Smelt Brook Local Protection Project
Section 1135 Environmental Restoration Project
Detailed Project Report & Environmental Assessment

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FINDING OF NO SIGNIFICANT IMPACT

Smelt Brook Local Protection Project
Section 1135 Environmental Restoration Project
in Weymouth and Braintree, Massachusetts

The U.S. Army Corps of Engineers (USACE) proposes to restore fish passage to the Smelt Brook Local Protection Project (LPP) in Weymouth, Massachusetts. The LPP was authorized by Section 205 of the Flood Control Act of 1948 and was constructed from July 1974 to May 1976. The LPP provides flood protection to eight acres of highly developed land and consists of: a small concrete dam and outlet at Pond Meadow Lake that maintain a permanent lake of 19 acres; an earthfill dike 300 feet long and five feet high next to Pond Meadow Lake; the widening, deepening, and straightening of 800 feet of channel at the lower end of Smelt Brook near the Monatiquot River; and a 1,140-foot long, eight feet diameter reinforced concrete conduit. USACE received a request for assistance with the restoration of anadromous fish passage in the Smelt Brook tributary to the Weymouth-Fore River in the towns of Weymouth and Braintree, MA in September 2010 from the Weymouth- Braintree Regional Recreation-Conservation Districts (WBRRCD). The feasibility study developed an array of alternatives to restore anadromous fish passage in Smelt Brook and throughout the Weymouth Fore River watershed which was adversely impacted through the construction of the Smelt Brook LPP.

The purpose for the proposed project is to restore diadromous fish passage in Smelt Brook and increase populations within the Weymouth Fore River watershed, which was adversely impacted through the construction of the Smelt Brook LPP in the mid-1970s. In order to access additional spawning habitat upstream, smelt must enter a 72-inch diameter culvert and swim through several hundred meters of pipe and stone box culverts, which pass under a railroad embankment, parking areas, roadways, and several businesses in Weymouth Landing. A second 96-inch diameter culvert carries flood control waters a similar parallel underground distance and discharges 25 feet east of the 72-inch culvert. As part of the Smelt Brook LPP, a sluice gate was included to allow smelt to pass upstream from the 72-inch culvert to an upper 650-foot channelized section of the brook, which offers good spawning habitat. The sluice gate is raised approximately 1 foot beginning in early February and closed at the end of May each year by rangers of the Pond Meadow Park to allow smelt access. When the sluice gate is not opened, the brook's flow is forced though the flood control pressure conduit and out via the 96-inch diameter culvert.

The need for the proposed project is to restore connectivity to historic spawning habitat for rainbow smelt and other diadromous species that the current LPP limits. Historically, rainbow smelt were a reliable resource for both commercial and recreational fisheries. Over the last century, the numbers have decreased drastically due to changes to water quality and flow that have impacted the smelt habitat. The various flood control measures of the LPP have caused

the degradation of rainbow smelt migration and spawning habitat. Assessments done in 1988-1990 and other observations suggest that rainbow smelt populations within the Fore River have the potential to re-occupy reaches of Smelt Brook, previously used by adult rainbow smelt for spawning but that the flood control structures seriously limit spawning access and success. The most significant obstacle in the movement of rainbow smelt up Smelt Brook in the 96-inch culvert with the stilling basin.

The proposed action involves constructing ladder pools on one side of the stilling basin which would allow for excessive streamflow to bypass the system. This would result in a more constant flow in the pools that would be conducive to smelt passage. Possible designs include nine to eleven pools and weirs, and the elevation of each pool would be a few inches different from those adjacent to it. The range of weir sizes limits the effective flow in the pools to a maximum of 3.3 cubic feet per second (cfs). The pools would be three to seven feet deep, so that there is significant room for energy to dissipate within each pool. Flows would discharge from the outlet of the culvert into Pool 1, which would extend the entire width of the stilling basin. Streamflows more than 1.5 cfs would diverge with partial flow discharging from Pool 1 directly into the stilling basin, and partial flow directed to the pool and weir structure. This design leaves more constant flow in the ladder pools and constrains flow velocities below 1.5 cfs. More detailed plans and specifications for the construction of the fishway will be finalized in the design phase. Construction would occur between July 1 and January 31 to avoid overlapping with migrating diadromous fish.

I find that based on the evaluation of environmental effects discussed in the Detailed Project Report and Environmental Assessment (DPR/EA), this project is not a major Federal action significantly affecting the quality of the environment. The DPR/EA includes an evaluation of the potentially affected environment and the degree of the effects of the action, which are summarized below. None are implicated to warrant a finding of National Environmental Policy Act significance.

(i) Short- and long-term effects: The project will result in short-term impacts such as temporary disturbance to sediments within the stilling basin with limited disturbance to water quality. These short-term effects will not significantly affect the environment as they will mitigated with the use of a cofferdam and silt curtains during construction. This will allow the construction area to be dewatered and prevent suspended sediment from moving outside of the project area and downstream. Long-term impacts of the project include the permanent displacement of approximately 350 square feet of stilling basin including physical and biological features. The LPP would continue to function as designed as the fish ladder would not alter the hydrology of the stilling basin.

(ii) Beneficial and adverse effects: The project will have long-term, beneficial effects. It will result in passing rainbow smelt upstream of the existing stilling basin and culvert to stream habitat between the culvert and dam at Pond Meadow Park. The area of stream habitat between the culvert and dam is about 27,900 square feet or 0.64 acres. Rainbow smelt will make use of most of this area for reproductive purposes. The adverse effects of

the project include a temporary loss of aquatic plants in the stilling basin, elevated turbidity, and reduced water quality which are short term and insignificant.

(iii) Effects on public health and safety: The project is not expected to have an adverse effect on public health and safety as it will maintain flood control features while restoring fish passage to Smelt Brook. It is not expected to provide unequal treatment of minority or economically disadvantage populations.

(iv) Effects that would violate Federal, State, Tribal, or local law protecting the environment: The action will not violate Federal or state laws protecting the environment. The project will not likely adversely affect any state or federally listed threatened or endangered species or designated critical habitat for such species. Additionally, the project will have no known negative impacts on any pre-contact or post-contact archaeological sites recorded by the State of Massachusetts.

Based on my review and evaluation of the environmental effects as presented in the DPR/EA, I have determined that restoring anadromous fish passage to Smelt Brook LPP is not a major Federal action significantly affecting the quality of the environment and is therefore exempt from requirements to prepare an Environmental Impact Statement.

_____ _____

Date

Justin R. Pabis
Colonel, U.S. Army Corps of Engineers
District Engineer

Smelt Brook Local Protection Project
Section 1135 Environmental Restoration Project
Detailed Project Report & Environmental Assessment

1. Introduction

1.1 Study Area*

Smelt Brook is located within the Monatiquot River-Frontal Quincy Bay watershed (Hydrologic Unit Code 010900010901) and forms a portion of the boundary between the towns of Braintree and Weymouth, in Norfolk County, Massachusetts (Figure 1-1). It is a relatively small second order stream that converges with the Monatiquot River in an area commonly referred to as Weymouth Landing. Here, it becomes the Weymouth-Fore River and flows into both Hingham Bay and Quincy Bay south of Boston.

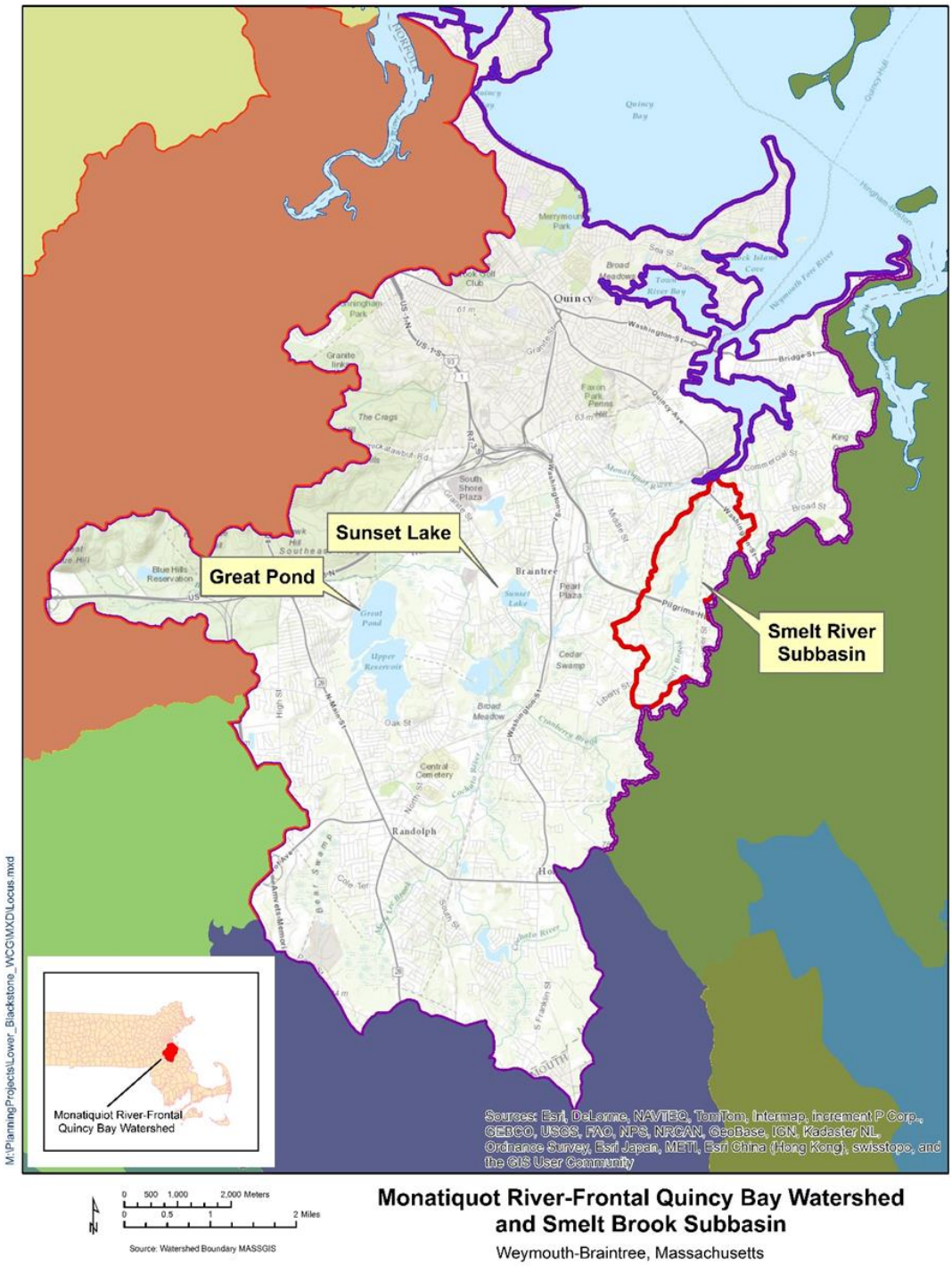

Figure 1-1: Study Location

1.2 Background Information

Once prized for its abundance of rainbow smelt during their spring migratory spawning runs, Smelt Brook was known not only for its fish, but also as the source of significant flooding in Braintree and Weymouth during meltwater runoff and other infrequent high streamflow events. Streamflows increased to dangerous levels, and flood events contributed to property damages in both Braintree and Weymouth. To address the risk of future flooding, the towns of Braintree and Weymouth collectively formed the Weymouth Braintree Regional Recreation Conservation District (WBRRCD) in 1974. Formation of this collaborative district enabled the towns to obtain Federal assistance with their Flood Risk Management (FRM) needs. In 1976, the Smelt Brook Local Protection Project was constructed by USACE to mitigate the risk to life and property and ensure the future growth and stability of the area. While the FRM measures that were constructed achieved their intended purpose, there were unintended consequences for the environmental habitat value of the area; consequences that this study seeks to address.

The Weymouth Fore River watershed was adversely impacted by the construction of the Smelt Brook LPP in the mid-1970s (see figure 1-2). The recurrence of flooding events in the Weymouth Landing area and its surroundings was the impetus for management measures that could mitigate the risk of future flooding in this rapidly developing area. The LPP involved construction of a small concrete dam and outlet works at Pond Meadow Lake that maintains a permanent lake of 19 acres; an earthfill dike 300 feet long and five feet high adjacent to Pond Meadow Lake; widening, deepening, and straightening 650 feet of the channel at the lower end of Smelt Brook near the Monatiquot River; an arched culvert that conveys flow underground for approximately 286 feet before discharging the channel flow 7.5 feet above a stilling basin floor through a perched culvert where hydraulic energy is dissipated and a 1,140-foot long reinforced concrete conduit eight feet in diameter that conveys Smelt Brook through Weymouth Landing's business district (see Figure 1-3) before reaching the intertidal waters of the Weymouth Fore River.

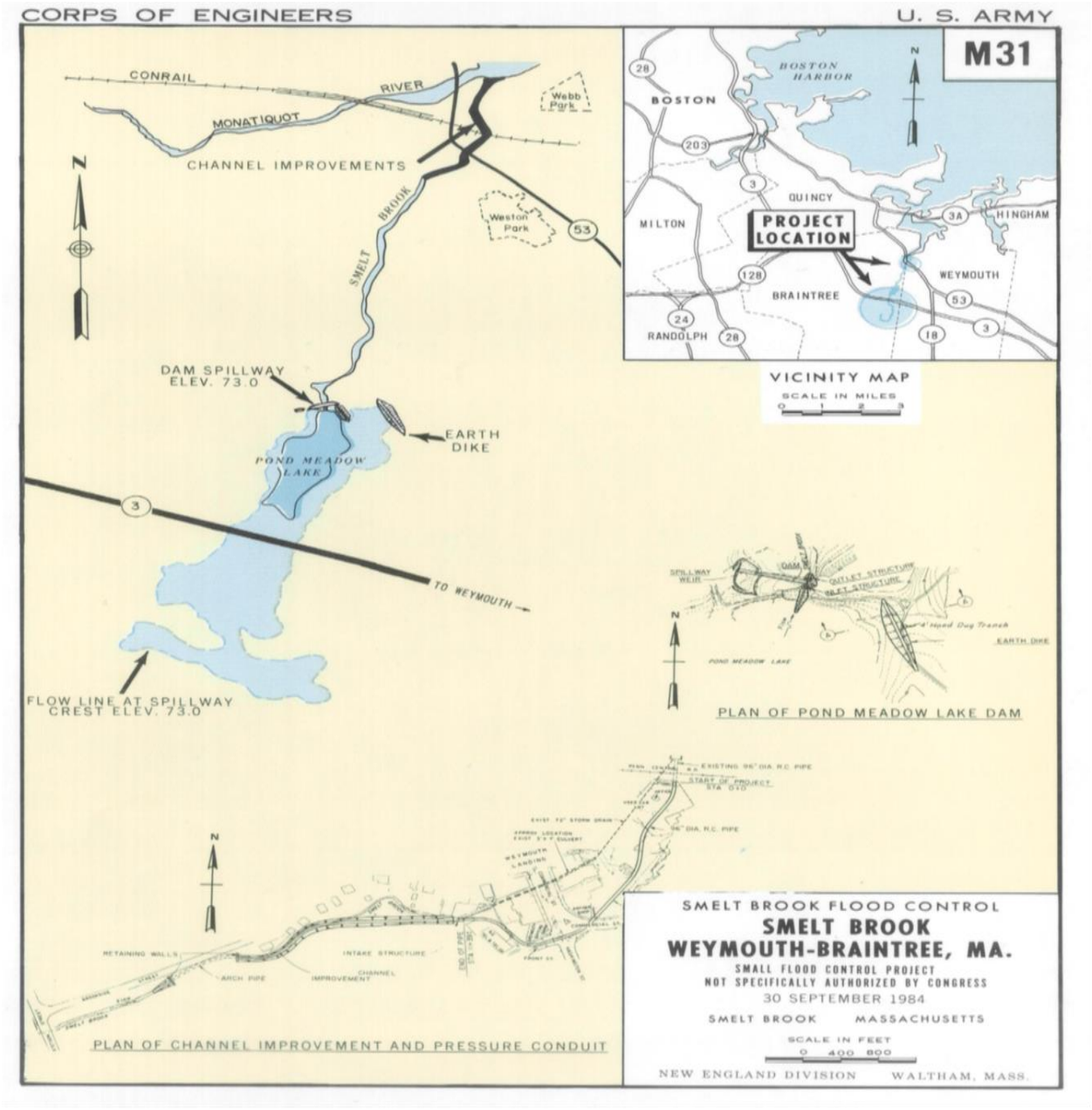

Figure 1-2. Smelt Brook Local Protection Project in Braintree and Weymouth, Massachusetts.

Unfortunately, the FRM structure known as the perched culvert blocks fish passage for rainbow smelt (*Osmerus mordax*) and several other species. The North Atlantic Aquatic Connectivity Collaborative (NAACC) issued a Score of 0.0 for Smelt Brook in Aquatic Passability. This score indicates a severe barrier with no aquatic organism passage. Due to this design flaw, the Weymouth Braintree Regional Recreation Conservation District (WBRRCD) requested the New England District of USACE to investigate the problem under Section 1135 of the Continuing

Authorities Program (CAP) and recommend a plan that allows for migratory fish passage and access to historical spawning habitat upstream of the flood risk management measures constructed in 1976. This report presents the findings of that investigation.

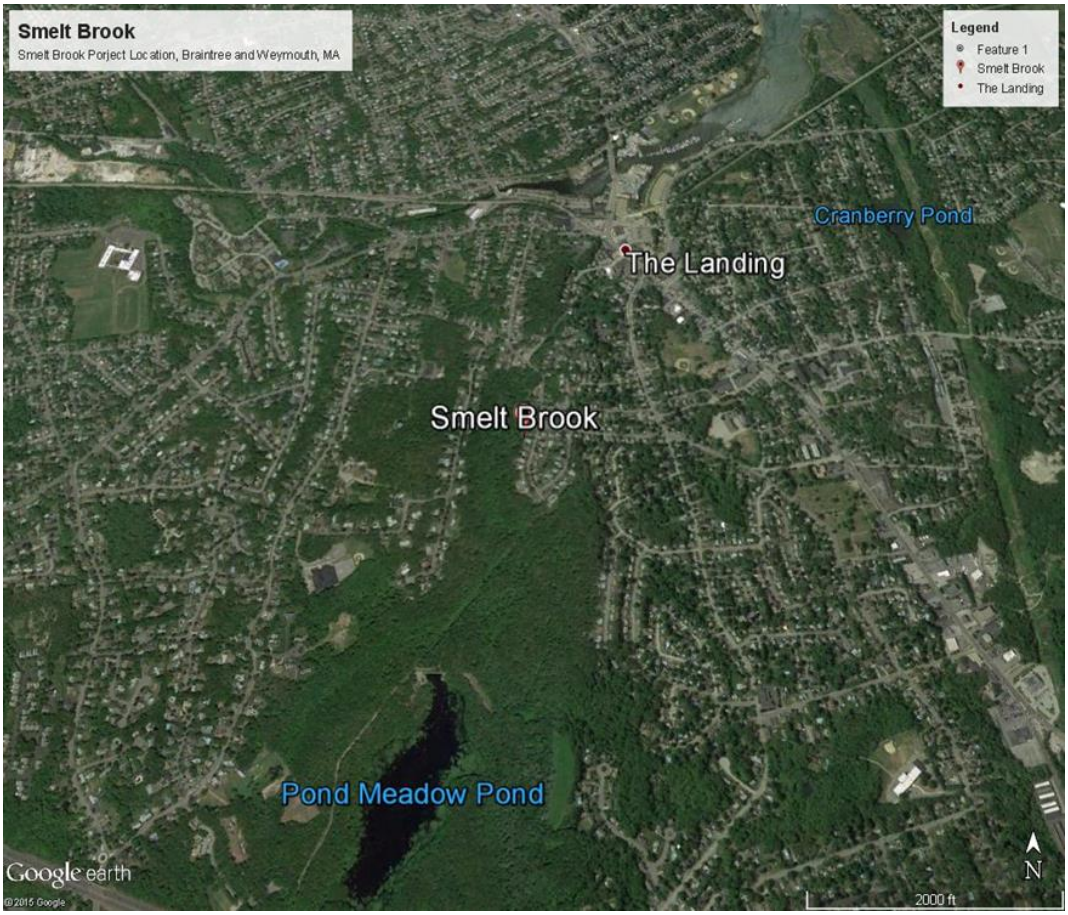

Figure 1-3. Smelt Brook, Pond Meadow Lake and The Landing

1.3 Study Authority

This report was prepared under authority provided in Section 1135 of Water Resources Development Act of 1986 (PL 99-662), as amended. The Continuing Authorities Program authorizes USACE to review and modify structures and operations of water resources projects constructed by USACE for the purpose of improving the quality of the environment when it is determined that such modifications are feasible, consistent with the authorized project purposes, and will improve the quality of the environment in the public interest. In addition, if it is determined that a USACE water resources project has contributed to the degradation of the quality of the environment, restoration measures may be implemented at the project site or at

other locations that have been affected by the construction or operation of the project, if such measures do not conflict with the authorized project purposes

The Federal expenditure limit for a project implemented under this authority has changed over the years with evolving legislation and is currently $10 million as most recently modified by the Water Resources Development Act (WRDA) of 2018. Additionally, the costs of any studies, or plans for the design and implementation for Section 1135 projects must be shared with the Non-Federal Sponsor according to the specific cost share requirements for each phase of the project lifecycle. Here, USACE provides the first $100,000 of feasibility study costs and the non-Federal sponsor must contribute 50 percent of the remaining cost for the feasibility study after the first $100,000 of expenditures. After the feasibility study is complete, the non-Federal sponsor is obligated to share 25 percent of the design and construction costs, and 100 percent of the cost of operation and maintenance.

1.4 Non-Federal Sponsor

The Weymouth Braintree Regional Recreation Conservation District (WBRRCD) is the non-Federal sponsor for this study. The WBRRCD was initially commissioned in 1974 jointly between the towns of Weymouth and Braintree Massachusetts specifically to address the forthcoming Operations and Maintenance requirements for the USACE Smelt Brook Local Protection Project (LPP). Since its inception, WBRRCD has shared the costs for operating and maintaining the LPP equally between the towns of Braintree and Weymouth.

1.5 History of the Investigation, Prior Reports, and Existing Water Projects

The WBRRCD and USACE initiated the feasibility phase of the Smelt Brook Aquatic Ecosystem Restoration Study in June 2019. This report presents the results of the feasibility evaluation.

The Smelt Brook Local Protection Project consists of a system of culverts running beneath Weymouth Landing (The Landing) and allow Smelt Brook to flow into the Weymouth Fore River. The brook also runs through Pond Meadow Lake, a man-made impoundment built by USACE for the 1976 Smelt Brook Local Protection Project (Figure 1-2). Figure 1-3 shows an aerial view of Pond Meadow Lake and The Landing.

In order to access additional spawning habitat upstream, smelt must enter a 72-inch (1.8-m) diameter culvert (Figure 1-4) and swim through several hundred meters of pipe and stone box culverts, which pass under a railroad embankment, parking areas, roadways, and several businesses in Weymouth Landing. A second 96-inch (2.4-m) diameter culvert carries flood control waters a similar parallel underground distance and discharges 25 feet (7.6 meters) east of the 72-inch (1.8-m) culvert.

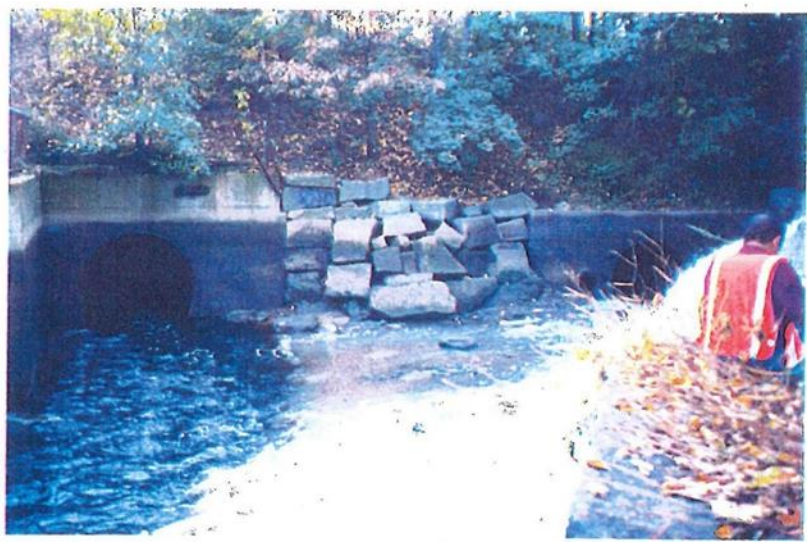

Figure 1-4. A 72-inch culvert that rainbow smelt use to access spawning ground

A fish gate was included in the Smelt Brook LPP to allow smelt to pass upstream from the 72-inch (1.8-m) culvert to an upper 650-foot (200-m) channelized section of the brook that offers good spawning habitat. The fish gate is raised approximately 1 foot (300 mm) beginning in early February and closed at the end of May each year by rangers of the Pond Meadow Park to allow smelt access. When the fish gate is not opened, the brook's flow is forced though the flood control pressure conduit and out via the 96-inch (2.4-m) diameter culvert.

Approximately 650 feet (200 m) of brook exist between the sluice gate and an upstream stilling basin. The stilling basin was a feature that was added to the LPP after design and is not included in any of the original design plans. It was included to decelerate the flow of water as the brook curves around a bend and nears the backside of several residential properties. According to the Pond Meadow Park Ranger, smelt eggs have been observed covering the rocky substrate throughout that 650-foot (200-meter) stretch up to the stilling basin(personal communication, November 2015). Upstream of the stilling basin, a full mile of suitable rainbow smelt spawning habitat exists. The dam at Pond Meadow Lake is located at the end of the mile and prevents fish from accessing the Pond or migrating further upstream.

Figure 1-5. Prominent Features Effecting Fish Passage in Smelt Brook LPP

There is a paucity of information from prior reports related to fish passage of rainbow smelt in Smelt Brook. However, Gomez and Sullivan Engineers completed a Feasibility Analysis for Restoring River Herring to the Fore River for the MADMF and provided detailed recommendations for improving fish passage in several areas within the Fore River watershed.

While their report focused on river herring, its findings indicate a need for fish passage improvements in the watershed. A summary of their findings is below.

> This feasibility analysis investigating the restoration of populations of river herring (*Alosa pseudoharengus*) to the Fore River system was conducted by the Massachusetts Division of Marine Fisheries in 2009 to determine possible methods of reestablishing fish passage through a variety of barriers on the Monatiquot River. Although the numbers have greatly declined since the construction during the industrial revolution, it was still believed that the river herring were spawning in marginal habitat in the main stem of the Monatiquot River below the natural barrier of Rock Falls. This study was conducted with the understanding that potential river herring spawning habitat at Great Pond and Sunset Lake existed beyond a number of dams and a waterfall that had made fish passage impossible (Figure 1-5). In addition, it evaluated the scale of the barriers and possible alternatives to bypass these obstacles to river herring movement up the river. The study concluded that a number of modifications to the waterway, including construction of fish ladders, would be effective in restoring passage of river herring upstream towards spawning habitat within the Fore River Watershed. Since the investigation, a dam rehabilitation project has been constructed with the inclusion of a fish ladder to provide access to Great Pond in anticipation of the downstream dam removal and passage improvements.

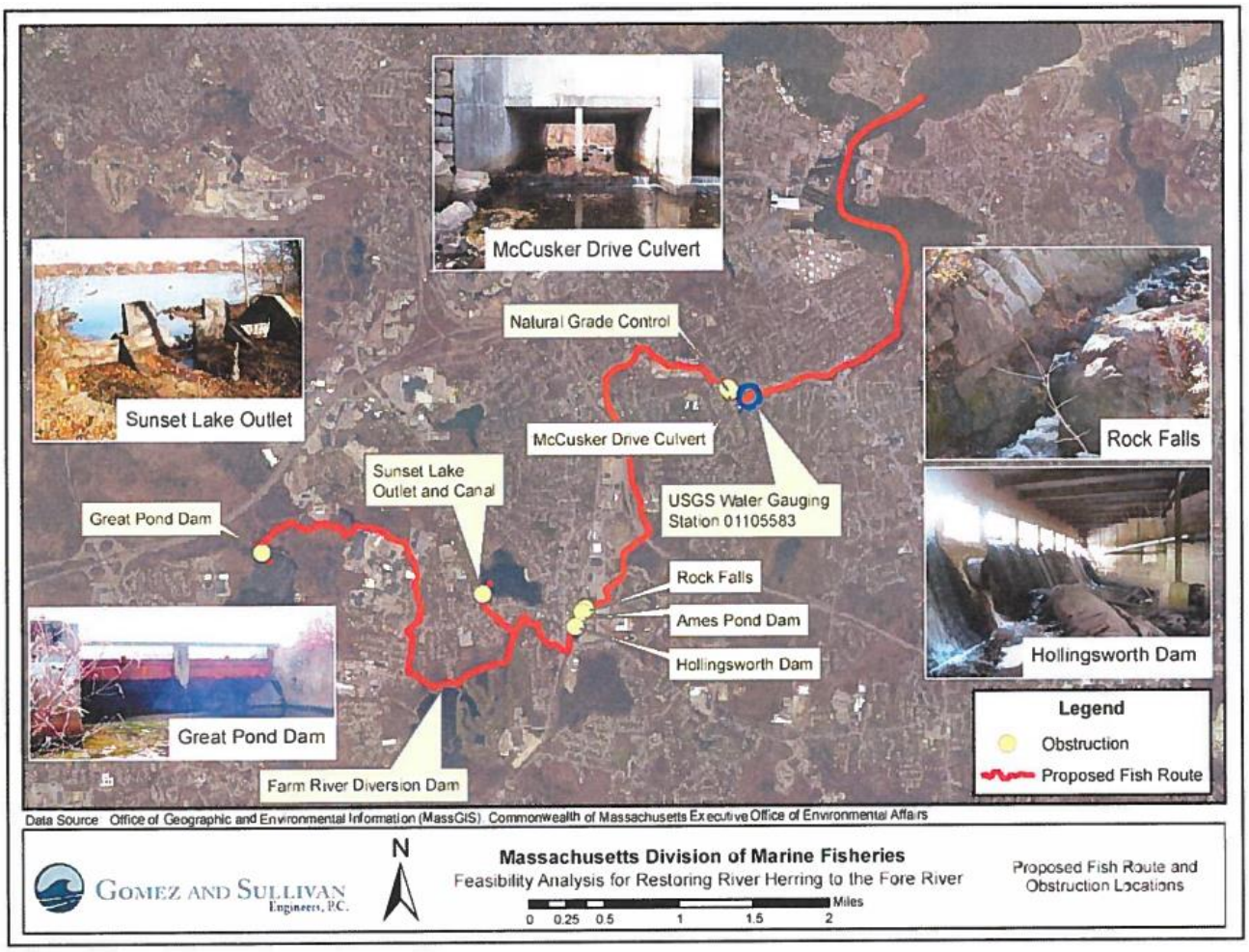

Figure 1-5. Fore River river herring restoration fish route and obstruction locations

1.6 Purpose and Need*

Rainbow smelt and other diadromous species presence and reproductive capacity within Smelt Brook have declined significantly since the construction of the Smelt Brook Local Protection Project (ACOE, 1976; Chase and Childs, 2001; Chase 2006). Diadromous fish are important fishery resources that play a significant ecological role in Quincy Bay. The ecological benefits associated with their presence include the strengthening of food webs by providing forage to a range of fish, birds, mammals, and reptiles in freshwater and marine environments; and the deposition of marine derived nutrients as fish spawn, die, and decay or are preyed upon in the freshwater system. There have been significant declines of diadromous fish population in the Northeast U.S. since the 19th-century due in part to the construction of dams for use in flood control, energy production, logging, milling, and other uses. Dams often serve as barriers to fish passage, preventing fish from migrating to spawning habitats, forcing fish to spawn in areas

where habitat conditions (i.e., water temperature, substrate, etc.) are poor and not conducive to the survival of spawn.

The stilling basin flood control structure within the Smelt Brook LPP obstructs upstream migration to historic spawning habitat for rainbow smelt and fish passage for other diadromous species. The result is the loss of reproductive potential for rainbow smelt and other species. Addressing fish passage for the spawning migration of diadromous species is significant to the public interest and garners resource conservation and restoration support at the Federal, state, and local level. The target species for fish passage restoration includes species that are NOAA species of special concern (rainbow smelt).

The purpose of this Feasibility study is to identify if a feasible opportunity exists to modify the Smelt Brook LPP to restore the reproductive spawning habitat for rainbow smelt. This study is needed to formulate an alternative plan that could fulfill the purpose.

2. Problems, Opportunities, Goals, Objectives

2.1 Problems

The construction of the Smelt Brook Local Protection Project reduced the amount of spawning habitat for rainbow smelt and other diadromous species within Smelt Brook (USACE, 1976; Chase and Childs, 2001; Chase 2006). The LPP's flood control structures obstruct upstream migration to historic spawning habitat for rainbow smelt and fish passage for other diadromous species such as alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestrivalis*), and American eel (*Anguilla rostrata*). The result is the loss of reproductive potential for rainbow smelt and other species.

Historically, rainbow smelt were a reliable resource for both commercial and recreational fisheries. Over the last century, the numbers have decreased drastically due to changes to water quality and flow that have impacted the smelt habitat. The implementation of various flood control measures has been a significant factor in the degradation of rainbow smelt migration and spawning habitat.

Assessments performed between 1988 and 1990, in addition to other observations, suggest that rainbow smelt populations within the Fore River have the potential to re-occupy reaches of Smelt Brook, previously used by adult rainbow smelt for spawning (Chase and Childs, 2001). These assessments conducted by the Massachusetts Division of Marine Fisheries between 1988 and

1990 indicate that smelt spawning occurred within Smelt Brook (Chase and Childs, 2001) but that the flood control structures limit spawning success within the brook (Chase and Childs, 2001). Chase and Childs describe egg deposition at the downstream opening of the USACE culvert as, “light and intermittent” within the reach of river between the fish gate and 8-foot culvert and stilling basin, with highest densities of eggs deposited at the railroad embankment (Chase and Childs, 2001).

Modifications to Smelt Brook have had consequences for other diadromous species and have also impeded fish passage to spawning habitat above the existing flood control system. Other species that have been observed in the Fore River that may migrate to spawning habitat in Smelt Brook include alewife, blueback herring, and American eel. Observations of these species during the April to May spawning run in the Fore River suggest improvements to fish passage within Smelt Brook may benefit these species as well as rainbow smelt (Chase, 2006).

The purpose of the proposed project is to address the impact that the LPP has had on the movement of rainbow smelt and other diadromous fish in migrating further upstream in Smelt Brook to suitable spawning habitat. This will be addressed by providing access past the 8-foot (2.4-m) culvert, which has been a known obstacle to the movement of rainbow smelt adults to the upper reaches of the brook. This modification to the project that improves the environment will restore fish passage and allow access to historical and suitable spawning habitat.

Addressing fish passage for the spawning migration of diadromous species is significant to the public interest and garners resource conservation and restoration support at the Federal, state, and local level.

2.2 Opportunities

This project presents opportunities to modify an existing flood risk management structure that was constructed nearly 50 years ago to improve aquatic ecosystem resources. These opportunities include:

- Reconnect fish passage and provide access to historic reproductive spawning habitat area
- Restore more natural flow regime
- Improve and restore natural benthic riverine habitat
- Improve operation of dam and fish gate to encourage more fish activity
- Strengthen food webs with the increase in availability of anadromous fish.

2.3 Planning Goals/Objectives

Planning objectives are the desired results of the planning process that will solve the identified problems and typically result in the desired changes between the without- and with-project conditions. Planning objectives serve to eliminate from consideration alternatives and considerations that will not solve the identified problem(s).

State and local objectives for the project area include the continued management and success of the Smelt Brook LPP as a flood risk management measure and resource conservation area.

Planning objectives that have been identified to specifically address the environmental degradation of Smelt Brook LPP are:

- Restore upstream and downstream passage for diadromous fish to reestablish self-sustaining populations in the Weymouth Fore River.
- Restore riverine ecosystem structure and function to the river reach within the LPP.
- Improve benthic and riparian habitat within the LPP.
- Restore migration capacity for anadromous fish within the LPP.

2.4 Planning Constraints

Unlike planning objectives, which represent desired positive changes, planning constraints represent restrictions that may prevent the achievement of the objectives. This project has a limited geographic extent and can therefore only address some of the problems and opportunities identified (Table 1). This project focuses on issues associated with improving fish passage for rainbow smelt within the Smelt Brook LPP. The planning constraints identified in this study are as follows:

- The alternatives must not cause significant flooding or erosion of existing banks, habitats, residential areas or other riverine properties unless mitigated.
- The selected alternative must not impact the intent of the flood control measures established in the Smelt Brook LPP.

Any proposed changes to promote fish passage upstream are required to preserve the ability to pass 600 cfs flow. This requires alterations to water levels remain below 24 ft NGVD at the upstream end of the stilling basin.

3. Plan Formulation

In general, the plan formulation process follows six major steps, as listed and summarized below. This procedure is in accordance with USACE Principles and Guidelines (P&G) and related regulations. These six steps are:

- Step 1: Identification of Problems and Opportunities;
- Step 2: Inventory and Forecasting Conditions;
- Step 3: Formulation of Alternative Plans;
- Step 4: Evaluation of Alternative Plans:
- Step 5: Comparison of Alternative Plans; and
- Step 6: Selection of a Plan.

Preliminary alternatives were formulated by combining management measures. Each alternative was formulated in consideration of the following four criteria described in the P&G:

- Completeness: Extent to which the plan provides and accounts for all necessary investments or actions to ensure realization of the planning objectives;
- Effectiveness: Extent to which the plan contributes to achieving the planning objectives;
- Efficiency: Extent to which the plan is the most cost-effective means of addressing the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment; and
- Acceptability: Workability and viability of the alternative plan with respect to acceptance by Federal and non-Federal entities and the public, and compatibility with existing laws, regulations, and public notices.

4. Resource Significance

4.1 Introduction

Significance of environmental resources is based on their non-monetary value demonstrated by institutional, public, or technical recognition of the environmental resources or attributes in the study area.

4.2 Institutional Recognition:

Institutional Recognition is demonstrated through the establishment of laws, restrictions and guidelines pertaining to the species. Some examples include:

- NOAA Fisheries institutionally recognizes rainbow smelt as a Species of Concern. Species of Concern are defined as species requiring additional management due to concerns regarding status and threats, but for which insufficient information is available to indicate a need to list the species under the Endangered Species Act (ESA). A "Species of Concern" status does not carry any procedural or substantive protections under the ESA, but is recognized as requiring proactive attention and conservation action. The area of concern for rainbow smelt on the Atlantic Coast is in rivers and coastal areas of eastern North America from Labrador to New Jersey. NOAA Fisheries first identified rainbow smelt as a Species of Concern in 2004.

- In addition to rainbow smelt being a Species of Concern, the Anadromous Fish Conservation Act of 1965 and the Corps of Engineers Ecosystem Restoration Policy (Engineering Pamphlet 1165-2-502, 30 September 1999) recognize the importance of all anadromous fish. The Anadromous Fish Conservation Act was enacted to conserve, enhance, and manage anadromous fishery resources. All species that return to rivers to spawn from the ocean are included. Several anadromous species are known to ascend the tributaries of the Weymouth Fore River.

4.3 Public Recognition:

Public significance is demonstrated when some segment of the general public recognizes the importance of an environmental resource:

- The MADMF has recognized restoration of anadromous fish species in these watersheds as important. They prepared a restoration plan for river herring in the Fore River watershed and have also submitted a request to USACE to assist with restoration. The WBRRCD have also requested that USACE assist in fish habitat restoration efforts in Smelt Brook. The most recent request was submitted by the Mayor of Braintree in May 2015.

- In 2018, the state funded MassWorks Infrastructure Program allocated $604,000 for Cooperative Projects at Weymouth Landing. Included in those cooperative program elements was the installation of substrate retention “Diamond Fabric” in the Smelt Brook stream channel substrate along the reach of the LPP included in the daylighting stretch in Weymouth Landing to improve the attractiveness for reproductive spawning habitat area.

- Officials at MADMF have agreed to facilitate passage into Pond Meadow Lake if monitoring efforts indicate measures to improve fish passage to the impoundment and upper reaches of Smelt Brook LPP is successful.

- Towns of Braintree and Quincy have expressed their support for additional fish passage improvement projects on the adjacent Hayward Creek LPP, a flood risk management project that reduces flood risk from Eaton Pond to the Weymouth Fore River.

4.4 Technical Recognition:

Technical recognition is demonstrated by numerous studies, research and programs focusing on diadromous fish species and aquatic habitats:

- Research conducted by the United States Geological Survey at various labs and centers such as the Conte Anadromous Fish Research Facility in Massachusetts; research includes topics such as Atlantic salmon growth modeling and fish passage design for multiple anadromous species

- Research funding by the United States Fish and Wildlife Service and related state fish and wildlife agencies throughout New England; research includes topics such as modeling the timing of downstream migration of Atlantic salmon smolts and impacts associated with climate change

- Federal Marine Fish Habitat Restoration and Creation Program administered by USACE and NOAA. Habitat restoration and creation opportunities are identified from within the overall USACE Civil Works Program and may include anadromous, estuarine, and marine fish habitats.

- Federal Watershed Protection Approach an initiative developed by the U.S. Environmental Protection Agency (EPA) to maintain and improve the health and integrity of aquatic ecosystems using comprehensive approaches that focus resources on the major problems facing these systems within the watershed context.

Scarcity, Status and Trends – A century ago, rainbow smelt were so plentiful that farmers caught them by the barrelful and had enough to eat, use as bait, and as fertilizer on their fields. The species has now largely disappeared from the southern part of its geographic range, and its numbers along the coast of the Gulf of Maine have dropped dramatically (Chase et al. 2009).

In Massachusetts, commercial smelt harvests have declined for at least the past 90 years. Researchers from the University of Connecticut summarized federal commercial catch rates and noted three peaks in the Massachusetts harvest: 35,000 pounds (lbs) in 1879, 39,000 lbs in 1919, and 25,000 lbs in 1938. Today, in Massachusetts there is limited recreational catch and trace commercial harvest. Evidence of low abundance and fewer smelt living to older ages has been apparent in studies comparing recent catch data to studies in the 1970s (MADMF 2011).

Limiting and Critical Habitat – A clear explanation for the decline in the rainbow smelt population is not yet known, but the species faces three broad types of potential threats: loss of suitable spawning habitat; unfavorable changes in ocean conditions, such as water temperature or predation; and fishing pressure. Scientists from state agencies in Massachusetts, Maine, and New Hampshire are collaborating on a study of threats to rainbow smelt, particularly spawning habitat alternation. The states are using the scientific findings to develop a regional solution that will be implemented across New England (NOAA 2015).

Human activities that are known to degrade rainbow smelt spawning sites include dams and poorly designed culverts that block smelt from spawning grounds. Sediment from construction sites, road maintenance, and other sources smother eggs. Fertilizers and faulty septic systems encourage the growth of algae in spawning grounds and on smelt eggs. Additionally, pavement and other impervious surfaces promote runoff of pollutant-laden rainwater into rivers and streams. All of these human actions have contributed to the decline of rainbow smelt populations.

Connectivity – Connectivity is a measure of the degree of habitat or population fragmentation; ranging from "connected and sustainable," to "fragmented," to "isolated." The Fore River watershed is fragmented by dams, perched culverts, poor habitat, and riparian development.

Biodiversity – The biodiversity of the watershed is limited due to fragmentation. Native species cannot access natural spawning and rearing habitat. Without these species in the system, the natural ecology has changed and reduced the number of species that colonize these areas.

Representativeness – Representativeness is a measure of an environmental resource's ability to exemplify the natural habitat or ecosystems of a specified geographic range. Under its current condition, the Fore River watershed does not represent a healthy, functioning river system supportive of natural diadromous fish habitat. This would be rectified with restoration connectivity and improving habitat.

Providing fish passage through the LPP would provide numerous benefits to the Weymouth Fore Watershed and region. Increased anadromous fish would provide valuable forage for:

- important marine commercial fish such as bluefish and striped bass,
- riverine recreational species such as bass and pickerel, and
- predatory birds such as waterfowl, wading birds and osprey.

In addition, passage would help re-establish an ecological connection between Quincy Bay, Hingham Bay and Weymouth Fore Watershed that was lost with the decline of anadromous fish runs on Smelt Brook from barrier construction and poor water quality associated with a historic industrial legacy.

5. Affected Environment*

The affected environment includes all areas where projected effects may occur or otherwise be observed. This includes the physical, biological, socioeconomic and cultural resources and the characteristics, attributes and properties that define them. All potential project modifications for environmental restoration must evaluate their benefits relative to these characteristics.

5.1 Physical Environment

5.1.1 Soils

The U.S. Department of Agriculture, Soil Conservation Service soil surveys (Flewelling, L.R. and Lisante, R.H., 1982) were used to determine and characterize the soils that are affected by the construction of the proposed project. These soils characterize the streambed and riparian environment in and around Smelt Brook.

The project will affect approximately 4,300 linear feet of Smelt Brook with the addition of the fishway. According to the Web Soil Survey (2022), Smelt Brook watershed soils are primarily of the Ridgebury and Whitman fine sandy loam, which consists of fine sandy loam, is poorly-drained, and is extremely stony. Soils around the project area are primarily of the Charlton-Hollis-Rock outcrop complex, which is also fine sandy loam but well drained. Approximately 800 feet of the channel was widened, deepened, and straightened when the LPP was constructed so much of Smelt Brook does not have the natural sediment distribution that is typical for brook of this size.

5.1.2 Hydrology

Smelt Brook drains the surrounding watershed into the Fore River. Smelt Brook is approximately 170 meters (560 feet) in length for an area of about 819 square meters (8,920 square feet; 0.205 acres) in a drainage area of about 5.4 square kilometers (2.1 square miles). Chase (2006) describes the stream channels in this watershed that support rainbow smelt eggs as having width 2.8 to 6.8 meters wide with an average (9.2 to 22 feet) and approximate average depth of about 0.28 meters (11 inches). Riffle and pool complex habitat with coarse cobble, ranging between 10 and 20 centimeters (4 to 8 inches) was also described as optimal habitat for egg deposition and resting habitat for adults. Vascular plants are commonly observed in Smelt Brook and are described by Chase (2006) as an important feature in maintaining optimal water quality conditions by holding sediments in place. A climate trend analysis in the HUC for rivers of similar-size

indicated that the annual instantaneous peak streamflow appears to be rising, while the monthly average peaks appear to be reducing year-over-year.

5.1.3 Water Quality

Surface water temperatures during the spawning period of March through May are typically greater than 50^{o}F, and dissolved oxygen (DO) is typically around 11.4 mg/L (Chase, 2006). Geffen (1990) suggested sustained exposure to pH levels of 5.5 may result in mortality to smelt eggs, however Chase (2006) reports water pH to be, on average, 6.8, and observes that pH levels are on the rise in streams that support rainbow smelt spawning habitat. Brackish water occurs in the lower reach of Smelt Brook, however, the area where modifications are being proposed is primarily considered freshwater. As part of the Weymouth Fore River system, Smelt Brook is classified as having Class SB waters, which are designated as habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation. Primary and secondary contact recreation allow for prolonged and intimate contact, and incidental or accidental contact with water, respectively.

5.1.4 Air Quality

The Clean Air Act (CAA) establishes the framework for modern air pollution control, and delegates primary responsibility for regulating air quality to the States, with oversight by the EPA. The EPA develops rules and regulations to preserve and improve air quality as minimum requirements of the CAA, and delegates specific responsibilities to State and local agencies. The EPA has identified seven specific pollutants (called criteria pollutants) that are of concern with respect to the health and welfare of the general public. The criteria pollutants are carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), particulate matter 10 micrometers or less in aerodynamic diameter (PM10), particulate matter 2.5 micrometers or less in aerodynamic diameter (PM2.5), and lead (Pb). These pollutants have established National Ambient Air Quality Standards (NAAQS).

Areas that do not meet the NAAQS are called non-attainment areas. For nonattainment areas, the CAA requires States to develop and adopt State Implementation Plans (SIPs). In Massachusetts, Federal actions must conform to the Massachusetts Ambient Air Quality Standards, which are consistent with the National Standards. USACE must evaluate and determine if the proposed action (construction and operation) will generate

air pollution emissions that aggravate a non-attainment problem or jeopardize the maintenance status of the area for ozone.

The entire commonwealth of Massachusetts is designated as an attainment zone for sulfur dioxide, lead, carbon monoxide, nitrogen dioxide, particulate matter-10, and particulate matter-2.5. The project location in Norfolk County, Massachusetts is also in attainment for ozone (O_3). Attainment zones are areas where the NAAQS have been met. The entire project area is located within a designated attainment zone according to the NAAQS set forth by the EPA (EPA, 2018).

5.1.5 Hazardous, Toxic and Radioactive Waste

The EPA's National Priorities List (NPL) is the list of sites of national priority among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. These substances are also known as hazardous, toxic, and radioactive waste (HTRW). The project area does not have any sites listed on the existing or proposed NPL (EPA, 2021). No underground storage tanks (USTs) are within the project area (MADEP, 2020).

The EPA's Toxic Release Inventory (TRI) tracks the management of certain toxic chemicals that may pose a threat to human health and the environment. Certain industrial facilities in the U.S. must report annually how much of each chemical is recycled, combusted for energy recovery, treated for destruction, and disposed of or otherwise released on- and off-site. One site in Weymouth is required to report to the TRI. Calpine Fore River Energy Center LLC, located approximately 1.75 miles north of the project site in Weymouth, released approximately 15.2 thousand pounds of ammonia into the air in 2020 (EPA, 2022).

5.1.6 Noise

Noise is defined as unwanted sound. The reach of Smelt Brook that includes the project area is bounded on the north and south sides of the brook by a congested residential community. The noise environment in the project area consists routinely of noise from passenger vehicles and perhaps, backup generators. The noise level in this area is relatively peaceful and generally considered a quiet community. Noise is regulated by the Commonwealth of Massachusetts through the Department of Environmental Protection (DEP) Noise Control Regulation 310 CMR 7.10.

5.2 Biological Resources

5.2.1 Fish and Wildlife Resources

Regulations and policies that protect biological resources under consideration as part of the proposed project include the Endangered Species Act (ESA), the Migratory Bird Treaty Act, the Magnuson-Stevens Fishery Conservation and Management Act, the Clean Water Act, EO 11990 – Protection of Wetlands, EO 13112, Invasive Species and the Fish and Wildlife Coordination Act.

Diadromous fish species that have been observed in the Weymouth-Fore River watershed include rainbow smelt, river herring, such as alewife and blueback herring, and American eel. Upstream migration for rainbow smelt generally begins in late February or early March and lasts through May. After adults spawn, they return to estuarine and marine waters during daylight hours. Eggs are negatively buoyant and sticky and will adhere to the benthic substrate, generally cobble material. Eggs generally hatch within 10 to 21 days of fertilization. Larvae will follow the downstream current to tidally influenced waters and begin feeding on zooplankton.

Alewife, blueback herring, and American eel have been observed between late March through April and into May, below the project area. Though, spawning activities appear to overlap with rainbow smelt egg release during the March through May period (Chase 2006), Smelt Brook is not known as a river to support a herring run (Chase 2006). Other fish species may be present in Smelt Brook given its character but have not been observed or documented.

Upstream of the project area, Smelt Brook continues for about a mile where is flows out of Pond Meadow Lake. This section of the brook and the lake are known to support frogs, such as the American bullfrog (*Lithobates catesbeianus*), green frog (*Lithobates clamitans*), toads, American toad (*Anaxyrus americanus*), Blandings turtle (*Emydoidea blandingii*), Eastern box turtle (*Terrapene carolina)* and Northern red-bellied cooter (*Pseudemys rubirentris*). The lake also supports a variety of fish species such as pickerel, trout, and perch.

Riparian habitat on either side of Smelt Brook is modest, perhaps anywhere from 10 feet to 30 feet. Downstream of the stilling basin, a 12 to 14-foot (3.6 to 4.2- meter) embankment is covered in grass and vines on the southern side of the stream. A modest 5 to 8-foot (1.5 to 2.4-meter) embankment is located on the right side of the stream and

supports a similar assemblage of mixed grass and vines. Riparian habitat is buffered by residential homes on either side of the stream. Riparian habitat is modified with limited suitability and is primarily comprised of mixed grass, blackberry and weeds. On three separate occasions, USACE biologists inspected Smelt Brook and did not observe wildlife within the project area. It is feasible that migratory birds or mammals may move through the area on occasion, but there is no evidence of wildlife shelter, forage, or reproduction within the project area.

Aquatic plants observed within the Smelt Brook project area include: common bladderwort (*Urticularia intermedia*), hydrilla (*Hydrilla vertiicillata*), and waterweed (*Eodea* sp).

Benthic macroinvertebrates are small aquatic animals and insect larvae that play an important role in the maintenance of healthy streams and watersheds and are often used as indicators of water and habitat quality due to their varying degrees of tolerance to pollution and disturbance. Healthy waterbodies tend to have high diversity and abundance of these macroinvertebrates. A study (Mitchell, 2014) of benthic macroinvertebrates in various subwatersheds within the greater Boston Harbor Watershed was conducted in 2009 to detect anthropogenic impacts on the aquatic community of the watershed. One of the sampling sites was located on the Monatiquot River tributary to the Weymouth Fore River about 0.1 mile upstream of Commercial Street in Braintree and about a half mile from the stilling basin within the project area. Both the sampling site and the project area are located about 0.4 miles upstream of where the tributaries enter the Weymouth Fore River. This study assessed habitat quality based on ten parameters (e.g., instream cover, sediment deposition, bank vegetative protection, etc.) and compared them to the macroinvertebrate community assemblage and structure.

The Monatiquot River site rated with primarily optimal and suboptimal instream parameters, and mostly optimal and suboptimal conditions for the riparian zone with one side of the riparian vegetative zone width rated as poor. Based on this habitat quality analysis, this sampling site represents a slightly impaired biological environment that is similar to Smelt Brook due to its proximity, and likeness in developed environs, water chemistry, and riparian conditions. There was a total of 14 genera from 7 families of macroinvertebrates that were sampled from the Montiquot River site with species from the Chironomidae (non-biting midges) and Hydropsychidae (net-spinning caddisflies) families being the most abundant. Other families that were found include

Glossosomatidae (saddle-case caddisflies), Gammaridae (scuds), Lumbriculidae (microdrile oligochaetes), Simuliidae (black flies), and Elmidae (riffle beetles).

The Chironomidae family is the most abundant and widespread aquatic insect family in North America and is found in most aquatic habitats. The larvae and pupae live on the bottom within slender tubes of silk and detritus and have a wide spectrum of feeding strategies and pollution tolerances. In this region of North America, the Chironomidae are moderately to most tolerant of pollution. There are 13 genera of Hydropsychidae in the United States. The larvae build stationary retreats of silk, detritus and rock fragments with a silken filter net to strain food from the water for which the size of the net varies based on the speed of the water in their habitat and the size of the food for which they specialize. The species that are in this region are least to moderately tolerant of pollution.

Upstream of the project area, the 320-acre Pond Meadow Park supports a wide variety of habitats: meadow, woodlands, marsh, and a 20-acre pond and tributaries. While there are no wetlands located at or surrounding the project area, there are wetlands located within the LPP upstream of the project site between Pond Meadow Park and the culvert. Just downstream of the levee, there are approximately 22 acres of connected freshwater forest/shrub wetlands. These wetlands are specifically designated as palustrine, forested, broad-leaved deciduous, seasonally flooded wetlands. This classification is characterized as nontidal dominated by broad-leaved trees and shrubs that shed their leaves during the cold months with surface water present for more than a month during the growing season. This type of wetland provides habitat for native plants, amphibian breeding, mammals, and migratory songbirds. During site visits, no migratory birds were observed within the project area.

5.2.2 Threatened and Endangered Species

No federally listed species, in accordance with the Endangered Species Act, and under the jurisdiction of the National Marine Fisheries Service (NMFS), occur within the project area. NMFS has not designated critical habitat for any part of the project area.

On February 8, 2021, USACE received a list of federally threatened and endangered species that may occur within the project area from the USFWS, New England Ecological Services Field Office. The February 8, 2021, communication identified the federally listed threatened northern long-eared bat (NLEB, *Myotis septentrionalis*) as potentially occurring within the project area. No designated critical habitat under the jurisdiction of USFWS was identified as within the project area.

The NLEB is found across much of the eastern and north central United States and all Canadian provinces from the Atlantic coast west to the southern Northwest Territories and eastern British Columbia. The species' range includes 37 states. White-nose syndrome, a fungal disease known to affect bats, is currently the predominant threat to this bat, especially throughout the Northeast where the species has declined by up to 99 percent from pre-white-nose syndrome levels at many hibernation sites.

No known maternity roost trees or hibernacula are located within or adjacent to the project area. The closest maternity roost trees are over two miles south of the project area (MA NHESP, 2019b).

A query of Massachusetts Natural Heritage Program resources produced a list of possible state-listed species that may be located within the project area. Of these species, only the Eastern box turtle (*Terrapene carolina*) and the mocha emerald damselfly (*Somatochora linearis*), both species of concern, were determined to potentially occur within the project area. The Eastern box turtle is a terrestrial turtle that is found in both dry and moist woodlands, brushy fields, thickets, marsh edges, bogs, swales, fens, stream banks, and well-drained bottomland. Some of this habitat is present in the project area. In Massachusetts, the mocha emerald damselfly has been found in fields and forest clearings outside of breeding habitats. It breeds in small to medium-sized streams that flow through woods or swamps with a sand or gravel bottom. This kind of habitat is present within the project area. During several site inspections of the project area, neither species was determined to be present within the project area (MANHESP, 2021; M. Cheeseman, personal communication, 2021).

5.2.3 Essential Fish Habitat

There is no designated Essential Fish Habitat for the reach of Smelt Brook that is constrained to the project area, between the flood gate and the stilling basin. Additionally, Smelt Brook is not considered as a historically important herring run (Chase, 2006).

5.3 Socioeconomic Resources

5.3.1 Household Income

According to the 2016-2020 American Community Survey, the population of Weymouth is 57,213 and the median household income is $85,536. As of May 2020, the median

hourly wage was $27.44; the mean hourly wage was $35.50 and the annual mean wage was $73,850 (U.S. Bureau of Labor Statistics, 2021). The average annual labor force is 34,152, of which 32,008 are employed, 3,065 are unemployed, and 14,498 are not in the labor force for the population 16 years and over. The unemployment rate was 6.2 percent. Average annual employment by occupation is shown in Table 5-1 (U.S. Census Bureau, 2016-2020 American Community Survey).

The rates for individuals living below the poverty level in the town of Weymouth and Braintree in 2020 were 6.3% and 4.3 %, respectively, which are lower than the national average (12.8%) for that year (U.S. Census Bureau, 2016-2020 American Community Survey).

TABLE 5-1. Average Annual Employment for Weymouth by Occupation (U.S. Census Bureau, 2016-2020)

Occupation	**Estimate**
Management, professional and related occupations	14,592
Service occupations	5,232
Sales and office occupations	6,502
Natural resources, construction, and maintenance occupations	3,295
Production, transportation, and material moving occupations	2,387
Total	**32,008**

5.3.2 Environmental Justice

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from an action, including the execution of Federal, State, local, and tribal programs and policies. Factors considered in determining whether the proposed project would significantly affect environmental justice include the extent or degree to which its implementation would (1) change any social, economic, physical, environmental, or health conditions so as to disproportionately affect any particular low-income or minority group or (2) disproportionately endanger children in areas within or near the project site. These factors are consistent with the requirement for compliance with EO 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations), EO 13045 (Protection of Children from Environmental Health Risks and Safety Risks), and EO 14008 (Tackling the Climate Crisis at Home and Abroad).

EO 12898 requires Federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable. The objective of EO 13045 is to make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children. EO 14008 requires federal agencies to make achieving environmental justice part of their missions by developing programs, policies, and activities to address disproportionately high and adverse human health, environmental, climate-related and other cumulative impacts on disadvantaged communities, as well as the accompanying economic challenges of such impacts.

EPA compiles environmental justice indices to compare populations vulnerable to environmental factors across the United States in their EJSCREEN tool. The EJSCREEN was used to draw a one-mile buffer from the center of the Town of Weymouth to include the project area. Within the buffer, the EJSCREEN reported that approximately 21% of the population was classified as people of color, 17% as low income, and 22% as over the age of 64. The EJSCREEN also reported that the Town of Weymouth buffer ranged from the 13th to the 43rd percentile, meaning that vulnerable populations in the area have a low exposure to environmental hazards relative to the rest of Massachusetts (EPA, 2022).

5.3.3 Recreation and Scenic Resources

No recreational activities have been observed within the project area. Due to the congested nature of residential community that borders the brook, it is unlikely the public has access to Smelt Brook for recreational purposes.

Upstream of the project area, Pond Meadow Park supports facilities for passive recreation use, including hiking, non-motor boating, picnicking, scout camping, and horseback riding, as well as fishing. Biking, jogging, and walking are popular on the two-mile paved bike path. Winter activities consist of cross-country skiing, snowshoeing, skating and ice fishing. In this densely populated area, Pond Meadow Park provides a place for people of all ages to enjoy and appreciate nature.

5.4 Cultural Resources

USACE is coordinating with the Massachusetts State Historic Preservation Office, the Massachusetts Board of Underwater Archaeological Resources, the Mashpee Wampanoag Tribe, the Wampanoag Tribe of Gay Head (Aquinnah), and the Narragansett

Tribe in accordance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended. The NHPA requires that Federal agencies take into account the effect of proposed undertakings upon historic properties (Historic and archaeological sites, buildings, cultural landscapes, and sacred/spiritual sites or locations significant to Tribes) and afford the Advisory Council on Historic Preservation the opportunity to comment.on such undertakings (36 CFR 800.1(a)).

A review of the Massachusetts Cultural Resources Information System (MACRIS), maintained by the Massachusetts Historical Commission, identified the follow historic and archaeological resources in the vicinity of the Smelt Brook LPP project area:

5.4.1 National Register Historic Districts

Commercial Street Historic District (BRA.5) – west of Smelt Brook in Braintree
Weymouth Landing Historic District (WEY.B) – east of Smelt Brook project area
Front Street Historic District (WEY.O) – south of Smelt Brook project area

5.4.2 Historic Buildings

WEY.118 – Richard, Elias Insurance Office and Shoe Manufactory, 1 Washington Street, 1850 Federal and Greek Revival.

5.4.3 Archaeological Sites

Several historic archaeological sites are located in the vicinity, though not within the project area of potential effect, including a 19th Century Powder Mill, 20th Century Piggery (pig farm) Foundations, and Surface Quarry Area sites. One Native American archaeological site, dating to the Middle-Late Archaic/Contact Period was identified within the nearby Weymouth/Braintree Recreational Area.

5.4.4 Previous Archaeological Surveys

A Phase 1, Step 2 archaeological survey was conducted of the Pond Meadow Park bicycle path in 1983. The survey revealed evidence of surface quarrying, agriculture, and pig raising within the study area, reflected in the historical archaeological sites (HA) from the MACRIS database above. However, no significant archaeological sites were encountered in the study area for the bicycle path.

5.5 Climate

Weymouth and Braintree have a temperate climate that includes warm summers, and cold, snowy, and windy winters with occasional exposure to coastal storms that travel up the coast as tropical storms or nor'easters.

Average monthly temperature ranges from a low of 22°F in January to a high of 83°F in July, with the temperature rarely going below 8°F or above 91°F. The warm season lasts for about 3.3 months, from June 4 to September 14, with an average daily high temperature above 74°F. The cold season lasts for about 3.4 months, from December 4 to March 14, with an average daily high temperature below 46°F (WS, 2022).

On average, there is little seasonal variation in the amount of monthly precipitation, which averages 3.2 inches. The snowy season in this area lasts about 4.8 months from November 15 to April 9, with the most snow falling in January with an average of 7.9 inches (WS, 2022). A literature review conducted for this study noted that northern New England has shown neither an increase or a decrease in both average and extreme precipitation.

6. Climate Change

A climate assessment for the Smelt Brook watershed is included to address the requirements contained in ECB 2018-14, Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects. A summary of results in this assessment is presented here to inform current and future studies of the proposed project modifications to improve fish-passage in the watershed. The analysis is tailored to provide an understanding of how the future with project condition may be altered by future changes in climate, which may or may not have an influence in the selection of alternatives. The full climate assessment is included as Appendix A2.

6.1 Factors to Consider

The recommended plan has been considered in greater detail than the other alternative plans, but all plans incorporate options to reduce obstacles to fish migrating upstream migratory fish passage from about elevation 19 feet to about 22 feet . The conclusions made in this review are not specific to any one alternative.

The following are the climate assessment conclusions for the Smelt Brook Watershed, Norfolk County, Massachusetts Fish Passage Enhancement Study:

1. There is a lack of flow gaging data pertaining directly to the Smelt Brook basin (no USGS station; one manually monitored water-level dataset, not yet calibrated).

2. A literature review indicated that Smelt Brook is perennial at the location of interest (Bent and Steeves 2006 for USGS), but anecdotal evidence exists to indicate that the stream does often run dry during the summer, and that this should be expected to increase because of groundwater pumping for apartment buildings in the basin. It is recommended as the project moves forward that the flow record be revisited periodically to assess the number of dry days in a typical summer, the associated variance, and whether these numbers are changing over time.

3. Despite regional (New England) trends of rising temperatures, the information in Weymouth is less clear (smaller changes, less significant) (Trombulak and Wolfson, 2004; Brown et al., 2010).

4. NOAA expects continuing "unprecedented" increases in temperature during the 21st century, with increases in heat wave intensity and decreases in cold wave intensity.

5. There is a trend of warmer winters and earlier spring snowmelt. For example, see Hayhoe et al. (2008) and the 10 other references that were reviewed in the section on temperature-related Relevant Climate Variables.

6. The HUC-4 level CHAT (Climate Hydrology Assessment Tool v.1.0) analysis performed for a wider area that includes southeastern Massachusetts and the states of Rhode Island, resulted in statistically significant projected trend of increase in the annual maximum monthly streamflow. Due to the nature of flooding in the region (being peak driven, rather volume driven), increases in predicted annual maximum monthly streamflow are not expected to increase the future risk of flooding. The trend must be viewed with skepticism, when considered for a Smelt Brook, given the much smaller scale of the subject basin (less than 2 square miles) as opposed to a wider study over multiple states.

7. In a study of 15-minute peak precipitation nation-wide, 1972 to 2002, there were no clear trends for the New England region in terms of storm magnitude, duration, or intensity for any season (Palecki et al 2005). Reviewing data 1950-2009, Wang et al (2009) noted increasing trends in New England for spring, summer and fall, with decreases in winter. Wang and Zhang (2008) noted that the frequency of extreme rainfall events in the south and east of New England had increased (in some cases, doubled) during the period 1949 to 1999. Horton et al (2014) reported a 10% annual increase in average annual precipitation for the years 1995-2011, with an increase in precipitation received from extreme events. Hayhoe et al (2007) noted that the winter ratio of rain to snow had changed to include more rain. Douglas and Fairbanks (2011) reviewed storm data in three New England states facing the Atlantic and noted an apparent increase of 1 to 2 inches in the size of the typical 100-year

storm, relative to National Weather Service predictions. Frumhoff et al (2007) noted that there appeared to have been increases in the frequency of storms with more than 2 inches in 48 hours. NOAA (Runkle et al 2022) reviewed Massachusetts data 1895-2014, and expected increases in precipitation post 2022, with an increased frequency of extreme precipitation events.

8. Observed changes in annual average temperature for the Northeast Region have increased by 1.43°F for the 1986-2016 period relative to the 1901-1960 period. Observed annual average maximum and annual average minimum temperature has increased by 1.16°F and 1.70°F in the Northeast region, respectively (Dupigny-Giroux, L.A. et al (2018)).

9. The literature review of the USACE report titled Recent US Climate Change and Hydrology Literature Applicable to US Army Corps of Engineers Missions- New England Region concluded that most studies identified an increase in both average and extreme precipitation, although some studies identified significant spatial variability and that northern New England may have experienced either no increase or a decrease.

10. The Vulnerability Assessment VA module of the CHAT was used to examine the HUC-4 with respect to ecosystem restoration and flood risk reduction. The tool did not indicate vulnerabilities, relative to the rest of the USACE portfolio. The "0 HUCs vulnerable" result should be treated with caution in that the HUC-4 was defined for a broad basin area and is not site-specific, and because the tool merely ranks vulnerability as being in, or not in, the highest 20% of estimated HUC-4 basins for the business lines selected.

11. NOAA expected that sea-level along the Massachusetts coastline would rise by 1 to 4 feet during the 21st century. It is therefore likely that upstream fish migration will shift to a different part of the high-tide cycles so that fish are less subject to closed-pipe/pressure flow conditions.

12. Review of winter precipitation indicated reducing total winter precipitation and reducing snow quantities. It was not yet clear whether the ratio of rain to snow had changed. It was also noted, however, that the NOAA (Runkle et al 2022) source materials implied increased winter precipitation and so were at variance with this finding.

Climate Risks are presented below in Table 6-1 to assess risk to the recommended plan for key climate variables as recommended in ECB 2018-14. One of the primary performance risks to the recommended plan is erosion along the Smelt Brook riverbank. This is mitigated with careful design; extreme high flows are already mitigated against by the presence of Pond Meadow Lake upstream of the project.

Table 6-1: Climate Risks Table

Feature or Measure	Trigger	Hazard	Harm	Qualitative Likelihood
Introduce a fish passage structure over 100 to 200 feet of the brook length (*objective of the project*)	Increased precipitation from more frequent high intensity storms	Future peak flows, flow velocities and erosion may be higher than present.	Lateral erosion of Smelt Brook may impact properties adjacent to river in the floodplain.	**Unlikely** Predicted climate changes are small, not "significant"; mitigated by Pond Meadow Lake Dam, proposed channel design.
Increased groundwater pumping in the basin (*this has been noted, and may continue*)	Groundwater levels fall below the river channel. (Limiting factor: unknown point at which excessive pumping starts to pull up briny water – the community will stop pumping when the water turns salty).	Brook runs dry more frequently.	Young fish die during the summer. Downstream migration is limited. Warmer water with lower oxygen content could cause fish-kills.	**Reasonably likely.** Pumping will likely continue. Stranded migrating fish will need to find deep pools in the channel, wait for adequate flow.
Warmer winter, earlier snowmelt runoff	Shorter winter season Fish do not arrive at an appropriate time for the "attractive" flows to upstream spawning regions.	The mix of species and of fish maturity changes in response to the extended summer periods.	Changing list of migrating species. New species may displace existing species.	**Likely**
Sea Level Rise	Water floods the railway station at Weymouth Landing. Properties at the Landing are flooded more frequently.	Roads and railway subject to flooding, salt damage, erosion. Parts of the underground sections of Smelt Brook go into pressure flow more frequently.	Roads and railway subject to flooding, salt damage, erosion. Fish are less likely to travel upstream through a pressurized pipe, so they will wait for a lower part of the tide cycle.	**Reasonably Likely** The design change occurs more than 10 feet vertically below the proposed project and is not expected to affect flows at the project site.

6.2 Summary

The USACE literature review noted that northern New England may have experienced either no increase or a decrease in both average and extreme precipitation. The trend analysis in the HUC for rivers of similar-size indicated that the annual instantaneous peak flows appeared to be rising, while the monthly average peaks appeared to be reducing year-over-year. Review of flow data from USGS gages at four sites in the Weymouth/Braintree/Quincy MA region, however, indicated that annual peak flows are decreasing over time, although the tests were not statistically significant. There are two sources of non-USGS flow data at Smelt Brook, but the datasets begin very recently (2020 at a downstream location and 2022 at an upstream location). This information has informed the project team and may be used more extensively for the PED phase, but it will not produce statistically significant trends information before the expected design and construction phases. Based on available information there is insufficient information to make an informed projection that the future condition of the project differs from present annual peak flow conditions used in the frequency analyses in this study.

Thenonstationarity detection tool was not utilized for the basin because there were no USGS data sets in the Smelt Brook basin itself. There is one 51-week data set of 200 readings. It included 51 notes of “dry”, which the monitoring team attributed to groundwater pumping for recently developed apartment buildings in the basin; but it should be noted that the observations began during a drought that broke during the observation period. Therefore, the flow frequency analyses incorporated could not be used with confidence to establish any flow trends in the Smelt Brook basin.

This review suggests that there has not been a statistically significant change in annual peak flows. Therefore, the flow frequency analyses of the dataset were utilized to define the future flow conditions.

7. Future Without Project Conditions/No Action Alternative*

7.1 Introduction

USACE planning requires the consideration of the Future Without Project (FWOP) conditions to assess scenarios for what might happen in the future if there are no changes made as a result of this study. This section also covers the no action alternative under NEPA. The FWOP comprises a projection of those conditions that can reasonably be expected to exist in the future, assuming USACE does not implement a project. The FWOP conditions are developed to better understand

what impacts might exist if USACE does not implement a project. The FWOP forms the basis against which all other alternative plans are evaluated.

7.2 Projected Conditions

For Smelt Brook, the FWOP conditions would mean that no modifications would be made to the existing channel improvements in the LPP, there would be no enhancements for fish passage between the flood control gate and the stilling basin with the 8-foot culvert, and the perched culvert located 7.5 feet above the stilling basin floor would forever remain a barrier to fish seeking to pass upstream of the culvert (see Figure 7-1).

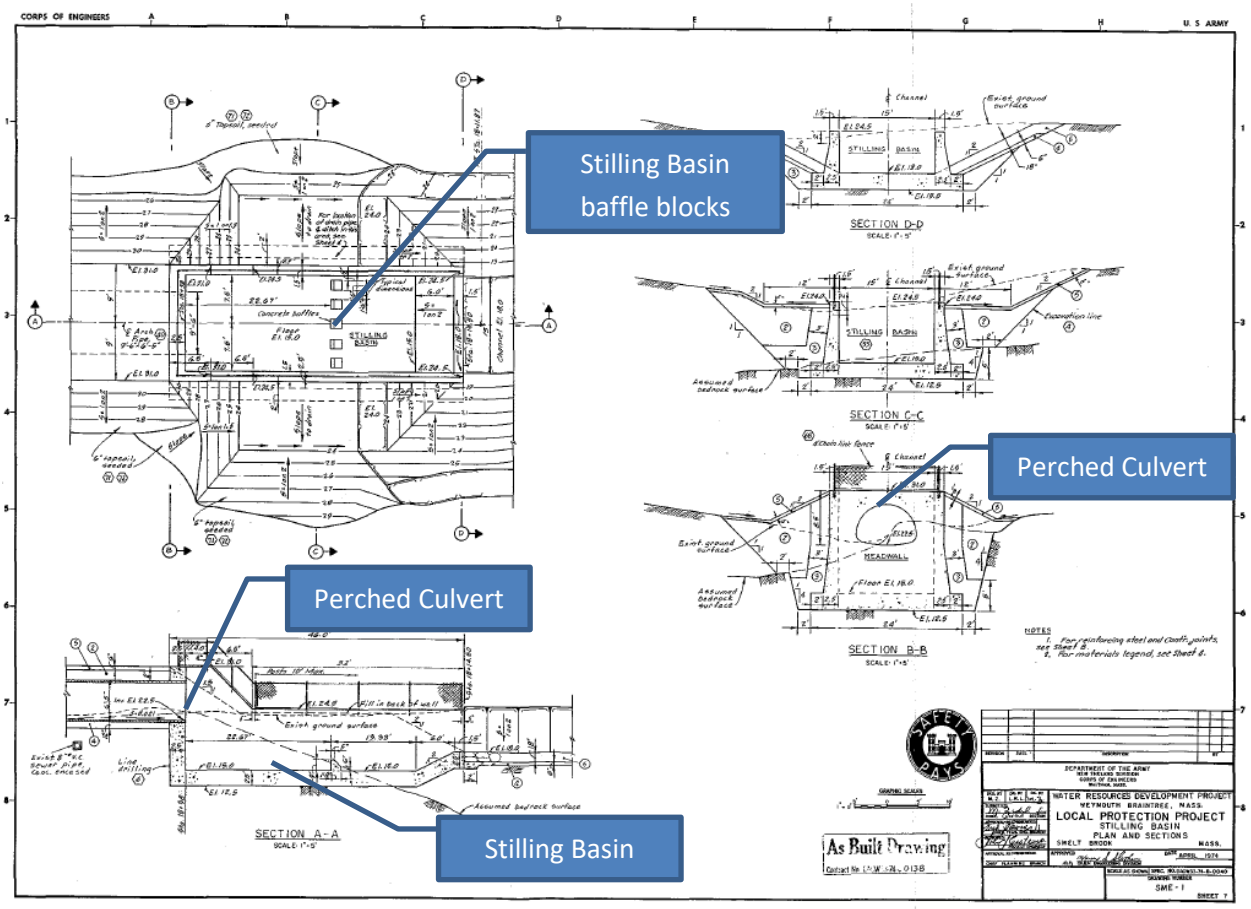

Figure 7-1. Perched Culvert / Stilling Basin with Baffle Blocks Design. Note design flaw that fails to allow upstream Fish Passage. Stilling Basin Floor elevation = 15.0 ASL, Perched Culvert = 22.5 ASL. Equivalent to 7.5 foot vertical barrier for fish passage.

There is a dearth of monitoring data for rainbow smelt in the Smelt Brook LPP, within the Weymouth Fore watershed, and for the species as a whole. Historical accounts of their migratory populations indicate abundance levels were once in the hundreds of thousands in Smelt Brook. Current observations of their presence indicates their relative abundance is in the hundreds. It is expected that their abundance will remain low in the FWOP conditions.

It is likely that the rainbow smelt population will remain diminished without improved access to historical spawning habitat areas as a result of the FWOP condition. The stilling basin barrier within the stilling basin structure will continue to limit the presence of diadromous migratory fish species within Smelt Brook LPP to only the lower reaches.

7.3 Projected Impacts

Potential impacts that can be attributed to further sustained limitation of migratory diadromous fish populations in the Smelt Brook LPP were examined within the context of the structural and functional impacts to the ecosystem health within the Weymouth Fore watershed. A continued presence of diadromous fish in the watershed provides a stable resource value for foraging wildlife and contributes to a healthy and resilient food web and enhanced diversity in biologic interactions.

- Rainbow smelt are a lower trophic level species, and as such, provide additional nutrition opportunity for higher trophic level predators in the Weymouth Fore watershed. Abundance of predators will continue to be suppressed as an impact of the FWOP conditions.

- Rainbow smelt eggs attach to river channel substrate and are a valued food source for foraging wildlife populations. Abundance of the foraging populations will continue to be suppressed as an impact of the FWOP conditions.

- Populations of rainbow smelt will remain low with the continued loss of access to historic migratory reproductive habitat areas. The potential for diadromous reproductive habitat in the upper reaches of the Smelt Brook LPP channel improvements will continue to be suppressed as an impact of the FWOP conditions.

8. Alternatives Analysis*

8.1 Introduction

The goal of the alternatives analysis under the Section 1135 authority is to develop and identify the most cost-effective method of mitigating damages to ecosystem structure and function that are attributable to existing USACE projects. The analysis is both iterative and adaptive in nature and includes several refinements to both the list of alternatives and their respective scope. As the study team progresses with the development and analysis of alternatives, it first screens out management measures) through initial screening and beyond to a focused array of alternatives, additional design features can be added or changed, and more importantly, sometimes additional constraints may be identified. Alternatives that violate the constraints or do not achieve the objectives are removed from analysis and are not carried forward for further consideration.

The alternatives analysis focuses on identifying the least costly, environmentally acceptable alternative for adequately restoring environmental features. A typical product of the alternative analysis for environmental restoration projects involves establishing the environmental benefits and conducting a cost-effectiveness / incremental cost analysis (CE/ICA) to determine what is the most efficient alternative to restore the environment. In the case of this study, there was only one alternative that achieves the study objectives and does not violate the constraints, so CE/ICA was not performed.

8.2 Initial Screening of Management Measures

8.2.1 Methodology

During the first iteration of the alternatives analysis, a suite of ecosystem enhancement measures were considered. These initial alternatives were developed across a broad array of considerations to effectively narrow the scope of the study and focus on measures with a high likelihood of achieving the desired outcome of environmental restoration in addition to being an implementable plan. Each measure was screened for its ability to meet the project constraints, restore degraded ecosystem resources, be constructible, and for its overall impact on the environment/existing usage of the area. This process allowed for measures to be eliminated from consideration while ensuring that measures were considered objectively and not ruled out prematurely. In some cases, additional constraints were identified.

8.2.2 Initial Screening Considerations

The initial screening of measures considered (1) modifications to the existing fish bypass structure adjacent to Weymouth Landing, (2) daylighting measures to enhance habitat quality and improve attractiveness for migratory diadromous fish, (3) the outright removal of the corrugated metal pipe (a.k.a. "perched culvert") that conveys flow in the LPP to the stilling basin and its replacement with a nature like fishway, (4) constructing a fish ladder solely within the flood risk management structure, and (5) constructing nature-like fishways (NLF) that extend downstream of the structure. NLF are unlike traditional fish ladders in that their features and attributes tend to mimic the natural environment, compared to a technical fishway - like a Denil fish ladder, which is not designed for environmental features.

Table 8-1 depicts the matrix that was used to screen the initial measures as well as a brief note explaining why they were carried forward or eliminated from consideration. The initial screening process resulted in 1 of the primary measures being considered in greater detail: constructing a fish ladder within the flood risk management structure.

Table 8-1. Initial Screening: Management Measures

Management Measures	Meets Constraints	Mitigates Ecosystem Degradation	Constructible	Cost-Effective to Improve Environment	Acceptable Impact on Environment	Achieves Multiple Objectives	Notes
Remove Stilling Basin and Perched Culvert Barrier to Fish Passage	**no**	yes	**no**	n/a	n/a	yes	Dropped from consideration for lack of constructability
In Stream Habitat Enhancements	yes	yes	yes	yes	yes	**no**	does not create new habitat or improve existing habitat
Daylighting Culverts to Enhance Habitat Quality and Improve Aesthetics*	yes	**no**	yes	yes	n/a	**no**	does not create new habitat or improve existing habitat
Fish Ladder	yes	yes	yes	yes	yes	yes	Restores access to spawning habitat
Modifying Existing Fish Bypass System	yes	**no**	yes	yes	yes	**no**	Does not restore access to historic spawning habitat

8.3 Initial Array of Alternatives

8.3.1 Methodology

An initial array of alternatives is developed based on the measures carried forward from the initial screening process. The alternatives are considered for their ability to meet the project objectives. The team identified several alternatives that enabled fish passage upstream of the stilling basin and perched culvert barrier as a means of restoring access for rainbow smelt and other fish to upstream spawning habitat areas.

As with the initial screening considerations, the analysis of the initial array of alternatives is iterative in nature and includes several refinements to both the list of alternatives and the screening considerations. As the study team progresses with the development of new alternatives, additional design features are added or changed, and more importantly, additional constraints are identified. Alternatives that do not achieve the study objectives or meet the constraints are removed from analysis and are not carried forward for further consideration.

8.3.2 Fish Ladder Alternative Development

The efficacy of any fish passage structure is highly dependent on local hydrology, target species, and a myriad of other site-specific considerations (Turek et al., 2016). With this collective information the study team relied on the technical requirements for the passability of the target species in their design efforts. Turek et al (2016) discussed fish passage design guidelines for rainbow smelt in their Federal interagency technical memorandum for NLF passage, which included the following recommendations:

> **Minimum Pool/Channel Width: 5.0 ft →** The guideline is based on creation of pools large enough to serve as resting areas and protection from terrestrial predators. Rainbow smelt is a schooling species and often aggregates in large numbers while resting in pools. Larger run sizes (hundreds to thousands) will require pools wider than this minimum dimension.
>
> **Minimum Pool/Channel Depth: 1.5 ft →** The guideline is based on creation of pools large enough to serve as resting areas and protection from terrestrial predators. Minimum pool depth was calculated using the formula 1 ft + 4BDmax: dp = 1 ft + (4*(28 cm * 0.129)* 0.0328) = 1.5 ft. Rainbow smelt is a schooling species and often aggregates in large numbers while resting in pools. Larger run sizes (hundreds to thousands) will require pools deeper than this minimum dimension.
>
> **Minimum Pool/Channel Length: 10.0 ft →** The guideline is based on creation of pools large enough to accommodate fish size, run size, and resting and schooling behavior, as well as meeting minimum weir velocity and maximum energy dissipation and slope guidelines. Rainbow smelt is a schooling species and

often aggregates in large numbers while resting in pools. Larger run sizes (hundreds to thousands) will require pools longer than this minimum dimension.

Minimum Weir Opening Width: 1.0 ft → The guideline is based on a weir dimension wide enough to accommodate downstream movement of adult rainbow smelt in a "worst case" perpendicular orientation to the flow, equivalent to 2 times TLmax or 2*28 cm = 56 cm = 1.84 ft . This value was reduced to WN = 1.0 ft to offset potential flow limitations during low fish-run flow periods for passageways on small to very small (first or second-order) coastal streams where wider openings may result in shallow water depths not meeting the passage opening depth guideline (See minimum weir opening depth guideline, below) . In the case of larger populations (thousands or greater), entrance dimensions should be greater than1.0 ft to accommodate multiple fish simultaneously passing through the weir opening.

Minimum Weir Opening Depth: 0.50 ft → The guideline is based on provision of sufficient water depth over the weir to enable protection from terrestrial predators, maneuvering in low flows, and use of lower velocity zone in high flows; equivalent to 3 times BDmax: 3 * 3.6 cm = 10.8 cm = 0.35 ft. This value was rounded up to dN = 0.50 ft.

Maximum Weir Opening Water Velocity: 3.25 ft/sec → The guideline is based on mean Ucrit = 0.30 m/s for 7 cm, smaller-sized adult rainbow smelt in respirometer experiments (Griffiths 1979); Ucrit = 4.29 BL/sec. Therefore Umax = 2 * 4.29 * 12 cm = 103.0 cm/sec = 3.38 ft/sec. Velocity barriers have been observed for rainbow smelt at water velocities greater than 3.9 ft/sec (B. Chase, MADMF, pers. comm., 8/30/2011). Vmax was rounded down to 3.25 ft/sec.

Maximum Fishway/Channel Slope: 1:30 → Rainbow smelt spawning runs are typically associated with low-gradient streams and rivers near the head-of-tide. Slope guidelines have not been previously established for rainbow smelt, so a conservative slope was selected. This nominal slope guideline approximates the maximum slope at natural river sites known to be passable by rainbow smelt, or is a conservative estimate of maximum slope based on known rainbow smelt swimming behavior and river hydro-geomorphologies in which smelt occur.

The migration and spawning season for rainbow smelt in Massachusetts occurs from late February and concludes in May. The fish gate that allows passage of diadromous fish past the 96-inch culvert is raised approximately 1 foot beginning in early February and closed at the end of May each year by rangers of the Pond Meadow Park to allow smelt access to spawning habitat upstream.

This information is used to formulate the basis of design for the alternatives being considered. As alternatives are developed, new information is discovered, and where possible, alternatives are adapted to better incorporate the new information. The initial array of alternatives is evaluated on the basis of the following four criteria:

1. Ability to avoid the project constraints

2. Constructability of design within the LPP

3. Ability to pass target fish species upstream of the stilling basin

4. Acceptable flood risk for life and property,

Table 8-1. Initial Array of Alternatives

Alternative	Avoids Constraints	Constructability	Passes Target Spp.	Acceptable Risk	Carried Forward	Notes
1 – Fish Ladder Across Entire Stilling Basin	**No**	-	-	-	**No**	Hi-Flow Events impacts hydraulics of flood structure
2 – Fish Ladder on One Side of Stilling Basin	Yes	Yes	Yes	Yes	Yes	
3 – NLF Passage Channel with Weirs	Yes	-	**No**	-	**No**	Length of channel prohibitive for passage of Rainbow Smelt
4 – NLF Passage Channel with Switchback	Yes	-	No	-	**No**	Length of channel prohibitive for passage of Rainbow Smelt
5 – Engineered Weirs Along a 600-ft Reach	Yes	-	-	**No**	**No**	Unacceptable risk during Hi-Flow Events
6 – Keyhole Slot at Base of Existing Culvert	**No**	-	-	-	**No**	Geotechnical concerns with stability of substrate
No Action	Yes	-	**No**	-	**No**	Future Without Project Conditions

8.3.3 Alternative 1: Fish Ladder Across Entire Stilling Basin

This alternative considers the construction of a fish ladder within the footprint of the existing stilling basin (see Figure 8-1). The length of the stilling basin is sufficient to accommodate fish passage with 9-11 pools and weirs. The elevation of each pool would be a few inches different from those adjacent to it. The flow of water would discharge from the outlet of the CMP into Pool 1, which would overflow a notched weir design into Pool 2, which would be 5-6 inches

lower than Pool 1, before overflowing into Pool 3, and so on until meeting the 19.0 ft elevation at the end of the stilling basin. The design criteria would meet the requirements of the NLF technical report, TR-30 (Chase, 2006) for passage of North Atlantic diadromous species.

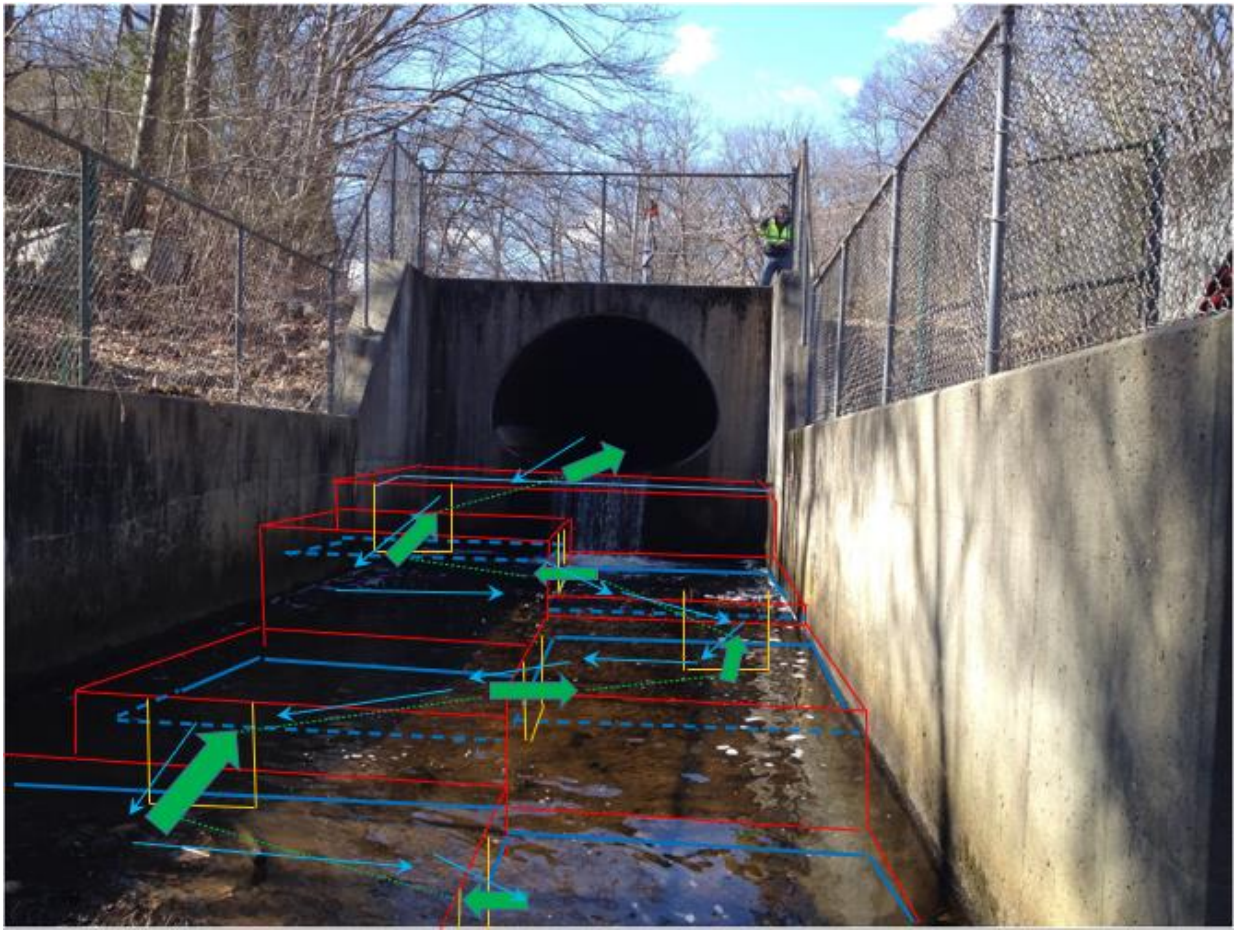

Figure 8-1. Fish Ladder Across Entire Stilling Basin. Red lines indicate concrete fish passage pool walls, yellow lines indicate weirs controlling flow between pools, blue lines are water levels, blue arrows are direction of streamflow, green arrows are the direction for upstream fish passage.

In the case of a design for 11 pools, the elevations of weirs would be 5 inches different from pool to pool. And in the case of a design with 9 pools, the elevations of weirs would be 6 inches different between pools. Both elevation differences, and resting pool areas, are sufficient to pass rainbow smelt under typical spring runoff flow conditions. In the scenario of 9 pools, rainbow smelt would pass through the fishway during flows of 10 cfs or lower. For greater flows, the system of pools passes the water, but the flows are too strong for the migrating smelt.

The Energy Dissipation Factor is estimated for this case, based on a flow of 10 cfs in the system of pools. Greater flows would prove overwhelming for migrating smelt, and the fish would need to wait in the ponds, or further downstream, until the storm subsided; the hydraulic estimate allows for a design storm to pass approximately 180 cfs over the weirs and up to 120 cfs over the banks of the stilling basin for a total maximum flow of only 300 cfs before the water level reaches 24 ft in a 15-ft-wide total channel. This fails to convey flows of 600 cfs while maintaining water levels below 24 ft and therefore was not carried forward in the analysis.

8.3.4 Alternative 2: Fish Ladder on One Side of Stilling Basin

Similar to alternative 1, this alternative also considers the construction of a fish ladder within the footprint of the existing stilling basin. However, the major difference is that this alternative calls for limiting the pools and weirs to one side of the stilling basin, leaving half the width of the stilling basin open (see Figure 8-2, below).

Pools and weirs would again range in number between 9-11, and the elevation of each pool would be a few inches different from those adjacent to it. Flows would discharge from the outlet of the CMP into Pool 1, which would extend the entire width of the stilling basin. Streamflows in excess of 1.5 cfs would diverge with partial flow discharging from Pool 1 directly into the stilling basin, and partial flow directed to the pool and weir structure. This design leaves more constant flow in the ladder pools and constrains migration flow <1.5 cfs.

This design would meet most of the recommendations from Turek et al. (2016) for passage of North Atlantic diadromous species. However, one drawback with this scheme is that the pools are smaller than 10 feet long by 5 feet wide, which is a recommended minimum spacing for a schooling species that prefers at least 10 feet between obstacles and requires frequent rest areas. To allow for increasingly calm water in each pool so the fish get more rest as they swim upstream, the depths could be increased up the pool and weir structure. If chosen for further development, then geometrical changes outlined below might be considered to maximize the design for fish passage in accordance with the recommendations presented by Turek et al. (2016).

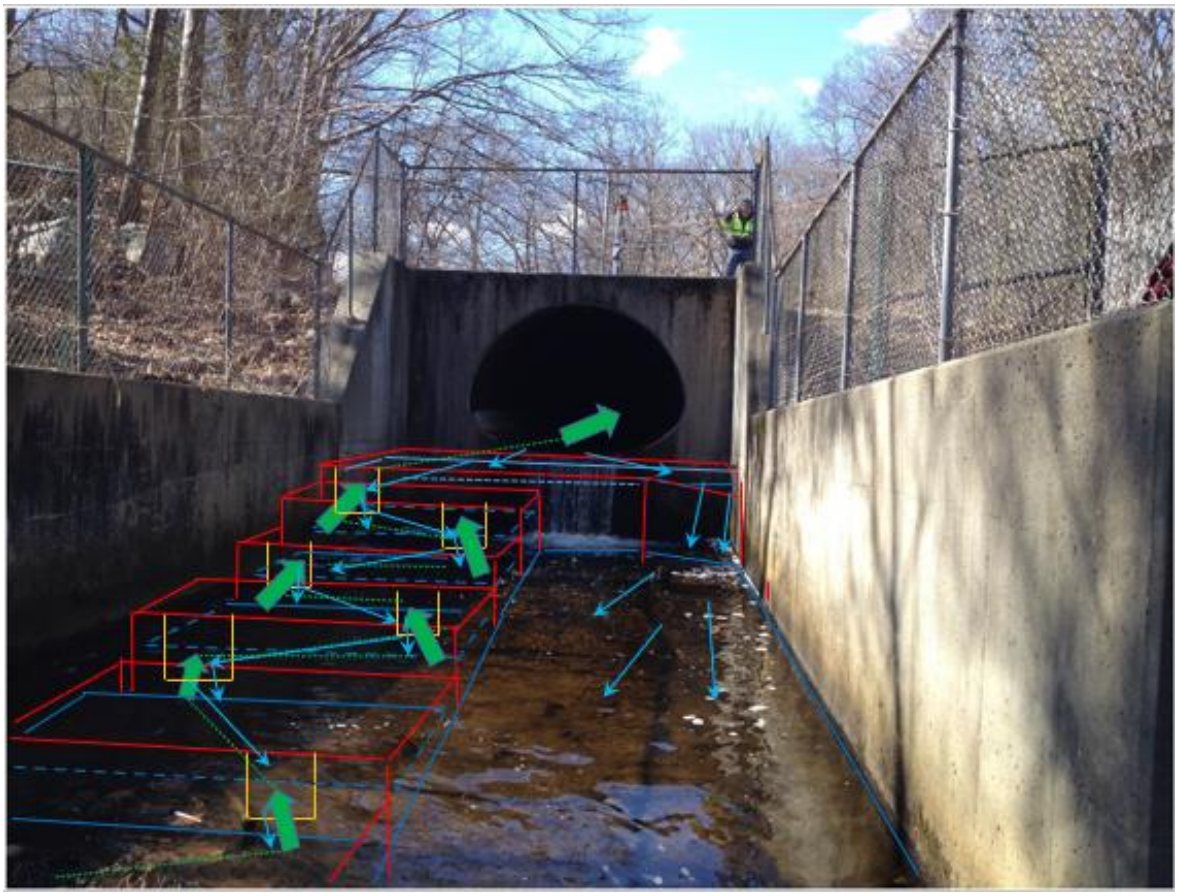

Figure 8-2 Alternative 2: Fish Ladder on One Side of Stilling Basin, conceptual rendering. Upstream fish passage shown with green broken lines and green arrows; blue arrows show water flow; notches in the weirs are shown in yellow.

Approximately 50% of the streamflow passes through the step pools during migration. This flow is concentrated as it passes through the notches in each of the weirs between the pools. At the lowest weir, this corresponds to approximately 10 cfs passing through approximately a 12-inch opening. Velocity would be approximately 4 fps. By comparison, the rest of the streamflow would have spread out at this point (the downstream end of the stilling basin) and would be slower than 0.5 fps. The 50%/50% flow ratio is likely adequate to attract fish, and the difference in velocity would serve as a strong signal to them.

The same basic fish ladder could be extended downstream of the stilling basin, into the wider valley to allow for longer pools. A 10-foot length of pools, with 9 pools, implies a total length of 90 feet. This is approximately 50 feet beyond the end of the current stilling basin. The stream invert at this location is known to be at 17.9 ft (lower than 18 ft), which would introduce an

impassable jump for the migrating fish. A tenth pool might therefore be necessary, leading to a total length of 100 feet.

In the case of a design for 11 pools, the elevations of weirs would be 5 inches different from pool to pool. And in the case of a design with 9 pools, there would be a 6-inch difference between elevations of successive weirs. Both elevation differences, and resting pool areas, are sufficient to pass Rainbow smelt under typical spring runoff flow conditions. In the scenario of 9 pools, Rainbow smelt would pass through the fishway during flows of 10 cfs or lower. For greater flows, the system of pools passes the water, but the flows are too strong for the migrating smelt.

The assumption of 10 cfs being a typical flow during the migration season is supported by the brief, with gaps, Smelt Brook site-specific, record of daily water levels since 2020. The record is too brief to be considered definitive. It is unclear if the elevation data accurately reflect flows, although there was an immediate downstream response to stop-log/gate-controlled changes in the upstream pool level. The gage has not been calibrated.

To assess the likely range of flow at Smelt Brook, the climate change assessment reviewed USGS records of 4 nearby sites including Old Swamp River near South Weymouth, MA (basin area 4.5 square miles) and Town Brook at Quincy, MA (basin area 4.11 square miles). Of these comparison sites, Town Brook is more like Smelt Brook in that it is downstream of a substantial flood risk management dam. The annual peak flows at these two comparison sites appear to have been decreasing over time, although the trend was not statistically significant in either case. The range of annual peak flows at these sites ranged from 48.9 cfs/square mile (cfm) at Old Swamp Brook to 83 cfm at Town Brook. The other two nearby comparison sites were downstream of larger drainage basin areas: Monatiquot River at East Braintree, MA (28.7 square miles) and Whitman's Pond Fish Ladder at East Weymouth, MA (12.5 square miles).

The precise geometry of the notches in the weirs will need to be subject to change as might be required if typical spring flows prove to be smaller than the 10 cfs assumption. If this should be the case, then a narrower notch width, or possibly a two-level notch-invert, might need to be considered in the PED design. Flow through a notch can be manipulated with stoplog structures to obtain the required depths or velocities through the notch. The flow can be augmented for a few days at a time by releasing water from the upstream dam if necessary. These possible design and operational tweaks to the design will need greater definition at the PED phase of the project.

Flow in the channel downstream of the stilling basin has been estimated at 3.1 feet deep when 600 cfs is passing. Assuming that there is a final weir at elevation 18 feet, with its own

downstream toe at 17.5 ft , then the headwater levels at each weir in the step-pool side of the stilling basin are:

27.20 ft upstream of the weir at elevation 22.5 ft
26.69 ft upstream of the weir at elevation 22.0 ft
26.18 ft upstream of the weir at elevation 21.5 ft
25.66 ft upstream of the weir at elevation 21.0 ft
25.13 ft upstream of the weir at elevation 20.5 ft
24.59 ft upstream of the weir at elevation 20.0 ft
24.03 ft upstream of the weir at elevation 19.5 ft
23.44 ft upstream of the weir at elevation 19.0 ft
22.79 ft upstream of the weir at elevation 18.5 ft
22.05 ft upstream of the weir at elevation 18.0 ft

On the open side of the basin, the same calculations apply for the theoretical headwater level of the last level (22.05 ft immediately upstream of the 18-ft weir) but the elevations at intermediate locations closer to the headwall of the stilling basin are less easily calculated for two reasons: firstly, there is a hydraulic jump occurring over the 42-ft length of the stilling basin, creating dynamic conditions that are not amenable to an exact theoretical solution; and secondly, there is no barrier to prevent water from the step-pool side of the weir from passing laterally from the "pool" side to the "open" side. Theoretically, this means that the values listed above are conservative (high), but the exact water levels cannot be stated with certainty.

Practically, therefore, the initial level of the training walls needs to be 4.7 ft higher than the invert level of the CMP In order to contain a flow of 600 cfs. The training walls are configured with a horizontal crest, followed by a sloped section, and then a longer horizontal crest. The upper portion (roughly the upper half) of the sloped section would support the design; the lower half (below the point where a fence post has been affixed) would need to be horizontal (See Figure 8-3).

The computations to reach this result were based on a series of weirs, the first of which is at elevation 22.5 ft. The weir discharge coefficient is 2.80. There is submergence at each weir, so the weir equation was modified to be:

$$Q_{submerged} = Q_{free\ flow} * [1 - \{H_{downstream}/H_{upstream}\}^{1.5}]^{0.385}$$

The last (most downstream) weir in the set is at elevation 18.0 ft; below it, the tailwater is calculated to be 3.1 ft deep using the Manning Equation for a Manning n value of 0.035 with a symmetrical trapezoidal section with base width 10 feet and sideslopes 1-on-2. The channel slope was approximately 0.0317 (1-in-31).

Figure 8-3: Expected Water Level in the Stilling Basin Under Alternative 2, with a Flow of 600 cfs.

The clear space in the CMP above the 27.2-ft level indicates a worst-case for a 600-cfs flow. The CMP is therefore unlikely to cause a back-up at its entrance, and so would not lead to a requirement for greater upstream structural changes in order to avoid inundation while passing 600 cfs.

The perched culvert discharging to the stilling basin is a bitumen-coated corrugated metal pipe. Although for hydraulic calculations it is usefully approximated as a circular pipe of diameter 8 feet (96 inches, or approximately 2.4 meters), the cross-section is in fact wider than it is tall: it is, however, flatter at the base (its invert) and there is an arch-shape to its "ceiling" (its soffit). The wider bottom and the corrugations in the material serve to promote fish passage up the pipe by providing rest areas in the pipe during normal flows. Required depth minima are to be confirmed during the PED phase of the project, in concert with operating and maintenance procedures for the upstream pond outlets and the downstream gate outlets and monitoring and adaptive management requirements.

This design for 10 pools leads to a total flow of 600 cfs when the water is contained in the stilling basin, with the wall heights raised to allow for water levels up to 27.2 ft at the upstream end of the stilling basin. The design is conservative in that it estimates elevations based on hydraulics on the side of the basin with the step pools, without regard to the open side of the stilling basin, where approximately 50% of the flow would pass at realistically lower depths (initial estimate would have the flow passing at current or FWOP depths, which are below the 24-ft elevation target depth).

Upstream of the stilling basin, the flow is conveyed in a bitumen-coated (BC) corrugated metal pipe (CMP). Give that the CMP is not circular in section, the wider base promotes a smoother, but shallower, outflow during normal or migration-season flows. Although there is a requirement for acceptable depths at weir notches, the full six-inch (150 mm) depth requirement, as cited for predator avoidance, is less critical in the closed CMP.

In the event of required depth-changes inside the CMP, pipe walls can be coated to adjust flow depths and effective diameter as a means to promote a desired depth of flow. For a circular pipe (a useful approximation), the following equation is introduced:

$$n_1 / n_2 = [d_1 / d_2]^{(8/3)}$$

Given that a typical CMP roughness is typically in excess of n=0.022, an equivalent flow of 600 cfs in the pipe should be feasible with a liner of smoother material. It is possible that a partial change for only the bottom of the pipe would increase flow depths inside the pipe under low flows (below 20 cfs) because of the non-circular shape of the existing pipe, while maintaining the 600 cfs design capacity. Similar Manning n and cross-section adjustments could be applied to allow for a partial lining of only a portion of the pipe, to enhance the flow depths during low profiles.

A liner could be inserted as a measure to address poor performance as part of adaptive management plan. These details will be expanded in a more detailed design phase. It is noted that an 8-ft diameter pipe with Manning n=0.024, being lined to create a 7.5-ft pipe, would need to have a Manning n of 0.020 (which is still rougher than a typical n-value of 0.015 for a rough concrete finish).

For the current layout of the CMP, a flow of 734 cfs passes through a circular 8-ft pipe of Manning n=0.024 when the pipe is 95% full. That this flow exceeds the target 600 cfs by 22% indicates that the structural changes downstream of the CMP will not lead to increased flooding upstream of the CMP.

This alternative meets the planning objectives and avoids the inundation constraints, and therefore was carried forward.

8.3.5 Alternative 3: Nature-Like Fish Passage Channel with Weirs

This alternative would extend a side-channel along the side of the reach of channel improvements downstream of the stilling basin to avoid the constraint of having the whole structure fit inside the stilling basin. This allows for longer pools, and smaller depths. However, this design extends for a significant distance downstream, with a large number of pools in order to achieve the grade and maintain flow velocities recommended by Turek et al. (2016).

A design objective is to funnel 15% of the spring flow through a side channel, so that it provides an attractive flow for any migrating fish. This conceptual alternative would require the construction of approximately 60 pools and weirs with an approximate 2-inch notch depth. By adjusting the weir locations in the dividing walls between the separate pools, the total distance of the fishway design is increased to approximately 950 feet with 10-foot long pools to result in fish swimming in a channel with an effective 1% grade. See Figures 8-4 and 8-5.

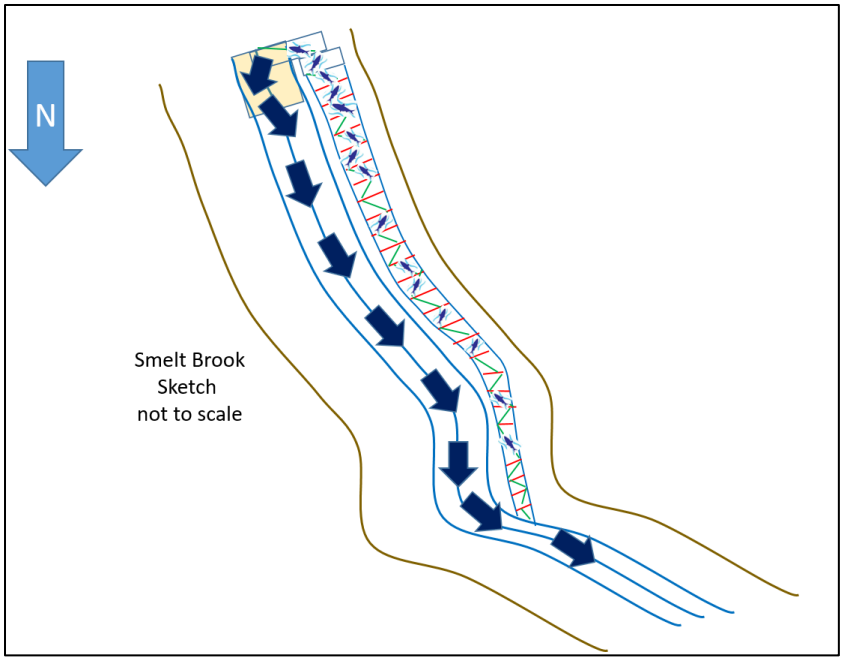

Figure 8-4: Alternative 3: Nature-Like Fish passage side-channel with weirs

The construction of this side-channel with canals would require approximately 18 feet of channel width. This is equivalent to almost half of the geographic area available for improvements within the LPP easement area. This could reduce the constructability of this design. Additional design features would include an overflow in the event that streamflow would exceed the canal capacity. The drop in water level per pool would be approximately 2 inches, which would result in overall lower velocities favorable to passage of rainbow smelt.

This design would partially obstruct extreme flow events and could create additional flood risk, or risk of snags and debris jams particularly around bends in the stream channel. Overall, this design would pass the 100-year event design flow criterion of 600 cfs. However, considering constructability and the likelihood of costs exceeding funding limits presented challenges and therefore was not carried forward for further consideration.

8.3.6 Alternative 4: Nature Like Fish Passage Channel with Switchback

Similar to alternative 3, this alternative design considers fish passage along one side of the improved channel using a structural modification that consists of three adjacent channels in a series of gently sloping pools oriented in a downstream – upstream – downstream fashion. Pools are approximately 5 feet wide for a total width of 19 feet including 1-foot-wide concrete walls.

The design would include a total of approximately 30 sections of approximately 30-35 feet long switchback runs for a total length of channel diversion of approximately 950 feet that would extend approximately 350 feet. The flow is gentle enough that rocks, soil and plants could be placed in the channel to qualify as a "nature-like" bypass. Flow velocities would range between 0.5 foot per second (fps) and 3.0 fps, and pool depths would be 2.0 feet, however there would be no real opportunity for fish to rest along the way.

Wider pools with longer separating walls could be obtained if the downstream "meander" is imposed with a series of bridges that take flow across the channel several times to obtain the 950 ft total distance for a 1% grade. The operation and maintenance of this proposed structure may prove to be challenging to perform on a routine and cost-effective basis. A general sketch is shown on Figure 8-4. The study team determined the likelihood of this alternative being prohibitive for fish passage was too high due to the length of run fish would be required to pass with no available resting pools. Constructability concerns were also apparent given the concept of 350 linear feet of concrete formed structures.

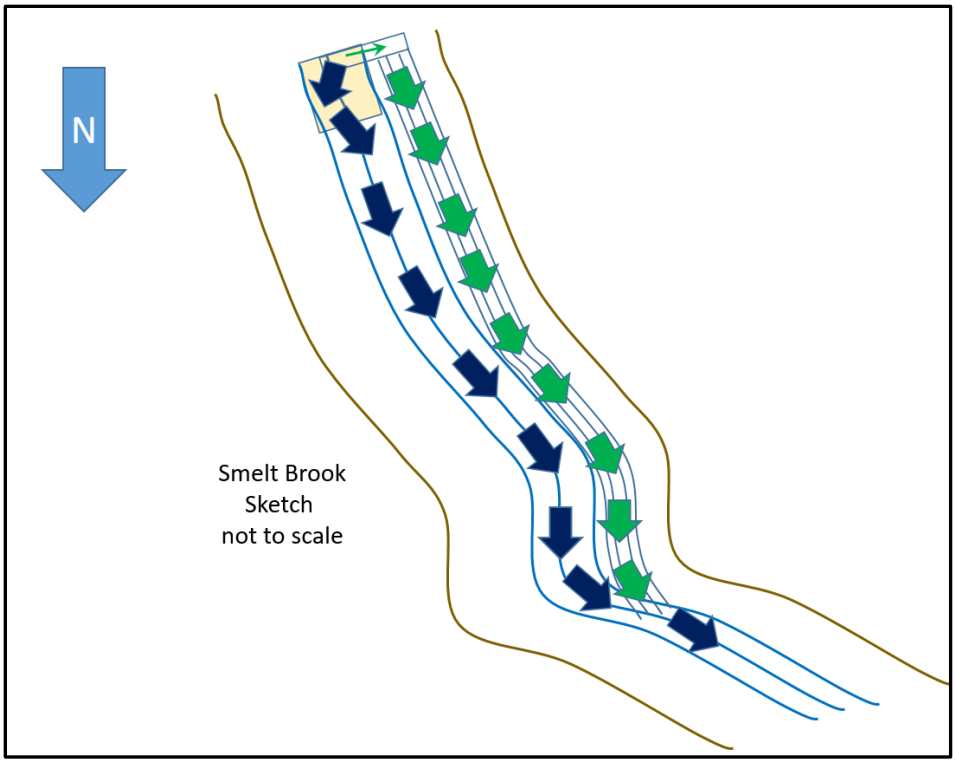

Figure 8-5: Alternative 4: Nature Like Fish Passage Channel with Switchback

8.3.7 Alternative 5: Engineered Weirs Along a 600-ft Reach

This alternative considers a series of weirs across the entire stream section that extends downstream for approximately 600 feet. The initial design considers spacing of 10 feet between the weirs for an equivalent length of pools. Weirs are notched for flow with at least three elevations. The intent of this design feature is to ensure that, even at relatively low flows, the weirs will accommodate flow in adequate depths to promote the migration of smelt.

The basic layout is shown in Figure 8-6. The central 6-ft part of the weir flows constantly. The narrower 2-ft sections to either side of it are narrower to ensure that there is likely to be enough depth of flow at the lower flows, and the depth quickly rises to or above 0.5 feet of overflow.

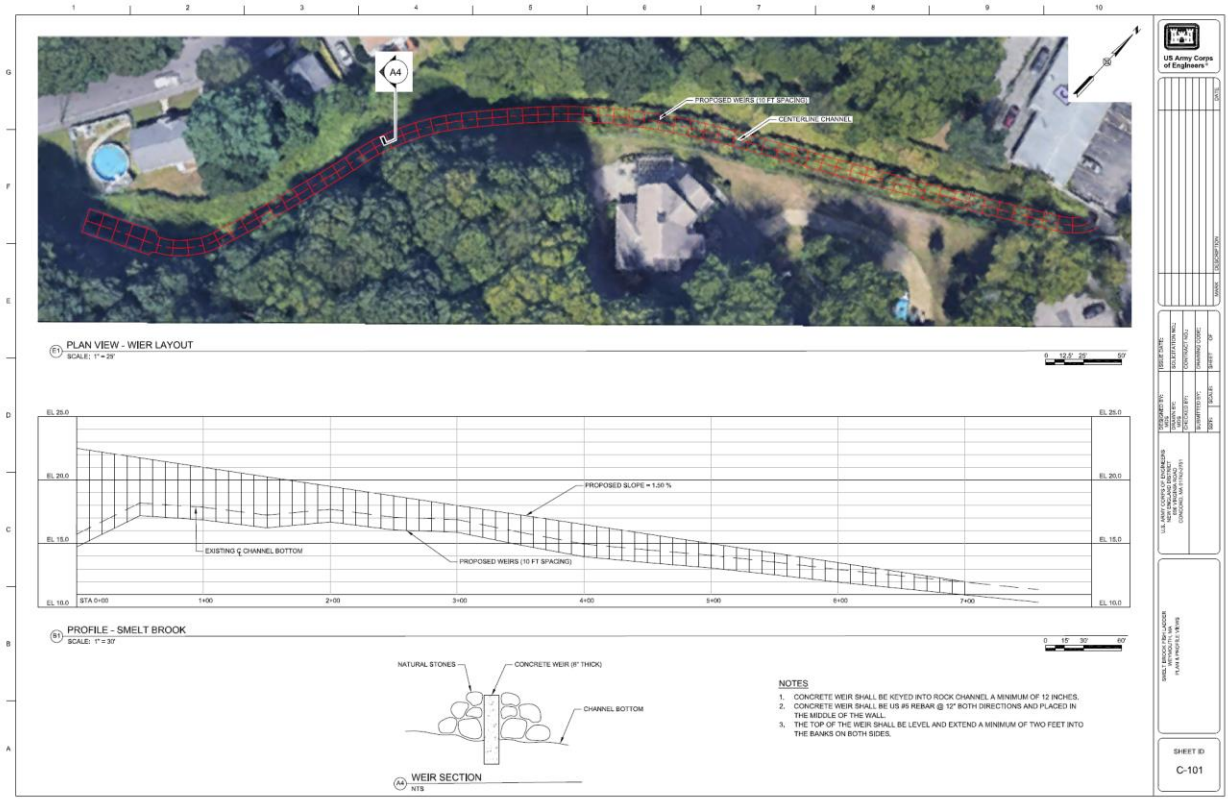

Figure 8-6: Alternative 5: Engineered Weirs at Intervals Along the 600-ft length of the River Reach

In free-flowing weirs, the weirs would comfortably pass 15 to 50 cfs without excessive depth over the weir. The smelt might find the central flow too rapid, but they would be able to move to the higher portions of the weir, making the flows feasible for migration under a wide range of

spring flow conditions. The concern is further alleviated in that the tailwater is more likely retained at a known acceptable level to maintain a stream profile (both elevation level and water surface level) of 3% or less. Given the potential for annual peak flows as high as 50 cfs, wider notches are suggested. As an example, assume notch widths of 2 or 3 feet each at elevations that rise progressively by 2-inch increments**.** As flow increases, the depth behind a weir increases. As the velocity over the weir becomes excessive, the increased depth leads to flow over the wider notches in the weir, so that the weir remains passable at the higher notch elevations. For even greater discharges, there is another notch elevation. A given weir might have three or four effective notches, supporting migration over a range of discharges (or potentially, for a range of stronger and weaker fish which might be of either different maturity levels or of different species).

The 3% grade would meet the current streambed level after 120 feet; 2% would do so in approximately 200 feet; 1.5% would reach the streambed at approximately 300 feet; the figure shown demonstrates that the 1% grade would reach the streambed at or possibly even after the next concrete structures (the intake to the split between the 8-ft flow and the grated overflow structures). The gentle multi-weired layout is a slight departure from the current landscape. Each pool between weirs is easily reached by migrating smelt. Although this is different than the 1% grade that is recommended, the figure demonstrates that the slightly greater slopes could accommodate the proposed layout without violating the 1/30 (3.33%) slope limitation that is recommended by the interagency guidelines for rainbow smelt (Turek et al., 2016).

The option of a steeper slope (3%) would pass more water, but flows would not reach the 600 cfs required flow without the water rising significantly higher than the 24 ft level at the first house. . Given the issues with control of the flow below the 24-ft level at the first house, and the diminished flow even using a 3% slope, the alternative has not been pursued as a feasible option.

8.3.8 Alternative 6: Keyhole Slot at Base of Existing Culvert

The perched culvert discharges several feet above the stilling basin floor. This option would reduce the drop at the culvert invert by excavating a sloped exit over an extended distance upstream of the invert, so that the energy is dissipated along a longer distance, both before and after the culvert exit. In this way the alternatives 1 and 2 (pools inside the stilling basin) need to dissipate less kinetic energy.

For each foot that the exit elevation is dropped, roughly a foot of kinetic head upstream of the exit must be dissipated; and the remaining energy needs to be dissipated downstream of the exit.

This is accomplished with a surface that is less smooth than the existing CMP finish (typically Manning n = 0.023; replacement would use a masonry/rock finish with a Manning roughness of about n ~ 0.04).

The alternative assumes the excavated channel would have its exit invert elevation at 20 ft , roughly midway between the current exit invert (22.5 ft) and the current floor of the stilling basin (taken as 18 ft NGVD). The excavated channel includes a 2-ft-wide base, and its sloped side-walls are 6 feet wide at the level of the culvert. The excavation invert rises to meet the culvert invert at a distance of 100 ft upstream of the current exit. The excavated channel has reinforced walls along its sides, with internal walls perpendicular to flow at even intervals.

In keeping with the previously adopted design procedure for "interruptions" at equal intervals of head difference, the 100 feet of excavation would have a lateral wall every 10 to 15 feet with a narrower notch for fish passage during periods of lower flow. This would define eight artificial pools in the excavated channel, leading to a less energetic exit velocity at the stilling basin. The basic layout is shown in Figure 8-7.

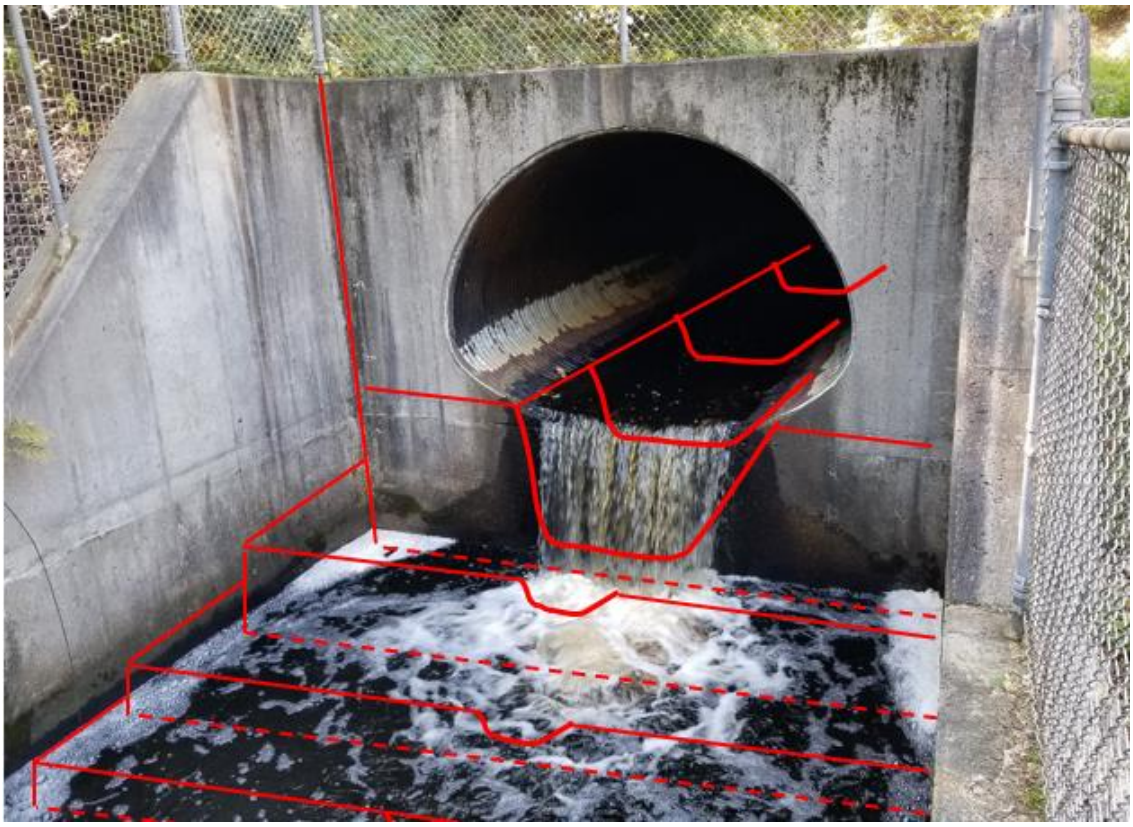

Figure 8-7: Alternative 6, View Shows the "Keyhole" Culvert exit

There would be a small number (3 to 6) of lower-level pools on the stilling basin, designed to ensure a smoother transition for fish from the elevation in their culvert-approach to their entrance into the culvert sections (to the first pool in the proposed keyhole).

A new designed culvert would be required to replace the removed part of the existing CMP culvert. The type and overall configuration of a new culvert could be precast concrete or some other material type, yet to be decided. The replacement culvert would be needed at least as far upstream as the point where the invert of the "keyhole" matches the invert of the existing culvert.

It is not clear that the need for the replacement culvert is obvious. Hydraulically, the capacity of the exposed channel would exceed the capacity of the closed-over channel. If the open "daylighted" section is extended upstream, then a new location should be chosen for the headwall shown in the figure, even if the current wall is retained.

The design capacity of 600 cfs would be maintained, but there are significant geotechnical concerns regarding erosion risks from construction of a new channel design.

Furthermore, the existing culvert is approaching its end of service life, although an April 2017 inspection reported a "minimally acceptable" or M condition with a suggestion to monitor corrosion and repair if necessary. The use of Federal funds to modify the culvert could be a violation of Federal law. Therefore this alternative was not carried forward due to both the geotechnical concerns regarding the design and because of the potential violation of Federal law with the replacement or modification of the culvert.

8.3.9 Key Findings from Initial Array of Alternatives

Evaluation of the initial array of alternatives considered the performance and environmental benefits of six distinct alternatives. Table 8-2 presents the complete list of alternatives evaluated during this iteration. Below are the key findings from this iteration of the alternatives analysis.

- Alternative 1, Fish Ladder Across Entire Stilling Basin achieved the fish passage requirements for rainbow smelt, as recommended by Turek, et al. (2016). While the objective of passing fish upstream to access additional reproductive spawning habitat is achieved, flow rates in the stilling basin in excess of 290 cfs would exceed the ability of the stilling basin to dissipate the hydraulic energy during high flow events and fail to meet the 600-cfs design criterion the stilling basin was intended to mitigate.

- Alternative 2, Fish Ladder Across One Side of Stilling Basin achieves fish passage criteria specified by Turek, et al. (2016) while also meeting the 600 cfs design criterion for the Flood Risk Management structure. This alternative avoids the constraints and meets the planning objectives.

- Alternatives 3 and 4, Nature Like Fishway Passage Channels, with Weirs and Switchbacks, avoids the constraints of the Flood Risk Management structure but does not achieve the planning objectives. The length of the channel is prohibitive for the passage of rainbow smelt, and these alternatives are not carried forward for this reason.

- Alternative 5, Engineered Weirs Along a 600-ft Reach avoids the constraints of the Flood Risk Management structure. However, the hydraulic conditions this alternative would create significantly increase the risk of flood damage to life and property downstream and is not carried forward for this reason.

- Alternative 6, Keyhole Slot at Base of Existing Culvert could result in unstable geotechnical conditions as a result of modifying the bedding substrate underneath the perched culvert to install a system of weirs. In addition to this concern, the culvert is in minimally acceptable condition. Any modifications to an existing structure identified as needing maintenance are a potential violation of congressional appropriations law.

The Analysis of the Initial Array of Alternatives identified a single alternative that could address the study objectives for fish passage of rainbow smelt and be constructed within the constraints of the congressionally authorized Local Protection Project. The goal of

this study was to identify a readily implementable project that would provide a long-term solution to restore aquatic environmental habitat in Smelt Brook LPP. Consequently, Alternative 2 is carried forward for additional development and consideration in the Focused Array of Alternatives.

8.4 Focused Array of Alternatives

8.4.1 Methodology

During the analysis of the initial array of alternatives, each alternative is evaluated to determine if it meets the project objectives and avoid the constraints before being carried forward for further consideration in the Focused Array of Alternatives. Since only one Alternative was carried forward, there is no additional comparative analysis possible and Alternative 2 - Fish Ladder Across Half the Stilling Basin, becomes the tentatively selected plan.

9. Environmental Consequences*

This section evaluates the environmental effects of the proposed project, or Alternative 2, and the no action alternative only. The other alternatives were not evaluated for their environmental impacts because they did not present solutions that were cost effective, environmentally practicable, constructable, or otherwise unlikely to meet fish passage needs of the rainbow smelt (i.e. did not pass screening considerations). The proposed action was determined to be the most cost effective, least environmentally damaging option to address the impedance to fish passage created by the Smelt Brook LPP. Analysis examines the potential direct and indirect effects of the proposed action to restore fish passage for rainbow smelt in Smelt Brook and discuss the temporary and permanent consequences of this action. *Direct effects* are caused by the action and occur at the same time and place, while *indirect effects* are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable (40 CFR Part 1508).

Tentatively Selected Plan

The alternative plan that is ultimately selected through step 6 of the iterative plan formulation process is considered the tentatively selected plan. To advance the tentatively selected plan to the recommended plan, it must be shared and discussed with the non-federal sponsor, and an agreement must be reached that the concept of the alternative is acceptable overall, achieves the desired outcome, and the cost-sharing requirements for the Tentatively Selected Plan fits within the allowable budget of the non-Federal sponsor. When the Tentatively Selected Plan meets these concerns, it becomes the recommended plan.

Recommended Alternative

The Recommended Alternative is the alternative tentatively selected for implementation based on the results of the Alternatives Analysis. This alternative is carried forward for an in-depth assessment of its environmental impacts as well as for a detailed cost estimate, before being identified as the final Recommended Plan.

Alternative 2 - Fish Ladder on One Side of Stilling Basin is the Tentatively Selected Plan

This alternative considers the construction of a fish ladder within the footprint of the existing stilling basin, along one side of the basin. It has a high degree of constructability and presents low risk to the flood risk management structures.

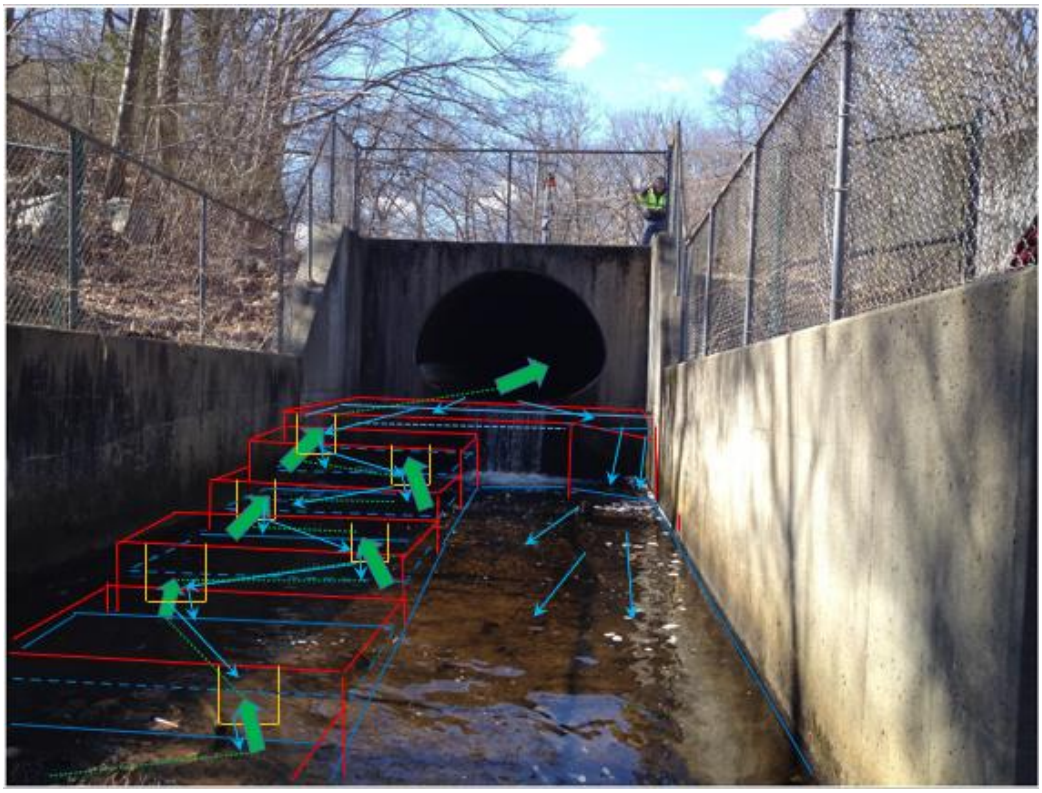

Figure 9-1: Alternative 2 - Fish Ladder on One Side of Stilling Basin, conceptual rendering. Fish passage illustrated in green, streamflow in blue.

The non-Federal sponsor is supportive of this concept. Not only will the design for Alternative 2 pass the species of interest upstream, but additional species may also be able to pass upstream. There are many features of this basic concept that can be refined and engineered to maximize its performance, and its potential to maximize environmental benefits (see Figure 9-1, above).

Construction Phase: Alternative 2 – Ladder on one side of stilling basin

The ladder would be constructed between July 1 and January 31 to avoid overlapping with migrating diadromous fish. Approximately 350 square feet of stream habitat, located within the stilling basin, will be displaced during the construction. This phase will take about two months to complete, with construction occurring during the time of year with the lowest flows (less than 3 cfs) with any significant streamflow being pumped through a bypass pipe around the culvert and stilling basin, which will mitigate for water quality impacts downstream. In addition, outstanding maintenance of the LPP, including removal of sediment accretions in the stilling basin, will occur prior to construction to mitigate for the effects of increased sediment and turbidity downstream of the construction area. These mitigation measures as well as implementation of best management practices will prevent contaminants (e.g., petroleum products) and waste from entering the stream during construction and will reduce the risk of indirect exposure to reduced water quality conditions, such as elevated turbidity levels or contaminants.

Operation Phase: Alternative 2 – Ladder on one side of stilling basin

Water quality conditions within the project area during the operation phase will be comparable to existing baseline water quality conditions. For example, the highest concentrations of suspended and dissolved solids as a consequence of effluents migrating through storm drains and urban tributaries into Smelt Brook. No additional storm drains or tributaries would be constructed or modified as part of this proposed action, and therefore, TSS and TDS levels for the FWOP and the recommended alternative to be similar.

In addition, the effectiveness of the existing flood control project would not be affected by installation of the proposed ladder on one side of the stilling basin once the walls are raised.

9.1 Physical Environment

No Action Alternative

Direct Effects: No construction would occur and therefore, temporary disturbances to stream sediments, water quality conditions, air quality, noise, recreation and scenic resources, and traffic would not occur. The LPP would remain unaffected and continue to function.

Indirect Effects: No construction would occur and therefore, the stilling basin would not be modified to include a ladder to improve fish passage. The physical environment would not be modified by any of the described features for the fish passage alternative and the Smelt Brook LPP would not be affected. The 8-foot culvert and stilling basin would remain an obstacle to fish migration upstream. The stilling basin is about 4,850 square feet (0.11 acres) and would remain intact and undisturbed. The LPP would continue to function as designed.

Proposed Action / Recommended Alternative

Direct Effects: Temporary disturbances to sediments within the stilling basin can be expected during project implementation. Best Management Practices would be incorporated into project planning to ensure that temporary disturbances to the stilling basin would not result in the release of sediments downstream or otherwise modify the existing stilling basin. Minor disturbances would not affect the functioning of the LPP and would have limited disturbance to water quality within the project area. Best management practices would be employed to maintain disturbed sediments to the project area and to control any accidental release of contaminants to the project area and therefore, water quality conditions beyond the project area would remain unaffected.

The project does not occur within known HTRW sites so HTRW would not be a consideration for project implementation. Project construction activities would be managed to abide by Commonwealth of Massachusetts regulations concerning Noise Control (310 CMR 7.10) and therefore would not be an issue during project construction activities. Therefore, the proposed action would have a minor effect with the permanent conversion of about 350 square feet of the basin.

Indirect Effects: The ladder placed on one side of the stilling basin would result in the permanent displacement of approximately 350 square feet of stilling basin. The fish passage structure would allow upstream migration through the LPP and would be physically placed on the eastern edge of the stilling basin. The LPP would continue to function as designed. The fish ladder would not alter the hydrology of the stilling basin since it would be placed along the edge, thus avoiding the main flow. Therefore, there would be no long-term adverse effects to hydrology, water quality, or air quality due to the proposed action.

Installation of the fish ladder would have a minor effect on air quality due to the emissions from construction equipment to assemble the fish ladder. Norfolk County, where the proposed project is located, is in attainment with the NAAQS for all criteria pollutants. As such, a general conformity review is not required. The project would have no long-term impacts on air quality. During construction, equipment operating on the site will temporarily increase localized emissions only during the proposed action's construction period. A Record of Non-Applicability is provided in Appendix A5.

9.2 Biological Resources

No Action Alternative

Direct Effects: The No Action Alternative would have no temporary, direct effects to aquatic plants, fish and wildlife within the project area.

Indirect Effects: Under the No Action Alternative, no construction would occur, and the upstream migration of rainbow smelt and other species would remain limited to the stilling basin area, from the metal gate to the 8-foot culvert and stilling basin. The stilling basin area, about 4,850 square feet (0.11 acres) area, affords a modest amount of reproductive habitat for rainbow smelt. The limited amount of habitat that is afforded to fish and wildlife resources in the stilling basin would remain undisturbed and a change in species behavior or habitat is not anticipated.

Proposed Action/Recommended Alternative

Direct Effects: The proposed action would result in the permanent displacement of approximately 350 square feet of stilling basin. Aquatic plants that exist within the stilling basin would be permanently displaced. There are no federally listed species under the jurisdiction of the National Marine Fisheries Service (NMFS) within the project area. The project will have no effect upon federally listed species or designated critical habitat under the jurisdiction of NMFS in accordance with Section 7 of the Endangered Species Act. This concludes USACE's Section 7 consultation responsibilities under the ESA with NMFS.

On February 8, 2021, USACE received the Service's Verification Letter, indicating that the Smelt Brook 1135 study is consistent with activities analyzed in the January 5, 2016, Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-eared Bat and Activities excepted from Take Prohibitions. Therefore, USACE has complied with Section 7 consultation responsibilities in accordance with the ESA for species and critical habitat under the jurisdiction of the U.S. Fish and Wildlife Service. This concludes USACE's Section 7 consultation responsibilities under the ESA with USFWS.

No adverse effects to Essential Fish Habitat will occur since the project would be undertaken exclusively in freshwater habitat. Project construction would occur during the window of July 1 to January 31, to avoid effects to rainbow smelt during the March through May migration period. Construction will occur during the time of year when flows are the lowest with any significant streamflow being pumped through a bypass pipe around the culvert and stilling basin to prevent sediments from moving downstream and impacting plants, fish, and wildlife.

There may be temporary impacts to benthic macroinvertebrates if there is an increase in turbidity of the water as a result of construction. Since the most common families of macroinvertebrates

that may occur in the project area, non-biting midges and net-spinning caddisflies, are moderately tolerant of pollution, the impacts to the macroinvertebrate community should be insignificant and temporary.

The freshwater aquatic plants observed within project area, such as common bladderwort, hydrilla, and waterweed, will be directly impacted if they occur within the 0.11 acres of the stilling basin due to the removal of sediment that has accreted within the area prior to construction. Aquatic plants that occur outside of the stilling basin may be temporarily impacted if there are increases in turbidity as a result of the construction but due to the timing of the construction window being outside of the growing season.

Fish and wildlife upstream of the CMP and in Pond Meadow Park may be temporarily impacted by the disturbance of the construction activities that will occur within the stilling basin. The noise of equipment and any foraging habitat that had been present within the construction and staging areas will discourage animals such as frogs, toads, turtles, small mammals, migratory birds, and deer from using the area while the work is occurring but should return as soon as the project is complete.

The riparian habitat both upstream and downstream of the CMP and stilling basin, as well as the habitats within Pond Meadow Park will not be impacted as the work will only occur within the stilling basin. No vegetation, riverbanks, or wetlands will be directly impacted at the time of construction.

Indirect Effects: Alternative 2 would result in passing rainbow smelt and other diadromous fish upstream of the existing stilling basin and CMP to stream habitat between the CMP and dam at Pond Meadow Park. The area of stream habitat between the CMP and dam is about 27,900 square feet or 0.64 acres. Rainbow smelt would make use of most of this area for reproductive purposes. Adults would make use of the 0.64-acre stream habitat for spawning eggs. Likewise, fertilized eggs would occupy the benthic stream habitat for a period of up to 21 days and undergo development to the larval stage. After hatching, larvae are transported downstream to estuarine waters and commence forage activities and growth. As a result of the project, the rainbow smelt population in Smelt Brook will increase with passage to more spawning habitat. Therefore, there would be positive, indirect impacts to fish and marine communities with increased numbers of rainbow smelt and other anadromous fish migrating to the ocean and contributing to ecosystem functions.

9.3 Socioeconomic Resources

<u>No Action Alternative</u>

Under the No Action Alternative, no construction would occur and the LPP would continue to function and provide flood control relief to the Braintree and Weymouth communities.

Proposed Action/Recommended Alternative

The project will restore fish passage for rainbow smelt and other diadromous fish passage and spawning in the USACE Flood Control project at Smelt Brook, thus maintaining flood control features while also restoring fish passage at Smelt Brook. Children from low-income or minority groups within or near the project area would not be disproportionately adversely affected. The project will have positive long-term effects on the surrounding community.

The project is not expected to provide unequal treatment of minority or economically disadvantaged populations, nor is it anticipated to diminish recreational activities within the Pond Meadow Park area. The project will provide temporary jobs, and this provides a temporary economic benefit to the community.

9.4 Cultural Resources

No Action Alternative

Without the proposed action, cultural and historic resources within the Smelt Brook area would maintain their status and condition if the normal maintenance and upkeep of historic buildings within the historic districts continues. However, since there are no existing historic properties within the Smelt Brook LPP site area due to previous site disturbances and construction, there would be no effect to cultural resources as a result of the "future without project."

Proposed Action/Recommended Alternative

Impacts to cultural and historic resources for the Smelt Brook project are not anticipated due to previous construction of the LPP and nearby urban development. The identified historic districts (Commercial Street, Front Street, and Weymouth Landing) and historic properties are all located outside of the area of potential, and any changes to the configuration of the LPP (culvert modifications, fish ladders, and weir structures within the stilling basin) will not impact the characteristics that contribute to the significance of these Historic Districts. Impacts to archaeological resources are not anticipated due to the heavily disturbed nature of the project area.

The proposed modifications to the Smelt Brook LPP will have no effect upon any historic, architectural, or archaeological properties in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and implementing regulations 36 CFR 800. The

Massachusetts State Historic Preservation Officer, in a letter dated May 18, 2023 has concurred with this determination.

In addition to the SHPO, the MA BUAR and the three Tribes (Mashpee Wampanoag Tribe, Wampanoag Tribe of Gay Head (Aquinnah), and Narragansett Tribe have been consulted on this project and the determination of no effect. MA BUAR was provided a letter on April 17, 2023, requesting their concurrence; USACE did not receive a reply. Letters were also sent to each Tribe on April 17, 2023, with the project description and a request for concurrence with our determination of effect and any comments they wish to provide. USACE has received no Tribal responses to date. As it has been more than 30 days, we can assume their concurrence.

9.5 Climate

No Action Alternative

Without the proposed action, there would be no effect on climate. Warmer, shorter winter conditions, increased groundwater pumping in the basin, and sea level rise are likely to occur in the future but these conditions are not likely to significantly impact rainbow smelt populations or their access to Smelt Brook without the proposed action as they would not be able to access the upper reaches of Smelt Brook for spawning.

Proposed Action/Recommended Alternative

Impacts from the construction of the fish ladder will not adversely impact climate. The climate change conditions listed above may impact the ability of rainbow smelt to reach the suitable habitat provided by the fish ladder described in the recommended plan. Changes to the water levels and flows in Smelt Brook from increased groundwater pumping, and warmer winters may impact the ability of the rainbow smelt to use the fish ladder and access the habitat upstream of the stilling basin. The impacts of climate change and their effects on the project area are further described in Section 6 (or in Appendix A2).

9.6 Cumulative Impacts

Cumulative effects are defined in 40 CFR 1508 as effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes

such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

The effects of future activities in the action area that may reasonably occur are continuation of a stream and riparian habitat modification as the project area and LPP are surrounded by residential and commercial structures. In addition, there may be more stream crossings constructed to accommodate increased population. This may result in disturbance of sediments due to road construction-related actions, and residential structure development, contaminant releases into Smelt Brook from largely non-point sources (e.g., runoff from roads, parking lots and residential structures).

Water quality conditions for aquatic systems throughout the Smelt Brook watershed may degrade when sediments are mobilized, and riparian habitats erode due to increased road crossing construction. Sediment accumulation over the cobble habitat, may impact the ease with which rainbow smelt eggs can attach to the substrate. Continued compliance with operation and maintenance requirements of the LPP will minimize these impacts to the watershed.
Without the proposed project, rainbow smelt spawning capacity would be limited to the small area inside the stilling basin, below the stilling basin and gate, and maximum spawning capacity would remain underutilized.

9.7 Measures Taken to Minimize Environmental Impacts

The following actions will be instituted to minimize potential adverse impacts from the proposed project.

1. Project construction activities will be scheduled to occur for a two-month period from July 1 to January 31 to avoid the upstream/downstream migration period (February to May) of rainbow smelt through Smelt Brook.

2. Project construction activities will be scheduled to occur during the time of year when streamflow is at its lowest (less than 3 cfs) to mitigate impacts of sediment transport downstream of the project area. An auto-pump connected to bypass pipe will pump water around the CMP and stilling basin when flow exceeds 3 cfs.

3. Best management practices will be employed to ensure that contaminants (e.g., petroleum products) are not introduced to the aquatic habitat system at Smelt Brook to avoid the risk of exposure to fish and wildlife resources.

10. Coordination & Compliance with Environmental Requirements*

10.1 Introduction

This section summarizes the project's compliance with applicable Federal laws, regulations, Executive Orders, and Executive Memorandum. In addition to compliance with NEPA, USACE must ensure that projects completed under Continuing Authorities comply with all applicable Federal laws. For example, compliance with the Endangered Species Act, the Fish and Wildlife Coordination Act, the National Historic Preservation Act, the Clean Water Act, etc., is always mandatory for Federal actions.

10.2 National Environmental Policy Act Requirements*

This Detailed Project Report (DPR) and integrated Environmental Assessment (EA) was prepared in compliance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality's (CEQ) NEPA Regulations, and USACE's Procedures for Implementing NEPA (33 CFR part 230). The sections of this report that are specifically to fulfill the requirements of NEPA are annotated with an asterisk (*) in the headings.

NEPA requires that Federal agencies integrate the environmental review of their proposed actions into their planning and decision-making process. This combined DPR/EA is consistent with the NEPA statutory requirements and is reflective of an integrated planning process.

10.3 Permits, Approvals, and Regulatory Requirements*

Major environmental permits and reviews (Federal and state) for the project as well as agencies consulted are outlined in Table 10-1, below. Section 10.6 of this report, *Compliance Summary*, summarizes the project's compliance with applicable Federal laws, regulations, Executive Orders, and Executive Memoranda (See Table 10-2).

Table 10-1: Environmental permitting laws and compliance requirements

Major Environmental Permits and Reviews for the Smelt Brook Environmental Restoration Project	
Agency	***Permit/Review***
Federal	
U.S. Department of the Army Corps of Engineers	Clean Water Act Section 404(b)(1) Evaluation
U.S. Department of the Interior Fish and Wildlife Service	Endangered Species Act Section 7 Consultation, Fish and Wildlife Coordination Act

Major Environmental Permits and Reviews for the Smelt Brook Environmental Restoration Project	
Agency	***Permit/Review***
U.S. Department of Commerce National Marine Fisheries Service	Essential Fish Habitat Consultation - Magnuson-Stevens Fishery Act (MSFCMA), Endangered Species Act Section 7 Consultation, and Fish and Wildlife Coordination Act
U.S. Environmental Protection Agency	Clean Air Act Compliance Evaluation, and NEPA Compliance Evaluation
Commonwealth of Massachusetts	
Dept. of Environmental Protection Division of Waterways and Wetlands Division of Marine Fisheries	Clean Water Act Section 401 Water Quality Certificate Fish and Wildlife Coordination
Massachusetts Coastal Zone Management Program	Coastal Zone Management Consistency Determination
Historic Preservation Commission and State Historic Preservation Office	Review/Comments on construction activities affecting cultural resources (Section 106, NHPA)

10.4 Public Involvement

There will be a 30-day public notice for the public comment period of the Draft DPR/EA. The following list indicates the Federal, State, and local governments that were contacted for comment and coordination. Appendix A contains all correspondence that occurred during preparation of this DPR/EA.

Federal agencies:
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
National Marine Fisheries Service

State agencies:
Massachusetts Department of Environmental Protection
Massachusetts Division of Marine Fisheries
Massachusetts Office of Coastal Zone Management
Massachusetts Historical Commission

Local agencies:
Town of Weymouth
Town of Braintree
Weymouth Braintree Regional Recreation Conservation District

Tribes:

Mashpee Wampanoag
Wampanoag Tribe of Gay Head (Aquinnah)
Narragansett

10.5 Summary of Public and Agency Comments

A number of public concerns were identified during the course of the study. Input was received through coordination and meetings with the sponsor, agencies and the public. Agencies and the public were invited to review and comment on draft and interim products. The evaluation of public concerns reflects a range of needs perceived by the public.

On February 10, 2021, the New England District hosted a meeting with the Massachusetts Division of Marine Fisheries, National Marine Fisheries Service's Habitat Division and Protected Resources Division, and the U.S. Fish and Wildlife Service, Ecological Services Division to share an overview of the CAP 1135 project to restore passage for rainbow smelt to spawning habitat in Smelt Brook. USACE delivered a presentation to participants that described the project purpose to allow passage for fish above the 8-foot culvert.

On January 27, 2021, USACE requested the U.S. Fish and Wildlife Service (USFWS) prepare a Planning Aid Letter (PAL), in accordance with the Fish and Wildlife Coordination Act, and provide conservation recommendations and best management practices that would conserve fish and wildlife resources under the USFWS's jurisdiction. USACE transmitted a similar request to the National Marine Fisheries Service for the purpose of understanding concerns for resources under NMFS's jurisdiction. Both agencies replied that they agreed with no effects determinations.

Public concerns focus on degradation of habitat, poor water and sediment quality and loss of diadromous fish. Urbanization has contributed to the deterioration in each of these categories:

- Direct alteration of habitat occurred through filling wetlands, streams and riparian areas for development.
- Development has increased impervious surface area and reduced the land's ability to infiltrate stormwater and attenuate pollutants.
- Development impacted watershed hydrology by reducing baseflow and increasing peak storm flows and caused loss of habitat, erosion and poor water quality.
- Historic pollutant discharge to the river contributed to water and sediment quality impairments.
- Dams, culverts and other manmade structures resulted in barriers to fish migration.

10.6 Compliance Summary

Table 10-2. Summary of Federal Laws and Regulations

Item	Citation	Compliance
Federal Statutes		
Archaeological Resources Protection Act of 1979	16 U.S.C. 470aa et seq.	Not applicable to this project.
American Indian Religious Freedom Act of 1978	42 U.S.C. 1996	This project will not impede access by Native Americans to sacred sites, possession of sacred objects, and the freedom to worship through ceremonials and traditional rites.
Bald and Golden Eagle Protection Act	16 U.S.C. 668 et seq.	No bald or golden eagles will be impacted by the proposed project.
Clean Air Act	42 U.S.C. §§ 7401 et seq.	The project area is in attainment for all criteria pollutants.
Clean Water Act	33 U.S.C. 1251 et seq.	A Clean Water Act, Section 401 Water Quality Certificate will be sought from the MADEP during the design phase of the project. A Clean Water Act Section 404(b)(1) evaluation is attached to the end of this report.
Coastal Barrier Resources Act	16 U.S.C. 3501 et seq.	No Coastal Barrier Resources Act Units exist within the project area.
Coastal Zone Management Act	16 U.S.C. §§ 1451-1464 CT Gen Stat § 22a-90 Chapter 444, as amended	A CZM concurrence will be sought from the Massachusetts Office of Coastal Zone Management during the design phase of the project.
Endangered Species Act of 1973	16 U.S.C. 1531 et seq.	Coordination with the USFWS and NMFS is complete. A no effects determination would made for USFWS species so formal consultation requirements pursuant to Section 7 of the Endanger Species Act were not required. No threatened or endangered species under jurisdiction of NMFS are designated in the project area.
Estuarine Areas Act	16 U.S.C. 1221 et seq.	Applicable only if report is being submitted to Congress.
Federal Water Project Recreation Act	16 U.S.C. 460l-12 et seq.	Public notice of availability to the project report to the National Park Service (NPS) and Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.
Fish and Wildlife Coordination Act	16 U.S.C. 661 et seq.	The project has been coordinated with the USFWS, NMFS, and State fish and wildlife agencies.

Land and Water Conservation Fund Act of 1965	54 U.S.C. 200301 et seq.	Public notice of the availability of this report to the National Park Service (NPS) and the Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.
Magnuson-Stevens Act Fishery Conservation and Management Act	16 U.S.C. 1855(b)(2)	There is no designated Essential Fish Habitat for the reach of Smelt Brook that is constrained to the project area, between the flood gate and the stilling basin.
Marine Mammal Protection Act of 1972	16 U.S.C. 1361-1407.	Not applicable.
Marine Protection, Research, and Sanctuaries Act of 1972	33 U.S.C. 1401 et seq.	Not applicable.
Migratory Bird Treaty Act	16 U.S.C. 703-712 et seq.	Migratory birds will not be adversely impacted by the proposed project.
National Environmental Policy Act of 1969	42 U.S.C. 432 et seq.	Signature of the Finding of No Significant Impact (FONSI) will fulfill the requirement of this act. A FONSI is located at the beginning of the report.
National Historic Preservation Act of 1966	16 U.S.C. 470 et seq.	This project has been coordinated with the Massachusetts State Historic Preservation Officer, and the Wampanoag Tribe of Gay Head (Aquinnah), Mashpee Wampanoag, and Narragansett Tribal Historic Preservation Officers. SHPO concurrence indicates compliance.
Native American Graves Protection & Repatriation Act	25 U.S.C. 3001-3013, 18 U.S.C. 1170	Not applicable to this project.
Preservation of Historic and Archeological Data Act of 1974	54 U.S.C. 312501 et seq.	No historical or archaeological data will be irrevocably lost or destroyed by the project.
Rivers and Harbors Act of 1899	33 U.S.C. 401 et seq.	No requirements for projects or programs authorized by Congress. The proposed aquatic ecosystem restoration project is being conducted pursuant to the Congressionally-approved authority.
Watershed Protection and Flood Prevention Act	16 U.S.C 1001 et seq.	Floodplain impacts must be considered in project planning. No floodplain impacts will occur.
Wild and Scenic Rivers Act	16 U.S.C. 1271 et seq.	Not applicable.
Executive Orders		

Protection and Enhancement of the Cultural Environment, 13 May 1971	EO 11593	Coordination with the State Historic Preservation Officer signifies compliance.
Floodplain Management, 24 May 1977	EO 11988 and amendments	The project is not within the base floodplain.
Protection of Wetlands, 24 May 1977	EO 11990	Circulation of this report for public and agency review fulfills the requirements of this order.
Environmental Effects Abroad of Major Federal Actions, 4 January 1979	EO 12114	Not applicable.
Environmental Justice, 11 February 1994	EO 12898	The project is not expected to have a significant impact on minority or low-income population, or any other population in the United States.
Accommodation of Sacred Sites, 24 May 1996	EO 13007	Access to and ceremonial use of Indian sacred sites by Indian religious practitioners will be allowed and accommodated. No adverse effects to the physical integrity of such sacred sites will occur.
Protection of Children from Environmental Health Risks and Safety Risks. 21 April, 1997	EO 13045	The project will not create a disproportionate environmental health or safety risk for children.
Federal Support of Community Efforts Along American Heritage Rivers	EO 13061, and Amendments	The project is not located along an American Heritage River.
Federal Agencies may not authorize, fund, or carry out actions likely to cause or promote the introduction or spread of invasive species	EO 13112	The project will not promote or cause the introduction or spread of invasive species.
Consultation and Coordination with Indian Tribal Governments, 6 November 2000	EO 13175	Consultation with Indian Tribal Governments, where applicable, and consistent with executive memoranda, DOD Indian policy, and USACE Tribal Policy Principles signifies compliance.
Executive Memorandum		
Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing NEPA, 11 August 1980		Not applicable; the project does not involve or impact agricultural lands.
White House Memorandum, Government-to-Government Relations with Indian Tribes, 29 April 1994.		Consultation with federally recognized Indian Tribes signifies compliance.

11. Recommended Plan

11.1 Recommended Plan*

Alternative 2 (see figure 11-1) was identified in the alternatives analysis as the only alternative that achieves the project objectives and avoids the project constraints.

Project First Cost Estimates indicate this alternative can be constructed for under $1,020,000. An environmental assessment concluded that Alternative 2 will not have any significant adverse impacts to environmental, cultural, or historic resources. As a result of those findings, Alternative 2 was determined to be the Recommended Plan. It includes the one-time construction of a series of pools and weirs, to be designed for placement within the original stilling basin flood control structure. The walls of the pools and weirs are intended to be formed with concrete approximately one foot thick and anchored within the existing stilling basin.

It should be noted that although the recommended plan currently calls for pools and weirs to be limited to one side of the stilling basin, this could change in order to maximize the attractiveness of the fish passage structure during the final design stage. Flexibility in the design of the structure may be necessary to achieve constructability that meets the needs for adaptive changes to facilitate passage of target species.

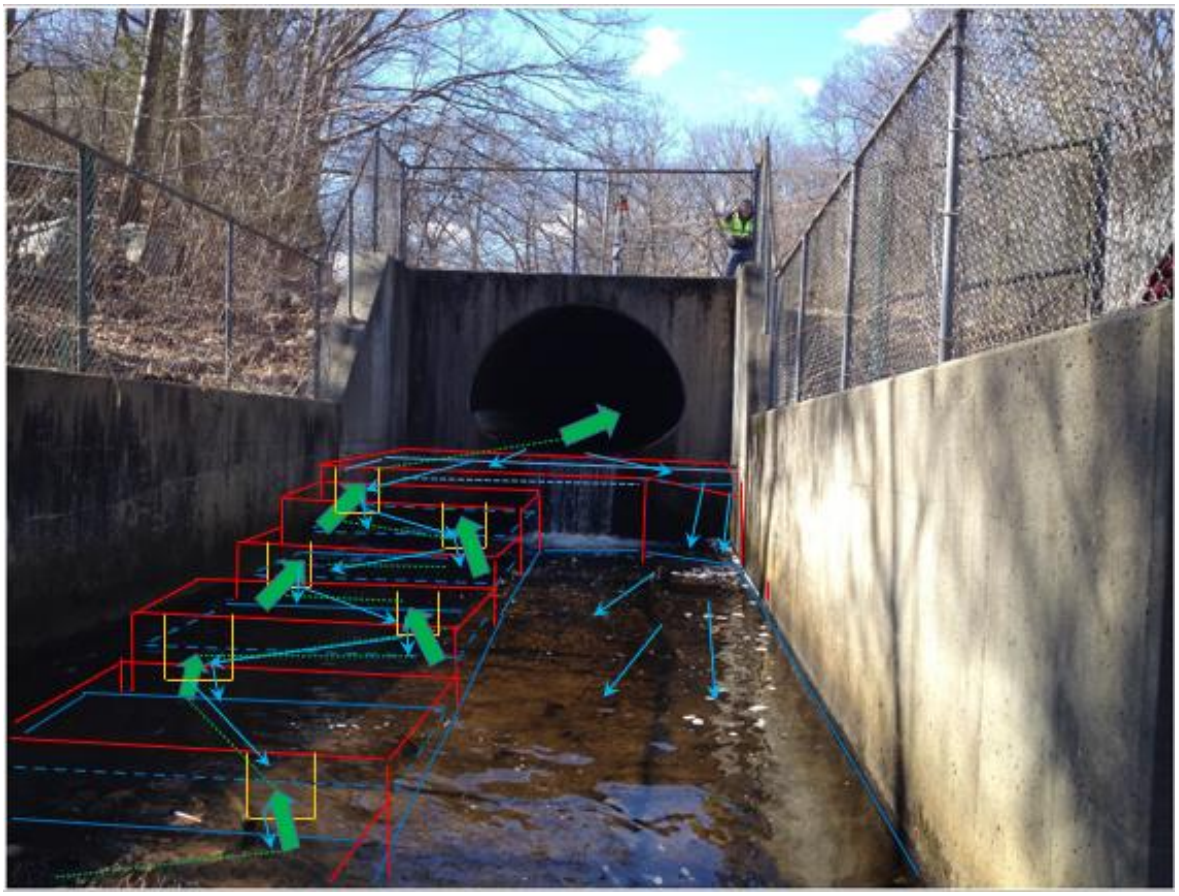

Figure 11-1: Alternative 2 - Fish Ladder on One Side of Stilling Basin, conceptual rendering. Fish passage illustrated in green, streamflow in blue.

11.2 Detailed Cost Estimate for the Recommended Plan

After Alternative 2 was identified as the Recommended Plan, USACE prepared a refined and more detailed cost estimate. This cost estimate presents a Total Project Cost (construction and non-construction costs) for the Recommended Plan at the current price level to be used for project justification/authorization and to project costs forward in time for budgeting purposes. Alternative 2 has a Project First Cost of $1,020,000, as shown in Table 11-1. The total project cost includes the fully funded cost and all costs associated with the feasibility study. The feasibility study cost is estimated to cost $452,000. Therefore, the estimated total project cost of the Recommended Plan is **$1,529,000**. A more detailed explanation of this process and a complete breakdown of the cost estimate can be found in Appendix D.

Table 11-1: Cost Estimate for the Tentatively Selected Plan; Alternative 2

CWBS	Feature Account	Estimated Cost	Project First Cost	Fully Funded Cost
Construction				
06	Alternative 2 - Fish Ladder One Side of Stilling Basin	$ 565,000	$ 581,000	$ 620,000
	Construction Subtotal	**$ 565,000**	**$ 581,000**	**$ 620,000**
Non-Construction				
01	Lands and Damages	$ -	$ -	$ -
30	Planning, Engineering & Design	$ 347,000	$ 356,000	$ 370,000
31	Construction Management	$ 81,000	$ 83,000	$ 87,000
	Non-Construction Subtotal	**$ 428,000**	**$ 439,000**	**$ 457,000**
	Total	$ 993,000	$ 1,020,000	$ 1,077,000

Costs estimated using FY2023 rates.

11.3 Cost Sharing and Non-Federal Sponsor Responsibilities

The costs of implementing a project under Section 1135 of the CAP program must be shared with the Non-Federal Sponsor in the proportion specified in Water Resources Development Act of 2018, as amended. In this case, the cost sharing responsibilities of implementing the Recommended Plan will be 75% Federal and 25% non-Federal, so long as the project does not exceed the $10 million per project Federal cost limit under Section 1135 authority. If the Federal share of the project were to exceed $10 million, then the non-Federal sponsor would be responsible for any additional costs. The cost limit includes the Federal cost of studies, design, implementation, and any future modifications to the Smelt Brook LPP that may be authorized under the Section 1135 Program.

Additional costs that may arise as a result of monitoring and adaptive management to ensure the project success will be the responsibility of the non-Federal sponsor.

11.4 Design and Construction Considerations

The recommended plan was developed to an initial level of detail commensurate with determining whether a project can be implemented within the constraints of the study authority. More detailed plans and specifications for construction will be developed during the design and implementation phase.

The Smelt Brook LPP is geographically located in both the Town of Braintree and the Town of Weymouth, and the towns jointly established the Weymouth Braintree Regional Recreation Conservation District with the express purpose to administer the Operations and Maintenance requirements incumbent on each town as a condition of the congressionally authorized LPP.

Outstanding operation and maintenance requirements that have not been performed must be completed prior to executing a cost share agreement for final design and construction. Specifically, the Non-Federal Sponsor must ensure that sediment accretions within the stilling basin are removed and that the structure is free of debris and sediment prior to implementation of the Recommended Plan.

The non-federal sponsor will need to provide authorization for entry for construction and any incidental real estate requirements for the project as noted below in section 11.5. The non-Federal sponsor will also need to secure any state or local permits required.

Modifications to the existing flood control structure will require the creation of an addendum to the existing Smelt Brook LPP Operation and Maintenance Manual to account for any additional operation, maintenance, repair, rehabilitation or replacement needs attributed to the new design features of the modification. It should be noted that preliminary estimation of flows may be high and field verification may be required to update calculations. Once the fishway design is finalized, this O&M addendum may include information and procedures on:

1. Periods of operation and target conditions during the fish passage season.
2. Defined discharge conditions that would trigger performance issues for the fishway.
3. Routine inspection and maintenance of:
    a. Fishway weirs and pools
    b. LPP structures
    c. Flow velocity at weir openings
4. Monitoring for passage during fish migration seasons
5. Recommended actions after major flood events
6. Recommend thresholds to define substantial or hydraulic failures at the fishway.
7. Repair guidelines for structural or hydraulic deviations from the original design.

The Non-Federal Sponsor is aware of the responsibilities incumbent upon them and understands that adaptive management plan has been developed during the feasibility phase and will be implemented post-construction. The intent of this plan is to maximize expected project benefits for ecosystem restoration. This may include adopting new procedures designated by USACE as needed to address unforeseeable circumstances to mitigate any potential deteriorations, degradations or any other undesirable effects or outcomes attributable to the modification.

11.5 Real Estate Requirements

The recommended plan includes the construction of a series of pools and weirs for fish passage within the footprint of the existing Smelt Brook LPP. To execute this project effectively, a Temporary Work Area Easement (TWAE) will be required from the town of Braintree on a parcel adjacent to the LPP to provide for temporary construction access, staging, and laydown for an area of 1,700 square feet. An additional 2,600 square feet of temporary access, staging, and laydown will be required from the permanent easement area. The TWAE real estate interests amount to 10,650 square feet and can be seen in Figure 11-1 below.

The modifications to the existing USACE project require that authorization for entry for construction is provided. All work performed will be within the real estate rights established in the existing permanent easements that were acquired by the towns of Braintree and Weymouth in 1976. These permanent easements were taken under town vote in order to provide the necessary real estate interests to establish the congressionally authorized Smelt Brook Local Protection Project and have sufficient title and interest necessary to authorize access for construction to proceed with proposed project modifications.

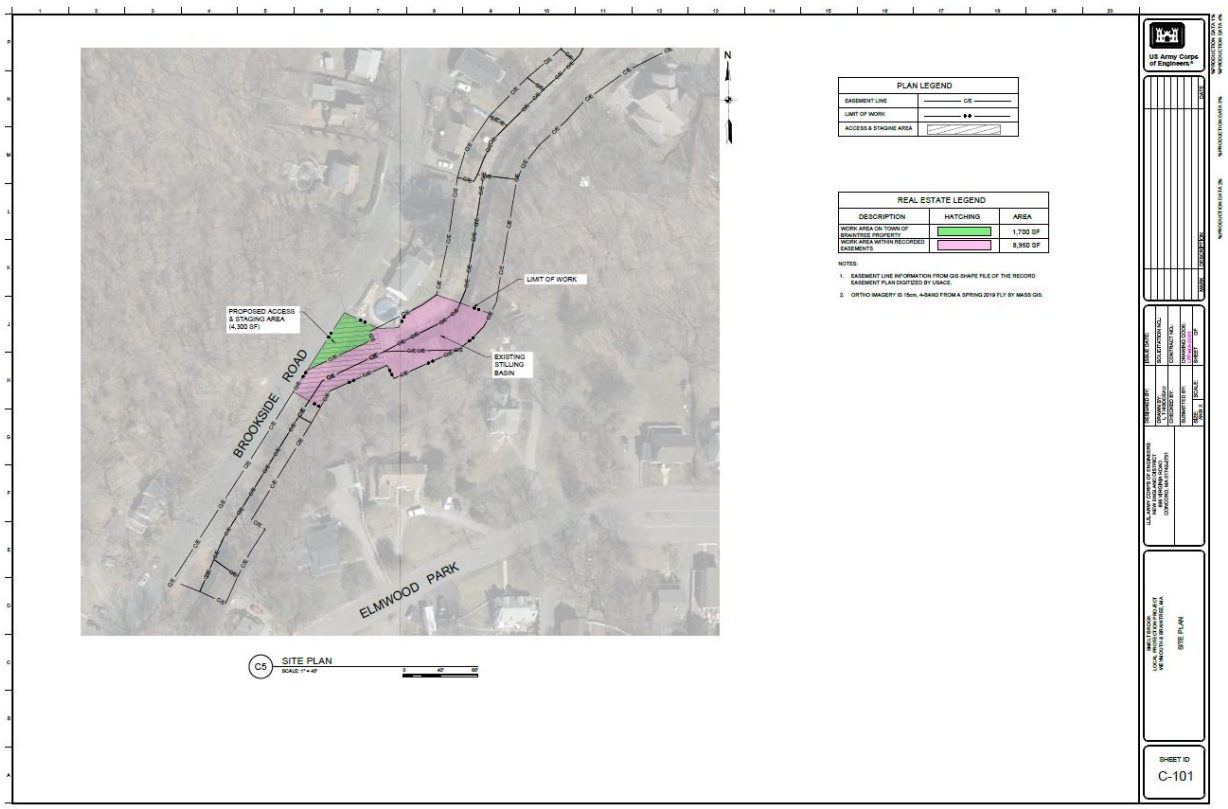

Figure 11-1: Real Estate Requirements

The project will be 75% federally funded with a 25% cost share from the Non-Federal Sponsor, per Section 1135 policy requirements. The Non-Federal Sponsor will be responsible for obtaining and certifying acquisition of all Lands, Easements, and Rights of Way, Relocations, and Disposal Areas (LERRDs) required for the construction of the project.

12. Monitoring and Adaptive Management

A monitoring plan is required following guidance from ER 1105-2-100 and is an important tool to help establish post-construction success of an ecosystem restoration project. Monitoring provides data to compare conditions before and after construction, and gauges the success of the project and achievement of the project objectives.

Adaptive management is a science and performance based approach to ecosystem management in situations where predicted outcomes have a high level of uncertainty. Adaptive management advances desired goals by reducing uncertainty, incorporating robustness into project design, and incorporating new information about ecosystem interactions and processes as our understanding of these relationships is augmented and refined. After initial construction activities are complete, adaptive management and monitoring are necessary to address uncertainties and ensure project success. The Monitoring and Adaptive Management Plan is in Appendix A4.

12.1 Monitoring Plan

USACE will prepare a detailed monitoring plan to evaluate the modification of the LPP to meet the project objectives. The plan will describe where monitoring will occur, who will perform the monitoring and their required competencies, when and how frequent monitoring will occur and how the results will be documented and reported. At a minimum, monitoring may include:

- Water depth, velocity, and chemistry
- Erosion and flooding observation surveys
- Fish migration and spawning observation surveys

Specific adaptive management activities will depend on the problems encountered. As previously mentioned, they can range from a very costly design deficiency from modifying the structure to less costly adjustments required like removing a small unforeseen obstruction to fish passage. Potential management actions will be proposed as part of the monitoring and adaptive management plan.

12.2 Adaptive Management

The purpose of adaptive management is to make changes to the project after construction to better achieve the project objectives. The adaptive management plan assumes potential minor project adjustments, in accordance with the small scale of the project. The nature and cost of potential adjustment measures assumes activities such as removing accumulated debris or sediment from fish passageways, constructing additional pools, or altering pool elevations and lengths.

These costs will be further defined in the Design and Implementation phase. USACE, in consultation with the sponsor, Federal and state agencies, will determine any adaptive management that may be needed. Adaptive management would need concurrence from the sponsor and would be cost shared with the sponsor. Monitoring and adaptive management are not the same as inspections or operation and maintenance for which the sponsor would be responsible even during the monitoring period.

12.3 Project Success Criteria

The successful restoration project would result in the achieving the following criteria:

- Successful upstream and downstream passage by rainbow smelt at the culvert and stilling basin.
    - Observations of the movement of fish through the fishway during spawning migration. Improvement of diadromous fish populations over time in the Smelt Brook and Fore River Watersheds may be an indication of passage success of this restoration.
- Rainbow smelt utilize habitats upstream of the perched culvert and stilling basin for spawning.
    - Fish eggs are observed and counted upstream of the perched culvert and stilling basin.
- The fishway maintains the biological design characteristics of the target species.
    - Water velocity through the fishway will be measured during certain seasonal timeframes to ensure adequate flow through the fishway for the target species.
- The modification does not alter the ability to fulfill the authorized project purposes.
    - USACE will continue to inspect perched culvert and fishway on a recuring basis to identify structural or maintenance concerns. The fishway will be

maintained according to the amendment to the O&M manual developed for the project.

13. Recommendations

In making the following recommendations, I have given consideration to all significant aspects in the overall public interest, including environmental, social and economic effects, engineering feasibility and compatibility of the project with the policies, desires and capabilities of the towns of Weymouth and Braintree and other non-Federal interests.

I recommend the aquatic ecosystem restoration project of constructing a fish ladder on one side of the stilling basin in Smelt Brook Local Protection Project, as fully detailed in this Integrated Detailed Project Report and Environmental Assessment, be authorized for construction as a Federal project, subject to such modifications as may be prescribed by the Division Engineer for the North Atlantic Division.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of highest review levels within the North Atlantic Division. Consequently, the recommendations may be modified (by the Division Engineer) before they are authorized for implementation. The towns of Weymouth and Braintree, the Weymouth Braintree Regional Recreation Conservation District, interested Federal agencies, and other parties will be advised of any such modifications and will be afforded an opportunity to comment further prior to final authorization.

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Justin R. Pabis
Colonel, U.S. Army Corps of Engineers
District Engineer

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NEW ENGLAND DISTRICT
U.S. ARMY CORPS OF ENGINEERS, CONCORD, MA
CLEAN WATER ACT SECTION 404 (b)(1) EVALUATION

PROJECT: Smelt Brook Section 1135 Environmental Restoration Project, Weymouth, Massachusetts
PROJECT MANAGER: Mr. Jordan Macy **Phone:** (978) 318-8584
FORM COMPLETED BY: Ms. Hannah Doherty **Phone:** (978) 318-8685

PROJECT DESCRIPTION:

The Smelt Brook Local Protection Project (LPP) is located in Weymouth, Massachusetts and was authorized by Section 205 of the Flood Control Act of 1948. It was constructed from July 1974 to May 1976. The LPP provides flood protection to eight acres of highly developed land and consists of: a small concrete dam and outlet at Pond Meadow Lake that maintain a permanent lake of 19 acres; an earthfill dike 300 feet long and five feet high next to Pond Meadow Lake; the widening, deepening, and straightening of 800 feet of channel at the lower end of Smelt Brook near the Monatiquot River; and a 1,140-foot long, eight feet diameter reinforced concrete conduit. USACE received a request for assistance with the restoration of anadromous fish passage in the Smelt Brook tributary to the Weymouth-Fore River in the towns of Weymouth and Braintree, MA in September 2010 from the Weymouth- Braintree Regional Recreation-Conservation Districts (WBRRCD). The feasibility study developed an array of alternatives to restore anadromous fish passage in Smelt Brook and throughout the Weymouth Fore River watershed which was adversely impacted through the construction of the Smelt Brook LPP.

The purpose for the proposed project is to restore anadromous fish passage in Smelt Brook and throughout the Weymouth Fore River watershed which was adversely impacted by the construction of the Smelt Brook LPP in the mid-1970s. In order to access additional spawning habitat upstream, smelt must enter a 72-inch diameter culvert and swim through several hundred meters of pipe and stone box culverts, which pass under a railroad embankment, parking areas, roadways, and several businesses in Weymouth Landing. A second 96-inch diameter culvert carries flood control waters a similar underground distance and discharges 25 feet east of the 72-inch culvert. As part of the Smelt Brook LPP, a sluice gate was included to allow smelt to pass upstream from the 72-inch culvert to an upper half mile channelized section of the brook, which offers good spawning habitat. The sluice gate is raised approximately one foot from early February and closed at the end of May each year by rangers of the Pond Meadow Park to allow

smelt access. When the sluice gate is not opened, the brook's flow is forced though the flood control pressure conduit and out of the 96-inch diameter culvert with a stilling basin.

The need for the proposed project is to restore connectivity to historic spawning habitat for rainbow smelt and other diadromous species that the current LPP limits. Historically, rainbow smelt were a reliable resource for both commercial and recreational fisheries. Over the last century, the numbers have decreased drastically due to changes to water quality and flow that have impacted the smelt habitat. The various flood control measures of the LPP have caused the degradation of rainbow smelt migration and spawning habitat. Assessments done in 1988-1990 and other observations suggest that rainbow smelt populations within the Fore River have the potential to re-occupy reaches of Smelt Brook, previously used by adult rainbow smelt for spawning but that the flood control structures seriously limit spawning access and success. The most significant obstacle in the movement of rainbow smelt up Smelt Brook in the 96-inch culvert with the stilling basin.

The recommended plan involves constructing ladder pools on one side of the stilling basin which would allow for excessive streamflow to bypass the system. This would result in a more constant flow in the pools that would be conducive to smelt passage. Possible designs include nine to eleven pools and weirs, and the elevation of each pool would be a few inches different from those adjacent to it. The range of weir sizes limits the effective flow in the pools to a maximum of 3.3 cubic feet per second (cfs). The pools would be three to seven feet deep, so that there is significant room for energy to dissipate within each pool. Flows would discharge from the outlet of the culvert into Pool 1, which would extend the entire width of the stilling basin. Streamflows more than 1.5 cfs would diverge with partial flow discharging from Pool 1 directly into the stilling basin, and partial flow directed to the pool and weir structure. This design leaves more constant flow in the ladder pools and constrains flow velocities below1.5 cfs. More detailed plans and specifications for the construction of the fishway will be finalized in the design phase. Construction would occur between July 1 and January 31 to avoid overlapping with migrating diadromous fish.

NEW ENGLAND DISTRICT
U.S. ARMY CORPS OF ENGINEERS
Evaluation of Clean Water Act Section 404(b)(1) Guidelines

PROJECT: Smelt Brook Section 1135 Aquatic Ecosystem Restoration Project, Weymouth, Massachusetts

1. Review of Compliance (Section 230.10(a)-(d)).

	YES	NO
a. The discharge/fill represents the least environmentally damaging practicable alternative and if in a special aquatic site, the activity associated with the discharge must have direct access or proximity to, or be located in the aquatic ecosystem to fulfill its basic purpose.	X	
b. The activity does not appear to: 1) violate applicable state water quality standards or effluent standards prohibited under Section 307 of the CWA; 2) jeopardize the existence of Federally listed threatened and endangered species or their habitat; and 3) violate requirements of any Federally designated marine sanctuary.	X	
c. The activity will not cause or contribute to significant degradation of waters of the U.S. including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values.	X	
d. Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem.	X	

2. Technical Evaluation Factors (Subparts C-F).

	N/A	Not Significant	Significant
a. Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C)			

		N/A	Not Significant	Significant
	1) Substrate		X	
	2) Suspended particulates/turbidity		X	
	3) Water column impacts	X		
	4) Current patterns and water circulation		X	
	5) Normal water fluctuations		X	
	6) Salinity gradients	X		
b.	Potential Impacts on Biological Characteristics of the Aquatic Ecosystem (Subpart D)			
	1) Threatened and endangered species		X	
	2) Fish, crustaceans, mollusks, and other organisms in the aquatic food web		X	
	3) Other wildlife (mammals, birds, reptiles, and amphibians)		X	
c.	Potential Impacts on Special Aquatic Sites (Subpart E).			
	1) Sanctuaries and refuges	X		
	2) Wetlands		X	
	3) Mud flats	X		
	4) Vegetated shallows		X	
	5) Coral reefs	X		
	6) Riffle and pool complexes		X	
	d. Potential Effects on Human Use Characteristics (Subpart F).			
	1) Municipal and private water supplies		X	
	2) Recreational and commercial fisheries		X	
	3) Water-related recreation		X	
	4) Aesthetics impacts		X	
	5) Parks, national and historic monuments, national seashores, wilderness areas, research sites and similar preserves		X	

3. Evaluation and Testing (Subpart G).

a.	The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material. (Check only those appropriate.)	
	1) Physical characteristics	X
	2) Hydrography in relation to known or anticipated sources of contaminants	X
	3) Results from previous testing of the material or similar material in the vicinity of the project	
	4) Known, significant sources of persistent pesticides from land runoff or percolation	
	5) Spill records for petroleum products or designated hazardous substances (Section 311 of CWA)	X
	6) Public records of significant introduction of contaminants from industries, municipalities, or other sources.	X
	7) Known existence of substantial material deposits of substances which could be released in harmful quantities to the aquatic environment by man-induced discharge activities	
	8) Other sources (specify)	
	List appropriate references. See Detailed Project Report/Environmental Assessment for Smelt Brook Section 1135 Environmental Restoration Project, Braintree and Weymouth, Massachusetts.	
		YES / **NO**
b.	An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredged material is not a carrier of contaminants or that levels of contaminants are substantively similar at extraction and disposal sites and not likely to require constraints. The material meets the testing exclusion criteria.	X /

4. Disposal Site Delineation (Section 230.11(f)).

a.	The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material. (Check only those appropriate.)	
	1) Depth of water at disposal site	X
	2) Current velocity, direction, variability at disposal site	X
	3) Degree of turbulence	
	4) Water column stratification	
	5) Discharge vessel speed and direction	

	6) Rate of discharge	
	7) Dredged material characteristics (constituents, amount, and type of material, settling velocities)	
	8) Number of discharges per unit of time	
	9) Other factors affecting rates and patterns of mixing (specify)	
	List appropriate references. See Detailed Project Report/Environmental Assessment for Smelt Brook Section 1135 Environmental Restoration Project, Braintree and Weymouth, Massachusetts.	

	YES	NO
b. An evaluation of the appropriate information factors in 4a above indicated that the disposal sites and/or size of mixing zone are acceptable.	X	

5. Actions to Minimize Adverse Effects (Subpart H).

	YES	NO
All appropriate and practicable steps have been taken, through application of recommendation of Section 230.70-230.77 to ensure minimal adverse effects of the proposed discharge.	X	
List actions taken. See Detailed Project Report/Environmental Assessment for Smelt Broo 1135 Environmental Restoration Project, Braintree and Weymouth, Massachusetts.		

6. Factual Determination (Section 230.11).

A review of appropriate information, as identified in Items 2 – 5 above, indicates there is minimal potential for short or long term environmental effects of the proposed discharge as related to:

	YES	NO
a. Physical substrate at the disposal site (review Sections 2a, 3, 4, and 5 above)	X	
b. Water circulation fluctuation and salinity (review Sections 2a, 3, 4, and 5)	X	
c. Suspended particulates/turbidity (review Sections 2a, 3, 4 and 5)	X	
d. Contaminant availability (review Sections 2a, 3, and 4)	X	
e. Aquatic ecosystem structure, function and organisms (review Sections 2b and 2c, 3, and 5)	X	

f. Proposed disposal site (review Sections 2, 4, and 5)	X	
g. Cumulative effects on the aquatic ecosystem	X	
h. Secondary effects on the aquatic ecosystem	X	

7. Findings of Compliance or Non-compliance

	YES	**NO**
The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines.	X	

_____
Date

_____
Justin R. Pabis
Colonel, Corps of Engineers
District Engineer