

Saugus River Watershed Smelt Spawning Habitat Assessment



**Final Report
December 2012**

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In Partnership with:
**National Park Service
Massachusetts Division of Marine Fisheries**



This project was funded in part by the Massachusetts Bays Program

Acknowledgements

The Saugus River Watershed Council extends its sincere thanks to the many volunteers and organizations who made this project possible. This project was funded in part through a generous grant from the Massachusetts Bays Program. We particularly appreciate contributions from the following staff and volunteers who participated in field surveys and / or provided technical support and advice.

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Marc Albert, National Park Service
Brad Chase, Massachusetts Division of Marine Fisheries
Ben Gahagan, Massachusetts Division of Marine Fisheries
Brian Waz, U.S. Fish and Wildlife Service
Michelle Bles, National Park Service
Marina Welch, National Park Service
Andrew Petit deMange, National Park Service
Lisa Engler, Massachusetts Bays Program
Prassede Vella, Massachusetts Bays Program
Frank McKinnon, Saugus Conservation Commission
Kasey Armstrong, volunteer
Pam Burgess, volunteer
Eric Devlin, volunteer
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Rachel Oblath, volunteer
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Background

The Saugus River Watershed Council worked in partnership with the National Park Service and the Massachusetts Division of Marine Fisheries to evaluate the presence and extent of rainbow smelt spawning habitat in the Saugus River and Shute Brook.

Rainbow smelt are a native anadromous fish in New England that utilize fast flowing riffles upstream of tidal influence as spawning habitat in the spring. Smelt migrate from marine waters at night during flood tides to spawn at riffle substrates leaving a demersal, adhesive egg that will incubate for one to three weeks depending upon water temperature. Upon hatching, smelt larvae move passively downstream to tidal waters where they feed and grow until maturity one to two years later.

In 2004, the federal government designated rainbow smelt as a Species of Concern, recognizing that this once abundant New England fishery is now in decline. Since that time, Maine, Massachusetts and New Hampshire have been working together to evaluate the status of rainbow smelt and promote regional conservation efforts. This research project supports those collaborative efforts and is directly linked to the Saugus River Watershed Council's efforts to protect and restore the historic rainbow smelt fishery in the Saugus River watershed. It also implements the Strategic Action of "Protecting and Enhancing Coastal Habitat", as identified in the Massachusetts Bays Program 2009 to 2012 Strategic Plan.

The status of smelt spawning habitat in the Saugus River watershed was last updated in 1992, when the Massachusetts Division of Marine Fisheries documented the temporal and spatial extent of spawning areas in the Saugus River. (Chase, B.C. 1992. Preliminary Report on the Saugus River. Massachusetts Division of Marine Fisheries, Massachusetts Bay Smelt Spawning Habitat Monitoring Program). In 2006, the Division of Marine Fisheries published the report, Rainbow Smelt Spawning Habitat on the Gulf of Maine Coast, by B. C. Chase. That report further described rainbow smelt spawning habitat data for the Saugus River and Shute Brook previously documented in the 1992 report.

Since 2005, the Saugus River Watershed Council has been working in partnership with the Massachusetts Division of Marine Fisheries, and the National Park Service to monitor rainbow smelt populations in the Saugus River. Each spring, staff and / or volunteers set a fyke net in the Saugus River during the spring migration period (Figure 1). Results indicated that rainbow smelt utilize the Saugus River for their spring spawning migration. However, changes to the river channel following the Saugus River Turning Basin Project (described below) made it difficult to compare results on a year to year basis and severely limited the fyke net's ability to catch smelt. As a result, the Massachusetts Division of Marine Fisheries will discontinue the fyke net sampling program in the Saugus River beyond 2012.



Figure 1. Smelt in fyke net at Saugus River, 2006.

From 2007 to 2010, the National Park Service implemented the Saugus River Turning Basin Project, a major undertaking to restore the park's historic waterfront and downstream emergent wetland and mudflat conditions. The project included excavation of several acres of phragmites, and the removal of

a downstream weir at the Hamilton Street bridge. Removal of the weir has led to increased tidal exchange and penetration of brackish water into smelt spawning habitat upstream at the Iron Works site. A key consideration of the planning for the project was protection of rainbow smelt spawning habitat. To protect riffle habitat necessary for smelt spawning, a gravel / cobble berm was created between the main stem of the Saugus River and the turning basin. Following the project, substrate conditions have shifted and the river channel below the berm has widened. One of the underlying objectives of this 2012 assessment was to determine if the smelt spawning habitat adjacent to the Saugus Iron Works is still viable and to identify potential opportunities for restoration in that region.

During 2011, the Saugus River Watershed Council and the National Park Service worked in partnership with the Massachusetts Division of Marine Fisheries to begin documenting conditions of smelt spawning habitat in the watershed. However, due to limited funds, the project included only two monitoring sessions at Shute Brook and only covered a portion of the spawning season for the Saugus River. The limited assessment in 2011 did confirm the presence of viable smelt eggs in the Saugus River adjacent to the Saugus Iron Works, but did not identify any eggs in Shute Brook. Results of the 2011 research are documented in the report Saugus River 2011 Rainbow Smelt Habitat Survey, prepared by Marina Welch and Marc Albert, National Park Service. Implementation of the 2012 smelt spawning habitat assessment project built upon the 2011 research by more fully documenting the extent of smelt spawning habitat in the main stem of the Saugus River and its tributary, Shute Brook.

Project Goals

The underlying goal of this project is to protect and restore the historic rainbow smelt fishery in the Saugus River watershed. The following two primary objectives were pursued:

1. Document the presence and extent of rainbow smelt spawning habitat in the Saugus River and Shute Brook, and
2. Develop and promote recommendations for protecting and restoring smelt spawning habitat in the Saugus River and Shute Brook.

Secondary objectives included assessing the impact of the Saugus River Turning Basin Project on smelt spawning habitat in the Saugus River, and evaluating the impact of the reconstructed Central Street Culvert in Saugus on spawning habitat in Shute Brook.

Geographic Project Area

The geographic project area is located in the main stem of the Saugus River and in its tributary Shute Brook, both located within the Town of Saugus (Figure 2). Saugus is located in the northern portion of the metropolitan Boston region, along the coast of Massachusetts. Specific survey areas were developed based upon previous research conducted by the Massachusetts Division of Marine Fisheries to assess smelt spawning habitat in the Saugus River during 1992.

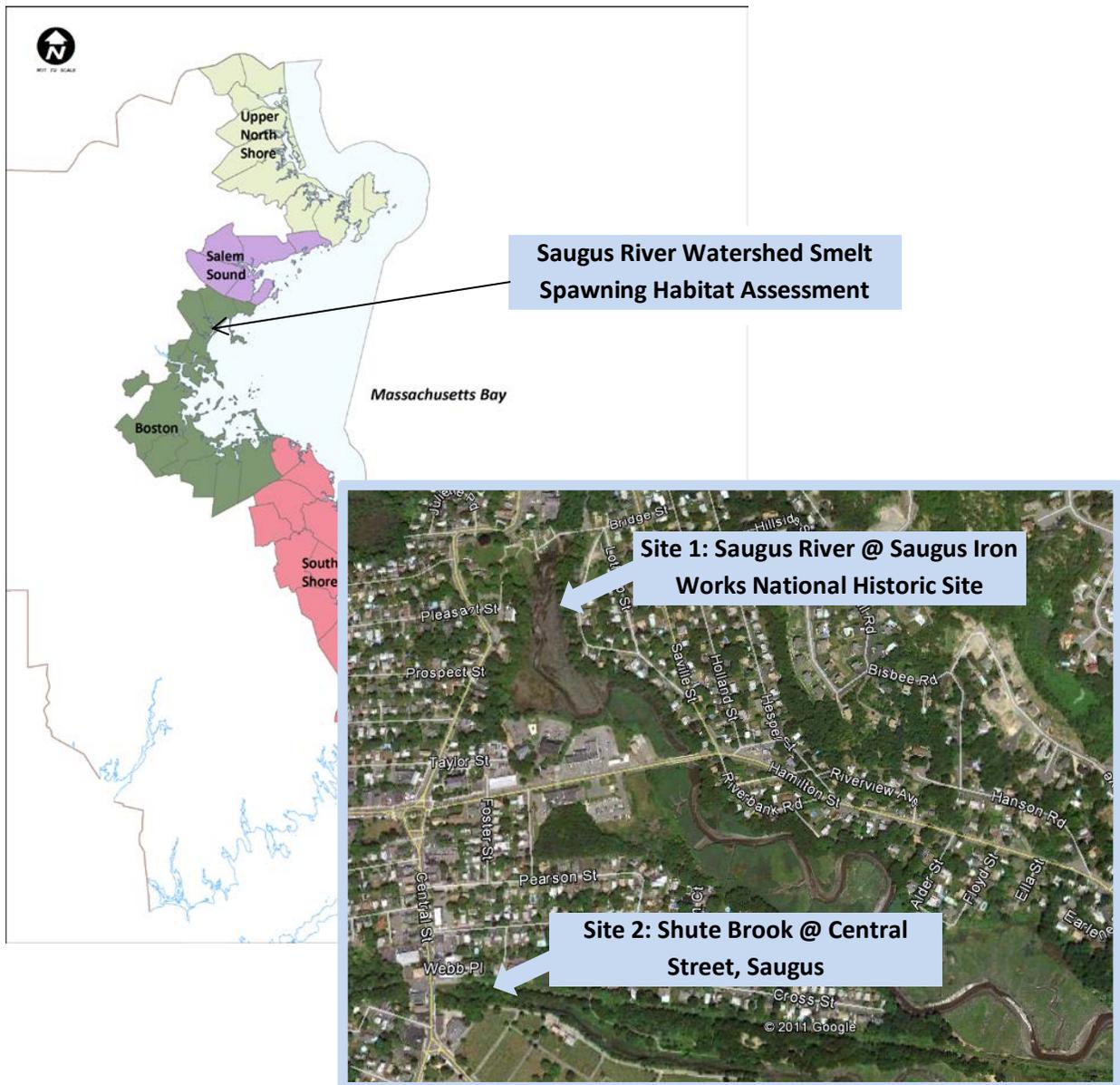


Figure 2. Project Area

Methodology

Sampling Locations

Sampling locations in the Saugus River and Shute Brook were selected based upon historic survey results and smelt spawning habitat known to Massachusetts Division of Marine Fisheries biologist Brad Chase, as well as data gathered during 2011 surveys which identified the presence of smelt eggs at sampling sites in the Saugus River (Figure 3). Because of the size of the sampling area in the Saugus River, that site was divided into five sections for purposes of recording data. Shute Brook was selected for sampling based upon historic documentation of viable smelt spawning habitat at the site. Visual observations at Shute Brook during 2011 indicated degraded conditions which did not appear to be suitable for adhesion of smelt eggs. The 2012 survey locations in Shute Brook were selected to help determine whether there was any active smelt spawning habitat in the brook.



Figure 3. Sampling Locations

Sampling Site 1, Saugus River @ Saugus Iron Works, was divided into five survey sections to help track locations where surveys were conducted (Figure 4).

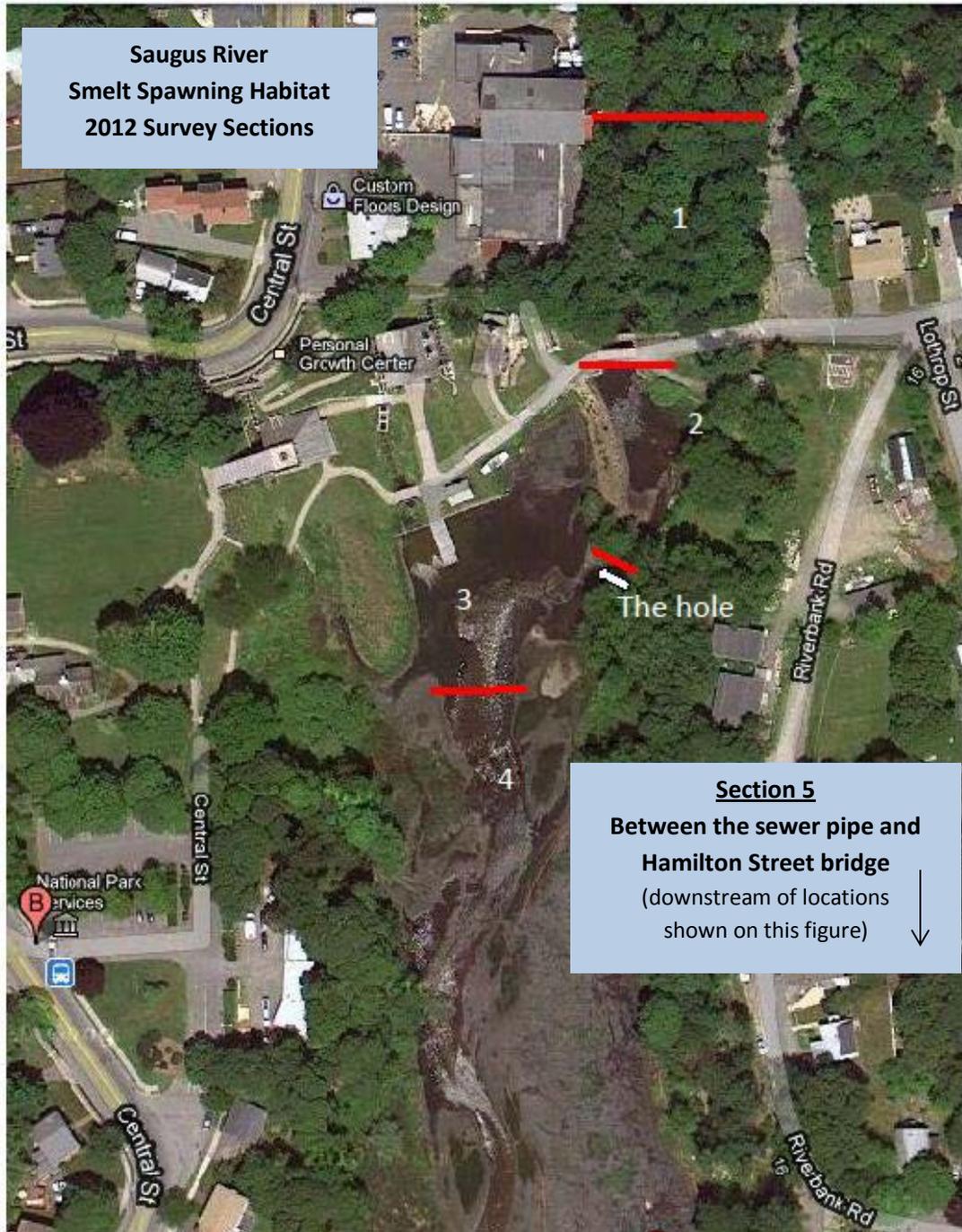


Figure 4. Saugus River Survey Areas

Sampling Schedule

Volunteers and staff conducted smelt spawning habitat assessments in the Saugus River and Shute Brook during March and April 2012. During that period, 17 monitoring sessions were conducted in the main stem of the Saugus River, and 12 monitoring sessions were conducted in Shute Brook. Surveys at the Saugus Iron Works site were conducted as close as possible to low tide.

Equipment

The following equipment was used: chest waders, gloves, sampling poles with metal scooping baskets, and a covered bucket containing a binder with data sheets, pen, operating guidelines, photos of sampling areas, PN40 GPS manual, volunteer agreement forms, and National Park Service safety analysis, PN40 GPS unit, and thermometer (Figure 5).



Figure 5. Equipment

Project Staff

SRWC Director Joan LeBlanc was the primary project manager. National Park Service Program Manager Marc Albert coordinated National Park Service staff involvement and assistance. J. LeBlanc and M. Albert supervised field work and participated in conducting the field surveys along with other staff and volunteers. Massachusetts Division of Marine Fisheries biologist Brad Chase acted as technical advisor for the project ensuring the smelt spawning habitat assessment was conducted in accordance with Massachusetts Division of Marine Fisheries protocols and helping to identify opportunities for habitat restoration and enhancement. Brian Waz of the U.S. Fish and Wildlife Service provided technical advice and support to help identify opportunities for restoration and enhancement of fish passage and spawning habitat. Ben Gahagan reviewed and provided feedback on the final project report. Lisa Engler

and Prassede Vella of the Massachusetts Bays Program provided feedback for the initial project scope and participated in field surveys and other aspects of the project.

Procedures

Procedures for identifying smelt spawning habitat in the Saugus River and Shute Brook followed Massachusetts Division of Marine Fisheries protocols and methods outlined in the December 2006 Technical Report – TR-30, Rainbow Smelt (*Osmerus mordax*) spawning habitat on the Gulf of Maine coast of Massachusetts, by B. C. Chase.

Observations of deposited eggs formed the basis for delineation of smelt spawning habitat. Smelt spawning habitat was defined as the river water and substrate where smelt egg deposition was observed. During each survey, stream substrata was inspected for adhesive smelt eggs for approximately 45 minutes to 1 hour at the Saugus River, and 30 to 45 minutes at Shute Brook.

A stainless steel basket attached to a wooden pole was used to scoop cobble, which was then inspected by hand to look for adhesive smelt eggs (Figure 6). Once egg deposition was identified, monitoring efforts expanded upstream and downstream of the initial riffle until the upstream and downstream limits of egg deposition were recorded. Qualitative observations were recorded on egg densities and viability (dead eggs were opaque white versus viable eggs which were nearly transparent). Data sheets were used to record whether or not eggs were found, the number of eggs found, the location of the eggs, and whether the eggs were viable. Water temperature was recorded using a handheld thermometer.



Figure 6. Saugus River adjacent to Saugus Iron Works.

Because the goal of this project was to identify the presence and extent of smelt spawning habitat, and not provide estimates of egg densities or population counts, the actual number of smelt eggs was much higher than documented in the surveys. Once smelt eggs were identified in one location, monitors then moved to a new location in an effort to evaluate as much potential habitat as possible, avoid double counting, and limit damage to the smelt eggs from the impact of volunteers walking on the river bed.

Safety was a primary concern for staff and volunteers. Volunteers were instructed to exercise caution and not conduct surveys if there were any conditions that appeared potentially dangerous. River conditions were evaluated following any major rainstorms to determine if high water levels or flows presented a potential danger. When river conditions posed a hazard, surveys were put on hold until conditions were safe. Volunteers and staff also reviewed the National Park Service’s safety analysis for the project prior to conducting field work.

Survey Results

During surveys conducted in March and April of 2012, viable smelt eggs (Figure 7) were found in several different locations in both the Saugus River and Shute Brook, indicating that both sites provide important habitat for smelt spawning. Approximately 2,104 m² of smelt spawning habitat was identified in the Saugus River, while 924 m² of habitat was identified in Shute Brook (Table 1). The combined area of spawning habitat for both areas was approximately 3,028 m² (Table 1). The smelt spawning areas documented in 2012 were larger than those identified during surveys conducted by the Massachusetts Division of Marine Fisheries between 1988 and 1990 (Chase 2006) (Table 1).



Figure 7. Smelt eggs on basket.

Table 1. Smelt Spawning Habitat in the Saugus River and Shute Brook.

Name	Downstream Latitude	Downstream Longitude	Upstream Latitude	Upstream Longitude	Length (m)	Area (m ²)
Saugus River 2012	42 ° 28.598' N	71° 00.269' W	42 ° 28.134' N	71° 00.259' W	305 m	2,104
Saugus River 1989-1990	42 ° 28.097' N	71° 00.457' W	42 ° 28.198' N	71° 00.434' W	175 m	1,215
Shute Brook 2012	42° 27.428' N	71° 00.336' W	42° 27.436' N	71° 00.336' W	168 m	924
Shute Brook 1988-1990	42° 27.714' N	71° 00.459' W	42° 27.729' N	71° 00.561' W	147 m	810

Saugus River Site

Results of the 2012 smelt spawning habitat assessment indicate that several areas in the Saugus River adjacent, upstream, and downstream of the Saugus Iron Works provide viable habitat for rainbow smelt spawning activity (Figure 8). The total spawning area in the Saugus River is 2,104 m² (Table 1). A total of 575 smelt eggs were identified in 59 locations in the Saugus River beginning on the first sampling date of March 7 through April 18 (Table 2).

Figure 8. Saugus River Results

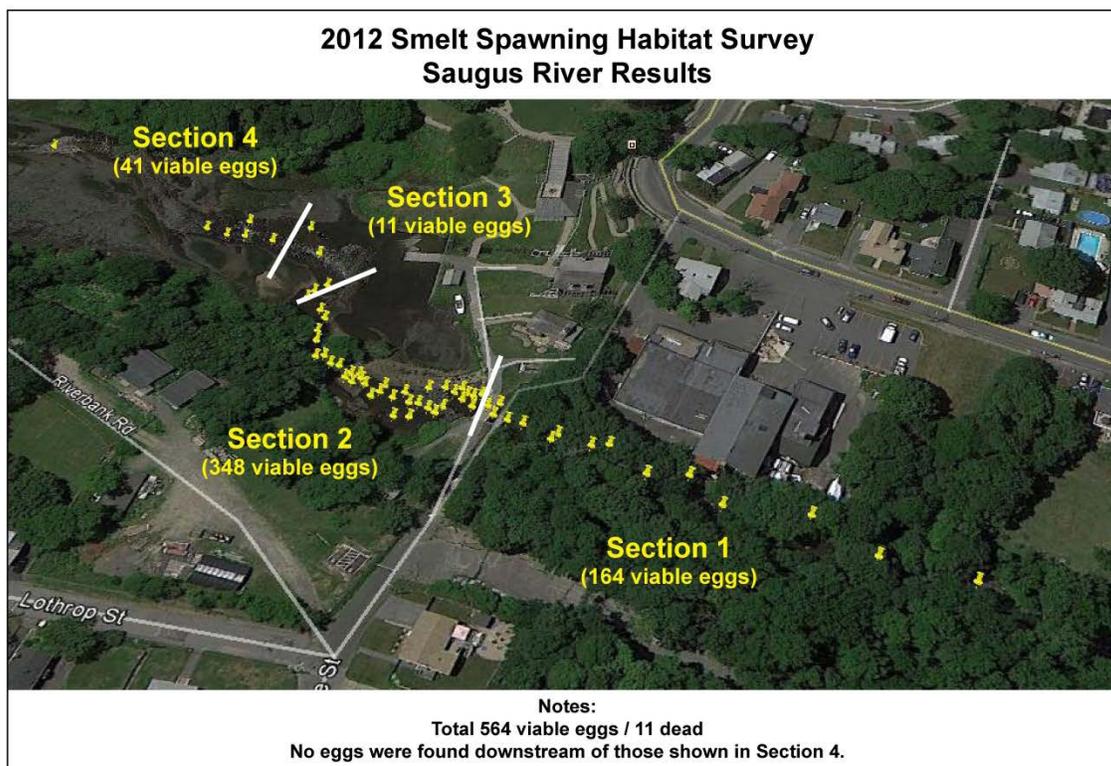


Table 2. Saugus River Survey Results

Date	Monitors	Area	Temp	# of Locations with eggs	# of Eggs	Viable	Nonviable
03/07/2012	Albert, Kreider, LeBlanc	2	8	10	181	181	
03/11/2012	Blees, LeBlanc, Oblath	2	4	7	54	54	
03/13/2012	Burgess, Kreider, LeBlanc, Welch	2	6	3	16	16	
03/16/2012	Albert, Devlin, Petit deMange	1	7	5	9	9	
03/21/2012	Albert, Burgess, LeBlanc	3 & 4	12	7	49	48	1
03/24/2012	Armstrong, Oblath, Welch	3	16	0	0		
03/28/2012	LeBlanc	4	8	0	0		
03/30/2012	Devlin, Kreider, LeBlanc	2 & 4	8.5	7	42	37	5
04/04/2012	Devlin, LeBlanc	1	n/a	6	144	143	1
04/06/2012	LeBlanc, Pike	2	n/a	6	61	59	2
04/10/2012	Burgess, LeBlanc	4	n/a	0	0		
04/11/2012	Albert, Engler, LeBlanc	2	11.5	4	5	5	
04/14/2012	Armstrong, Devlin, Oblath, Welch	3	16	0	0		
04/18/2012	Devlin, LeBlanc, Oblath	1	16	4	14	12	2
04/20/2012	Blees, Devlin, Kreider, Oblath	2	17	0	0		
04/25/2012	Blees, LeBlanc	2 & 3	11	0	0		
04/28/2012	Oblath, Welch	1	15	0	0		
Totals:				59	575	564	11

The beginning of the spawning period for the Saugus River was not delineated as smelt eggs were present during the first sampling date of March 7 (Table 2). The spawning period in the Saugus River continued through April 18. Average water temperature for the surveys conducted in the Saugus River was 8.7° c during March and 14.4° c during April. The spawning season for the Saugus River began and ended earlier than documented from 1988 to 1990 (Chase 2006).

Section 1 – Upstream of Saugus Iron Works Bridge

The segment of Saugus River upstream of the Saugus Iron Works contains large boulders with intermittent areas of small cobble (Figure 9). This region provided valuable habitat, with smelt eggs found in several locations where cobble was smaller. The limit of smelt spawning habitat extended further upstream than previously documented by the Massachusetts Division of Marine Fisheries from surveys conducted in 1988 to 1990 (Table 1).



Figure 9. Saugus River, Section 1.

Section 2 – Adjacent to Saugus Iron Works

The most active spawning areas in the Saugus River were located adjacent to the Saugus Iron Works historic waterfront in or near riffles with substrate made up of small to medium cobble (Figure 10). Smelt eggs were found in all of the riffles in this area. Survey results showed that, while the Saugus River Turning Basin Project resulted in several changes to the Saugus River channel width and substrate, this section of the river still provides important smelt spawning habitat. Construction of the berm adjacent to the ‘restored’ turning basin has provided the intended benefit of protecting the riffle habitat located in the Saugus River adjacent to the berm. While riffle habitat downstream of the berm was likely altered when the river channel was widened during phragmites removal, it is not clear whether or not these alterations had a net negative impact on smelt spawning activity.



Figure 10. Saugus River, Section 2.

Sections 3, 4 and 5 – Downstream of Iron Works to Hamilton Street Bridge



Figure 11. Saugus River, Section 4.

The river channel sections located downstream of the Saugus Iron Works site contain less cobble, more sand, and extensive tidal mud flats (Figure 11). A small number of smelt eggs were found in Sections 3 and 4 where intermittent patches of cobble substrate provided habitat (see Sections 3 and 4 in Figure 8). No surveys were conducted in Section 5 below the sewer line as the downstream limit of egg deposition was determined to be located further upstream. No eggs were found in a potentially ideal riffle located where the sewer line crosses over the Saugus River.

Shute Brook Site

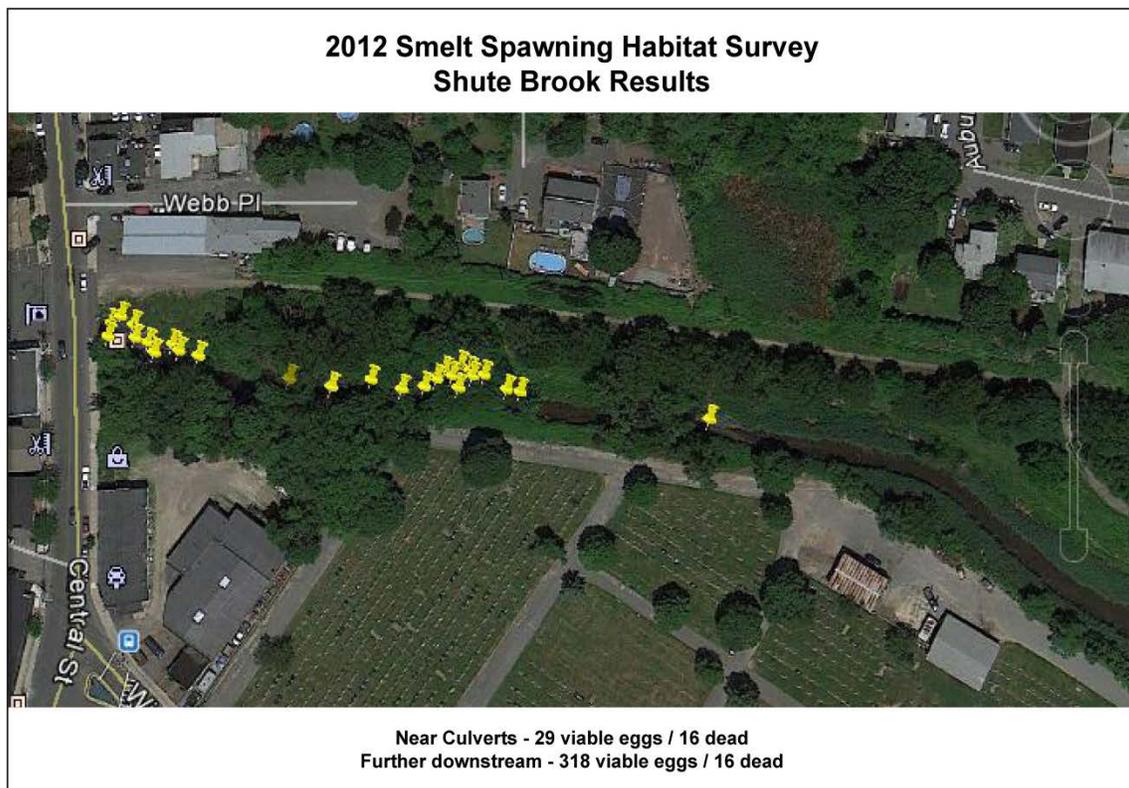


Figure 12. Shute Brook Results.

One of the priorities of the 2012 smelt spawning habitat survey was to determine if any smelt spawning habitat in Shute Brook was still viable, as both the Saugus River Watershed Council and the

Massachusetts Division of Marine Fisheries had observed degraded environmental conditions in Shute Brook over the past decade. This survey determined that several locations downstream of the Central Street culverts in Shute Brook provided viable smelt spawning habitat during 2012 (Figure 12). In Shute Brook, 379 smelt eggs were found in 29 locations during the period from March 11 through April 14 (Table 3).

Table 3. Shute Brook Results

Date	Monitors	Temp	# of Locations with eggs	# of Eggs	Viable	Nonviable
03/07/2012	Albert, Kreider, LeBlanc	8.5	0	0		
03/11/2012	Blees, LeBlanc, Oblath	4.5	2	2	2	
03/13/2012	Burgess, Kreider, LeBlanc, Welch	6	2	2	2	
03/21/2012	Albert, Burgess, LeBlanc	10	1	3	3	
03/24/2012	Armstrong, Oblath, Welch	14	0	0		
03/30/2012	Devlin, Kreider, LeBlanc	10	8	171	164	7
04/04/2012	Devlin, LeBlanc	n/a	3	31	30	1
04/10/2012	Burgess, LeBlanc	n/a	4	49	47	2
04/11/2012	Albert, Engler, LeBlanc	12	4	94	87	7
04/14/2012	Armstrong, Devlin, Oblath, Welch	16	5	27	12	15
04/18/2012	Devlin, LeBlanc, Oblath	16	0	0		
04/25/2012	Blees, LeBlanc	11	0	0		
Totals:			29	379	347	32



Figure 13. Shute Brook at culvert.

Most of the smelt eggs found in Shute Brook were located in two primary areas. First, small numbers of eggs were found immediately downstream of the Central Street culverts (Figure 13). This area contains several areas of small cobble suitable for habitat. Survey results indicate that reconstruction of the Central Street culvert has not damaged smelt spawning habitat in Shute Brook. Determining whether or not the smelt utilized spawning habitat upstream of the culvert was beyond the scope of this project.

The most active area of habitat was located further downstream from the culvert in a shallow area of the brook with small cobble and adequate riffle. This portion of Shute Brook was dubbed ‘the nursery’ by volunteers because it was loaded with thousands of smelt eggs (Figure 14). Consistent with project protocols, actual counting in this area was limited in an effort to protect the eggs



Figure 14. Shute Brook 'nursery'.

from being trampled. This location had the highest level of egg density of all of the sites surveyed in both Shute Brook and the Saugus River. Egg densities in this area were likely related to smelt crowding below the branches in the brook and responding to the higher water velocity and scoured cobble caused by the branches. Very high densities of eggs were found within the branches as well as approximately one to two meters upstream and downstream of the branches.



Figure 15. Shute Brook downstream.

Very few smelt eggs were found downstream where the brook is bordered by phragmites and there is greater tidal influence (Figure 15). The spawning period for Shute Brook began on March 11 and extended through April 14. Average water temperature for the surveys conducted in Shute Brook was 7.6°C during March and 13.8°C during April. During 2012, the 35 day spawning period in Shute Brook was significantly shorter than previously documented spawning periods of 56 days in 1988, 50 days in 1989, and 48 days in 1990 (Chase 2006).

Discussion and Recommendations for Restoration

On 20 November 2012, the following project team members participated in a field visit to identify site specific opportunities for restoration and enhancement of smelt spawning habitat at both the Saugus River and Shute Brook: Joan LeBlanc, Saugus River Watershed Council, Marc Albert, National Park Service, Lisa Engler, Massachusetts Bays Program, Brad Chase, Division of Marine Fisheries, and Brian Waz, U.S. Fish and Wildlife Service.

Team members identified potential opportunities to improve, expand or enhance smelt spawning habitat in the main stem of the Saugus River and Shute Brook by: 1) protecting existing cobble, 2) grooming substrate conditions by adjusting boulders and cobble in the river to enhance and expand riffle habitat, 3) protecting and / or enhancing quality and shading of adjacent vegetated buffers, 4) protecting natural areas in the river that provide sheltered spawning opportunities, and 5) improving environmental conditions.

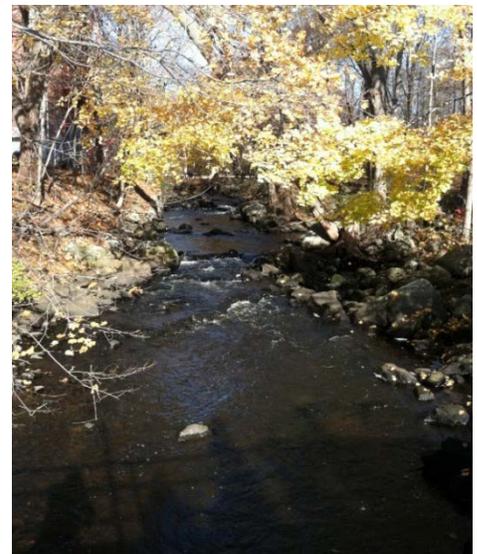


Figure 16. Saugus River, Section 1.

Saugus River

The project team noted that the segment of the Saugus River upstream of the Saugus Iron Works bridge provided the best potential for higher egg survival rates because it had excellent riffles along with a healthy vegetated buffer and tree canopy with ample shade (Figure 16). This region is also located upstream of the upper limits of tidal influence reducing the potential for exposure of smelt eggs during low tide. As tidal influence expands upstream over time due to predicted sea level rise in New England, spawning habitat in this segment of the river may become even more important.



Figure 17. B. Chase and M. Albert, Saugus River site visit.

Several opportunities for ‘grooming’ the river bed to expand or enhance riffle habitat were identified. This restoration effort would involve strategically relocating larger boulders and medium size cobble to enhance and expand the riffle habitat in the river. In the vicinity of the old historic dam (Figure 17), leveling and grading work is needed to improve fish passage. Work could be conducted by volunteers and staff from the Saugus River Watershed Council and / or National Park Service with on site technical supervision from the Division of Marine Fisheries and U.S. Fish and Wildlife Service. Staff

from the Massachusetts Bays Program and the Division of Ecological Restoration would also be consulted for potential technical and / or financial support. Permitting for the project would involve preparation of a Request for Determination of Applicability (RDA) for submittal to the Saugus Conservation Commission. Because the purpose of the project would be to improve fish passage, the RDA would be prepared in partnership with the Massachusetts Division of Marine Fisheries.

The valuable smelt spawning habitat in this portion of the Saugus River relies upon continued protection of a 3.9 acre property that provides healthy vegetated buffer adjacent to the east side of the river. Although there are no specific development proposals in permitting right now, the property owner has indicated a strong desire to develop the entire parcel with housing. Permanently protecting the vegetated buffer along this segment of the Saugus River was identified as an extremely high priority by all members of the project team. As of this report date, the Saugus River Watershed Council has initiated discussions with Essex County Greenbelt Association regarding strategies for working with the property owner to explore opportunities for protecting this important habitat. If the property were permanently protected, the National Park Service would explore their potential for playing a role in

operations and maintenance of the site. With its location adjacent to the Saugus Iron Works National Historic Site and the presence of a historic fish ladder on the site, this segment of property along the Saugus River offers opportunities for historic interpretation in addition to its environmental benefits.



Figure 18. B. Waz and B. Chase evaluate riffle @ Iron Works.

Division of Marine Fisheries and U.S. Fish and Wildlife Service staff identified additional restoration opportunities in the main stem of the Saugus River adjacent to the berm at the Saugus Iron Works site (Figure 18). The berm served to protect an important riffle in this segment of the river where the highest egg densities were found. Division of Marine Fisheries staff recommended pursuing limited habitat restoration by grooming the cobble in this area to expand and enhance the existing riffle. Permitting and procedures would be similar to proposed restoration work upstream. The project team also noted the need to continue ongoing efforts to improve plantings on the berm to reduce erosion and increase shading of the spawning habitat.

During the site visit, the project team identified several healthy patches of common water moss (Figure 19) in the Saugus River both upstream and downstream of the Saugus Iron Works bridge. The presence of this aquatic moss is a positive sign for overall environmental conditions in the river.



Figure 19. Aquatic Moss.

Shute Brook



Figure 20. B. Chase evaluates intentionally 'blocked' culvert at right, culvert with cobble at left.

The purpose of research in Shute Brook was to determine whether there was any viable smelt spawning habitat in the brook, and to inform habitat restoration efforts by the Saugus River Watershed Council and the Massachusetts Division of Marine Fisheries in partnership with the Town of Saugus. In 2007, the Town of Saugus replaced the large culvert crossing Shute Brook at Central Street to alleviate chronic flooding problems in adjacent neighborhoods. Massachusetts Division of Marine Fisheries required placement of cobble in the apron of the culvert to help promote smelt spawning activity, though it was unclear at that time whether that habitat was still viable. For the second drainage culvert,

Massachusetts Division of Marine Fisheries required placement of large boulders to discourage smelt from attempting to enter (Figure 20). During the site visit, Brad Chase indicated that the mitigation measures taken to promote smelt passage and spawning near the culverts were deployed as designed and constituted a net improvement over the degraded conditions found prior to 2007; however, much of the cobble placed on the apron of both culverts had migrated downstream. During the 2012 surveys, smelt eggs were found within several patches of small cobble just downstream of the culverts.

Despite conditions that are more degraded than the main stem of the Saugus River, Shute Brook still provides valuable active smelt spawning habitat. Opportunities for restoration and enhancement of smelt spawning habitat in Shute Brook should focus on reconfiguring the two segments of rocky outcropping that cross the brook (Figure 21), and adding a small number of large cobble to the main culvert apron. Grooming the brook is needed to promote fish passage and enhance riffle habitat.

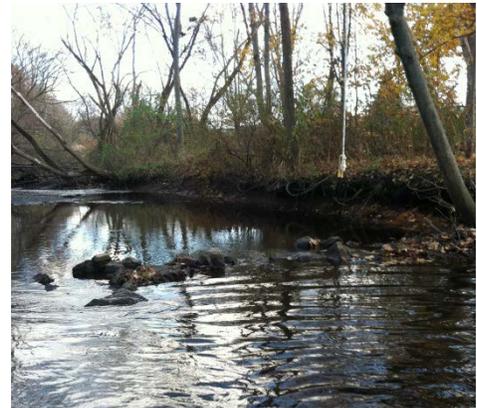


Figure 21. Rocky outcropping at Shute Brook.

Permitting for this minor in-stream restoration activity would be similar to the main stem of the Saugus River and involve the Massachusetts Division of Marine Fisheries and the Saugus Conservation Commission.

During the site visit, patches of common water moss were identified in Shute Brook, but their growth was stunted in comparison to the aquatic moss found in the main stem of the Saugus River. Continued efforts are needed to improve degraded environmental conditions associated with storm water pollution and debris in Shute Brook. Additional plantings are needed to improve the vegetated buffer and shading in the grassy area along Shute Brook adjacent to the Central Street culvert. This type of planting was required as part of the environmental permitting for the culvert replacement project.

Potential Impact of Climate Change on Smelt Spawning Habitat

Environmental conditions associated with climate change may have an impact on future survival rates for smelt eggs, spawning habitat locations, and the length of spawning periods in the Saugus River and Shute Brook. Earlier spawning periods may be linked to an overall rise in temperatures throughout the New England region. Increased variability in weather, extended dry periods, and high intensity rain storms may also have a negative impact on smelt spawning and egg survival. Rising temperatures are

also linked to increasing algal growth on cobble, making egg adhesion and survival more difficult. At the same time, expected increases in upstream salinity levels associated with predicted sea level rise may cause rainbow smelt to utilize spawning habitat further upstream in the future.

Summary of Key Recommended Actions (Table 4)

Recommended Actions for Saugus River

- **1. Restore Saugus River Habitat:** Improve and enhance riffle habitat by conducting strategic grooming of the river substrate. Several potential restoration / enhancement sites are located upstream and downstream of the Saugus Iron Works bridge. River grooming upstream of Bridge Street in the vicinity of the old dam should focus on improving fish passage to enhance upstream spawning opportunities. Grooming adjacent to the Saugus Iron Works should focus on expanding riffle habitat and improving slope at specific locations to aid upstream passage. This recommendation is consistent with Massachusetts Division of Marine Fisheries recommendations from the previous survey (Chase 2006).
 - **Key Partners:** Saugus River Watershed Council, National Park Service, Massachusetts Division of Marine Fisheries, U.S. Fish and Wildlife Service, Massachusetts Bays Program, Massachusetts Division of Ecological Restoration, Saugus Conservation Commission.
 - **Timeline:** Prepare Request for Determination of Applicability (RDA), conduct slope and cross section survey, and implement initial improvements in Year 1 - or as soon as funding and staff capacity permit. Assess impact of changes during the next spawning season. Conduct additional improvements in Year 2 and beyond as needed.

- **2. Protect Vegetated Buffer Along Saugus River:** Explore opportunities for permanent conservation of the undeveloped vegetated buffer adjacent to the east side of the Saugus River immediately upstream of Bridge Street. This 3.9 acre privately-owned parcel provides valuable shading, stormwater protection, flood storage, and wildlife corridor.
 - **Key Partners:** Private property owner, Saugus River Watershed Council, National Park Service, Essex County Greenbelt Association, Massachusetts Bays Program, Department of Conservation and Recreation, and other regional land protection organizations and public agencies.
 - **Timeline:** Initiate dialogue with property owner and partners about potential opportunities for long-term protection of the property, and conduct assessment to determine market value of

property (Year 1). Identify potential strategies and funding opportunities for permanent conservation of the property (Year 1 and beyond). Coordinate with state and regional land protection organizations. (Year 1 and beyond).

- **3. Improve Plants on Berm at Saugus Iron Works:** Conduct additional plantings to improve woody vegetated cover and shading of the riffle habitat next to the berm adjacent to the Saugus River Turning Basin.
 - Key Partners: National Park Service.
 - Timeline: Conduct additional plantings in Year 1. Evaluate success and conduct additional plantings in future years as needed (Year 2 and beyond).

Recommended Actions for Shute Brook

- **4. Restore Shute Brook Habitat:** Improve and enhance riffle habitat by conducting strategic grooming of the river substrate downstream of the Central Street culverts. Focus primarily on adjusting the areas in the brook with two rocky outcroppings to enhance fish passage. This recommendation is consistent with the Massachusetts Division of Marine Fisheries recommendations from the previous survey (Chase 2006).
 - Key Partners: Saugus River Watershed Council, Massachusetts Division of Marine Fisheries, U.S. Fish and Wildlife Service, Saugus Conservation Commission, Massachusetts Division of Ecological Restoration, Massachusetts Bays Program
 - Timeline: Prepare Request for Determination of Applicability (RDA), conduct slope and cross section survey, and implement initial improvements in Year 1 - or as soon as funding and staff capacity permit. Assess impact of changes. Conduct additional improvements in Year 2 and beyond as needed.

- **5. Improve Vegetated Buffer at Shute Brook:** Plant trees and shrubs adjacent to Shute Brook at the Central Street culvert to enhance shading and reduce stormwater runoff.
 - Key Partners: Saugus River Watershed Council, Town of Saugus Department of Public Works, Saugus Conservation Commission
 - Timeline: Conduct plantings in Year 1 or as soon as funding and staff capacity are available. Conduct additional plantings in Year 2 and beyond as needed.

- **6. Monitor Shute Brook Culvert:** Conduct future research to determine if smelt are traveling upstream in Shute Brook through the Central Street culvert.
 - Key Partners: Saugus River Watershed Council, Massachusetts Division of Marine Fisheries, Saugus Conservation Commission
 - Timeline: Conduct survey (Year 1 or when funding and staff resources are available).

Recommended Actions for Both Saugus River and Shute Brook

- **7. Improve Environmental Conditions in Saugus River and Shute Brook:** Continue efforts to improve water quality, reduce stormwater pollution, and maintain adequate flow in the Saugus River. This recommendation is consistent with the Massachusetts Division of Marine Fisheries recommendations from the previous survey (Chase 2006).
 - Key Partners: Saugus River Watershed Council, Lynn Water and Sewer Commission, local communities.
 - Timeline: Continue working with local communities on a wide range of projects aimed at reducing sources of pollution to the river (Year 1 and beyond). Continue implementation of Memorandum of Understanding with Lynn Water and Sewer Commission to limit water withdrawals during key spawning and fish migration period (agreement has been in place since 2003, ensure future continuation).

- **8. Conduct Monitoring:** Continue monitoring the status of smelt spawning habitat in the Saugus River and Shute Brook. Consult and receive approval from the Massachusetts Division of Marine Fisheries to work in smelt spawning run during closed season (M.G.L. Chapter 130, Section 36).
 - Key Partners: National Park Service, Saugus River Watershed Council, Massachusetts Division of Marine Fisheries, U.S. Fish and Wildlife Service, Saugus Conservation Commission, other state agencies and funding partners.
 - Timeline: Conduct full habitat survey either every three or five years in order to minimize disturbance of the smelt eggs (Year 3 and beyond). Conduct spot check surveys to determine presence of spawning activity each year (Year 1 and each subsequent year when a full survey is not being conducted).

Table 4. Timeline for Habitat Restoration Activities

Recommended Action	Year 1	Year 2	Year 3	Year 4	Year 5	Partners
<u>1. Restore Saugus River Habitat</u> - Prepare RDA - Slope and cross section survey - Initial improvements - Assess and follow up as needed	x x x	x x	x	x	x	SRWC, NPS, DMF, USFWS, MBP, MDER, SCC
<u>2. Protect Vegetated Buffer</u> - Pursue conservation of 3.9 acre parcel upstream of Iron Works on east side of Saugus River	x	x	x	x	x	SRWC, property owner, NPS, Essex County Greenbelt, MBP
<u>3. Improve Plantings on Berm</u> - Conduct additional plantings on berm adjacent to Iron Works - Evaluate and conduct additional plantings as needed	x	x	x	x	x	NPS
<u>4. Restore Shute Brook Habitat</u> - Prepare RDA - Slope and cross section survey - Initial improvements - Assess and follow up as needed	x x x	x x	x	x	x	SRWC, DMF, USFWS, MBP, MDER, SCC
<u>5. Improve Buffer at Shute Brook</u> - Conduct plantings - Assess and follow up as needed	x	x	x	x	x	SRWC, SCC, Town of Saugus DPW
<u>6. Monitor Shute Brook Culvert</u> - Survey to determine if smelt are traveling upstream through Central Street culvert	x					SRWC, DMR, SCC
<u>7. Improve Environmental Conditions at Shute Brook and Saugus River</u> - Pursue efforts to reduce pollution	x	x	x	x	x	SRWC and others
<u>8. Conduct Future Monitoring</u> - Spot check surveys - Full habitat survey	x	x	x	x	x	SRWC, NPS, DMF, USFWS, SCC

Note: Proposed actions and timeline are subject to funding and staff availability.

References

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