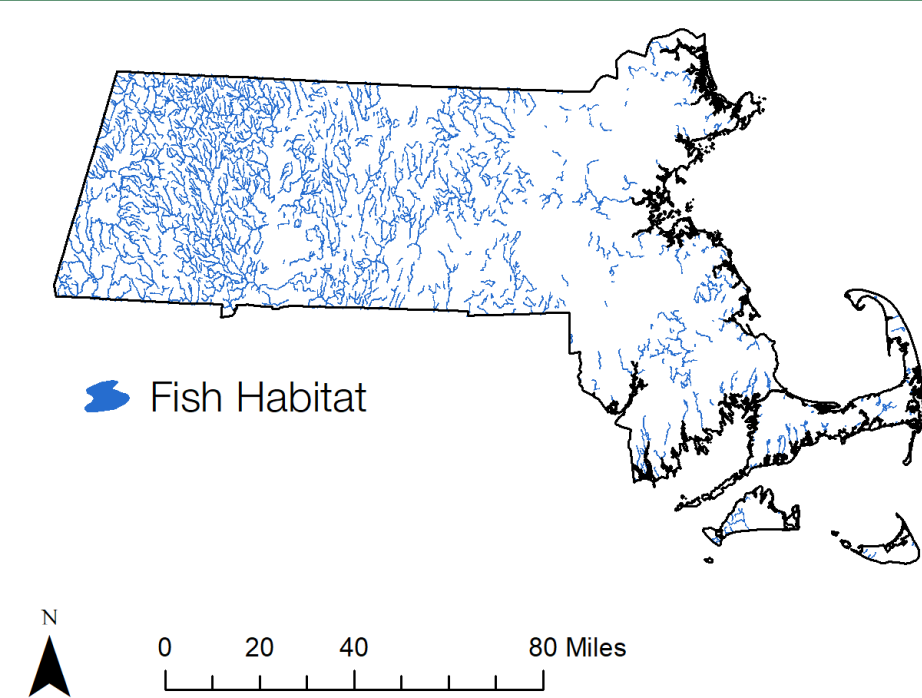
Class: Introduction to GIS / CEE 187

Date: May 2, 2019

Data Sources: MassGIS, NID, ESRI, HERE, Garmin, OpenStreetMap contributors

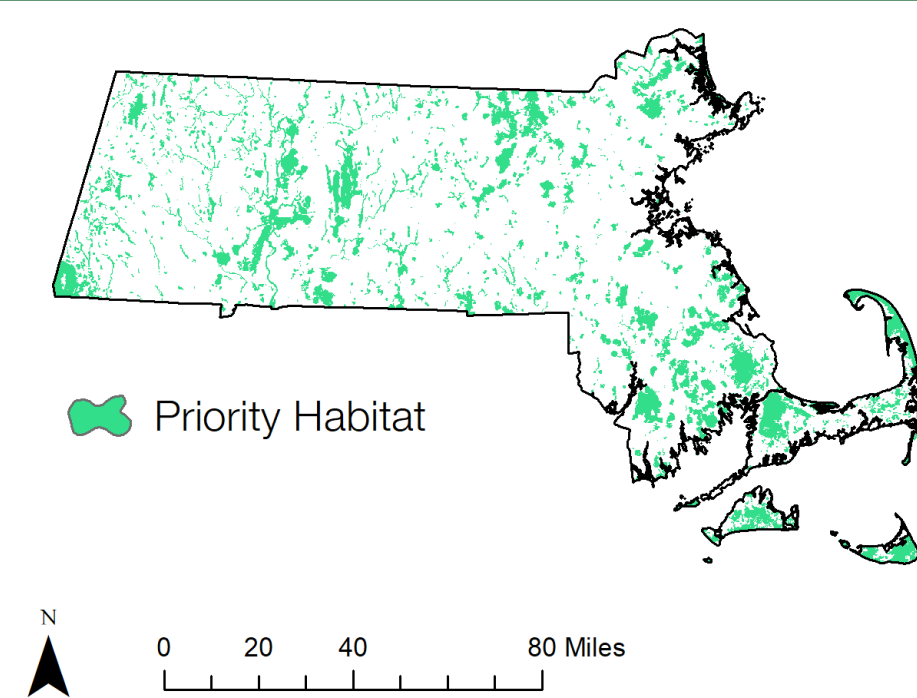
Projection: NAD 1983 State Plane Massachusetts Mainland FIPS 2001

Migratory Fish Pathways



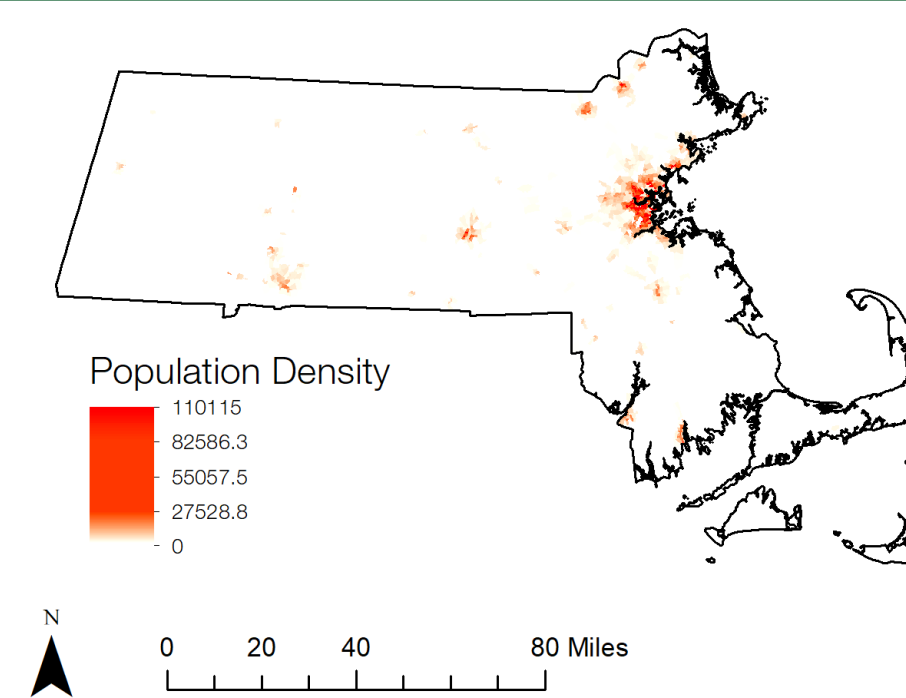
This map was created by joining MassGIS data of rivers that are home to anadromous fish in coastal Eastern Massachusetts and data for Coldwater Fisheries in Western Massachusetts. Dams received a score of 0 if they did not block the identified fish habitats and received a score of 1 if they did block the identified fish habitats.

Priority Habitat for Rare Species



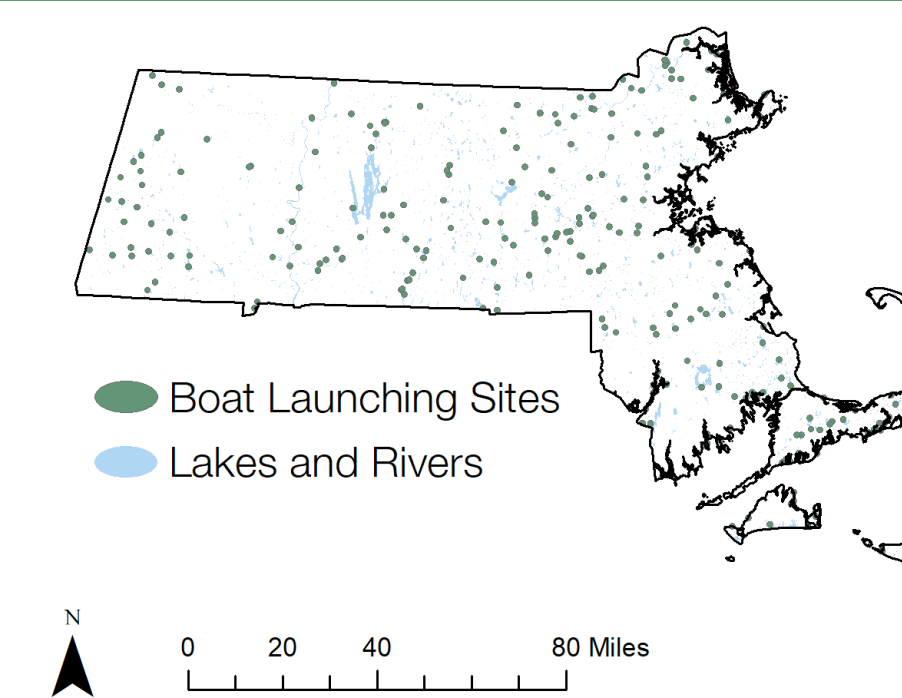
Natural Heritage and Endangered Species Program Priority Habitats for Rare Species are presented on this map. It is important to preserve these habitats and return them to their pre-industrial conditions when possible. Dams received a score of 0 if they did not fall within priority habitats and received a score of 1 if they did fall within priority habitats.

Population Density



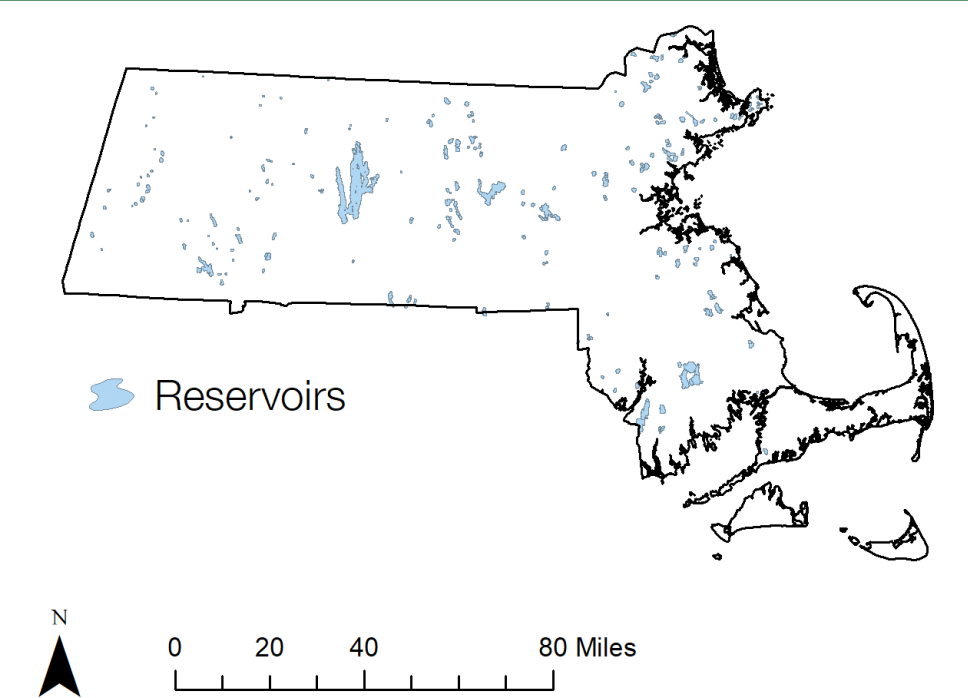
Population density is shown on this map with units of people per square mile. The map was created using census block data from the 2010 United States Census. Dams received a score from 1 to 4 based on how densely populated their location is with 1 being the least dense and 4 being the most dense.

Boat Launching Sites



Boat Launching Sites are displayed using data from the Office of Fishing and Boating Access. This criterion was selected in order to identify locations where dams provide services to communities by creating valuable outdoor recreation areas for boating and swimming. Dams located near boat launching sites received a score of 0 while dams not located near boat launching sites received a score of 1.

Reservoirs



Reservoirs are artificial lakes created by dams to store water. This map is used to identify dams that have usefulness due to their role in creating these reservoirs for drinking water storage or flood control. Dams located on reservoirs were assigned a score of 0 while dams not on reservoirs received a score of 1.