



Pilgrim Lake Fishway
Orleans, MA

Fish Passage Improvement Study

Town of Orleans

January 2024

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SECTION 1



Section 1

Executive Summary

On behalf of the Town of Orleans Department of Public Works (DPW), Tighe & Bond has prepared the following Feasibility Study for the Pilgrim Lake Fishway Improvements project. This Study has been prepared to evaluate the opportunities and constraints of reconstruction and/or repair and improvement of the existing fishway between Kescayo Gansett Pond and Pilgrim Lake in Orleans, Massachusetts.

The existing fishway is comprised of multiple segments including a technical fishway, natural stream channel, and a flow control structure to allow fish to migrate into Pilgrim Lake in the spring, and fry out-migrating to Kescayo Gansett Pond in the fall. The Town of Orleans applied for a Natural Resources Conservation Service (NRCS) grant to design and replace an approximately 500-foot long section of fishway that is currently in poor condition and limits the movement of migratory fish. This work is being conducted under the Watershed and Flood Prevention Operations (WFPO) Program's Cape Cod Water Resources Restoration Project (CCWRRP). The NRCS Project ID is OR-FP-UP-1.

With NRCS providing funding for the project, a 50-year service life is required. This service life is expected to be achieved through a combination of new construction, repair to the existing structure, or routine maintenance.

This report has been prepared to identify the existing conditions and site constraints associated with the fishway, present opportunities for improvement based on a varying scope of work, and summarize discuss cost, permitting and construction challenges. A United States Geological Survey (USGS) Site Locus figure, Orthophotograph, and Priority Resource figure of the Project site are provided in Appendix A as Figures 1-3 (respectively).

SECTION 2



Section 2 Existing Conditions

2.1 Location

The Pilgrim Lake fishway is located off of Herring Brook Way in Orleans, Massachusetts, providing fish passage from Kescayo Gansett Pond (also referred to as Lonnie's Pond) to Pilgrim Lake. A Site Locus, Orthophotograph and Priority Resource Map are provided in Appendix A as Figures 1-3, respectively.

The existing fishway sits within a Town-owned parcel (Parcel ID 55-0-53) with an address of 0 Herring Brook Way. Abutting parcels include private residences, as well as a Town-owned parcel (Parcel ID 55-0-41) which includes the Pilgrim Lake Recreation and Conservation Area parking lot at the terminus of Herring Brook Way. Further, a Town-owned right-of-way, which is undeveloped, provides access to the fishway from Monument Road to the west.

Pilgrim Lake is primarily spring-fed and 43 acres in size. Its contributing watershed is approximately 172 acres. Pilgrim Lake is one of the Town of Orleans' largest lakes and is considered a Great Pond owned by the Commonwealth of Massachusetts. The lake is served by a Town-owned landing and parking area in the northeastern corner of the lake at the end of Herring Brook Way.

2.2 Existing Fishway System

Tighe & Bond conducted a limited level traverse of the site on November 15, 2023 and a stream assessment of Herring Brook between Herring Brook Way and Pilgrim Lake on December 19, 2023. The existing fishway system is comprised of three distinct segments: a concrete pool and weir technical fishway at the lower, steeper elevations; a natural stream channel segment at the flatter intermediate elevations; and a third section that consists of a second, shorter pool and weir fishway that doubles as the outlet control structure to Pilgrim Lake. The lower technical fishway was constructed in the 1930's with most recent repairs in the early 2000's. Refer to Figure 4 in Appendix A presenting the alignment and stationing of the fishway, representative photos and other information. Existing technical fishway longitudinal profile is provided in Appendix A as Figure 5.



Photo 1: Herring Brook Way,
fishway entrance looking south

The fishway system begins at the tidal portion of Herring Brook at Kescayo Gansett Pond. The fishway entrance consists of an approximately 15 foot long concrete channel that is outfitted with vertical slots that allows for installation of wooden weir boards (stop logs). These weir boards provide the ability to control water depths and velocities at the fishway entrance and through the culvert under Herring Brook Way. This culvert is a 30-inch

smooth, reinforced concrete pipe (RCP) that is approximately 33 feet long. Based on staining, the culvert downstream end is fully submerged during high tide.

Moving upstream to the south side of Herring Brook Way, the technical fishway measures approximately 380 linear feet and has five distinct horizontal bends. At the south culvert opening, there is a 44" by 40" concrete pool before the pool and weir segment of the fishway. The structure/pool width is approximately 25 inches, the pool length between each weir is approximately 6 feet, and each weir has a slot that is 5 inches wide and 10 inches tall. The northernmost 112 feet of the technical fishway appears to have been rehabilitated to include struts as bracing for the walls of the concrete basin, extending from approximate Sta. 10+50 to Sta. 9+38. These struts are spaced approximately 7 feet on center.



Photo 2: Technical Fishway looking south



Photo 3: Technical Fishway looking north toward Herring Brook Way

Beyond the struts, the concrete basins display isolated heaving of the concrete walls, most prominently observed between Sta. 9+17 and 7+84. Minor concrete abrasion is consistent throughout the length of the technical fishway, with the heaviest abrasion occurring at the weirs. Minimal root intrusion was observed between the cast concrete basins. There is also evidence of erosion along the banks of the technical fishway, which is anticipated to occurring during heavy storm events where flow exceeds the capacity of the fishway and contributes to bank erosion and downstream sedimentation.

The natural stream channel segment is a 640 foot long section of Herring Brook located between the Pilgrim Lake outlet structure to the fishway exit. It consists of a measured bankfull width ranging from 6 feet to 8 feet and a bankfull depth of 16 inches to 20 inches. The conditions of the channel vary over this natural segment. Some areas are entrenched and exhibit tall banks and moderate erosion, while others appear stable and well connected to their floodplains. There are portions of the brook that have been altered by abutters through the addition of foot bridges to artificial straightening to riparian clearing. This segment is extremely flat with a total elevation change of 0.08 feet. An inverse slope was measured in at least two locations within this segment. Tighe & Bond walked the stream on December 19, 2023, and observed one to two feet of organic



Photo 4: Natural Channel, Sta. 5+00 Fishway looking south

muck through the flattest areas. Sediment and debris accumulation in flatter segments of the stream channel reduce available flow depth. Vegetation growth on banks and within the stream provide shade to maintain water temperature, as well as provide cover from predators.

The third, most upgradient segment is the concrete outlet control structure to Pilgrim Lake that also functions as a second pool and weir technical fishway. This fishway is 18 feet long, 2 feet wide, and 4 feet tall, and it consists of six pools approximately 33 inches long. Each weir is made of wood and each weir slot is approximately 6 inches width and 4 inches tall. The structure is outfitted with a staff gauge and automated fish counting device. The structure was in very good condition, having been recently constructed in 2015.



Photo 5: Pilgrim Lake outlet control structure

2.3 Target Species

The fishway primarily provides passage to river herring of two distinct species: alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*). Both species are anadromous, meaning they annually migrate from saltwater to spawn in freshwater. Juvenile herring will remain in their freshwater habitat for the first few months of their life before migrating to saltwater in the fall season.

Alewife populations are considered to be depleted on the east coast, with recreational and commercial harvesting being prohibited by the Massachusetts Division of Marine Fisheries (DMF) in 2006.

2.4 Operation

Flow within the fishway is controlled manually. As Pilgrim Lake is sourced by a relatively small watershed, adequate flow rates are often difficult to achieve to allow ideal conditions for fish passage. Stoplogs at the pond outlet control structure are adjusted daily to control flow rates during the fish migration season.

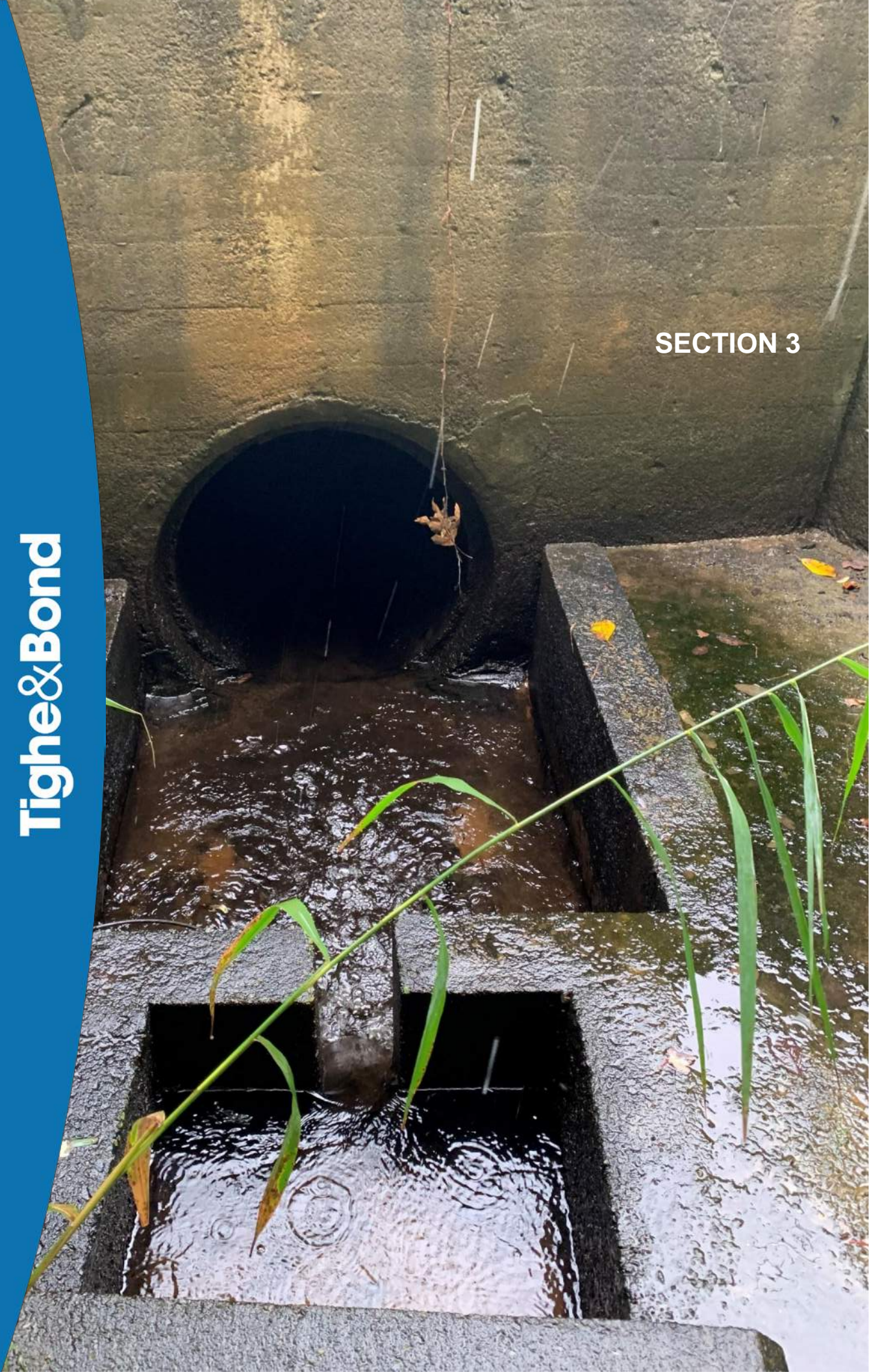
Flow rate measurements have not been obtained within the fishway. Flow rates are controlled by experienced Town of Orleans Department of Natural Resource staff. Staff visit the fishway daily to observe flow conditions and make manual adjustments to stoplogs to either increase or decrease flow. There is a staff gauge present on the Pilgrim Lake outlet structure, so it is possible that the Town may have records of pond stage. Seasonal fluctuations in available flow are often regulated in preparation of future migratory needs (i.e., storing water upstream for future flow needs).



Photo 6: Pilgrim Lake outlet control structure, weir and stoplog orientation, looking south

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SECTION 3



Section 3

Conceptual Design Opportunities

The main objective of the study is to evaluate opportunities for improving fish passage for river herring. Lack of sufficient water flow and depth are the primary impediments that currently limit passability. A slate of restoration opportunities were considered for possible advancement to conceptual design. These opportunities primarily focus on work at the two downstream stream segments. Due to its good condition, no major modifications are proposed at this time to the Pilgrim Lake outlet structure / upstream technical fishway segment.

Table 3.1
Summary of Conceptual Design Options

Option 1	Repair Existing Fishway, Sta. 6+50 to 10+50
Option 2	Replace Existing Fishway with Technical Fishway, Sta. 6+50 to 10+50
Option 3	Replace Existing Fishway with Nature-Like Fishway, Sta. 6+50 to 10+50
Option 4	Improve Natural Channel Flow Dynamics, Sta. 0+00 to 6+50
Option 5	Replace Natural Channel with Nature-Like Fishway, Sta. 0+00 to 6+50

The improvements to the existing technical fishway range from repairing the existing structure, to replacement in-kind with a technical fishway, to replacement with a more natural solution such as a nature-like fishway. The natural channel segment also requires modification to improve fish passage due to its shallow depth, sediment accumulation and streambed widening. Each option is discussed further in the following subsections.

3.1 Technical Fishway Repair

The existing concrete pool and weir fishway is showing signs of aging and portions of this segment are in need of repair. Repair would consist of reinforcement with an environmentally-safe, structural epoxy coating to address isolated heaving of the concrete walls and abrasion of the concrete. This coating would strengthen the walls and inhibit further wall failure while also filling existing cracks in the structure. A structural epoxy coating would also preserve the existing geometry of the structure, protect against additional concrete abrasion, and negate the need for drilling into the existing concrete to install struts.

It is important to note that the option to repair the existing fishway does not address aging concerns of subsurface structural components. While the fishway foundation components are unknown in terms of presence, condition and design, no improvements are proposed to increase the subsurface lifespan. Further evaluation of the subsurface conditions will be required if this option is desirable to the Town and its project partners.

In addition to improvements to the technical fishway, stabilization practices are required along the upper banks of the fishway. It is recommended that a minimally-wide access path be established on one side (likely the eastern side) of the technical fishway to formalize and allow for improved operation and maintenance access. Side slopes along this segment should be stabilized with a bioengineered slope, using soil and plant materials, supported by natural or synthetic support materials to stabilize the slope and promote appropriate vegetation growth. Installation of a bioengineered slope as compared to traditional stone armoring provides many benefits such as improved water quality and temperature regulation.

In order for this option to obtain a 50-year lifespan, regular inspection and maintenance activities will be required. The lifespan of epoxy coating could range up to 75 years. The epoxy coating would protect concrete from further wear and would provide additional structural support to the vertical walls, however it does not provide additional protection to uncoated surfaces.

Regular inspection, operation, and maintenance is necessary for proper function of any engineered fishway. In addition to near-daily inspection during the fish migration season, monthly visual inspection of the technical fishway to identify areas where epoxy coating is cracking or flaking off. It is anticipated that re-application of epoxy coating may be occasionally required.

Inspections should also observe side slope stability and identify areas where erosion is occurring for immediate repair. Vegetation growth should be managed to address growth within to immediately adjacent to the technical fishway which can impact the structural integrity of the fishway components.

3.2 Technical Fishway Replacement

The replacement of the existing degraded fishway would include demolition of the existing fishway and reconstruction. The Fish Passage Engineering Design Criteria, published by the United States Fish and Wildlife Service Northeast Region, dated June 2019 provides design criteria for various fishway designs. Due to physical constraints of the fishway system, such as limited area, accessibility and available water flow, the replacement design is anticipated to be similar to the existing condition of a pool and weir fishway system. The replacement structure could be constructed with natural stone in order to provide the appearance of a more natural structure (see example from the Howlett Brook fishway in Topsfield, MA¹).



Photo 7: Representative photo, technical fishway, Topsfield, MA

Fishway design is based on target species requirements and physical constraints such as slope, available width, and available flow. The existing technical fishway is approximately 380 feet in length, with a total elevation

¹ <http://www.tarrtalk.com/2023/10/howlett-brook-fishway-officially-opened.html>

change of approximately 4.75 feet. It is commonly understood that while Alewife can leap, or jump, up to 2 to 2.5 feet in height, a 1-foot leap height is a typical design parameter for the species.²

More analysis is required to determine the exact pool and weir spacing and sizing that would be most appropriate for this site. One possible replacement option to increase passage efficiency could be to increase the pool sizes (length and depth) to allow for a higher Energy Dissipation Factor (EDF) and to create more resting space between pools. This change may consequently increase the step heights between weirs but since the total elevation change of the fishway is only 4.75 feet this may be possible without sacrificing passability. It may also be possible to decrease the total structure length because the average slope is less than 1.2%, which is very low for engineered fishways, and the upper 150 feet of the structure is even flatter. Should replacement be preferred, Tighe & Bond recommends a more detailed survey of the fishway and development of a stage-discharge relationship in order to explore a series of alternative layouts.

A newly constructed technical fishway can provide a 50-year life span provided regular operation and maintenance occurs. Operation and maintenance activities include routine inspection of the fishway to remove debris and sediment, identify signs of deterioration, and structural repairs when needed. Inspections should include observation of the stream channel for signs of erosion, and side slope stability. Regular measurement of flows, depths, and velocities during the migration season is also recommended to ensure conditions are passable to the target species.

Design challenges for this option include construction access and low and inconsistent stream flows. Design of any engineered fishway will require careful consideration of the stage-discharge relationship, particularly during the fish migration season. Refer to Figure 6 showing available Town-owned property that may be used to provide access to the fishway for reconstruction.

3.3 Nature-like Fishway Design

A nature-like fishway is a type of engineered fishway that incorporates natural materials, such as rock, into a structure that resembles something more commonly found in the environment (see example from the Acushnet River in Dartmouth, MA³). This type of solution could be used in either the existing technical fishway segment or the natural stream segment depending on specific site conditions. The engineering process in terms of fish passage would not differ substantially from the technical fishway approach. Instead, opportunities



Photo 8: Representative photo, nature-like fishway, Dartmouth, MA

² David L. Belding, 1920. *A Report upon the Alewife Fisheries of Massachusetts*. Commonwealth of Massachusetts, Department of Conservation, Division of Fisheries and Game

³ <https://usfwnortheast.wordpress.com/2013/04/11/after-remaking-the-way-for-fish-huge-increases-follow-for-migrating-herring-in-a-massachusetts-river/>

to incorporate boulders, native vegetation, and natural channel design techniques into the strategy would be investigated. The challenges of the existing fishway system for incorporating a nature-like solution includes low and inconsistent stream flows, shallow water depths, limited elevation change, steep embankments, and limited real estate to expand the footprint of the brook.

Nature-like fishway designs incorporate technical design requirements to create impoundments and channel design with natural materials to maintain the hydraulic design of a system while providing aesthetics and habitat for fish and other aquatic organisms. If following the same pool and weir concept as the technical fishway option, natural stone materials could be used to function as the weirs or to form the pool boundaries. Nature-like fishway design criteria for the target species is provided in Table 3.2 below.⁴

**Table 3.2
Nature-like Design Criteria**

	Blueback Herring	Alewife
Pool/Channel Width (minimum)	5.0 ft	5.0 ft
Pool/Channel Depth (minimum)	2.0 ft	2.25 ft
Pool/Channel Length (minimum)	10.0 ft	10.0 ft
Weir Opening Width (minimum)	2.25 ft	2.5 ft
Weir Opening Depth (minimum)	1.0 ft	1.0 ft
Weir Opening Water Velocity (maximum)	6.0 ft/sec	6.0 ft/sec
Fishway/Channel Slope (maximum)	1:20	1:20

It will be important to evaluate the streambed cross-section for each pool to provide the required channel depths and velocities during the anticipated migration season.

If a nature-like option is preferred, it will be important to improve the water balance of the system. This can be done by lining the streambed with a geo-composite clay liner (GCL) to prevent exfiltration and seepage through pool features. While the GCL will retain water within the pools, it will also reinforce and maintain the stream channel section to promote an increase in lifespan and reduce maintenance requirements.

Design challenges for this option include construction access and low and inconsistent stream flows. Design of any engineered fishway will require careful consideration of the stage-discharge relationship, particularly during the fish migration season.

Annual operation and maintenance activities will be frequent in initial years as the streambed establishes and flows cause shifting in the placed stone and bed material. Inspection after every storm in excess of 0.25 inches for at least the first year is suggested. Inspections should include observation of the stream channel for signs of

⁴ Turek, J., A. Haro, and B. Towler. 2016. *Federal Interagency Nature-like Fishway Passage Design Guidelines for Atlantic Coast Diadromous Fishes*. Interagency Technical Memorandum. Pilgrim Lake Fish Passage Improvement Study

erosion, and side slope stability. Regular measurement of flows, depths, and velocities during the migration season is also recommended to ensure conditions are passable to the target species.

3.4 Natural Channel Improvements

The natural channel segment of Herring Brook is approximately 640 feet in length and is extremely flat. The total elevation change of the streambed over this distance was measured at 0.08 feet, and an inverse slope was measured in at least two locations within this segment. Due to the flat channel slope, limited options exist that will improve flow conditions. It would likely not be feasible regulatorily, nor warranted from a fish passage perspective, to construct a new technical fishway through the natural segment. A nature-like fishway would also only be appropriate if the channel slope was steep enough to necessitate a structure to improve passability. In contrast to the downstream stream segment, fish passage is primarily inhibited by water depth, not by slope or velocity. Although limited, there are a several options that could be considered to help address the depth and discharge issues. Options may include (but may not be limited to):

3.4.1 Streambank and Riparian Restoration

There are isolated areas along the natural channel experiencing streambank erosion and failure. The likely sources of the erosion differ by location but range from riparian bank clearing activities, to flow redirection from obstructions such as trees, to impacts from abutters and foot traffic. Streambank and riparian restoration will aid in reduction of sedimentation within low-flow segments.



Photo 9: Example of unformalized stream crossing, Sta. 5+50

3.4.2 In-stream Habitat Features

This improvement option could include installation of habitat features such as root wads, boulder clusters, or rock weirs in strategically placed locations to force streambed scour and improve channel depth. This strategy may be appropriate in areas currently prone to sediment deposition. Adjusting the stream alignment to increase slope or add sinuosity may also help to provide localized depth improvement. These types of solutions are unlikely to improve depth across the entire natural channel segment but could be beneficial in the most problematic areas. More investigation and survey of the site is necessary to advance these types of solutions. Identification of a reference channel to inform design is also advisable if one can be located nearby.

3.4.3 Stream Maintenance/Dredging

Certain stream maintenance activities may be warranted to improve depth and flows through Herring Brook. These activities must abide by MassDEP's Wetland Program Policy 22-01: Diadromous Fisheries Stream Management⁵. Actions could include strategic removal of debris, dead wood, leaf and yard waste, or other vegetative obstructions. Removal of human-placed obstructions, such as the footbridges, may also be warranted to improve flows. Strategic channel dredging is another solution that could be considered for improving depth through the shallowest areas. The project could be permitted in a manner to allow for long-term maintenance dredging should that be desired.



Photo 10: Example of flow obstruction from unformalized crossing, Sta. 1+50

3.4.4 Increase Flow

Removing stoplogs at pond outlet to generate more regular and higher flows, particularly during non-migratory seasons, could be investigated. The crest of the stoplogs were observed at approximately 18 inches above the pond surface on December 19, 2023. These could be lowered in the winter months to increase channel flows and enhance sediment transport. Pond levels may fluctuate more depending on weather conditions but stream conditions could potentially improve. This option would need to be discussed with and approved by Orleans Natural Resources Department and DMF. A monitoring program to measure flows and water depths at this location over at least one fish migration season would be needed in order to determine what stop log adjustments, if any, are feasible.

3.5 Replacement of Herring Brook Way Culvert

The existing culvert under Herring Brook Way is a 30-inch reinforced concrete pipe. Replacement of this culvert may be warranted to further enhance fish passage. Since the culvert is tidal influenced, it is not subject to the Massachusetts River and Stream Crossing Standards, however, increasing its size will benefit river herring by lowering exit velocities and increasing daylight and openness ratio. Replacing the structure would allow for lowering the culvert outlet which would improve the tailwater depths and passage conditions during all tide conditions. The outlet invert is currently exposed at low tide and requires stoplogs to provide sufficient tailwater. Replacement will also provide a more deliberate and continuous design with the selected upstream fishway improvements.



Photo 11: 30-inch Culvert beneath Herring Run Way

⁵ [https://www.mass.gov/info-details/wetlands-program-policy-22-01-diadromous-fisheries-stream-management#:~:text=DMF%20has%20developed%20standards%20for,March\)%20inspections%20of%20stream%20channels.](https://www.mass.gov/info-details/wetlands-program-policy-22-01-diadromous-fisheries-stream-management#:~:text=DMF%20has%20developed%20standards%20for,March)%20inspections%20of%20stream%20channels.)

In order to propose viable culvert replacement alternatives, we first recommend a structure condition assessment and additional data collection to monitor tides and water depths. This project element could be included under any of the proposed options.

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SECTION 4



Section 4

Permitting Considerations

When undertaking the construction or repair of the fishway, careful consideration of permitting requirements is key, especially when exploring alternative designs. Each design option, whether it involves modifications to an existing structure or the construction of an entirely new fishway, necessitates adherence to specific environmental regulations at the local, state, and federal level.

The Site contains a variety of sensitive environmental resources that are regulated at the local, state, and federal level that will affect permitting requirements for the Project. Please refer to the Priority Resource Figure in Appendix A. To provide context for the permitting discussion, the following resource areas are present within the project area:

- Wetland resource areas including Salt Marsh, Bordering Vegetated Wetlands, Bank, Bordering Land Subject to Flooding, Land Subject to Coastal Storm Flowage, Riverfront Area, and Fish Run, which are regulated pursuant to the Massachusetts Wetlands Protection Act (WPA) and Orleans Wetland Bylaw. Wetlands at the Site are also regulated by MassDEP and the Army Corps of Engineers (ACOE) in accordance with Section 401, 404, and 10 of the Clean Water Act.
- The entire site is located in the Pleasant Bay Area of Critical Environmental Concern (ACEC). An ACEC is an area in Massachusetts that receives special recognition because of the quality, uniqueness, and significance of its natural and cultural resources. By virtue of the Site being in an ACEC, the Project will be subject to a more comprehensive level of review for required permits. Additionally, Pilgrim Lake and Kescayo Gansett Pond are considered Outstanding Resource Waters (ORW) because the Site is in the ACEC. The ORW designation also means that wetlands and stormwater standards are higher.
- The project area is not located within Estimated or Priority Habitat for state-listed rare species. As such, review by the Natural Heritage Endangered Species Program (NHESP) in accordance with the Massachusetts Endangered Species Act (MESA) will not be required.

As discussed in Section 3, numerous design options were evaluated to identify permitting challenges anticipated. Regardless of the selected option, the project will involve a comprehensive review of each design's impact on fish migration, review of impacts to the environment, and compliance with state and federal environmental regulations. Table 4.1 summarizes the permits and regulatory reviews that were reviewed for applicability for the various design options. It is anticipated that regardless of the selected solution, all of the following permits will be required.

Public input and notices may be required, ensuring that stakeholders and the public have the opportunity to contribute insights or express concerns regarding the proposed project. Given the complexity of fishway projects and the potential environmental impacts, engaging with regulators and agencies at the beginning of the project will facilitate a smoother permitting process and aid in the selection of the most ecologically sound and efficient design.

Table 4.1
Regulatory Review Applicability

Agency/Permit	Applicability
MA Environmental Policy Act (MEPA) Review	Environmental Notification Form required
Division of Marine Fisheries (DMF), Fishway Construction Permit	Required
Wetlands Protection Act Review - Massachusetts Department of Environmental Protection (MassDEP) & Orleans Conservation Commission	Order of Conditions (Ecological Restoration Project)
National Historic Preservation Act Section 106 Review/ Massachusetts Historical Commission	Project Notification Form
Public Waterfront Act Ch 91 Waterways (MassDEP)	Further coordination with MassDEP required
Clean Water Act Sec 401 Water Quality Certification (MassDEP)	Applicability depends on extent of resource area impacts and dredging quantity
Clean Water Act Sec 404 & Rivers and Harbors Act Sec 10 Review (Army Corps of Engineers)	Applicability depends on extent of resource area impacts
MA Office of Coastal Zone Management – Federal Consistency Review	Required
Massachusetts Endangered Species Act (MESA) Review	Not required
National Pollutant Discharge Elimination System (NPDES) Stormwater Pollution Prevention Plan (SWPPP)	Unlikely
Chapter 253 Dam Safety Permit (MA Office of Dam Safety)	Not required

The following sections further detail each potential regulatory program evaluated for applicability.

4.1 Massachusetts Environmental Policy Act (MEPA)

Review by the Massachusetts Environmental Policy Act (MEPA) office is required for projects in Massachusetts that exceed a MEPA review threshold at 301 CMR 11.03 and that involve a state agency action (i.e. permit, financial assistance, or land transfer). MEPA is designed to ensure that environmental concerns are taken into account during the planning and decision-making processes for projects that may have significant impacts on the environment.

The review thresholds identify categories of projects that are likely, directly or indirectly, to cause Damage to the Environment. Depending on the thresholds exceeded, the project will be required to submit an Environmental Notification Form (ENF) or an Environmental Impact Report (EIR) to the MEPA Office.

Based on our current understanding of the project, it is likely that one or more of the following ENF review thresholds will be exceeded, regardless of what project alternative is implemented:

- 301 CMR 11.03(11)(b): Any project of ½ or more acres within a designated ACEC
- 301 CMR 11.03(3)(b)(1)(b): Alteration of 500 or more linear feet of bank along a fish run or inland bank
- 301 CMR 11.03(3)(b)(1)(c): Alteration of 1,000 or more square feet of salt marsh or outstanding resource waters
- 301 CMR 11.03(3)(b)(1)(d): Alteration of 5,000 or more square feet of bordering or isolated vegetated wetlands

MEPA includes a public participation component that will allow stakeholders to provide input during the review process. Additionally, MEPA requires coordination with various state agencies including DMF to ensure fisheries experts and relevant regulators are involved in the assessment of potential impacts on fish runs.

Further considerations related to Environmental Justice (EJ) Populations within the MEPA process may be applicable, contingent on the precise extent of the project area. MEPA recently enacted two Protocols related to Environmental Justice that require enhanced public outreach and an in-depth analysis of potential impacts to EJ populations for projects within 1 mile of a mapped EJ community. Currently, the project area lies slightly beyond one mile from a designated EJ population. Should the project be situated within one mile of a mapped EJ Population, heightened public engagement standards and a mandatory EIR would be imposed. It is recommended that this distance be reassessed following the confirmation of the project design.

The project may qualify as an Ecological Restoration Project under 310 CMR 10.13, in which case it would not require full MEPA review provided the requirements set forth at 301 CMR 11.01(2)(b)4 are satisfied. Instead, these projects are required to submit a Notice of Project (NOP) to the MEPA Office. The NOP must be submitted at least 60 days prior to the submittal of the Ecological Restoration Notice of Intent (see further discussion below) and must also be published in the Environmental Monitor. The process also includes a 20-day public comment period before the Secretary issues a determination indicating that the project does or does not require an ENF or EIR filing. This regulatory pathway is advisable for this project should it be eligible because it may avoid the need to complete and file an Environmental Notification Form (ENF) and/or an Environmental Impact Report (EIR).

4.2 Division of Marine Fisheries Fishway Construction Permit

In Massachusetts, the Division of Marine Fisheries (DMF) is responsible for managing fisheries resources, including overseeing fish passage and fishway construction. MassDEP supports the maintenance of anadromous/catadromous (diadromous) fish runs which are significant to the protection of marine fisheries, an interest protected under the Wetlands Protection Act (MGL Chapter 131 §40). The DMF is authorized pursuant to MGL Chapter 130 §19 to maintain passageways for diadromous fish. DMF routinely provides related

guidance to property owners and municipalities on the proper methods for maintenance of stream channels to allow safe and efficient fish passage.

A Fishway Construction Permit is required for projects involving the construction, alteration, or repair of fishways or fish passages in Massachusetts. In addition to the Fishway Construction Permit issuance, DMF makes recommendations to regulatory agencies within the context of permitting under the WPA, Clean Water Act, and other processes, further discussed below.

Submittal to DMF will need to outline information about the location, design specifications, and potential impacts on fish species. The DMF will review the project materials to ensure that the proposed fishway meets the necessary standards of review⁶, regulations, and does not inhibit fish passability. This review may include assessing the potential impact on fish populations and the effectiveness of the fishway in facilitating fish migration. The DMF may impose specific conditions or require mitigation measures to minimize any adverse effects on fish populations or their habitats.

There is no formal application form or fee for the DMF Fishway Construction permit, rather, DMF will issue a permit following the review of design plans for the fishway project once a contractor and final design is in place. Although the Fishway Construction permit process starts late in the project schedule, early coordination is key to a smooth permit approval process. DMF should be consulted during the alternative selection phase of the project to guide design and permitting pathways.

DMF coordination and permitting will play a central role in the project's success and will be required for all design options.

4.3 Massachusetts Wetlands Protection Act

The Wetlands Protection Act (310 CMR 10) is administered by the Orleans Conservation Commission and overseen by the Massachusetts Department of Environmental Protection (MassDEP). The WPA is designed to protect wetland resource areas, such as wetlands, marshes, ponds, rivers, and other water bodies, and the surrounding buffer zones. Any activity that may impact a wetland resource or area within 100 feet (Buffer Zone) of a wetland resource area or 200 feet of a perennial stream (Riverfront Area) will require a filing of a Notice of Intent (NOI) with MassDEP and the Orleans Conservation Commission. Additionally, the Town of Orleans has a Wetland Protection Bylaw (§ 160-11 of the Orleans Code). This bylaw imposes more stringent regulations than the WPA.

The proposed project, under all options, will include work within wetland resource areas including: Salt Marsh, Bordering Vegetated Wetlands, Bank, and Land Subject to Flooding and therefore require an Order of Conditions (OOC).

⁶ Wetlands Program Policy 22-01: Diadromous Fisheries Stream Management standards:
<https://www.mass.gov/info-details/wetlands-program-policy-22-01-diadromous-fisheries-stream-management>

4.2.1 Ecological Restoration Project

Under the WPA, Ecological Restoration Projects can be conducted, provided they meet eligibility criteria outlined at 310 CMR 10.13. Ecological Restoration projects involve activities aimed at returning a degraded or altered ecosystem to a more natural state. Restoration projects include fish passageway construction, repair, or restoration. Due to the nature of the Pilgrim Lake Fishway Improvements project, an Ecological Restoration Order of Conditions is anticipated to be feasible for all project alternatives; however, coordination with MassDEP and the Town of Orleans Conservation Commission should occur early in the project's planning process.

This project meets all applicable eligibility criteria at 310 CMR 10.13 under all alternatives. Additionally, the project must meet Additional Eligibility Criteria for Restoring Fish Passageways as follows:

If the Ecological Restoration Project involves the restoration or repair of a fish passageway as identified by the Division of Marine Fisheries in its Marine Fisheries Technical Reports, TR 15 through 18, dated 2004, the Ecological Restoration Project shall be approved by a Restoration Order of Conditions, provided that in addition to the eligibility criteria set forth in 310 CMR 10.13(1), the applicant has submitted a Fishway Permit Application to the Division of Marine Fisheries, pursuant to MGL c. 130, §§ 1 and 19, and 322 CMR 7.01(4)(f) and (14)(m), and the fish passageway will be operated and maintained in accordance with an Operation and Maintenance Plan approved by the Division of Marine Fisheries.

The Restoration OOC will contain the following special conditions, standard to Fish Passageway Restoration Projects:

- *The property owner is responsible for maintaining and repairing the fishway in good condition so that it will support safe and efficient fish passage in accordance with an operation and maintenance plan approved by the Division of Marine Fisheries. This requirement is a continuing condition that shall be set forth in the Certificate of Compliance.*
- *A post-construction project summary using surveys, a narrative and photographs as needed, that confirm the fishway slope and entrance and exit elevations shall be submitted to and approved by the Division of Marine Fisheries, prior to submittal of a request for a Certificate of Compliance.*

4.4 Chapter 91 License/Permit

Chapter 91 is a Massachusetts state law administered by MassDEP that governs activities and structures in tidelands, great ponds, and certain rivers and streams. Chapter 91 is rooted in the Public Trust Doctrine, which recognizes that certain natural resources, including tidal and coastal waters, are held in trust for the benefit of the public. Projects must be consistent with this doctrine, and public access and use are considered in the permitting process.

Some activities taking place within Chapter 91 jurisdiction do not require authorization, including "Fish ladders, fishways and other devices that allow or assist fish to pass a dam or other obstruction in the waterway". However, even though the proposed project may

not require Chapter 91 licensing, applicants must notify MassDEP of their intent to perform such projects before undertaking them. MassDEP will in turn provide written notification as to whether or not a Chapter 91 License authorization is required.

For this project, the fishway exemption is complicated by the fact that the project is likely within Chapter 91 jurisdiction due to its connection to the tidal estuary and Pilgrim Lake, which is classified as a Great Pond. Any activity that takes place within flowed tidelands, filled tidelands, Great Ponds⁷, or non-tidal navigable rivers and streams requires Chapter 91 authorization. Potential dredging activities may also trigger Chapter 91 permit review.

If MassDEP determines that the project is not exempt under 310 CMR 9.05(3)(g), a Chapter 91 license and/or permit will be required. Projects subject to Chapter 91 also require coordination with other permits and regulatory processes, such as MEPA, the Wetlands Protection Act, and other relevant environmental laws.

4.5 Massachusetts Historical Commission

Any project that requires funding, licenses, or permits from any state or federal governmental agencies must be reviewed by the Massachusetts Historic Commission (MHC), in compliance with Massachusetts General Laws Chapter 9, sections 26-27C and Section 106 of the National Historic Preservation Act, for impacts to historic and archaeological properties. It is the nature of the federal or state agency involvement that triggers MHC review, not listing in the National or State Registers of Historic Places.

The project is unlikely to impact historical, archeological or cultural sites; however, because this project has received public funding and will require various federal, state, and local licenses and permits, a Project Notification Form (PNF) will need to be submitted to the MHC regardless of the resulting design. Further, the most recently issued General Permit for Massachusetts issued by the Army Corps of Engineers (June 2023) requires a stand-alone PNF for any projects subject to ACOE review.

4.6 401 Water Quality Certification (WQC)

The 401 Water Quality Certification (314 CMR 09: 401 Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredged Material Disposal in Waters of the United States Within the Commonwealth) regulation is administered by MassDEP and is a crucial aspect of the regulatory process for projects that may impact water quality. The regulation applies to the discharge of dredge or fill materials into waters of the Commonwealth and can play a role in fishway construction or repair projects. The certification is a requirement under Section 401 of the Clean Water Act, and it is intended to ensure that a proposed project will not violate water quality standards and will not have significant adverse effects on water quality.

It is unknown at this time the extent of the dredging or filling to waters of the Commonwealth that will be required for the different alternatives. If any project

⁷ Pilgrim Pond is a designated Great Pond: <https://www.mass.gov/doc/massachusetts-great-ponds-list>

alternatives involve the dredging of 100 cubic yards of sediment or more or dredging of any amount of dredging in an Outstanding Resource Water, a Water Quality Certification will need to be issued by the Department in accordance with 314 CMR 9.00. As the project area is located within the Pleasant Bay Area of Critical Environmental Concern ACEC, the entirety of Pilgrim Lake and Kescayo Gansett Pond are considered Outstanding Resource Waters. Therefore, it is likely that a 401 WQC will be required for any proposed dredging. Final applicability will depend on the extent of the proposed dredging and associated resource area impacts. A sediment Sampling and Analysis Plan (SAP) will be required to identify elevated concentrations of pollutants within sediment to be dredged. Sediment samples will be obtained and analyzed in accordance with 314 CMR 9.07 and a sediment management plan may be required depending on the quantity of sediment proposed to be dredged.

4.7 Section 404 Clean Water Act / Section 10 Rivers & Harbors

Section 404 of the Clean Water Act (33 USC 1344) is a federal regulation administered by the U.S. Army Corps of Engineers (ACOE) and authorizes the ACOE to issue permits for the discharge of dredged or fill material into the waters of the United States, which includes rivers, streams, wetlands, and other water bodies.

As outlined above, is unknown at this time the extent of the dredging or filling to waters of the United States that will be required for the different alternatives. If any project alternative does require discharge of dredged or fill material into waters, or requires excavation, grading, filling, alteration to the bottom of elevation or bed of these waters, or placement of structures, applicability to Section 404 of the Clean Water Act will need to be revisited. Final applicability will depend on the extent of the proposed dredging and associated resource area impacts.

Many projects subject to Section 404 permits also fall under the jurisdiction of Section 10, particularly when they involve structures or alterations in navigable waters. This is because projects impacting wetlands or other aquatic environments often occur in areas subject to Section 10 jurisdiction. When there is overlapping jurisdiction, a joint application can be submitted to the ACOE to address the requirements of both regulatory programs.

The ACOE review process incorporates formal review by other federal agencies, including the National Marine Fisheries Service (NMFS), the US Fish and Wildlife Service (USFWS), and the MA Office of Coastal Zone Management (CZM, discussed in more detail below). The project may require Essential Fish Habitat (EFH) review NMFS as part of the Section 404/ 10 review. Additionally, the USFWS Information for Planning and Consultation (IPaC) was used to identify the project location and receive an official species list (pursuant to 50 CFR 402.12) of threatened and endangered species that should be considered when evaluating the potential impacts of the project. The project received a no effect determination and no further consultant/coordination for the project is required at this time; however, IPaC should be run again once design of potential solutions are further developed.

4.8 Coastal Zone Management – Federal Consistency Review

The Site is located in the Coastal Zone. Projects located in the Coastal Zone that require approvals by a federal agency (i.e. ACOE) require review by the MA Office of Coastal Zone Management (CZM) to determine consistency with various coastal management objectives and policies. CZM will formally participate in the Section 404/ 10 permitting process, and typically also provides input during the MEPA and MassDEP review. The project may need a CZM Federal Consistency Determination.

4.9 Additional Considerations

4.9.1 Time of Year Restrictions

DMF/DFWF may impose certain time of year restrictions for construction activities, including fishways to protect sensitive species during critical life stages such as fish migration, spawning, juvenile fish presence, or other sensitive life stages.

Outlined in DMF's Technical Report TR-47⁹, Marine Fisheries recommends:

"...a TOY for river herring during the spring spawning migration from April 1 to June 15 for alewife and April 1 to June 30 for blueback herring. The spring TOY encompasses the adult migration, spawning, egg incubation and juvenile development within nursery habitats. A TOY may also be recommended for the juvenile emigration from September 1 to November 15. Whether or not these TOYs will pertain to a given project is dependent on the nature and location of the proposed work and the most current data on the system in question. In general, in-water, silt producing work should be avoided or fully contained when conducted in a known river herring run during these periods."

TR-47 goes on to explain that:

" a TOY for the spring glass eel immigration from March 15 through June 30 and during the silver eel emigration from September 15 to October 31. Larger projects with direct impacts may warrant protection into November. Whether or not this TOY will pertain to a given project is dependent on the nature and location of the proposed work. In general, no in-water work should be conducted that would permanently impact resting habitat at the head of tide within a known eel run."

Further coordination with DMF is required to confirm exactly which TOYs will apply to this project, however, for planning purposes, it is likely that in-water or silt producing work will be prohibited from at least April 1 to June 30.

⁹ Evans, N. T., K. H. Ford, B. C. Chase, and J. J. Sheppard. 2011. Recommended time of year restrictions (TOYs) for coastal alteration projects to protect marine fisheries resources in Massachusetts.

4.9.2 FEMA Letter of Map Revision

A Letter of Map Revision (LOMR) from the Federal Emergency Management Agency (FEMA) is typically needed when there are changes to the Flood Insurance Rate Map (FIRM) or Flood Insurance Study (FIS). LOMRs are used to request changes to flood hazard information, including the addition or removal of areas from the Special Flood Hazard Area (SFHA) or changes to base flood elevations. Changes to local infrastructure, such as the construction of levees, dams, or flood control structures, can impact floodplain mapping. The site is mapped as Special Flood Hazard Area, Zone AE and has Base Flood Elevations (BFEs) of 13 feet in the tidal portions and 12 feet in the upland portions between Pilgrim Lake and Herring Brook Way. Presently, we do not anticipate the alternatives changing base flood elevations; therefore, a FEMA Letter of Map Revision is likely not required. More investigation is required to determine if the Herring Brook Way culvert replacement would result in any BFE changes.

4.9.3 Chapter 253 Dam Safety Permit

A Chapter 253 Dam Safety Permit is not required for any project alternative. The fishway is not located in close proximity to a jurisdictional dam, does not interact with or are integrated into a dam structure, and there are no proposed alterations to an existing dam or impoundment that would affect the integrity, safety, or operation of the dam. Tighe & Bond confirmed that the Pilgrim Lake outlet structure is not considered a jurisdictional dam.

Tighe&Bond

SECTION 5



Section 5

Additional Considerations

Construction period limitations and cost considerations are significant for the replacement or improvement to the existing fishway. The following section presents construction period challenges and cost implications for the alternates presented in this report.

5.1 Construction Considerations

Time of year restrictions due to fish passage needs may limit construction activities to the periods between July and September and November and March (refer to Section 4.9.1). The fishway may be required to be operational from when fish are ready to migrate to Pilgrim Lake in the spring through the time fry leave the lake in the fall.

Construction access may also pose challenges due to the narrow right-of-way in which the fishway sits. Close coordination with abutting property owners will be critically important. It is expected that the parking lot at Pilgrim Lake can serve as a construction lay-down area. The right-of-way is narrow and does not allow heavy machinery access without impacting private property. Refer to Figure 6 showing available Town-owned property that may be used to provide access to the fishway for reconstruction.

Water control will consist of rerouting the Herring Brook flows via gravity flow or pumping around work areas. If work is proposed at the Herring Brook Way culvert, consideration of tides will be a critical water control element. Conducting the work in the summer months may provide the best opportunity to accomplish the work during low flow conditions, providing time of year restrictions allow. However, we understand that work in the winter may be preferred due to summer tourism and recreation.

5.2 Opinion of Probable Construction Costs

The construction costs associated with each alternative evaluated is another important piece to the evaluation of the project's next steps. A Conceptual Opinion of Probable Construction Costs (OPCC) was prepared for each option individually to assist the Town and other stakeholders the opportunity to evaluate various combinations of solutions. OPCC estimates were developed based on similar projects and industry standard. Table 5.1 presents estimated per linear foot costs for the various options previously described. These estimates do not include soft costs (i.e. engineering and permitting fees).

**Table 5.1
Conceptual Opinion of Probable Construction Costs**

Option	Description	Conceptual OPCC
Option 1	Repair Existing Fishway, Sta. 6+50 to 10+50	\$100 - \$500 per linear foot
Option 2	Replace Existing Fishway with Technical Fishway, Sta. 6+50 to 10+50	\$2,000 - \$3,000 per linear foot
Option 3	Replace Existing Fishway with Nature-Like Fishway, Sta. 6+50 to 10+50	\$1,500 - \$2,000 per linear foot
Option 4	Improve Natural Channel Flow Dynamics, Sta. 0+00 to 6+50	\$300 - \$500 per linear foot
Option 5	Replace Natural Channel with Nature-Like Fishway, Sta. 0+00 to 6+50	\$1,000 - \$2,000 per linear foot

In addition to construction costs, annual maintenance costs are important to evaluate. All options will require annual maintenance to ensure the system is functioning as intended. Annual maintenance activities may include activities such as epoxy re-application, dredging to remove sediment, or stabilization of eroding banks. Annual maintenance costs are difficult to determine at this stage of design, but can be further evaluated once designs are advanced such that the Town can establish a budget for future and recurring maintenance activities.

5.3 Culvert Replacement

While not part of the technical evaluation of the fishway, the culvert beneath Herring Brook Way plays an important role in both fishway function and fish passage. As discussed in Section 3.5, replacement of the culvert may provide a benefit to river herring by lowering exit velocities and increasing daylight and openness ratio. Further evaluation of the tidal influences, and structural condition should be performed. Based on our experience with similarly sized culvert replacements, a budget of \$1M - \$2M should be established.



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SECTION 6

Section 6 Summary and Recommendations

In summary, fish passability can be improved using a variety of solutions ranging from improvement of the existing condition to construction of new fishway systems. As Pilgrim Lake provides necessary spawning grounds for river herring, it is important to consider the opportunities to maximize passability for fish, while balancing cost and long-term operation and maintenance requirements.

Table 6.1 summarizes three potential alternative scenarios, combining various options presented throughout this report. Each option includes a rating of effectiveness in fish passage, capital costs, and operation and maintenance requirements ranging from low to high. As previously noted in Section 4, permitting requirements are likely similar for any combination of the presented options, therefore challenges in permitting efforts were excluded for this evaluation.

Table 6.1
Recommended Alternatives

Alternative	Proposed Improvement		Fish Passage Effectiveness	Capital Budget	Operation & Maintenance Requirements
	Sta. 0+00 to 6+50 Natural Channel	Sta. 6+50 to 10+50 Technical Fishway			
1	Deepen channel, improve flow dynamics	Repair existing	Low	Low	High
2	Deepen channel, improve flow dynamics	Replace in-kind	High	High	Medium
3	Replace with nature-like hybrid	Replace with nature-like hybrid	High	Medium	Low to Medium

As the low cost solution, Alternative 1 will make necessary repairs to the existing fishway and provide flow and channel improvements to the natural channel segment. In order for this alternative to achieve a 50-year lifespan, aggressive maintenance will be required consisting of inspection and repair of the technical fishway segment through structural improvements on an as needed basis, as well as regular management of natural stream channel improvements which will require a sediment management program and potentially routine dredging to maintain the necessary channel depth.

Alternative 2 improves on Alternative 1 with the replacement of the technical fishway segment rather than simply repair efforts. Replacement of the technical fishway in-kind or with a similar concrete structure can achieve a 50-year lifespan with reduced maintenance than that of Alternative 1, yet will require an increased capital investment

due to construction of new fishway components. Improvements to the natural channel with a deepened channel and improved flow dynamics will continue to require regular maintenance with sediment accumulation control and potential routine maintenance dredging.

Alternative 3 involves a complete reconstruction of both the technical fishway and natural stream channel to introduce nature-like fishway components to create pool and weir structures incorporating natural materials. A hybrid approach to a nature-like fishway uses concrete weir structures with footings to withstand freeze/thaw cycle heaving and maintain weir elevations. It would be dressed with natural materials to illicit a natural stream aesthetic while improving water depth and velocity to promote fish passage. It is expected that the number of pools and weirs could be reduced based on the up and downstream constraints in elevation, which reduces construction materials costs. Maintenance of this system would still require inspection and maintenance, however those annual costs are expected to be lower than other alternatives due to the decrease in infrastructure, but may not require routine dredging if designed to maintain sediment transport velocities.

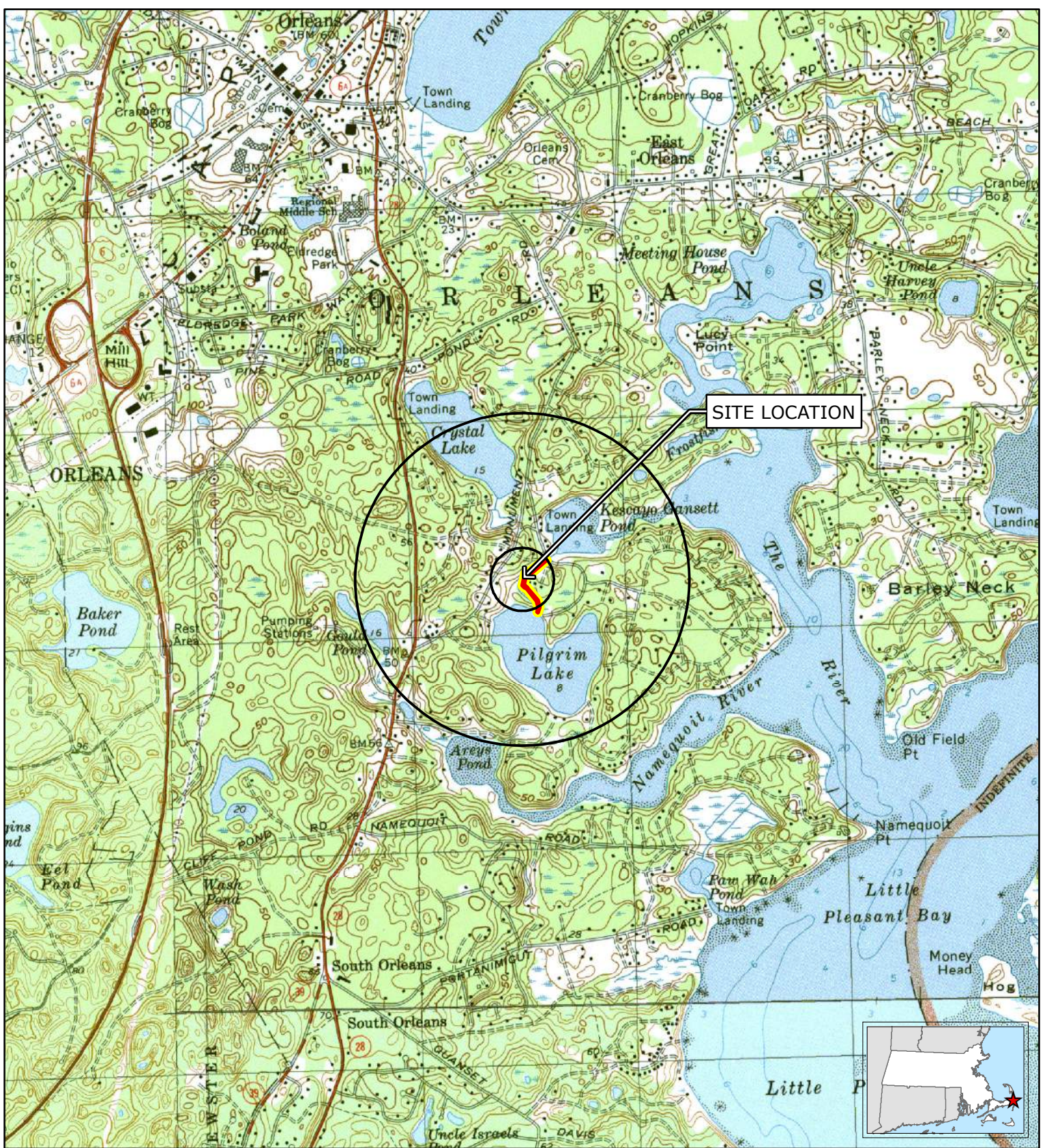
Regardless of the alternative selected, the next steps for consideration include:

1. Install flow measurement devices at various locations to evaluate how flow changes throughout the spring migration season, as well as tidal influence on the hydraulics of the system.
2. Conduct a topographic, bathymetric, and property line survey of the entire fishway and brook, including the Herring Brook Way culvert. Conduct a geotechnical investigation of the Herring Brook Way culvert should replacement be considered.
3. Consult with local experts from DMF, NRCS, and/or the US Fish and Wildlife Service to review fishway alternatives and determine specific design criteria of the target species that is appropriate for this site. Perform hydrologic and hydraulic modeling of Herring Brook system to evaluate flow conditions during the fish migration period, as well as for low flow and storm event conditions. Evaluate preferred design alternatives to select weir and pool sizing and spacing and conform passability of the target species.
4. Advance conceptual design of the preferred design alternative(s).
5. Initiate a pre-filing consultation meeting with regulatory agencies to discuss the preferred alternative and to establish the likely permitting pathway.


A photograph of a concrete drainage channel with wooden weirs. The channel is filled with water, and the weirs are made of wood. The channel is set in a concrete structure. The background is a solid blue color.

Tighe&Bond

APPENDIX A

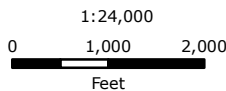


Legend

 Subject Parcel

Tighe & Bond

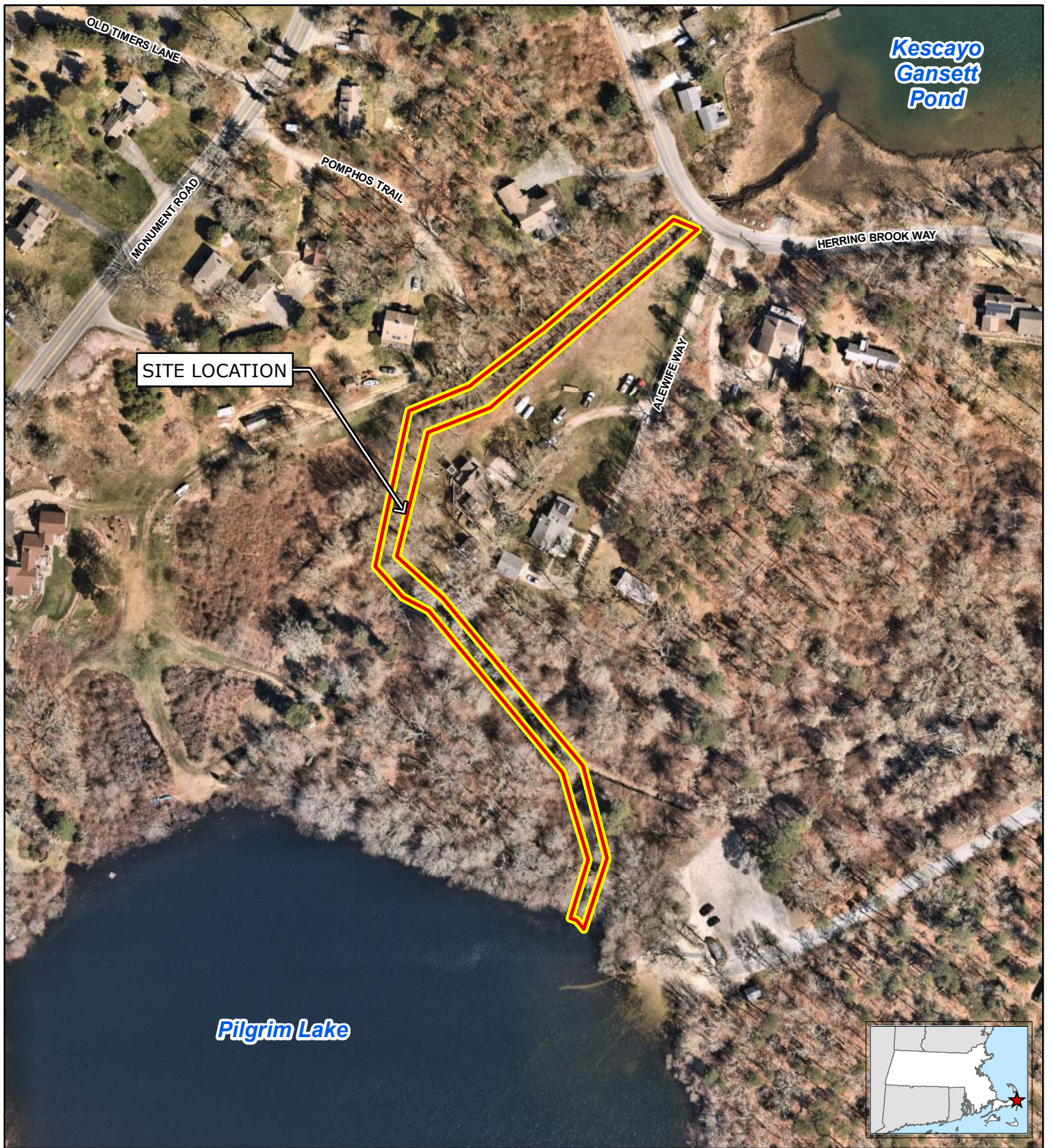
Based on USGS Topographic Map for Orleans, MA Revised 1977 (Site Quad), Harwich, MA Revised 1974, Chatham, MA Revised 1974. Contour Interval Equals 10-foot. Circles indicate 500-foot and half-mile radii. Orleans parcel data (FY 2023) courtesy of MassGIS.




**FIGURE 1
SITE LOCATION**

Orleans Fishway Evaluation
Orleans, Massachusetts

January 2024

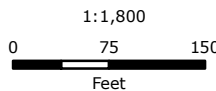


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 Subject Parcel

Tighe & Bond

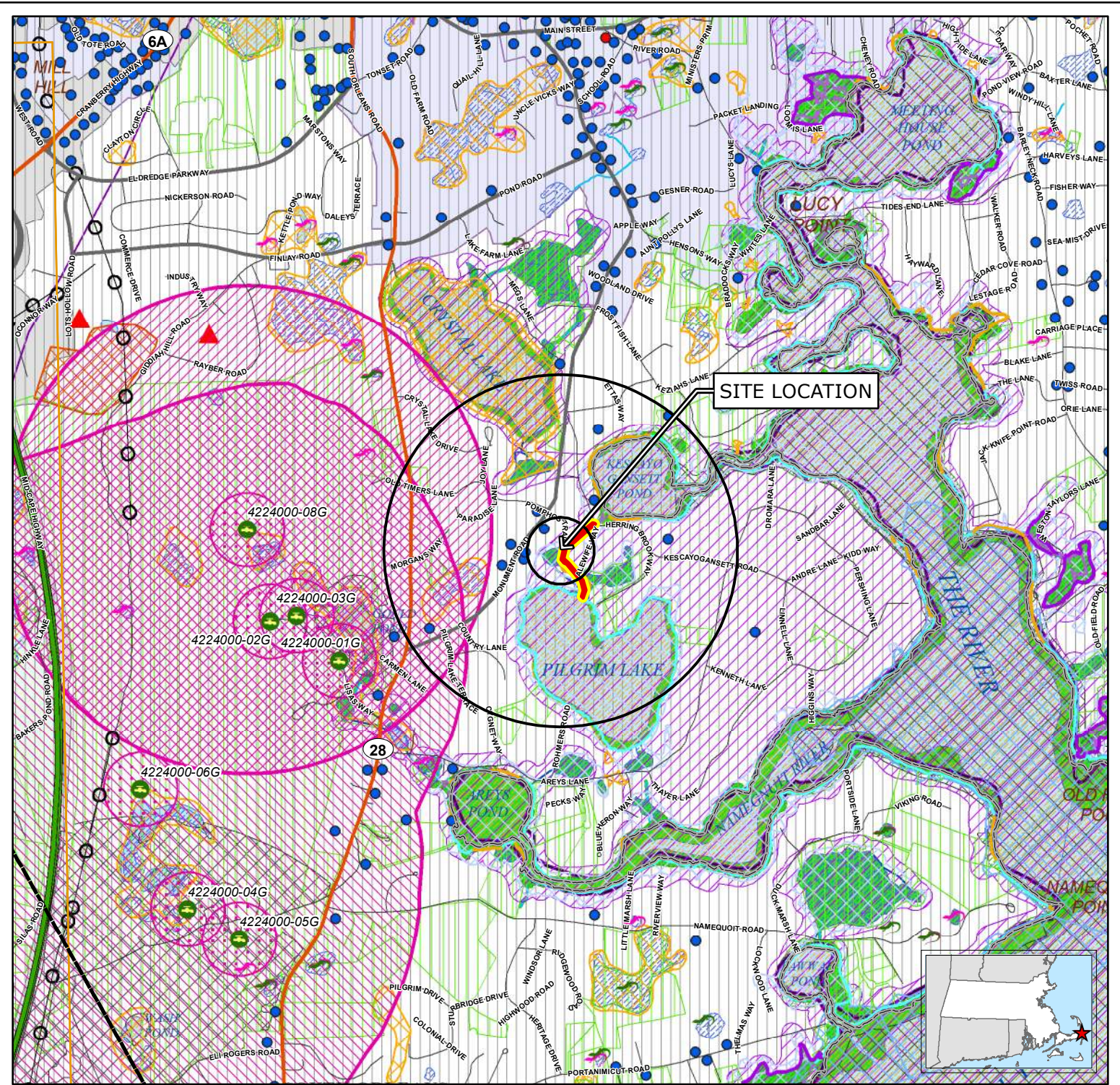
Based on Nearmap Color Orthophotography (2023)
Orleans parcel data (FY 2023) courtesy of MassGIS.



**FIGURE 2
ORTHOPHOTOGRAPH**

Orleans Fishway Evaluation
Orleans, Massachusetts

January 2024



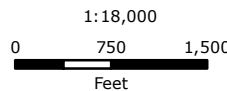
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- | | | | |
|--|---|--|---|
| <ul style="list-style-type: none"> ● National Register of Historic Places ● MHC Inventoried Property 🌿 NHESP Certified Vernal Pools 🌿 NHESP Potential Vernal Pools 🌿 Community Public Water Supply - Groundwater 📏 Marsh Boundary - landward 📏 Jurisdiction 📏 Historic High Water 📏 Marsh Boundary - seaward 📏 Contemporary High Water 📏 Inferred Contemporary High Water 📏 Inferred Historic High Water | <ul style="list-style-type: none"> 📏 Limited Access Highway 📏 Other Numbered Route 📏 Major Road - Arterials and Collectors 📏 Minor Street or Road 📏 Hydrologic Connections 📏 Stream/Intermittent Stream ⚡ Powerline 📏 Track or Trail 📏 DEP Approved Wellhead Protection Area (Zone I) 📏 DEP Approved Wellhead Protection Area (Zone II) 📏 DEP Interim Wellhead Protection Area (IWPA) 📏 Protected and Recreational Open Space 📏 Solid Waste Landfill 📏 Area of Critical Environmental Concern (ACEC) 📏 100 Year Flood Zone 📏 100 Year Flood Zone (Coastal) 📏 500 Year Flood Zone | <ul style="list-style-type: none"> 📏 NHESP Priority Habitats for Rare Species 📏 NHESP Estimated Habitats for Rare Wildlife 📏 EPA Designated Sole Source 📏 Major Drainage Basin 📏 Sub Drainage Basin 📏 MassDEP Open Water 📏 MassDEP Inland Wetlands 📏 MassDEP Coastal Wetlands 📏 Water Bodies 📏 Public Water Supply Contributor 📏 Other ORW 📏 Non-Potential Drinking Water Source Area - Medium Yield 📏 County Boundary 📏 Municipal Boundary 📏 USGS Quadrangle Sheet Boundary 📏 Local Historic District 📏 Inventoried Property | <ul style="list-style-type: none"> 📏 Subject Parcel 📏 Migratory Habitat <ul style="list-style-type: none"> 📏 No 📏 Yes 📏 River Herring Spawning Nursery Habitat <ul style="list-style-type: none"> 📏 No 📏 Yes |
|--|---|--|---|

FIGURE 3
PRIORITY RESOURCES

Orleans Fishway Evaluation
Orleans, Massachusetts

Data source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology, Massachusetts Division of Marine Fisheries (DMF). Circles indicate 500-foot and half-mile radii. Data valid as of January 2024.



January 2024



CONCEPTUAL DRAWINGS

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Herring Brook Way Fish Ladder Rehabilitation

Town of Orleans

DRAWINGS PLOTTED AT HALF SCALE

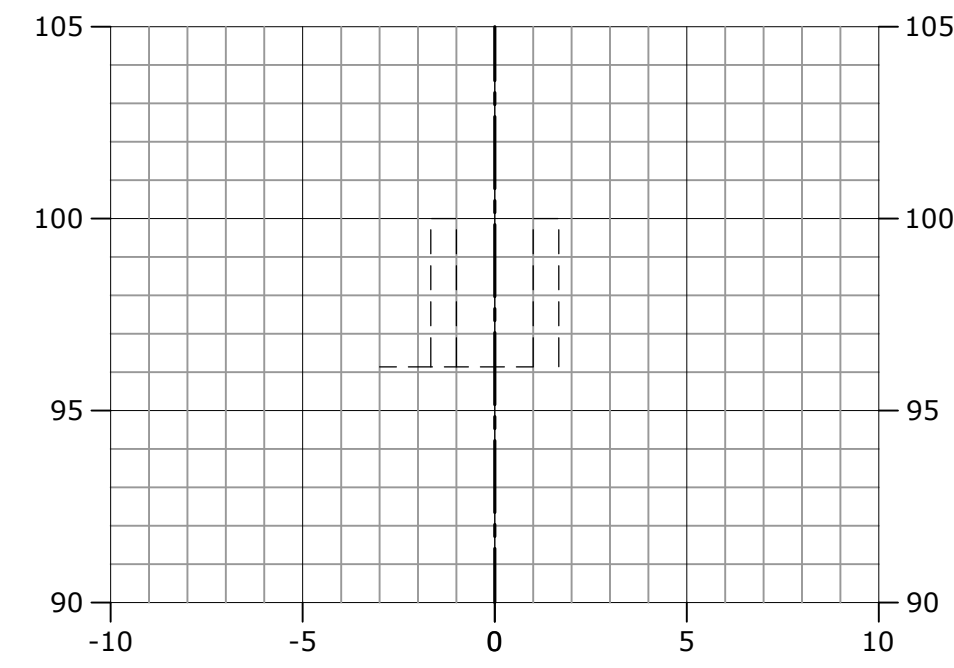
Orleans, MA

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DESIGNED/CHECKED BY:	JEC	
APPROVED BY:	FJH	

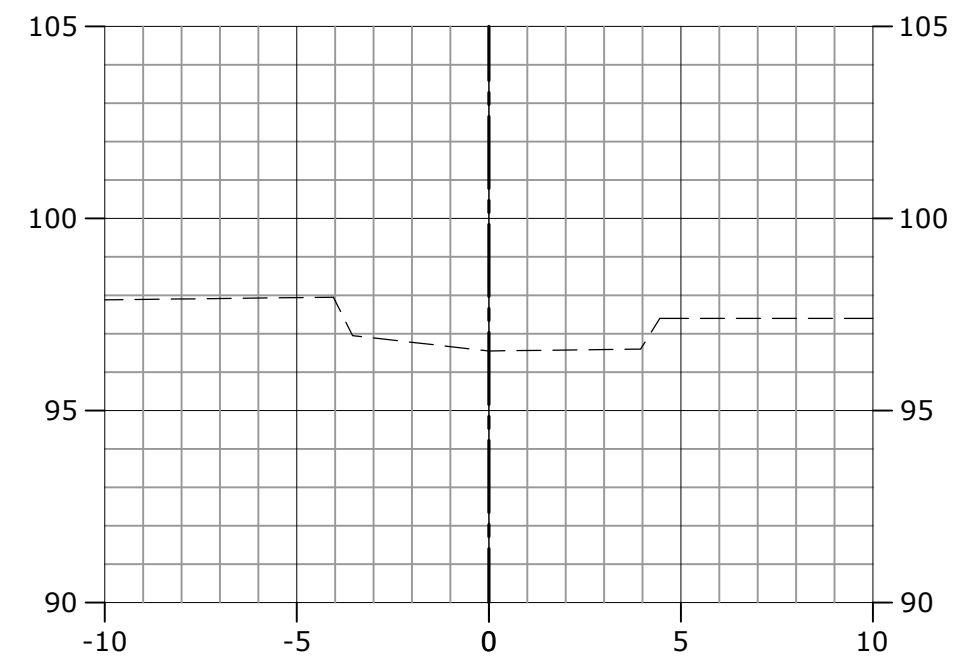
STREAM PLAN AND CROSS SECTIONS

SCALE: AS SHOWN

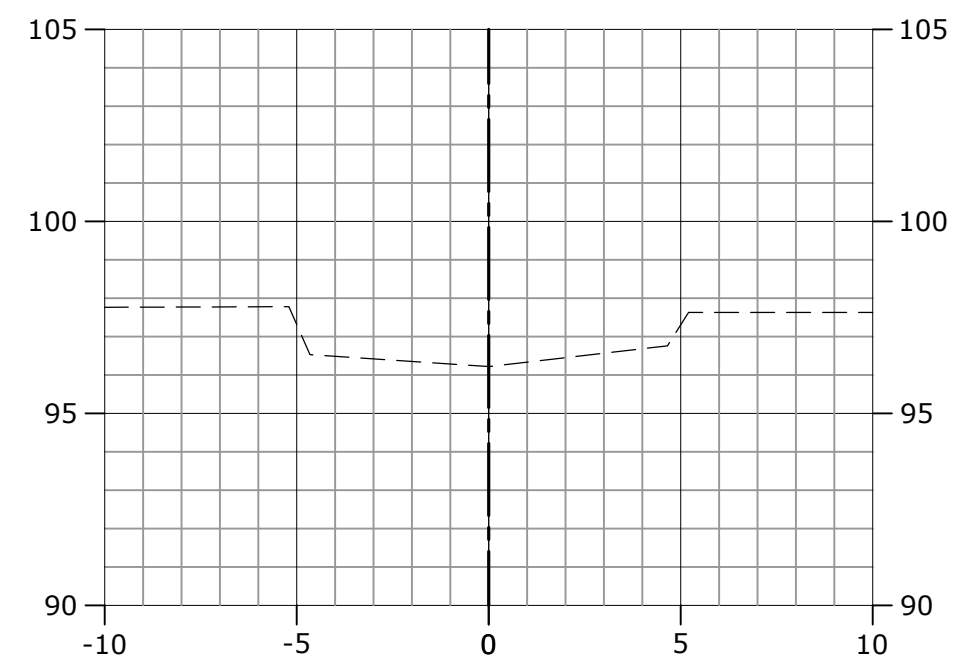
FIGURE 4



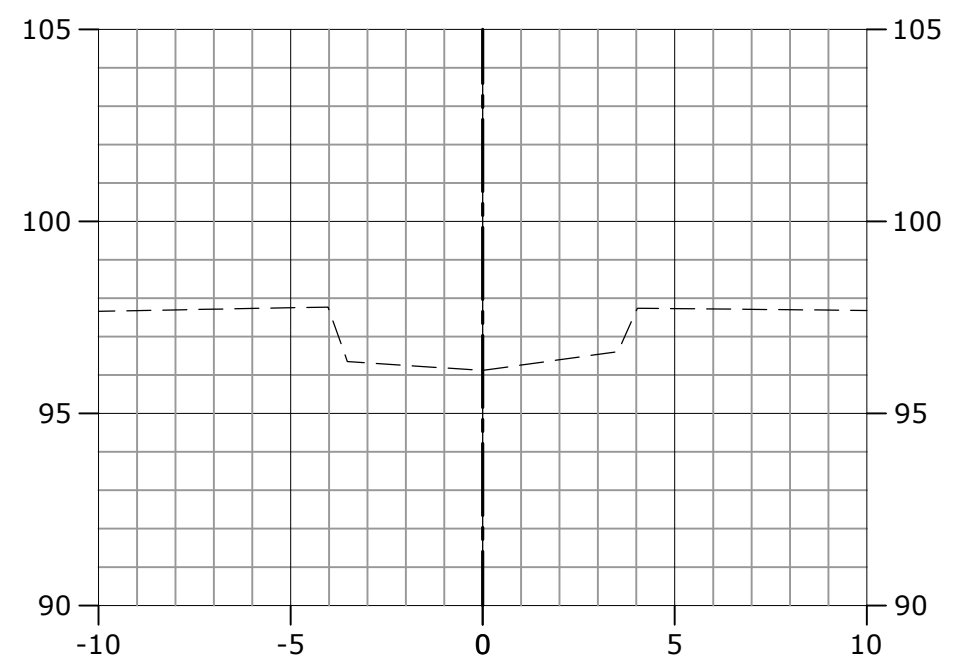
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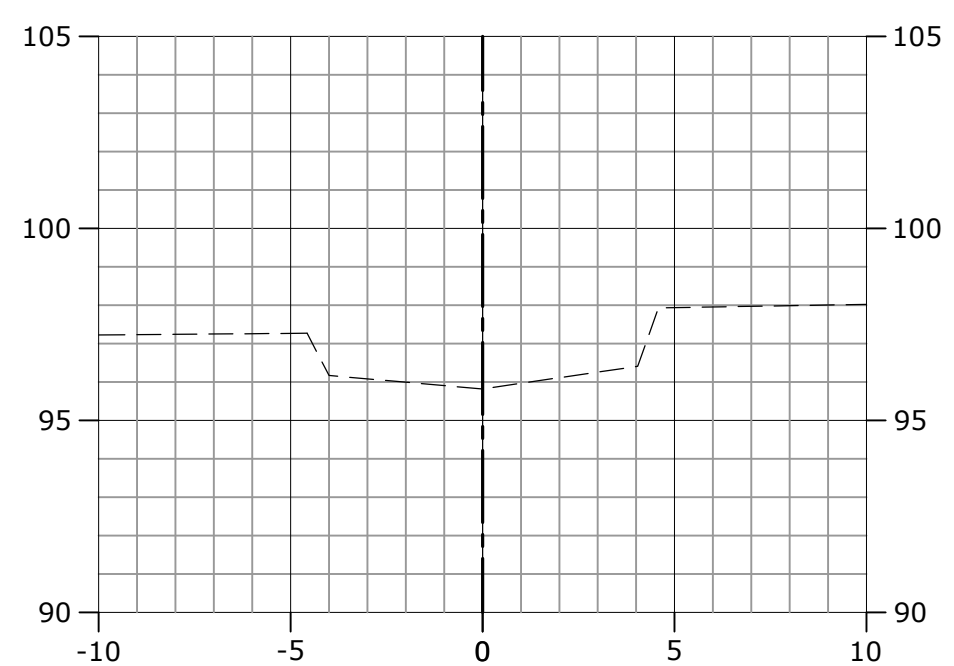
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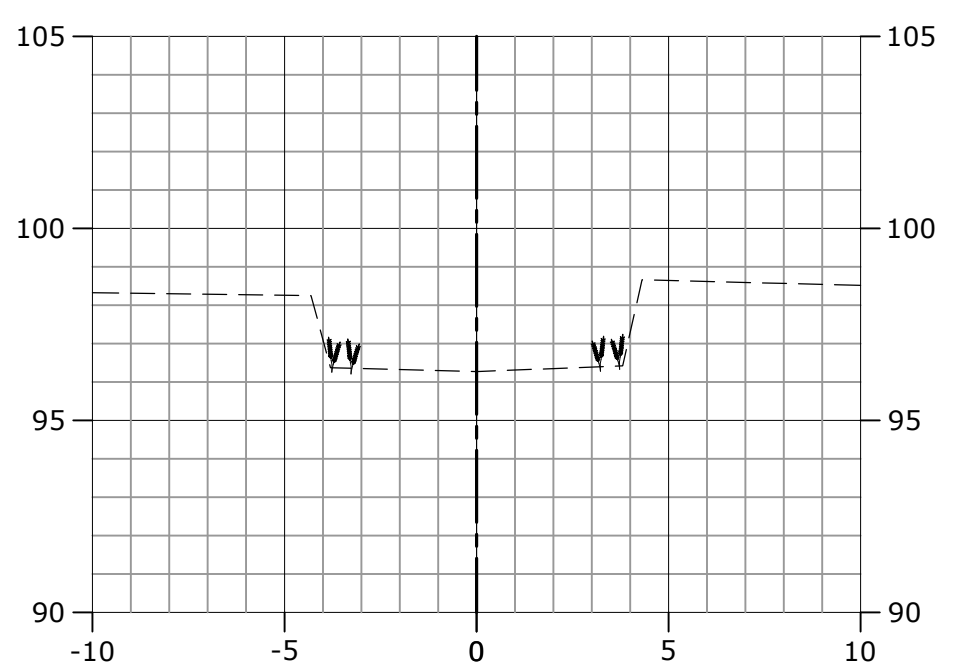
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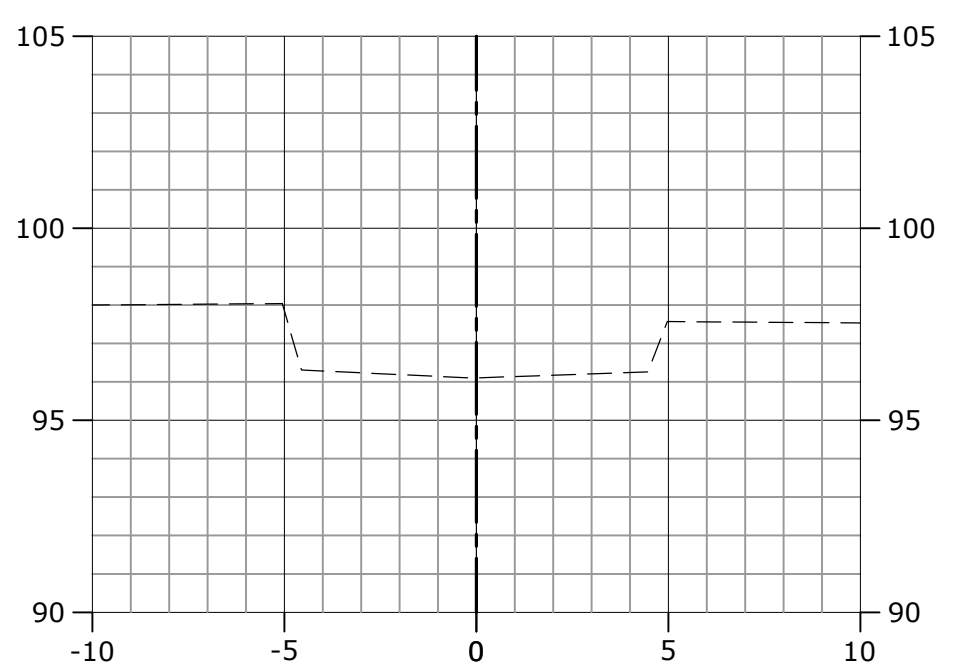
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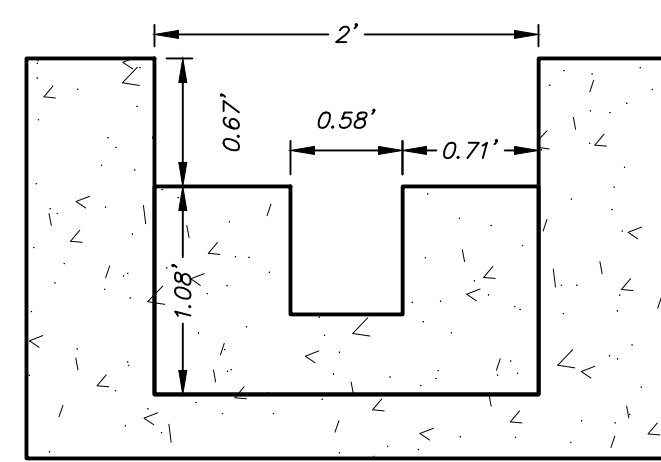
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CROSS SECTION: SL-5



STATION: 5+23
CROSS SECTION: SL-6

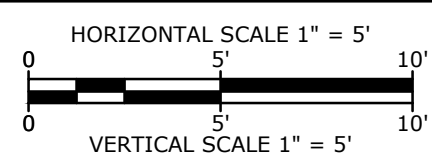


STATION: 6+03
CROSS SECTION: SL-7



TECHNICAL FISHWAY

STREAM CROSS SECTIONS



STREAM PLAN

SCALE: 1"=60'

SCALE: 1"=60'

CONCEPTUAL DRAWINGS

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Herring Brook Way Fish Ladder Rehabilitation

Town of Orleans

DRAWINGS PLOTTED AT HALF SCALE

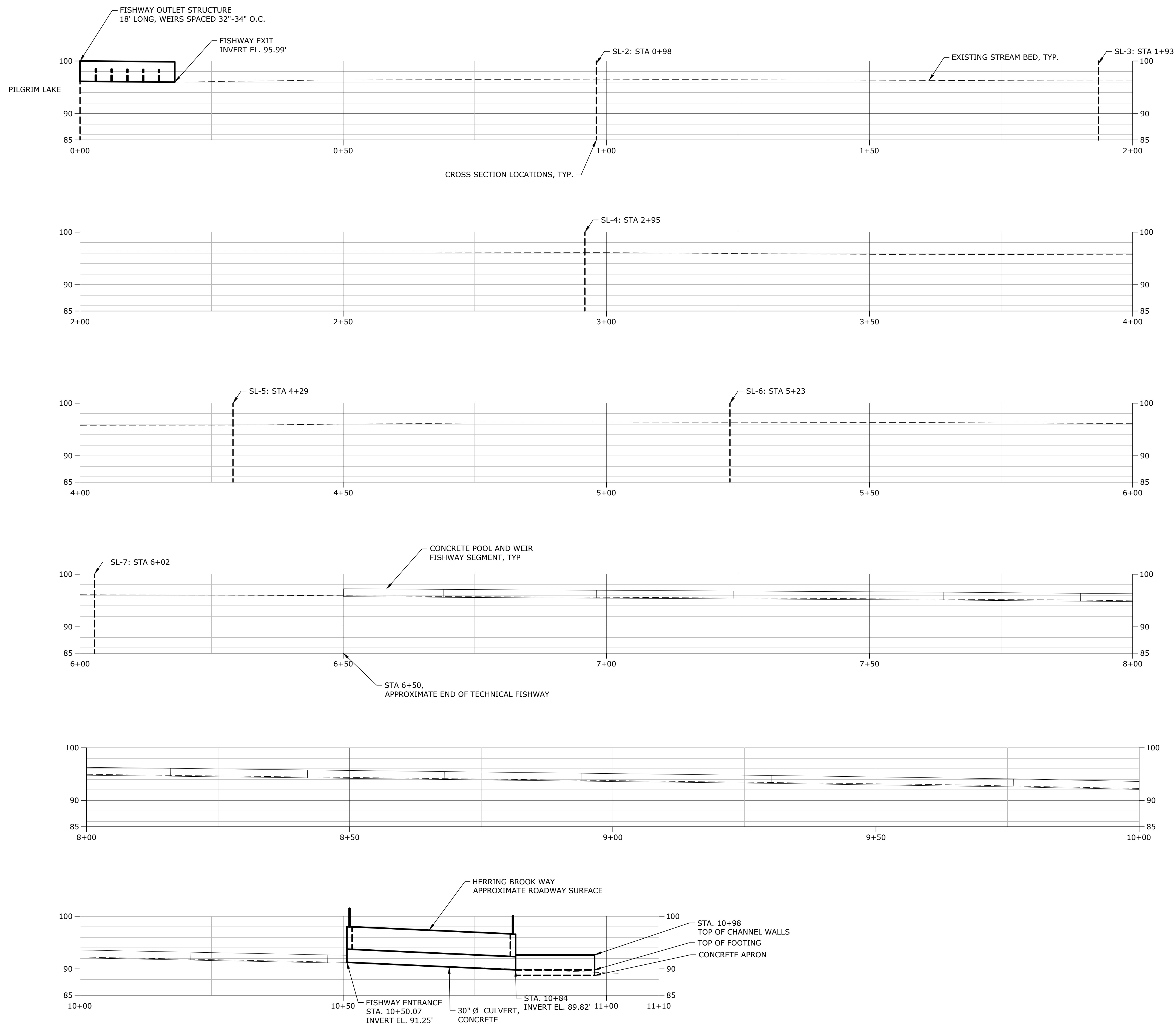
Orleans, MA

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DESIGNED/CHECKED BY:	JEC	
APPROVED BY:	FJH	

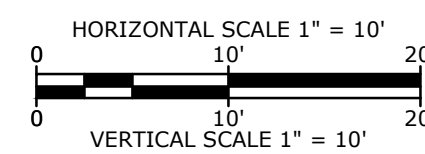
STREAM PROFILE

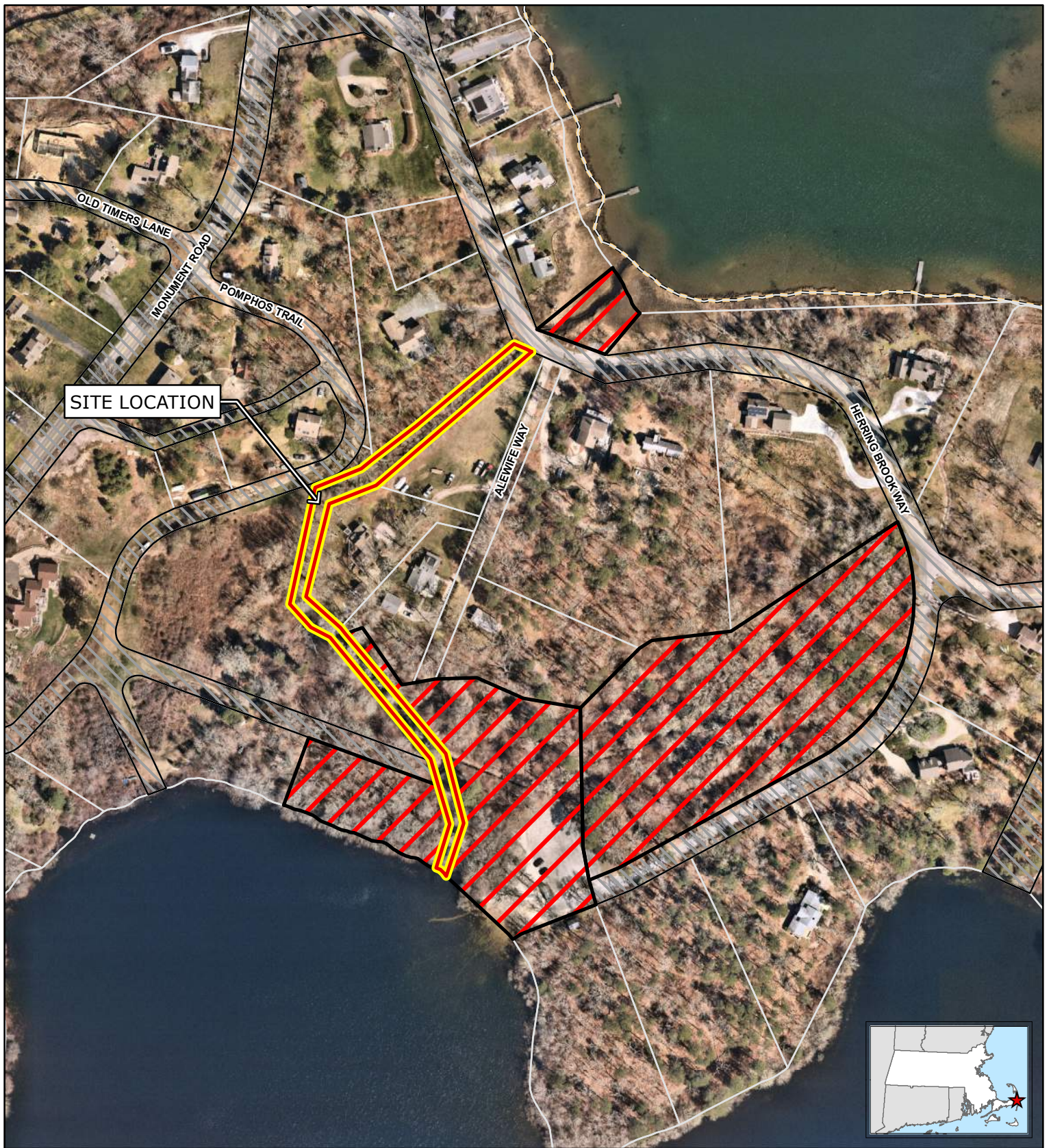
SCALE: AS SHOWN

FIGURE 5



STREAM PROFILE



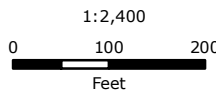


Legend

-  Subject Parcel
-  Other Parcel Boundary
-  Town-Owned Parcel
-  Public Right of Way



Based on Nearmap Color Orthophotography (2023)
 Orleans parcel and assessor data (FY 2023) courtesy of MassGIS.




**FIGURE 6
 TOWN-OWNED PARCELS**

Orleans Fishway Evaluation
 Orleans, Massachusetts

January 2024



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