

SHANNOCK FISH PASSAGE FEASIBILITY STUDY

**PAWCATUCK RIVER
RICHMOND AND CHARLESTOWN, RHODE ISLAND**

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MMI #2989-01



Prepared for:

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EXECUTIVE SUMMARY

The Wood-Pawcatuck Watershed Association in partnership with the Town of Richmond has been awarded funding through the National Oceanic and Atmospheric Administration-American Rivers partnership and the Rhode Island Coastal Resources Management Council to conduct a Feasibility Study to assess anadromous fish passage and riverine habitat restoration at three dam sites on the Pawcatuck River in Richmond and Charlestown, Rhode Island. This document presents the detailed analysis of restoration alternatives. Figure ES-1 is a location plan of the project corridor identifying the three dams.

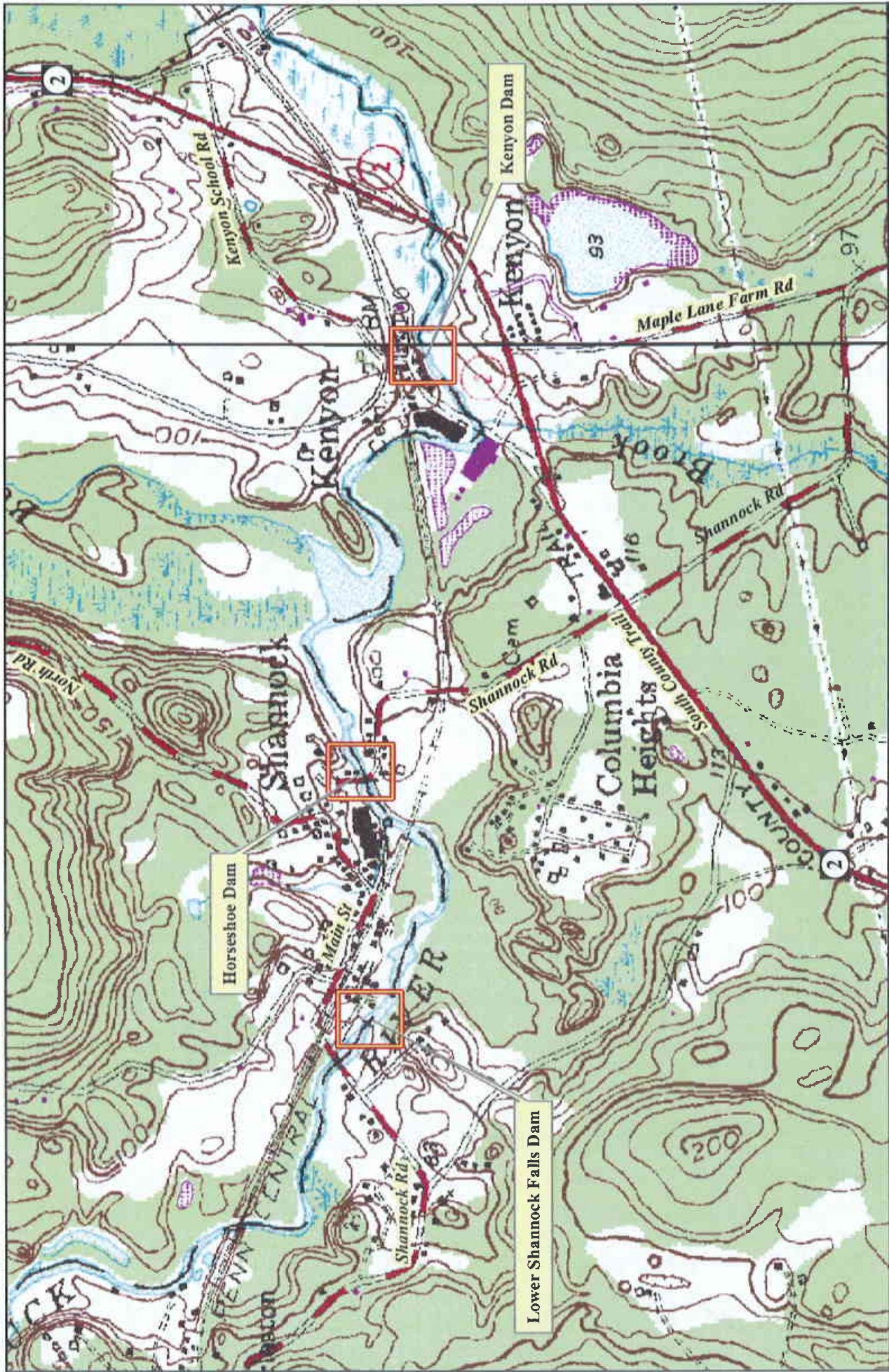
The Pawcatuck River watershed encompasses a total drainage area of 317 square miles. Approximately 260 square miles lie within Rhode Island; the remaining 57 square miles lie within Connecticut. The basin is approximately 25 miles long and 24 miles wide at its widest point. The upper and middle portions of the basin are characterized by gently rolling hills interspersed with wetlands and ponds. The Pawcatuck River meanders 33 miles through rural areas in Rhode Island before entering a more urban setting in the Westerly-Pawcatuck area. The lower five miles of the Pawcatuck River are tidal. The river flows in to the Narragansett Bay.

Historically, it is believed that the Pawcatuck River was of regional importance to diadromous fisheries, including Atlantic salmon and American shad. The system may have also supported a strong brook trout population. Over the last several centuries, the river has been physically and ecologically altered as a result of human activity. The many dams placed within the river have impacted the anadromous and resident fisheries habitat.

Three early run-of-the-river dams are located on the main stem of the Pawcatuck River, all of which currently block fish passage. From downstream to upstream, they are known as the Lower Shannock Falls Dam, the Upper Shannock Horseshoe Falls Dam, and the Kenyon Mill Dam. The Lower Shannock Falls Dam is located approximately 25 river miles above the estuary. The Upper Shannock Horseshoe Falls Dam is located approximately one-half mile above the Lower Shannock Falls Dam; the Kenyon Mill Dam is located an additional three-quarters of a mile upstream of the Upper Shannock Horseshoe Falls Dam. These three dams are currently the furthest upstream fish blockages to spawning and nursery habitat.

The following goals and objectives have been identified for the restoration of the Pawcatuck River:

- Achieve diadromous and resident fish passage;
- Improve riverine habitat conditions;
- Maintain or enhance aesthetics;
- Address dam safety;
- Minimize long-term dam maintenance;
- Consider and address cultural resources; and
- Identify cost-effective solutions.



Location: **Richmond & Charlestown, RI**

Date: April 2007

Scale: 1" = 1,000'

Sheet: **Figure ES-1**

Site Location Map

Shannock Fish Passage Feasibility Study

MMI#: 2989-01
 MXD: H:\Site.mxd
 Source: RIGIS

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View of Lower Shannock Falls Dam from the right bank



View of Upper Shannock Horseshoe Falls Dam looking upstream



View of Kenyon Mill Dam from the right bank

RESTORATION ALTERNATIVES CONSIDERED

A total of 13 alternatives were evaluated at the Lower Shannock Falls, Upper Shannock Upper Shannock Horseshoe Falls, and Kenyon Mill dams. These are summarized in Table ES-1. Conceptual renderings for selected alternatives are included as figures in the body of this document. Conceptual design drawings for alternatives are appended, and show plan and profile views. Evaluated alternatives include installation of fish ladders, dam removal, high gradient riffles, and bypass channels.

**TABLE ES-1
Summary of Alternatives Considered**

<i>Alternative</i>	<i>Description</i>
<i>Lower Shannock Falls Dam</i>	
S-1	No Action
S-2	Fish Ladder on Right Bank
S-3	Full Dam Removal
S-4	Bypass Channel Through Right Raceway
<i>Upper Shannock Horseshoe Falls Dam</i>	
H-1	No Action
H-2a	High Gradient Riffles at Right Raceway
H-2b	Fish Ladders at Raceway
H-3	Fish Ladder at Left Abutment
<i>Kenyon Mill Dam</i>	
K-1	No Action
K-2	Fish Ladder on Right Bank
K-3	Bypass Channel through Existing Breach
K-4	Full Dam Removal
K-5	High Gradient Riffle

Table ES-2 summarizes the above alternatives with regard to their ability to meet the project goals and objectives. Preliminary engineering opinions of costs were developed for the most feasible alternatives, as well as the no action alternative for each of the three dams. Table ES-3 presents costs for each of the alternatives.

**TABLE ES-2
Summary of Alternatives at Kenyon Mill Dam**

<i>Alternative</i>	<i>Description</i>	<i>Achieves Fish Passage?</i>	<i>Improves Habitat Conditions?</i>	<i>Minimizes Long Term Dam Maintenance?</i>	<i>Potential for Impact to Historic Resources?</i>	<i>Prudent and Feasible Alternative?</i>
S-1	No Action	No	No	No	No	No
S-2	Fish Ladder	Yes	No	No	Yes	Maybe
S-3	Full Dam Removal	Yes	Yes	Yes	Yes	Yes
S-4	Bypass Channel	No	No	No	Yes	No
H-1	No Action	No	No	No	No	No
H-2	Ladder/Bypass Channel	Maybe	No	No	Yes	No
H-3	Ladder -- Left Abutment	Yes	No	No	Yes	Yes
K-1	No Action	No	No	No	No	No
K-2	Fish Ladder	Yes	No	No	Yes	Yes
K-3	Bypass Channel	Yes	No	No	Yes	Yes
K-4	Full Dam Removal	Yes	Yes	Yes	Yes	Yes
K-5	High Gradient Riffle	Yes	No	Yes	Yes	No

**TABLE ES-3
Cost Summary of Individual Alternatives**

<i>Alternative</i>	<i>Description</i>	<i>Total Cost</i>
<i>Lower Shannock Falls Dam Alternatives</i>		
S-1	No Action	\$370,000
S-2	Fish Ladder on Right Bank	\$450,000
S-3	Full Dam Removal	\$413,000
<i>Upper Shannock Horseshoe Falls Dam Alternatives</i>		
H-1	No Action	\$217,000
H-2	Fish Ladders at Right Raceway	\$421,000
H-3	Fish Ladder at Left Abutment	\$308,000
<i>Kenyon Mill Dam Alternatives</i>		
K-1	No Action	\$132,000
K-2	Fish Ladder at Right Bank	\$169,000
K-3	Bypass Channel through Existing Breach	\$226,000
K-4	Full Dam Removal	\$384,000
K-5	High Gradient Riffle	\$288,000

As indicated in Table ES-3, cost opinions fall within a close range. The least costly "action" alternatives are full dam removal at the Shannock Dam, installation of a fish ladder at the left abutment at the Upper Shannock Horseshoe Falls Dam, and installation of a fish ladder at the right bank at the Kenyon Mill Dam. Recommended alternatives are summarized in Table ES-4.

**TABLE ES-4
Summary of Recommended Alternatives**

<i>Location</i>	<i>Recommended Alternative</i>		
Lower Shannock Falls Dam	S-3	Full Dam Removal	\$413,000
Upper Shannock Horseshoe Falls Dam	H-3	Fish Ladder at Left Abutment	\$308,000
Kenyon Mill Dam	K-4	Full Dam Removal	\$384,000

It is important to note that the recommended alternatives are believed to meet the project goals and objectives, and are all believed to be technically feasible. However, the ultimate selection of preferred alternatives will depend upon a balance of cost, potential ecological benefits, and potentially public input. For example, while full dam removal is recommended at Kenyon Mill Dam, the fish ladder option is the least costly alternative.

In addition to the restoration elements involving fish passage, channel restoration should be considered as part of any future activities. The existing habitat upstream of the dams consists of wide pools with low velocities. Preferred habitat includes mixed pool, runs, and riffles, with intermediate velocities and increased cover. As part of any stream restoration effort, consideration should be given to creating in-stream channel enhancements to add stream features that will increase the habitat diversity. These types of stream improvements can be coupled with any of the selected alternatives.

Executive Summary.doc

Section 1

1.0 INTRODUCTION

1.1 Project Background

The Wood-Pawcatuck Watershed Association (WPWA) in partnership with the Town of Richmond, has been awarded funding through the National Oceanic and Atmospheric Administration (NOAA) - American Rivers (AR) partnership and the Rhode Island Coastal Resources Management Council to conduct a Feasibility Study to assess diadromous fish passage and habitat restoration at three dam sites on the Pawcatuck River in Richmond and Charlestown, Rhode Island.

The subject study has been undertaken to assess the feasibility of providing diadromous fish passage past three dams to the upper Pawcatuck River, including the Beaver, Usquepaug, and Chipuxet tributaries. The dams are located on the main stem of the Pawcatuck River, and currently represent the furthest upstream fish blockages to upstream spawning and nursery habitat. From downstream to upstream, they are known as the Lower Shannock Falls Dam, the Upper Shannock Horseshoe Falls Dam and the Kenyon Mill Dam. Figure 1-1 is a location plan of the project corridor.

The WPWA retained Milone & MacBroom, Inc. (MMI) to evaluate various alternatives to restore access to historic upstream habitat for species including American shad, river herring, and American eel, as well as brook trout and other resident fish species. Various fish passage alternatives have been considered for each of the three dams, including structural fishways, bypass channels, high gradient riffles, and full or partial dam removal.

The following goals and objectives have been identified for the restoration of the subject reaches of the Pawcatuck River: