ENVIRONMENTAL ASSESSMENT

Rattlesnake Brook Restoration Project

Freetown, Massachusetts

U.S. Fish & Wildlife Service
Partners for Fish and Wildlife Program
New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301
Contact: Bill Bennett
(603)223-2541 (extension 6422)
william_bennett@fws.gov

This Environmental Assessment becomes a Federal document when evaluated and signed by the responsible Federal Official.

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Date

Acting For Thomas R. Chapman
Supervisor
New England Field Office
U.S. Fish and Wildlife Service

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1.0 INTRODUCTION

This Environmental Assessment (EA) addresses environmental impacts associated with the Rattlesnake Brook Restoration Project (Project) in Freetown, Massachusetts. The Project's goal is to restore natural stream processes, upstream and downstream fish passage, and improve public safety by removing an aging and obsolete dam. Currently, the Rattlesnake Brook Dam (Dam) blocks fish passage, impedes natural stream process, and is a potential threat to human safety. The Project is a partnership between the U.S. Fish and Wildlife Service (Service), the Massachusetts Division of Ecological Restoration (MA DER), the City of Fall River (dam owner), The Nature Conservancy, and the Town of Freetown. The Service is acting as lead Federal agency for the Project, and funding for the Project is from the Disaster Relief Appropriations Act of 2013 (Hurricane Sandy), provided through the Department of the Interior to the National Fish and Wildlife Foundation and MA DER.

The Service is completing this EA consistent with the National Environmental Policy Act of 1969 (P.L. 91-190; 42 U.S.C. 4321 *et seq*.) to evaluate and display potential environmental impacts of the alternatives considered for the Proposed Action.

1.1 Background

The Project is located at the head of tide on Rattlesnake Brook in the Town of Freetown, Massachusetts (Figure 1). The Brook's watershed is 6.5 square miles and is a tributary of the Assonet River estuary. In 1882, the Dam, historically called the Crystal Springs Dam, was constructed to supply water to the Crystal Springs Bleaching and Dyeing Company (Bleachery). The Dam is a 400-foot-long earthen and masonry structure with three water control structures that diverted flow through the Bleachery House and Dye Room (Banister et al. 2014).

In 1955, the Bleachery was destroyed by a fire and subsequently abandoned (Banister et al. 2014). The 10-acre property is now reforested and under ownership by the City of Fall River. The Dam is no longer maintained and has deteriorated. A safety inspection conducted by Pare Corporation in 2009 determined the Dam to be in an unsafe condition and susceptible to failure (Chelminski 2010). In March of 2010, a large flood partially breached the Dam and washed out the downstream Town-owned Narrows Road causeway (Field Engineering Co., Inc. 2011). While the Road has been repaired, breaches within the Dam still exist and activate during high flows (Chelminski 2010).

The Dam fragments the watershed and impairs river and ecological processes of Rattlesnake Brook, including sediment transport, hydrology, aquatic habitat, aquatic organism passage, and water quality. The Dam prevents alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) from accessing their historic spawning grounds (Reback et al. 2004). The Dam and the historical modifications made to the stream during operation of the Bleachery have also degraded rainbow smelt (*Osmerus mordax*) spawning habitat.

MA DER determined the Dam's removal to be a State Priority Project for river restoration in 2011. Since that time, MA DER has provided lead project management services and has been working with the Service, other project partners, and Milone and MacBroom, Inc. (MMI) - under

contract for engineering services - to collect information, determine the feasibility of, perform modeling, and develop engineering designs to remove the Dam. Photos and maps of the site can be found in Appendix A.

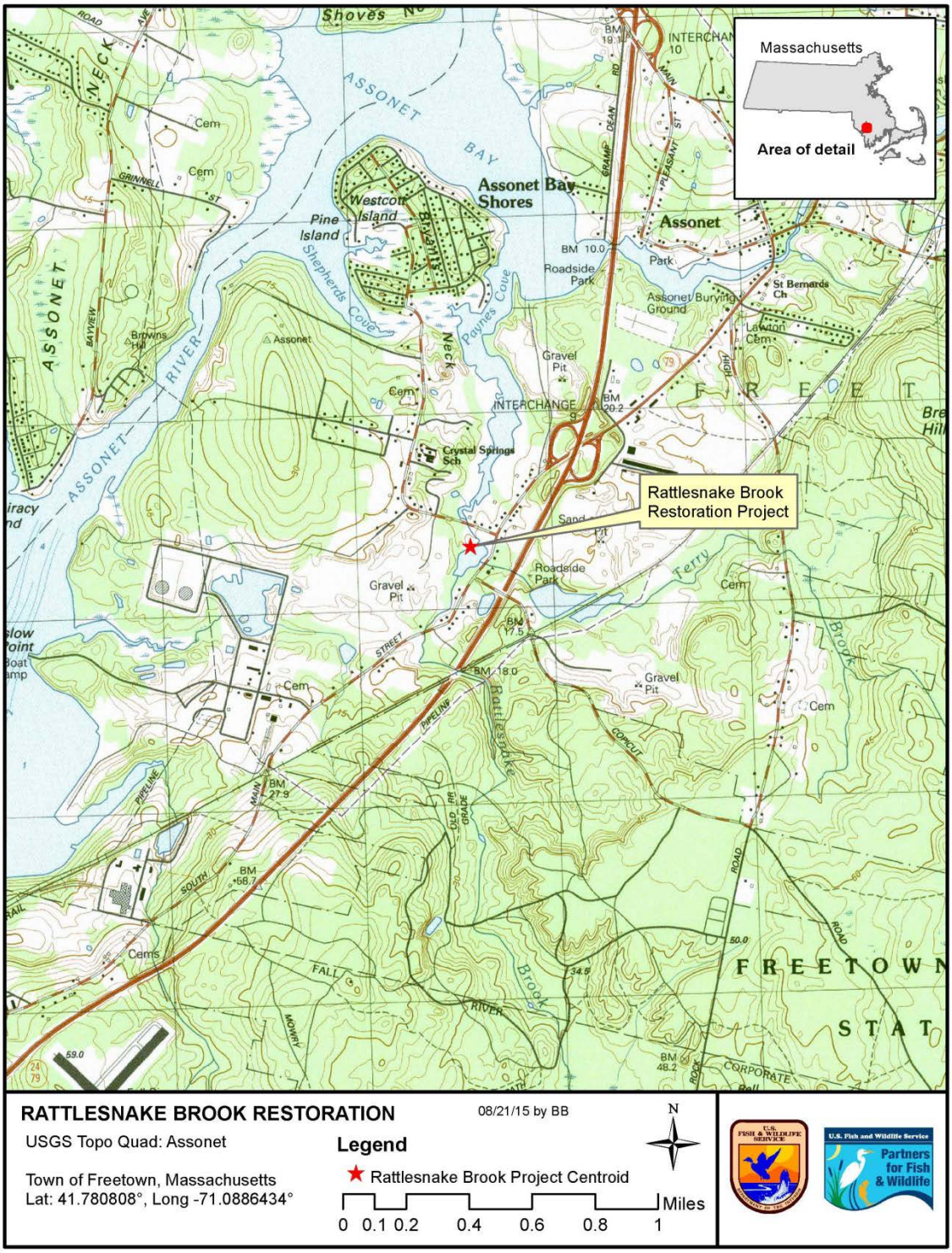

Figure 1. Map showing the location of the Rattlesnake Brook Restoration Project.

1.2 Purpose and Need

The purpose of the proposed Project is to restore fish passage and natural river process to Rattlesnake Brook and eliminate risks to life and property associated with the existing obsolete Dam.

The Dam is a complete barrier to upstream fish passage, with the exception of the American eel (*Anguilla rostrata*). Alewife and blueback herring, referred to collectively as river herring, have been observed attempting to pass the Dam (Reback et al. 2004). Consequently, river herring have been extirpated from the upper watershed due to their inability to access historic spawning grounds. Both alewife and blueback herring are listed as Species of Concern by the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS). Species of Concern are those species in which there are concerns regarding status and threats, but insufficient information is available to indicate a need to list the species under the Endangered Species Act (ESA). One of the primary factors listed by the NMFS as contributing to river herring decline is the loss of access to spawning habitat, which this Project would help address by restoring access (NOAA NMFS 2009).

Reestablishment of anadromous fish populations would also result in a healthier and more resilient ecosystem by increasing the watershed's productivity and ability to support a greater diversity of species. Anadromous fish return marine-derived nutrients into the watershed through the release of eggs during spawning and partial die-off benefitting the base of the food web (Jardine et al. 2009). The increased production of river herring would provide important forage for piscivorous birds, marine mammals, river otters, and larger predatory fish in the Assonet River and Narragansett Bay estuary that feed on the out-migrating juveniles and returning adults (Hall et al. 2012; Hall et al. 2011).

Improved passage would benefit the American eel, which are found within the Rattlesnake Brook watershed. While the eel's presence indicates its ability to migrate past the Dam, it is still a barrier to elvers and smaller bodied eels. Presence of the Dam also exposes eels to increased predation by piscivorous birds, which prey upon the eels as they accumulate at the base of the Dam and try to pass over it. Restoring passage will aid this declining species by allowing unimpeded passage past the Dam to important headwater habitats (Hitt et al. 2012).

Rainbow smelt have been observed spawning in Rattlesnake Brook downstream of the Dam (Reback et al. 2004). Smelt spawn in stream riffles near the head of tide to deposit eggs. Modifications to the stream and construction of the Dam, however, have degraded and limited the amount of available spawning habitat within the project area. Loss and degradation of spawning habitat across the species' entire geographic range has been one of the primary reasons for the species' decline and contributed to the designation of rainbow smelt as a Species of Concern by the NMFS (NOAA NMFS 2007). Restoration of habitat and ecosystem processes within the project reach would create spawning habitat for smelt and help address the loss of this important habitat type of this declining species.

The Dam has also disrupted sediment transport processes within Rattlesnake Brook and adjacent Terry Brook, causing a conversion of approximately 1,400 feet of stream channel from a lotic (free-flowing) to a lentic (still water) system. Consequently, finer sediments that would have once naturally been carried downstream of the Dam into the estuary are now accumulating in the 4.6-acre impoundment. This sediment has buried the stream's natural substrate of gravels and cobbles, rendering the benthic habitat unusable by many of the native species that typically would occur within this type of riverine system. Moreover, estuary habitat has been starved of the finer-grained sediment that would normally have been transported downstream. Removal of Rattlesnake Brook Dam will restore these sediment transport processes, enhancing habitat both upstream and downstream of the Dam.

The Dam impairs downstream water quality by raising water temperatures and lowering dissolved oxygen (DO) levels (Zaidel 2015). Such elevated stream temperatures can cause coldwater fish to become physiologically stressed, thereby increasing their risk to predation, susceptibility to disease, and a decrease in reproductive success (Wehrly et al. 2007; Lessard and Hayes 2003). Prior to the construction of the Dam, Rattlesnake Brook likely had a narrower width and a forested riparian buffer shading the stream, contributing to cooler water temperatures. Removal of the Dam would restore the stream to a free-flowing river, helping to moderate water temperatures supportive of a native fishery.

In the most recent inspection of Rattlesnake Brook Dam by Pare Corporation in 2009, the Dam was found to be in unsafe condition due to deterioration of the Dam and embankment (Chelminski 2010). While the Massachusetts Office of Dam Safety (MA ODS) classifies the Dam as "small" with a "Low" hazard potential, catastrophic failure of the Dam would allow an uncontrolled release of water and sediment that would damage the Town-owned Narrows Road that is just downstream (MASSGIS 2015). Narrows Road is the primary access route to approximately 1,000 homes, the Crystal Springs Special Needs School, and the Assonet Bay Shores community (Field Engineering Co., Inc. 2011). In 2010, storm flows that caused multiple breaches in the Dam washed out Narrows Road, disconnecting the community from the mainland for three days (Field Engineering Co., Inc. 2011; Toness 2010). While Narrows Road has been repaired, it is still at risk of being washed out should the Dam breach again.

2.0 ALTERNATIVES CONSIDERED

The Service and project partners considered a range of alternatives and their ability to meet the Project's purpose and need. Environmental, social, economic and cultural factors were considered to identify those alternatives that met the Project's objectives. Initially, six alternatives were considered for analysis, but four were identified as not feasible and therefore eliminated from further consideration.

2.1 Alternatives Eliminated From Further Consideration

Repair Dam and Install Fish Passage

This alternative would rehabilitate Rattlesnake Dam to current MA ODS regulations and install a nature-like fishway, fish ladder, or some other means to restore fish passage past the Dam. An inspection of the Dam by Pare Corporation in 2009 found the Dam to be in poor condition and in need of significant repairs, estimated to be between $472,000 and $630,000 (Chelminski 2010). Not included in this estimate is the cost to construct a nature-like fishway or fish ladder. Given the high expense to rehabilitate the Dam, the inability of the alternative to restore ecological processes and lack of use of the impoundment, this alternative was eliminated from further consideration.

Breach Dam at the Eastern Spillway

Under this alternative, the eastern spillway of the Dam would be breached and a new channel would be constructed, connecting to the western box culvert under Narrows Road. While this alternative restores fish passage, ecological processes, and removes the hazard, significant excavation would be required through wetlands to construct the new stream channel. Not only would this alternative be significantly more complicated and expensive, but also substantial impacts to existing wetlands would occur. Due to these reasons, the alternative was removed from further consideration.

Breach Dam at the Eastern Spillway and Daylight Culvert

Under this alternative, the eastern spillway of the Dam would be breached and a new channel would be constructed by daylighting the 210-foot downstream diversion culvert that connects the Dam to the eastern box culvert under Narrows Road. To daylight the culvert, 2,000 cubic yards of material would need to be excavated to construct the new stream channel. Not only would the successful construction of a completely new stream channel be more complicated, but also substantial impacts to existing wetlands would occur. While this alternative restores fish passage, ecological processes, and removes the hazard Dam, the alternative was eliminated from further consideration due to the impacts to wetlands and large amount of excavation required.

Breach Dam at Eastern and Western Spillways

Under this alternative, breaches would be constructed at the eastern and western spillways of the Dam. At the eastern breach, the 210-foot-long diversion culvert connecting the eastern box culvert under Narrows Road would be daylighted and restored to a natural channel. At the western breach, the existing channel would be modified to an appropriate width and depth to connect the western box culvert under Narrows Road. This alternative would require the greatest volume of excavation and cause the most wetland impact. The alternative may also result in insufficient depth to allow for fish passage during normal flow conditions. Due to the impacts to wetlands, higher costs, and unreliable fish passage conditions under normal flows, this alternative was eliminated from further consideration.

2.2 Alternatives Receiving Further Consideration

Two alternatives received further in-depth analysis under this EA to evaluate their ability to meet the Project's purpose and need. These two alternatives consist of the Proposed Action: Breach Dam at the Western Spillway with Passive Release of Sediment and a No Action Alternative.

Alternative 1 - Proposed Action: Breach Dam at the Western Spillway with Passive Release of Sediment

Under this alternative, 100 feet of the entire vertical extent of the western spillway would be breached and connected to the existing downstream channel. Approximately 400 linear feet of downstream channel would be restored to a natural form by reshaping the channel geometry to a watershed-appropriate width and depth, along with the installation of random boulder clusters, large woody debris, and two grade control riffles. Native shrubs and trees would be planted along the western channel to restore a diverse native riparian community. In addition, all legacy infrastructure associated with the Bleachery within the channel will be removed, including the concrete walls, culverts, and bridge abutments. It is estimated that restoration of the western channel will require excavation of 1,390 cubic yards of material. All sediment excavated during the construction of the downstream channel will be disposed of in a licensed landfill due to elevated contaminant levels found within the floodplain soils. In addition, the existing 215-foot-long diversion culvert at the eastern spillway would be filled with ordinary clean borrow material by removing the top portion of the culvert and bringing it up to the previously existing grade.

Upstream of the Dam, Rattlesnake Brook would be allowed to naturally form a meandering channel through the current impoundment, which will passively transport the accumulated sediments downstream. It is expected that channels will form in both Rattlesnake and Terry brooks in this fashion. Passive sediment migration is the preferred method for channel formation within the impoundment because it will minimize impacts to wetlands that would occur if the channel were to be excavated by mechanical means. In addition, sampling of the impoundment found the accumulated sediments to be relatively uncontaminated and cleaner than all samples downstream of the Dam. By releasing these accumulated sediments downstream, it is expected the cleaner sediment will bury, displace, and/or mix with some of the more contaminated sediments, thereby improving environmental conditions. Following removal of the Dam, the exposed sediments in the impoundment will also be seeded with native vegetation to help establish a native floodplain community. Proposed construction drawings depicting this alternative can be found in Appendix D.

Implementation of this alterative would have a net ecological benefit by restoring natural stream processes to the watershed and reconnecting 5 miles of high quality habitat for alewife, blueback herring, American eel, and other aquatic organisms within the watershed. The Project complements the Service's ongoing efforts to restore diadromous fish populations within the Taunton River watershed, of which Rattlesnake Brook is a tributary. The Project will improve public safety by removing the potential of a catastrophic dam failure that would damage downstream private property and public infrastructure. The Proposed Action eliminates the

owner's responsibility to maintain and operate the Dam and removes any liability associated with it.

Alternative 2 - A No-Action Alternative

Under the No Action alternative, no modifications would be made to Rattlesnake Brook Dam. The Dam would continue to prevent upstream and downstream passage of fish and other aquatic organisms. Natural stream processes would continue to be disrupted by the Dam as it continues to capture sediment and aggrade the upstream channel. Water quality would continue to be impaired by the Dam impoundment due to increased solar exposure, which would result in elevated water temperatures and lowered DO levels. The private dam owner would continue to bear the maintenance, inspection and liability costs and risks associated with the Dam. The risk of catastrophic failure that would damage private property and public infrastructure would continue, as the existing spillway is rated in an "unsafe" condition (MASSGIS 2015). Under this alternative, the Dam would continue to access an existing breach during high flows at its eastern edge, allowing overland flow and erosion to occur through the upland forest area between the Dam and Narrows Road.

2.3 Comparison of Alternatives

The ability of the two alternatives to meet the Project's "Purpose and Need" are compared in Table 1. The Proposed Action *Alternative 1 –Breach Dam at the Western Spillway with Passive Release of Sediment* meets each of the "Needs" of the Project, while *Alternative 2 – No Action* does not address any of them. The Environmental Consequences chapter of this EA provides a more detailed explanation of each of these topics.

Table 1. Comparison of Project objectives between Alternatives.

Project Objectives	Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment	Alternative 2 – No Action
Dam Safety and Condition	Dam removal resolves hazards to the public, infrastructure, and the environment.	Dam remains in place, leaving the existing threats to public safety and infrastructure unresolved.
Habitat Fragmentation	Stream connectivity is restored, allowing up- and downstream passage of aquatic organisms.	Dam continues to act as barrier to aquatic organism passage.
Habitat Degradation	Restoration of stream to a free-flowing condition.	Dam impoundment continues to exist, maintaining unnatural lentic conditions.
River Processes	Sediment transport, channel morphology, and hydrology restored.	Sediment transport, morphology, and hydrology continue to be disrupted by the Dam.
Water Quality	Natural thermal regime of the stream is restored by removing the impoundment, restoring free-flowing conditions, and allowing establishment of a riparian canopy.	Thermal regime of the stream continues to be adversely impacted by the Dam maintaining elevated water temperatures and lowered DO levels in the impoundment.

3.0 AFFECTED ENVIRONMENT

3.1 General

The Rattlesnake Brook watershed is 6.5 square miles, including the subwatershed of Terry Brook, which connects with Rattlesnake Brook in the Dam's impoundment from the southeast. The watershed drains the towns of Fall River and Freetown, Massachusetts before flowing into Assonet Bay. The watershed is 92 percent forested, with the Freetown-Fall River State Forest making up 74 percent of the entire watershed (NOAA CSC 2010). The next most predominant land cover type is low intensity developed at 1.6 percent (Table 2).

Table 2. Percentage of land cover type within the Rattlesnake Brook watershed. Land cover data was collected by the NOAA Coastal Change Analysis Program (CCAP) in 2010 and analyzed using ArcGIS 10.2.2 to calculate the percent cover within the watershed.

LAND COVER CLASS	PERCENT COVER
Deciduous Forest	41.8%
Mixed Forest	20.0%
Palustrine Forested Wetland	17.4%
Evergreen Forest	13.1%
Developed, Low Intensity	1.6%
Bare Land	1.3%
Palustrine Scrub/Shrub Wetland	0.8%
Pasture/Hay	0.7%
Grassland/Herbaceous	0.6%
Developed, Medium Intensity	0.6%
Developed, Open Space	0.6%
Open Water	0.6%
Scrub/Shrub	0.4%
Palustrine Emergent Wetland	0.4%
Developed, High Intensity	0.1%
Cultivated Crops	0.1%

3.2 Geology and Soils

The Rattlesnake Brook watershed occurs in the Seaboard Lowlands section of the New England Physiographic Province. Seaboard Lowlands are characterized by upland glaciated ridges and hills that transition into level plains near the coast that were shaped during the Wisconsin glaciation (Flanagan et al. 1999). During this period, the Laurentide ice sheet expanded and contracted across New England, scouring and reshaping the land. With the ice sheet's last retreat between 15,000 to 20,000 years ago, a thin layer of glacial till was left across the watershed, consisting of an unsorted, unstratified matrix of boulders, gravels, sands, some silts, and clays. Where no till was left due to steep slopes and irregular topography, bedrock outcrops occur in the watershed's headwaters. Glacial meltwaters also flowed out of the ice sheet as it melted and

receded northward. The meltwaters formed the river valleys, depositing a thick layer of coarse stratified deposits consisting almost entirely of sands and gravels. Coarse-grained deposits occur within the lower watershed and in the Assonet River valley. Following the ice age, rivers and hillslope erosional processes delivered alluvium with a high content of silt, fine sand, and organic matter to the river valleys.

The United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) soil survey describes soils in the project area as being Walpole sandy loam and Sudbury fine sandy loam, which are often found near stream and low-lying areas (Soil Survey Staff 2014). Walpole soils are the predominant soil and occur within the floodplain downstream of the Dam and along the eastern and southeastern sides of the impoundment. The Sudbury fine sandy loam soils occupy the northeast side of the Project to South Main Street and Narrows Road. Upstream of the impoundment, soils are classified as very poorly drained Scarboro muck (Soil Survey Staff 2014). A field assessment by MMI conducted during multiple visits between 2013 and 2014 confirm the general classification of the soils within the project area (MMI 2015). However, due to the industrial nature of the site, there is some deviation from soils mapped by the USDA NRCS soil survey due to placement of fill during construction of the Bleachery (Banister et al. 2014).

3.3 Water Resources

3.3.1 River Morphology and Processes

Rattlesnake Brook's headwaters start in the varied topography of the Freetown State Forest. From the headwaters, the stream flows in a northerly direction to its confluence with the Assonet River. Over 90 percent of the watershed is forested, with less than 2 percent of the land converted into impervious surface (USGS 2015). The lack of development has protected Rattlesnake Brook's natural riverine and geomorphological processes.

The Dam backwaters the stream creating an open water impoundment that is approximately 4.6 acres (MA DER 2015a). Consequently, sediment transport processes are disrupted as finer sediments, such as sands and silts, are deposited within the impoundment instead of being transported downstream into the Assonet River and estuarine environments. Sediment deposition has had the effect of the streambed by burying the stream's natural substrate of coarser material. Depth of refusal surveys completed by MMI estimate that 6,000 cubic yards of sediment have accumulated within the impoundment (2014). Upstream of the dam impoundment, the river substrate is characterized by a diversity of grain sizes and has been classified as having higher quality habitat. Downstream of the Dam, the western spillway channel is characterized by predominantly larger size substrate and lacking in finer-grained material (MA DER 2015b).

Rattlesnake Brook has multiple flow paths downstream of the Dam, with the baseflow split between the eastern and western spillways. The western spillway directs Rattlesnake Brook into an incised channel with stone and concrete walls for approximately 250 feet. This channelized section of stream also has two stream crossings consisting of a masonry culvert and a small concrete bridge. After exiting the walled section, the stream runs for 150 feet through a ditch before flowing under the Narrows Road west box culvert that was replaced after the 2010 flood.

The eastern spillway directs the stream into a buried 215-foot-long culvert that discharges into another 115-foot-long earthen ditch before flowing through the east box culvert underneath Narrows Road. At higher flows, the stream accesses breaches located at the far eastern and western ends of the Dam. During these higher flows, the stream connects to a series of braided channels that traverse the site's wetlands. After flowing under Narrows Road, the east and west ditches merge as they enter the estuary.

3.3.2 Hydrology and Hydraulics

MMI conducted hydrologic and hydraulic analyses to understand Rattlesnake Brook's full range of flows and the effects of the Dam. The analyses were conducted using the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center River Analysis System (HEC-RAS). HEC-RAS allows the user to calculate flood elevations, velocities, and channel hydraulics for different storm events.

Peak discharges calculated by the Federal Emergency Management Agency's (FEMA) 2009 Bristol County Flood Insurance Study (FIS) were used for the 10-, 50-, 100-, and 500-year flow. USGS StreamStats 2015 was used for the 2-, 5-, and 25-year flows, which were not calculated by FEMA (Table 3). StreamStats utilizes regional regression equations to calculate discharge based upon statistical analysis of flows at USGS gages in Massachusetts. The 2-, 5-, and 25-year flows were calculated by analysis of gauged sites in Connecticut by Jim MacBroom, P.E. of MMI (MMI 2014).

Table 3. Rattlesnake Brook summary of flows in cubic feet per second and the data sources (MMI 2014).

Storm Event	Discharge (cubic feet per second)		
	FEMA FIS 2009, Bristol County, MA	**USGS 1993 Regional Regression Equations**	**MMI Drainage Area Relationships**
Mean Low	N/A	N/A	12 (1.8xDA)
Mean Normal	N/A	N/A	30 (4.5xDA)
Mean Spring	N/A	N/A	50 (7.6xDA)
2-year	N/A	131	N/A
5-year	N/A	196	N/A
10-year	344	250	N/A
25-year	N/A	330	N/A
50-year	588	399	N/A
100-year	664	477	N/A
500-year	1,115	N/A	N/A

DA = Drainage Area

MMI calculated tidal water surface elevations using water surface elevation data collected by MA DER upstream and downstream of Narrows Road. Observed tidal fluctuations ranged from 1.1 to 4.4 feet on the upstream side of the Road. Downstream of the Road, the tidal fluctuations ranged from 0.2 to 4.2 feet (MMI 2014).

The results of MMI's HEC-RAS model show that Rattlesnake Brook Dam is a run-of-river structure that only raises water surface elevations upstream of the Dam depending upon flows. The Dam has no effect on water surface elevations downstream of the Dam, as it has no significant flood storage capacity. The FIS Base Flood Elevation is 14 feet at Narrows Road and 15 feet upstream of the Dam (MMI 2014). Model outputs showing the existing water surface elevations can be found in Appendix A.

3.3.3 Water Quality

Rattlesnake Brook is listed as Class B waters, according to the 2013 Massachusetts Surface Water Standards. The classification is based upon the most sensitive use of the water, which sets the minimum water quality criteria. Class B waters are described in the 2013 Massachusetts Surface Water Standards 314 CMR 4.05 as:

> **Class B** - "These waters are designated as a habitat for fish, other aquatic life, and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation. Where designated in 314 CMR 4.06, they shall be suitable as a source of public water supply with appropriate treatment ("Treated Water Supply"). Class B waters shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value (2013)."

Water temperature was monitored by Peter Zaidel in Rattlesnake Brook upstream of the Dam impoundment and downstream of the western spillway from July to October 2015. During the monitoring period, the downstream reach was significantly warmer than the upstream reach (Table 4). DO levels were also monitored for one week in September upstream of the Dam impoundment and downstream of the Dam. During the sampling period, the downstream reach went dry due to no water spilling over the Dam. Consequently, mean DO concentrations for the week were 7.56 mg/L upstream of the dam impoundment and 0.07 mg/L downstream of the Dam's western spillway (Zaidel 2015).

Table 4. Average monthly water temperatures for measurements taken in Rattlesnake Brook upstream of the dam impoundment and downstream of the western spillway (Zaidel 2015).

Month	Rattlesnake Brook Upstream Avg. Temperature °C	Rattlesnake Brook Downstream Avg. Temperature °C
July	19.73	20.63
August	20.36	20.74
September	17.89	18.5
October	11.83	13.25

A 2001 biomonitoring survey of Rattlesnake Brook within the Freetown-Fall River State Forest identified the watershed as having the best attainable conditions (MassDEP 2005). Bacteria sampling was also conducted in 2001 at Narrows Road and just upstream of the project area at Main Street. Samples were all within normal levels (Table 5).

Table 5. Bacteria sampling results for streams within the Rattlesnake Brook watershed in 2001 (MassDEP 2005).

Date	Stream	Location	Time (24-hr)	Fecal Coliform (CFU/100ml)	E. Coli (CFU/100ml)	Enterococcus (CFU/100ml)
07/23/01	Rattlesnake Brook	Narrows Road Freetown, MA	11:15	45	15	<5
08/06/01	Rattlesnake Brook	South Main St. Freetown, MA	08:30	43	<5	490b
09/18/01	Terry Brook	South Main St. Freetown, MA	08:18	14	<5	250b

" b " = blank Contamination in lab reagent blanks and/or field blank samples (indicating possible bias high and false positives).

The most recent Massachusetts Department of Environmental Protection (MassDEP) assessment of Rattlesnake Brook identifies the waterbody as "unimpaired for some uses and not assessed for others" (MassDEP 2012).

3.3.4 Sediment Quality

A due diligence review of the watershed was completed by MA DER and MMI along with sediment sampling to identify potential contaminants. The study reviewed general land uses that could cause potential hazardous materials to be introduced to any waterway as well as any documented chemical spills or cleanups that may have happened within the watershed. Completion of the due diligence survey aids in identifying potential contaminants that may occur within the project area and the appropriate laboratory tests that need to be conducted.

The results of the due diligence survey indicate that under existing conditions, there is little potential for commercial or industrial pollutants to be introduced to the River upstream of the project area. The watershed is highly forested, predominantly in conservation, and has no current or historic industry that could have had a hazardous materials release. However, the history of the dam site as a bleachery, which was burned and razed in the 1950's, indicates the potential for contaminants such as heavy metals, polyaromatic hydrocarbons (PAHs), and dioxins occurring within the impoundment and downstream of the Dam (MA DER 2015b).

Sediment sampling was conducted upstream of the impoundment, within the impoundment, downstream of the Dam, and within the estuary north of Narrows Road (Figure 2). Samples were analyzed and compared to the Toxicity Characteristic Leaching Procedure (TCLP) threshold (314 CMR 9.07(2)(b)), the Massachusetts Contingency Plan (MCP) S-l/GW1, and the Probable Effects Concentration (PEC) thresholds (MacDonald et al. 2000). The MCP S1/GW-1 is the concentration by which there is a risk of harm to humans resulting from direct exposure to contaminants in the soil and potential impacts on groundwater at the site (310 CMR 40 2014). The PEC is the concentration in sediment above which organisms that are directly exposed are likely to be adversely affected. The samples drawn from the downstream estuary were also compared to the Screening Quick Reference Tables (SQRT) developed by NOAA to describe contaminant effects in the marine environment (MA DER 2015b; Buchman 2008).

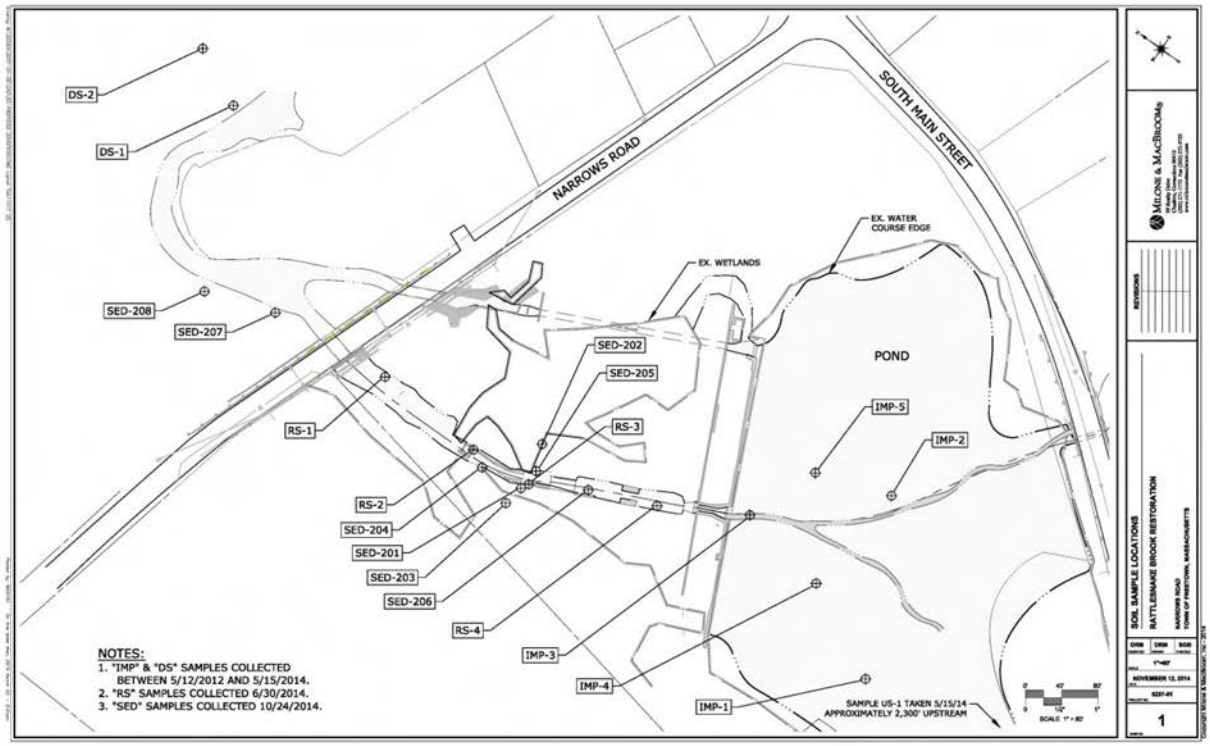

Figure 2. Map of sediment sampling locations for the Rattlesnake Brook Restoration Project.

The current impoundment sediments show no exceedances of human health thresholds MCP S-1/GW1 (Table 6). There was one slight exceedance of the PEC in one sample for Sum DDD. Some dioxins and furans were also detected in the sample IMP-5 drawn from upstream of the main spillway (Table 7). Overall dioxins and furans are present in higher concentrations downstream of the Dam as indicated by samples DS-2 and SED-207, although none exceeds human health thresholds (Tables 8 and 9). Similarly, the downstream sample DS-1 shows exceedances of MCP S-1/GW1 for chromium (total) and benzo[a]anthracene. PAHs in sample DS- 1 and SED-207 exceed the PEC thresholds as well.

The sediments drawn from the main spillway channel are dominated by sands. No odors or sheen were detected in any of the samples during processing. The laboratory results are shown in Tables 7 and 8, which compare the chemical concentrations to the MCP S-1/GW1 and the PEC.

The PEC was exceeded downstream of the Dam along the western channel for several contaminants, including PAHs, lead, copper, and cadmium (Table 8). Lead was found to exceed the MCP S-1/GW1 as well, with one sample registering 41,800 mg/Kg-dry. It was determined that this high reading was an anomaly because it could not be reconfirmed by additional sampling. The total amount of polychlorinated biphenyls (PCBs) were found to exceed the PEC in sample RS-4. No other samples found PCBs and because no aroclors were detected, it was determined that sample RS-4 may not be reliable. Similar concentrations of contaminants were found in the estuary downstream of the Project (Table 9).

Table 6. Sediment sampling results for contaminants within the Dam impoundment (MA DER 2015b).

Parameter	Screening Benchmarks (empty cell = no standard)			Dam Impoundment			Samples		Impoundment Sample Statistics		
	MCP S1 / GW1	TEC	PEC	Imp-1	Imp-2	Imp-3	Imp-4	Imp-5	Min	Max	Mean
	Human Health	Freshwater		5/12/2012	5/12/2012	2/12/2012	11/15/2013	5/15/2014			
Metals [mg/kg]	se parameters)										
Arsenic	20	9.79	33	2.09	3.48	2.79		ND	2.09	3.48	2.79
Barium	1,000.00							50	50	50	50
Cadmium	70	0.99	4.98	0.155	0.224	0.217		ND	0.16	0.22	0.2
Chromium (TOTAL)	100	43.4	111	6.47	12.5	8.05		13	6.47	13	10.01
Copper		31.6	149	7.32	17.8	11.4			7.32	17.8	12.17
Lead	200	35.8	128	39.1	75.7	53.2		43	39.1	75.7	52.75
Mercury	20	0.18	1.06	0.069	0.221	0.1	0.068	0.31	0.07	0.31	0.15
Nickel	600	22.7	48.6	6.26	11	8.73			6.26	11	8.66
Selenium	400							ND	0	0	0
Silver	100							ND	0	0	0
Zinc	1,000.00	121	459	28.1	48.2	43.9			28.1	48.2	40.07
SVOCs (**PAHs**)[ug/kg]	ing on PAH test)										
Acenaphthene	4,000.00			ND	25.3	ND		ND	25.3	25.3	25.3
Acenaphthylene	1,000.00			ND	99.9	25.7		ND	25.7	99.9	62.8
Anthracene	1,000,000.00	57.2	845	ND	80.1	23.4		ND	23.4	80.1	51.75
Benz[a]anthracene	7,000.00	108	1,050.00	72.9	464	128		ND	72.9	464	221.63
Benzo[a]pyrene	2,000.00	150	1,450.00	62	416	110		ND	62	416	196
Benzo[b]fluoranthene	7,000.00	27.3	13,400.00	84	571	152		ND	84	571	269
Benzo[g,h,i]perylene	1,000,000.00			46.6	346	82.6		ND	46.6	346	158.4
Benzo[k]fluoranthene	70,000.00			84	300	74.5		ND	74.5	300	152.83
Chrysene	70,000.00	166	1,290.00	84.2	493	147		ND	84.2	493	241.4
Dibenz[a,h]anthracene	700	33	260	ND	68.7	18.1		ND	18.1	68.7	43.4
Fluoranthene	1,000,000.00	423	2,230.00	183	1,030.00	310		ND	183	1,030.00	507.67
Fluorene	1,000,000.00	77.4	536	ND	58.1	20.7		ND	20.7	58.1	39.4
Indeno[1,2,3-cd]pyrene	7,000.00			43.7	354	84.6		ND	43.7	354	160.77
Phenanthrene	10,000.00	204	1,170.00	101	539	163		ND	101	539	267.67
Pyrene	1,000,000.00	195	1,520.00	159	872	267		ND	159	872	432.67
2-Methylnaphthalene	700								0	0	0
Naphthalene	4,000.00	176	561	ND	41.3	14		ND	14	41.3	27.65
Total PAHs		1,610.00	22,800.00								
Pesticides (ug/kg)]											
2,4'-DDD				ND	2.3	2.88			2.3	2.88	2.59
4,4'-DDD	8,000.00			8.39	19	27.3		ND	8.39	27.3	18.23
Sum DDD		4.88	28	8.39	21.3	30.18		ND	8.39	30.18	19.96
2,4'-DDE				ND	ND	ND			0	0	0
4,4'-DDE	6,000.00			4.99	14.8	10.9		ND	4.99	14.8	10.23
Sum DDE		3.16	31.3	4.99	14.8	10.9		ND	4.99	14.8	10.23
2,4'-DDT				ND	ND	ND			0	0	0
4,4'-DDT	6,000.00			4.97	7.99	8.95		ND	4.97	8.95	7.3
Sum DDT		4.16	62.9	4.97	7.99	8.95		ND	4.97	8.95	7.3
Total DDTs		5.28	572						0	0	0
alpha-Chlordane		0.5	6						0	0	0
Aldrin	80			ND	ND	ND		ND	0	0	0
Chlordane	5,000.00	3.24	17.6	ND	ND	ND		ND	0	0	0
Dieldrin	80	1.9	61.8	ND	ND	ND		ND	0	0	0
Endrin	10,000.00	2.22	207	ND	ND	ND		ND	0	0	0
gamma-BHC/Lindane		2.37	4.99	ND	ND	ND		ND	0	0	0
gamma-Chlordane				ND	ND	ND			0	0	0
Heptachlor epoxide	100	2.47	16	ND	ND	ND		ND	0	0	0
Hexachlorobenzene	700			ND	ND	ND		ND	0	0	0
PCBs (ug/kg)									0	0	0
Total PCBs	1,000.00	59.8	676	56	67.3	184	0	0	0	184	61.46
VPH / **EPH** (mg/kg)[**Petroleum Hydrocarbons**]											
C19-C36	3,000.00			ND	ND	ND		69			
C11-C22	1,000.00			ND	ND	ND		63	63	63	63
VOCs (mg/kg)											
Methyl tert-butyl ether (MTBE)	0.1			ND	ND	ND		ND	0	0	0
Benzene	2			ND	ND	ND		ND	0	0	0
Toluene	30			ND	ND	ND		ND	0	0	0
Ethylbenzene	40			ND	ND	ND		ND	0	0	0
m&p-Xylenes	400			ND	ND	ND		ND	0	0	0
o-Xylene	400			ND	ND	ND		ND	0	0	0

ND= Non-Detect

Table 7. Sediment sampling results for Dioxin within the Rattlesnake Brook Dam impoundment (IMP-2) and downstream of Dam (DS-2) (MA DER 2015b).

	IMP-5	**DS-2**
Total TCDD	6.26	3.44
Total PeCDD	4.99	7.29
Total HxCDD	12.1	59
Total HpCDD	53.6	234
Total TCDF	60.3	67.4
Total PSCDF	31.7	35.2
Total HxCDF	18	41.4
Total HpCDF	9.38	73.4
Total PCDD/Fs	1700	2000

All units in pc/g

Table 8. Sediment sampling results for contaminants between the Dam and Narrows Road (MA DER 2015b).

Parameter	Screening Benchmarks (empty cell = no standard)			DS Channel Samples										Downstream Channel Sample Statistics		
rtant: Units listed by category b	MCP S1 / GW1	TEC	PEC	RS-1	RS-2	RS-3	RS-4	Sed-201	Sed-202	Sed-203	Sed-204	Sed-205	Sed-206	Min	Max	Mean
	Human Health	Freshwater		6/30/2014	6/30/2014	6/30/2014	6/30/2014	10/24/2014	10/24/2014	10/24/2014	10/24/2014	10/24/2014	10/24/2014			
Metals [mg/kg] (typically testing does not involve a		if of these para	meters)													
Arsenic	20	9.79	33	4	6	11	ND	5.1	17	8.6	3	2.9	10	2.9	17	7.53
Barium	1,000.00							20	120	46	34	25	140	20	140	64.17
Cadmium	70	0.99	4.98	14 5 5			ND	6.1	1.0 3.9		11 20		1.2	1	20.00 7.46	
Chromium (TOTAL)	100	43.4	111	19	23	24	7	10	39	85	12	12	19	6.6	85	24.91
Copper		31.6	149	35	182 1,640		9							8.9	1,640.00 466.55	
Lead	200	35.8	128	71 52		**41,800.00**	38	130	**350**	**590**	**230**	18	**770**	18	**41,800.00**	**4,404.89**
Mercury	20	0.18	1.06	0	0	0	ND	ND	ND	0.54	ND	ND	0.43	0.07 0.54 0.27		
Nickel	600	22.7	48.6	7	6	14	5							5.3	13.7	7.9
Selenium	400			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	0	0
Silver	100			ND	ND	1	ND	ND	ND	ND	ND	ND	ND	1.33	1.33	1.33
Zinc	1,000.00	121	459	863	329	502	21							21.4	863	428.85
SVOCs (PAHs)[ug/kg]																
Acenaphthene	4,000.00		PAH test)	797	ND	**11,800**	ND	ND	550	1,900	610	ND	**5,700**	550	**11,800.00**	3,559.50
Acenaphthylene	1,000.00			463	ND	**4,900**	ND	ND	ND	520	ND	ND	**1,200**	463	4,900.00	1,770.75
Anthracene	1,000,000.00	57.2	845	1,920	ND	1,800	265	500	1,000 4,000	1,200		ND	14,000	264.5	14,000.00 3,085.56	
Benz[a]anthracene	7,000.00	108	1,050.00	3,620	ND	**67,400**	1,010	1,500 2,100	6,700 2,200			ND	**24,000**	1,010.00	**67,400.00**	**13,566.25**
Benzo[a]pyrene	2,000.00	150	1,450.00	**3,040**	265	**67,100**	814	1,500	2,000	6,300	2,100	ND	23,000	265	**67,100.00**	**11,791.00**
Benzo[b]fluoranthene	7,000.00	27.3		3,350	ND	**77,200**	930	1,100 1,500	5,800 1,600			ND	**17,000**	930	**77,200.00**	**13,560.00**
Benzo[g,h,i]perylene	1,000,000.00		13,400.00	8,810	ND	17,600	ND	840	710	1,800	670	ND	6,000	670	17,600.00	5,204.29
Benzo[k]fluoranthene	70,000.00			1,550	ND	36,100	ND	1,200	2,400	5,100	2,000	ND	9,800	1,200.00	36,100.00	8,307.14
Chrysene	70,000.00	166	1,290.00	3,610	374	**73,800**	1,070	1,600 2,400	6,700 2,300			ND	28,000	374	**73,800.00**	13,317.1
Dibenz[a,h]anthracene	700	33	260	**3,090**	ND	**7,520**	133	ND	ND	**810**	ND	ND	**3,000**	132.5	**7,520.00**	**2,910.50**
Fluoranthene	1,000,000.00	423	2,230.00	9,030	664	170,000	2,170	3,300 5,300	15,000 5,400			ND	54,000	664	170,000.00	29,429.33
Fluorene	1,000,000.00	77.4	536	890	ND	91,500	ND	ND	470	1,900 640		ND	6,100	470	91,500.00	16,916.67
Indeno[1,2,3-cd]pyrene	7,000.00			863	ND	**19,600**	ND	820	700	2,200	730	ND	**7,200**	700	**19,600.00**	4,587.57
Phenanthrene	10,000.00	204	1,170.00	9,200	570	**136,000**	1,640	2,300 5,100		**15,000**	5,300	ND	**61,000**	570	**136,000.00**	**26,234.44**
Pyrene	1,000,000.00	195	1,520.00	6,850	532	118,000 1,810		2,900 4,400	13,000 4,700			ND	48,000	532	118,000.00	22,243.56
2-Methylnaphthalene	700			ND	ND	ND	ND	ND	ND	550	ND	ND	**2,100**	550	**2,100.00**	1,325.00
Naphthalene	4,000.00	176	561	768	ND	380	ND	ND	ND	870	ND	ND	3,400	380	3,400.00 1,354.50	
Total PAHs		1,610.00	22,800.00	57,851	2,405	900,700	9,841	17560	28080	88150	29450	0	313500			144,753.70
Pesticides (ug/kg)																
2,4'-DDD																
4,4'-DDD	8,000.00							ND	ND	ND	ND	ND	ND	0	0	0
Sum DDD		4.88	28													
2,4'-DDE																
4,4'-DDE	6,000.00							48	ND	ND	ND	ND	ND	48	48	48
Sum DDE		3.16	31.3													
2,4'-DDT																
4,4'-DDT	6,000.00							74	ND	ND	ND	ND	ND	74	74	74
Sum DDT		4.16	62.9													
Total DDTs		5.28	572													
alpha-Chlordane		0.5	6													
Aldrin	80							ND	ND	ND	ND	ND	ND	0	0	0
Chlordane	5,000.00	3.24	17.6					ND	ND	ND	ND	ND	ND	0	0	0
Dieldrin	80	1.9	61.8					ND	ND	ND	ND	ND	ND	0	0	0
Endrin	10,000.00	2.22	207					ND	ND	ND	ND	ND	ND	0	0	0
gamma-BHC/Lindane		2.37	4.99					ND	ND	ND	ND	ND	ND	0	0	0
gamma-Chlordane																
Heptachlor epoxide	100	2.47	16					ND	ND	ND	ND	ND	ND	0	0	0
Hexachlorobenzene	700															
PCBs (ug/kg)																
Aroclor 1016								ND	ND	ND	ND	ND	ND	0	0	0
Aroclor 1221								ND	ND	ND	ND	ND	ND	0	0	0
Aroclor 1232								ND	ND	ND	ND	ND	ND	0	0	0
Aroclor 1242								ND	ND	ND	ND	ND	ND	0	0	0
Aroclor 1248								ND	ND	ND	ND	ND	ND	0	0	0
Aroclor 1254								ND	ND	ND	ND	ND	ND	0	0	0
Aroclor 1260								ND	ND	ND	ND	ND	ND	0	0	0
Total PCBs	1,000.00	59.8	676	0	0	191	780	0	0	0	0	0	0	0	780	97.1
VPH / EPH (mg/kg) [**Petroleum**	**Hydrocarb ons**]															
Aliphatics																
C5-C8	100			42.6	23.4	ND	ND							23.4	42.6	33
C9-C12	1,000.00			ND	ND	ND	ND							0	0	0
C9-C18	1,000.00			ND	ND	ND	ND	ND	6	3.4	ND	ND	43	3.4	43	17.47
C19-C36	3,000.00			ND	63.2	73.7	ND	ND	140	130	45	23	70	23	140	77.84
Aromatics																
C9-C10	100			ND	ND	ND	ND							0	0	0
C11-C22	1,000.00			79.6	27.9	463	59.4	64	310	160	160	46	920	27.9	920	228.99
Total Petroleum Hydrocarbons (T	1,000.00															
VOCs (mg/kg)																
Methyl tert-butyl ether (MTBE)	0.1			ND	ND	ND	ND							0	0	0
Benzene	2			ND	ND	ND	ND							0	0	0
Toluene	30			ND	ND	ND	ND							0	0	0
Ethylbenzene	40			ND	ND	ND	ND							0	0	0
m&p-Xylenes	400			ND	ND	ND	ND							0	0	0
o-Xylene	400			ND	ND	ND	ND							0	0	0

ND= Non-Detect

Table 9. Sediment sampling results upstream of the Project and downstream estuary (MA DER 2015b).

Parameter	Screening Benchmarks (emptycell = no standard)					Downstream Estuary Samples				Upstream Samples	Estuary Sample Statistics		
(Important: Units listed bycategory below)	MCP S1/GW1	TEC	PEC	TEL	PEL	DS-1	DS-2	Sed-207	Sed-208	US-1	Min	Max	Mean
	Human Health	Freshwater		Marine		5/12/2012	12/5/2013	10/24/2014	10/24/2014	5/15/2014			
Metals [mg/kg]													
Arsenic	20	9.79	33	7.2	41.6	4.06		17	5.9		4.06		17.00 8.99
Barium	1,000.00							24	11	14	11	24	17.5
Cadmium	70	0.99	4.98	0.7	4.2	0.734		170	1.2		0.73	170	57.31
Chromium (TOTAL)	100	43.4	111	52.3	160.4	37.7		160	26	6.5	26	160	74.57
Copper		31.6	149	18.7	108.2	39.6							39.60 39.60 39.60
Lead	200	35.8	128	30.2	112.2	52		360	19	11	19	360	143.67
Mercury	20	0.18	1.06	0.1	0.7		0.185 0.31	0.92	ND		0.19	0.92	0.47
Nickel	600	22.7	48.6	15.9	42.8	8.03					8.03	8.03	8.03
Selenium	400							ND	ND		0	0	0
Silver	100			0.7	1.8			ND	ND		0	0	0
Zinc	1,000.00	121	459	124	271	87.6					87.6	87.6	87.6
SVOCs (PAHs)[ug/kg]	g on PAH test)												
	4,000.00			6.7	88.9								
Acenaphthene	1,000.00			5.9		66.4		990	ND	ND	66.4		990.00 528.20
Acenaphthylene	1,000,000.00	57.2	845		127.9	187		ND	ND	ND			187.00 187.00 187.00
Anthracene	7,000.00	108	1,050.00			221		2,300	ND	ND	221	2,300.00	1,260.50
Benz[a]anthracene	2,000.00	150	1,450.00			1010		4,100	ND	ND	1,010.00	4,100.00	2,555.00
Benzo[a]pyrene	7,000.00	27.3	13,400.00			954		4,100.00	ND	ND	954	4,100.00	2,527.00
Benzo[b]fluoranthene	1,000,000.00					1,100.00		3,100	ND	ND	1,100.00	3,100.00	2,100.00
Benzo[g,h,i]perylene	70,000.00					754		1,200	ND	ND	754	1,200.00	977
Benzo[k]fluoranthene	70,000.00	166	1,290.00			509		4,000	ND	ND	509	4,000.00	2,254.50
Chrysene	700	33	260	107.8	846	907		4,300	ND	ND	907	4,300.00	2,603.50
Dibenz[a,h]anthracene	1,000,000.00	423	2,230.00	6.2	134.6	141		ND	ND	ND	141	141	141
Fluoranthene	1,000,000.00	77.4	536	112.8	1,493.50	2,280.00		10,000	ND	ND	2280	10000	6140
Fluorene	7,000.00			21.2	144.4	114		1,200	ND	ND	114	1,200.00	657
Indeno[1,2,3-cd]pyrene	10,000.00	204	1,170.00			771		1,300	ND	ND	771	1,300.00	1,035.50
Phenanthrene	1,000,000.00	195	1,520.00	86.7	543.5	1380		9,100	ND	ND	1,380.00	9,100.00	5,240.0 5240
Pyrene	700			152.7	1,397.60	1910		8,800	ND	ND	1,910.00	8,800.00	5355
2-Methylnaphthalene	4,000.00	176	561	20.2	201.3			ND	ND		0	0	0
Naphthalene		1,610.00	22,800.00	34.6	390.6	62.5		ND	ND	ND			62.50 62.50 62.50
Total PAHs				1,684.10	16,770.40								
Pesticides (ug/kg)													
2,4'-DDD						ND					0	0	0
4,4'-DDD	8,000.00			1.2	7.8	3.86		ND	ND	ND	3.86		3.86 3.86
Sum DDD		4.88	28			3.86					3.86	3.86	3.86
2,4'-DDE						ND					0	0	0
4,4'-DDE	6,000.00			2.1	374.2	3.13		ND	ND	ND			3.13 3.13 3.13
Sum DDE		3.16	31.3										
2,4'-DDT						ND					0	0	0
4,4'-DDT	6,000.00			1.2	4.8	ND		ND	ND	ND	0	0	0
Sum DDT		4.16	62.9										
Total DDTs		5.28	57.2	3.9	51.7								
alpha-Chlordane		0.5	6										
Aldrin	80					ND		ND	ND	ND	0	0	0
Chlordane	5,000.00	3.24	17.6	2.3	4.8	ND		ND	ND	ND	0	0	0
Dieldrin	80	1.9	61.8	0.7	4.3	ND		ND	ND	ND	0	0	0
Endrin	10,000.00	2.22	207			ND		ND	ND	ND	0	0	0
gamma-BHC/Lindane		2.37	4.99	0.3	1	ND		ND	ND	ND	0	0	0
gamma-Chlordane						ND					0	0	0
Heptachlor epoxide	100	2.47	16			ND		ND	ND	ND	0	0	0
Hexachlorobenzene	700					ND				ND	0	0	0
PCBs (ug/kg)													
Total PCBs	1,000.00	59.8	676	21.6	188.8	3.5	0			0	0	3.5	1.75
VPH / EPH (mg/kg) [Petroleum Hydrocarbons]													
C9-C18	1,000.00							ND	ND		0	0	0
C19-C36	3,000.00					27.4		120	38	38	27.4	120	61.8
C11-C22	1,000.00					38.3		230	83	37	38.3	230	117.1
VOCs (mg/kg) /													
Methyl tert-butyl ether (MTBE)	0.1					ND	ND				0	0	0
Benzene	2					ND	ND				0	0	0
Toluene	30					ND	ND			0.003	0	0	0
Ethylbenzene	40					ND	ND				0	0	0
m&p-Xylenes	400					ND	ND				0	0	0
o-Xylene	400					ND	ND				0	0	0

ND= Non-Detect

3.4 Riparian Floodplain and Wetlands

MMI conducted wetland delineations of the project area between Narrows Road and the South Main Street culvert upstream of the Dam (see Figure 1). During the survey, palustrine forested, palustrine scrub shrub, palustrine emergent marsh, and palustrine open water wetlands were identified (MMI 2015). A complete description and maps of wetland resources within the project area can be found in Appendix C.

3.5 Biological Resources

3.5.1 Fish and Aquatic Species

The Massachusetts Department of Fisheries and Wildlife (MA DFW) conducted fish surveys of Rattlesnake Brook in the upper watershed in 2001 and 2002. The American eel (*Anguilla rostrata*) was the predominant species collected with chain pickerel (*Esox niger*), redfin pickerel (*Esox americanus americanus*), and banded sunfish (*Enneacanthus obesus*) found in smaller numbers (MassDEP 2005). In addition, MA DFW historically stocked Rattlesnake Brook with brook trout (*Salvelinus fontinalis*), rainbow trout (*Oncorhynchus mykiss*) and/or tiger trout (*Salmo trutta x Salvelinus fontinalis*) (French 2011). In recent years, MA DFW has not stocked recreational fisheries within the watershed.

The MA Division of Marine Fisheries identifies the reach of Rattlesnake Brook downstream of the Dam and the Assonet River as providing habitat for anadromous fish, including alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), rainbow smelt (*Osmerus mordax*), and white perch (*Morone americana*) (Pierce 2015; Reback et al. 2004). Alewife, blueback herring and rainbow smelt are identified as Species of Concern by NMFS due to declining populations. Local citizens have also observed river herring attempting to pass the Dam unsuccessfully (unidentified personal communication, January 29, 2015).

The Magnuson-Stevens Fishery Conservation Management Act provides NMFS the authority to conserve and manage the Essential Fish Habitat (ESH) of marine fish species, including anadromous fish, crustaceans, and mussels. ESH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 USC 1801-1884). While ESH does extend up into the Taunton River, it does not extend into Rattlesnake Brook or its embayment (EFH Mapper, accessed on 4/19/16).

3.5.2 Wildlife

The Rattlesnake Brook watershed is predominantly undeveloped with 74 percent occurring within the Freetown-Fall River State Forest. The state forest is a Southeastern Massachusetts Bioreserve whose purpose is to “. . . protect, restore and enhance the biological diversity and ecological integrity of a large scale ecosystem representative of the region . . .” (Green Futures, accessed on 04/19/16). A large diversity of wildlife is expected to occur within this reserve. A diversity of wildlife has been observed during site visits and surveys of the project area, including migratory and resident birds, reptiles, and amphibians. A variety of mammals are expected to occur within the area, but have not been observed.

Mammals that occur within southeastern Massachusetts and potentially within the Project area include, but are not limited to the eastern chipmunk (*Tamias striatus*), gray squirrel (*Sciurus carolinensis*), Virginia opossum (*Didelphis virginiana*), woodchuck (*Marmota monax*), meadow jumping mouse (*Zapus hudsonius),* white-footed deermouse *(Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), eastern cottontail rabbit (*Sylvilagus floridanus*), northern short-tailed shrew (*Blarina brevicauda*), big brown bat (*Eptesicus fuscus*), little brown myotis (*Myotis lucifugus*), gray fox (*Urocyon cinereoargenteus*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), and white-tailed deer (*Odocoileus virginianus*) (MassWildlife, accessed on 4/19/15).

Many species of migratory and resident birds common to mixed second-growth forests and wetlands are found within the watershed. Representative species include, but are not limited to American robin (*Turdus migratorius*), American crow (*Corvus brachyrhynchos*), black-capped chickadee (*Parus atricapillus*), tufted titmouse (*Parus bicolor*), house finch (*Carpodacus mexicanus*), northern cardinal (*Cardinalis cardinalis*), American goldfinch (*Carduelis tristis*), house sparrow (*Passer domesticus*), red-winged blackbird (*Agelaius phoeniceus*), Carolina wren (*Thryothorus ludovicianus*), swamp sparrow (*Melospiza georgiana*), catbird (*Dumetella carolinensis*), and potentially other more area-sensitive passerines that may use the larger tract of adjacent forest.

Waterbirds and waterfowl observed at the site include great blue heron (*Ardea herodia*), Canada geese (*Branta canadensis*), and mallard (*Anas platyrhynchos*) (MMI 2015). Other species potentially found within the Project's floodplain wetlands and the adjacent downstream estuary may include the American black duck (*Anas rubripes*),herring gull (*Larus argentatus*), greater black-backed gull (*Larus marinus*), and ring-billed gull (*Larus delawarensis*),

A diversity of amphibians and reptiles likely occupy the site's wetlands and impoundment. The green frog (*Lithobates clamitans*) and spring peeper (*Pseudacris crucifer*) are amphibians that have been observed within the project area (MMI 2015). Other amphibians that likely occur within the area include the spotted salamander (*Ambystoma maculatum*), eastern newt (*Notophthalmus viridescens*), northern dusky salamander (*Desmognathus fuscus*), eastern red-backed salamander (*Plethodon cinereus*), northern two-lined salamander (*Eurycea bislineata*), American toad (*Anaxyrus americanus*), gray treefrog (*Hyla versicolor*), American bullfrog (*Lithobates catesbeianus*), pickerel frog (*Lithobates palustris*), and wood frog (*Lithobates sylvaticus*) (MassWildlife, accessed on 4/20/15). Reptiles observed include the snapping turtle (*Chelydra serpentine*), northern watersnake (*Nerodia sipedon*), and the common gartersnake (*Thamnophis sirtalis*) (MMI 2015). Additional reptiles that have the potential to occur within the project area include the eastern musk turtle (*Sternotherus odoratus*), painted turtle (*Chrysemys picta*), spotted turtle (*Clemmys guttata*), northern black racer (*Coluber constrictor),*the State-listed Special Concern eastern box turtle (*Terrapene Carolina*), State-listed threatened diamond back terrapin (*Malaclemmys terrapin*), eastern hog-nosed snake (*Heterodon platirhinos*), milksnake (*Lampropeltis Triangulum*), smooth greensnake (*Opheodrys vernalis*), DeKay's brownsnake (*Storeria dekayi*), red-bellied snake (*Storeria occipitomaculata*), and eastern ribbonsnake (*Thamnophis sauritu)* (MassWildlife, accessed on 4/20/15).

3.5.3 Vegetation

The project area is predominantly wetland, consisting of palustrine forested, palustrine scrub shrub, palustrine emergent marsh, and palustrine open water (MMI 2015). Vegetation within these communities is representative of those wetland community types typical of southeastern Massachusetts. Dominant tree and shrub wetland species include speckled alder (*Alnus incana*), dogwood (*Cornus amomum*), buttonbush (*Cephalanthus occidentalis*), red maple (*Acer rubrum*), swamp white oak (*Quercus bicolor*), and black tupelo (*Nyssa sylvatica*). Herbaceous species within the wetlands consist of soft rush (*Juncus effusus*), skunk cabbage (*Symplocarpus foetidus*), sensitive fern (*Onoclea sensibilis*), American burreed (*Sparganium americanum*), and tussock sedge (*Carex stricta*) (MMI 2015).

Within the adjacent upland areas, the overstory consists predominantly of white pine (*Pinus strobus*), red maple, black cherry (*Prunus serotina*), eastern red-cedar (*Juniperus virginiana*), and northern red oak (*Quercus rubra*). The understory is characterized by high incidence and density of non-native invasive species. Species within the upland understory include white pine, eastern-red-cedar, Oriental bittersweet (*Celastrus orbiculatus*), autumn olive (*Elaeagnus umbellate*), Japanese barberry (*Berberis thunbergii*), and highbush blueberry (*Vaccinium corymbosum*).

3.5.4 Threatened and Endangered Species

The Service performed an intra-agency section 7 evaluation, which identified the northern long-eared bat (*Myotis septentrionalis*) as potentially occurring within the area of the Project. The northern long-eared bat is federally listed as a threatened species with a 4(d) rule under the Endangered Species Act (50 CFR part 17). Although the northern long-eared bat may be present in the project area, there are no recent records confirming their presence. During the summer, northern long-eared bats roost singly or in colonies in forested habitat underneath bark, in cavities or in crevices of both live trees and snags (dead trees). Northern long-eared bats seem to be flexible in selecting roosts, choosing roost trees based on suitability to retain bark or provide cavities or crevices. During the evening, northern long-eared bats can be found foraging in a variety of forested and non-forested habitats, including wetlands. During winter, northern long-eared bats hibernate in caves and mines (hibernacula) with constant temperatures, high humidity, and no air currents. Factors affecting the species include modifications to bat hibernacula, disturbance of hibernating bats, and loss of forest habitat, including forest fragmentation.

The Massachusetts Natural Heritage Atlas by the Massachusetts Natural Heritage and Endangered Species Program (MA NHESP) was consulted to identify if any State-listed or at-risk species may occur within the project area. No species were identified within the project area, although immediately north of the site, the State-threatened diamond-backed terrapin (*Malaclemys terrapin*) may occur. The terrapin is a medium-sized turtle that inhabits salt marshes and other coastal habitats and nests in sandy dry uplands (MA NHESP 2015; MA NHESP 2012). No suitable habitat exists within the project area.

3.6 Historic and Archaeological Resources

Projects receiving Federal funding and permitting are required to undergo a review for compliance with section 106 of the National Historic Preservation Act (36 CFR 800). In 2014, the Public Archaeology Laboratory, Inc. (PAL), a firm of professional archaeologists and historians, conducted an intensive historic properties survey and archaeological walkover/mapping of the project area. The historic properties and archaeological surveys included historical research to document and evaluate the Rattlesnake Brook Dam Project area for its potential historical significance in the context of the late nineteenth to mid-twentieth century. The surveys also attempted to locate visible archaeological remains of the historic Crystal Springs Bleachery Site and any archaeologically sensitive areas for Pre-Contact Period resources (Banister et al. 2014).

PAL's survey determined one historic industrial resource, the Rattlesnake Brook (aka Crystal Springs) Dam and one archaeological industrial site, the Crystal Springs Bleachery Site, to occur within the project area. The Dam is associated with the operations of the Bleachery (Crystal Springs Bleachery Site) in the late nineteenth to mid-twentieth centuries. The Dam was determined by PAL in consultation with the Massachusetts Historical Commission (MHC) to not be eligible for listing in the National Register because of a lack of engineering significance and lost association with the historical bleaching and dyeing activities due to the destruction of the complex. PAL and MHC also determined the Crystal Springs Bleachery Site is also not eligible for listing in the National Register because the site remains are not expected to contribute important data to the industrial history of the Town or to the current body of knowledge relating to late-nineteenth-to-mid-twentieth-century textile bleaching operations (Banister et al. 2014).

PAL's archaeological survey did not identify any intact native soils or evidence of pre-contact resources within the project's Area of Potential Effect (APE). The APE is predominantly covered by artificial fill between the former millpond and Narrows Road. No significant pre-contact cultural resources are expected to be present within the project APE (Banister et al. 2014).

Consultations with MHC and Tribal Historic Preservation Offices for the Mashpee Wampanoag Tribe, Wampanoag Tribe of Gay Head (Aquinnah), and Narragansett Indian Tribe were completed during the site investigation. All responding parties have concurred with the previously described conclusions and that the site is not eligible for listing in the National Register. Copies of the correspondence with these organizations is included in Appendix E.

3.7 Public Health and Safety

Recent engineering inspections describe the Dam as deteriorating, in an unsafe condition, and with no functional means to control the pool elevation (Chelminski 2010). As such, a large storm event could lead to further deterioration of the Dam and exacerbate conditions and erosion potential that still exist from the 2010 floods. Such an event could potentially lead to a catastrophic breach of the Dam that would allow an uncontrolled release of sediment and water that could wash out the downstream Narrows Road.

The site's history of textile bleaching operations and destruction of the Bleachery by fire has likely left some soils and sediments between the Dam and Narrows Road in exceedance of the MCP S-1/GW 1 threshold for several contaminants. The MCP S1/GW1 is the concentration by which human health may be affected negatively in either drinking water or through contact with soil. Activities commonly associated with the S-1 soil category include residential use, parks, playgrounds, and schoolyards where incidental ingestion of soil and dermal contact is likely to occur. A description of contaminants present and sediment sampling locations is provided in Section 3.3 Sediment Quality.

3.8 Socioeconomics

The Bleachery operated within the Rattlesnake Brook Restoration Project site from the late nineteenth to mid-twentieth century. The Bleachery burned down in the 1950s, destroying the structure. The site had been abandoned until the City of Fall River purchased the property to augment its drinking water supply. Subsequently, these plans were abandoned by the City due to the poor condition of the Dam and high expense of repair. The Dam and property currently no longer provide power, electricity, irrigation water, municipal or industrial water supply, or manufacturing of any goods or services. The Dam provides no flood control benefit and likely contributed to the washing out of the Narrows Road causeway in March of 2010. Repair of the Road costs in excess of $1 million dollars (Wagner 2010). A storm event of a similar magnitude or greater could cause the Dam to breach more and wash out the road again.

3.9 Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires Federal agencies to examine proposed actions to determine whether they will have disproportionately high and adverse human health or environmental effects on minority or low income populations. The Massachusetts Executive Office of Energy and Environmental Affairs (MA EEA) defines Environmental Justice populations as those meeting any of the following criteria: 1) having a median household income that is at or below 65 percent of the statewide median income; 2) 25 percent or more of the residents are classified as minority; 3) 25 percent or more of the residents are foreign-born; or 4) 25 percent or more of the residents lack English language proficiency.

A map of environmental justice areas published in 2010 by the MA EEA indicates that no Environmental Justice populations (meeting any of the above criteria) are located in the Town of Freetown (MASSGIS 2010). The property is abutted by residential and commercial property. Within this area, there are no known specific populations meeting the above criteria that could be disproportionately affected by the Project.

3.10 Air Quality

Ambient air quality is protected by Federal and state regulations. The Environmental Protection Agency (EPA) has developed National Ambient Air Quality Standards (NAAQS) for criteria airborne pollutants within each state. The NAAQS set concentration limits that are not to be exceeded in order to protect public health, including those particularly sensitive populations, such as the elderly, asthmatics, and children. Criteria pollutants that have an NAAQS in

Massachusetts include sulfur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), lead (Pb), particulate matter ≤10 microns (PM_{10}), and particulate matter ≤ 2.5 microns ($PM_{2.5}$). Currently, Bristol County is considered in nonattainment of NAAQS for ozone only in 2015 (EPA 2016).

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 General

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)

The Proposed Action will have no long-term adverse effect on the existing land use patterns or the watershed's environment. Removal of the Dam will restore the natural sediment and organic matter transport processes, water quality, hydrology, and migration of aquatic organisms within the watershed. This will improve the overall ecological functioning of the watershed by restoring it to a free-flowing natural state.

Alternative 2 – No Action

Under the No Action Alternative, the Dam is left in place and no actions will be taken to enhance habitat. There would be no change to the degraded conditions in the watershed or with existing land uses under this alternative.

4.2 Geology and Soils

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)

The Proposed Action will not have any effect on the existing geology of the site or watershed. There are no prime farmland soils within the project area; therefore, the Proposed Action will have no effect on prime farmland soils.

Alternative 2 – No Action

Under the No Action Alternative, there would be no change to the surrounding geology or soils of the project area.

4.3 Water Resources

4.3.1 River Morphology and Processes

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)

The Proposed Action would remove 100 feet of the full vertical extent of the Rattlesnake Brook Dam and widen the downstream western channel between the Dam and Narrows Road to a natural bankfull width and depth. The Proposed Action is not expected to have any long-term negative effects on riverine processes and is likely to have major beneficial effects. Removal of the Dam would convert the impoundment to a free-flowing river system and restore flow to a

single channel. This would reestablish Rattlesnake Brook's natural riffle-pool sequence and the native stream channel substrates that existed prior to installation of the Dam and Bleachery.

Immediately after breaching the Dam, the River upstream of the Dam will begin to follow a somewhat predictable sequence of events, described by the Stream Evolution Model (Cluer and Thorne 2013; Pizzuto 2002). With the Dam no longer providing grade control, the river channel will begin to narrow and incise through the impoundment's fine accumulated sediments to expose the native coarser substrate of cobbles and gravel. This is expected to be a relatively rapid process that will occur under regular stream flows due to increased stream velocities associated with the new steeper stream gradient (Pizzuto 2002). Research on other dam removals similar to Rattlesnake Brook has found the channel to complete the incision process in less than 2-3 months (Pearson et al. 2011). Once the incision process is complete, the stream will begin to form a new floodplain by eroding the accumulated sediments within the impoundment (Pizzuto 2002). The widening process is storm event-driven, based upon the ability of floodwaters to erode the impounded sediments outside of the active channel (Pearson et al. 2011).

Depth-of-refusal surveys estimate that approximately 2,000 cubic yards of sediment consisting primarily of sand and organics will be mobilized during the channel formation process (MMI 2014). Short-term impacts immediately downstream of the Dam may occur due to increased sediment transport. However, reintroduction of this material into the estuary immediately downstream of the Dam is expected to be beneficial by contributing nutrients and sediment to the marsh. Stream habitat downstream of the Dam would be enhanced by the reintroduction of fine-grained materials that are currently lacking.

The remaining accumulated sediment (approximately 4,000 cubic yards) within the impoundment is expected to become a new floodplain and stream terrace. Following processes described by Shafroth et al. (2002), the existing seedbank, along with newly introduced seed via wind or water dispersal, will colonize the bare, moist alluvial soils within the first growing season following the Dam's removal. Some limited seeding and riparian planting is planned as a part of the Project within zones disturbed during construction. This will help stabilize the newly exposed soils within the floodplain and riparian buffer. Following establishment of the vegetation, the newly exposed floodplain should follow natural successional stages from grasses and forbs to shrubs to eventually a mature forest.

Alternative 2 – No Action

The No Action Alternative leaves the Dam and existing habitat conditions in place. The impoundment would continue to exist, with an elevated streambed and impounded slackwater habitat. This would continue to benefit more lake-adapted (lentic) aquatic species over the native aquatic assemblage that would be more typical of a free-flowing (lotic) stream. There would also not be an infusion of sediments into the estuary and downstream habitats, which are lacking in fine-grained material.

4.3.2 Hydrology and Hydraulics

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)

Under the Proposed Action, water surface elevations would be lowered upstream of the Dam and the backwater effect would be removed, thereby restoring Rattlesnake Brook to a free-flowing River. MMI (2014) developed a HEC-RAS model (as described in Section 3.3.2) to simulate river conditions without the Dam's spillway in place. With the dam spillway removed, model results show reduced water surface elevations of 2.2 to 3.6 feet just upstream of the Dam for all flows up through the 100-year storm event (Table 10). See Appendix A for modeled water surface profiles associated with this alternative.

Table 10. HEC-RAS modeling comparing the existing to proposed water surface elevations just upstream of the Dam (MMI 2014).

Flow Rate and/or	Water Surface Elevations (Ft NAVD88)	
Storm Recurrence Interval	Existing	Proposed
12 Cubic Feet per Second	11.21	7.64
50 Cubic Feet per Second	11.58	8.34
2-yr Storm Event (High Tide)	11.92	9.12
2-yr Storm Event (Low Tide)	11.92	9.12
10-yr Storm Event (High Tide)	12.53	10.29
10-yr Storm Event (Low Tide)	12.53	10.34
100-yr Storm Event (High Tide)	13.83	13.76
100-yr Storm Event (Low Tide)	13.47	11.31

Alternative 2 – No Action

Under the No Action Alternative, the current water surface elevations and flooding along Rattlesnake Brook would not change.

4.3.3 Water Quality

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)

Under the Proposed Action, water quality would be improved over the long term by eliminating the Dam impoundment. Removal of the Dam will reduce solar insolation of the impounded reach by returning the stream to a free-flowing condition with a narrower wetted width and shorter water residence time. This will reduce water temperatures and restore the River's natural thermal regime. DO concentrations likely would be increased by the decrease in water temperature and the return of the impoundment to a natural riffle-pool system (i.e., greater re-aeration). Over the longer term, shrubs and trees will become established in the former impoundment, which will provide shade to the Brook and further reduce stream temperatures.

Short-term increases in turbidity are expected immediately following removal of the spillway (see Section 4.3.1). The increased turbidity has the potential to stress aquatic organisms downstream of the Dam. To minimize turbidity, construction work areas will be dewatered and the impoundment will be drawn down prior to Dam breaching. In addition, construction will be

conducted during seasonal low flows and outside of any critical life history activities of aquatic organisms that occur within the watershed. It is expected that with these measures implemented during construction, the increased turbidity will have a short-term minor effect on aquatic organisms.

Alternative 2 – No Action

Under the No Action Alternative, water quality conditions would not change. Similar to the conditions described by Lessard and Hayes (2003), the impoundment would continue to exhibit elevated water temperatures and reduced DO levels. These conditions stress the River's native biota. In the short term, there would likely be no increased turbidity or sedimentation under this alternative, which is likely to occur with the Proposed Action. Over the long term, it is possible a catastrophic breach will occur if the Dam is not repaired. Such a breach would release a significant amount of sediment in an uncontrolled manner that may temporarily damage downstream habitats.

4.3.4 Sediment Quality

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)

Under the Proposed Action, the River would be allowed to naturally transport accumulated sediments downstream as described in Section 4.3.1. It is estimated that approximately 2,000 cubic yards of sediment (out of 6,000 total within the impoundment) would be mobilized. There was only one sample with a slight exceedance of the Probable Effects Concentration for Sum DDD. Most of the contaminants within the impoundment sediments are found downstream of the Dam at higher concentrations. Therefore, the release of impoundment sediments by natural transport is unlikely to have an adverse effect on the downstream receiving waters (Langley 2016). The infusion of impounded sediment is expected to improve habitat conditions by introducing clean sediment to the existing sediments, nourishing the marsh, and introducing finer-grained material into the stream reach immediately downstream of the Dam that currently is lacking in fine-grained material (MA DER 2015b).

Sediment downstream of the Dam and within the old footprint of the Bleachery showed numerous exceedances of the MCP S-1/GW 1 thresholds for multiple contaminants. Therefore, all material excavated within this area will be transported to an appropriately licensed landfill to be used as cover material except for sediments in the vicinity of sample RS-3. Sediments excavated within the vicinity of sample RS-3 shall be disposed of at an in-state lined landfill to be approved by the Division of Solid Waste in MassDEP's Regional Office (Langley 2016). By implementing these measures, no adverse effect to the human environment is anticipated with the restoration of the western stream channel. A more complete description of how the sediment will be managed can be found in Appendix B.

Alternative 2 – No Action

The No Action Alternative would result in no construction and therefore there would be no change to existing conditions. Contaminated sediments may be mobilized as large storms activate existing breaches within the Dam and erode the downstream channel and floodplain.

4.4 Riparian Floodplain and Wetlands

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)

The Proposed Action would replace the existing lentic conditions caused by the Dam and restore free-flowing riverine conditions. It is expected that this process would convert 4.6 acres of the impoundment from open water to vegetated wetlands (MA DER 2015a). This process will likely take years as the remaining sediments behind the Dam vegetate from the dormant seedbank and transition through natural succession from an herbaceous to forested wetland.

Alternative 2 – No Action

Under the No Action Alternative, the Dam's spillway would not be removed and there would be no change to the existing riparian floodplain or wetlands with the project area. It is predicted that if the Dam is left in place, the impoundment will continue to accumulate sediments, which will eventually allow what is now open water to convert into vegetated wetland. No short- or long-term impacts are predicted to happen to the wetlands under this alternative.

4.5 Biological Resources

4.5.1 Fish and Aquatic Species

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)

The Proposed Action is not predicted to have any long-term adverse effects on fisheries or other aquatic species. The proposed Project will have an overall positive ecological benefit on the aquatic community by restoring watershed connectivity. This would allow diadromous and resident fish to migrate past the Dam to historic spawning and rearing habitats that are currently inaccessible. Research has shown fish colonization of newly accessible habitats to be rapid following dam removal (Gardner et al. 2011; Catalano et al. 2007). Reestablishment of a river herring population within the watershed would restore a fishery that has been extirpated for nearly 150 years.

American eel would benefit by allowing juvenile elvers and smaller-bodied eels that currently cannot pass the Dam to migrate upstream to desired headwater habitats. As an example, following the removal of a dam on the Rappahannock River in Virginia, the American eel population doubled within the watershed, as many juveniles colonized newly accessible habitats within the headwaters (Hitt et al. 2012). In addition, instream habitat within the impoundment would be restored from lentic to lotic conditions favoring the native stream biota.

Rainbow smelt spawning habitat would be enhanced by restoration of the western channel and removal of the Dam. Smelt use riffles near the head-of-tide to spawn. Restoration of the stream channel will involve the construction of several riffles with a more suitable spawning substrate for smelt than what is currently present. Removal of the Dam would also expand their access to additional spawning habitat that is currently unavailable. Stream flow will no longer be divided between the eastern and western channel as well as improving fish passage and habitat. This will help maintain more consistent flows within the western channel, which in turn will prevent

dewatering of spawning riffles during periods of drought. Concentration of flows within the western channel will also facilitate fish passage during low water periods.

It is expected over the long term that the Proposed Action will increase the abundance, species richness, and diversity of the fish community within the watershed (Hogg et al. 2015; Burroughs et al. 2010). This will support a more productive aquatic ecosystem that is resilient to potential changes associated with climate change or other anthropogenic disturbance.

Alternative 2 – No Action
Under the No Action Alternative, the Dam will continue to impair river connectivity by preventing the migration of fish and other aquatic organisms. This will prevent the restoration of diadromous fish populations within the watershed and will maintain existing poor spawning conditions for rainbow smelt. Habitat conditions would persist in a lentic state upstream of the Dam supporting larger-bodied warmwater species adapted to pond-like habitat.

4.5.2 Wildlife

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)
Proposed project activities will not have a long-term adverse impact to wildlife. Short-term impacts may arise from construction activity during the 1-to-2-month project period, as wildlife such as birds and small mammals may avoid the immediate construction area. There is also a small potential for some wildlife to become injured during the forest clearing. Construction activities have been timed, however, to minimize the potential of this happening.

The removal of Rattlesnake Brook Dam would have an overall positive effect upon the wildlife populations in the watershed. Dam removal would allow for unencumbered movement of wildlife along the riparian corridor. The return of diadromous fish would introduce marine-derived nutrients to the watershed supporting the base of the food web. Increased fish populations associated with the reestablishment of river herring would also provide beneficial forage to resident wildlife species such as birds and predatory terrestrial wildlife. Many birds (including herons and raptor species) and terrestrial mammals (such as river otter and, to a lesser extent, raccoons and black bear) are piscivorous.

Alternative 2 – No Action
The No Action Alternative would not change current conditions and therefore have no impacts to existing wildlife populations.

4.5.3 Vegetation

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)
There are no long-term adverse effects to vegetative communities that are anticipated with the Proposed Action. Approximately 1 acre of forest will be cleared to implement the Project. At completion of the Project, native trees and shrubs will be planted within the cleared area. The impoundment and other disturbed areas will be seeded with native grasses and forbs and over the long term, the project area is expected to return to a natural shrub-scrub and forested wetland.

Alternative 2 – No Action
The No Action Alternative would not have adverse effects on the vegetation community. It is expected that as the impoundment continues to trap sediment, the open water habitat would convert to a more vegetated wetland over the long term.

4.5.4 Threatened, and Endangered Species

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment Proposed Action
An intra-Service section 7 consultation was completed with the Service's New England Field Office's Endangered Species Program. Information was utilized from this consultation to design and plan the Project in a manner that minimizes any potential adverse impacts to the northern long-eared bat or its habitat. At the completion of the consultation process, a determination of not likely to adversely affect for the Proposed Action was given for the federally threatened northern-long eared bat.

No suitable habitat for the State-threatened diamond-backed terrapin occurs within the project area. Therefore, we anticipate no terrapins to be present within the construction area. The turtle may be positively benefitted by the release of sediments from the impoundment, which may nourish and help maintain the health of the estuarine marsh that it currently occupies.

Alternative 2 – No Action
Under this Alternative, the Dam will remain in place, which will continue to fragment the river corridor. There are no adverse effects to rare or threatened species from the No Action alternative.

4.6 Historic and Archaeological Resources

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)
The Proposed Action will have no short- or long-term impact to historic and archaeological resources. The historic properties and archaeological surveys identified no features eligible for listing in the National Register of Historic Places within the Project's APE (Banister et al. 2014). MHC and the Mashpee Wampanoag Tribe concurred with this determination.

Alternative 2 – No Action
The No Action Alternative would cause no impacts to historic or archaeological resources.

4.7 Human Health and Safety

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)
Over the long term, the project will improve safety for the public by eliminating a dam considered to be in an unsafe condition (Chelminski 2010). This will improve safety by preventing damage and/or a washout of the downstream Narrows Road causeway during a catastrophic breach of the Dam. Such a washout could cause a vehicular accident or impede the

ability of the vehicles or personnel to access the residences of Assonet Bay Shores in an emergency.

Contaminated sediments downstream of the Dam will also likely be improved by implementation of the Proposed Action. Release of the impoundment's cleaner sediment will displace, mix and/or bury some of the more contaminated sediments downstream of the Dam, which will improve overall soil quality. In addition, approximately 2,000 cubic yards of contaminated soil will be removed from the site to an appropriately licensed landfill during the restoration of the western channel. Hauling the soil off-site would help enhance environmental conditions by permanently removing these pollutants from the stream and adjacent floodplain.

For a short duration, there will be an increase in vehicular traffic and the operation of heavy construction equipment during the dismantling of the spillway. To mitigate any hazards during construction, the public will not be allowed to enter the work area. Trucks will be limited to the public roadways and the existing project access road, and therefore are not expected to cause any disproportionate direct, indirect or cumulative adverse impacts associated with environmental health or safety risks to the public. Construction is expected to last for approximately 1 to 2 months; therefore, this increased traffic will be for a short duration and temporary.

Alternative 2 – No Action
Under the No Action Alternative, the Dam will remain in place and continue to present a potential threat to downstream infrastructure should it fail.

4.8 Socioeconomics

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)
The Proposed Action is not expected to have any short- or long-term impacts on the City or Town socioeconomics. The Dam is no longer functional and the site is no longer utilized for manufacturing. Removal of the spillway will remove the financial burden and legal liability of the dam owner to repair and maintain the Dam into the future. The Project will also prevent potential damage to the downstream Narrows Road causeway should the Dam catastrophically breach. The Road was recently repaired at a cost of over $1 million dollars due to damage sustained in 2010 when the Dam partially breached (Field Engineering Co., Inc. 2011; Wagner 2010).

Alternative 2 – No Action
Under the No Action Alternative, there will be no changes to the Dam. The dam owner will be required to pay for repairs and continued maintenance of the Dam to comply with Massachusetts Office of Dam Safety regulations. There would continue to be a risk of a catastrophic breach as well, which could damage downstream infrastructure.

4.9 Environmental Justice

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)

The Project is not expected to have any impact on minority or low income populations adjacent to or near the Project pursuant to Executive Order No. 12898. Removal of the Dam will provide benefits to the recreational angling community and remove a public safety hazard. There are no known human populations that meet the Environmental Justice criteria noted in Section 3.9 that are located in the immediate vicinity of the proposed Project.

Alternative 2 – No Action

Under the No Action Alternative, no impacts to Environmental Justice Zones would occur.

4.10 Air Quality

Alternative 1 – Breach Dam at the Western Spillway with Passive Release of Sediment (Proposed Action)

Partial removal of the spillway will require the use of heavy construction equipment, labor, and materials within the project area. Construction activities will require the use of equipment such as excavators, loaders, generators, and other heavy equipment. Transportation of labor and materials will require delivery trucks, dump trucks, and pickup trucks.

Staging areas will be established in a manner such that the abutting properties would not be affected by construction equipment emissions. Idling of diesel-powered construction equipment will be limited to minimize emissions at the site. Since the construction time is short and few pieces of equipment will be used, any impacts will be short-term. There are no long-term increases in air pollutants resulting from the activities.

Alternative 2 – No Action

Under the No Action Alternative, no construction would occur and therefore, there would be no change in air quality.

4.11 Cumulative Effects

A cumulative impact analysis considers the potential impact to the environment that may result from the incremental impact of the Proposed Action when added to other past, present, and reasonably foreseeable future actions (40 CFR 1508.7). The lack of maintenance and use of the Rattlesnake Brook Dam has left it in a poor and unsafe condition that could lead to catastrophic failure. If the Dam fails, there will be an uncontrolled release of water and sediment from the impoundment with high potential to damage downstream property and infrastructure, as well as potentially cause injury and/or loss of life. The Proposed Action would restore fish passage, riverine processes, water quality, and prevent a catastrophic dam failure. Following removal of the spillway, the private landowner will have no financial or legal obligation to the Dam.

The proposed Project is expected to benefit the overall ecological health of the Rattlesnake Brook watershed. Removal of the Dam would help enhance the abundance and diversity of aquatic species within the watershed. The direct effects of the proposed Project are not

anticipated to add to any impacts from other actions in the area. Completion of the Project would contribute to community and agency efforts to conserve and restore river herring and rainbow smelt. Therefore, no adverse cumulative impacts are expected as a result of this Project.

5.0 CONSULTATION AND COORDINATION

The following individuals, Federal, State, and local agencies, Tribes, and non-governmental organizations were consulted during the development of this EA:

- U.S. Fish and Wildlife Service, Northeast Region;
- Massachusetts Department of Fish and Game, Division of Ecological Restoration;
- Massachusetts Department of Fish and Game, Division of Fisheries and Wildlife;
- Massachusetts Department of Fish and Game, Division of Marine Fisheries
- The City of Fall River;
- The Town of Freetown, Massachusetts;
- The Nature Conservancy;
- U.S. Army Corps of Engineers;
- Massachusetts Department of Environmental Protection;
- Massachusetts Historical Commission;
- Milone & MacBroom, Inc.;
- Massachusetts Board of Underwater Archaeological Resources;
- Trout Unlimited;
- Public Archaeology Laboratory, Inc.;
- Mashpee Wampanoag Indian Tribal Council;
- Narragansett Indian Tribe; and
- Wampanoag Tribe of Gay Head (Aquinnah).

5.1 Required Permits and Approvals

In addition to this EA, the following permits and/or consultations are required by State and Federal agencies:

- 401 Water Quality Certification (MassDEP);
- Section 404 Clean Water Act General Permit (Habitat Restoration) (USACE);
- Environmental Notification Form (Massachusetts Executive Office of Energy and Environmental Affairs), and a decision under MEPA;
- MA Wetlands Protection Act - Restoration Order of Conditions (Freetown Conservation Commission);
- MESA Project Review (Massachusetts NHESP);
- Chapter 91 Dredging Permit issued (MassDEP);
- Intra-Service Section 7 Consultation of the Endangered Species Act;
- Federal consistency concurrence (Massachusetts Office of Coastal Zone Management)
- Chapter 253 Dam Alteration Permit from the Massachusetts Office of Dam Safety; and
- Section 106 of the National Historical Preservation Act Historical and Archeological Review (MHC).

5.2 Public Involvement

Resource agencies, abutters, and other stakeholders have been involved throughout the feasibility and conceptual design planning stages of the Project. The Project is undergoing local, State, and Federal permitting processes, as described under the Permits section above. Each permit process requires extensive environmental and planning agency advertisement, as well as ample public notice and involvement. Therefore, there are existing and suitable opportunities for a wide variety of specialists, regulators, and the interested public to comment on and condition the Project's unavoidable short-term impacts.

Public meetings were held with interested government agencies and non-profit groups, including Trout Unlimited, MassDEP, the Service, USACE, the Town of Freetown, the City of Fall River, American Rivers, and local residents. A public meeting in Freetown was conducted on January 29, 2015, with all abutters and potentially interested parties invited. A public hearing was completed with field a visit on April 17, 2015 as part of the Massachusetts Environmental Policy Act process. A public presentation was given to the Freetown Conservation Commission on January 25, 2016 and continued on February 22, 2016, which was advertised in the local paper, and for which notifications were sent to all project abutters.

6.0 REFERENCES

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36 CFR 800, Protection of Historic Properties (2004).

40 CFR 1508.7, Cumulative Impact (2011).

50 CFR Part 17, Endangered and Threatened Wildlife and Plants; 4(d) Rule for the Northern Long-Eared Bat; Final Rule (2016).

310 Code of Massachusetts Regulations 40: Massachusetts Contingency Plan (2014).

314 Code of Massachusetts Regulations 4: Surface Water Quality Standards (2013).

314 Code of Massachusetts Regulations 9: Water Quality Certification (2008).

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