

## 5.0 METHODOLOGY

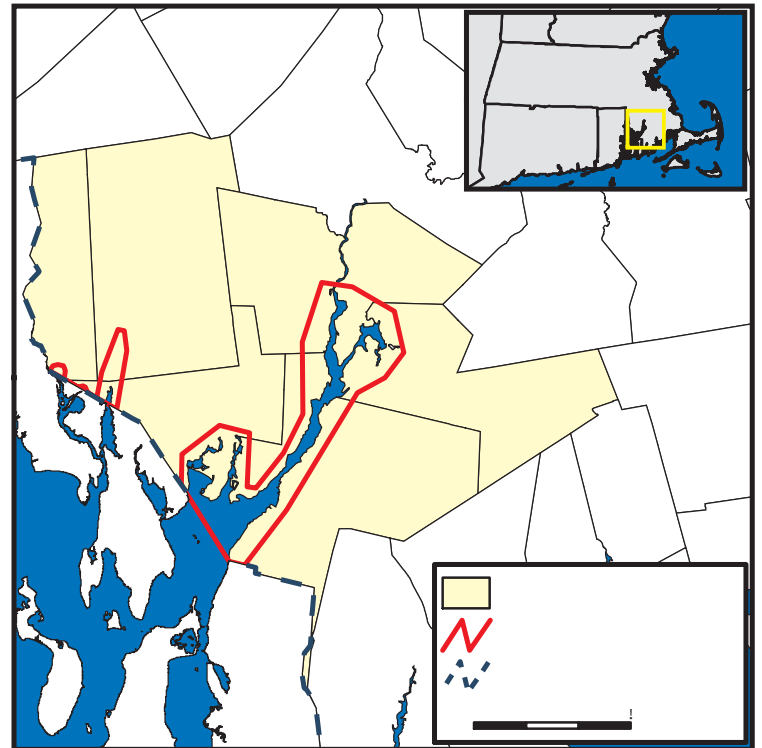
The methodology employed for developing the Mount Hope Bay Tidal Restriction Atlas is similar to those used in previous Atlas Projects. It includes (1) initial site identification using a Geographic Information System (GIS) program; (2) stakeholder review of initial site list; (3) field investigations of a subset of sites; and (4) desktop GIS analysis to complete data collection on field visited sites. Each step in the process is described in detail below.

### Initial Site Identification and Preliminary

#### GIS Analysis

The geographic scope of the project study area was confined to that area defined by the limits of the polygon shapefile provided by the MWRP (see Figure 3). The upland boundaries of the study area approximate the area subject to the one-year storm tidal flood elevation.

ArcGIS v.8.2 was used as the supporting program for initial site identification. The following datalayers were incorporated to complete the analysis:



**Figure 3. Project Study Area**

- Massachusetts Geographic Information Systems (MassGIS) 1:5,000 scale wetlands and streams layers developed by the Massachusetts Department of Environmental Protection Wetlands Conservancy Program through photo-interpretation of color-infrared aerial photography taken in the early 1990s;
- MassGIS 1:25,000 scale hydrography layer digitized from mid 1970's USGS topographic maps;
- MassGIS 1:5,000 scale 0.5 meter resolution digital true color aerial orthophoto images obtained in April 2001; and,
- MassGIS 1:25,000 scale digital images of the mid-1980's USGS topographic maps.

These datalayers were assembled into a single project file and viewed simultaneously as overlapping layers. The study area was systematically inspected at a scale no smaller (coarser) than 1:6,000. Potential restriction sites were identified at locations

where man-made infrastructure and landscape alterations were observed as potentially restricting or blocking tidal flow to wetlands that historically were affected by the tides.

Wetlands and waterbodies were identified as being tidally influenced based on the following criteria: hydrologic connection to obvious tidal waterways (i.e. major rivers), topography, and proximity to salt marsh. Upgradient wetlands determined to be “potentially affected” were limited to the following wetland types: open water, salt marsh, deep marsh, shallow marsh, and shrub swamp; wooded swamp was included only in cases where site characteristics strongly indicated that the wetland was affected by an identified restriction.

A point shapefile was created to show the location of all potential tidal restriction sites in the study area. Each site (point) was assigned a unique integer “Site ID” number. After all potential sites were identified, the following information was collected for each site: town where located; name of waterbody if available; proximity to other “hydrologically-connected” restriction sites (i.e., isolated or in a series); area of cumulative affected wetlands; and area of adjacent affected wetlands for sites in a series.

A **series** of restrictions is defined by two or more restriction sites located on the same waterbody (i.e., tidal tributary stream). In a series, each restriction site located downstream of other restriction site(s) affects the tidal influence on those upstream sites. As a result, potential sites cannot be evaluated independent of other sites in the series. **Cumulative affected wetlands** are defined for each potential restriction as all potentially affected wetlands located upstream of the site, including upstream wetlands affected by other restrictions when part of a series. **Adjacent affected wetlands** are defined as the potentially affected wetlands directly upstream of the site, and downstream of another restriction site where the restriction is part of a series.

After compiling all of the information for each site, a second shapefile was created to show all wetland areas potentially affected by the suspected restriction sites. Criteria used to define the extent of affected wetlands included topography, MassGIS Wetlands Conservancy Program Wetlands and Streams, and adjacency as further defined. Salt marsh upstream of a restriction was always included as part of the affected wetland, while open water, non-tidal deep marsh, shallow marsh and shrub swamp were included when the above-mentioned criteria suggested that they would likely be affected by restoration of tidal flow. Wooded swamp was typically excluded, except in cases where site characteristics strongly indicated that it would be affected. The attribute data associated with this shapefile was derived from the original MassGIS datalayer and includes such fields as wetland type and area.

### *Review of Site List by Stakeholders*

Upon completion of the comprehensive restriction site list, the information was forwarded to local stakeholders for comment. Stakeholders were chosen based on their knowledge of the area and local wetlands issues, as well as anticipated interest in the Atlas results. A summary cover letter and a series of maps illustrating identified sites

were distributed to each stakeholder to solicit comments on the sites as well as suggestions of additional potential restrictions. This information was then used to aid in identifying a smaller subset of sites to undergo further inspection in the field. A description of the stakeholder input process is included in [Appendix C](#).

The MWRP, in consultation with USACE, selected a subset of sites for further evaluation in the field. Sites were selected based on stakeholder input and potential area affected by the restriction.

### Implementation of the Field Program

Sites selected for the field program were initially inspected to determine whether the site was tidally influenced and indeed contained a tidal restriction. Sites that were determined to be tidally restricted were then investigated and documented. Staff from Epsilon Associates, MWRP and USACE was present on the first day of the field program to establish data collection procedures and methodology. Subsequent evaluations were conducted solely by staff from Epsilon. One Epsilon staff member was present on every field visit to ensure consistency of results.

A four-page field inspection form was created to aid in data collection for each site that was confirmed, based on best professional judgment, to be a tidal restriction. A sample field inspection form is included in [Appendix D](#). Field information collected included restriction feature type and dimensions, condition of the restriction and its components, salinity, adjacent land uses, severity of the restriction, and supporting evidence for the estimate of severity. Salinity was measured using a YSI field water quality meter. Digital photographs were taken of the restriction, affected wetland, and upstream and downstream landscape.

Structures observed as potential restrictions during the study included culverts, bridges, dams, dikes, berms, tide gates, and fill material. These structures support active or abandoned highways, roads, cartpaths, railroad lines, and stone walls. Two fundamental field indicators were used to evaluate whether a structure presented a restriction to tidal flow: (1) the physical extent of the structure relative to the channel as viewed upstream and downstream of the structure; and (2) hydrologic observations at the structure such as “ponded” water above the structure and a strong current passing water through the structure. For this study, an inclusive definition of tidal restriction was used to ensure that all potential restriction sites are included in this Atlas. This allows for verification of all sites in the comprehensive site list through future work and lowers the potential for inadvertent omission of sites.

Specific indicators of environmental impact produced by a tidal restriction were not as easily identified given the geographic breadth of the project and the total number of sites assessed. Impact assessment focused on identifying indicators of impairment to wetlands, water quality, and marine habitats. However, more often than not, indicators of impact were not readily observed during brief field visits, but rather require detailed study during different seasons and hydrologic conditions due to the multitude of variants

influencing the local ecosystem. However, despite the complex nature of the Mount Hope Bay system and the rapid assessment approach used to review multiple sites in a short period of time, reliable information on potential impacts was successfully collected based on field characteristics. This information was assembled to form reasonable conclusions about relative impacts and the potential for restoration. Because non-ecological site information (e.g., ownership, current uses, condition of the structure, etc.) will also have a strong bearing on the feasibility of site restoration, similar conclusions were formed for these attributes. This information can be used by parties interested in restoration of habitats in the region to prioritize future investigations and implement restoration projects.

### Desktop Analysis

Upon completion of the field work, each confirmed tidal restriction site underwent further computer-based analysis (i.e., desktop analysis) as a follow-up to field investigation. The following digital information sources (in addition to those named earlier) were used in the desktop analysis:

- MassGIS 1:25,000 scale land use datalayer interpreted by the Resource Mapping Project at the University of Massachusetts in 1999;
- MassGIS 1:25,000 or 1:24,000 scale Natural Heritage and Endangered Species Program (NHESP) Priority Habitats of Rare Species and Estimated Habitats of Rare Wildlife datalayers produced in June 1999;
- MassGIS 1:25,000 scale anadromous fish point coverage produced in early 1997 by the Department of Fisheries, Wildlife and Environmental Law Enforcement GIS Program working in conjunction with the MA Division of Marine Fisheries and MA Division of Fisheries and Wildlife, and;
- MassGIS 1:25,000 scale protected and recreational open space datalayer produced by a collaboration of state environmental agencies, regional planning commissions, local watershed associations, town conservation commissions, municipal planning and engineering departments, local and regional nonprofits, and open space plan committees. This datalayer is continually under development as open space changes occur constantly.

A one-page analysis sheet was created to provide a consistent and organized approach to information gathering. A sample desktop analysis sheet is included in [Appendix E](#). The following basic attributes were determined for each restriction (where possible): ownership, upstream/downstream restrictions in the series, and location within a designated fish run. The following basic attributes were determined for the wetlands affected by each restriction: total acreage, acres of open water, acres of salt marsh, acres of non salt marsh, location within NHESP rare species or priority habitat, and location within protected open space. For restrictions in a series, the “attributes of affected wetlands” only describes adjacent affected wetlands (i.e., those wetlands

immediately upstream of the restriction but downstream of the next restriction in the series.\* Where the acreage of affected wetland could not be estimated, a “-1.00” has been inserted.\*\* For sites where an estimate of affected wetlands was not possible, the attributes refer to the restriction site itself.

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\* For restrictions in a series, the cumulative affected wetland area was also computed and included in the point shapefile described previously under “Initial Site Identification and Preliminary GIS Analysis.”

\*\* All of the data presented in the Atlas is contained in an Access Database and this format allows users to query the Access Database.

## **Appendix C. Public Input**

The project team initiated broad public input during the development of the *Mount Hope Bay Tidal Restriction Atlas*. This input was essential both for ensuring the accuracy and comprehensiveness of the information, and for providing education about the project and its benefits for the local communities. Public input was solicited at two key points during project development: after the identification of the initial “comprehensive” site list and after production of the draft *Mount Hope Bay Tidal Restriction Atlas*.

The project team compiled a stakeholder list in the early stages of the project. The list included representatives of each of the municipal conservation commissions, local and regional non-profit groups, and individuals from state (both Massachusetts and Rhode Island) and federal agencies involved in wetland restoration. Each stakeholder received a description of the project, a map showing the comprehensive list of sites identified from aerial photographs, and an invitation to provide comments on the initial information. The project team received several comments and incorporated these comments into the initial site list.

Prior to completion of the draft, the project team scheduled a formal presentation on the draft Atlas at a Massachusetts Watershed Initiative Narragansett/Taunton Watershed Team Meeting. Notices about meeting time and place were sent to representatives from the municipalities. Each representative was also sent a CD containing the draft Atlas. Members of the watershed team in attendance at the meeting included representatives from federal and state agencies and regional non-profit groups. A project team member presented an overview of the project and methodology and then briefly reviewed the draft Atlas through a Computer and Projection Presentation. Attendees provided useful comment during the presentation and these comments were incorporated into the final *Mount Hope Bay Tidal Restriction Atlas*.

SITE ID: \_\_\_\_\_

**Appendix D. Mount Hope Bay Tidal Atlas Field Data Collection Sheet**

**Field Inspector:** \_\_\_\_\_ **Date:** \_\_\_\_\_ **Time:** \_\_\_\_\_

**Weather:** Sunny Partly Cloudy Overcast Rain Snow

**Tidal Conditions:** High Tide: \_\_\_\_\_ Low Tide: \_\_\_\_\_  
 Low Mid/Low Mid Mid/High High  
 Incoming Outgoing Slack

**Access to Site?** Yes No **Description:** \_\_\_\_\_

Location	
Site ID	
Town	
Street	
Landmark/Location Description	
Waterbody	
GPS Coordinates (NAD 83)	N _____ W _____ Accuracy: _____ feet

Restriction Information	
<b>NAME of Infrastructure Crossing:</b>	
<b>Underground Utilities:</b> yes no unknown	
<b>Principal Restriction Feature:</b>	
Road Bridge	Railroad Bridge
Road	Driveway
Dirt Road	Footpath
Other: _____	Public Private Unknown
Foot Bridge Dike or Berm Railroad Tracks	
Comments:	
<b>Restriction Opening:</b>	
No Opening	Pipe Culvert
Ditch	Channel
Other: _____	Box Culvert Tide Gate
Condition: good fair poor	
Comments:	

SITE ID: \_\_\_\_\_

<b>Bridge Information:</b>		
Draw Bridge	Piers Present	Mostly Fill with culverts
Condition: good fair poor		
Comments: _____		
Length: _____ ft Width: _____ ft # of piers: _____ # of culverts: _____		
Distance from top of bridge opening to high water line: _____ ft		
Width of bridge opening: _____ ft		
Comments: _____		
<b>Road Information:</b>		
Paved	Gravel	Dirt
Other: _____		
Condition: good fair poor		
Comments: _____		
Number of Lanes: _____		
Comments: _____		
<b>Culvert Information:</b>		
Corrugated Metal	Concrete	Clay
Pebble	Conglomerate	Other: _____
Condition: good fair poor		
Comments: _____		
Dimensions: CIRCLE: Diameter: _____ ft BOX: W: _____ ft x H: _____ ft		
Length: _____ ft		
Distance from top of culvert to high water line: _____ ft		
<b>Tide Gate:</b>	yes	no
	Type: _____	
	Condition: _____	
	Operation: _____	
Comments: _____		

SITE ID: \_\_\_\_\_

<b>Fill Obstruction:</b>			
Road	Footpath	Dike/Earthen Berm	Rocks/Rubble
Length: _____ ft	Width: _____ ft		
Number of Lanes (if applicable): _____			
Comments:			

<b>Site Attributes</b>		
<b>Land Use Adjacent to Affected Wetlands:</b>		
Commercial/Industrial	Residential	
Agricultural	Undeveloped	
Other: _____		
<b>Low-laying Structures:</b>	yes	no
<u>Type</u>	<u>Potential to Flood</u>	<u>Distance from Restriction</u>
1.		
2.		
3.		
4.		
<b>Stream Channel Dimensions:</b>		
Upstream	@ crossing: _____ ft	@ 100': _____ ft
Seaward	@ crossing: _____ ft	@ 100': _____ ft
<b>Salinity:</b>		
Depth: _____	Upstream: _____	Seaward: _____
Depth: _____	Upstream: _____	Seaward: _____
Depth: _____	Upstream: _____	Seaward: _____
<b>Evidence of Restriction</b>		
seaward scouring basin	upstream scouring basin	bank erosion
slumping	culvert crushed	culvert clogged
vegetation die back	<i>Lythrum salicornia</i>	<i>Phragmites australis</i>
culvert invert problem	presence of encroaching woody vegetation	
ponded water on upstream side of restriction		
ponded water on seaward side of restriction		
Seaward culvert opening submerged at high tide		
Comments:		

SITE ID: \_\_\_\_\_

Wetland Plant Communities
<b>Upstream</b>
Dominance type: _____
Invasive species observed: _____
Relative coverage: low    medium    high
Evidence of fill material or stormwater outfall:    yes    no
Salt marsh present: Yes    No
<b>Seaward</b>
Dominance type: _____
Invasive species observed: _____
Relative coverage: low    medium    high
Salt marsh present: Yes    No

**Estimated Severity of Restriction:**

severe    moderate    minimal

**Supporting Evidence:**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Sketch:**

**Photos:**

**Principal Restriction Feature**

**Structure Seaward Opening**

**Structure Upstream Opening**

**Upstream Affected Wetland**

**Seaward Wetland**

**Other** \_\_\_\_\_

