4.14 BIODIVERSITY, WILDLIFE, AND VEGETATION

4.14.1 Introduction

This chapter describes the biological resources and evaluates impacts, both direct and indirect, within and adjacent to the South Coast Rail project corridors in terms of biodiversity, including plant communities, fish and wildlife, and vernal pool habitat for each alternative and its project elements. Threatened and Endangered Species are described in Chapter 4.15. Background information on the proposed project and a summary of each of the alternatives under consideration are provided in Chapter 2 and Chapter 3. Regulatory jurisdiction and compliance with local, state, and federal regulations is discussed as well as measures to minimize, mitigate and compensate for impacts.

This section provides information relative to biodiversity and associated regulations, identifies the Project study area and provides a regional overview of biodiversity including BioMap and Living Water Core Habitats, plant communities, fish and wildlife. Section 4.14.2 describes existing conditions within the study area, relative to biodiversity and Section 4.14.3 describes potential impacts and mitigation measures.

4.14.1.1 Resource Definition

Biological diversity, or "biodiversity," is an assessment of the numbers, types, and relative abundance of plant and animal species in natural communities. It also describes their relationships to each other and their interactions with the environment. There are three levels of biodiversity; the first is based on the genetic differences among individuals, the second on species richness (i.e. the abundance or rarity of species in a landscape), and the third on the variety of habitats, communities, ecosystems, and landscapes in which those species occur. The concept of biodiversity plays an important role in the connections within and between these levels, and how the interrelated elements sustain the system as a whole. Higher levels of biodiversity are important in maintaining robust ecological communities. This report evaluates the species richness and the variety of habitats, communities, ecosystems, and landscapes in which those species occur within the study area.

All biotic community analyses were conducted in accordance with the requirements of NEPA of 1969;[1] CEQ's *Incorporating Biodiversity Considerations Into Environmental Impact Analysis Under the National Environmental Policy Act*.[2] In January 1993, the CEQ, in conjunction with the USEPA, prepared a report on biodiversity and how biodiversity conservation can be incorporated into NEPA analyses. CEQ's *Incorporating Biodiversity Considerations Into Environmental Impact Analysis Under the National Environmental Policy Act* is intended to assist federal agencies in fulfilling their responsibilities under NEPA in the context of biological diversity, by identifying situations where consideration of biodiversity under NEPA is appropriate and to strengthen their effects to do so.[3] For this chapter, biodiversity is described primarily in terms of important wildlife and vegetative resources or "biotic communities" that are known to occur in the South Coast Rail study area. Biotic communities are populations of different organisms including fish, wildlife, and plants that live together in a particular place. Biotic communities are ecological systems in which the natural resources are interdependent. Rare species represent one of

[1] National Environmental Policy Act of 1969, as amended. Pub. L. 91-190, 42 U.S.C. 4321-4347, January 1, 1970, as amended by Pub. L. 94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, and Pub. L. 97-258, § 4(b), Sept. 13, 1982.

[2] Council on Environmental Quality. Incorporating Biodiversity Considerations into Environmental Impact Analysis under the National Environmental Policy Act. Washington, DC: U.S. Council on Environmental Quality. TIC: 241456. (1993).

[3] Ibid.

the most sensitive elements of biodiversity and are addressed specifically in Chapter 4.15, *Threatened and Endangered Species*.

4.14.1.2 Regulatory Context

There are currently no applicable federal or state regulations that specifically regulate biodiversity. However, federal and state laws (Endangered Species Act)[4,5] protect rare plants and animals and their critical habitats, and state regulations (Wetland Protection Act)[6] protect the wildlife habitat value of wetlands. Vernal pool habitats are protected under the Massachusetts Water Quality Certification[7] standards as Outstanding Resource Waters. The consequences of the proposed South Coast Rail alternatives are evaluated for comparative purposes under the environmental jurisdiction of MEPA and NEPA. The Secretary's Certificate on the Environmental Notification Form (ENF) identified the need for (1) a baseline ecological assessment and maps and graphics indicating biodiversity values for the project area and (2) a description of the indicators and metrics used to assess biodiversity, including the weighting system used to differentiate among habitat values.

The requirements of the Secretary's Certificate on the DEIR are summarized below:

- The FEIR should include the results of breeding bird surveys and other studies conducted to refine the wildlife impact assessment and mitigation plans. The mitigation plans should include time of year restrictions to protect migratory birds, which are protected under the National Migratory Bird Treaty.

- The FEIR should update the vernal pool inventory and impact assessment for the Stoughton Alternative to clarify vernal pool and vernal pool habitat impacts, as agreed by the Interagency Coordinating Group, and to inform the proposed mitigation plan

- The FEIR should include details on the existing conditions at stream crossings, and explain where culverts will be replaced, extended, or modified. The designs for proposed culverts, bridges, or other alterations at stream crossings should incorporate the Massachusetts River and Stream Crossing Standards.

- The FEIR should evaluate potential direct and indirect hydrological changes, opportunities for maximizing hydrological connections between wetlands for enhancement and restoration as well as for flood capacity, and impacts to fish, amphibians, reptiles, and other wildlife passage.

- The FEIR should include an analysis of spans and open bottom arches to meet Stream Crossing Standards, and consider such arches as mitigation measures throughout the entire rail alignment to the extent they are practicable to improve fish and wildlife passage, and do not interfere with safe train operations.

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[4] Endangered Species Act of 1973, Section 7(16 USC 1531 et seq., as amended), United States Fish and Wildlife Service.

[5] Massachusetts Endangered Species Act of 1990 (MESA [321 CMR 10.00: MGL c. 131A.]), Natural Heritage Endangered Species Program.

[6] Massachusetts Wetlands Protection Act regulations (WPA [310 CMR 10.00 et seq.]).

[7] Massachusetts Water Quality Certification (Section 401 of the Clean Water Act [MGL c. 21 §§ 26 – 53]).

- The FEIR should include mitigation proposals for any unavoidable impacts from bridges and culverts.
- The FEIR should include a summary of the CAPS analysis of ecological integrity impacts associated with the proposed project and the results of additional analysis on the proposed improvements in the Index of Ecological Integrity (IEI) as a result of proposed mitigation measures.

4.14.1.3 State Wildlife Action Plan

The State Wildlife Action Plan (September 2006) is a Comprehensive Wildlife Conservation Strategy (CWCS) developed by the Massachusetts Division of Fisheries and Wildlife (DFW) with the goal of conserving wildlife biodiversity in Massachusetts. The CWCS describes past successful efforts to conserve the biodiversity of the Commonwealth and a review of the landscape changes that have affected wildlife populations. It identifies species and habitats in the greatest need of conservation and lists the primary strategies that DFW plans to use to conserve these species and their habitats through coordination and partnerships with governmental and non-governmental agencies and organizations.

The CWCS identifies seven broad conservation strategies for species and habitats in greatest need of conservation. These include: habitat protection, surveys and inventories of the CWCS species and habitats, conservation planning, environmental regulation, habitat restoration and management, coordination and partnerships, and conservation/environmental education.

The CWCS does not designate specific areas for protection of high diversity. However, it proposes specific conservation actions for each habitat. A summary of common conservation actions among these habitats includes:

- Determining Species Habitat Polygons for each current occurrence of a state-listed animal;
- Locating, mapping, and field-surveying a selected percentage of habitats that are used by rare and uncommon animals;
- Conducting research and surveying for habitats and species of greatest conservation needs that are under-surveyed in Massachusetts;
- Protecting land and areas along waters that support populations of rare and uncommon animals;
- Regulating and limiting the impacts of development on habitats used by state-listed animals;
- Coordinating and working with local agencies and other organizations;
- Identifying and implementing new and old restoration efforts within these habitats and documenting their effects on rare and uncommon species;
- Funding and researching the natural history of animals found within these habitats;
- Informing and educating the public and local decision makers about the value of habitat and species biodiversity and issues related to their conservation; and

- Monitoring and assessing the effectiveness of these conservation actions.

Habitat types found within the study area are discussed below.

4.14.2 Existing Conditions

4.14.2.1 Regional Overview

This chapter includes a general description of the study area and identifies the associated bioregions and major concentrations of Core Habitats along the project corridors.

Study Area

The South Coast Rail study area is considered to be the region of southeastern Massachusetts consisting of southern Bristol and Plymouth Counties, bordering on Buzzards Bay or Mount Hope Bay, including the cities of Fall River and New Bedford and nearby towns. For purposes of this chapter, the study area is the portion of the South Coast region that is adjacent to or crossed by the Build Alternatives. Potential impacts are evaluated in Section 4.14.3 to include all mapped cover types within the proposed limits of work, regardless of the distance from the track center line.

Within the study area, the corridors associated with the alternatives intersect areas that contain wetlands and undeveloped ecosystems that provide higher biodiversity value than other portions of the corridors. Areas of important biodiversity value include wetland areas such as the Hockomock Swamp, Pine Swamp, Assonet Cedar Swamp, Acushnet Cedar Swamp, and Forge Pond, and upland areas such as the Freetown-Fall River State Forest (Figure 4.14-1). Several of these ecosystems are within ACECs, such as the Hockomock Swamp ACEC (Figure 4.14-2). ACECs are described in detail in Chapter 4.10, *Protected Public Open Space and Areas of Critical Environmental Concern*. Relevant Biodiversity features associated with project alternatives are shown on Figures 4.14-3, 4.14-4, 4.14-5, and 4.14-6.

Bioregions

Bioregions are relatively large land areas characterized by broad, landscape-scale descriptions of their natural features and the environmental processes that influence functions of the entire ecosystem.[8] The USEPA defines Bioregions as Ecoregions which are "*areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources; they are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components.*"[9]

Bioregions provide a useful means for simplifying and reporting on more complex patterns of biodiversity, because they include large-scale geophysical patterns in the landscape that are linked to the faunal and floral assemblages and processes at the ecosystem scale. Bioregions vary in size since they can be defined by different criteria, including physical or ecological criteria such as watersheds or associations of biological communities. For example: The USEPA has identified a set of 13 "ecoregions" in Massachusetts based on geology, hydrology, climate, and the distribution of species. The study area is within the ecoregion called "Bristol Lowland/Narragansett Lowland" which is defined as a region that

[8] Department of Environment and Climate Change, New South Whales Government. Website accessed January 2009. (http://www.environment.nsw.gov.au/bioregions/BioregionsExplained.htm).

[9] U.S. Environmental Protection Agency (EPA),Ecoregions of Massachusetts, Connecticut, and Rhode Island. Website accessed January 2009. (http://www.epa.gov/wed/pages/ecoregions/mactri_eco.htm).

has flat, gently rolling plains, the forests are mostly central hardwoods, and there are numerous wetlands, cranberry bogs, and rivers that drain this area.

Most of the study area is within the Taunton River watershed as defined by the Massachusetts Department of Fish and Game Riverways Program.

As defined by the U.S. North American Bird Conservation Initiative (NABCI) Committee, the entire project area is within the New England/Mid-Atlantic Coast Bird Conservation Region (BCR). BCRs are ecologically distinct regions in North America with similar bird communities, habitats, and resource management issues.

Southeastern Massachusetts Bioreserve

Portions of the study area are within the Southeastern Massachusetts Bioreserve. The bioregion concept can be used to guide land management practices adopted in protected areas such as bioreserves. The Southeastern Massachusetts Bioreserve was designated in 2002 and includes approximately 13,600 acres of land just east of Fall River. The Bioreserve is composed of land units owned and managed by separate entities, including the Commonwealth of Massachusetts, the City of Fall River, and The Trustees of Reservations, a nonprofit land conservation organization. The Bioreserve includes 5,150 acres of the Freetown-Fall River State Forest, 360 acres of the Acushnet Wildlife Management Area, 4,300 acres of watershed and conservation lands owned by the City of Fall River, and 3,800 acres of the former Acushnet Saw Mills property that were acquired by the Commonwealth of Massachusetts and The Trustees of Reservations. The purpose of the Bioreserve is "to protect, restore and enhance the biological diversity and ecological integrity of a large scale ecosystem representative of the region; to permanently protect public water supplies and cultural resources; to offer interpretive and educational programs; and to provide opportunities for appropriate public use and enjoyment of this natural environment."[10]

The Bioreserve is managed under a joint management plan that covers several aspects, including forest and wildlife management, water supply protection, and public access. Figure 4.14-1 illustrates the major land units that are part of the Bioreserve.

Important Bird Areas

An Important Bird Area (IBA) is an area that provides important habitat to one or more species of breeding, wintering, and/or migrating birds.[11] These areas are designated as part of an international effort to protect bird habitat around the world. The Massachusetts Audubon Society has designated two Important Bird Areas (IBAs) within the study area: the Hockomock Swamp and the Freetown-Fall River State Forest/Southeastern Massachusetts Bioreserve. Figure 14.14-1 illustrates the major land units that are part of these IBAs. A list of bird species found in the study area and the types of habitat that they require is provided in Table 4.14-1.

[10] Green Features, Facts about the Southeastern Massachusetts Bioreserve. Website accessed January 2009. (http://www.greenfutures.org/projects/green/biofacts.html).

[11] Massachusetts Audubon Society, Massachusetts Important Bird Areas. Website accessed January 2009. (http://massaudubon.org/Birds_and_Birding/IBAs/index.php).

Hockomock Swamp IBA

Hockomock Swamp IBA is a 5,126-acre area located in Bridgewater, Easton, Norton, Taunton, West Bridgewater, Bridgewater, and Plymouth. It includes three state-owned wildlife management areas (WMA): the Hockomock Wildlife Management Area, the Wilder Wildlife Management Area, and West Meadows Wildlife Management Area. This IBA provides important migratory/stopover habitat as well as nesting habitat.

The Hockomock Swamp IBA has been reported to contain nine breeding and/or wintering/migrant state-listed species, and at least 47 regional and five state high conservation priority species. Very abundant species are gray catbird (*Dumetella carolinensis*), northern waterthrush (*Seiurus noveboracensis*), common yellowthroat (*Geothlypis trichas*), swamp sparrow (*Melospiza georgiana*), common grackle (*Quiscalus quiscula*), and veeries (*Catharus fuscescens*). State-listed species within this IBA include: grasshopper sparrow (*Ammodramus savannarum*), short-eared owl (*Asio flammeus*), upland sandpiper (*Bartramia longicauda*), common moorhen (*Gallinula chloropus*), king rail (*Rallus elegans*), sharp-shinned hawk (*Accipiter striatus*), northern harrier (*Circus cyaneus*), least bittern (*Ixobrychus exilis*), and pied-billed grebe (*Podilymbus podiceps*).

The major habitat types found within this IBA include oak-conifer forest, cultivated grassland, cultivated field, emergent freshwater wetland, palustrine woodland swamp, shrub-scrub wetland, lake/pond, and river/stream.

Freetown-Fall River State Forest/ Southeastern Massachusetts Bioreserve IBA

The Freetown-Fall River State Forest/Southeastern Massachusetts Bioreserve IBA is a 15,000-acre area located in the towns of Freetown, Fall River, and Bristol. It includes the Freetown-Fall River State Forest, the Acushnet Cedar Swamp, and the Southeastern Massachusetts Bioreserve. This area supports important avian habitat diversity, especially in the Rattlesnake Brook area, and provides important migratory/stopover habitat as well as nesting habitat. Because of the Bioreserve designation, there is a focus on habitat management, research, and monitoring of flora and fauna. Some of the bird monitoring efforts include: Christmas Bird Counts, spring migration bird counts, Breeding Bird Surveys, and Biodiversity Day events. Christmas Bird Counts and Breeding Bird Surveys have been conducted since 1970.

The Freetown-Fall River State Forest/Southeastern Massachusetts Bioreserve IBA has been reported to contain one breeding and/or wintering/migrant state-listed species, and at least seven regional and one state high conservation priority species. Very abundant species include the Eastern towhee (*Pipilo erythophthalmus*), ovenbird (*Seiurus aurocapillus*), and prairie warbler (*Dendroica discolor*). The migrant state-listed species reported to use the site is the Northern parula (*Parula americana)*.

The major habitat types found within this IBA include northern hardwoods forest, oak-conifer forest, pitch pine (*Pinus rigida*)/scrub oak (*Quercus ilicifolia*), early successional shrubland, power line, shrub-scrub wetland, and river/stream.

BioMap Core Habitats

The Natural Heritage and Endangered Species Program (NHESP) published the BioMap Report in 2001. While the report and mapping was updated as BioMap 2 in 2010,[12] the analysis for the DEIS had already been completed and is based on the data provided in the original edition. This study was undertaken to identify critical land in Massachusetts needed to preserve biodiversity in the Commonwealth and is based, in part, on rare species and locations of exemplary natural community in the state. The BioMap Report identified Core Habitats as areas representing "the rare and exemplary habitat of Massachusetts" and Supporting Natural Landscapes as "buffer areas around Core Habitat." The BioMap (BM) Core Habitats encompass nearly 1.4 million acres of uplands and wetlands in Massachusetts. Areas of BioMap Core Habitat that have been mapped within the study area include parts of the Southeastern Massachusetts Bioreserve, Freetown-Fall River State Forest, Acushnet Cedar Swamp, Assonet Cedar Swamp, Hockomock Swamp, and Pine Swamp. Threatened and endangered species are described in detail in Chapter 4.15. The major concentrations of BioMap Core Habitat in the study area are shown on Figures 4.14-1 and 4.14-2 and include:

- Acushnet Cedar Swamp, the Freetown-Fall River State Forest, and the Assonet Cedar Swamp (BM1229) are located in New Bedford, Freetown, and Lakeville (Figures 4.14-3a-e and 4.14-4a and b). This BioMap core habitat contains extensive, minimally fragmented and diverse natural communities that range from forested swamp and bogs (large coastal and alluvial Atlantic white cedar (*Chamaecyparis thyoides*) swamps), to a dry upland pitch pine scrub oak community. This large Core Habitat is an important site that supports several species of rare plants, rare turtles and salamanders, as well as rare moths, butterflies, dragonflies, and damselflies.

- Forge Pond and Assonet River (BM1232) in Freetown provide habitat for the attenuated bluet damselfly (*Enallagma daeckii*) (Figure 4.14-4a).

- Hockomock Swamp (BM1166 and BM1168) is located within the Hockomock Swamp ACEC in Raynham, Easton, Bridgewater, and West Bridgewater and contains the largest unfragmented and pristine areas of wetland habitat in eastern Massachusetts (Figures 4.14-5c-d).[13] These Core Habitats include the highest quality acidic graminoid fen and the largest coastal Atlantic cedar swamp in Massachusetts and a very large red maple (*Acer rubrum*) swamp community. This assemblage provides habitat for several rare insects, rare salamanders and turtles, as well as rare plant species.

- Pine Swamp (BM1196) in Raynham includes an unfragmented Atlantic white cedar swamp that provides habitat for the rare Hessel's hairstreak butterfly (*Callophrys hesseli*) (Figure 4.14-5d).

Living Waters Core Habitats

In 2003, NHESP completed the Living Waters project. Living Waters are critical sites (Core Habitats) of freshwater biodiversity identified within rivers, streams, lakes, and ponds in Massachusetts. Designated

[12] Massachusetts Department of Fish & Game and The Nature Conservancy. 2010. BioMap2: Conserving the Biodiversity of Massachusetts in a Changing World. Commonwealth of Massachusetts, DFG Natural Heritage and Endangered Species Program, Westborough, MA, 60pp.

[13] Hockomock Swamp ACEC website: (http://www.mass.gov/dcr/stewardship/acec/acecs/l-hcksmp.htm).

Living Waters in the study area are shown on Figures 4.14-3d, 4.14-4a-b, and 4.14-5e. The major Living Waters found within the study area include:

- Acushnet Cedar Swamp and Turner Pond (LW239) in New Bedford provide habitat for the rare coastal swamp amphipod (*Synurella chamberlain)* and the rare American clam shrimp (*Limnadia lenticularis*) (Figure 4.14-3d).
- Sections of Rattlesnake Brook (LW321) and the Assonet River (LW330) in Freetown provide habitat for several anadromous fishes including blueback herring (*Alosa aestivalis*), rainbow smelt (*Osmerus mordax*), and white perch (*Morone americana*) (Figures 4.14-4a-b).
- Taunton River (LW080) in Taunton provides habitat for the state-listed endangered Atlantic sturgeon (*Acipenser oxyrinchus*), which was listed as an endangered species at the federal level by the National Marine Fisheries Service in 2012 (Figures 4.14-3a and 4.14-5e).

Plant Communities

This section describes the plant communities within the study area grouped into wetland cover types and upland cover types. These community types are based on the NHESP's "*Classification of Natural Communities*" but include some refinements of these types to reflect local conditions.[14] The cover type data was produced based on interpretation of GIS aerial mapping, as well as land use data and wetlands cover type data available from MassGIS.

Wetland Cover Types

Wetland cover types include red maple swamp, Atlantic white cedar swamp, mixed forested wetland, shrub swamp, marshes and fens, and open water. Wetland resources in the study area are described in Chapter 4.16, *Wetlands*.

Red Maple Swamp (RM)

The red maple swamp community is the most abundant community within the study area, as it is throughout southeastern Massachusetts wetlands. The community type includes a red maple overstory, with understory vegetation consisting of highbush blueberry (*Vaccinium corymbosum*), sweet pepperbush (*Clethra alnifolia*), swamp azalea (*Rhododendron viscosum*), common winterberry (*Ilex verticillata*), skunk cabbage (*Symplocarpus foetidus*), cinnamon fern (*Osmunda cinnamomea*), and sensitive fern (*Onoclea sensibilis*). In the Cowardin classification system, these areas are characterized as Palustrine Forested Wetland (PFO), with the ecological subcategory of Wooded Swamp Deciduous (WSD).

Inland Atlantic White Cedar Swamp (AWC)

The Atlantic white cedar swamp is listed by NHESP as a Priority Natural Community. This community type includes Atlantic white cedar in association with red maple, fetterbush (*Leucothoe racemosa*), common winterberry, swamp azalea, cinnamon fern, and royal fern (*Osmunda regalis*). This community also occurs within the Pine Swamp. The Hockomock Swamp and Assonet Cedar Swamp AWC

[14] Natural Heritage Endangered Species Program, Classification of Natural Communities. Website accessed February 2009: (http://www.mass.gov/dfwele/dfw/nhesp/nhclass.htm).

communities consist generally of small to medium sized trees with some larger trees in Assonet Cedar Swamp as well. The size classes of trees indicate that cedar lumber was harvested in these areas during the 18th and 19th centuries, as occurred in most New England AWCs. In the Cowardin classification system, these areas are characterized as Palustrine Forested Wetland (PFO), with the ecological subcategory of Wooded Swamp Coniferous (WSC).

Mixed Forested Wetland (RM/AWC)

The mixed forested wetland community (RM/AWC) is associated with transition areas between Atlantic white cedar swamps and red maple swamps, and transition areas between wetland and upland communities. This community consists of a mixture of deciduous and evergreen overstory trees, and understory shrubs. Dominant plants may include red maple, Atlantic white cedar, highbush blueberry, fetterbush, common winterberry, swamp azalea, sphagnum moss (*Sphagnum* spp.), and cinnamon fern. In the Cowardin classification system, these areas are characterized as Palustrine Forested Wetland (PFO), with the ecological subcategory of Wooded Swamp Mixed (WSM).

Shrub Swamp (SS)

Shrub swamp communities are transition zones between the open water and marshes of the river and the surrounding forested wetlands and uplands. The shrub swamp community includes speckled alder (*Alnus incana*), pussy willow (*Salix discolor*), red-osier dogwood (*Cornus amomum)*, buttonbush (*Cephalanthus occidentalis*), arrow-wood (*Viburnum dentatum*), sensitive fern, and skunk cabbage. In the Cowardin classification system, these areas are characterized as Palustrine Shrub Scrub (PSS) Wetlands.

Marshes and Fens (M)

Marshes are characterized by shallow, standing water throughout the year and have limited shrub and tree cover. Vegetation is generally dominated by herbaceous species such as reeds, sedges, rushes, and grasses. Acid fen plant communities are listed by NHESP as a Priority Natural Community. This community includes sphagnum mosses and sedges with a limited shrub cover of leatherleaf (*Chamaedaphne calyculata*), bog rosemary (*Andromeda glaucophylla*), and Labrador tea (*Ledum groenlandicum*). In the Cowardin classification system, these areas are characterized as Palustrine Emergent Marsh (PEM) Wetlands.

Open Water (W)

This community includes the estuary of Taunton River and Mount Hope Bay as well as a range of fisheries and wildlife habitat such as rivers, ponds, coldwater and warmwater brooks and streams. Coastal plain ponds occupy depressions in glacial outwash plains that are directly linked to the underground aquifer. The coastal plain pondshore community occurs in those ponds with no surface inlet or outlet, and with a gradual slope to the shore. In the Cowardin classification system, these areas are characterized as Open Water (POW) Wetlands.

Permanent ponds and waterways within the study area include Black Brook, Snake River, Assonet River, Taunton River, Neponset River, Three Mile River, Forge Pond, and Turner Pond. Shallow and slow moving portions of this community may be vegetated by aquatic plant species such as fragrant water lily (*Nymphaea odorata*). Areas of open water with deeper and faster flowing waters are generally unvegetated.

Upland Cover Types

Upland cover types include deciduous forest, coniferous forest, mixed forest, agricultural use, developed land, powerline easements, and cleared areas.

Deciduous Forested Upland (UD)

Vegetation within this mixed oak community includes northern red oak (*Quercus rubra*), red maple, gray birch (*Betula populifiolia*), mountain laurel (*Kalmia latifolia*), teaberry (*Gaultheria procumbens*), nannyberry (*Viburnum lentago*), and wild lily-of-the-valley (*Maianthemum canadense*).

Coniferous Forested Upland (UC)

Vegetation within this successional white pine forest community includes eastern white pine, eastern hemlock, mountain laurel, and poison ivy (*Toxicodendron radicans*).

Mixed Forested Upland (C/D)

The mixed forested upland oak-hemlock-white pine community is found within the Freetown-Fall River State Forest and it is the second largest community type within the Hockomock Swamp. This forested community consists of northern red oak, red maple, gray birch, white pine, eastern hemlock (*Tsuga canadensis*), mountain laurel, teaberry, nannyberry, and wild lily-of-the-valley.

Agricultural Use (AG)

Agricultural areas include land in active agricultural use that support cultivated crops or cranberry bogs.

Powerline (P)

Powerline easements occupy wide strips of maintained land that crosses portions of the study area. Both uplands and wetlands occur within this area along maintained access roads. Vegetation growing under the powerlines is maintained by seasonal cutting and herbicide application as part of a vegetation management plan. Due to the artificial nature of its boundaries, this community type includes a variety of both wetlands and uplands with a corresponding diversity of soil types.

Cleared Area (CL)

The cleared areas are generally located along the powerlines. They consist of excavated gravel pits and are largely unvegetated due to clearing activities. This is considered to be a habitat type because some wildlife species may use these cleared areas as suitable habitat for breeding, nesting, and migration.

Wildlife

The study area includes wildlife habitat areas for a diversity of species. These areas include several large wetland complexes and protected upland habitat. These areas possess characteristics that are necessary for maintaining and expanding wildlife populations, particularly area-sensitive species. The wildlife value of these areas is increased by the adjacent undeveloped uplands, which provide habitat for upland species along with breeding and overwintering habitat for wetland-dependent wildlife.

This section provides an overview of the range of wildlife species likely to exist within the study area. The analysis of vertebrate species is based, in part, on wildlife habitat analysis performed using the

NEWILD computer model for the 2002 Final EIR (Stoughton Alternative). The NEWILD computer model was developed by the U.S. Department of Agriculture, Northeastern Research Station as part of the NED project, a program to develop software tools to support ecosystem management decision making.[15] Other literature used to determine occurrences are referenced at the end of each vertebrate list.

Birds

Table 4.14-1 lists bird species that may potentially occur within the Hockomock Swamp and other important habitat areas along the project corridors. The list includes species that may breed in the study area, as well as species that may stop over on migratory flights or overwinter. The table also indicates whether species are area-sensitive (require large areas of unfragmented forest), require forest interior or edge habitats, and the types of vegetation that the species utilizes. Some of the species found in the study area are opportunists that can be found in a variety of habitat types, while some species are more specialized and occur in a narrower range of habitat types.

Table 4.14-1 Potential Bird Species Found Within the Study Area

Common Name	Scientific Name	Wetland	Habitat Use[1]	Area: Hockomock	Area: Pine Swamp	Area: Assonet	Area: Freetown -Fall River	Area: Acushnet
Great blue heron	*Ardea herodias*	X	--	X	X	X	X	
Mute swan	*Cygnus olor*	X	-	X	X	X	X	X
Canada goose	*Branta canadensis*	X	--	X	X	X	X	X
Wood duck[2]	*Aix sponsa*	X	--	X	X	X	X	
Gadwall	*Anas strepera*	X	-					X
American black duck	*Anas rubripes*	X	--				X	
Mallard	*Anas platyrhynchos*	X	--		X	X	X	X
Hooded merganser	*Lophodytes cucullatus*	X	--	X			X	
Osprey	*Pandion haliaetus*	X	--		X	X	X	X
Cooper's hawk	*Accipiter cooperii*		--		X			X
Red-shouldered hawk	*Buteo lineatus*		I/E	X	X	X	X	X
Broad-winged hawk	*Buteo platypterus*		I			X	X	X
Red-tailed hawk	*Buteo jamaicensis*		E	X	X	X	X	X
Wild turkey	*Meleagris gallopavo*		I/E	X	X	X	X	X
Ruffed grouse	*Bonasa umbellus*		I/E				X	
Northern bobwhite	*Colinus virginianus*		I/E					X
Killdeer	*Charadrius vociferus*		--		X	X	X	X
Spotted sandpiper	*Actitis maculata*	X	--			X	X	X
American woodcock	*Scolopax minor*	X	E	X	X	X	X	X

[15] Thomasma, S.A.; L. Ebel; and M.J. Twery. 1998. NEWILD (Version 1.0) user's manual (computer program).

Common Name	Scientific Name	Wetland	Habitat Use[1]	Area				
				Hockomock	Pine Swamp	Assonet	Freetown -Fall River	Acushnet
Mourning dove	*Zenaida macroura*		E	X	X	X	X	X
Yellow-billed cuckoo	*Coccyzus americanus*		I/E	X				
Black-billed cuckoo	*Coccyzus erythrophthalmus*		I/E			X		
Eastern screech owl	*Otus asio*		--		X			X
Great horned owl	*Bubo virginianus*		--			X		X
Barred owl	*Strix varius*		I			X	X	X
Whip-poor-will	*Caprimulgis vociferus*		--				X	
Chimney swift	*Chaetura pelagica*		--	X	X	X	X	X
Ruby-throated hummingbird	*Archilochus colubris*		E	X		X		X
Belted kingfisher	*Ceryle alcyon*	X	--		X		X	
Red-bellied woodpecker	*Melanerpes carolinus*		I/E	X	X	X	X	X
Downy woodpecker	*Picoides pubescens*		I/E	X	X	X	X	X
Hairy woodpecker	*Picoides villosus*		I	X	X	X	X	
Northern flicker	*Colaptes auritus*		I/E	X	X	X	X	X
Eastern wood pewee	*Contopus virens*		I/E	X	X	X	X	X
Eastern phoebe	*Sayornis phoebe*		I/E	X	X	X	X	X
Great crested flycatcher	*Myiarchus crinita*		I/E	X	X	X	X	X
Eastern kingbird	*Tyrannus tyrannus*		E	X	X	X	X	X
Tree swallow	*Iridoprocne bicolor*		E	X	X	X	X	X
N. rough-winged swallow	*Stelgidopteryx serripennis*		--		X		X	
Bank swallow	*Riparia riparia*		--			X		X
Barn swallow	*Hirundo rustica*		--	X	X	X	X	X
Blue jay	*Cyanocitta cristata*		I/E	X	X	X	X	X
American crow	*Corvus brachyrhynchos*		E	X	X	X	X	X
Fish crow	*Corvus ossifragus*		--	X	X	X		
Black-capped chickadee	*Parus atricapillus*		I/E	X	X	X	X	X
Tufted titmouse	*Parus bicolor*		I/E	X	X	X	X	X
Red-breasted nuthatch	*Sitta canadensis*		I/E			X	X	
White-breasted nuthatch	*Sitta carolinensis*		I/E	X	X	X	X	X
Brown creeper	*Certhia americana*		I	X			X	
House wren	*Troglodytes aedon*		E	X	X	X	X	X

				Area				
Common Name	Scientific Name	Wetland	Habitat Use[1]	Hockomock	Pine Swamp	Assonet	Freetown -Fall River	Acushnet
Carolina wren	*Thryothorus ludovicianus*		--	X	X	X	X	X
Blue-gray gnatcatcher	*Polioptila caerulea*		I/E			X	X	X
Eastern bluebird	*Sialia sialis*		E	X	X	X	X	
Veery	*Catharus fuscescens*		I	X	X	X	X	X
Hermit thrush	*Catharus guttatus*		I				X	
Wood thrush	*Hylocichla mustelina*		I/E	X	X	X	X	X
American robin	*Turdus migratorius*		E	X	X	X	X	X
Gray catbird	*Dumetella carolinensis*		I/E	X	X	X	X	X
Northern mockingbird	*Mimus polyglottus*		E		X	X	X	X
Brown thrasher	*Toxostoma rufum*		E				X	
Cedar waxwing	*Bombycilla cedrorum*		E	X	X	X	X	X
European starling	*Sturna vulgaris*		E	X	X	X	X	X
Warbling vireo	*Vireo gilvus*		E	X	X			
Yellow-throated vireo	*Vireo flavifrons*		E	X				
White-eyed vireo	*Vireo griseus*		E			X		
Red-eyed vireo	*Vireo olivaceous*		I/E	X	X	X	X	X
Blue-winged warbler	*Vermivora pinus*		E	X	X	X	X	X
Chestnut-sided warbler	*Dendroica pensylvanica*		E			X	X	
Black-and-white warbler	*Mniotilta varia*		I	X	X	X	X	X
Black-throated green warbler	*Dendroica virens*		I			X	X	
Prairie warbler	*Dendroica discolor*		E	X	X	X	X	X
Pine warbler	*Dendroica pinus*		I	X	X	X	X	X
Yellow warbler	*Dendroica petechia*	X	E	X	X	X	X	X
Canada warbler	*Wilsonia canadensis*		I				X	
Hooded warbler	*Wilsonia citrina*		I/E				X	
Worm-eating warbler	*Helmitherus vermivorus*		I/E				X	
Ovenbird	*Seiurus aurocapillus*		I	X	X	X	X	X

Common Name	Scientific Name	Wetland	Habitat Use[1]	Area: Hockomock	Area: Pine Swamp	Area: Assonet	Area: Freetown -Fall River	Area: Acushnet
Northern waterthrush	*Seiurus novaboracensis*	X	I	X	X	X	X	
Louisiana waterthrush	*Seiurus motacilla*	X	I	X	X			
Common yellowthroat	*Geothlypis trichas*	X	I/E	X		X	X	X
American redstart	*Setophaga ruticilla*		I	X		X	X	X
Scarlet tanager	*Piranga olivacea*		I	X	X		X	X
Eastern towhee	*Pipilo erythophthalmus*		I/E	X	X	X	X	X
Chipping sparrow	*Spizella passerina*		E	X	X	X	X	X
Field sparrow	*Spizella pusilla*		E	X	X	X	X	X
Savannah sparrow	*Passerculus sandwichensis*		--		X			
Song sparrow	*Melospiza melodia*		E	X	X	X	X	X
Swamp sparrow	*Melospiza georgiana*	X	E	X	X	X		X
Rose-breasted grosbeak	*Pheucticus ludovicianus*		I/E	X	X	X	X	X
Northern cardinal	*Cardinalis cardinalis*		I/E	X	X	X	X	X
Indigo bunting	*Passerina cyanea*		E	X	X	X	X	X
Bobolink	*Dolichonyx oryzivorus*		E					X
Red-winged blackbird	*Agelaius phoeniceus*	X	E	X	X	X	X	X
Common grackle	*Quiscalus quiscula*		E	X	X	X	X	X
Brown-headed cowbird	*Molothrus ater*		E	X	X	X	X	X
Orchard oriole	*Icterus spurius*		E	X	X		X	X
Baltimore oriole	*Icterus galbula*		E	X	X	X	X	X
Purple finch	*Carpodacus purpureus*		I/E	X			X	X
House finch	*Carpodacus mexicanus*		E	X	X	X	X	X
American goldfinch	*Carduelis tristis*		E	X	X	X	X	X
House sparrow	*Passer domesticus*		E	X	X	X	X	X

Habitat Use: I = Interior (nest only within forest interiors, rarely near forest edge); I/E = Interior/Edge – territories located entirely within the forest but can only use edges; E = Edge – species use forest perimeters, nearby fields or large clearings during breeding season.

Source: Freemark, K. and B. Collins. 1992. Landscape ecology of birds breeding in temperate forest fragments. Pages 443-454 in *Ecology and conservation of neotropical migrant landbirds*, J.M. Hagan III and D.W. Johnston, eds. Smithsonian Institution Press, Washington, DC.

Shading indicates forest-interior breeding bird species

As described in the section on Important Bird Areas, the Massachusetts Audubon Society has designated two IBAs within the study area, the Hockomock Swamp and the Freetown-Fall River State Forest/Southeastern Massachusetts Bioreserve, which includes the Acushnet Cedar Swamp State Reservation. These areas provide habitat for breeding birds of concern, as well as migratory and overwintering habitat for both wetland and upland bird species.

Mammals

Mammals are a diverse class of vertebrates that inhabit a wide variety of community types and niches. The list of mammals expected to be found within the study area was generated using the NEWILD computer program and supplemented with *New England Wildlife: Habitat, Natural History, and Distribution*[16] and other reference lists of mammals of Massachusetts.

With the exception of the northern water shrew (a state-listed species not identified by NHESP as inhabiting the Hockomock Swamp), the list includes all mammal species identified as likely inhabitants of the Hockomock Swamp in the publication *Hockomock Wonder Wetland*.[17]

Table 4.14-2 presents the list of mammal species that may find suitable feeding, breeding, and/or overwintering habitat within the study area. The Habitat Usage column lists each community type that may provide habitat for the individual species.

Reptiles, Amphibians, and Fish

Natural areas and waterways throughout the study area provide habitat for common and state-listed reptiles, amphibians, and fish. Previous studies have identified populations of some uncommon species of turtles such as the Eastern box turtle (*Terrapene carolina*), Blanding's turtle, spotted turtle (*Clemmys guttata*), and salamanders such as the blue-spotted salamander and the four-toed salamander (*Hemidactylium scutatum*) within the Hockomock Swamp wetlands. Table 4.14-3 lists the reptiles and amphibians that are likely to be found within the study area.

Table 4.14-2 Potential Mammalian Species Found Within the Study Area

Common Name	Scientific Name	Habitat Usage[1]
Virginia opossum	*Didelphis virginiana*	RM, SS, M, W/U, UD, C/D, P
Masked shrew	*Sorex cinereus*	RM, AWC, RM/AWC, SS, M, W/U, UD, UC, C/D, P
Smoky shrew	*Sorex fumeus*	RM, AWC, RM/AWC, W/U, UD, UC, C/D
Northern short-tailed shrew	*Blarina brevicauda*	RM, AWC, RM/AWC, SS, M, W/U, UC, C/D, P
Star-nosed mole	*Condylura cristata*	RM, AWC, RM/AWC, SS, M, W, W/U
Hairy-tailed mole	*Parascalops breweri*	W/U, UD, UC, C/D, P
Eastern mole	*Scalopus aquaticus*	AG, D, P
Little brown myotis	*Myotis lucifugus*	SS, M, W, AG, D, P
Keen's myotis	*Myotis keenii*	SS, M, W, AG, D, P
Silver-haired Bat	*Lasionycteris noctivagans*	SS, M, W, AG, D, P
Eastern pipistrelle	*Pipistrellus subflavus*	SS, M, W, AG, D, P
Big brown bat	*Eptesicus fuscus*	SS, M, W, AG, D, P

[16] DeGraaf, R. M., and Yamasaki, M. 2001. *New England wildlife: habitat, natural history, and distribution*. University Press of New England, Lebanon, NH, 482pp.

[17] Anderson, K.S. n.d. *Mammals In Hockomock Wonder Wetland*. Mass. Audubon Society, Lincoln, 34 p.

Common Name	Scientific Name	Habitat Usage[1]
Red bat	*Lasiurus borealis*	RM, SS, M, W, W/U, UD, UC, C/D, AG, P
Hoary bat	*Lasiurus cinereus*	SS, M, W, W/U, UD, UC, C/D, AG, P
Eastern cottontail	*Sylvilagus floridanus*	SS, M, AG, D, P
New England cottontail	*Sylvilagus transitionalis*	RM, AWC, RM/AWC, SS, M, W/U, UD, C/D, P
Snowshoe hare	*Lepus americanus*	RM, AWC, RM/AWC, SS, W/U, UD, UC, C/D, P
Eastern chipmunk	*Tamias striatus*	RM, W/U, UD, UC, C/D, P
Gray squirrel	*Sciurus carolinensis*	RM, W/U, UD, C/D, D
Red squirrel	*Tamiasciurus hudsonicus*	RM, AWC, RM/AWC, W/U, UD, UC, C/D, D
Southern flying squirrel	*Glaucomys sabrinus*	W/U, UD, C/D, D
Beaver	*Castor canadensis*	RM, SS, M, W, W/U, UD, C/D
Woodchuck	*Marmota monax*	AG, D, P
White-footed mouse	*Peromyscus leucopus*	RM, AWC, RM/AWC, SS, W/U, UD, UC, C/D, D, P
Southern red-backed vole	*Clethrionomys gapperi*	RM.AWC, RM/AWC, SS, W/U, UC, C/D
Meadow vole	*Microtus pennsylvanicus*	SS, M, W, P
Woodland vole	*Microtus pinetorum*	RM, W/U, UD, C/D, P
Muskrat	*Ondatra zibethicus*	SS, M, W
Norway rat	*Rattus norvegicus*	AG, D, P
House mouse	*Mus musculus*	AG, D, P
Meadow jumping mouse	*Zapus hudsonius*	RM, SS, M, P
Woodland jumping mouse	*Napaeozapus insignis*	RM, AWC, RM/AWC, SS, W/U, UD, UC, C/D, P
Coyote	*Canis latrans*	RM, AWC, RM/AWC, SS, M, W/U, UD, UC, C/D, AG, P
Red fox	*Vulpes vulpes*	RM, AWC, RM/AWC, SS, M, W/U, UD, UC, C/D, AG, P
Gray fox	*Urocyon cinereoargenteus*	RM, AWC, RM/AWC, SS, M, W/U, UD, C/D, P
Raccoon	*Procyon lotor*	RM, AWC, RM/AWC, W/U, UD, UC, C/D, AG, D, P
Ermine	*Mustela erminea*	RM, AWC, RM/AWC, SS, W/U, UD, UC, C/D, AG, P
Long-tailed weasel	*Mustela frenata*	RM, AWC, RM/AWC, SS, M, W/U, UD, UC, C/D, P
Mink	*Mustela vison*	RM, AWC, RM/AWC, SS, M, W
Striped skunk	*Mephitis mephitis*	RM, SS, W/U, UD, UC, C/D, AG, P, D
River otter	*Lutra canadensis*	RM, AWC, RM/AWC, SS, M, W
Bobcat	*Felis rufus*	RM, AWC, RM/AWC, SS, W/U, UD, UC, C/D, P
White-tailed deer	*Odocoileus virginianus*	RM, AWC, RM/AWC, SS, W/U, UD, UC, C/D, AG, P

1 Habitat: RM-red maple swamp; AWC-Atlantic white cedar swamp; RM/AWC-red maple/Atlantic white cedar swamp mix; SS-shrub swamp; M--marsh/fen; W-open water; W/U-wetland/upland forested mix; UD-deciduous upland forest; UC-coniferous upland forest; C/D-mixed upland forest; AG-agricultural land; D-developed; P-powerline easement; CL-cleared land (gravel pits).

Table 4.14-3 Potential Amphibian and Reptilian Species Found Within the Study Area

Common Name	Scientific Name	Habitat[1]
Amphibians		
Blue-spotted salamander	*Ambystoma laterale*	RM, AWC, RM/AWC, SS, M, W, W/U, UD, C/D
Spotted salamander	*Ambystoma maculatum*	RM, AWC, RM/AWC, SS, M, W, W/U, UD, C/D
Marbled salamander	*Ambystoma opacum*	RM, AWC, RM/AWC, SS, M, W, W/U, UD
Eastern newt	*Notophthalmus viridescens*	RM, AWC, RM/AWC, SS, M, W, W/U, UD, C/D
Northern dusky salamander	*Desmognathus fuscus*	RM, AWC, RM/AWC, SS, M, W, W/U, UD, C/D
Eastern red-backed salamander	*Plethodon cinereus*	RM, AWC, RM/AWC, SS, M, W, W/U, UD, UC, C/D
Four-toed salamander	*Hemidactylium scutatum*	RM, AWC, RM/AWC, SS, W/U, UD, C/D
American toad	*Bufo americanus*	W/U, UD, AG, D, P, CL
Fowler's toad	*Bufo fowleri*	RM, RM/AWC, SS, M, W/U, P
Spring peeper	*Pseudacris crucifer*	RM, AWC, RM/AWC, SS, M, W
Gray treefrog	*Hyla versicolor*	RM, SS, W, W/U
American bullfrog	*Rana catesbeiana*	RM, SS, M, W,
Green frog	*Rana clamitans*	RM, AWC, RM/AWC, SS, M, W, W/U, UD, P
Pickerel frog	*Rana palustris*	RM, RM/AWC, SS, M, W, W/U, UD, C/D
Northern leopard frog	*Rana pipiens*	M, P
Wood frog	*Rana sylvatica*	RM, AWC, RM/AWC, SS, M, W, W/U, UD, P
Reptiles		
Snapping turtle	*Chelydra serpentina*	M, W, W/U, P
Eastern musk turtle	*Sternotherus odoratus*	W, M, P
Painted turtle	*Chrysemys picta*	RM, RM/AWC, SS, M, W, W/U, UD, C/D, P, CL
Spotted turtle	*Clemmys guttata*	RM, RM/AWC, SS, M, W, W/U, UD, C/D, P, CL
Blanding's turtle	*Emydoidea blandingii*	RM, RM/AWC, SS, M, W, W/U, UD, C/D, P, CL
Wood turtle	*Clemmys insculpta*	RM, RM/AWC, SS, W
Eastern box turtle	*Terrapene carolina*	RM, RM/AWC, SS, M, W/U, UD, C/D, AG, D, P, CL
Eastern racer	*Coluber constrictor*	AG, P, CL
Ringnecked snake	*Diadophis punctatus*	RM, CL, P, UC, UD, C/D
Milksnake	*Lampropeltis triangulum*	AG, D, P, CL
Northern watersnake	*Nerodia sipedon*	RM, AWC, RM/AWC, SS, M, W
Smooth greensnake	*Opheodrys vernalis*	RM, W/U, UD, P
Dekay's brownsnake	*Storeria dekayi*	RM, RM/AWC, SS, M, W/U, UD, C/D, AG, D, P, CL
Red-bellied snake	*Storeria occipitomaculata*	RM, SS, UD, C/D, AG, P
Eastern ribbonsnake	*Thamnophis sauritus*	AG, D, P, CL
Common gartersnake	*Thamnophis sirtalis*	RM, AWC, RM/AWC, SS, M, W/U, UD, UC, C/D, AG, D, P, CL

Source: Hunter, M.L., A.J.K. Calhoun, and M. McCollough. 1999. Maine Amphibians and Reptiles. University of Maine Press, Orono, ME. DeGraaf, R.M., and D.D. Rudis. 1983. Amphibians and Reptiles of New England. University of Massachusetts Press; Amherst, MA.

1 Habitat: RM = Red maple; AWC = Atlantic white cedar; RM/AWC = red maple Atlantic white cedar mix; SS = shrub swamp; M = marsh/fen; W = open water; W/U = wetland/upland forested mix; UD = deciduous forested upland; UC = coniferous forested upland; C/D = upland mixed forest; AG = agricultural; D = developed; P = powerline; CL = cleared land (*e.g.,* gravel pit).

The Taunton River, in particular, is an important anadromous fish run that supports the Atlantic sturgeon (a federally and state-listed endangered species). Based on information provided by the DMF and DFW, there are 34 freshwater, anadromous, or diadromous fish recorded in the waterways crossed by the Stoughton Alternative. Although several other species have been recorded from the lower, saline, reaches of the Taunton River (bluefish, *Pomatomus saltatrix*; crevalle jack, *Caranx hippos*; winter flounder, *Pseudopleuronectes americanus*) these fish are not found in freshwater. Salt water extends 12.6 miles inland from the mouth of the Taunton River, which is approximately 2 miles below the point where the New Bedford Main Line crosses the Taunton River south of Ingells Street (Weir Junction). Table 4.14-4 lists the fish species that are documented by NHESP to occur within the study area.

Vernal Pools

Vernal pools are generally small, seasonally-inundated wetland depressions that lack a permanent, population of predatory fish, provide breeding habitat for amphibians (wood frogs, *Rana sylvatica*; and ambystomid salamanders), and may also be utilized by reptiles and other wildlife. Numerous vernal pools, including NHESP certified and potential vernal pools occur adjacent to the railroad embankment and other locations within the study area. These are small pools or seasonal ponding areas within bordering vegetated wetlands, or small isolated wetlands. Certified vernal pools (CVPs) are field verified and documented vernal pools that have been certified by the NHESP according to the *Guidelines for the Certification of Vernal Pool Habitat* (2009[18]). They are included as points in the MassGIS data layer. Potential vernal pools (PVPs) are unverified, vernal pool habitats with a MassGIS data layer produced by the NHESP to help locate likely vernal pools across the state. Potential vernal pools do not receive protection under the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00), or under any other state or federal wetlands protection laws. With the exception of a new vernal pool identified in 2009 (VP-13), no other vernal pools occur within the railroad embankment, although there are numerous vernal pools adjacent to the right-of-way. In several locations there are clusters of vernal pools, which may have higher wildlife habitat value than single, isolated pools.

Vernal pool investigations of the right-of-way were conducted in 2000-2001 for the Stoughton Alternative and were documented in the 2002 Final EIR. Additional surveys were conducted in the spring of 2008 and 2009 along the, Stoughton Line and Whittenton Branch. In 2008 the surveys were conducted within portions of the right-of-way along the inactive Stoughton Main Line in Stoughton, Easton, and Raynham. In 2009 the surveys were conducted within portions of the right-of-way in Stoughton, Taunton, Easton and Raynham along the inactive Stoughton Main Line and Whittenton Branch.

Table 4.14-4 Fish Species Potentially Found Within Waterways in the Study Area

Common Name	Scientific Name	Waterway [1, 2]
Alewife	*Alosa pseudoharengus*	Assonet River, Fall Brook, Mill River, Rattlesnake Brook, Taunton River
American eel	*Anguilla rostrata*	Assonet River, Black Brook, Cedar Swamp River, Cotley River, Fall Brook, Mill River, Pine Swamp Brook, Queset Brook, Rattlesnake Brook, Taunton River, Terry Brook, Whitman Brook
American shad	*Alosa sapidissima*	Taunton River
Atlantic menhaden	*Brevortia tyrannus*	Taunton River
Atlantic sturgeon	*Acipenser oxyrhynchus*	Taunton River

[18] Guidelines for the Certification of Vernal Pool Habitat (2009). Massachusetts Division of Fisheries and Wildlife. Natural Heritage and Endangered Species Program.

Common Name	Scientific Name	Waterway [1, 2]
Banded killifish	*Fundulus diaphanous*	Taunton River
Banded sunfish	*Enneacanthus obesus*	Cedar Swamp River, Fall Brook, Rattlesnake Brook
Black crappie	*Pomoxis nigromaculatus*	Mill River, Taunton River
Blacknose dace	*Rhinichthys atratulus*	Taunton River
Blueback herring	*Alosa aestivalis*	Assonet River, Fall Brook, Mill River, Rattlesnake Brook, Taunton River
Bluegill	*Lepomis macrochirus*	Assonet River, Mill River, Queset Brook, Taunton River
Brook trout	*Salvelinus fontinalis*	Cedar Swamp River, Rattlesnake Brook
Brown bullhead	*Ameiurus nebulosus*	Assonet River, Fall Brook, Mill River, Pine Swamp Brook, Rattlesnake Brook, Taunton River
Brown trout	*Salmo trutta*	Rattlesnake Brook
Carp	*Cyprinus empio*	Taunton River
Chain pickerel	*Esox niger*	Assonet River, Cotley River, Fall Brook, Mill River, Taunton River, Whitman Brook
Common shiner	*Notropis cornutus*	Mill River, Taunton River
Creek chubsucker	*Erimyzon oblongus*	Cedar Swamp River, Fall Brook, Taunton River
Fallfish	*Semotilus corporalis*	Taunton River
Gizzard shad	*Dorosoma cepedianum*	Taunton River
Golden shiner	*Notemigonus crysoleucas*	Fall Brook, Taunton River
Inland silverside	*Menidia beryllina*	Taunton River
Largemouth bass	*Micropterus salmoides*	Assonet River, Cotley River, Mill River, Pine Swamp Brook, Taunton River, Whitman Brook
Mummichog	*Fundulus heteroclitus*	Taunton River
Pumpkinseed	*Lepomis gibbosus*	Assonet River, Cotley River, Mill River, Pine Swamp Brook, Taunton River, Whitman Brook
Rainbow smelt	*Osmerus mordax*	Assonet River, Rattlesnake Brook, Taunton River
Rainbow trout	*Oncorhynchus mykiss*	Rattlesnake Brook
Redfin pickerel	*Esox americanus americanus*	Assonet River, Cedar Swamp River, Fall Brook, Mill River, Pine Swamp Brook, Rattlesnake Brook, Taunton River
Striped bass	*Morone saxatilis*	Taunton River
Swamp darter	*Etheostoma fusiforme*	Cedar Swamp River, Cotley River
Tessellated darter	*Etheostoma olmstedi*	Mill River, Queset Brook, Taunton River, Whitman Brook
Tiger trout	*Salmo trutta x Salvelinus fontinalis*	Rattlesnake Brook
White perch	*Morone americana*	Assonet River, Fall Brook, Rattlesnake Brook, Taunton River
White sucker	*Catastomus commersoni*	Taunton River
Yellow perch	*Perca flavescens*	Taunton River

Source: List of species and names of rivers and streams provided by NHESP in a letter dated January 9, 2009.

1 Currently NHESP has no fisheries survey information for Black Brook, Blue Hill River, Lovett Brook, Steep Brook or Terry Brook.

2 Beaver Brook, Rattlesnake Brook and Wading River are annually stocked in the spring with brook trout, brown trout, rainbow trout and/ or tiger trout.

During these investigations, several NHESP-identified potential vernal pools within 100 feet of the right-of-way were inspected for the presence of certification characteristics under NHESP guidance. Previously unidentified vernal pools were located and documented using GPS technology. A summary of results from these vernal pool investigations is included in Section 4.14.2.2. Some of the vernal pool point data available from GIS were found to be incorrectly located when compared to field verified locations and certification forms provided by NHESP. The correct locations for all field verified vernal pools are shown in the figures in Volume II (4.14-7 through 4.14-10).

In April 2009 vernal pool inspections were conducted along the Stoughton Line (within the Hockomock Swamp), in conjunction with NHESP staff. New vernal pools were identified along the Stoughton Line with sufficient evidence of obligate species to allow certification. NHESP has indicated that additional information on these pools will be provided once the certification forms are completed.

In 2010, field work began in order to identify and delineate all wetland resource areas along the Stoughton Alternative. At that time, any additional vernal pools not found during earlier surveys were identified. Visual searches were conducted along the right-of-way to identify any previously unidentified vernal pools. Several NHESP identified potential vernal pools within 100 feet of the right-of-way were inspected for the presence of certification characteristics under NHESP guidance. Previously unidentified vernal pools were located and documented. Some of the vernal pool point data available from MassGIS were found to be incorrectly located when compared to field verified locations and certification forms provided by the NHESP. The locations of all certified, potential, and field verified vernal pool are shown in Figures 4.14-7 through 10.

The June 29, 2011 Secretary's Certificate on the DEIR required a more expansive level of vernal pool assessment, including indirect impacts to upland habitat for vernal pools up to 750 feet on either side of the right-of-way. It is not practicable to conduct complete searches of the entire area within 750 feet from the right-of-way, due to the large area which would require review (approximately 15 square miles) as well as the fact that the vast majority of the land is under private ownership. However, all known certified and potential vernal pools within 750 feet of the right-of-way were used in the impact analysis.

Wildlife Action Plan

The Comprehensive Wildlife Conservation Strategy (CWCS) describes 22 habitats and proposes conservation strategies for each of them. Eleven of these habitats are found within the study area and include:

- Large and mid-sized rivers
- Upland forest
- Large unfragmented landscape
- Small streams
- Shrub swamps
- Forested swamps

- Lakes and ponds
- Young forests and shrublands
- Riparian forest
- Vernal pools
- Marshes and wet meadows

4.14.2.2 Existing Conditions within the Study Corridor

The following describes existing conditions and identifies areas along each segment of the alternatives corridors that have the potential to support important biodiversity elements such as plant communities, wildlife habitat, birds, aquatic life, and fish. These areas are notable because they provide a higher biodiversity value than other segments of the alternatives corridors.

Southern Triangle Study Area (Common to All Rail Alternatives)

All rail alternatives would require improvements to the existing active rail infrastructure south of Cotley Junction in Taunton (the New Bedford Main Line and the Fall River Secondary) (Figures 4.14-3a through e, 4.14-4a through c, 4.14-7e, 4.14-8a through d, and 4.14-9a through c).

Both the New Bedford Main Line and Fall River Secondary are active freight lines with ballasted right-of-way, tracks, and ties. There are culverts that convey streams underneath the embankment. The right-of-way itself does not provide suitable habitat wildlife and the tracks and ties prevent turtles, amphibians, and small mammals from moving across the right-of-way except through the culverts.

New Bedford Main Line

The New Bedford Main Line passes through several areas of Core Habitat including the Acushnet Cedar Swamp and the Assonet Cedar Swamp (BM1229). It is adjacent to one Living Water (LW239) in New Bedford and crosses rivers and streams that are considered important fisheries habitat.

BioMap Core Habitat

BioMap Core Habitat (BM1229) is a large polygon that includes the Assonet Cedar Swamp and the Acushnet Cedar Swamp, which are crossed by the New Bedford Main Line, and the Southeastern Massachusetts Bioreserve, Freetown-Fall River State Forest, which is crossed by the Fall River Secondary.

Assonet Cedar Swamp (BM1229)—Located in Freetown, the Assonet Cedar Swamp is sometimes referred to as the Great Cedar Swamp and borders the Cedar Swamp River and the Assonet River south of Myricks Junction. The extensive wetland contains one of the largest Atlantic white cedar swamps in the state, and supports numerous state-listed species. The Assonet Cedar Swamp includes the Assonet Cedar Swamp Wildlife Sanctuary, a 1,000-acre parcel of conservation land owned by the Massachusetts Audubon Society in Lakeville. The New Bedford Main Line crosses (approximately 5,150 feet) and abuts (approximately 4,550 feet) the Assonet Cedar Swamp for a total of approximately 2 miles (Figures 4.14-3b-c).

Acushnet Cedar Swamp (BM1229)—The Acushnet Cedar Swamp State Reservation is an approximately 1,000-acre property located in New Bedford and Dartmouth, north of the New Bedford Airport. It is an outstanding example of an Atlantic white cedar swamp and provides habitat for state-listed rare wetlands wildlife and other state-listed rare, endangered, or special concern species. This is one of eight cedar swamps in public ownership in Massachusetts, and has been designated by the U.S. Department of the Interior, National Park Service as a National Natural Landmark (36 CFR Part 62). The existing New Bedford Main Line, currently active for freight rail service, forms a major portion of the eastern boundary of the Reservation in New Bedford (Figures 4.14-3c-d). In New Bedford, the Acushnet Cedar Swamp encompasses Living Water Core Habitat (LW239).

Living Waters

The New Bedford Main Line is adjacent to Living Water Core Habitat (LW239) that includes the Acushnet Cedar Swamp and Turner Pond. This Living Water provides habitat for the rare coastal swamp amphipod and the rare American clam shrimp (Figure 4.14-3d). It abuts the track for approximately 0.6 mile south of Route 140 in New Bedford.

Fisheries Habitat

The New Bedford Main Line crosses the Cotley River, Cedar Swamp River, and Fall Brook, which are all important fisheries habitats. Table 4.14-4 lists the fish species that are documented by the Massachusetts Department of Fish and Wildlife to occur within these stream systems.

Vernal Pools

A discussion of vernal pools along the New Bedford Main Line is included in the narrative for the Stoughton Alternative.

Fish and Wildlife Passage

A discussion of fish and wildlife passage along the New Bedford Main Line is included in the narrative for the Stoughton Alternative.

Other Important Habitat Areas

The New Bedford Main Line crosses and is adjacent to large wetland areas located in Berkley, between Route 24 and Myricks Street (Figure 4.14-3a). These wetlands areas are unfragmented open space that could be important wildlife habitat because they may be used as dispersal, migration, breeding, foraging, and as bird stopover areas.

Fall River Secondary

The Fall River Secondary is adjacent to several areas of Core Habitat that includes Forge Pond (BM1232) and the Southeastern Massachusetts Bioreserve, Freetown-Fall River State Forest (BM1229). It is not adjacent to any Living Waters, however it crosses rivers and streams that are considered important fisheries habitats.

BioMap Core Habitat

This section includes a description of the BioMap Core Habitat adjacent to and crossed by the Fall River Secondary.

Forge Pond (BM1232)—Forge Pond is an irregularly shaped surface waterbody located mainly on the southwestern side of the Fall River Secondary in Freetown. A wetland complex of trees, shrubs, and emergent vegetation exists between the bank of the pond and the track in several areas, most notably along the northern portion of the pond. In this area, the wetland complex borders the tracks for approximately 1,100 feet. The track abuts the Forge Pond Core Habitat for approximately 400 feet in Freetown (Figure 4.14-4a).

Freetown-Fall River State Forest (BM1229)—BioMap Core Habitat (BM1229) is a large polygon that includes the Southeastern Massachusetts Bioreserve and Freetown-Fall River State Forest, which are adjacent to the Fall River Secondary, and includes the Assonet Cedar Swamp and Acushnet Cedar Swamp, which are only crossed by the New Bedford Main Line. The Fall River Secondary crosses the Assonet River, which runs through the Assonet Cedar Swamp.

The Freetown-Fall River State Forest is a 5,441-acre property with access from Slab Bridge Road in Freetown. The state forest provides recreational facilities, including a picnic area and 50 miles of unpaved roads and trails used for hiking, mountain biking, horseback riding, and snowmobiling. Hunting and fishing are also popular uses of the state forest, particularly Rattlesnake Brook, which is stocked with brook trout. None of the active public recreation areas or trails is adjacent to the tracks, which are currently used for freight rail service. The Freetown-Fall River State Forest is bounded on the northwest by the existing Fall River Secondary for approximately 1.4 miles in Freetown (Figures 4.14-4a-b). The state forest is part of the Southeastern Massachusetts Bioreserve.

Living Waters

The Fall River Secondary is not adjacent to any Living Waters, however it crosses rivers and streams that are considered important fisheries habitat.

In Freetown, the Fall River Secondary crosses Rattlesnake Brook at the same location where it is crossed by Route 24. North of this location, the track abuts the eastern bank of the Assonet River between Forge Road and Beechwood Road. Farther north in Lakeville, the track crosses the Assonet River. In none of these locations is the track adjacent to (within 100-feet of the track centerline), nor does it cross the areas of Core Habitat that have been designated for sections of Rattlesnake Brook (LW321) and the Assonet River (LW330) (Figures 4.14-4a-b).

Fisheries Habitat

The Fall River Secondary crosses the Assonet River, Rattlesnake Brook, and Terry Brook (Figures 4.14-4a-b) and is adjacent to the Taunton River. These waterways all provide important fisheries habitat. Table 4.14-4 includes fisheries survey results for these habitats.

Vernal Pools

A discussion of vernal pools along the Fall River Secondary is included in the narrative for the Stoughton Alternative.

Fish and Wildlife Passage

A discussion of fish and wildlife passage along the Fall River Secondary is included in the narrative for the Stoughton Alternative.

Other Important Habitat Areas

The Fall River Secondary is not adjacent to nor does it cross any other large unfragmented habitat or protected open spaces.

Stoughton Alternative

The Stoughton Alternative, north of Cotley Junction, includes improvements to existing active freight or rail lines (track sections north of Stoughton Station and from Dean Street to Cotley Junction) and track construction on out-of-service or abandoned rights-of-way (between Stoughton Station and Dean Street or between Whittenton Junction and Route 138 for the Whittenton variant of the Stoughton Alternative (Whittenton Alternative). All alternatives that use the Stoughton line (including the Whittenton variant) would include constructing a trestle through part of the Hockomock Swamp to reduce impacts to wetlands, biodiversity, and rare species. The Stoughton Electric and Diesel Alternatives are illustrated in Figures 4.14-5a-e and 4.14-7a-e.

The Stoughton Line is an inactive line without tracks and ties in most areas. There are culverts that convey streams underneath the embankment. In addition to the culverts, the right-of-way itself provides suitable migratory habitat for wildlife because there are no tracks and ties to prevent turtles, amphibians, and small mammals from moving across the right-of-way. However, the right-of-way does not likely provide suitable nesting, breeding, or foraging habitat for wildlife. This is in part due to disturbance caused by frequent, although unauthorized use of the right-of-way by pedestrians, bicycles, and in particular, all-terrain vehicles (ATVs), which also cause erosion.

Both the Stoughton Alternatives (diesel/electric) (as well as the Whittenton Variant) cross through a Core Habitat polygon that includes the Hockomock Swamp ACEC (BM1166). Unlike the Whittenton variant, the Stoughton Alternatives cross the Pine Swamp (BM1196) in Raynham. Both the Stoughton Alternatives and the Whittenton Variant (Whittenton Alternative) cross the Taunton River near a reach that is mapped as a Living Water Core Habitat (LW080). The Taunton River is identified as providing important fisheries habitat.

BioMap Core Habitat

This section includes a description of the BioMap Core Habitat crossed by the Stoughton Line.

Hockomock Swamp (BM1166)—The Hockomock Swamp ACEC includes approximately 16,950 acres of land in Bridgewater, Easton, Norton, Raynham, Taunton, and West Bridgewater (Figures 4.14-5c-d). The ACEC is fragmented by several major transportation corridors, including Routes 24, I-495, 138, 106, and other major roadways, and it includes substantial upland areas within the watershed of the Hockomock Swamp. These uplands include land developed in commercial and residential uses as well as undeveloped forested upland and farmland.

Much of the Hockomock Swamp portion of the ACEC (approximately 5,000 acres) is owned by the Massachusetts Division of Fisheries and Wildlife as the Hockomock Swamp Wildlife Management Area (WMA). The DCR describes the ACEC is one of the most extensive inland wildlife habitats in southeastern

Massachusetts and as the largest vegetated freshwater wetland system in Massachusetts. The wetland system includes Hockomock Swamp, Dead Swamp, Titicut Swamp, and Little Cedar Swamp.[19]

The ACEC provides habitat for at least 13 species listed as rare, endangered, or of special concern by the NHESP, and contains several different plant communities. The Atlantic white cedar swamp and fen wetland communities scattered throughout the ACEC are considered to be outstanding examples of these unique natural communities. The Atlantic white cedar community is found on the western side of the embankment. Because the railroad berm controls the flow of water from west to east, higher surface water elevations are maintained west of the embankment and are associated with the Atlantic white cedar community. The portion of the wetland east of the railroad berm contains a red maple-dominated wetland. The hydrology of this area is controlled by the Route 138 embankment.

This wetland complex includes two Core Habitats (BM1166 and BM1168). The Stoughton Line crosses the Hockomock Swamp for approximately 1.6 miles and the BioMap Core Habitat (BM1166) for approximately 3 miles (Figures 4.14-5c-d). The Stoughton Line is not adjacent to the Core Habitat (BM1168).

Pine Swamp (BM1196)—Pine Swamp is a 275-acre wetland system located in western Raynham and includes several properties that are owned by the Town of Raynham Conservation Commission (Figure 4.14-5d). This area consists of forested and marsh wetlands, is located within mapped estimated habitat of several rare wetland species, and supports an Atlantic white cedar swamp community. The right-of-way for the Stoughton Alternatives (diesel, electric)) crosses the both the Pine Swamp and Core Habitat (BM1196) for approximately 1 mile between King Phillip Street and East Britannia Street.

Living Waters

The Stoughton Line is adjacent to Living Water Core Habitat (LW080) near a reach of the Taunton River that provides habitat for the federally listed Atlantic sturgeon. The right-of-way crosses this section of the Taunton River for approximately 125 feet, south of Weir Junction in Taunton (Figure 4.14-3a). North of Weir Junction, the Stoughton Alternatives (diesel, electric) cross the Taunton River three more times on a series of bridges located upstream from the area mapped as Living Water (LW080) (Figure 4.14-5e).

Fisheries Habitat

The Stoughton Line crosses Whitman Brook, Queset Brook, Black Brook, Pine Swamp Brook, Taunton River, and the Mill River, which are all important fisheries habitats. Table 4.14-4 includes fisheries survey results for these habitats. According to the Massachusetts Department of Fish and Wildlife comment letter on the DEIS/DEIR, fisheries surveys of the Mill River yielded 10 species, including American eel (*Anguilla rostrata*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), brown bullhead (*Ameiurus nebulosus*), chain pickerel (*Esox niger*), common shiner (*Notropis cornutus*), largemouth bass (*Micropterus salmoides*), pumpkinseed (*Lepomis gibbosus*), redfin pickerel (*Esox americanus americanus*) and tessellated darter (*Etheostoma olmstedi*).

[19] Hockomock Swamp ACEC website: (http://www.mass.gov/dcr/stewardship/acec/acecs/l-hcksmp.htm).

Breeding Bird Diversity along the Stoughton Corridor

In response to requirements of the Secretary's Certificate, as well as other comments received in the DEIS/DEIR, breeding bird surveys and other studies conducted to refine the wildlife impact assessment and mitigation plans. The updated evaluation of breeding bird diversity includes a description of key avian habitats and an updated list of breeding birds (identifying area-sensitive bird species as well as wetland-dependent birds) likely to occur along the Stoughton Alternative.

Key Avian Habitats

Although breeding birds occur along the entire South Coast Rail corridor, several key areas for the protection of bird diversity have been identified by the Massachusetts Audubon Society (Mass Audubon) and the Natural Heritage and Endangered Species Program (NHESP) Biomap program. This section describes these key habitat areas and provides an update of the breeding birds likely to occur in the key avian habitat areas.

An Important Bird Area (IBA) is an area that provides important habitat to one or more species of breeding, wintering, and/or migrating birds. These areas are designated as part of an international effort to protect bird habitat around the world. The Massachusetts Audubon Society has designated two IBAs within the study area: the Hockomock Swamp and the Freetown Fall River State Forest/Southeastern Massachusetts Bioreserve. Other key bird habitats are large, relatively intact forested areas and include Pine Swamp in Raynham, the Assonet Cedar Swamp in Lakeville, and the Acushnet Cedar Swamp in New Bedford.

Hockomock Swamp IBA—The Hockomock Swamp IBA is a 5,126 acre area located in Bridgewater, Easton, Norton, Taunton, West Bridgewater, Bridgewater, and Plymouth. It includes three state owned wildlife management areas (WMA): the Hockomock Wildlife Management Area, the Wilder Wildlife Management Area, and the West Meadows Wildlife Management Area. This IBA provides important migratory/stopover habitat as well as nesting habitat.

The area has been reported to contain nine breeding and/or wintering/migrant state-listed species, and at least 47 regional and five state high conservation priority species. Very abundant species are gray catbird, northern waterthrush, common yellowthroat, swamp sparrow, common grackle, and veeries. State-listed species within this IBA include: grasshopper sparrow, short-eared owl, upland sandpiper, common moorhen, king rail, sharp shinned hawk, northern harrier, least bittern, and pied-billed grebe.

The major habitat types found within this IBA include oak-conifer forest, cultivated grassland, cultivated field, emergent freshwater wetland, palustrine woodland swamp, shrub-scrub wetland, lake/pond, and river/stream.

Freetown Fall River State Forest/ Southeastern Massachusetts Bioreserve IBA—The Freetown Fall River State Forest/Southeastern Massachusetts Bioreserve IBA is a 15,000 acre area located in the towns of Freetown, Fall River, and Bristol. It includes the Freetown Fall River State Forest, the Acushnet Cedar Swamp, and the Southeastern Massachusetts Bioreserve. This area supports important avian habitat diversity, especially in the Rattlesnake Brook area, and provides important migratory/stopover habitat as well as nesting habitat. Because of the Bioreserve designation, there is a focus on habitat management, research, and monitoring of flora and fauna. Some of the bird monitoring efforts include: Christmas Bird Counts, spring migration bird counts, Breeding Bird Surveys, and Biodiversity Day events. Christmas Bird Counts and Breeding Bird Surveys have been conducted since 1970.

The area has been reported to contain one breeding and/or wintering/migrant state listed species, and at least seven regional and one state high conservation priority species. Very abundant species include the Eastern towhee, ovenbird, and prairie warbler. The migrant state listed species reported to use the IBA is the Northern parula.

The major habitat types found within this IBA include northern hardwoods forest, oak-conifer forest, pitch pine/scrub oak, early successional shrubland, power line, shrub-scrub wetland, and river/stream.

Pine Swamp—Pine Swamp is a 275 acre wetland system in western Raynham that includes several properties owned by the Town of Raynham Conservation Commission. This area consists of forested and marsh wetlands, is located within mapped estimated habitat of several rare wetland species, and supports an Atlantic white cedar swamp community. The right-of-way crosses Pine Swamp for approximately 1 mile between King Phillip Street and East Britannia Street.

Assonet Cedar Swamp—As previously discussed as a BioMap Core Habitat, the Assonet Cedar Swamp in Lakeville and Freetown is considered key bird habitat.
Acushnet Cedar Swamp

As previously discussed as a BioMap Core Habitat, the Acushnet Cedar Swamp State Reservation located in New Bedford and Dartmouth, is considered key bird habitat

Breeding Bird Diversity

A list of potential breeding birds along the Stoughton alignment (including the Southern Triangle) was developed using the Mass Audubon Breeding Bird Atlas 2 data. Data for atlas blocks in five areas were reviewed: Hockomock Swamp (Blocks Brockton 09, Taunton 07); Pine Swamp (Taunton 08); Assonet Cedar Swamp (Somerset 11); Freetown-Fall River State Forest (Somerset 09, 12); Acushnet Cedar Swamp (New Bedford North 02). Birds listed as Confirmed, Probable, or Possible breeders were assumed to be potential breeding birds along the Stoughton corridor.

As described above, the breeding bird atlas block lists were used to develop a list of potential breeding bird species for each of the key habitat areas (the Hockomock Swamp, Pine Swamp, the Assonet Swamp, Freetown-Fall River State Forest, and the Acushnet Cedar Swamp). As shown in Table 4.14-1 , there are potentially 101 breeding bird species along the Stoughton Alternative corridor, in the key habitat areas.

Each atlas block is 1/12 of a USGS topographic quad, and covers 10 square miles. The breeding bird data for each block therefore includes substantial areas that are not adjacent to the rail corridor, and includes a range of habitats (suburban neighborhoods, open fields, ponds and lakes, marshes, upland forest, forested swamps). This diversity of habitats is reflected in the list presented in Table 4.14-1, which includes suburban birds (cardinal [*Cardinalis cardinalis*], robin [*Turdus migratorus*], chipping sparrow [*Spizella passerine*], chimney swift [*Chaetura pelagica*]); birds of ponds and lakes (mute swan [*Cygnus olor*], osprey [*Pandion haliaetus*], kingfisher [*Ceryle alcyon*]); birds of marshes (red-winged blackbird [*Agelaius phoeniceus*], marsh wren [*Cistothorus palustris*], yellow warbler [*Dendroica petechial*]), birds of fields and shrublands (bluebird [*Sialia sialis*], savannah sparrow [*Passerculus sandwichensis*], song sparrow [*Melospiza melodia*], indigo bunting [*Passerina cyanea*]); and birds of upland dry forest (whip-poor-will [*Caprimulgis vociferous*], Eastern towhee, pine warbler [*Dendroica pinus*]).

The primary bird species of concern are the forest interior species, birds that require large areas of forest (upland or wetland) for nesting. These include such species as barred owl [*Strix varius*], broad-winged hawk [*Buteo platypterus*], veery [*Catharus fuscescens*], wood thrush [*Hylocichla mustelina*], black-and-white warbler [*Mniotilta varia*], American redstart [*Setophaga ruticilla*], and scarlet tanager [*Piranga olivacea*]. As shown in Table 4.14-1, the Acushnet Cedar Swamp area has the highest number (16) of these forest interior birds, while the other areas are similar in the level of diversity of forest interior birds, with 9 to 11 species reported in each area.

There are 18 wetland-dependent bird species reported from these key habitat areas. These species occupy a wide range of breeding habitats, including open water (osprey, great blue heron [*Ardea Herodias*], mute swan), marshes (red-winged blackbirds), and shrub swamps (common yellowthroat, swamp sparrow). None are restricted to forested wetlands. As shown in Table 4.14-1, the majority of the wetland-dependent species occur in all of the key habitat areas.

Vernal Pools

In 2000-2001, the South Coast Rail right-of-way for the Stoughton Alternative was delineated for wetlands and investigated for the presence of vernal pool habitat. During these investigations, 16 certified vernal pools and 14 uncertified vernal pools were identified adjacent to the Stoughton Line and documented in the 2002 Final EIR. Some of the vernal pool point data available from GIS were found to be incorrectly located when compared to field verified locations.

Previous vernal pool surveys were supplemented by additional surveys conducted in 2008 and 2009. The 2008 investigations included surveys of the right-of-way in Stoughton, Easton, and Raynham along the inactive Stoughton Main Line. Three previously unidentified vernal pools were observed and documented adjacent to the right-of-way in Easton and Raynham (VP-10, VP-11, and VP-12). The 2009 investigations included surveys of the right-of-way in Stoughton, Taunton, Easton, and Raynham along the inactive Stoughton Main Line and Whittenton Branch. Three additional vernal pools were identified and documented adjacent to the right-of-way in Easton and Raynham (VP-13, PVP-23791, and PVP-25089). These vernal pools were mapped using GPS technology and are described below.

On April 7, 2009 additional vernal pools inspections were conducted along the Stoughton Line in Easton and Raynham in conjunction with NHESP staff. During this field visit NHESP inspected certified, potential, and previously-unidentified vernal pools found between Depot Street and Bridge Street (Hockomock Swamp). The following is a summary of this effort:

Approximately three new vernal pools, illustrated in Figures 4.14-7c-d as NHESP-1, NHESP-2, and NHESP-3, were identified with sufficient evidence of obligate species (wood frogs, spotted salamanders, and fairy shrimp) to allow certification.

Three previously identified potential vernal pools (PVP-7256, PVP-7257, and PVP-20158) had sufficient evidence of obligate species to allow certification. All certified vernal pools had evidence of obligate species.

In 2010, field work began in order to identify and delineate all wetland resource areas along the Stoughton Alternative. At that time, any additional vernal pools not found during earlier surveys were identified. Visual searches were conducted along the right-of-way to identify any previously unidentified vernal pools. Several NHESP identified potential vernal pools within 100 feet of the right-of-way were inspected for the presence of certification characteristics under NHESP guidance. Previously unidentified vernal pools were located and documented. Some of the vernal pool point data available from MassGIS were found to be incorrectly located when compared to field verified locations and certification forms provided by the NHESP. The locations of all certified, potential, and field verified vernal pool are shown in Figures 4.14-7-10.

The Secretary's Certificate required a more expansive level of vernal pool assessment, including indirect impacts to upland habitat for vernal pools up to 750 feet on either side of the right-of-way. It is not practicable to conduct complete searches of the entire area within 750 feet from the right-of-way, due to the large area which would require review (approximately 15 square miles) as well as the fact that the vast majority of the land is under private ownership. However, all known certified and potential vernal pools within 750 feet of the right-of way were used in the impact analysis.

Existing Vernal Pools along the Stoughton Alternative inclusive of the Southern Triangle—Numerous vernal pools are present within the right-of-way and in other locations within the study area. Several vernal pools occur adjacent to the railroad embankment. There are clusters of vernal pools in several locations that may have higher wildlife habitat value than single, isolated pools. Table 4.14-5 summarizes the vernal pools that have at least some portion inside the right-of-way, pools within 100 feet of the right-of-way, and pools within 750 feet of the right-of-way.

The Stoughton Alternative passes through four large vernal pool complexes, consisting mostly of PVPs. Vernal pools are present on both sides of the right-of-way in Easton, immediately south of the proposed North Easton Station site (Figure 4.14-7b). Movement of vernal pool amphibians between pools in this area may occur to some degree, but this movement is likely to be constrained by the presence of the existing, abandoned tracks (rails) in this area. A large vernal pool complex is present within Hockomock Swamp in Easton, south of Foundry Street, extending to the powerline corridor (Figure 4.14-7c). Several discrete vernal pools are present south of the powerline corridor. Large areas of the Hockomock Swamp support breeding of vernal pool amphibians and spotted turtles although they do not meet the regulatory definition of vernal pools. Movement between these areas is currently unrestricted. These sections of the out-of-service right-of-way are heavily used by All Terrain Vehicles (ATVs), which drive through the vernal pools in serpentine and circuitous routes and adversely affect the habitat of vernal pool fauna, particularly during breeding, egg and larval stages. A group of PVPs is mapped within the Hockomock Swamp ACEC in Raynham, north of Bridge Street (Figure 4.14-7d). The right-of-way in this area is open and unvegetated, but does not have tracks or ties. Vernal pool complexes are also present along both sides of the right-of-way south of Pine Swamp in Raynham between East Brittania Street and Thrasher Street, and between Thrasher Street and Winter Street (Figure 4.14-7e).

The New Bedford Main Line and Fall River Secondary pass by relatively few vernal pools, and the pools along these lines do not form clusters. Connectivity between these pools is often already fragmented by existing roads.

Table 4.14-5 Summary of Vernal Pools Inclusive of the Southern Triangle

Municipality	Pools within ROW	Field Verified Pools within 100 of ROW (additional)	Mapped Certified and Potential Pools within 750 feet of ROW (additional)
Canton	0	0	1
Stoughton	1	2	2
Easton	11	20	14
Raynham	6	4	17
Taunton	5	7	22
Berkley	0	4	8
Lakeville	0	1	2
Freetown	4	3	7
New Bedford	0	1	6
Fall River	0	0	0
Total	27	42	78

Fish and Wildlife Passage

A detailed inventory of bridges and culverts was conducted to identify the location, condition, and function of each structure. Dimensions, construction materials, and railroad bed characteristics (such as condition and depth of cover) were recorded. For this biodiversity assessment, the subset of bridges and culverts with potential ecological value was determined by reviewing wetland mapping (as depicted in the Abbreviated Notice of Resource Area Determination [ANRAD] for each municipality), surrounding land use (as visible in aerial photographs), and other ecological setting features, as modeled by the University of Massachusetts' Conservation Assessment and Prioritization System CAPS, of the complete bridge and culvert inventory. The CAPS model background information is provided in Section 4.14.3.1 Impact Assessment Methodology. The inventory of this subset of bridges and culverts is provided in Appendix 4.14-A, and summarized in this section.

There are 128 structures (23 bridges and 105 culverts) along the Stoughton Alternative alignment (comprised of the Stoughton Line, New Bedford Main Line, and Fall River Secondary) that may have biodiversity value by connecting ecosystems, which can allow fish and wildlife to pass from one side of the tracks to the other. Many of these structures also have a hydrologic function, allowing water to flow under or through the railroad structure (subgrade, ballast, ties, and tracks). Bridges that convey roads under or over the railroad bed would also be improved for the project but do not have an ecological function connecting ecosystems and are therefore not included in this biodiversity evaluation. Bridges and culverts that have been replaced prior to the South Coast Rail project are also not included in this biodiversity evaluation, as are 29 culverts within the right-of-way that do not cross under the railroad bed (are parallel to it) and therefore do not connect ecosystems bisected by the railroad.

The distribution of these existing 128 structures with potential ecological value between the three rail segments is indicated in Table 4.14-6. A detailed inventory of the structures is provided in Appendix 4.14-A. Figures 4.14-11 through 4.14-13 depict existing bridge and culvert locations.

Table 4.14-6 Summary of Bridges and Culverts

Structure	Stoughton Line	New Bedford Main Line	Fall River Secondary	Total
Bridges	10	6	7	23
Culverts	50	28	27	105
Total	60	34	34	128

Portions of the three railroad lines were originally constructed in the mid-1800s and many of the culverts may date from that period. The current major bridges, such as those over the Taunton River in Taunton, were constructed in the early 1900s.[20] Many of these structures would be replaced to meet modern engineering standards.

The bridges along the Stoughton Alternative are open-bottom structures with abutments or pilings supporting a deck stringer, girder, slab, or trestle to which the tracks are affixed. Most of the bridges considered in this biodiversity evaluation convey the tracks over perennial streams, rivers, or ponds and therefore allow unimpeded passage of aquatic species (fish and amphibians). These over-water bridges generally accommodate flood flow. Some bridges are located in upland areas and may have originally conveyed the tracks over farm roads, and can now serve as open passage for wildlife on the abandoned roads; a subset of these bridges are located along the Taunton River in Fall River and also allow flood access to land subject to coastal storm flowage (LSCSF), as shown in Table 4.14-7. The majority of the bridges range in length from 12 to 36 feet; the longest bridges are the four over the Taunton River in Taunton (Figure 4.14-11e), ranging from 113 to 176 feet long, on the Stoughton Line. Another substantial bridge, 64 feet long, crosses the Cedar Swamp River in Freetown (Figure 4.14-12b) on the Fall River Secondary. Construction features of each bridge are provided in the culverts along the Stoughton Alternative are open- or closed-bottom box or pipe structures beneath the tracks, covered with a layer of railroad bed ballast. Most of the culverts along the alignment are stone boxes; others are cast iron pipe, ductile iron pipe, corrugated metal pipe, or other materials. The culverts considered in this biodiversity evaluation provide a variety of hydrologic functions, as indicated in Table 4.14-8 and Appendix 4.14-A.

Culverts providing upland drainage accommodate stormwater flow but are otherwise dry. Wetland equalization functions maintain surface water levels in adjoining wetlands. Intermittent or perennial streams are conveyed by some culverts, while others connect parts of a pond bisected by the railroad.

Some of the culverts along the alignment are collapsed, buried, or washed out and no longer perform their original hydrologic function or any ecological function. Others are submerged, either continuously or seasonally, and may no longer perform their original hydrologic function but currently allow water flow and fish or amphibian passage. At some culvert locations, the railroad bed has dammed surface water flow, creating a pond or wetland on the upstream side, especially where the culvert has collapsed. Culverts at these locations maintain water levels in the upstream pond or wetland.

[20] A number of bridges over or under roadways were replaced within the last 15 years.

Table 4.14-7 Bridge Features

Bridge	Figure Number	Crosses	Type	Number of Spans	Length (feet)
Stoughton Line					
Forge Pond	4.14-11a	Perennial Pond	Stone arch	1	29
Mill Brook (Beaver Meadow Brook)	4.14-11a	Perennial Stream	Through girder	1	18
Cowessett Brook (Whitman Brook)	4.14-11b	Perennial Stream	Deck stringer	1	20
Quesett Brook (Small Creek)	4.14-11b	Perennial Stream	Deck stringer	1	15
Pine Swamp Brook #1	4.14-11d	Perennial Stream	Unknown	1	15
Pine Swamp Brook #2	4.14-11d	Perennial Stream	Unknown	1	12
Taunton River (at MP 34.38)	4.14-11e	Perennial River	Deck girder	11	118
Taunton River (at MP 34.62)	4.14-11e	Perennial River	Deck girder	16	172
Taunton River (at MP 34.73)	4.14-11e	Perennial River	Deck stringer	17	176
Mill River	4.14-11e	Perennial River	Deck girder	1	37
New Bedford Main Line					
Taunton River (at MP 35.56)	4.14-11e	Perennial River	Through girder	4	113
Brickyard Road	4.14-11e	Upland	Deck stringer	1	20
Cotley River (at MP 38.93)	4.14-12a	Perennial River	Deck girder	1	20
Cotley River (at MP 39.46)	4.14-12a	Perennial River	Deck girder	1	21
Cedar Swamp River	4.14-12b	Perennial River	Timber pile trestle	2	21
Fall Brook	4.14-12b	Perennial Stream	Deck stringer	1	17
Fall River Secondary					
Cedar Swamp River	4.14-13a	Perennial River	Deck stringer	3	64
Farm Road	4.14-13b	Upland	Deck stringer	1	18
Farm Road	4.14-13b	Upland	Deck stringer	1	17
Miller's Cove Road	4.14-13b	Upland/ LSCSF	Concrete slab	1	15
Collins Road	4.14-13b	Upland/LSCSF	Through girder	1	35
Ashley's Underpass	4.14-13b	Upland/LSCSF	Timber stringer	1	23
Channel near Battleship Cove	4.14-13c	Perennial Stream	Unknown	1	Unknown

Table 4.14-8 Culvert Hydrologic Functions

	Hydrologic Function				
Railroad	Upland Drainage	Wetland Equalization	Stream Conveyance	Pond Connector	TOTAL
Stoughton Line	13	23	14	0	50
New Bedford Main	3	16	9	0	28
Fall River Secondary	8	7	11	1	27
Total	24	46	34	1	105

Other Important Habitat Areas

The Stoughton Line crosses and is adjacent to large wetland and upland areas in Stoughton (adjacent to Stoughton Memorial Conservation Land), and in Easton, between River Terrace and Partridge Way and between Baldwin Street and Prospect Street (Figures 4.14-5b-c). These wetlands and wooded upland areas are mostly unfragmented open space that could be important wildlife habitat because they may be used as dispersal, migration, breeding, foraging, and as bird stopover areas.

Stoughton Memorial Conservation Land—The Town of Stoughton's Memorial Conservation Land (which includes the Bird Street Conservation Lands) is a 675-acre parcel west of the Stoughton Line right-of-way, extending from Plain Street to the Easton town line and west of the Bird Street Conservation Area (which is not within 0.5 mile of the corridor). The Stoughton Conservation Memorial Lands represent the largest contiguous conservation area owned by the Town of Stoughton.[21]

The majority of the land is wooded, but it also contains large areas of open fields. The area supports a variety of habitats, including a former quarry, old fields, a pond, marshes, forested wetlands, and forested uplands. The primary access to the property is off Bird Street. The area extends to the MBTA right-of-way in two locations, with approximately 1,500 feet of frontage on the right-of-way (Figure 4.14-5b). One location is a narrow strip where the railroad closely parallels Route 138 south of Morton Street. The second location is south of Totman Farm Road, extending to the Easton town line west of the right-of-way. The majority of the area and all of the developed trail system are more than 1,000 feet from the right-of-way and it does not include any BioMap Core Habitat. This area contains a cluster of potential vernal pools.

Whittenton Alternative

The Whittenton Alternative runs predominantly along the same course as the Stoughton Alternative. The Whittenton Alternative is different from the Stoughton Alternative only along a portion of right-of-way between Raynham Junction and Weir Junction, a length of approximately 5.8 miles. A section of the Whittenton Alternative, known as the Whittenton Branch, diverges from the Stoughton Line at Raynham Junction and travels through Raynham and Taunton for approximately 3.4 miles to Whittenton Junction. This section of track is currently inactive. At Whittenton Junction, the track joins the Attleboro Secondary, an active rail line, for approximately 2.4 miles to Weir Junction at the beginning of the New Bedford Main Line. The Whittenton and Stoughton Alternatives run the same course on the Stoughton Line from Canton to Raynham Junction. The New Bedford Main Line and the Fall River Secondary are

[21] Town of Stoughton Open Space and Recreation Plan, prepared by Horsley Witten Group, public review draft April 2006, p. 38.

also identical for both alternatives. Figures 4.14-6 and 4.14-10 show the Whittenton Branch and Attleboro Secondary segments of the Whittenton Alternative.

The right-of-way corridor in Raynham is approximately 1.2 miles long and is characterized by a wide, well-worn path used by ATVs, horses, mountain and motor bikes, and pedestrians. A power line runs down the eastern edge of the right-of-way from Raynham Junction to King Philip Street, creating a canopy gap at least 20 feet wide in most places. Although the western side of the right-of-way passes by a large wetland area (Wetland RWB 02), the majority of the eastern side of the right-of-way from Raynham Junction to King Philip Street is characterized by residential development. From south of King Philip Street to the municipal border between Raynham and Taunton, the right-of-way passes through a highly disturbed area, currently the site of a construction and demolition (C&D) debris disposal facility that has encroached onto the railroad right-of-way. New England Recycling, Inc. of Taunton stores the C&D debris at the Raynham Facility, which abuts the railroad right-of-way and has an address of 138 (Rear) Broadway in Raynham. Disposal of C&D debris on the railroad right-of-way is not an authorized use of the land. The right-of-way is currently occupied by what appears to be material containing stumps, compost, sand, gravel, boulders, and minor amounts of solid waste and debris. The disposal facility operator has indicated that this material is frequently relocated and new material brought into the site and would be relocated at the request of MassDOT.

For these reasons, biodiversity issues are fairly limited in scope along the Raynham section of the Whittenton Branch. Because of the canopy gap and the development on the eastern side of the right-of-way, no large areas of wetland or upland habitat would be fragmented by the railroad. No endangered species habitat exists along the right-of-way, and no perennial streams are crossed.

The Taunton section of the right-of-way is approximately 2.2 miles long. From the municipal border between Raynham and Taunton, the right-of-way passes by Prospect Hill Pond and travels through a wooded upland for approximately 0.6 mile. The path in this section remains wide with a canopy gap, and several side ATV trails branch off from the right-of-way. This section of the right-of-way also passes by a wetland area (Wetland TWB 09) containing Atlantic white cedar, a state listed rare species. The right-of-way then enters another developed area and crosses Bay and Whittenton Streets, passing close by several residential properties to the east as well as an industrial land parcel to the west, for approximately 0.6 mile. South of Whittenton Street, the right-of-way has been widened into an access road which was previously used to access a stone quarry site to the west. The roadway is approximately 20 feet wide. The right-of-way then crosses the Mill River and Warrren Street, a distance of approximately 0.3 mile. South of Warren Street, the right-of-way follows the access road for another 0.3 mile. Finally, the right-of-way branches off from the access road, and for the remaining 0.3 mile, it travels through an area of denser vegetation, with a narrow path approximately 6 to 8 feet wide and a closed canopy in places. The entire 0.6 mile area south of Warren Street has also been designated as eastern box turtle habitat by the Natural Heritage and Endangered Species Program (NHESP). Threatened and endangered species are discussed in detail in Chapter 4.15.

Prospect Hill Pond and the surrounding forested upland provide wildlife habitat, despite nearby ATV use of the area. The Mill River is a perennial stream and provides a wildlife corridor for both fish and birds. Finally, the area south of Warren Street has several large wetland areas adjacent to it that ultimately drain to the Mill River (Wetlands TWB-05.1 through TWB-01).

Biomap Core Habitats

Similar to the Stoughton Alternative the Whittenton Alternative would cross Biomap Core Habitat in two areas. The Hockomock Swamp, from Foundry Street in Easton south to Bridge Street in Raynham, is designated as Core Habitat.

Living Waters

No mapped Living Waters occur along the Whittenton Alternative.

Fisheries Habitat

According to the Massachusetts Department of Fish and Wildlife comment letter on the DEIS/DEIR, fisheries surveys of the Mill River yielded ten species, including American eel, black crappie, bluegill, brown bullhead, chain pickerel, common shiner, largemouth bass, pumpkinseed, redfin pickerel and tessellated darter.

Breeding Bird Diversity

Potential breeding birds along the Whittenton Alternative are similar to Stoughton Alternative (including the Southern Triangle) as detailed above.

Vernal Pools

A total of 17 vernal pools lie within 750 feet of the right-of-way along the Whittenton Branch and Attleboro Secondary (Table 4.14-9). Much of the Attleboro Secondary is in developed areas of Taunton, and no vernal pools are present in these developed areas.

Table 4.14-9 Summary of Vernal Pools–Whittenton Alternative

Municipality	Pools within ROW	Pools within 100 of ROW (additional)	Pools within 750 feet of ROW (additional)
Canton	0	0	1
Stoughton	1	2	2
Easton	11	20	14
Raynham	0	5	11
Taunton	1	8	18
Berkley	0	4	8
Lakeville	0	1	2
Freetown	4	3	7
New Bedford	0	1	6
Fall River	0	0	0
Total	17	43	71

A total of 136 vernal pools lie along or within 750 feet of the right-of-way of the Whittenton Alternative as a whole.

Similar to the Stoughton Alternative, the Whittenton Alternative passes several large vernal pool complexes, consisting mostly of PVPs. Vernal pools are present on both sides of the right-of-way in Easton, immediately south of the proposed North Easton Station site (Figure 4.14-5b). Movement of vernal pool amphibians between pools in this area may occur to some degree, but this movement is likely to be constrained by the presence of the existing tracks. A large vernal pool complex is present in Easton south of Foundry Street, extending to the powerline corridor (Figure 4.14-5c). Several discrete vernal pools are present south of the powerline corridor. Large areas of the Hockomock Swamp support breeding of vernal pool amphibians and spotted turtles although they do not meet the regulatory definition of vernal pools. Movement between these areas is currently unrestricted. These sections of the out-of-service right-of-way are heavily used by All Terrain Vehicles (ATVs), which drive through the vernal pools and adversely affect the habitat. A group of PVPs is mapped within the Hockomock Swamp ACEC in Raynham, north of Bridge Street (Figure 4.14-5d). The right-of-way in this area is open and unvegetated, but does not have tracks or ties. This alternative avoids potential impacts to vernal pool complexes present along both sides of the right-of-way south of Pine Swamp in Raynham between East Brittania Street and Thrasher Street, and between Thrasher Street and Winter Street (Figure 4.14-5e).

The New Bedford Main Line and Fall River Secondary pass by relatively few vernal pools, and the pools along these lines do not form clusters. Connectivity between these pools is often already fragmented by existing roads.

Fish and Wildlife Crossings

A detailed inventory of bridges and culverts was conducted to identify the location, condition, and function of each structure. Dimensions, construction materials, and railroad bed characteristics were recorded. For this biodiversity assessment, the subset of bridges and culverts with potential ecological value was determined by reviewing wetland mapping, surrounding land use (as visible in aerial photographs), and other ecological setting features (as modeled by CAPS) of the complete bridge and culvert inventory. The CAPS model output indicates areas with a high (over 50 percent) Index of Ecological Integrity (IEI). No areas with a high IEI exist along the Whittenton Branch.

There are eight structures (one bridge and seven culverts) along the Whittenton Branch that may have biodiversity value by connecting ecosystems, which can allow fish and wildlife to pass from one side of the tracks to the other. Most of these structures also have a hydrologic function, allowing water to flow under or through the railroad structure (subgrade, ballast, ties, and tracks). Bridges that convey roads under or over the railroad bed would also be improved for the project but do not have an ecological function connecting ecosystems and are therefore not included in this biodiversity evaluation.

The culverts along the Whittenton Branch are open- or closed-bottom box or pipe structures beneath the tracks, covered with a layer of railroad bed ballast. Most of the culverts along the alignment are stone boxes; one culvert consists of a clay pipe. The culverts considered in this biodiversity evaluation provide a variety of hydrologic functions, as indicated in Table 4.14-10. Culverts providing upland drainage accommodate stormwater flow but are otherwise dry. Wetland equalization functions maintain surface water levels in adjoining wetlands. Intermittent or perennial streams are conveyed by some culverts. Figures 4.14-14a-b depict existing bridge and culvert locations.

Table 4.14-10 Existing Conditions along the Whittenton Branch–Fish and Wildlife Passage

Wetland ID	Municipality	Description	Function
RWB-02.1, RWB-02	Raynham	Stone box culvert under ROW, 4 feet wide by 5 feet high, intermittent stream likely flows east to west	Carries intermittent stream flow
TWB-10, TWB-09	Taunton	Stone box culvert under ROW, 2.5 feet wide by 3 feet high, intermittent stream likely flows east to west	Limited ecological functions – collapsed/sunken at western end
TWB-08, TWB-07	Taunton	Stone box culvert under Whittenton St., 2.5 feet wide by 3 feet high, intermittent stream likely flows north to south	Carries intermittent stream flow
TWB-07, TWB-06	Taunton	Bridge (approx. 50 feet) over Mill River (perennial), flows west to east	Perennial stream flows under bridge
TWB-06, TWB-05.1	Taunton	Stone box culvert under Warren St., 4 feet wide by 3 feet high, intermittent stream flows south to north	Wetland equalizer
TWB-05.1, TWB-05	Taunton	Stone box culvert under ROW, 2 feet wide by 2.5 feet high at west end, 5 feet wide by 2.5 feet high at east end, intermittent stream flows west to east	Wetland equalizer
TWB-05, TWB-04	Taunton	Stone box culvert under ROW, 3.5 feet wide by 2 feet high at west end, 2 feet wide by 1.5 feet high at east end, intermittent stream flows east to west	Wetland equalizer
TWB-02, TWB-01	Taunton	12-inch diameter clay pipe culvert under ROW, intermittent stream likely flows east to west	Wetland equalizer
TOTAL CROSSINGS: 8			

Other Important Habitat Areas

The Whittenton Branch (Whittenton Alternative), crosses and is adjacent to large wetland and upland areas in Raynham between Route 138 and King Philip Street, and in Taunton adjacent to Prospect Hill Pond, and between Meadow Street and Whittenton Junction (Figure 4.14-6a). These wetlands and wooded upland areas are mostly unfragmented open space that could be important wildlife habitat because they may be used for dispersal, migration, breeding, foraging, and as bird stopover areas.

Stations

This section describes the areas of important biodiversity value within the proposed station sites. None of the proposed station sites are within mapped areas of BioMap Core Habitat, areas of important biodiversity value, or within large areas of undeveloped land. All of the proposed station sites are within fully or partially developed areas.

The station sites that are within fully developed areas and do not contain potential habitat include:

King's Highway—The station would be located in northern New Bedford south of King's Highway, immediately east of Route 140. This station would occupy part of a site that is an existing shopping plaza.

Whale's Tooth—The station would be located on Acushnet Avenue at the existing Whale's Tooth parking lot, which was constructed by the City of New Bedford in anticipation of the commuter rail project.

Fall River Depot—The station would be located 1 mile north of downtown Fall River at Route 79 and Davol Street at the site of the former train station.

Battleship Cove—The station would be located behind the Ponta Delgada monument along Water Street in Fall River. The City of Fall River constructed the Ponta Delgada monument, which includes a pick-up/drop off loop road, in anticipation that this site would be utilized as a commuter rail station.

Easton Village—This station would be located immediately south of the historic H.H. Richardson train station along Sullivan Street in Easton. The existing Historical Society building contains a small parking facility that would be partially reconfigured for pick-up/drop-off traffic flow through the lot.

Raynham Park—The station would be located adjacent to the former Raynham-Taunton Greyhound Park off of Route 138, which is currently operated as a simulcast betting location.

Dana Street (Whittenton Alternative only)—The Dana Street Station would be located just south of the Danforth Street grade crossing, within walking distance of downtown Taunton. The site is a currently vacant lot.

Taunton (Stoughton Alternative only)—The Taunton Station would be located along Arlington Street near Dean Street (Route 44), adjacent to the historic Old Colony train station. The City of Taunton has begun the process of remediating this brownfield site in anticipation of a future train station.

Canton Center—Canton Center Station is an existing station site off of Washington Street that would be modified to accommodate a second track. Two new 800 foot long low-level platforms with mini-high platforms would be constructed (one adjacent to each track). Modifications to the tracks and platforms would require minor changes to the parking layout in the existing lots near the station

Stoughton—The existing Stoughton Station would be relocated to accommodate a second track. The station would be shifted from its present location between Porter and Wyman streets to a new location south of the Wyman Street at-grade crossing. Two new 800 foot long, full-length high-level platforms would be constructed (one adjacent to each track).

With a focus on potential biodiversity, the following sections describe the proposed station sites that are within partially undeveloped areas and may require construction in naturally vegetated areas.

Freetown—The Freetown station site is located on South Main Street and would serve all of the rail alternatives. The approximately 18-acre site is currently in industrial use and is partially occupied by a self-storage facility. The area adjacent to the proposed site is mainly forested and undeveloped and contains areas of wetland habitat. The site is near the western end of the Freetown-Fall River State Forest/Bioreserve. There are additional industrial parcels located north and south of the site. The potential of the site to support biodiversity is limited because it is surrounded by developed areas. No certified or potential vernal pools have been identified near the site (Figure 4.14-4b).

North Easton—The North Easton station site is located at the rear of the Roche Brothers plaza and would serve the Stoughton and Whittenton Alternatives. The proposed site is located just off Route 138 in Easton and would be within the undeveloped portion of the commercial parcel. This portion of the site contains areas of wetland habitat and is near a cluster of certified and potential vernal pools. Land uses on adjacent parcels are commercial, residential, and agricultural. The potential of the site to support biodiversity is limited because, although open space is located across the tracks, the remainder of the surrounding area is developed (Figure 4.14-5b).

Taunton Depot—The Taunton Depot station site is located at the rear of Target Plaza and would serve the Stoughton and Whittenton Alternatives. The proposed site is currently undeveloped and contains areas of wetland habitat. Adjacent land uses include commercial and residential parcels immediately east and west of the site. The potential of the site to support biodiversity is limited because it is currently surrounded by developed areas. A large wetland complex and two potential vernal pools that have been identified near the station site (Figure 4.14-3a).

Layover Facilities

None of the proposed layover facilities are located within a Priority or Estimated Habitat polygon (see Figures 4.14-3e and 4.14-4b).

4.14.2.3 Summary of Existing Conditions

The study area is the portion of the South Coast region that is adjacent to or crossed by the Build Alternatives. The study area is within the ecoregion called "Bristol Lowland/Narragansett Lowland," which is defined as a region that has flat gently rolling plains, the forests are mostly central hardwoods, and there are numerous wetlands, cranberry bogs, and rivers that drain this area.[22]

Within the study area, there are several areas of important biodiversity value that are mapped by NHESP as Core Habitat. These include:

- Assonet Cedar Swamp (adjacent to and crossed by the New Bedford Main Line)
- Acushnet Cedar Swamp (adjacent to the New Bedford Main Line)
- Freetown-Fall River State Forest /Southeastern Massachusetts Bioreserve (adjacent to the Fall River Secondary)
- Forge Pond (adjacent to and crossed on a bridge by the Fall River Secondary)
- Hockomock Swamp ACEC (crossed by the Stoughton Alternative)
- Pine Swamp (crossed by the Stoughton Line (Electric and Diesel)

The New Bedford Main Line and Stoughton Line are adjacent to Living Waters Core Habitats. All the alternatives cross important fisheries habitat. Except for the Fall River Secondary, all segments of the alternatives cross and/or are adjacent to large wetlands and/or wooded upland areas. In some instances, these areas include public or privately owned lands under conservation management. These adjacent unfragmented open space areas could be important wildlife habitat because they may be used for wildlife dispersal, migration, breeding, foraging, and as bird stopover areas.

[22] U.S. Environmental Protection Agency (EPA),Ecoregions of Massachusetts, Connecticut, and Rhode Island. Website accessed January 2009. (http://www.epa.gov/wed/pages/ecoregions/mactri_eco.htm).

There are no proposed station sites within BioMap Core Habitat, areas of important biodiversity value, or within large undeveloped areas. All the proposed station sites are within partially or entirely developed areas.

Both of the proposed layover sites (Weaver's Cove East, Wamsutta) have been previously developed for industrial and other uses but have pockets of undeveloped land with limited potential to support biodiversity, depending on site conditions.

Both certified and potential vernal pools are found adjacent to each rail alternative. Several clusters of vernal pools are mapped in the vicinity of each rail alternative. The largest numbers of these occur along the Stoughton Alternative routes.

Table 4.14-11 provides a summary of existing conditions and compares the different alternatives.

Table 4.14-11 Summary of Biological Resources Adjacent to Project Alternatives

Project Alternative (segments)	BioMap Core Habitat	Living Water	Vernal Pools[1]	Important Fisheries Habitat (named Rivers/ streams)[2]	Location
Stoughton Alternative Stoughton Line (Electric and Diesel) Including Southern Triangle	5	2	252	7 (Beaver Brook, Whitman Brook, Queset Brook, Black Brook, Pine Swamp Brook, Taunton River Mill River)	Hockomock Swamp ACEC/ Hockomock Swamp WMA, Pine Swamp, Stoughton Memorial Conservation Land, and other areas of unfragmented habitat.
Whittenton Alternative Stoughton Line (Electric and Diesel) Including Southern Triangle	5	2	203	7 (Beaver Brook, Whitman Brook, Queset Brook, Black Brook, Pine Swamp Brook, Taunton River Mill River)	Hockomock Swamp ACEC/ Hockomock Swamp WMA, Pine Swamp, Stoughton Memorial Conservation Land, and other areas of unfragmented habitat. Tributary to Mill River, Prospect Hill Pond and other areas of unfragmented habitat.

1 Vernal pool numbers were calculated based on MassGIS data for vernal pools found within 750 feet of the right-of-way; and includes certified, potential and other field verified vernal pools

2 Important Fisheries Habitat data streams provided by NHESP in the ENF comment letter dated January 9, 2009.

4.14.3 Analysis of Impacts and Mitigation

4.14.3.1 Impact Assessment Methodology

The proposed South Coast Rail alternatives and associated stations are expected to have direct and indirect effects on natural communities and populations of fish, wildlife and plants. This section discusses direct and indirect effects in general, and describes the methodology used to calculate and evaluate impacts to biodiversity within the project study area. The Secretary's Certificate on the ENF identified the need for (1) an evaluation of direct and indirect environmental impacts on wildlife and their habitats including but not limited to: hydrological changes; fragmentation of habitat and populations; edge effects; noise and vibration; and restrictions to wildlife mobility, and (2) an evaluation of impacts to migratory birds and their habitats, including Important Bird Areas and Blue Heron nesting sites.

Method for Assessing Direct Impacts

Direct impacts of the alternatives would result from constructing the rail, or station elements. For the rail elements that include active freight railroad, construction includes removing vegetation, grading to widen or adjust the profile of the rail, removing and replacing ballast, track and ties, replacing culverts, and restoring bridges. Both rail alternatives utilize active freight lines with ballasted right-of-way, tracks, and ties. There are culverts that convey streams underneath the embankment. The existing culverts under the berm maintain wetland hydrology and provide crossing points for migratory wildlife to access wetland areas on either side of the embankment. The right-of-way itself does not provide suitable habitat wildlife and the tracks and ties prevent turtles, amphibians, and small mammals from moving across the right-of-way except through the culverts.

Station construction would include clearing vegetation, grading, and paving. In both cases, impacts to biodiversity would occur along the edges of natural habitats and would largely be limited to the loss of narrow strips of habitat along existing edges and would not result in fragmentation.

Constructing railroad infrastructure along abandoned railroad corridors could result in different types of direct or indirect impacts. This construction could result in more substantial loss of habitat, fragment large habitat blocks, and create barriers to animal movement, particularly where old rails have been removed and thus no such barriers currently exist.

The direct effects of these actions include the loss of wildlife habitat and plant communities. Actual habitat loss is a direct effect of transportation projects. Habitat loss occurs if an area that previously provided food, cover, water, and/or breeding resources to a species is cleared, paved, filled or altered in such a way that it no longer provides one or more of these resources. These effects were quantified by overlaying the limit of work for each alternative onto the vegetation cover type mapping provided by MassGIS and described in Section 4.14.2.

Direct effects to vernal pools, a specific category of wildlife habitat that receives special attention under wetland protection regulations, were quantified as the loss of wetland containing a vernal pool. Amphibians that breed in vernal pools use upland forested areas as non-breeding habitat. Therefore, consistent with USACE policy,[23,24] the loss of upland forest within 750 feet of a vernal pool was also quantified as the loss of upland habitat for these organisms. To provide a context for evaluating the numerical loss of upland habitat, the area lost was calculated as a percentage of the total upland area within 750 feet of the affected vernal pools.

Areas within permanent alteration limits that are previously disturbed, such as ballasted railbed and roads, were not counted as habitat loss. In addition, impact areas less than 10 feet wide were not counted as habitat loss.

[23] U.S. Army Corps of Engineers, New England District. 2010. Department of the Army General Permit: Commonwealth of Massachusetts. USAED, New England, Concord, MA.

[24] Massachusetts Division of Fisheries and Wildlife. 2009. Natural Heritage and Endangered Species Program's Guidelines for the Certification of Vernal Pool Habitat. MA Div. Fish. & Wildlife, Westborough, MA.

Types of Indirect Impacts

Indirect impacts are defined as the consequences of an action's direct impacts. These are generally not quantifiable, and may occur over a larger area or over a longer time than the direct impacts. Indirect effects change the quality or functions of a resource. They are measured qualitatively and, therefore, are more difficult to accurately assess than direct effects. Indirect effects will generally be described qualitatively for each of the alternatives.

Indirect effects may include habitat fragmentation and associated edge effects; the loss of genetic diversity of plant and animal populations; increased competition for resource, and physical or psychological restrictions on movements caused by some feature within a corridor that wildlife are unwilling or unable to cross. Short-term temporary indirect effects can be caused by the increased noise and visual disturbance from land-clearing, earth-moving, and construction machinery during construction. Following construction, noise associated with an active rail line may cause indirect effects if noise levels are of sufficient magnitude that wildlife avoid habitat near the facility.

Fragmentation is defined as the subdivision of once large and continuous tracts of habitat into smaller patches. It results from agriculture, urbanization, and transportation or other rights-of-way).[25] Habitat fragmentation is associated with 'edge effects' when there is a disturbed or developed area created adjacent to a natural and/or forested area. Edge effects may include the spread of invasive species, increase in the canopy gap and a decrease in species dependent on core and/or undisturbed habitat. In general, fragmentation of habitat is viewed as detrimental when considering original native, climax species composition and abundance, natural history, and relative ecological stability of unmanaged plant and animal populations. In particular, habitat fragmentation increases the amount of edge relative to the amount of interior habitat.[26] Scientific experts agree that preservation of continuous forest blocks is essential to the long-term protection of biodiversity. However, there is considerable controversy among the scientific community as to what are the critical dimensions of 'unfragmented' forests needed to sufficiently protect wildlife habitat and biodiversity.

A railroad may act as a barrier that interferes with the movement of some mammals, amphibians, birds and reptiles from one habitat to another. The width of a railroad corridor can influence the frequency of wildlife crossings, as well as the mortality associated with potential collisions with rail or vehicular traffic. The rail itself on which the tracks are laid can create a barrier to smaller species such as amphibians, reptiles, and smaller mammals. Traffic density and traffic speed may also influence wildlife avoidance of transportation corridors. [27, 28, 29,30]

A potential indirect effect is the introduction of non-native invasive plant species along the linear corridors of disturbed land.

[25] Rosenfield,R.N., C.M. Morasky,. J. Bielefeldt, and W.L. Loope. 1992. Forest fragmentation and island biogeography: a summary and bibliography. U.S. Department of the Interior Technical Report NPS/NRUW/NRTR 92/08.

[26] Primack, R.B. 2008. A Primer of Conservation Biology, 4th Ed. Sinauer Associates, Sunderland, MA, 349 pp.

[27] Reijnen, R. R. Foppen, C. ter Braak, and J. Thissen. 1995. The effects of car traffic on breeding bird populations in woodland. III. Reduction of density in relation to the proximity of main roads. Journal of Applied Ecology. 32: 187-202.

[28] Reijnen, R., R. Foppen, and H. Meeuwsen. 1996. The effects of traffic on the density of breeding birds in Dutch agricultural grasslands. Biological Conservation. 75: 255-260.

[29] Reijnen, R. 1995. Disturbance by car traffic as a threat to breeding birds in The Netherlands. PhD thesis, DLO Institute of Forestry and Natural Resources. Wageningen, Netherlands.

[30] Forman, R.T.T. and L.E. Alexander. 1998. Roads and their major ecological effects. Annual Review of Ecological Systems. 29:207-31.

Impacts on Vegetation Community Composition Due to Changes in Physical Parameters of Light and Temperature

Removal of the forest canopy on the existing or proposed railbed could potentially alter the physical conditions (light, wind, temperature) in adjacent forested areas. No adverse effects are anticipated to herbaceous or shrub-dominated communities, since there would be no change in the light, wind or temperature regimes. The canopy gap for the rail alternatives would vary with the width of the limit of work and adjacent land uses. In locations where single track sections are proposed (much of the Southern Triangle, sections of the Stoughton Line and along the Whittenton Branch), the canopy gap would vary between approximately 40 to 80 feet wide. In locations where double track sections are proposed, the canopy gap would vary between 60 to 100 feet wide. Because the project corridors are predominantly oriented along a north-south axis, the resulting forest edges will primarily face east and west.

A review of the relevant scientific literature indicates that incident radiation (direct sunlight) within the understory is a primary factor in determining microclimate in forest ecosystems. Incident radiation within a forest ecosystem is a function of the density of tree canopy and the cumulative amount of projected leaf area. Increases in ambient light levels have been correlated with higher near-ground temperatures, higher vapor pressure deficit and drying of leaf litter.

Recent field studies investigating the edge effects generated by clearcuts have attempted to quantify the increase in light intensity within forests. One study[31] examined forest edge sites in eastern deciduous forests and found strong edge effects associated with increases in light intensity in south, east and west facing forest edges. No statistically significant light intensity edge effects were observed in north facing cuts. Edge effects observed included increases in ambient temperature and vapor pressure deficit and decreases in soil and litter moisture.

The increased light zone extended from 33 feet (10 meters) in east and west facing cuts and up to 115 feet (35 meters) in south facing cuts. These distances are greater than previously published estimates for northern temperate forests. The study examined forest edges associated with wide clearcuts such as fields. Where the proposed rail will require the clearing of a corridor through a forested area, the potential increase in ambient light levels in the understory canopy will be reduced by the shape and orientation of the clearing. The relatively narrow canopy gap and its north-south orientation will limit the potential increase in ambient light within the understory area. Accordingly, the impacts associated with the clearing are considerably less than would be expected in most clear cut/forest edge conditions and would be more similar to a north-facing exposed cut. The study found no significant edge microclimate effects in northern facing cuts. The impact analysis conservatively assumes that increased light, wind and temperature are likely to occur within 30 feet of the cleared edge of the right-of-way, based on the research cited above. The most likely potential effect of this physical change would be to increase the growth rates of the shrubs currently growing in this zone, resulting in a denser shrub layer along the edge. Increased drying of the leaf litter, if this effect occurred, may affect recruitment of shrub and herbaceous species by affecting seed germination and seedling establishment. The anticipated effect would be that the existing sweet pepperbush (*Clethra alnifolia*) and greenbrier (*Smilax rotundifolia*) currently found along the edges of the railbed in wetland areas would respond with enhanced growth and fill the edge gap. These species have responded in this way to increased light

[31] Matlack GR. 1993. Microenvironment variation within and among deciduous forest edge sites in the eastern United States. *Biological Conservation* 66: 185–194.

along the edges of the Hockomock Swamp created by Route 138, and in the Assonet Cedar Swamp along the edges of the New Bedford Main Line.

The temporary nature of the alteration reduces the potential impacts associated with the proposed corridor clearing. An increase in sunlight adjacent to the rail corridor will result in an increase in adventitious limb growth and increased development of the shrub layer. "Closed edges" as defined by Matlack are edges of older clear-cuts where adventitious limbs and shrub growth have closed or partially closed the gaps created by clear-cuts. Once this gap in the canopy is closed, measurable differences in light, temperature, humidity, vapor pressure density and soil moisture are no longer observed.

Impacts to Aquatic Communities Due to Discharge of Pollutants or Change in Light/Temperature Regimes

The rail alternatives are not anticipated to generate non-point source discharges of pollutants to surface waters, and therefore are not considered to have an adverse impact on aquatic communities. A complete discussion of water quality issues is presented in Chapter 4.17, *Water Resources*.

Indirect impacts may occur from the reduction in tree canopy over waterbodies. By reducing canopy cover, surface waters may exhibit changes in light and temperature regimes which have the potential to increase the water body's algal or macrophyte growth, thereby affecting trophic status. However, based upon the existing canopy coverage and trophic status of these areas, impacts are anticipated to be negligible.

Impacts to Community Structure or Composition Due to Changes in Hydrology

The construction of the existing rail lines altered the hydrology of existing wetlands, and the existing rail and roadway embankments and culverts currently play an important role in the hydrology of adjacent wetlands. Altering the dimensions or elevations of culverts could adversely affect the hydrology of upstream wetlands.

Impacts to Community Composition Due to Introduction of Invasive Species

Construction along any active or inactive rail corridor, or constructing a new rail line, may increase the width of the canopy gap over the railbed and would likely require removing existing vegetation on the elevated railbed. This linear gap, extending through natural communities, which include Atlantic white cedar swamp and red maple swamp, may allow invasive exotic plant species to colonize the railbed or areas adjacent to the railbed. This section examines the invasive species that may potentially be introduced, assesses the likelihood and magnitude of the impacts, and proposes monitoring and mitigation measures.

Invasive species may be defined as "alien species whose introduction does or is likely to cause economic or environmental harm" (Federal Executive Order on Invasive Species).[32] The Massachusetts Invasive Plant Advisory Group (MIPAG) defines invasive plants as "non-native species that have spread into native or minimally managed plant systems in Massachusetts. These plants cause economic or environmental harm by developing self-sustaining populations and becoming dominant and/or

[32] Executive Order 13112, 6183 Federal Register 64 (February 8, 1999).

disruptive to those systems.[33] When established in disturbed sites or old fields, these species suppress the natural pattern of plant community succession.

There is a wide range of invasive species known to occur in Massachusetts, occurring in many habitats from ponds and lakes to sand dunes. The primary potential invasive species that could affect wetland edges include:

- *Phragmites australis*, common reed
- *Lythrum salicaria*, purple loosestrife
- *Berberis thunbergii*, Japanese barberry
- *Frangula alnus*, glossy buckthorn
- *Phalaris arundinacea*, reed canary grass
- *Typha angustifolia*; *T. x glauca*, narrow-leaf and hybrid cattail

Other upland species are potential colonizers of the railbed or the forest edges along the railbed, and include:

- *Fallopia japonica*, Japanese knotweed
- *Elaeagnus umbellata*, Autumn olive
- *Celastrus orbiculata*, oriental bittersweet
- *Rosa multiflora*, multiflora rose

Phragmites australis, common reed, is a robust (2 to 5 meters tall) grass believed to be native to North America, but distributed worldwide. The invasive genotype is likely to be a non-native introduction. *Phragmites* spreads by long underground rhizomes that have a very rapid growth rate, and is capable of colonizing large areas and forming monodominant stands that eliminate virtually all native grasses and forbs. Unlike the native species, *Phragmites* provides little wildlife food value, and the tough leaves decompose slowly, which may alter nutrient dynamics of the wetland system. *Phragmites*, although most commonly a species of wetlands, is also found extensively in dry disturbed upland sites such as fill piles, landfills, and gravel areas. *Phragmites* is wind-dispersed. It typically becomes established following disturbance which substantially alters the soil or removes the forest canopy of a wetland, particularly in roadside sites where soil salt contents may be elevated.

Lythrum salicaria, purple loosestrife, is an herbaceous perennial characterized by long showy spikes of magenta flowers. A native of Eurasia, purple loosestrife was introduced into the northeastern US and Canada in the early 1800s. It spreads through wind dispersal of tiny dry seeds (a single stalk may produce as many as 300,000 seeds) and through underground rhizomes. Purple loosestrife may rarely occur in drier wetland-upland transition sites or disturbed uplands such as cultivated fields, but is

[33] Massachusetts Invasive Plant Advisory Group. 2005. The Evaluation of Non-Native Plant Species for Invasiveness in Massachusetts.

typically a plant of wetland wet meadows and marshes. It generally becomes established following disturbance which exposes the soil surface and may remove native species, but may also invade natural undisturbed wetland communities. Once established, it forms monodominant stands which replace the more diverse native community. Purple loosestrife provides little wildlife habitat or food value.

Berberis thunbergii, Japanese barberry, is a thorny shrub with small leaves and attractive bright-red berries. It was introduced into the northeastern U.S. as an ornamental, and continues to be a popular landscaping shrub. It is dispersed by birds. Japanese barberry has become an aggressive invader of forested wetlands south of Massachusetts (Pennsylvania, New Jersey, Connecticut), and is occasionally found in Massachusetts wetlands. Once introduced, it forms a dense nearly monodominant shrub layer less than 1 meter high that eliminates the native shrubs and herbaceous species. This species appears to be able to colonize natural undisturbed wetland communities.

Frangula alnus, glossy buckthorn, is a tall shrub native to Eurasia. It produces small dark berries, and is dispersed by birds. This species typically invades old fields and pastures, and is a major threat to native prairie ecosystems in the Midwest. In New England, it invades native upland forest and wet meadow swamp communities (although generally not forested wetlands with saturated or seasonally inundated soils), particularly along edges where fruit-eating birds may perch. It is a habitat concern due to its ability to outcompete native shrub species, and because its open branching habit provides poor nesting habitat for songbirds.

Fallopia japonica, Japanese knotweed, is a large (1 to 3 meters tall) herbaceous perennial with large heart-shaped leaves and jointed, bamboo-like stems. It was introduced from England as a garden ornamental in the late 1800s. Japanese knotweed’s small seeds are not easily dispersed by either wind or birds, and it does not spread or colonize new sites aggressively. Once established, it spreads by underground rhizomes that form extremely dense patches. No other species grow in the dense shade under the large leaves of Japanese knotweed. This species occurs in open disturbed sites, typically the edges of roads or old fields. It does not grow in the shaded forest understory.

Elaeagnus umbellata, autumn olive, is a shrub with distinctive silvery leaves and fragrant flowers. It has a very dense branching habit, and tends to form monodominant patches in dry disturbed sites. This species was widely planted in the 1950s through 1970s for wildlife habitat, and was recommended by the Soil Conservation Service. The bright red berries are bird-dispersed. This species spreads only by seed, and does not colonize or survive in forested sites or wetlands.

***Celastrus orbiculata*,** oriental bittersweet, is a deciduous twining vine that may reach 6 inches or more in diameter. The plant was introduced in the mid-1800s, and currently is found from Maine to Georgia. Bittersweet produces attractive fruits with bright orange fleshy seeds in a yellow leathery capsule. Seeds are bird-dispersed. The vine also spreads aggressively through underground rhizomes. Oriental bittersweet can overrun natural vegetation, overtopping trees and shrubs to form pure stands. The vines can weaken trees by weighting the crown, making it more susceptible to wind and ice damage. Bittersweet tends to become established in open areas such as roadsides or old fields, but, once established, can spread into undisturbed forests. It may occur in the wetland-upland transition zone, but does not occur in the saturated soils typical of wetlands.

Rosa multiflora, multiflora rose, is a perennial shrub with distinctive clusters of small white flowers. It was introduced from Asia in the 1880s as an ornamental, and subsequently was widely planted for wildlife food and cover. Multiflora rose has also been planted along highway medians to reduce headlight glare and provide a barrier to vehicles. Like other berry-producing shrubs, multiflora rose is dispersed by birds (particularly robins and mockingbirds). It invades old fields, pastures, and roadsides, typically in upland sites that are not excessively well-drained (i.e., more mesic sites than autumn olive), and forms very dense monodominant stands that eliminate native shrubs and herbaceous species. Although *Rosa multiflora* may occur in wet meadows, it does not occur in wetland habitats where soils are saturated or seasonally inundated.

Phalaris arundinacea, reed canary-grass, is a perennial grass that grows 1.6 to 6.5 feet tall. It is native to North America as well as Europe. Since it is native to the United States, it may have been present in the northern parts of New England all along. However, European cultivars were introduced in the early 1800 as forage grasses, and are still used for hay. Reed canary-grass readily spreads via rhizomes and can form dense monocultures that does not allow for native species to readily coexist with it. It has little value for wildlife, and can be too dense to serve as cover for waterfowl and small mammals.

Typha angustifolia; T. x glauca, narrow-leaf and hybrid cattail are perennial aquatic plants that can grow up to 9 feet and are generally found in wet areas. Narrow-leaf cattail is considered by some as an invasive species due to its rapid spreading range and ability to form dense monocultures monospecific stands that replace native plants. While *Typha latifolia* is a common native plant, narrow-leaf cattail is believed to have been introduced into North America from ballast of European ships. Hybrid cattail is thought to be sterile (not likely to produce seed) however form large stands by means of vegetative reproduction.

Upland edges in forested habitats may be potentially colonized by invasive species dispersed by birds (primarily the fruit-eating bird species such as American robin, Northern mockingbird, European starling and cedar waxwing) that perch in the trees along the edge of the right-of-way. This creates the potential for establishment of glossy buckthorn, Japanese barberry, multiflora rose, oriental bittersweet or autumn olive on or along the edges of the right-of-way. Common reed seeds could be blow in by wind gusts, although increased wind is unlikely due to the narrow canopy opening.

Any common reed, multiflora rose, autumn olive and Japanese knotweed would be confined to the open habitat of the right-of-way, and would not be anticipated to invade the forested wetlands. Oriental bittersweet would also not invade the forested wetlands, but has the potential to increase the canopy gap by damaging trees along the edge of the right-of-way. Glossy buckthorn and Japanese barberry, if established, could potentially invade the adjacent forested wetlands, although the saturated and seasonally flooded soils that may be found on the sides of right-of way would reduce the potential for successful establishment or spread except on hummocks.

Impacts to Avian Communities Due to Fragmentation and Edge Effects

Fragmentation of forested tracts has been cited as a major cause in the decline of bird communities, particularly neotropical migrant songbirds (NTMs). Scientific studies generally support the positive correlation between size of a forest and reproductive success of NTMs, and that minimum threshold levels are necessary to maintain successful breeding populations. NTMs appear to be especially susceptible to fragmentation and other indirect effects because they generally have fewer offspring than other birds, and certain behavioral adaptations such as ground-nesting increase their vulnerability to predators and brood parasites.

Fragmentation occurs at several spatial scales, from local, which includes edge effects, to landscape, which encompasses differences in size and shape of forest tracts, to regional, where differences in canopy cover are studied to determine the effects on breeding birds.[34] The majority of the available literature has focused on large-scale fragmentation that breaks existing forest blocks into disconnected remnants across a landscape by major roadways, residential subdivisions, and clear cuts. Most studies do not define a forest fragment unless it is separated from another forest patch by 300 feet of open land.[35]

Scientific literature provides some information on the size of forests needed to support populations of NTMs. These studies document a positive correlation between the presence and abundance of NTMs, their reproductive success, and the size of a forest block.[36,37,38,39,40] The "core" or interior area necessary to maintain successfully reproducing populations varies widely, depending on the species context. In landscape studies, NTMs have been found to require areas at least 250 acres to maintain successful reproductive populations.[41,42] In general, smaller isolated forest blocks are thought to be "sinks" where local populations are likely to undergo frequent extinction and recolonization, and larger forest blocks are thought to be "sources" which maintain stable populations and from which birds disperse to colonize smaller sites.[43,44]

Some birds that breed in the Hockomock Swamp, such as brown creeper, ovenbird, and northern waterthrush, require large, unbroken tracts of forest to maintain successful populations. Such species are considered "area-sensitive" and may be more susceptible to edge effects and other indirect results of forest fragmentation than more disturbance-tolerant species. Forest areas that are less than 12 to 25 acres do not support area-sensitive, forest-nesting NTMs.[45,46,47] The available studies indicate that forest blocks smaller than 60 acres may contain nesting NTMs, but that reproductive success is limited and species diversity is low. These should be considered "small."[48, 49]

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[34] Robinson, S.K. 1998 Another threat posed by forest fragmentation: reduced food supply. *Auk,* 115(1): 1-3.

[35] Rich, A.C., D.S. Dobkin, and L.J. Niles. 1994. Defining forest fragmentation by corridor width: the influence of narrow forest-dividing corridors on forest-nesting birds in southern New Jersey. *Conservation Biology* 8(4): 1109-1121.

[36] Ambuel, B. and S.A .Temple. 1983. Area-dependent changes in the bird communities and vegetation of southern Wisconsin forests. Ecology, 64(5), 1983. pp. 1057-1068.

[37] Askins, R.A.; M.J. Philbrick and D.S. Sugeno Relationship between regional abundance of forest and the composition of forest bird communities. *Biological Conservation* 39, pp. 129-152.

[38] Blake, J.G. and J.R Karr. 1984. Species composition of bird communities and the conservation benefit of large versus small forests. *Biological Conservation*. 30:173-187.

[39] Freemark, K. and B. Collins. 1989. Landscape ecology of birds breeding in temperate forest fragments. In Ecology and conservation of neotropical migrant landbirds (J.M. Hagan & D. W. Johnston, eds.). Smithsonian Institution Press, Washington D.C.

[40] Flather, C.H. and Sauer, J.R. 1996. Using landscape ecology to test hypotheses about large scale abundance patterns in migratory birds.*Ecology*. 77(1): 28-35.

[41] Sorrell, J.P. 1997. Using Geographic Information Systems to evaluate forest fragmentation and identify wildlife corridor opportunities in the Catarqui watershed. http://wgs.nhb.com/sorrell/index.htm/.

[42] Robbins, C.S., D.K. Dawson, and B.A. Dowell. 1989. Habitat area requirements of breeding birds in the middle Atlantic states. *Wildlife Monographs*. No. 103.

[43] Donovan, T.M., F.R. Thompson III, J. Faaborg, and J.R. Probst. 1995. Reproductive success of migratory birds in habitat sources and sinks. *Conservation Biology*. 9(6): 1380–1395.

[44] Robinson, S.K., F.R. Thompson III, T.M. Donovan, D.R. Whitehead, and J. Faaborg. 1995. Regional forest success and the nesting success of migratory birds. *Science*. 267: 1987-1990.

[45] Blake, J.G. and J.R Karr. 1984. *Ibid.*

[46] Herkert, J.R. 1993. The effects of habitat fragmentation on midwestern grassland bird communities. Ecological Applications Vol. 4 No.3 pp. 461-471.

[47] Freemark, K. and B. Collins. 1989. *Ibid.*

[48] Donovan, T.M., F.R. Thompson III, J. Faaborg, and J.R. Probst. 1995. Reproductive success of migratory birds in habitat sources and sinks. *Conservation Biology*. 9(6): 1380–1395.

[49] Villard, M., P.R. Martin and C.G. Drummond. 1993. Habitat fragmentation and pairing success in the ovenbird *(Seiurus aurocapillus). Auk* 110(4) pp. 759-768.

Studies indicate that moderately-sized forest blocks averaging 125 to 150 acres are likely to support some NTMs, particularly the "common" species such as rose-breasted grosbeak [*Pheucticus ludovicianus*], red-eyed vireo [*Vireo olivaceous*], or eastern peewee, but do not support the less common area-sensitive species such as yellow-throated vireo [*Vireo flavifrons*], hermit thrush [*Catharus guttatus*], or veery.[50, 51] Large forest blocks, which provide sufficient contiguous forest-interior habitat to support successfully reproducing populations of area-sensitive forest-interior nesters such as ovenbird or Louisiana waterthrush [*Seiurus motacilla*], must be over 500 acres.[52] Several studies suggest that 750 to 1,200 acres are necessary, and that even larger areas in excess of 7,500 acres are optimal.[53, 54, 55, 56]

Predation is an indirect effect associated with forest fragmentation, and may increase as opportunist predators such as crows [*Corvus brachyrhynchos*] and raccoons [*Procyon lotor*] move into the edges adjacent to the project alignment. However, the existing active railbeds are open, and the inactive segments (Hockomock Swamp, Pine Swamp, and the Whittenton Branch) are used as trails, so there are likely to be existing predation-related edge effects under existing conditions. Segments adjacent to an open overhead powerline clearing may exhibit similar characteristics. There may also be increased brood-parasitism on songbirds if brown-headed cowbirds (*Molothrus ater*) colonize the edges adjacent to the rail. However, it is unlikely that large numbers of cowbirds will colonize the reconstructed right-of-way because the increase in canopy width is minimal. One study found that brown-headed cowbirds were significantly more abundant along paved secondary road forest edges than along either unpaved roads or powerline corridors.[57] This study also showed that there was no significant reduction in forest-interior nesters where corridors were less than 25 feet wide.

Also, it is possible that the commuter rail will displace some individuals of wildlife populations that are sensitive to noise and vibration, causing increased competition for nearby suitable habitat. Woodland songbirds such as the black-billed cuckoo (*Coccyzus erythropthalmus*) have been shown have lowered reproductive success adjacent to noise sources, where these sources produce continuous high noise levels, possibly due to increased stress hormones, interference with communication during the breeding season, or reduced food supply from noise avoidance of prey.[58] Most of the scientific studies conducted on noise and wildlife involve assessing impacts from roads, and there is limited scientific data for impacts to wildlife from rail. Most studies show that noise associated with high-density roads impacts avian communities by interfering with communication during courtship and brood-rearing. However, the continuous noise resulting from highways is substantially different from the infrequent noise produced by trains. Noise impacts are expected to be minor because of the low numbers of trains and relatively low noise associated with single-welded rail.

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[50] Freemark, K. and B. Collins. 1989. *Ibid.*

[51] Robbins *et al.* 1989. *Ibid.*

[52] Finch, D.M. 1991. Population ecology, habitat requirements, and conservation of neotropical migrant birds. USDA Forest Service Technical Report RM-205.

[53] Donovan *et al.* 1995.

[54] Faaborg, J., M. Brittingham, T. Donovan and J. Blake. 1995. Habitat fragmentation in the temperate zone. *In*: Ecology and management of neotropical birds: a synthesis and review of critical issues. T.E. Martin and D.M. Finch, eds. Pages 357-380.

[55] Gibbs, J.P. and J. Faaborg. 1990. Estimating the viability of ovenbird and Kentucky warbler populations in forest fragments. Cons. Biol. 4(2): 193-196.

[56] Porneluzi, P., J.C. Bednarz, L.J. Goodrich, N. Zawada, and J. Hoover. 1993. Reproductive performance of territorial ovenbirds occupying forest fragments and a contiguous forest in Pennsylvania. Cons. Biol. 7(2): 618-622.

[57] Rich, A.C., D.S. Dobkin, and L.J. Niles. Defining forest fragmentation by corridor width: the influence of narrow forest-dividing corridors on forest-nesting birds in southern New Jersey. *Conservation Biology* 8(4): 1109-1121.

[58] Forman, R.T.T. and L.E. Alexander. 1998. Roads and their major ecological effects. Annual Review of Ecological Systems. 29:207-31.

Impacts to Reptile or Amphibian Communities Due to Fragmentation

A railroad corridor may act as a barrier that interferes with the movement of amphibians and reptiles from one habitat to another. The width of a railroad corridor can influence the frequency of wildlife crossings, as well as the mortality associated with potential collisions with rail traffic. The railbed on which the tracks are laid can itself create a barrier to smaller species such as amphibians, reptiles, and smaller mammals. Traffic density and traffic speed may also influence wildlife avoidance of transportation corridors.[59, 60, 61, 62] The existing rail and highway rights-of-way currently provide limited habitat for reptiles and amphibians.

Indirect impacts to reptile and amphibian populations could include lowered reproductive success of existing amphibian populations if rail collisions affect amphibian mortality rates. If the rail is experienced as a barrier by migrating amphibians, existing populations may be divided into subpopulations. This, in turn, may result in a reduced gene pool in the remaining subpopulations, which could result in loss of the population if the remaining genetic variation is not diverse enough to offset the joint action of natural selection and genetic drift. Preserving genetic diversity is important because it allows populations the potential to adapt by "saving" genes that may be useful during future environmental changes. However, the rail will not create a complete barrier to movement between the eastern and western sides of the right-of-way.

Indirect Impacts to Vernal Pool Species

Indirect effects change the quality or functions of a resource and can be caused by a number of factors:

- Direct fill to vernal pools, which reduces the size of the pool;
- Impacts to vernal pool habitat (wetland areas within 100 feet of a vernal pool);
- Impacts to immediate upland buffer habitat (naturally vegetated, undeveloped upland areas within 100 feet of a vernal pool);
- Impacts to surrounding upland habitat (naturally vegetated, undeveloped upland areas between 100 and 750 feet from a vernal pool); and
- Habitat fragmentation.

Direct fill to vernal pools can have indirect impacts in addition to the direct impacts discussed in the previous section. By reducing the volume of water that collects in a given pool, fill to portions of a vernal pool may increase the chances that the pool will warm up more quickly during the season and/or dry out completely before species have matured enough to leave the pool. In some cases, early warming can be beneficial by speeding larval growth. However, pools that dry out early have a reduced ability to provide effective breeding habitat.

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[59] Reijnen, R. R. Foppen, C. ter Braak, and J. Thissen. 1995. The effects of car traffic on breeding bird populations in woodland. III. Reduction of density in relation to the proximity of main roads. Journal of Applied Ecology. 32: 187-202.

[60] Reijnen, R., R. Foppen, and H. Meeuwsen. 1996. The effects of traffic on the density of breeding birds in Dutch agricultural grasslands. Biological Conservation. 75: 255-260.

[61] Reijnen, R. 1995. Disturbance by car traffic as a threat to breeding birds in The Netherlands. PhD thesis, DLO Institute of Forestry and Natural Resources. Wageningen, Netherlands.

[62] Forman, R.T.T. and L.E. Alexander. 1998. Roads and their major ecological effects. Annual Review of Ecological Systems. 29:207-31.

Filling vernal pool habitat results in losses of wetlands in the vicinity of a given pool; these losses can affect pools in several ways. Losses of wetlands, particularly mature forested wetlands, close to a given pool can reduce the shading over the pool, which contributes to increased warming and drying effects. Loss of wetlands near vernal pools also reduces the amount of leaf litter and detritus that seasonally falls into the pool. Since these detrital inputs form the basis of the food web for the pool, reducing these inputs results in a loss of the pool's overall ability to sustain healthy populations. Loss of wetlands near the pool also reduces the available non-breeding habitat for species that use the pools, and can therefore impact biodiversity in the pool. However, for many "classic" vernal pools that consist only of a confined basin depression, there are no adjacent wetland areas at all, and the entire surrounding area provides upland buffer habitat.

Upland buffer habitat is also a necessary component of a vernal pool ecosystem. This habitat is undeveloped land with natural vegetation that provides upland non-breeding habitat and/or migratory habitat for vernal pool species. Many obligate vertebrate vernal pool species, such as wood frogs and spotted salamanders, spend the majority of a given year in the upland areas near vernal pools, using these areas for foraging, shelter, and overwintering. A loss of upland buffer habitat translates to a loss in the ability of the area to provide a necessary component of the life cycle of these obligate species. Mature forested uplands in particular can provide valuable habitat for species, since treefalls, rotting logs, and heavy leaf cover all provide shelter and foraging opportunities for obligate vernal pool species.

Surrounding upland habitat is important for providing additional foraging, shelter, and overwintering habitat for many obligate vernal pool species. Some species have a lifespan of several years or more, and often these animals will travel several hundreds of feet away from a vernal pool, then return to the same pool or cluster of pools each spring to breed. Surrounding upland habitat thus maintains a healthy species density and distribution.

The effects of habitat fragmentation can create additional indirect impacts on vernal pools and the species that use the pools. Habitat fragmentation is of particular concern where the rail line has been abandoned and only portions of the original berm exist. In these cases, construction of new tracks and widening of existing berms as a result of the project would create additional barriers to movement. The project would create a barrier to wildlife movement through portions of the Hockomock Swamp area (north of the proposed trestle and south of Raynham Park station) and through the entire Pine Swamp. This barrier effect is likely to fragment populations of vernal pool amphibians that are unable to cross the railroad tracks. Areas with existing tracks (whether active or not and especially those on top of steep embankments), are likely to provide some current barrier to movement, although some movement across existing rail lines can occur through gaps and openings under rails and between rail ties. Constructing the railroad would create more areas of steep slopes, wider portions of ballast, an expanded railroad bed from single track to multiple tracks, and new retaining walls in many locations, all of which would increase the effects of habitat fragmentation on vernal pool amphibians.

Impacts to Mammalian Communities Due to Fragmentation

Direct impacts include collisions between mammals and trains. Indirect impacts from fragmentation include potentially lowered reproductive success rates from interruption of migration routes to breeding areas (restricted gene flow), increased predation on small mammals due to lack of cover on the ballasted railroad embankment, and general disturbance of mammalian communities immediately adjacent to the right-of-way. These disturbances include alterations to foraging, denning and overwintering habitat due to changes in vegetative cover and light and temperature regimes.

There may be minor indirect impacts to small mammals but this is not expected to affect population stability because of their small home ranges. Deer are expected to continue to cross the tracks with minimal impedance.

Impacts to Wildlife from Noise

The study of noise and its effects on wildlife, or acoustic ecology, began in the 1970s, and several papers have been published documenting the effects of noise on wildlife populations. However, most of the research to date has been on noise generated from aircraft and sonic booms, with few studies on vehicle and rail traffic. Studies have also focused more on laboratory animals than wildlife because of the logistical difficulties and costs associated with evaluating noise effects in the wild. Comments on the DEIS/DEIR asked the applicant to provide additional information on the effects of noise on wildlife specific to the habitat surrounding the alternatives and reference scientific literature as appropriate.

There is currently no accepted method of measuring the effects of noise on wildlife. Most of the research to date indicates that the sound exposure level (SEL) provides the most useful predictor in noise effects. Because wildlife differ in their sensitivities to noise from humans, and amongst other species, (*e.g.,* bats are sensitive to a greater sound frequency than humans, while bullfrogs have a much lower detection range), an A-weighted scale was devised. The A-weighted scale interprets the sound based on the loudness perceived by the listener.

Noise can induce physiological and behavioral responses in animals. Effects are most often noted when the noise source is brief in duration and in excess of 100 dB.[63,64] Physiological stress can include higher adrenal weights and ascorbic acid levels, and increased cortisol levels, which play a role in the stress reaction. Prolonged exposure to loud, abrupt noise (such as sonic booms) may decrease the life expectancy, induce weight loss, and lower reproductive success of animals that cannot move away from the noise source. Prolonged exposure to very high noise levels may also result in loss of hearing for animals that are unable to relocate from the noise source.

Behavioral responses of wildlife to noise are somewhat easier to document in the field. Noise may result in masking, which is the inability of animals to communicate effectively. This may have effects on reduced breeding success for courting birds that are unable to advertise territories or secure mates, lowered prey captures for species that depend on auditory cues to locate food, increased mortality for species that rely on hearing predators approach in order to escape, or increased mortality associated with winter-stressed animals attempting to escape a perceived threat.

Some wildlife species habituate to noise. Upland sandpipers (*Bartramia longicauda*), a state-listed species, are most frequently found nesting in airfields and adjacent open spaces in the northeast. Research has shown that some species, such as terns, caribou, and grizzly (none of which have been documented to occur within the study area), do not habituate but continue to experience each noise event as a stressor.

[63] USEPA Office of Noise Abatement and Control. 1973. Public health and welfare criteria for noise. Government Publication 550/9-73-002. Washington, D.C.

[64] Bradley, F., C. Book, and A.E. Bowles. 1990. Effects of low-altitude aircraft overflights on domestic turkey poults. Report No. HSD-TR-90-034. US Air Force Systems Command, Noise and Sonic Boom Impact Technology Program.

The loudest noise that the commuter rail will emit is the whistle as it approaches at-grade crossings (105 dB). Under normal operating conditions, the train will produce a noise disturbance of between 80 and 88 dB that is infrequent, short in duration, and is below potential impact thresholds.

Scientific literature and other relevant publications concerning the effects of train pass-by noise on wildlife were reviewed. Many of the available studies are from western states; far less is known about the effects in the eastern United States, presumably because highway and rail infrastructure was largely already in place well in advance of the advent of modern wildlife ecology and conservation biology, and also because of the proportionately larger numbers of endangered mammals long displaced in the east and now confined to the less-developed west. As documented in the National Park Service's Annotated Bibliography – Impacts of Noise on Wildlife,[65] the effects of noise on wildlife have been studied for roads (where noise is continuous), aircraft, boats, and off-road vehicles and snowmobiles. No specific studies on the effects of trains are listed in this bibliography. The FHWA's Highway Traffic Noise website provides an extensive discussion of the impacts of road and highway noise on all classes of wildlife and concludes that different groups of wildlife respond to highway noise in different ways. The FHWA notes that very few studies have directly addressed the impact of noise from roads, and that studies primarily focus on the distribution and abundance of wildlife in areas adjacent to roads. As a result, the effects of noise cannot be separated from the effects of mortality or barriers to movement. The only mention of trains in the FHWA document is this passage: "It has been found that various mammals will avoid roads and (in some cases) this has been attributed to noise… For example, mountain goats would hesitate to cross the road if they heard a truck changing gears over 1 kilometer away. Passing vehicles in this study were perceived as a threat (speed limit 50 mph). Interestingly, the goats did not seem to be disturbed by the noise from trains." The literature review regarding analysis of effects of train pass-by noise on wildlife also included recent Environmental Impact Statements available on the Federal Railroad Administration (FRA) website. This review did not indicate additional information regarding potential impacts or assessment methods beyond those previously described in the DEIS. In absence of additional indirect noise impact assessment methods identified in more recent applicable scientific studies the assessment method for the FEIS remained unchanged from the DEIS.

CAPS Analysis

The University of Massachusetts' Conservation Assessment and Prioritization System (CAPS) model was used as a supplemental method of evaluating indirect impacts to biodiversity. CAPS is a computer software program designed to assess the ecological integrity and biodiversity value of every location based on natural community-specific models, in order to help prioritize lands for conservation action based on their assessed ecological value. It provides a quantitative assessment of ecological integrity that can be used to compare various scenarios. Appendix 4-14-B provides the complete UMass CAPS analysis report for the South Coast Rail project. More information about CAPS can also be found at the University of Massachusetts web site: http://www.umass.edu/landeco/research/caps/caps.html.

About CAPS

As stated in the Conservation Assessment and Prioritization System (CAPS) South Coast Rail Analysis[66]:

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[65] National Park Service Annotated Bibliography-Impacts of Noise on Wildlife. Available online at http://www.nature.nps.gov/sound/assets/docs/Wildlife_AnnotatedBiblio_Aug2011.pdf.

[66] Conservation Assessment and Prioritization System (CAPS) South Coast Rail Analysis, B. W. Compton, S. D. Jackson and K. McGarigal, September 18 2009.

"[T]he Conservation Assessment and Prioritization System (CAPS) is an ecosystem-based (coarse-filter) approach for assessing the ecological integrity of lands and waters. We define ecological integrity as the ability of an area to support biodiversity and the ecosystem processes necessary to sustain biodiversity, over the long term. CAPS is a computer software program and an approach to prioritizing land for conservation based on the assessment of various ecological communities (e.g. forest, shrub swamp, headwater stream) within an area. This approach combines principles of landscape ecology and conservation biology with the capacity of modern computers to compile spatial data and characterize landscape patterns.

"The CAPS approach begins with the characterization of both the developed and undeveloped elements of the landscape (Appendix A). With a computer base map depicting various classes of developed and undeveloped land, we then evaluate a variety of landscape-based variables ("metrics"; Appendix C). A metric may, for example, take into account how well a point in the landscape is connected to similar points, the intensity of traffic on nearby roads, or the expected vulnerability to invasions by exotic plants. The results of each metric are rescaled by percentiles for each community so that, for instance, the best 10 percent of marshes have values greater than or equal to 0.90, and the best 25 percent have values greater than or equal to 0.75. This is done to adjust for differences in units of measurement among metrics and to account for differences in the range of metric values for each community. The rescaling by community is done to facilitate identifying the "best" of each community, as opposed to the best overall—which is strongly biased towards the dominant, matrix-forming communities.

"Various metrics are applied to the landscape and then integrated in weighted linear combinations as models for predicting ecological integrity. The rescaled values are weighted using weights determined by expert teams, to reflect the relative importance of each metric for each community (Appendix D), and then added together to compute an overall IEI. Thus, the final index of ecological integrity for each cell is a weighted combination of the metric outputs for that cell, based on the community the cell falls in. This process results in a final Index of Ecological Integrity (IEI) for each point in the landscape based on models constructed separately for each ecological community.

"Because CAPS provides a quantitative assessment of ecological integrity it can be used for comparing various scenarios. In essence, scenario analysis involves running CAPS separately for each scenario, and comparing results to determine the loss (or gain) in IEI units. This scenario testing capability can be used to evaluate and compare the impacts of development projects on habitat conditions as well as the potential benefits of habitat management or environmental restoration. CAPS is an objective and flexible approach for assessing ecological integrity and supporting decision-making for land protection, habitat management, ecological restoration, project review and permitting to protect habitat and biodiversity."

Methods Used for the South Coast Rail Analysis

The CAPS analysis was based on the most recent CAPS statewide run (CAPSma 2009, Conservation Assessment and Prioritization System (CAPS) Preliminary Statewide Massachusetts Assessment, June 2, 2009) with modifications as necessary to more fully represent the effects of railroads.

The geographic scope of the analysis (Figure 4.14-15) includes the entire Taunton River watershed, plus a 5-kilometer (3.2 miles) buffer around the project elements outside of the Taunton River Watershed (the Northeast Corridor, the Fall River Secondary, and the New Bedford Main Line). This buffer allows CAPS to capture all changes in IEI among scenarios. Using the entire Taunton River Watershed gives CAPS a large enough context to reasonably scale IEI.

CAPS was modified for this analysis to better represent the effects of railroads on biodiversity. The principal effects are barriers to wildlife movement and traffic intensity (which results in noise, disturbance, and mortality). These modifications included:

Several new cover types were added to CAPS to represent rail lines. Rail classes included “abandoned rail with tracks”, “abandoned rail without tracks”, “commuter rail with a trestle”, and “commuter rail with a retaining wall”. Abandoned rail lines represented in CAPS from MassGIS were considered to have no tracks except where they were more accurately represented in the South Coast Rail data.

Numbers of tracks (1, 2, 3) were estimated based on MassGIS data and information from the SCR conceptual design. In general, the SCR scenarios were represented as having two sets of tracks. All rails were assumed to be unfenced, since commuter rails are typically fenced only in developed areas.

The analysis estimated train frequency on each segment as 2 freight trains per day and 33 commuter rail trains. The number of Amtrak passenger trains was determined using the Amtrak schedules. Train length was estimated at 25 cars/train for freight trains, 6 cars/train for commuter rail trains and 8 cars/train for Amtrak passenger trains. The traffic rate parameter was set at one rail car = 20 automobiles except for the trestle alternatives, which used one rail car = 6.7 automobiles to account for a lower “roadkill” mortality.

The parameters of new cover types were developed by an expert team including representatives of The Nature Conservancy, MassAudubon, MassWildlife, and UMass Amherst. The team also developed a new variable (terrestrial barriers) which includes various anthropogenic barriers to wildlife movement. The values assigned to terrestrial barriers ranged from 1 (no barrier, abandoned rail without tracks) to 10 (noise barrier or retaining wall).

The CAPS model was run for each alternative listed below:

- Current (base) scenario
- No-Build Alternative
- Stoughton Alternatives (without a trestle)
- Stoughton Alternatives (with a trestle)
- Whittenton Alternatives (without a trestle)
- Whittenton Alternatives (with a trestle)

The analysis calculated the direct loss of IEI by the complete loss of IEI for affected cells (cells which fell within the stations or new right-of-way). Indirect loss was calculated for each metric, and the integrity model was used to create an overall indirect loss grid for each alternative.

A sensitivity analysis was conducted by varying the relative traffic rate for trains, from 1 rail car = 5 automobiles, to 1 rail car = 100 automobiles. The sensitivity analysis was run for the three metrics that are affected by the intensity of the barrier and by traffic rate: connectedness, similarity, and traffic intensity. The sensitivity analysis, showing the range of expected results given the uncertainty in the effects of train traffic, shows that although traffic rates have a moderate effect on absolute loss in IEI, the ranking of the alternatives does not change under either the high or low traffic scenarios. The sensitivity analysis suggests that the uncertainty in accounting for traffic effects of railroads has only a minor effect on the relative results.

4.14.3.2 Impacts of Alternatives by Element

No-Build (Enhanced Bus) Alternative

The No-Build Alternative would consist of enhancing current bus service along existing roads and highways. The alignments would not change and no new highway construction would be required for the No-Build Alternative. Three existing Park-and-Ride facilities would be re-striped to improved capacity and traffic flow as part of the No-Build Alternative. The three affected Park-and-Ride facilities are:

- The West Bridgewater Park and Ride, located near the southwest corner of the intersection of Routes 106 and 24 in West Bridgewater
- The Mount Pleasant Street Park and Ride, located on the northwest corner of the intersection of King's Highway and Route 140 in New Bedford
- The Silver City Galleria Park and Ride, adjacent to the Silver City Galleria shopping mall in Taunton

Biodiversity would not be adversely affected by this alternative, as there would be no loss of natural habitats and no new habitat fragmentation.

Southern Triangle (Common to All Rail Alternatives)

Portions of the rail lines within the southern part of the South Coast Rail study area are common to all rail alternatives. These rail lines form a rough triangular shape running south from Myricks Junction to Fall River (the Fall River Secondary) and from Weir Junction through Myricks Junction to New Bedford (the New Bedford Main Line), and are therefore referred to as the Southern Triangle. There are no Areas of Critical Environmental Concern (ACECs) within the Southern Triangle. The following sections describe the environmental consequences to biodiversity that may result from each alternative of the South Coast Rail project which is inclusive of the Southern Triangle.

Stoughton Electric Alternative

The Stoughton Electric Alternative includes improvements to existing active freight or commuter rail lines (from Weir Junction to Dean Street, and north of Stoughton Station) and track construction on out-of-service or abandoned rights-of-way (between Dean Street and Stoughton Station as well as the Southern Triangle. It includes constructing a trestle through part of the Hockomock Swamp to reduce impacts to wetlands, biodiversity, and rare species. A section of the out-of-service line crosses land within the Hockomock Swamp ACEC.

Biomap Core Habitats

The Stoughton Alternative would cross Biomap Core Habitat in two areas. The Hockomock Swamp, from Foundry Street in Easton south to Bridge Street in Raynham, is designated as Core Habitat. Pine Swamp in Raynham, from King Philip Street to East Britannia Street, is also a Biomap Core Habitat.

The Stoughton Electric Alternative would create a barrier to wildlife movement through portions of the Hockomock Swamp area (north of the proposed trestle and south of Raynham Park station) and through the entire Pine Swamp. This barrier effect is likely to fragment populations of small vertebrates (e.g. small mammals, reptiles, and amphibians) that are unable to cross the railroad tracks. The portion of the Stoughton Electric Alternative that is a proposed trestle (approximately 8,500 feet long) would not impede wildlife movement.

The Stoughton Electric Alternative would create a new canopy gap through portions of the Hockomock Swamp, primarily from Foundry Street south to the proposed Raynham Park station, where the forest canopy has partially closed over the railbed since the tracks were removed. This canopy gap could impede the movement of forest interior birds across the right-of-way, reducing the effective size of the forest block, and would create new “edge effects” of increased light and temperature, and decreased humidity, adjacent to the right-of-way. The barrier effects of the Stoughton Electric Alternative would extend upward from the tracks as a result of the overhead catenary system. Reconstructing the rail line would create and maintain a canopy gap that varies with the width of the limit of work. This gap would divide the Hockomock swamp south of Foundry Street into two units of approximately 2,293 acres west of the rail line and 505 acres east of the rail. These areas are further divided by the existing powerline corridor, as shown on Figure 4.14-16. On the east side of the MBTA right-of-way there are two blocks divided by the powerline with the northeast quadrant totaling 157 acres and the southeast quadrant totaling 348 acres. On the west side of the MBTA right-of-way, there are two blocks divided by the powerline with the northwest quadrant totaling 84 acres and the southwest quadrant totaling 2,209 acres.

Removing the forest canopy on the railbed within the Hockomock Swamp ACEC study area could potentially alter the physical conditions (light, wind, temperature) in adjacent forested areas. No adverse effects are anticipated to herbaceous or shrub dominated communities, since there would be no change in the light, wind or temperature regimes. The canopy gap is anticipated to be approximately 40 feet in width for the length of the trestle, and the resulting forest edges will face east and west.

During the original construction of the embankment through the Hockomock Swamp in the 1840s, alterations to the hydrology of the Swamp occurred. This is evident in the existing vegetation of the area. Currently, surface water occurs at a slightly higher elevation on the western side of the embankment. Water flows from west to east through all culverts beneath the embankment. This alternative would not include repair or replacement of any culverts. Therefore, there would be no potential changes to hydrology, and no potential impacts to community structure or composition.

Reconstructing the railroad track system through the Hockomock Swamp ACEC would increase the width of the canopy gap over the railbed to approximately 30 feet wide in areas with single track (through the Hockomock and Pine Swamps) and somewhat wider in in areas with double track (north of North Easton Station and a segment south of the trestle near Raynham Park Station), and would require the removal of existing vegetation on the elevated railbed. Canopy clearance requirements will be specified in the Vegetation Management Plan.

This linear gap, extending through natural communities, which include Atlantic white cedar swamp and red maple swamp, may allow invasive plant species to colonize the railbed or areas adjacent to the railbed. This section examines the invasive species that may potentially be introduced, assesses the likelihood and magnitude of the impacts, and identifies monitoring and mitigation measures.

Within the Hockomock Swamp ACEC, common reed has become established in the open, disturbed wetlands within the powerline corridor; and has sparsely penetrated approximately 15 to 20 feet into the adjacent red maple swamp by rhizome growth (although not vigorous, due to dense shade). It is well-established in open wetlands throughout Pine Swamp, particularly under the existing powerline corridor. Glossy buckthorn is sporadically established along the dirt road within the powerline corridor and occasionally on hummocks within the red maple swamp south of the powerline corridor. Autumn olive has not been observed within the study area, but is present on the old ballast between I-495 and Carver Street. Oriental bittersweet is sparsely established along the dirt road within the powerline corridor. Multiflora rose is sparsely established along the dirt road within the powerline corridor; and more abundantly on the old ballast south of I-495.

Any common reed, multiflora rose, autumn olive and Japanese knotweed would be confined to the open habitat of the right-of-way, and would not be anticipated to invade the forested wetlands. Oriental bittersweet would also not invade the forested wetlands, but has the potential to increase the canopy gap by damaging trees along the edge of the right-of-way. Glossy buckthorn and Japanese barberry, if established, could potentially invade the adjacent forested wetlands, although the saturated and seasonally-flooded soils on the west side of the right-of-way would reduce the potential for successful establishment or spread except on hummocks. There is a low likelihood of successful establishment of common reed in the closed-canopy red maple or Atlantic white cedar swamps due to the dense shade and lack of soil disturbance. For these reasons, purple loosestrife is also not anticipated to invade the ACEC swamps. The trestle, since it would minimize earth disturbance and vegetation management along the right-of-way, would be expected to result in less potential for invasive species introductions than at-grade rail construction.

Although the Stoughton Alternative would increase the canopy gap and create a partial barrier to vertebrate movement in areas north, and south, of the proposed trestle, Hockomock Swamp would continue to provide moderate- to large-sized forest blocks. West of the right-of-way, there would be two forest blocks, one north and one south of the powerline corridor. The southern block constitutes the majority of Hockomock Swamp and will provide 2,209 acres of continuous forest. The northern block will continue to provide sufficient size (84 acres) to support all area sensitive species successfully that currently may be present. The eastern segments at 157 acres north of the powerline corridor and 348 acres south of the powerline corridor will likely also continue to provide habitat for area-sensitive NTMs.

Predation is an indirect effect associated with forest fragmentation, and may increase as opportunist predators such as crows and raccoons move into the edges adjacent to the project alignment. However, the existing railbed is open and used as a trail, so there are likely to be predation-related edge effects under existing conditions. Through the Hockomock Swamp, the existing upland berm will not be widened, and therefore the possibility that this will be used as a trail by ground predators is not likely to be any different than under existing conditions.

There may also be increased brood-parasitism on songbirds if brown headed cowbirds colonize the edges adjacent to the rail. However, it is unlikely that large numbers of cowbirds will colonize the reconstructed right-of-way because the increase in canopy gap width is minimal. One study found that brown headed cowbirds were significantly more abundant along paved secondary road forest edges than along either unpaved roads or powerline corridors. This study also showed that there was no significant reduction in forest interior nesters where corridors were less than 25 feet wide.

The trestle is not expected to have direct effects to reptile or amphibian movements in Hockomock Swamp. The structure will be elevated approximately 5 feet above the existing railroad berm, and therefore will not impede movement across or along the right-of-way. This is not expected to result in loss of nesting habitat because there would be no construction on the existing berm except for pilings, and the habitat characteristics of open sandy soil will not be altered. Minor indirect impacts are anticipated from the trestle. These may include an aversion to using the existing nesting habitat along the rail. However, it is possible that turtles along the MBTA right-of-way will seek other areas to nest.

This alternative would not create a new canopy gap or expand the canopy gap in Pine Swamp, because Taunton Municipal Power and Light which currently owns the former rail right-of-way already maintains a linear clearing in the canopy to accommodate an overhead power line corridor below which the proposed tracks would be located. Pine Swamp consists of approximately 475 acres of forest, bounded by King Philip Street and developed areas to the north and east, Route 138 to the west, and developed areas and Thrasher Street to the south. Based on its size, Pine Swamp likely supports common NTMs, and may support other, more area sensitive species.

Living Waters

The Stoughton Alternative is adjacent to Living Water Core Habitat (LW080) near a reach of the Taunton River that provides habitat for Atlantic sturgeon. As noted in Section 4.15.3.3, the NMFS stated it is unlikely that any species listed under their jurisdiction will be exposed to any direct or indirect effects of the proposed South Coast Rail project. The right-of-way crosses this section of the Taunton River for approximately 125 feet, south of Weir Junction in Taunton (Figure 4.14-3a). North of Weir Junction, the Stoughton Alternative crosses the Taunton River three more times on a series of bridges located upstream from the area mapped as Living Water (LW080) (Figure 4.14-5e). The proposed reconstruction would not have a direct or indirect effect on the ability of the Taunton River to support aquatic biodiversity.

Portions of the Acushnet Cedar Swamp, particularly Turner Pond, are designated as Living Waters. The proposed reconstruction of the New Bedford Main Line would be approximately 7,500 feet west of Turner Pond and would not have a direct or indirect effect on the ability of the pond to support aquatic biodiversity.

Fisheries Habitat

The Stoughton Alternative crosses Whitman Brook, Queset Brook, Black Brook, Pine Swamp Brook, Taunton River, Mill River, Cotley River, Cedar Swamp River, and Fall Brook which are all important fisheries habitats. The proposed alternative would reconstruct existing bridges at Whitman Brook, Queset Brook, Black Brook, Pine Swamp Brook, Cedar Swamp River and the Taunton River, and would construct a new bridge at Black Brook (the former rail bridge was washed out). These bridges would be reconstructed with the same or wider opening, maintaining habitat connectivity and the riverine substrate. The capacity of these waters to support aquatic diversity would not be adversely affected.

Breeding Bird Diversity

This section discusses potential impacts to breeding bird populations within each of the key avian habitat areas.

Hockomock Swamp—The railroad alignment through the Hockomock Swamp, under existing conditions, largely has a closed forest canopy in the segment between Foundry Street and the proposed Raynham Park Station. South of the proposed station, the right-of-way is maintained as an overhead power line corridor and trail used by pedestrians and ATVs. Converting the out-of-service railroad alignment to active rail would not increase or create a new canopy gap, and therefore would not change the existing forest interior conditions. Reconstructing the railroad track system through the Hockomock Swamp will increase the width of the canopy gap over the railbed to 30 feet wide in areas with single track.

Although the Stoughton Alternative would increase the canopy gap and create a partial barrier to vertebrate movement in areas north, and south, of the proposed trestle, the Hockomock Swamp would continue to provide moderate- to large-sized forest blocks. West of the right-of-way, there would be two forest blocks, one north and one south of the powerline corridor. The southern block constitutes the majority of Hockomock Swamp and will provide 2,557 acres of continuous forest. The northern block will continue to provide sufficient size to support all area sensitive species successfully that currently may be present. The eastern segments at 157 acres north of the powerline corridor and 348 acres south of the powerline corridor will likely also continue to provide habitat for area-sensitive NTMs.

Pine Swamp—The railroad alignment through Pine Swamp, under existing conditions, is maintained as an overhead power line corridor and trail used by pedestrians and ATVs. Converting the out-of-service railroad alignment to active rail would not increase or create a new canopy gap, and therefore would not change the existing forest interior conditions. There would be some loss of open shrub vegetation along the powerline, potentially reducing the available breeding habitat for birds such as catbird, common yellowthroat, or song sparrow. However, routine maintenance of the corridor by Taunton Municipal Power and Light already results in frequent and ongoing clearing of shrubs and saplings (and concomitant impacts to bird species) in this area. The re-introduction of trains would have a negligible effect on breeding bird usage.

Assonet Cedar Swamp—The Assonet Cedar Swamp is crossed by active freight rail lines under existing conditions. The reconstruction of the active rail line would not create a new canopy gap, and would therefore not change the existing forest interior or edge conditions. The only change to bird habitat would be increased train passage.

Freetown-Fall River State Forest—The Freetown-Fall River State Forest is crossed by active freight rail lines under existing conditions. The reconstruction of these active rail lines would not create a new canopy gap, and would therefore not change the existing forest interior or edge conditions. The only change to bird habitat would be increased train passage.

Acushnet Cedar Swamp—The Acushnet Cedar Swamp is crossed by an active freight rail line under existing conditions. The reconstruction of these active rail lines would not create a new canopy gap, and would therefore not change the existing forest interior or edge conditions. The only change to bird habitat would be increased train passage.

Vernal Pools

The vernal pool analysis in the DEIS/DEIR sought to quantify the effects of impacts from the South Coast Rail project on vernal pools, vernal pool habitat, and associated upland habitat surrounding vernal pools. The analysis used the GIS coordinates for each vernal pool data point, and used 100 foot and 750 foot circles around each point to determine the extent of adjacent upland habitat and surrounding upland habitat.

The Secretary's Certificate required that the FEIR include an analysis of all vernal pools within 750 feet of either side of the right-of-way for the Stoughton Alternative. The existing MassGIS data layer was combined with all field survey and observation data in order to make a new data layer showing all NHESP certified, potential, and field surveyed vernal pools within 750 feet of either side of the right-of-way.

The original analysis did not attempt to quantify direct impacts to vernal pools themselves; rather, it defined direct impact as "loss of a wetland where a vernal pool occurs." The updated analysis clarifies impacts to vernal pools themselves, as well as habitat surrounding vernal pools. The different areas were defined as follows:

- Impacts to Vernal Pools: Direct impacts (fill) to vernal pools themselves
- Impacts to Vernal Pool Habitat: Impacts to any wetland area within 100 feet of the boundary of a vernal pool, where the pool is within that wetland
- Impacts to Upland Buffer Habitat: Impacts to any undisturbed, natural upland area within 100 feet of the boundary of a vernal pool
- Impacts to Surrounding Upland Habitat: Impacts to any undisturbed, natural upland area between 100 and 750 feet from the boundary of a vernal pool

The limits of each pool were estimated for all vernal pools within the right-of-way and for any pools that had any portion within 100 feet of the Limit of Disturbance (LOD). Since field delineation of every pool within 100 feet of the LOD in the field was not practicable, limits were established by examining aerial photographs and creating polygons in a GIS data layer to represent the boundary of each pool. 100 foot and 750 foot extents were then generated around these polygons, resulting in a larger area of analysis and a more accurate representation of the extent of actual pools, vernal pool habitat, upland buffer habitat, and surrounding upland habitat than simply assuming the pools to be points. Pools farther away from the LOD (i.e., pools that did not have any portion within 100 feet of the LOD) would not receive any direct impacts to either vernal pool habitat or upland buffer habitat from the South Coast Rail project. The GIS point locations were used to generate the 100 foot and 750 foot areas around these pools. Vernal pool habitat was delineated using the MassGIS wetland layer, along with the updated wetland delineations.

Once the 100 foot and 750 foot areas had been generated around each polygon and point, the impacts to each habitat category described above were calculated. Equal treatment has been given to all vernal pools and potential vernal pools within the Project study area, regardless of their certification status. This conservative approach likely includes some areas in the analysis that do not actually function as vernal pools in the landscape. PVPs that were visually inspected and determined not to function as vernal pools during investigations for the DEIR/DEIS were removed from the updated analysis. Impact calculations conservatively include areas on both sides of the right-of-way, even when separated by a section of berm or track, under the assumption that tracks and ballast are somewhat permeable to small animal movement. The majority of impacts, particularly to vernal pool habitat, occur in areas where the tracks are disused or have been removed altogether, so use of habitat on both sides of the right-of-way is likely in most of the areas that will receive impacts.

Impacts calculated for upland buffer habitat and surrounding upland habitat did not include any areas of existing railbed or the surrounding ballast. The extent of ballast was not delineated in the field, but an approximation was made for the analysis by using a measurement of 10 feet to either side of the track centerline. Impacts to areas of upland buffer habitat and surrounding upland habitat also did not include any existing developed areas, including buildings and parking areas. Developed areas were estimated by using a land use data layer in the GIS analysis and subtracting any areas of development from impacted areas.

The impacts to vernal pools, vernal pool habitat, upland buffer habitat, and surrounding upland habitat are discussed in detail in this section. Impacts to vernal pools, as well as impacts all associated habitats for the Stoughton Alternative are shown in Figures 4.14-7, 4.14-8 and 4.14-9.

Impacts to Vernal Pools—The most ecologically important impacts are to vernal pools that would be directly filled, resulting in a permanent alteration of the pool. The total fill to vernal pools would be 0.53 acre, or 23,158 square feet, and would affect 19 vernal pools. Table 4.14-12 describes the impacts to vernal pools along the Stoughton Alternative project corridor.

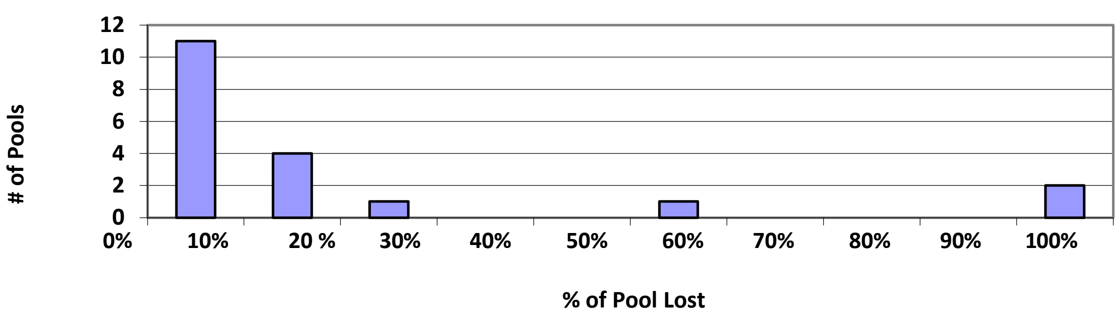
Average depths were not calculated for each of the above pools, so the total volume of fill to vernal pools is not known. The amount of filled surface area in square feet gives an approximate measure of the relative size of disturbance to any given pool. Two vernal pools lie completely (or nearly so) in abandoned sections of the rail bed: PVP 20230 in Raynham and VP 13 in Taunton (Figure 4.14-7e). PVP 20230 would be filled completely, while VP 13 would be filled 96.4 percent, essentially a complete loss. One other pool, PVP 8286 in Freetown, would have a majority (59.8 percent) of its area filled (Figure 4.14-9b). The impacts to the other pools that would be directly affected range from 1.1 percent to 21.3 percent. Easton has the largest number of pools that would be directly affected (6 pools), while Freetown has the largest amount of fill proposed (10,065 SF). While it is impossible to avoid impacting vernal pools to some degree along the Stoughton Alternative, no direct filling would occur to any vernal pools in Canton, Berkley, Lakeville, New Bedford, or Fall River.

Figure 4.14-17 shows the distribution of the percentage impacts to vernal pools. Of the 19 vernal pools that are impacted, 11 pools would lose up to 10 percent or less of their total area, and 15 pools would lose 20 percent or less of their total area.

Table 4.14-12 Impacts to Vernal Pools of the Stoughton Electric Alternative

Municipality	Pools Affected	Amount of Fill (SF)	Approx. Size of Pool (SF)	Approx. Size of Pool (Ac.)	Percent of Pool Filled
Stoughton	PVP 23791	1,480	8,579	0.20	17.2%
Stoughton Total	1	1,480	8,579	0.20	
Easton	PVP 7222	2,197	10,324	0.24	21.3%
	VP-10	112	2,373	0.05	4.7%
	EA-2	661	28,403	0.65	2.3%
	CVP 1462	105	5,589	0.13	1.9%
	NCVP-2	553	50,486	1.16	1.1%
	CVP 1463	292	19,148	0.44	1.5%
Easton Total	6	3,920	116,323	2.67	
Raynham	CVP 1972	660	34,289	0.79	1.9%
	CVP 1971	416	5,816	0.13	7.1%
	PVP 20231	262	4,152	0.10	6.3%
	PVP 20230	418	418	0.01	100.0%
	PVP 20235	1,397	7,652	0.18	18.3%
Raynham Total	5	3,153	52,327	1.21	
Taunton	VP-13	3,323	3,345	0.08	96.4%
	PVP 25089	232	7,009	0.16	3.3%
	PVP 25090	482	7,581	0.17	6.4%
	PVP 25092	503	3,735	0.09	13.5%
Taunton Total	4	4,540	21,670	0.50	
Freetown	PVP 8324	4,470	53,142	1.22	8.4%
	PVP 8284	873	4,940	0.11	17.7%
	PVP 8286	4,722	7,900	0.18	59.8%
Freetown Total	3	10,065	65,982	1.51	
Totals	19	23,158 (0.53 Ac.)			

Figure 4.14-17 Percent Impacts to Vernal Pools Stoughton Electric Alternative



These results are based on preliminary design. In the final design phase of the project, additional small impacts may be avoided or minimized through different grading (for example, steepened slopes along the rail line). Additional design efforts would attempt to minimize impacts. These efforts are discussed in more detail in Section 4.14.3.6.

Impacts to Vernal Pool Habitat—Impacts to vernal pool habitat are defined as impacts to any wetland containing a vernal pool within 100 feet of the boundary of a vernal pool. The loss of vernal pool habitat would affect 40 vernal pools.

Table 4.14-13 describes the impacts to vernal pool habitat along the South Coast Rail project corridor. Where pools are in close proximity to one another, the impacted areas of vernal pool habitat overlap. In these cases, the impacts to the affected area of vernal pool habitat are identified as a whole, and the pools that make up each affected area are denoted. As a conservative measure, the entire area of the Hockomock Swamp under the proposed trestle in Easton was included in the calculation of total vernal pool habitat, since this entire area is known to provide good habitat for vernal pool amphibians. No impacts to vernal pool habitat would occur in the area under the trestle.

Table 4.14-13 Impacts to Vernal Pool Habitat of the Stoughton Electric Alternative

Municipality	Pools Affected	Area of Impact to VP Habitat (SF)	Total Area of VP Habitat (SF)	Total Area of VP Habitat (Ac.)	Percent of VP Habitat Impacted
Stoughton	PVP 23791	166	20,488	0.47	0.8%
	CVP 2140	244	21,802	0.50	1.1%
Stoughton Total	2	410			
	PVP 7222 CVP 2152	949	59,472	1.37	1.6%
	PVP 7218	189	52,039	1.19	0.4%
	CVP 2377 VP-11	325	56,239	1.29	0.6%
	EA-1 EA-2	1,791	89,117	2.05	2.0%
	CVP 1463	3,151	86,590	1.99	3.6%
	PVP 7255 PVP 7256	373	116,929	2.68	0.3%
Easton	CVP 1665 NHESP 2 CVP 1710	819	42,611	0.98	1.9%
Easton Total	13	7,597			
	VP-12	1,965	40,667	0.93	4.8%
	CVP 1972 CVP 1971	1,073	24,615	0.57	4.4%
	PVP 20231	4,239	45,086	1.04	9.4%
	PVP 20230	2,440	20,445	0.47	11.9%
Raynham	PVP 20235	5,446	27,365	0.63	19.9%

Municipality	Pools Affected	Area of Impact to VP Habitat (SF)	Total Area of VP Habitat (SF)	Total Area of VP Habitat (Ac.)	Percent of VP Habitat Impacted
Raynham Total	6	15,163			
	VP-13	3,675	7,722	0.18	47.6%
	PVP 25087	5,237	5,237	0.12	100.0%
	PVP 25089				
	PVP 25090				
	PVP 25092	2,746	88,956	2.04	3.1%
	PVP 25270	894	15,858	0.36	5.6%
	PVP 25271	1,162	40,851	0.94	2.8%
	PVP 25303	1,860	81,817	1.88	2.3%
	PVP 25306				
	PVP 25302	2,197	224,848	5.16	1.0%
	PVP 25314	369	4,967	0.11	7.4%
Taunton	PVP 25317	4,333	17,388	0.40	24.9%
Taunton Total	12	22,473			
	PVP 2320	6,495	129,756	2.98	5.0%
Berkley	PVP 2353	2,228	15,849	0.36	14.1%
Berkley Total	2	8,723			
	PVP 8348	185	67,952	1.56	0.3%
	PVP 8324	4,517	80,935	1.86	5.6%
	PVP 8326	822	12,515	0.29	6.6%
Freetown	PVP 8286	1,302	13,391	0.31	9.7%
Freetown Total	4	6,826			
New Bedford	CVP 2647	1,289	36,463	0.84	3.5%
New Bedford Total	1	1,289			
Totals	40	62,481			

A total of 30 areas would be impacted, affecting a total of 40 vernal pools. The largest impact to vernal pool habitat around any single pool would be to that of PVP 25087 in Taunton (Figure 4.14-7e), which would lose 100 percent of its vernal pool habitat. This vernal pool is a small pool surrounded mainly by upland areas, with all nearby wetlands lying entirely in the right-of-way. Although there are no other wetland areas contiguous to PVP 25087, a large wetland area of wetlands lies less than 200 feet to the east, giving this pool additional wetland habitat nearby. VP 13 would lose 26.4 percent of its vernal pool habitat; however, since this is one of the two pools that would be filled in completely, the loss of additional vernal pool habitat is moot. The impacts to the other pools and habitats that would be directly affected range from 0.3 percent to 24.9 percent. Easton has the largest number of pools that would be affected (13 pools), while Taunton has the largest amount of fill proposed (22,473 SF). While it is impossible to avoid impacting vernal pool habitat to some degree along the Stoughton Alternative, no impacts to vernal pool habitat would occur in Canton, Lakeville, or Fall River. Additionally, Stoughton and New Bedford would experience impact to vernal pool habitat associated with either one or two pools, totaling less than 500 SF in Stoughton and less than 1,300 SF in New Bedford.

Figure 4.14-18 shows the distribution of the percentage impacts to vernal pool habitat. Of the 30 areas impacted, 24 would lose 10 percent or less of their total vernal pool habitat, and 27 would lose 20 percent or less of their total vernal pool habitat.

Impacts to Upland Buffer Habitat—Impacts to upland buffer habitat are defined as impacts to any naturally-vegetated upland area within 100 feet of the boundary of a vernal pool. The loss of upland buffer habitat would affect 60 vernal pools. Table 4.14-14 describes the impacts to upland buffer habitat along the South Coast Rail project corridor. Where pools are in close proximity to one another, the impacted areas of upland buffer habitat overlap. In these cases, the analysis identifies the impacts to the affected area of upland buffer habitat as a whole, and denotes which pools make up each affected area. Impacts are calculated for the loss of undeveloped land with natural vegetation that could provide non-breeding and/or migratory habitat for vernal pool amphibians. Therefore impacts calculated to upland buffer habitat did not include any areas of existing rail bed or the surrounding ballast, which were estimated by using a measurement of 10 feet to either side of the track centerline. Impacts to and total areas of upland buffer habitat also did not include any existing developed areas, including buildings and parking areas. Developed areas were estimated by using a land use data layer in the GIS analysis and subtracting any areas of development from impacted areas. No impacts to upland buffer habitat would occur in the area under the proposed trestle in Easton.

Figure 4.14-18 Percent Impacts to Vernal Pool Habitat Stoughton Electric Alternative

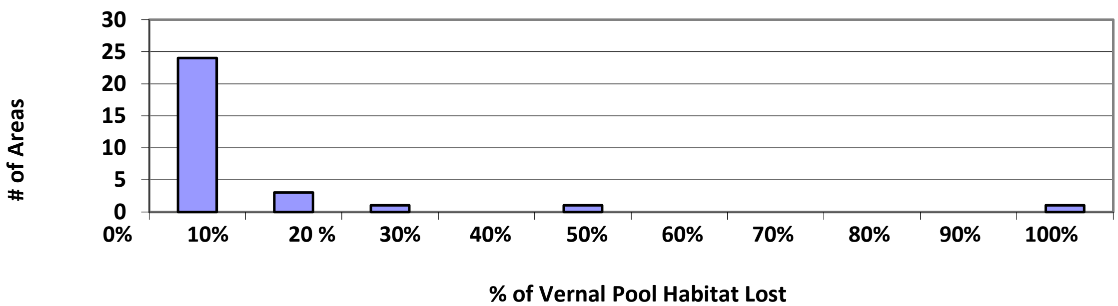


Table 4.14-14 Impacts to Upland Buffer Habitat of the Stoughton Electric Alternative

Municipality	Pools Affected	Area of Impact to Buffer Habitat (SF)	Area of Impact to Buffer Habitat (Ac.)	Total Area of Buffer Habitat (SF)	Total Area of Buffer Habitat (Ac.)	Percent of Buffer Habitat Impacted
	PVP 23791	3,773	0.09	30,166	0.69	12.5%
Stoughton	PVP 23784	24,986	0.57	129,503	2.97	19.3%
	CVP 2140	21,393	0.49	103,765	2.38	20.6%
Stoughton Total	3	50,152	1.15			
	PVP 7222 CVP 2152 VP-10 VP-3	51,658	1.19	192,509	4.42	26.8%
Easton	PVP 7218	12,024	0.28	120,591	2.77	10.0%

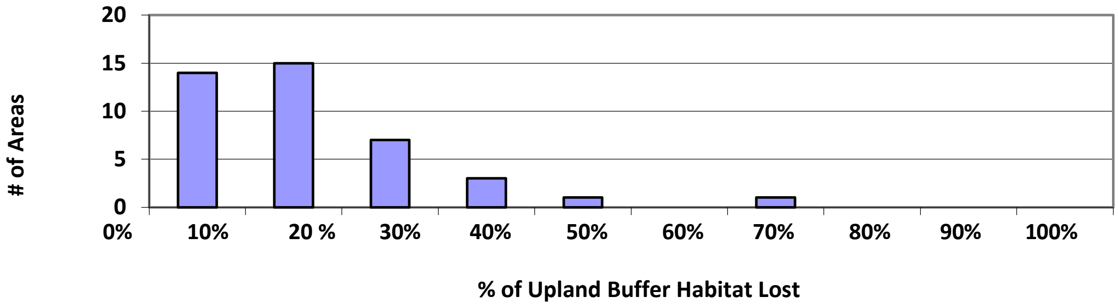
Municipality	Pools Affected	Area of Impact to Buffer Habitat (SF)	Area of Impact to Buffer Habitat (Ac.)	Total Area of Buffer Habitat (SF)	Total Area of Buffer Habitat (Ac.)	Percent of Buffer Habitat Impacted
	VP-6	12,348	0.28	35,510	0.82	34.8%
	CVP 2377					
	VP-11					
	VP-7	17,797	0.41	123,093	2.83	14.5%
	EA-1					
	EA-2	12,133	0.28	129,186	2.97	9.4%
	CVP 1462					
	NCVP-3	16,973	0.39	127,139	2.92	13.3%
	NCVP-2	17,764	0.41	66,665	1.53	26.6%
	CVP 1463	11,386	0.26	28,116	0.65	40.5%
	PVP 7255					
	PVP 7256	12,068	0.28	107,474	2.47	11.2%
	NHESP 1	12,684	0.29	55,629	1.28	22.8%
	CVP 1712	4,136	0.09	49,627	1.14	8.3%
	CVP 1665					
	NHESP 2					
	CVP 1710	11,036	0.25	91,827	2.11	12.0%
Easton Total	22	192,006	4.41			
	NHESP 3	4,679	0.11	6,991	0.16	66.9%
	PVP 20158	8,947	0.21	27,104	0.62	33.0%
	VP-12	4,266	0.10	31,587	0.73	13.5%
	CVP 1972					
	CVP 1971	17,580	0.40	74,925	1.72	23.5%
	PVP 20231	7,288	0.17	113,818	2.61	6.4%
	PVP 20230	4,919	0.11	14,462	0.33	34.0%
Raynham	PVP 20235	6,986	0.16	43,386	1.00	16.1%
Raynham Total	8	54,665	1.25			
	VP-13	5,241	0.12	40,951	0.94	12.8%
	PVP 25087	10,130	0.23	52,366	1.20	19.3%
	PVP 25089					
	PVP 25090					
	PVP 25092	16,916	0.39	144,958	3.33	11.7%
	PVP 25270	3,189	0.07	39,561	0.91	8.1%
	PVP 25271	652	0.01	46,707	1.07	1.4%
	PVP 25303	2,853	0.07	40,708	0.93	7.0%
	PVP 25306					
	PVP 25302	2,462	0.06	16,122	0.37	15.3%
	PVP 25317					
Taunton	PVP 25316	1,288	0.03	97,900	2.25	1.3%
Taunton Total	12	42,731	0.98			

Municipality	Pools Affected	Area of Impact to Buffer Habitat (SF)	Area of Impact to Buffer Habitat (Ac.)	Total Area of Buffer Habitat (SF)	Total Area of Buffer Habitat (Ac.)	Percent of Buffer Habitat Impacted
	PVP 2318					
	PVP 2319	18,684	0.43	75,118	1.72	24.9%
	PVP 2320	8,653	0.20	36,558	0.84	23.7%
Berkley	PVP 2353	2,367	0.05	37,870	0.87	6.3%
Berkley Total	4	29,704	0.68			
Lakeville	PVP 11932	5,557	0.13	237,065	5.44	2.3%
Lakeville Total	1	5,557	0.13			
	PVP 8348	1,717	0.04	18,615	0.43	9.2%
	PVP 8324	1,191	0.03	37,652	0.86	3.2%
	PVP 8326	969	0.02	21,773	0.50	4.5%
Freetown	PVP 8308	5,793	0.13	47,416	1.09	12.2%
	PVP 8284	6,500	0.15	47,444	1.09	13.7%
	PVP 8286	11,045	0.25	69,954	1.61	15.8%
Freetown Total	6	27,215	0.62			
New Bedford	CVP 2647	1,448	0.03	22,081	0.51	6.6%
New Bedford Total	1	1,448	0.03			
Totals	57	403,478	9.26			

A total of 41 areas would be impacted, affecting a total of 57 vernal pools. Impacts to upland buffer habitat would be generally larger than impacts to vernal pool habitat, both in terms of area in square feet and in terms of percentage of available upland buffer habitat associated with each vernal pool or cluster of pools. The majority of impact associated with constructing new tracks and widening existing tracks and berms involves existing uplands. The percentage impacts to upland buffer habitat are therefore greatest in areas where this type of habitat is limited to berms and slopes along large wetlands or wetland complexes. For example, the largest percentage impact to upland buffer habitat is at NHESP 3 in Raynham (Figure 4.14-7d), which would lose 66.9 percent of its upland buffer habitat. The nearby pool of PVP 20158 is approximately the same distance from the limit of disturbance as NHESP 3, but would lose only 33.0 percent of its upland buffer habitat. This lower percentage is due to the fact that PVP 20158 has additional upland area within 100 feet of the boundary of the pool, whereas the upland area within 100 feet of the boundary of NHESP 3 is mainly limited to the railroad berm.

Figure 4.14-19 shows the distribution of the percentage impacts to upland buffer habitat. Of the 41 areas impacted, 14 would lose 10 percent or less of their total upland buffer habitat, and 29 would lose 20 percent or less of their total upland buffer habitat. Twelve areas would lose more than 20 percent of their total upland buffer habitat. While impacts to upland buffer habitat can affect the ability of vernal pools to sustain viable populations, all affected pools have additional upland buffer habitat or surrounding upland habitat contiguous to their impacted upland buffer habitat, with the exception of pool NHESP 3.

Figure 4.14-19 Percent Impacts to Upland Buffer Habitat Stoughton Electric Alternative



Impacts to Surrounding Upland Habitat

Impacts to surrounding upland habitat are defined as impacts to any naturally vegetated upland area between 100 and 750 feet of the boundary of a vernal pool. For these pools, point locations were used to represent each pool. The loss of surrounding upland habitat would affect 147 vernal pools. Table 4.14-15 lists the impacts to surrounding upland habitat along the South Coast Rail project corridor. Where pools are in close proximity to one another, the impacted areas of buffer habitat overlap. In these cases, the impacts to the affected area of surrounding upland habitat are identified as a whole, and the pools that make up each affected area are denoted. Impacts are calculated for the loss of undeveloped land with natural vegetation that could provide non-breeding and/or migratory habitat for vernal pool amphibians. The impacts calculated for surrounding upland habitat did not include any areas of existing rail bed or the surrounding ballast, which were estimated by using a measurement of 10 feet to either side of the track centerline. Impacts to and total areas of surrounding upland habitat also did not include any existing developed areas, including buildings and parking areas. Developed areas were estimated by using a land use data layer in the GIS analysis and subtracting any areas of development from impacted areas. No impacts to surrounding upland habitat would occur in the area under the proposed trestle in Easton. For a single pool surrounded by completely undeveloped area, the total potential surrounding upland habitat would be over 40 acres.

Table 4.14-15 Impacts to Surrounding Upland Habitat of the Stoughton Electric Alternative

	Pools Affected	Area of Impact to Surrounding Upland Habitat (Ac.)	Total Area of Surrounding Upland Habitat (Ac.)	Percent of Upland Habitat Impacted
Stoughton	PVP 23791	0.63	10.42	6.0%
	PVP 23778	1.72	35.57	4.8%
	PVP 23784 CVP 2140	8.63	54.45	15.9%
Stoughton Total	4	10.98		
Easton	PVP 7222 CVP 2152 VP-10 VP-3 PVP 7218 VP-6 CVP 2377	4.15	66.10	6.3%

	Pools Affected	Area of Impact to Surrounding Upland Habitat (Ac.)	Total Area of Surrounding Upland Habitat (Ac.)	Percent of Upland Habitat Impacted
	VP-11			
	VP-7			
	PVP 7220			
	PVP 7221			
	PVP 7219			
	CVP 2153			
	CVP 2154			
	PVP 7223			
	VP 2			
	VP 4			
	CVP 1827	0.19	16.37	1.2%
	EA-1			
	EA-2			
	CVP 1462			
	NCVP-3			
	NCVP-2			
	PVP 7242			
	CVP 1463	1.39	48.56	2.9%
	PVP 7255			
	PVP 7256			
	PVP 7254			
	PVP 7324			
	PVP 7257			
	PVP 7325	1.60	46.42	3.4%
	NHESP 1	0.61	10.69	5.7%
	CVP 1712			
	CVP 1665			
	NHESP 2			
	CVP 1710	1.57	60.97	2.6%
Easton Total	36	9.50		
	PVP 20158			
	NHESP 3	0.75	4.55	16.4%
	PVP 20178			
	PVP 20179			
	PVP 20181			
	PVP 20182	1.99	56.30	3.5%
	PVP 20186			
	PVP 20189	0.40	33.67	1.2%
	PVP 20193	0.70	17.30	4.1%
	VP-12			
	PVP 20198			
Raynham	PVP 20197	2.11	96.90	2.2%

	Pools Affected	Area of Impact to Surrounding Upland Habitat (Ac.)	Total Area of Surrounding Upland Habitat (Ac.)	Percent of Upland Habitat Impacted
	PVP 20195			
	PVP 20196			
	PVP 20208			
	PVP 20209			
	PVP 20210			
	PVP 20211			
	PVP 20214			
	PVP 20215			
	CVP 1972			
	CVP 1971			
	PVP 20231			
	PVP 20233			
	PVP 20232			
	PVP 20230			
	PVP 20235	0.78	34.77	2.2%
Raynham Total	27	6.72		
	VP-13			
	PVP 25087			
	PVP 25099			
	PVP 25091			
	PVP 25090			
	PVP 25098			
	PVP 25097			
	PVP 25089			
	PVP 25096			
	PVP 25095			
	PVP 25092			
	PVP 25094			
	PVP 25093			
	PVP 25109	0.85	83.62	1.0%
	PVP 25270			
	PVP 25271			
	PVP 25278			
	PVP 25295			
	PVP 25294	0.84	74.97	1.1%
	PVP 25303			
	PVP 25302			
	PVP 25304			
	PVP 25305			
	PVP 25306			
	PVP 25308			
	PVP 25307			
Taunton	PVP 25309	0.38	21.36	1.8%

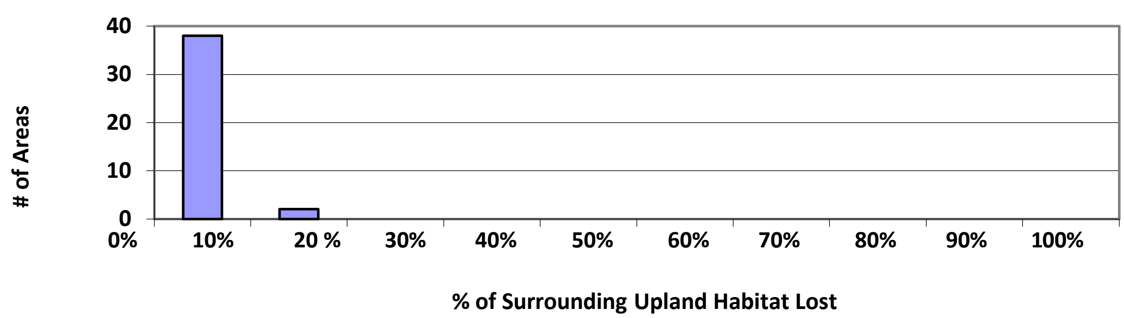
	Pools Affected	Area of Impact to Surrounding Upland Habitat (Ac.)	Total Area of Surrounding Upland Habitat (Ac.)	Percent of Upland Habitat Impacted
	PVP 25310			
	PVP 25317			
	PVP 25316			
	PVP 25315			
	PVP 25318	0.58	47.67	1.2%
	PVP 25395			
	PVP 25397	1.29	32.96	3.9%
Taunton Total	34	3.93		
	PVP 2316	0.83	21.67	3.8%
	PVP 2318			
	PVP 2319			
	PVP 2320			
	PVP 2317	1.60	62.16	2.6%
	PVP 2353	0.39	18.49	2.1%
	PVP 2354			
	PVP 2356			
	PVP 2358	0.46	31.14	1.5%
	PVP 2360	0.96	15.39	6.3%
Berkley	PVP 2361	0.02	13.79	0.1%
Berkley Total	11	4.26		
	PVP 11932	0.38	18.88	2.0%
	PVP 11931	0.20	24.75	0.8%
Lakeville	PVP 11883	0.12	8.93	1.4%
Lakeville Total	3	0.70		
	PVP 8348	0.42	14.07	3.0%
	PVP 8362	0.33	28.17	1.2%
	PVP 8324	0.17	12.42	1.4%
	PVP 8326	0.48	24.56	1.9%
	PVP 8308			
	PVP 8309			
	PVP 8310	1.34	63.30	2.1%
Freetown	PVP 8312			
	PVP 8313	0.46	29.68	1.6%
	PVP 8284			
	PVP 8286			
	PVP 8283			
	PVP 8285			
	PVP 8287	3.05	55.18	5.5%
Freetown Total	14	6.26		
	CVP 1892			
	CVP 1893	0.23	34.01	0.7%
New Bedford	CVP 2647	0.28	18.42	1.5%

	Pools Affected	Area of Impact to Surrounding Upland Habitat (Ac.)	Total Area of Surrounding Upland Habitat (Ac.)	Percent of Upland Habitat Impacted
	PVP 15554			
	CVP 2525	0.29	26.71	1.1%
	PVP 15571			
	PVP 15572	0.26	35.64	0.7%
New Bedford Total	7	1.06		
Totals	136	43.40		

A total of 40 areas would be impacted, affecting a total of 136 vernal pools. While impacts to surrounding upland habitat are larger in terms of size than either vernal pool habitat or upland buffer habitat, the overall impacts would be negligible. The large total area of surrounding upland habitat around a given pool, or more often a cluster of pools, tends to ameliorate the impacts to surrounding upland habitat in any one area. The largest percentage impact to surrounding upland habitat is around the pair of pools PVP 20158 and NHESP 3 in Raynham (Figure 4.14-7d), which would lose 16.4 percent of their surrounding upland habitat. This impact is due to a combination of significant wetland areas surrounding these two pools as well as large developed areas on the eastern side of the right-of-way. The pair of pools PVP 23784 and CVP 2140 in Stoughton (Figure 4.14-7b) would lose 15.9 percent of their surrounding upland habitat from constructing the North Easton station. Impacts to pools already segregated from the right-of-way by an existing road, such as PVP 4291 in Canton (Figure 4.14-7a), are unlikely to have any real effect on the pool in question. Conversely, in areas such as that around the pair of pools PVP 23778 and PVP 23779 in Stoughton (Figure 4.14-7b), impacts are more likely to exclusively affect PVP 23778 due to the separation of PVP 23779 from the right-of-way, again by an existing roadway. Still, the overall effects to either pool would be very small since both have a large contiguous area of surrounding upland habitat around the pool. There are no pools or cluster of pools along the length of the Stoughton Alternative corridor that would have a large percentage of surrounding upland habitat impacted.

Figure 4.14-20 shows the distribution of the percentage impacts to surrounding upland habitat. Of the 40 areas impacted, 38 would lose 10 percent or less of their total surrounding upland habitat, and all 40 would lose less than 20 percent of their total surrounding upland habitat.

Figure 4.14-20 Percent Impacts to Surrounding Upland Habitat Stoughton Electric Alternative



Fragmentation Effects

Habitat fragmentation can occur to individual pools as well areas with multiple pools, and can affect the species that use vernal pools by restricting or cutting off their access to vernal pool habitat, upland buffer habitat, and surrounding upland habitat.

Fragmentation of individual pools would occur when a given pool has a large area of an associated habitat on the opposite side of the tracks, and little to no associated habitat on the same side of the tracks. Most often the habitat on the same side of the tracks is either cut off by existing roadways or is developed with structures or parking areas. For these pools, the vernal pool amphibians that use the pool will spend the majority of the year in the more naturally vegetated areas on the opposite side of the tracks, crossing over to use the pool during breeding season. Constructing new tracks, widening berms, and constructing steeper slopes and retaining walls can all separate vernal pool amphibians from their necessary breeding habitat, thereby reducing the effectiveness of the pool. Along the Stoughton Alternative corridor, the only vernal pool that would experience these effects to is NHESP 3 in Raynham (Figure 4.14-7d). This pool at the southern end of the Hockomock Swamp past the end of the trestle, and is part of the large Hockomock wetland complex. Constructing the railroad would impact the majority of the upland buffer habitat of this pool, and the majority of the surrounding area is wetland. The small amount of undeveloped upland buffer habitat across the existing berm would be cut off from NHESP 3. No other pools have any of their associated habitats cut off from the South Coast Rail project. The majority of pools occur in less developed areas, and have contiguous additional vernal pool habitat, upland buffer habitat, and surrounding upland habitat available to vernal pool amphibians that use the pools. Even pools in more densely developed areas are either already separated from the right-of-way by an existing road (such as PVP 4291 in Canton, Figure 4.14-7a), or would not experience separation of the pool from additional areas of associated habitats by constructing the railroad.

Larger-scale fragmentation effects can occur in areas with multiple pools. These areas may have pools separated from one another due to fragmentation from the new railway. New tracks, track widening, steepened slopes, and retaining walls can all create significant barriers to animal movement between pools, where before the barrier effects of the abandoned railroad bed may have been only moderate or minimal. This can affect the health of the entire pair, cluster, or system of pools by preventing animal movement between them. Table 4.14-16 highlights areas where pools are likely to be separated from one another or have their current level of separation increased. Pairs or clusters of pools where fragmentation occurs within 100 feet represent more tightly associated pools. Pools already separated by existing roadways or other developed areas that provide barriers to movement were not considered.

New fragmentation effects would occur entirely in Easton, Raynham, and Taunton. One additional cluster in Freetown already has PVP 8283 separated from PVPs 8284, 8285, 8286, and 8287 (Figure 4.14-9b) by an existing maintained railway, so additional fragmentation effects are unlikely. Separating pools from one another can decrease the amount of associated vernal pool habitat, upland buffer habitat, and supporting upland habitat available to all pools in the cluster or pair. This can affect species density and the ability of the pool to provide adequate breeding habitat, if the majority of the organisms that use the pool originate from the other side of the railroad. Fragmentation is likely to have the largest effects in cases where one pool is newly separated from a cluster, or where a pair of pools is separated to create two single pools, and when the pools are close together (i.e., within 100 feet of one another). This would occur, for example, in Easton, where VP-3 is separated from a cluster of four other pools (Figure 4.14-7b). In the areas of fragmentation listed in Table 4.14-16, there are no cases where one pool is separated from a pair or cluster without at least some extant surrounding habitat of its own.

Table 4.14-16 Fragmentation Effects of the Stoughton Electric Alternative

Municipality	Pools on Western Side of ROW	Pools on Eastern Side of ROW	Fragmentation occurs within 100 feet	Fragmentation occurs within 750 feet
		PVP 7222		
		CVP 2152		
		PVP 7223		
	VP-3	VP-10	X	
	PVP 7219	CVP 2154		
	PVP 7218	VP-7		
	CVP 2153	CVP 2377		X
		VP-7		
	VP-11	CVP 2377	X	
	EA-1	EA-2	X	
	CVP 1462	NCVP-3	X	
	PVP 7255	PVP 7256	X	
		PVP 7234		
Easton	PVP 7255	PVP 7257		X
	PVP 20181			
	PVP 20179			
	PVP 20182	PVP 20178		X
		PVP 20209		
		VP-12		
	PVP 20208	PVP 20210		X
Raynham	CVP 1971	CVP 1972	X	
	PVP 20235	PVP 25087		X
	PVP 25090			
	PVP 25089			
	PVP 25092	PVP 25096	X	
		PVP 25099		
		PVP 25098		
	PVP 25091	PVP 25097		
	PVP 25090	PVP 25095		
	PVP 25089	PVP 25096		
	PVP 25092	PVP 25094		X
	PVP 25318			
	PVP 25317			
Taunton	PVP 25316	PVP 25315		X

Summary of Impacts

Table 4.14-17 provides a summary of the impacts to vernal pools and surrounding habitat of the Stoughton Electric Alternative. The majority of impacts to vernal pools occur on the Stoughton Line. The Stoughton line contains 16 of the 19 pools that would experience direct impact (fill) from the Project, 28 of the 40 pools that would experience impacts to vernal pool habitat, 42 of the 57 pools that would experience impacts to upland buffer habitat, and 88 of the 136 pools that would experience impacts to surrounding upland habitat.

Table 4.14-17 Summary of Vernal Pool Impacts of the Stoughton Electric Alternative

Pools with Direct Fill / Amount of Fill	Pools with Impacts to Vernal Pool Habitat	Pools with Impacts to Buffer Habitat	Pools with Impacts to Surrounding Upland Habitat
19 / 0.53 Ac.	40 / 1.43 Ac.	57 / 9.29 Ac.	136 / 43.40 Ac

The following points summarize the impacts by municipality.

- Canton: There are no impacts in Canton. The one vernal pool within 750 feet of the right-of-way is already separated from the right-of-way by an existing roadway.
- Stoughton: Impacts in Stoughton are small. One pool (PVP 23791) would receive direct fill but has large contiguous areas of adjacent vernal pool habitat, upland buffer habitat, and surrounding upland habitat around it. No clusters of pools are present.
- Easton: Six pools would receive direct fill in Easton, although only one (PVP 7222) would lose greater than 20 percent of its area. While upland buffer habitat within 100 feet would be impacted around several pools, in all cases these pools have additional surrounding upland habitat between 100 and 750 feet away. Several clusters and pairs of pools are in close proximity to the right-of-way and would experience fragmentation both of associated habitats and of entire pools from one another. The majority of these clusters and pairs are in close association with one another (i.e., pools are within 100 feet of each other or within 100 feet of another pool in the same cluster).
- Raynham: One pool (PVP 20230) would be completely filled for the project, resulting in a loss of the pool as well as the utility of its associated habitats. Five other pools would also receive direct fill. One pool (NHESP 3) would lose upland buffer habitat and does not have contiguous adjacent upland habitat nearby. Two clusters of pools would experience fragmentation within 750 feet, plus an additional pair of pools which would experience fragmentation within 100 feet.
- Taunton: One pool (VP 13) would be filled 96.4 percent, essentially a complete loss. Four additional pools would receive direct impact. In addition, Taunton has some of the largest impacts to both vernal pool habitat and upland buffer habitat. However, in all cases these pools have additional habitat between 100 and 750 feet away. Taunton also has several clusters of pools that would experience fragmentation within 750 feet, and one cluster within 100 feet.
- Berkley: Impacts in Berkley would be small. No pools would receive direct fill, and impacts to vernal pool habitat are small. Impacts to upland buffer habitat, particularly around PVP 2318 and PVP 2319 are more significant, but these pools have additional surrounding upland habitat. No cases of fragmentation between pools occur in Berkley.

- Lakeville: Impacts in Lakeville are very small. Few vernal pools exist along the right-of-way and no pools would receive direct fill. Impacts to other associated habitats are also small, and there are no cases of fragmentation between pools.

- Freetown: One pool (PVP 8286) in Freetown would receive fill to a majority of its area, and would also receive an impact greater than 25 percent to both vernal pool habitat and upland buffer habitat. The nearby pool of PVP 8284 would also receive direct fill as well as impacts to vernal pool habitat and upland buffer habitat. In both cases these pools have additional habitat between 100 and 750 feet away. The remainder of the pools in Freetown do not receive large impacts.

- New Bedford: Impacts in New Bedford would be very small. Few pools exist along the right-of-way. No pools would receive direct impacts, and impacts to other associated habitats are small, with exception of one large impact to the upland buffer habitat of CVP 2647. However this pool has large unfragmented areas of additional surrounding upland habitat.

- Fall River: There are no impacts in Fall River.

Overall, impacts to vernal pools along the South Coast Rail project corridor are small and are not likely to compromise the functions of pools or communities of pools along the route. Two vernal pools would be filled completely (PVP 20230 in Raynham and VP 13 in Taunton, Figure 4.14-7e), and one additional pool would lose a majority of its area (PVP 8286 in Freetown, Figure 4.14-9b). Of the remaining pools, no pool or group of pools would lose a large portion of its vernal pool habitat, upland buffer habitat or supporting upland habitat. Additionally, pools that lose areas of associated habitats have additional, larger contiguous areas of these habitats adjacent to them, with the exception of NHESP 3 in Raynham (Figure 4.14-7d).

Appendix 4.14-C shows the impacts to vernal pools that would be directly filled, along with the impacts to all associated habitats: vernal pool habitat, buffer habitat, and surrounding upland habitat. Where pools are in close proximity to one another, the impacted areas of habitat will overlap; a given habitat area can therefore have impacts from multiple pools. The table shows the impacts to each habitat area as a whole. Where multiple pools contribute to an affected area, the number of pools associated with each given habitat area are given.

Fish and Wildlife Passage

This part discusses fish and wildlife crossings. Culverts and bridges along the South Coast Rail Stoughton Alternative alignment are described and a plan for providing crossings in areas with high biodiversity value to enhance fish and wildlife passage is provided.

A detailed inventory of bridges and culverts was conducted to identify the location, condition, and function of each structure. Dimensions, construction materials, and railroad bed characteristics (such as condition and depth of cover) were recorded. For this biodiversity assessment, the subset of bridges and culverts with potential ecological value was determined by reviewing wetland mapping (as depicted in the Abbreviated Notice of Resource Area Determination [ANRAD] for each municipality), surrounding land use (as visible in aerial photographs), and other ecological setting features (as modeled by CAPS[67])

[67] UMass Extension. 2011. CAPS Index of Ecological Integrity. http://umasscaps.org/. The CAPS model output indicates areas with a high (over 50 percent) Index of Ecological Integrity (IEI). CAPS maps for each town along the Stoughton Alternative are provided in Appendix C.

of the complete bridge and culvert inventory. The inventory of this subset of bridges and culverts is provided in Appendix 4.14-A and summarized in this section.

There are 128 structures (23 bridges and 105 culverts) along the Stoughton Alternative alignment (comprised of the Stoughton Line, New Bedford Main Line, and Fall River Secondary) that may have biodiversity value by connecting ecosystems, which can allow fish and wildlife to pass from one side of the tracks to the other. Many of these structures also have a hydrologic function, allowing water to flow under or through the railroad structure (subgrade, ballast, ties, and tracks). Bridges that convey roads under or over the railroad bed will also be improved for the project but do not have an ecological function connecting ecosystems and are therefore not included in this biodiversity evaluation. Bridges and culverts that have been replaced prior to the South Coast Rail project are also not included in this biodiversity evaluation, as are 29 culverts within the right-of-way that do not cross under the railroad bed (but instead are parallel to it) and therefore do not connect ecosystems bisected by the railroad.

Proposed Bridge and Culvert Replacement

Most of the bridges and culverts along the Stoughton Alternative alignment will be replaced to meet engineering requirements for operation of the South Coast Rail. The track design is conceptual at this stage but takes into consideration operational and safety requirements as well as the gentle elevation change requirements of a fixed guideway transit system. Railroad track elevation changes and curves must be gradual to accommodate the design requirements for a safe high speed train track. Additionally, the railroad bed must meet certain width and depth specifications (depending on the nature of the underlying ground surface) to provide proper track support and ballast drainage. The following sections describe the engineering evaluation of bridges and culverts conducted to support the preliminary design.

Bridges—The 23 existing bridges considered in this biodiversity evaluation are in deteriorating condition and have insufficient capacity for the expected loads and speeds of the South Coast Rail trains. Many of the bridges along the Stoughton Alternative will be replaced to meet current engineering standards for the high-speed commuter rail service, regardless of whether or not the bridges span roads or waterbodies. One new bridge to replace a washed-out culvert, and a new trestle through Hockomock Swamp, will be constructed. Table 4.14-18 describes the proposed substructure for the bridges and trestle that could impact fish and wildlife passage; typical bridge cross-sections for single-span and two-span structures are depicted in Figures 4.14-21a and b, respectively.

Piers or pilings supporting existing multiple-span bridges (see Table 4.14-18) will be replaced by a single pier at the center of a two-span structure, minimizing impacts to stream hydrology and fish habitat. Abutments for most of the bridges will be replaced, offering an opportunity to improve wildlife passage on stream and river banks. Typically, existing piles would be removed and one new cast-in-place concrete pier would be constructed in the center of the span. New cast-in-place concrete abutments would be constructed behind the existing timber crib abutments, which would then be partially removed to an elevation equal to the river's average seasonal high water elevation.

Table 4.14-18 Proposed Bridge Substructure Construction

Bridge	Figure Number	Proposed Substructure Construction
Stoughton Line		
Forge Pond	4.14-11a	No change to existing abutment location. The new superstructure (above or adjacent to existing historic arch structure) would be supported on adjacent augured piles or drilled shafts.
Mill Brook (Beaver Meadow Brook)	4.14-11a	No change to existing abutment location. The new superstructure (above or adjacent to existing historic arch structure) would be supported on adjacent augured piles or drilled shafts.
Cowessett Brook (Whitman Brook)	4.14-11b	New abutments would be constructed behind existing abutments, which would then be removed.
Quessett Brook (Small Creek)	4.14-11b	Existing stacked stone abutments would be rehabilitated to accommodate increased loads; there would be no change in abutment location.
Black Brook	4.14-11c	New bridge would be constructed to replace washed out culvert. Cast-in-place concrete abutments would be constructed beyond the banks of Black Brook so as to not change the hydrology of the stream or conditions of the surrounding wetlands, and to provide shelves for wildlife passage.
Hockomock Swamp	4.14-11c	New 8,500-foot long trestle over existing rail bed, constructed on steel h-piles or concrete piles at 30-foot intervals.
Pine Swamp Brook #1	4.14-11d	The design for this structure has not yet been determined, but would provide wildlife shelves.
Pine Swamp Brook #2	4.14-11d	The design for this structure has not yet been determined, but would provide wildlife shelves.
Taunton River (@MP 34.38)	4.14-11e	Existing piles would be removed and one new cast-in-place concrete pier would be constructed in the center of the span. New abutments would be constructed behind the existing abutments, which would then be removed.
Taunton River (@MP 34.62)	4.14-11e	Existing piles would be removed and one new cast-in-place concrete pier would be constructed in the center of the span. New abutments would be constructed behind the existing abutments, which would then be removed.
Taunton River (@MP 34.73)	4.14-11e	Existing piles would be removed and one new cast-in-place concrete pier would be constructed in the center of the span. New abutments would be constructed behind the existing abutments, which would then be removed.
Mill River	4.14-11e	New abutments would be constructed behind the existing abutments, which would then be removed.
New Bedford Main Line		
Taunton River (@MP 35.56)	4.14-11e	Existing piles would be removed and one new cast-in-place concrete pier would be constructed in the center of the span. New abutments would be constructed behind the existing abutments, which would then be removed.
Brickyard Road	4.14-11e	Existing stacked stone abutments would be rehabilitated to accommodate increased loads; there would be no change in abutment location.
Cotley River (@MP 38.93)	4.14-12a	New abutments would be constructed behind the existing abutments, which would then be removed.

Bridge	Figure Number	Proposed Substructure Construction
Cotley River (@MP 39.46)	4.14-12a	New abutments would be constructed behind the existing abutments, which would then be removed.
Cedar Swamp River	4.14-12b	New abutments would be constructed behind the existing abutments, which would then be removed.
Fall Brook	4.14-12b	New abutments would be constructed behind the existing abutments, which would then be removed.
Fall River Secondary		
Cedar Swamp River	4.14-13a	Existing piles would be removed and one new concrete pier would be constructed in the center of the span. New abutments would be constructed behind the existing abutments, which would then be removed.
Farm Road	4.14-13b	Existing stacked stone abutments would be rehabilitated to accommodate increased loads; the abutment location would not be changed.
Farm Road	4.14-13b	This bridge will be filled in, as the existing dirt road spanned by the bridge has been abandoned.
Miller's Cove	4.14-13b	New abutments would be constructed to replace the existing stacked stone abutments; the abutment location would not be changed.
Collins Road	4.14-13b	Existing stacked stone abutments would be rehabilitated to accommodate increased loads; the abutment location would not be changed.
Ashley's Underpass	4.14-13b	Existing stacked stone abutments would be rehabilitated to accommodate increased loads; the abutment location would not be changed.
Channel near Battleship Cove	4.14-13c	The design for this structure has not yet been determined.

Culverts—The 105 existing culverts considered in this biodiversity assessment along the three railroad lines range in condition from good to poor, with most performing their hydrologic function but many partially or fully collapsed, buried, or plugged. Depending upon the recommendations made to enhance ecological connections, project requirements, and engineering constraints, these culverts may be replaced, left in place, or abandoned.

From an engineering perspective alone, culvert replacement would be based on a variety of existing conditions or project needs. Culverts that are no longer performing their hydrologic function (e.g., are plugged or collapsed) or that exhibit structural failure would likely be replaced. Culverts that would need to be extended to accommodate a change in the track for the South Coast Rail project, such as relocating the track or installing double tracks where a single track currently exists, would also be replaced. Culverts that are in good condition, are functioning properly, and meet the requirements of the South Coast Rail project, do not require any action.

Other Important Habitat Areas

The Stoughton Alternative also passes the Stoughton Memorial Conservation Lands (including the Bird Sanctuary) north of the proposed North Easton station. The railroad tracks and ties are currently in place through this section, although the canopy has closed over the out-of-service tracks. Restoring the tracks would require removing vegetation along the right-of-way, which would result in a new "edge effect" that would alter the microhabitat characteristics of wooded areas adjacent to the rail, potentially reducing the ability of this area to support forest interior species.

Indirect Impacts of the Stoughton Electric Alternative

The analysis of indirect impacts evaluates the effects of the Stoughton Electric Alternative on key elements of biodiversity. Where the Stoughton Alternative's impacts on natural communities would occur entirely along the edge of existing active rail lines, indirect impacts to natural communities, wildlife or fisheries are anticipated to be minor and restricted to the edges of these communities. The Stoughton Alternative also has the potential to cause larger indirect effects to natural communities where it would reconstruct an out-of-service rail line, particularly along the Stoughton Line from Foundry Street in Easton to Thrasher Street in Taunton.

Vegetation Management—Right-of-way maintenance is critical to the protection of the tracks and ties and to maintaining railroad safety. Right-of-way maintenance can only be done in accordance with an approved Vegetated Management Plan (VMP) and Yearly Operating Plan (YOP) that have been reviewed by the Massachusetts Department of Food and Agriculture (DFA) and made available for public comment. These management plans are developed in accordance with the DFA's regulations, which prohibit or restrict the application of herbicide in sensitive areas such as close proximity to wetlands and public or private drinking water supplies. Under existing conditions and the No-Action Alternative, CSX Corporation maintains the track from Whittenton Junction to Cotley Junction in Taunton, MassCoastal Railroad maintains the track from Cotley Junction to New Bedford and Fall River, and MBCR maintains the track north of Stoughton Station in accordance with approved VMPs and YOPs.

To protect state-listed species, as well as aquatic organisms and water quality, the applicant has committed to treat the entire portion of the corridor through the Hockomock Swamp (from Foundry Street to the Raynham Park Station) and through Pine Swamp as No-Application sensitive areas. In addition, in accordance with the DFA requirements, the following will be designated as No-Application zones:

- Areas within 10 feet of a surface water or wetland
- Areas within 50 feet of a private drinking water supply
- Areas within 100 feet of a surface water public water supply
- Areas within 400 feet of a public water supply well (Zone 1)

These specific locations will be identified and shown on detailed project plans during the subsequent final design and permitting phase of the project, when a VMP is developed. The 1" = 1250' scale graphics used to depict the Stoughton Alternative for the purposes of the DEIS/DEIR are not sufficiently detailed to allow these areas to be shown.

The vast majority of areas disturbed for construction (extending 14 feet to each side of the track centerline, for a total width of 28 feet for single track and 42 feet for double track) will be surfaced with ballast and will be within the area where vegetation must be managed for railroad safety. These areas will not be allowed to revegetate. Disturbed areas outside of the trackbed would be seeded with an appropriate stabilization seed mix using native species. These seeded areas would be expected to revegetate within one growing season.

Habitat Fragmentation—Comments on the DEIS/DEIR, request that the applicant update the discussion of reference studies regarding habitat fragmentation impacts of linear transportation infrastructure with more recent studies, as available. These comments also suggested that the applicant should consider wildlife habitat evaluations for the portions of the track that will fragment locally important wildlife habitats, and specifically assess the impacts to wildlife movement in the segment of track adjacent to the Acushnet Cedar Swamp.

Important Wildlife Habitats—In November, 2011 the UMass Extension Center for Agriculture, in conjunction with DEP, produced Important Wildlife Habitat maps. These maps are based on the CAPS integrated index of ecological integrity and show the areas in each municipality that fall into the top 40 percent for IEI value.[68] According to the DEP Wildlife Habitat Protection Guidance, these Important Wildlife Habitat polygons are considered Designated Habitat of Potential Regional or Statewide Importance. Wetland impacts, above the regulatory thresholds established in 310 CMR 10.00 for each resource area, may trigger the requirement for detailed wildlife habitat evaluations as described in Appendix B of the DEP Guidance.[69]

The Stoughton Alternative does not cross any Important Wildlife Habitat in Canton, Stoughton, Taunton, New Bedford or Fall River. The alignment crosses Important Wildlife Habitat in the following locations:

- Easton: the Hockomock Swamp south of Foundry Street
- Raynham: the Hockomock Swamp north of the former Raynham Greyhound Park, a small area north of Bridge Street, and the Pine Swamp west of the railroad
- Berkley: the area between Cotley Street and Padelford Street
- Lakeville: along the New Bedford Main Line between Malbone Street and Howland Road (the Assonet Cedar Swamp), and an area south of Howland Road
- Freetown: along the New Bedford Main Line north of Chace Road and a small area between Chace Road and Braley Road

Detailed wildlife habitat evaluations will be required in these areas as part of the subsequent Notice of Intent filings for the Stoughton Alternative, once final design plans have been developed and wetland impacts have been more precisely determined. Such detailed evaluations are not appropriate or feasible at this planning level.

Predation is an indirect effect associated with forest fragmentation, and may increase if opportunist predators such as crows and raccoons move into the edges adjacent to the project alignment. However, the existing railbed is open and used as a trail, so there are likely to be predation-related edge effects under existing conditions. The existing upland berm will not be widened through the Hockomock Swamp, and therefore the possibility that this will be used as a trail by ground predators is not likely to be substantially greater than under existing conditions.

[68] http://www.umass.edu/landeco/research/caps/dep/dep.html, accessed 15 March 2012.
[69] Department of Environmental Protection, Wildlife Habitat Protection Guidance, 2006.

There may also be increased brood-parasitism on songbirds if brown headed cowbirds colonize the edges adjacent to the rail. However, it is unlikely that large numbers of cowbirds will colonize the reconstructed right-of-way because the increase in canopy width is minimal.

Acushnet Cedar Swamp—The active freight railroad passes along the east edge of the Acushnet Cedar Swamp between the New Bedford Industrial Park (Samuel Barnett Boulevard) and Route 140. The land east of the railroad is occupied by the industrial park, a large industrial complex accessed from Welby Road, a residential neighborhood, and Route 140, a divided highway with two travel lanes in each direction. The DEP Important Wildlife Habitat map for New Bedford shows Important Wildlife Habitat only west of the railroad. A wetland (NB-20) is also located east of the railroad, south of the Industrial Park, west of Doreen Street, and north of Route 140. It is connected to Acushnet Cedar Swamp via culverts under the track and the linear channel adjacent to the Industrial Park, also east of (and parallel to) the railroad line. Therefore, this wetland not a part of the mapped DEP Important Wildlife Habitat, but there may be some movement of wetland-dependent wildlife between the Acushnet Cedar Swamp and NB-20, possibly warranting new between-the-tie crossings at this location.

Additional Information on Barrier Effects—A literature search to identify additional scientific studies on the barrier effects of railroads was undertaken, including review of Environmental Impact Statements currently or recently prepared by the FRA.[70] The search did not identify any additional information on the barrier effects of railroads, although one paper suggested that roads and railroads may restrict bumblebee movement, fragmenting both bumblebee populations and also restrict pollen transfer between plant populations.[71]

Noise Impacts to Wildlife—Comments on noise included requests that the project incorporate strategies to minimize noise impacts on wildlife during construction in ecologically sensitive areas, that the FEIS/FEIR provide additional information about noise impacts to wildlife in ecologically sensitive areas, and that additional mitigation measures be identified. In particular, these comments focused on the Acushnet Cedar Swamp in New Bedford, which has been designated as a National Natural Landmark by the National Park Service and which is owned by the Division of Conservation and Recreation as the Acushnet Cedar Swamp State Reservation.

Noise Impacts to Wildlife – National Natural Landmark (NNL) Acushnet Cedar Swamp—In the Acushnet Cedar Swamp section of the New Bedford Main Line, trains are anticipated to be traveling at approximately 100 miles per hour (1.6 miles per minute, 140 feet per second). At this speed, with an 8-car train, it will take a train less than 6 seconds to pass any given spot. The duration of the noise (88 dB) at any location would be 6 seconds, repeated for every train pass (20 times per day). Northbound trains will blow horns ¼ mile south of the Samuel Barnett Boulevard grade crossing, resulting in higher noise levels (105 dB) in this ¼ mile section for the 6-second period. Noise impacts to wildlife will therefore be extremely short in duration. There will not be prolonged exposure to noise that would disrupt breeding or feeding activity.

No measures are necessary or proposed to reduce train noise during wildlife breeding seasons. Such measures are not reasonable, as there are no adverse noise impacts anticipated, and it is not reasonable

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[70] http://www.fra.dot.gov/rpd/freight/250.shtml, accessed March 15, 2012

[71] Bhattachyara, M., R.B. Primack and J. Gervein. 2003. Are roads and railroads barriers to bumblebee movement in a temperate suburban conservation area? Biological Conservation 109:37-45.

to reduce train service to New Bedford. Trains are required to sound horns as they approach roadway at-grade crossings, in compliance with FRA safety regulations.

All efforts will be taken to avoid construction during the avian breeding season (May through June) adjacent to the Acushnet Cedar Swamp State Reservation. In all cases construction will be limited to normal daylight hours, which will avoid interference with amphibian breeding calls.

Findings of the CAPS Model—The CAPS model used for the South Coast Rail project evaluated the ecological integrity of the landscape corridors adjacent to each of the alternatives considered in the DEIS/DEIR in the absence of the South Coast Rail, and evaluated the change in ecological integrity with each alternative, measured in IEI units. The model included both the physical barrier effects of the South Coast Rail alternatives (measured as the presence or absence of rail tracks and ballast, the number of tracks, the presence and height of a trestle, and the presence and height of retaining walls) and the noise or disturbance effects of the South Coast Rail alternatives (measured as the number of trains per day and the number of cars per train).

The CAPS analysis is a landscape-level tool useful in understanding secondary impacts to biodiversity and long-term biodiversity shifts that may result from a particular action, rather than the localized smaller impacts resulting from wetland fills.

The analysis showed that the No-Action Alternative had some level of reduced connectedness resulting from the presence of a railbed and culverts along the entire length of the Stoughton route. This railbed with culverts, even in the absence of tracks or rail traffic, represents a partial barrier to the movement of aquatic organisms. The changes in the IEI values as a result of the South Coast Rail project are due to decreased connectedness that result from constructing tracks on ballast, constructing a trestle, or constructing retaining walls (all of which serve, to varying degrees of severity, as barriers to animal movement) or decreased connectedness that results from adding or increasing train traffic. Noise and physical disturbances, to varying degrees of severity depending on the frequency of train movements and the length of the trains, cause wildlife to avoid areas near tracks or avoid crossing tracks.

The CAPS analysis showed that the Stoughton Alternative would result in the loss of IEI units, as shown in Table 4.14-19. Not unexpectedly, the majority of the loss of connectivity (64 percent) would occur north of Weir Junction, where there is no existing rail traffic. The Hockomock trestle would have less impact on connectedness than an at-grade track as it would present less of a barrier to wildlife movement.

Table 4.14-19 Loss of Ecological Integrity–Stoughton Alternative[1]

Option	Total Loss	Loss North of Weir Junction
With Trestle	474.5	302.0
Without Trestle	481.8	309.3

1 Measured in Index of Ecological Integrity Units

Stoughton Diesel Alternative

The Stoughton Diesel Alternative generally would have the same direct and indirect effects to biodiversity as the Stoughton Electric Alternative. However, since there would be no overhead catenary structures or wires, the Stoughton Diesel Alternative would have a reduced impact to the movement of birds across the track. Because this alternative would not require power substations, the Stoughton

Diesel Alternative would have a reduced direct impact to natural communities (1.95 acres) when compared to the Stoughton Electric Alternative.

Whittenton Electric Alternative

The Whittenton Electric Alternative includes reconstructing the Stoughton Line from Canton to Route 138 in Raynham, reconstructing the abandoned Whittenton Branch from Raynham Junction to Whittenton Junction in Taunton, and improving the existing active Attleboro Secondary from Whittenton Junction to Weir Junction. Various traction power substations and an overhead catenary system would be constructed in the same locations as for the Stoughton Alternative. A section of the out-of-service line crosses land within the Hockomock Swamp ACEC.

Biomap Core Habitats

The Whittenton Alternative would cross Biomap Core Habitat in two areas. The Hockomock Swamp, from Foundry Street in Easton south to Bridge Street in Raynham, is designated as Core Habitat. The Whittenton Electric Alternative would create a barrier to wildlife movement through portions of the Hockomock Swamp area (north of the proposed trestle and south of Raynham Park station). This barrier effect is likely to fragment populations of small vertebrates that are unable to cross the railroad tracks. The portion of the Whittenton Electric Alternative that is a proposed trestle (approximately 8,500 feet long) would not impede wildlife movement.

The Whittenton Electric Alternative would create a new canopy gap through portions of the Hockomock Swamp, primarily from Foundry Street south to the proposed Raynham Park station, where the forest canopy has closed over the railbed since the tracks were removed. This canopy gap could impede the movement of forest interior birds across the right-of-way, reducing the effective size of the forest block, and would create new “edge effects” of increased light and temperature, and decreased humidity, adjacent to the right-of-way. The barrier effects would extend upward from the tracks as a result of the overhead catenary system.

Living Waters

The Whittenton Alternative is adjacent to Living Water Core Habitat (LW080) near a reach of the Taunton River that provides habitat for Atlantic sturgeon. As noted in Section 4.15.3.3, the NMFS stated it is unlikely that any species listed under their jurisdiction will be exposed to any direct or indirect effects of the proposed South Coast Rail project. The right-of-way crosses this section of the Taunton River for approximately 125 feet, south of Weir Junction in Taunton (Figure 4.14-3a). The proposed reconstruction would not have a direct or indirect effect on the ability of the Taunton River to support aquatic biodiversity.

Portions of the Acushnet Cedar Swamp, particularly Turner Pond, are designated as Living Waters. The proposed reconstruction of the New Bedford Main Line would be approximately 7,500 feet west of Turner Pond and would not have a direct or indirect effect on the ability of the pond to support aquatic biodiversity.

Fisheries Habitat

The Stoughton Alternative crosses Whitman Brook, Queset Brook, Black Brook, Pine Swamp Brook, Taunton River, Mill River, Cotley River, Cedar Swamp River, and Fall Brook which are all important fisheries habitats. The proposed alternative would reconstruct existing bridges at Whitman Brook, Queset

Brook, Black Brook, Pine Swamp Brook, Cedar Swamp River and the Taunton River, and would construct a new bridge at Black Brook (the former rail bridge was washed out). These bridges would be reconstructed with the same or wider opening, maintaining habitat connectivity and the riverine substrate. The capacity of these waters to support aquatic diversity would not be adversely affected.

According to the Massachusetts Department of Fish and Wildlife comment letter on the DEIS/DEIR, fisheries surveys of the Mill River yielded 10 species, including American eel, black crappie, bluegill, brown bullhead, chain pickerel, common shiner, largemouth bass, pumpkinseed, redfin pickerel and tessellated darter. The NHESP restricts construction activities related to the Mill River to low flow periods of the year in order to prevent impacts to fisheries.

Breeding Bird Diversity

Potential breeding birds along the Whittenton Alternative are similar to Stoughton Alternative (including the Southern Triangle) as detailed above.

Vernal Pools

This section presents a vernal pool assessment, including indirect impacts, to wetland and upland habitat for vernal pool up to 750 feet on either side of the right-of-way of the Whittenton Branch. Similar to the Stoughton Alternative the analysis identified impacts to vernal pools as well as different areas surrounding vernal pools:

Whittenton Branch and Attleboro Secondary—The most ecologically important impacts are to vernal pools that would be directly filled, resulting in a permanent alteration of the pool. The total fill to vernal pools would be 0.36 acre, or 15,465 square feet, and would affect 10 vernal pools.

Table 4.14-20 describes the impacts to vernal pools along the Whittenton Alternative project corridor.

Table 4.14-20 Impacts to Vernal Pools–Whittenton Alternative

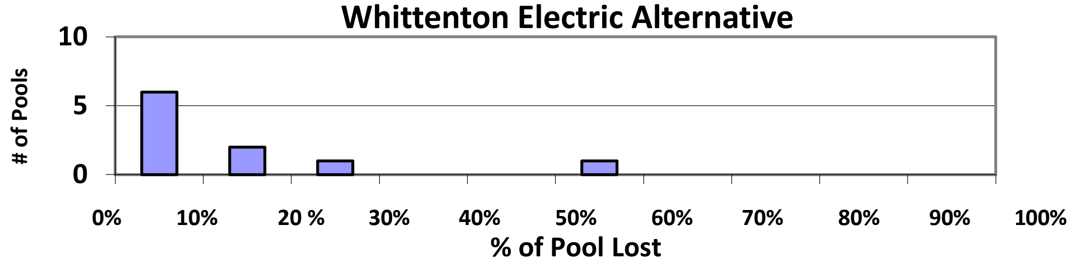
Municipality	Pools Affected	Amount of Fill (SF)	Approx. Size of Pool (SF)	Approx. Size of Pool (Ac.)	Percent of Pool Filled
Stoughton	PVP 23791	1,480	8,579	0.20	17.2%
Stoughton Total	1	1,480	8,579	0.20	
Easton	PVP 7222	2,197	10,324	0.24	21.3%
	VP-10	112	2,373	0.05	4.7%
	EA-2	661	28,403	0.65	2.3%
	CVP 1462	105	5,589	0.13	1.9%
	NCVP-2	553	50,486	1.16	1.1%
	CVP 1463	292	19,148	0.44	1.5%
Easton Total	6	3,920	116,323	2.67	
Freetown	PVP 8324	4,470	53,142	1.22	8.4%
	PVP 8284	873	4,940	0.11	17.7%
	PVP 8286	4,722	7,900	0.18	59.8%
Freetown Total	3	10,065	65,982	1.51	
Totals	10	15,465 (0.36 Ac.)			

Average depths were not calculated for each of the above pools, so the total volume of fill to vernal pools is not known. The amount of filled surface area in square feet gives an approximate measure of the relative size of disturbance to any given pool. One pool, PVP 8286 in Freetown, would have a majority (59.8 percent) of its area filled (Table 4.14-20).

The impacts to the other pools that would be directly affected range from 1.1 percent to 21.3 percent. Easton has the largest number of pools that would be directly affected (6 pools), while Freetown has the largest amount of fill proposed (10,065 SF). While it is impossible to avoid impacting vernal pools to some degree along the Whittenton Alternative, no direct filling would occur to any vernal pools in Canton, Raynham, Taunton, Berkley, Lakeville, New Bedford, or Fall River.

Figure 4.14-22 shows the distribution of the percentage impacts to vernal pools. Of the 10 vernal pools that are impacted, 6 pools would lose to 10 percent or less of their total area, and 8 pools would lose 20 percent or less of their total area.

Figure 4.14-22 Percent Impacts to Vernal Pools Whittenton Electric Alternative



These results are based on preliminary design. In the final design phase of the project, additional small impacts may be avoided or minimized through different grading (for example, steepened slopes along the rail line). Additional design efforts would attempt to minimize impacts.

Impacts to vernal pool habitat are defined as impacts to any wetland containing a vernal pool within 100 feet of the boundary of a vernal pool. The loss of vernal pool habitat would affect 27 vernal pools. Table 4.14-21 describes the impacts to vernal pool habitat along the South Coast Rail Whittenton Alternative project corridor. Where pools are in close proximity to one another, the impacted areas of vernal pool habitat overlap. In these cases, the impacts to the affected area of vernal pool habitat are identified as a whole, and the pools that make up each affected area are denoted. As a conservative measure, the entire area of the Hockomock Swamp under the proposed trestle in Easton was included in the calculation of total vernal pool habitat, since this entire area is known to provide good habitat for vernal pool amphibians. No impacts to vernal pool habitat would occur in the area under the trestle.

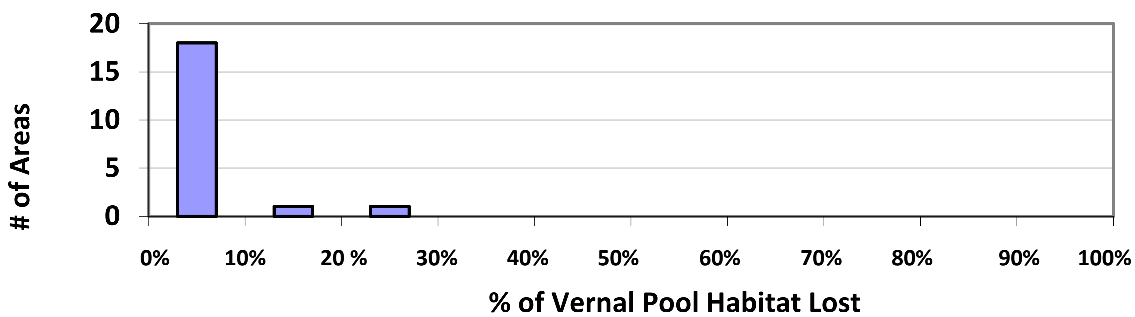
A total of 20 areas would be impacted, affecting a total of 27 vernal pools. The impacts to pools and habitats that would be directly affected range from 0.3 percent to 24.9 percent. Easton has the largest number of pools that would be affected (13 pools), while Taunton has the largest amount of fill proposed (8,759 SF). While it is impossible to avoid impacting vernal pool habitat to some degree along the Stoughton Alternative, no impacts to vernal pool habitat would occur in Canton, Raynham, Lakeville, or Fall River. Additionally, Stoughton and New Bedford would experience impact to vernal pool habitat associated with either one or two pools, totaling less than 500 SF in Stoughton and less than 1,300 SF in New Bedford.

Table 4.14-21 Impacts to Vernal Pool Habitat–Whittenton Alternative

Municipality	Pools Affected	Area of Impact to VP Habitat (SF)	Total Area of VP Habitat (SF)	Total Area of VP Habitat (Ac.)	Percent of VP Habitat Impacted
Stoughton	PVP 23791	166	20,488	0.47	0.8%
	CVP 2140	244	21,802	0.50	1.1%
Stoughton Total	**2**	**410**			
	PVP 7222 CVP 2152	949	59,472	1.37	1.6%
	PVP 7218	189	52,039	1.19	0.4%
	CVP 2377 VP-11	325	56,239	1.29	0.6%
	EA-1 EA-2	1,791	89,117	2.05	2.0%
	CVP 1463	3,151	86,590	1.99	3.6%
	PVP 7255 PVP 7256	373	116,929	2.68	0.3%
Easton	CVP 1665 NHESP 2 CVP 1710	819	42,611	0.98	1.9%
Easton Total	**13**	**7,597**			
	PVP 25303	1,860	81,817	1.88	2.3%
	PVP 25306 PVP 25302	2,197	224,848	5.16	1.0%
	PVP 25314	369	4,967	0.11	7.4%
	PVP 25317	4,333	17,388	0.40	24.9%
Taunton Total	**5**	**8,759**			
	PVP 2320	6,495	129,756	2.98	5.0%
Berkley	PVP 2353	2,228	15,849	0.36	14.1%
Berkley Total	**2**	**8,723**			
	PVP 8348	185	67,952	1.56	0.3%
	PVP 8324	4,517	80,935	1.86	5.6%
	PVP 8326	822	12,515	0.29	6.6%
Freetown	PVP 8286	1,302	13,391	0.31	9.7%
Freetown Total	**4**	**6,826**			
New Bedford	CVP 2647	1,289	36,463	0.84	3.5%
New Bedford Total	**1**	**1,289**			
Totals	**27**	**33,604 (0.77 ac)**			

Figure 4.14-23 shows the distribution of the percentage impacts to vernal pool habitat. Of the 20 areas impacted, 17 would lose 10 percent or less of their total vernal pool habitat, and 18 would lose 20 percent or less of their total vernal pool habitat.

Figure 4.14-23 Percent Impacts to Vernal Pool Habitat Whittenton Electric Alternative



Impacts to upland buffer habitat are defined as impacts to any naturally-vegetated upland area within 100 feet of the boundary of a vernal pool. The loss of upland buffer habitat would affect 50 vernal pools. Table 4.14-22 describes the impacts to upland buffer habitat along the South Coast Rail project corridor. Where pools are in close proximity to one another, the impacted areas of upland buffer habitat overlap. In these cases, the analysis identifies the impacts to the affected area of upland buffer habitat as a whole, and denotes which pools make up each affected area. Impacts are calculated for the loss of undeveloped land with natural vegetation that could provide non-breeding and/or migratory habitat for vernal pool amphibians. Therefore impacts calculated to upland buffer habitat did not include any areas of existing rail bed or the surrounding ballast, which were estimated by using a measurement of 10 feet to either side of the track centerline. Impacts to and total areas of upland buffer habitat also did not include any existing developed areas, including buildings and parking areas. Developed areas were estimated by using a land use data layer in the GIS analysis and subtracting any areas of development from impacted areas. No impacts to upland buffer habitat would occur in the area under the proposed trestle in Easton.

A total of 35 areas would be impacted, affecting a total of 50 vernal pools. Impacts to upland buffer habitat would be generally larger than impacts to vernal pool habitat, both in terms of area in square feet and in terms of percentage of available upland buffer habitat associated with each vernal pool or cluster of pools. The majority of impact associated with constructing new tracks and widening existing tracks and berms involves existing uplands. The percentage impacts to upland buffer habitat are therefore greatest in areas where this type of habitat is limited to berms and slopes along large wetlands or wetland complexes. For example, the largest percentage impact to upland buffer habitat is at NHESP 3 in Raynham, which would lose 66.9 percent of its upland buffer habitat. The nearby pool of PVP 20158 is approximately the same distance from the limit of disturbance as NHESP 3, but would lose only 33.0 percent of its upland buffer habitat. This lower percentage is due to the fact that PVP 20158 has additional upland area within 100 feet of the boundary of the pool, whereas the upland area within 100 feet of the boundary of NHESP 3 is mainly limited to the railroad berm.

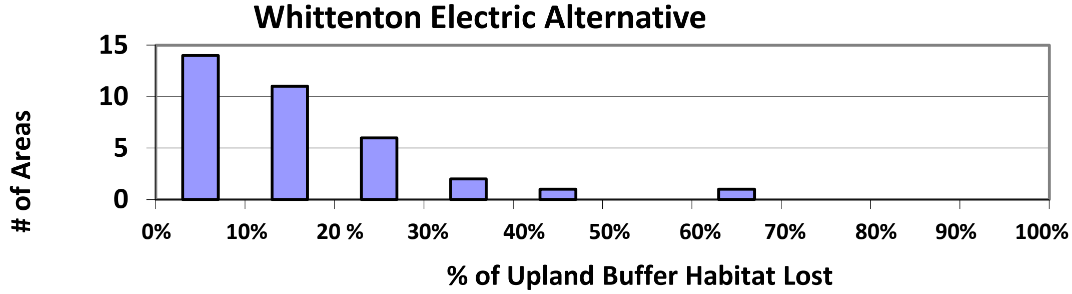
Table 4.14-22 Impacts to Upland Buffer Habitat–Whittenton Alternative

Municipality	Pools Affected	Area of Impact to Buffer Habitat (SF)	Area of Impact to Buffer Habitat (Ac.)	Total Area of Buffer Habitat (SF)	Total Area of Buffer Habitat (Ac.)	Percent of Buffer Habitat Impacted
	PVP 23791	3,773	0.09	30,166	0.69	12.5%
Stoughton	PVP 23784	24,986	0.57	129,503	2.97	19.3%
	CVP 2140	21,393	0.49	103,765	2.38	20.6%
Stoughton Total	**3**	50,152	1.15			
	PVP 7222					
	CVP 2152					
	VP-10					
	VP-3	51,658	1.19	192,509	4.42	26.8%
	PVP 7218	12,024	0.28	120,591	2.77	10.0%
	VP-6	12,348	0.28	35,510	0.82	34.8%
	CVP 2377					
	VP-11					
	VP-7	17,797	0.41	123,093	2.83	14.5%
	EA-1					
	EA-2	12,133	0.28	129,186	2.97	9.4%
	CVP 1462					
	NCVP-3	16,973	0.39	127,139	2.92	13.3%
	NCVP-2	17,764	0.41	66,665	1.53	26.6%
	CVP 1463	11,386	0.26	28,116	0.65	40.5%
	PVP 7255					
	PVP 7256	12,068	0.28	107,474	2.47	11.2%
	NHESP 1	12,684	0.29	55,629	1.28	22.8%
	CVP 1712	4,136	0.09	49,627	1.14	8.3%
	CVP 1665					
	NHESP 2					
Easton	CVP 1710	11,036	0.25	91,827	2.11	12.0%
Easton Total	**22**	192,006	4.41			
	NHESP 3	4,679	0.11	6,991	0.16	66.9%
	PVP 20158	8,947	0.21	27,104	0.62	33.0%
	PVP 20197					
	PVP 20195	4,202	0.10	156,331	3.59	2.7%
Raynham	VP-14	4,283	0.10	150,474	3.45	2.8%
Raynham Total	**5**	22,111	0.51			
	PVP 24940A					
	PVP 24940C	4,824	0.11	229,801	5.28	2.1%
	PVP 25217	2,803	0.06	27,411	0.63	10.2%
	PVP 25303	2,853	0.07	40,708	0.93	7.0%
	PVP 25306					
	PVP 25302	2,462	0.06	16,122	0.37	15.3%
	PVP 25317					
Taunton	PVP 25316	1,288	0.03	97,900	2.25	1.3%

Municipality	Pools Affected	Area of Impact to Buffer Habitat (SF)	Area of Impact to Buffer Habitat (Ac.)	Total Area of Buffer Habitat (SF)	Total Area of Buffer Habitat (Ac.)	Percent of Buffer Habitat Impacted
Taunton Total	**8**	14,230	0.33			
	PVP 2318					
	PVP 2319	18,684	0.43	75,118	1.72	24.9%
	PVP 2320	8,653	0.20	36,558	0.84	23.7%
Berkley	PVP 2353	2,367	0.05	37,870	0.87	6.3%
Berkley Total	**4**	29,704	0.68			
Lakeville	PVP 11932	5,557	0.13	237,065	5.44	2.3%
Lakeville Total	**1**	5,557	0.13			
	PVP 8348	1,717	0.04	18,615	0.43	9.2%
	PVP 8324	1,191	0.03	37,652	0.86	3.2%
	PVP 8326	969	0.02	21,773	0.50	4.5%
Freetown	PVP 8308	5,793	0.13	47,416	1.09	12.2%
	PVP 8284	6,500	0.15	47,444	1.09	13.7%
	PVP 8286	11,045	0.25	69,954	1.61	15.8%
Freetown Total	**6**	27,215	0.62			
New Bedford	CVP 2647	1,448	0.03	22,081	0.51	6.6%
New Bedford Total	**1**	1,448	0.03			
Totals	**50**	342,423	7.86			

Figure 4.14-24 shows the distribution of the percentage impacts to upland buffer habitat. Of the 35 areas impacted, 14 would lose 10 percent or less of their total upland buffer habitat, and 25 would lose 20 percent or less of their total upland buffer habitat. Ten areas would lose more than 20 percent of their total upland buffer habitat. While impacts to upland buffer habitat can affect the ability of vernal pools to sustain viable populations, all affected pools have additional upland buffer habitat or surrounding upland habitat contiguous to their impacted upland buffer habitat, with the exception of pool NHESP 3.

Figure 4.14-24 Percent Impacts to Upland Buffer Habitat Whittenton Electric Alternative



Impacts to surrounding upland habitat are defined as impacts to any naturally vegetated upland area between 100 and 750 feet of the boundary of a vernal pool. For these pools, point locations were used to represent each pool. The loss of surrounding upland habitat would affect 116 vernal pools. Table 4.14-23 lists the impacts to surrounding upland habitat along the South Coast Rail project corridor.

Where pools are in close proximity to one another, the impacted areas of buffer habitat overlap. In these cases, the impacts to the affected area of surrounding upland habitat are identified as a whole, and the pools that make up each affected area are denoted. Impacts are calculated for the loss of undeveloped land with natural vegetation that could provide non-breeding and/or migratory habitat for vernal pool amphibians. The impacts calculated for surrounding upland habitat did not include any areas of existing rail bed or the surrounding ballast, which were estimated by using a measurement of 10 feet to either side of the track centerline. Impacts to and total areas of surrounding upland habitat also did not include any existing developed areas, including buildings and parking areas. Developed areas were estimated by using a land use data layer in the GIS analysis and subtracting any areas of development from impacted areas. No impacts to surrounding upland habitat would occur in the area under the proposed trestle in Easton. For a single pool surrounded by completely undeveloped area, the total potential surrounding upland habitat would be over 40 acres.

Table 4.14-23 Impacts to Surrounding Upland Habitat–Whittenton Alternative

	Pools Affected	Area of Impact to Surrounding Upland Habitat (Ac.)	Total Area of Surrounding Upland Habitat (Ac.)	Percent of Upland Habitat Impacted
	PVP 23791	0.63	10.42	6.0%
	PVP 23778	1.72	35.57	4.8%
Stoughton	PVP 23784			
	CVP 2140	**8.63**	**54.45**	**15.9%**
Stoughton Total	4	10.98		
	PVP 7222			
	CVP 2152			
	VP-10			
	VP-3			
	PVP 7218			
	VP-6			
	CVP 2377			
	VP-11			
	VP-7			
	PVP 7220			
	PVP 7221			
	PVP 7219			
	CVP 2153			
	CVP 2154			
	PVP 7223			
	VP 2			
	VP 4	4.15	66.10	6.3%
	CVP 1827	0.19	16.37	1.2%
	EA-1			
	EA-2			
	CVP 1462			
	NCVP-3			
Easton	NCVP-2	1.39	48.56	2.9%

	Pools Affected	Area of Impact to Surrounding Upland Habitat (Ac.)	Total Area of Surrounding Upland Habitat (Ac.)	Percent of Upland Habitat Impacted
	PVP 7242			
	CVP 1463			
	PVP 7255			
	PVP 7256			
	PVP 7254			
	PVP 7324			
	PVP 7257			
	PVP 7325	1.60	46.42	3.4%
	NHESP 1	0.61	10.69	5.7%
	CVP 1712			
	CVP 1665			
	NHESP 2			
	CVP 1710	1.57	60.97	2.6%
Easton Total	36	9.50		
	PVP 20158			
	NHESP 3	0.75	4.55	16.4%
	PVP 20178			
	PVP 20179			
	PVP 20181			
	PVP 20182	1.99	56.30	3.5%
	PVP 20186			
	PVP 20189	0.40	33.67	1.2%
	PVP 20193	0.70	17.30	4.1%
	PVP 20198			
	PVP 20197			
	PVP 20195			
	PVP 20196			
	VP-14	0.54	46.89	1.2%
	PVP 20227	0.07	29.61	0.2%
Raynham	PVP 25188	0.43	21.15	2.0%
Raynham Total	16	4.88		
	PVP 25210	0.25	8.38	3.0%
	PVP 25209			
	PVP 25208	0.43	32.27	1.3%
	PVP 24940			
	PVP 24940A			
	PVP 24940C			
	PVP 25215			
	PVP 25216			
	PVP 25217	1.03	72.98	1.4%
	PVP 25227	0.01	7.32	0.1%

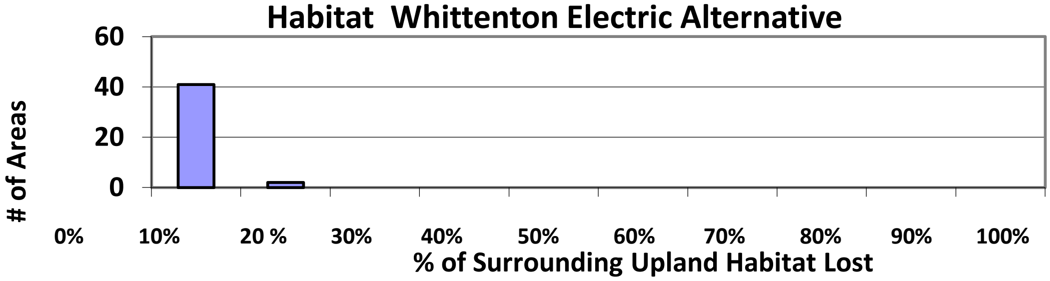
	Pools Affected	Area of Impact to Surrounding Upland Habitat (Ac.)	Total Area of Surrounding Upland Habitat (Ac.)	Percent of Upland Habitat Impacted
	PVP 25303			
	PVP 25302			
	PVP 25304			
	PVP 25305			
	PVP 25306			
	PVP 25308			
	PVP 25307			
	PVP 25309			
	PVP 25310	0.38	21.36	1.8%
	PVP 25317			
	PVP 25316			
	PVP 25315			
	PVP 25318	0.58	47.67	1.2%
	PVP 25395			
Taunton	PVP 25397	1.29	32.96	3.9%
Taunton Total	25	3.97		
	PVP 2316	0.83	21.67	3.8%
	PVP 2318			
	PVP 2319			
	PVP 2320			
	PVP 2317	1.60	62.16	2.6%
	PVP 2353	0.39	18.49	2.1%
	PVP 2354			
	PVP 2356			
	PVP 2358	0.46	31.14	1.5%
	PVP 2360	0.96	15.39	6.3%
Berkley	PVP 2361	0.02	13.79	0.1%
Berkley Total	11	4.26		
	PVP 11932	0.38	18.88	2.0%
	PVP 11931	0.20	24.75	0.8%
Lakeville	PVP 11883	0.12	8.93	1.4%
Lakeville Total	3	0.70		
	PVP 8348	0.42	14.07	3.0%
	PVP 8362	0.33	28.17	1.2%
	PVP 8324	0.17	12.42	1.4%
	PVP 8326	0.48	24.56	1.9%
	PVP 8308			
	PVP 8309			
	PVP 8310	1.34	63.30	2.1%
Freetown	PVP 8312			
	PVP 8313	0.46	29.68	1.6%

	Pools Affected	Area of Impact to Surrounding Upland Habitat (Ac.)	Total Area of Surrounding Upland Habitat (Ac.)	Percent of Upland Habitat Impacted
	PVP 8284			
	PVP 8286			
	PVP 8283			
	PVP 8285			
	PVP 8287	3.05	55.18	5.5%
Freetown Total	14	6.26		
New Bedford	CVP 1892			
	CVP 1893	0.23	34.01	0.7%
	CVP 2647			
	PVP 15554	0.28	18.42	1.5%
	CVP 2525	0.29	26.71	1.1%
	PVP 15571			
	PVP 15572	0.26	35.64	0.7%
New Bedford Total	7	1.06		
Totals	116	41.61		

A total of 43 areas would be impacted, affecting a total of 116 vernal pools. While impacts to surrounding upland habitat are larger in terms of size than either vernal pool habitat or upland buffer habitat, the overall impacts would be negligible. The large total area of surrounding upland habitat around a given pool, or more often a cluster of pools, tends to ameliorate the impacts to surrounding upland habitat in any one area. The largest percentage impact to surrounding upland habitat is around the pair of pools PVP 20158 and NHESP 3 in Raynham (Figure 4.14-25), which would lose 16.4 percent of their surrounding upland habitat. This impact is due to a combination of significant wetland areas surrounding these two pools as well as large developed areas on the eastern side of the right-of-way. The pair of pools PVP 23784 and CVP 2140 in Stoughton would lose 15.9 percent of their surrounding upland habitat from constructing the North Easton station. Impacts to pools already segregated from the right-of-way by an existing road, such as PVP 4291 in Canton, are unlikely to have any real effect on the pool in question. Conversely, in areas such as that around the pair of pools PVP 23778 and PVP 23779 in Stoughton, impacts are more likely to exclusively affect PVP 23778 due to the separation of PVP 23779 from the right-of-way, again by an existing roadway. Still, the overall effects to either pool would be very small since both have a large contiguous area of surrounding upland habitat around the pool. There are no pools or cluster of pools along the length of the Stoughton Alternative corridor that would have a large percentage of surrounding upland habitat impacted.

Figure 4.14-25 shows the distribution of the percentage impacts to surrounding upland habitat. Of the 43 areas impacted, 41 would lose 10 percent or less of their total surrounding upland habitat, and all 43 would lose less than 20 percent of their total surrounding upland habitat.

Figure 4.14-25 Percent Impacts to Surrounding Upland Habitat Whittenton Electric Alternative



Fragmentation Effects—New fragmentation effects would occur entirely in Easton, Raynham, and Taunton. One additional cluster in Freetown already has PVP 8283 separated from PVPs 8284, 8285, 8286, and 8287 by an existing maintained railway, so additional fragmentation effects are unlikely. Fragmentation is likely to have the largest effects in cases where one pool is newly separated from a cluster, or where a pair of pools is separated to create two single pools, and when the pools are close together (i.e., within 100 feet of one another). This would occur, for example, in Easton, where VP-3 is separated from a cluster of four other pools. In the areas of fragmentation listed in Table 4.14-24, there are no cases where one pool is separated from a pair or cluster without at least some extant surrounding habitat of its own.

Table 4.14-24 Fragmentation Effects–Whittenton Alternative

Municipality	Pools on Western Side of ROW	Pools on Eastern Side of ROW	Fragmentation occurs within 100 feet	Fragmentation occurs within 750 feet
Easton	VP-3	PVP 7222 CVP 2152 PVP 7223 VP-10	X	
	PVP 7219 PVP 7218 CVP 2153	CVP 2154 VP-7 CVP 2377		X
	VP-11	VP-7 CVP 2377	X	
	EA-1	EA-2	X	
	CVP 1462	NCVP-3	X	
	PVP 7255	PVP 7256	X	
	PVP 7255	PVP 7234 PVP 7257		X
Raynham	PVP 20181	PVP 20178		X

Municipality	Pools on Western Side of ROW	Pools on Eastern Side of ROW	Fragmentation occurs within 100 feet	Fragmentation occurs within 750 feet
	PVP 20179			
	PVP 20182			
	PVP 20198	VP-14		X
	PVP 20197			
	PVP 20195			
	PVP 20196			
	CVP 1971	CVP 1972	X	
Taunton	PVP 25318	PVP 25315		X
	PVP 25317			
	PVP 25316			

Table 4.14-25 presents the direct and indirect impacts to vernal pools within 750 feet of the right-of-way of the Whittenton Branch. Figures 4.14-10a and 4.14-10b show the vernal pools in proximity to the Whittenton Branch and Attleboro Secondary.

Table 4.14-25 Vernal Pool Impacts along the Whittenton Branch

Pools Directly Filled	Amount of Fill (ac)	Pools with VP Wetland Habitat Impacted	Amount of Impact (ac)	Pools with Upland Buffer Habitat Impacted	Amount of Impact (ac)	Pools with Surrounding Upland Habitat Impacted	Amount of Impact (ac)
0	0.0	0	0.0	5	0.7	17	2.8

Summary of Entire Whittenton Alternative

A total of 116 vernal pools lie along or within 750 feet of the right-of-way of the Whittenton Alternative as a whole. A total of 10 vernal pools would receive direct fill as a result of constructing the Whittenton Alternative, for a total of 0.4 acre of fill. A total of 27 vernal pools would receive fill to vernal pool wetland habitat, for a total of 0.8 acre of fill. The upland buffer habitat of 50 vernal pools would be impacted, for a total of 7.86 acres of impact. The surrounding upland habitat of 116 vernal pools would be impacted, for a total of 41.61 acres of impact. Table 4.14-26 summarizes the direct and indirect impacts to vernal pools along the Whittenton Alternative as a whole.

Table 4.14-26 Vernal Pool Impacts along the Whittenton Alternative

Pools Directly Filled	Amount of Fill (ac)	Pools with VP Wetland Habitat Impacted	Amount of Impact (ac)	Pools with Upland Buffer Habitat Impacted	Amount of Impact (ac)	Pools with Surrounding Upland Habitat Impacted	Amount of Impact (ac)
10	0.36	27	0.8	50	7.86	116	41.61

The following points summarize the impacts by municipality.

- Canton: There are no impacts in Canton. The one vernal pool within 750 feet of the right-of-way is already separated from the right-of-way by an existing roadway.

- Stoughton: Impacts in Stoughton are small. One pool (PVP 23791) would receive direct fill but has large contiguous areas of adjacent vernal pool habitat, upland buffer habitat, and surrounding upland habitat around it. No clusters of pools are present.

- Easton: Six pools would receive direct fill in Easton, although only one (PVP 7222) would lose greater than 20 percent of its area. While upland buffer habitat within 100 feet would be impacted around several pools, in all cases these pools have additional surrounding upland habitat between 100 and 750 feet away. Several clusters and pairs of pools are in close proximity to the right-of-way and would experience fragmentation both of associated habitats and of entire pools from one another. The majority of these clusters and pairs are in close association with one another (i.e., pools are within 100 feet of each other or within 100 feet of another pool in the same cluster).

- Raynham: No fill would occur to any vernal pools or to any vernal pool habitat. One pool (NHESP 3) would lose upland buffer habitat and does not have contiguous adjacent upland habitat nearby. Two clusters of pools would experience fragmentation within 750 feet, plus an additional pair of pools which would experience fragmentation within 100 feet.

- Taunton: No fill would occur to any vernal pools. Five pools would receive impact to vernal pool habitat, with one pool in particular (PVP 25317) losing 24.9 percent of its vernal pool habitat. Taunton also has some of the largest impacts to upland buffer habitat. However, in all cases these pools have additional habitat between 100 and 750 feet away. Taunton also has one cluster of pools that would experience fragmentation within 750 feet.

- Berkley: Impacts in Berkley would be small. No pools would receive direct fill, and impacts to vernal pool habitat are small. Impacts to upland buffer habitat, particularly around PVP 2318 and PVP 2319 are more significant, but these pools have additional surrounding upland habitat. No cases of fragmentation between pools occur in Berkley.

- Lakeville: Impacts in Lakeville are very small. Few vernal pools exist along the right-of-way and no pools would receive direct fill. Impacts to other associated habitats are also small, and there are no cases of fragmentation between pools.

- Freetown: One pool (PVP 8286) in Freetown would receive fill to a majority of its area, and would also receive an impact greater than 25 percent to both vernal pool habitat and upland buffer habitat. The nearby pool of PVP 8284 would also receive direct fill as well as impacts to vernal pool habitat and upland buffer habitat. In both cases these pools have additional habitat between 100 and 750 feet away. The remainder of the pools in Freetown do not receive large impacts.

- New Bedford: Impacts in New Bedford would be very small. Few pools exist along the right-of-way. No pools would receive direct impacts, and impacts to other associated habitats are small, with exception of one large impact to the upland buffer habitat of CVP 2647. However this pool has large unfragmented areas of additional surrounding upland habitat.

- Fall River: There are no impacts in Fall River.
- Overall, impacts to vernal pools along the South Coast Rail Whittenton Alternative project corridor are small and are not likely to compromise the functions of pools or communities of pools along the route. One vernal pool would lose a majority of its area (PVP 8286 in Freetown). Of the remaining pools, no pool or group of pools would lose a majority of its vernal pool habitat, upland buffer habitat or supporting upland habitat. Additionally, pools that lose areas of associated habitats have additional, larger contiguous areas of these habitats adjacent to them, with the exception of NHESP 3 in Raynham.

Fish and Wildlife Crossings—A detailed inventory of bridges and culverts was conducted to identify the location, condition, and function of each structure. Dimensions, construction materials, and railroad bed characteristics were recorded. For this biodiversity assessment, the subset of bridges and culverts with potential ecological value was determined by reviewing wetland mapping, surrounding land use (as visible in aerial photographs), and other ecological setting features (as modeled by CAPS[72]) of the complete bridge and culvert inventory. The CAPS model output indicates areas with a high (over 50 percent) Index of Ecological Integrity (IEI). No areas with a high IEI exist along the Whittenton Branch.

Most of the culverts along the Whittenton Branch currently have limited ecological function. Almost all of culverts under the Whittenton Branch right-of-way are at least 50 feet in length; the use of these culverts by wildlife for crossing the right-of-way is unlikely. The culvert connecting Wetlands RWB 02 and RWB 02.1 in Raynham is the largest culvert along the Whittenton Branch, measuring four feet wide and nearly 5 feet high, and approximately 35 feet in length. This culvert is large enough and allows enough daylight to penetrate to allow for animal passage under the right-of-way. This culvert appears to carry little water from drainage ditches along Wetland RWB-02.1 and is dry for long portions of the year. However, most of the land on the eastern side of this culvert is residential, impacting the usefulness of this culvert. At least one culvert along the right-of-way (between Wetlands TWB 09 and TWB 10) is mostly collapsed or buried, and has a reduced hydrologic function and little or no ecological function.

The bridge and most of the culverts along the Whittenton Branch alignment will be replaced to meet engineering requirements for operation of the South Coast Rail. The track design is conceptual at this stage but takes into consideration operational and safety requirements as well as the gentle elevation change requirements of a fixed guideway transit system. Railroad track elevation changes and curves must be gradual to accommodate the design requirements for a safe high speed train track. Additionally, the railroad bed must meet certain width and depth specifications (depending on the nature of the underlying ground surface) to provide proper track support and ballast drainage.

Piers or pilings supporting the existing Mill River bridge will be replaced by a single pier at the center of a two-span structure, minimizing impacts to stream hydrology and fish habitat. Existing piles would be removed and one new cast-in-place concrete pier would be constructed in the center of the span. New cast-in-place concrete abutments would be constructed behind the existing abutments, which would then be partially removed to an elevation equal to the river’s average seasonal high water elevation to improve wildlife passage.

Other Important Habitat Areas—The Whittenton Alternative crosses two large undeveloped areas that provide potentially important wildlife habitat. Near the north end of the Whittenton Branch is a large

[72] UMass Extension. 2011. CAPS Index of Ecological Integrity. http://umasscaps.org/.

undeveloped forested upland and wetland complex that includes Prospect Hill Pond. Near its south end, the Whittenton Branch crosses a large undeveloped wetland and upland complex just north of Whittenton Junction. The former right-of-way through these areas is currently used as a recreational trail for ATVs, and as an access road for a gravel pit in the southern portion. Restoring the track would create a barrier to the movement of small vertebrates, fragmenting habitat and potentially affecting genetic diversity and long-term persistence of some populations. The overhead catenary system of poles and wires would increase the width of the canopy gap, potentially affecting bird movement

Indirect Impacts of the Whittenton Electric Alternative: Stoughton/Whittenton Rail Segment

The analysis of indirect impacts evaluates the effects of the Whittenton Electric Alternative on key elements of biodiversity. Where the Whittenton Alternative's impacts on natural communities would occur entirely along the edge of, existing active rail lines, indirect impacts to natural communities, wildlife or fisheries are anticipated to be minor and restricted to the edges of these communities. The Whittenton Alternative also has the potential to cause larger indirect effects to natural communities where it would reconstruct an out-of-service rail line, particularly along the Stoughton Line south of Foundry Street in Easton, and along the Whittenton Branch from Raynham Junction to Whittenton Junction in Taunton.

Converting the out-of-service railroad alignment to active rail would increase habitat fragmentation in two areas: the Prospect Pond area and the southernmost section of the Whittenton Branch between the quarry access road and Whittenton Junction. None of these areas are mapped as Important Wildlife Habitat by DEP. Although the proposed project would not substantially increase or create a new canopy gap, and therefore would not change the existing forest interior conditions, there would be increased train activity and noise, and the raised track would impede movement of small vertebrates. Reconstructing the railroad track system at the southernmost end of the Whittenton Branch, between the quarry access road and Whittenton Junction, would increase the width of the canopy gap over the railbed to 30 feet wide in areas with single track. Although this would increase the canopy gap and create a partial barrier to vertebrate movement the adjacent areas would continue to provide moderate sized forest blocks and would sustain wildlife habitat.

Vegetation—The information and analyses presented for the Stoughton Alternative are equally applicable to this section of the Whittenton Alternative.

Habitat Fragmentation and Noise Impacts—The information and analyses presented for the Stoughton Alternative are equally applicable to this section of the Whittenton Alternative

Findings of CAPS Model—The CAPS analysis showed that the Whittenton Alternative would result in the loss of IEI units, as shown in Table 4.14-27. Not unexpectedly, the majority of the loss of connectivity (64 percent) would occur north of Weir Junction, where there is no existing rail traffic. The Hockomock trestle would have less impact on connectedness than an at-grade track as it would present less of a barrier to wildlife movement.

Table 4.14-27 Loss of Ecological Integrity–Whittenton Alternative[1]

Option	Total Loss	Loss North of Weir Junction
With Trestle	484.6	312.1
Without Trestle	492.0	319.5

1 Measured in Index of Ecological Integrity Units

Whittenton Diesel Alternative

The Whittenton Diesel Alternative would generally have the same effects on biodiversity as the Whittenton Electric Alternative. However, there would be no overhead catenary system and consequently a slightly lower impact on continuity of forest bird habitats. Because there would be no power substations, the Whittenton Diesel Alternative would result in 2.24 acres less habitat loss overall compared to the Whittenton Electric Alternative.

Stations

Station locations have remained as shown in the DEIS/DEIR, with the exception of the Stoughton Station, which was relocated to eliminate conflicts with traffic in Stoughton Center and to support downtown revitalization efforts. Additionally, the Downtown Taunton Station has been replaced by the Dana Street Station, which would be located on the east side of the railroad between the alignment and Dana Street.

Station layout, parking, grading, and drainage designs have been advanced since completion of the DEIS/DEIR at the North Easton, Easton Village, Raynham Park, Taunton, Taunton Depot, and Freetown locations. The majority of the proposed stations would be in developed areas and would not affect natural habitats or biodiversity. These stations (Battleship Cove, Easton Village, Fall River Depot, King's Highway, Taunton, Dana Street, and Whale's Tooth) are not included in this analysis. Reconstructing existing commuter rail stations (Canton, Canton Junction, Mansfield, and Stoughton) would also not affect biodiversity. The remaining stations (Taunton Depot, Freetown, North Easton, and Raynham Park) are discussed in this section.

Taunton Depot—Taunton Depot Station (Figure 4.14-26) would be a new station constructed on the Attleboro Secondary in Taunton and would serve all of the rail alternatives. The proposed station site is in a previously-disturbed area and is not within a large block of undisturbed habitat. Impacts to biodiversity would be negligible. Approximately 6.01 acres of habitat would be lost, largely cleared land (disturbed habitat).

Freetown—Freetown Station (Figure 4.14-27) would be a new train or bus station constructed to serve the Fall River Secondary for all rail alternatives. The proposed station site may fragment an already disturbed corridor of forest and fields that extends from the Copicut Road/Route 24 intersection to South Main Street, along the west side of the active freight tracks. While there is development along the frontage of South Main Street, this development has also resulted in the clearing and grading of adjacent land surrounding the development. Constructing the proposed station may fragment this area and reduce habitat value of the remaining portions. Approximately 4.33 acres of habitat would be lost, largely upland shrub habitat.

North Easton—North Easton Station (Figure 4.14-28) would be a new station constructed on the Easton/Stoughton town line. The station is proposed on the east side of the Stoughton Line right-of-way in an area partially consisting of a heavily disturbed, mostly unvegetated area, and partially within a mixed forested area. The station would be directly east of the Stoughton Memorial Conservation Lands, a large and important habitat area. Approximately 8.40 acres of habitat would be lost, largely upland forest and shrub land. Impacts to biodiversity are expected to be minimal and will result in increased edge effects surrounding the station. Minor edge effects on the adjacent conservation land could occur as a result of noise, lights and activity at the station. No mapped rare species habitats occur in proximity to the station.

Raynham Park—Raynham Park Station (Figure 4.14-29) would be a new station constructed along the Stoughton Line that would serve the Stoughton and Whittenton Alternatives. It would be constructed in a disturbed area adjacent to the north buildings of the Raynham Park. The area is mostly paved and has been previously altered. Stormwater controls will be implemented into the project design to improve the water quality of runoff leaving the site and entering the receiving waters, which flow into the Hockomock Swamp ACEC.

Effects to biodiversity are expected to be minimal from construction of this station because the station will be constructed in disturbed upland that is mostly paved. Approximately 3.25 acres of habitat would be lost, largely wooded uplands.

Layover Facilities

One of the proposed layover sites (Weaver's Cove East) would affect undeveloped land with the potential to support biodiversity and is described below. The Wamsutta site (Figure 4.14-3e) proposed along the New Bedford Main line and the mid-day layover facility planned for the Boston area would be entirely within previously developed land and do not support biodiversity.

Fall River–Weaver's Cove East—The proposed Weaver's Cove East layover facility (Figure 4.14-4b), would be located east of the Fall River Secondary in a previously-disturbed and developed area, and approximately 100 feet from the Taunton River. It is partially a brownfield site that is cleared (some foundations and roadways remain) but is mostly undeveloped. Constructing a layover facility at this location would result in the loss of 9.12 acres of plant communities, primarily upland forest and cleared land.

4.14.3.3 Temporary Construction-Period Impacts

Constructing the South Coast Rail alternatives could result in temporary, short-term impacts to biodiversity during the construction period.

Temporary Impacts

Temporary impacts include short-term disturbances to biological resources during construction that would cease once construction activities are complete. This may include, but is not limited to, installing erosion controls, establishing work areas, or installing temporary structures at stream crossings.

Potential short-term construction related impacts may include impaired ground and surface water due to sedimentation in stormwater runoff or accidental spills; displaced wildlife due to physical disturbance and noise; and plant and animal injury or death from construction equipment and activities.

Sediment discharges to surface water bodies could increase turbidity, potentially clogging the gills or feeding apparatus of aquatic organisms. Sediment accumulation on aquatic substrates could affect fish breeding habitat, or could reduce the growth of aquatic plants. Sediment discharges to vernal pools could affect the survival of aquatic larvae.

Temporary impacts to water quality during construction would be reduced or eliminated through the use of appropriate best management practices, documented in the Stormwater Pollution Prevention Plan (SWPPP) prepared and implemented in accordance with the requirements of the NPDES Construction Permit program. BMPs for erosion control would include perimeter sedimentation controls (silt fence, haybales, filter berms, siltation booms), temporary stabilization of disturbed areas, and temporary siltation basins where appropriate. The proposed project is not anticipated to result in long-term adverse effects to water quality, as the proposed design will treat runoff generated by the track prior to discharge, and will comply with all of the Massachusetts Stormwater Standards for work at the proposed stations. Compliance with the standards ensures that the proposed stations will not affect groundwater discharge that supports base streamflows, as well as protecting water quality. Following construction all construction areas will be permanently stabilized with pavement, railroad ballast, or vegetation, and will not change siltation in any waterway. None of the proposed stations would discharge runoff to a waterway.

The proposed project will not result in the loss of riparian habitat. The rehabilitation of existing commuter rail and freight rail lines will not affect riparian habitat. The restoration of out-of-service rail right-of-way through Stoughton, Easton, Raynham and Taunton will likely require that vegetation within the right-of-way, adjacent to waterways, be removed to the proposed width of the ballast (ranging from 25 to 40 feet, depending on the topography and the number of tracks). This will remove overhanging vegetation from short segments (25 to 40 feet) of Whitman Brook, Black Brook, and Pine Swamp Brook, but is not anticipated to change water temperatures as the overhanging vegetation will be replaced by a bridge, maintaining shade over the banks and channel.

The only stocked trout water is Rattlesnake Brook. No work is proposed within or adjacent to the waterway at this location, as Rattlesnake Brook is below Route 24.

Erosion and sedimentation controls along the perimeter of the railroad corridor may affect the ability of small vertebrates (amphibians, turtles, small rodents) to cross the railroad right-of-way during construction. This barrier effect would be temporary and would cease when erosion controls were removed. Coffer dams or sandbags used to allow bridges or culverts to be replaced could affect the movement of fish if the entire waterway were blocked.

Construction noise and construction activity could displace wildlife from areas adjacent to the rail or highway corridor. This impact would be temporary, and wildlife is expected to return to areas near the rail or highway corridor once construction activities cease.

Temporary Impacts–Stoughton Alternatives

The Stoughton Alternatives would have temporary impacts to terrestrial and aquatic wildlife communities along the Stoughton Line, New Bedford Main Line (north of Route 140) and the Fall River Secondary (north of the developed center of Fall River). In the absence of mitigation, these impacts could be most severe along undeveloped areas with important aquatic habitats (the Hockomock Swamp, Pine Swamp, the New Bedford Main Line through the Assonet Cedar Swamp, and the New Bedford Main Line at the boundary of the Acushnet Cedar Swamp).

Temporary Impacts–Whittenton Alternatives

The Whittenton Alternatives would have temporary impacts to terrestrial and aquatic wildlife communities along the Stoughton Line, the Whittenton Branch, the Attleboro Secondary (except through the developed center of Taunton), the New Bedford Main Line (north of Route 140) and the Fall River Secondary (north of the developed center of Fall River). In the absence of mitigation, these impacts could be most severe along undeveloped areas with important aquatic habitats (the Hockomock Swamp, Prospect Hill Pond, the New Bedford Main Line through the Assonet Cedar Swamp, and the New Bedford Main Line at the boundary of the Acushnet Cedar Swamp).

Mitigation for Construction-Period Impacts

Construction impacts to aquatic resources will be mitigated by the appropriate use of erosion and sedimentation controls to minimize and eliminate sedimentation of wetlands and waterways. Erosion and sedimentation controls would be installed before construction begins, properly maintained, and removed after disturbed areas have stabilized. A Stormwater Pollution Prevention Plan would be developed and implemented as required by the NPDES Construction General Permit. Erosion controls would be monitored and maintained throughout the construction period, and removed after disturbed areas have stabilized.

Timing of construction may affect the extent of impacts to fish and wildlife species. Disturbance of habitat during the breeding season is likely to have greater short-term or individual effects on reproductive success, though short-term effects are not likely to have long-term repercussions unless the species population is already unstable. To avoid potential short-term effects to breeding wildlife, all efforts will be taken to avoid construction during the breeding season (March through June) in Hockomock and Pine Swamps, and in areas where movement of rare species is a concern. In all cases construction will be limited to normal daylight hours. Additional measures, such as “turtle gates,” may be used in sensitive areas to allow small vertebrates to cross the right-of-way during critical breeding periods.

The vast majority of areas disturbed for construction (extending 14 feet to each side of the track centerline, for a total width of 28 feet for single track and 42 feet for double track) will be surfaced with ballast and will be within the area where vegetation must be managed for railroad safety. These areas will not be allowed to revegetate. Disturbed areas outside of the trackbed would be seeded with an appropriate stabilization seed mix using native species. These seeded areas would be expected to revegetate within one growing season.

4.14.3.4 CAPS Analysis Impacts

The results of the CAPS analysis show that the differences among the alternatives are obscured to some degree by the large sections of the routes that are common to all the alternatives. To better highlight the differences among the alternatives, the analysis computed the IEI for each alternative only for those sections that were not shared among all alternatives (i.e., excluding the Southern Triangle south of Weir Junction and tracks north of Canton Junction) (Table 4.14-28).

Table 4.14-28 Loss of Index of Ecological Integrity Units

Alternative	Direct Loss	Indirect Loss	Total Loss	Total Loss Excluding Common Elements
Stoughton with Trestle	17.6	456.9	474.5	302.0
Stoughton without Trestle	17.7	464.1	481.8	309.3
Whittenton with Trestle	17.6	467.1	484.6	312.1
Whittenton without Trestle	17.7	474.3	492.0	319.5

This analysis shows that reconstructing the tracks and re-introducing commuter rail service on the Southern Triangle (the New Bedford Main Line from Weir Junction to Whale's Tooth, and the Fall River Secondary from Myricks Junction to Battleship Cove, including stations in undeveloped areas at Taunton Depot and Freetown) would result in a decrease of 172.5 IEI Units. This represents 36 percent of the total loss for the Stoughton (with trestle) Alternative or the Whittenton Alternatives. Figure 4.14-30 shows the effect of the Southern Triangle on IEI Units. Within the Southern Triangle there is no change in connectedness among the different rail alternatives.

The Stoughton (Figures 4.14-31 and 4.14-32) and Whittenton (Figures 4.14-33 and 4.14-34) Alternatives are similar, with the Whittenton Alternatives showing a slightly higher loss of IEI Units. The trestle through the Hockomock Swamp would reduce the biodiversity effects for either the Stoughton or Whittenton Alternatives by 7 IEI Units.

The CAPS analysis shows that three metrics, connectedness, similarity, and traffic intensity, have the greatest effect on the loss of IEI Units. Connectedness, with its broader scale and integration of landscape resistance, is the most relevant metric. The change in connectedness is shown by the different color tones (darker areas = higher loss). Implementation of the rail alternatives would result in no change in connectedness within the Southern Triangle among the different rail alternatives. The higher rates of train traffic on the New Bedford Main Line and the Fall River Secondary would result in a slight decrease in connectivity through the Assonet Cedar Swamp area in Lakeville when compared to the existing connectedness (Figure 4.14-35 and Figure 4.14-36).

The Stoughton and Whittenton Alternatives would reduce connectivity in the Hockomock Swamp with a gradient ranging from major impacts close to the rail line to negligible impacts at greater distances, compared to the existing connectedness (Figure 4.14-37). Without a trestle (Figure 4.14-38), these alternatives would result in substantial losses in connectivity in the Hockomock Swamp east of the rail line, between the Raynham dog track and Foundry Street and between the rail line and Route 138, and in some areas west of the rail line. Moderate impacts would extend through much of the Hockomock, including areas east of Route 138. These impacts would be reduced by the trestle (Figure 4.14-39), with major losses restricted to a smaller area east of the rail line and north of the dog track. Impacts would also extend over a smaller area than the "no-trestle" option.

The restoration of commuter rail through Pine Swamp in Raynham, for the Stoughton Alternatives, would result in a decrease in connectivity throughout the swamp when compared to the existing connectedness (Figure 4.14-40). The effect is moderate, with some higher areas of decrease occurring west of the rail line (Figure 4.14-41).

Relevance of the CAPS Model to Mitigation and Limitations of CAPS Analysis

In November 2011 the UMass Extension Center for Agriculture published two sets of town maps based on CAPS. In conjunction with DEP, UMass produced Important Wildlife Habitat maps. In cooperation with the applicant and the Federal Highway Administration (FHWA), UMass produced IEI maps showing the 50 percent of the landscape with the highest IEI values and color-coded by habitat type (forests, shrublands, freshwater wetlands and aquatic habitats). These maps show the existing conditions and are useful in visualizing the existing important biodiversity areas. In addition, these maps are useful in identifying areas where biodiversity mitigation may be of the most value.

Because CAPS is a coarse-filter analysis based on the ecological and geospatial information available in 30 x 30 meter squares, it is not sufficiently fine-grained to evaluate the effects of specific mitigation measures such as improved culverts. The CAPS input data for stream crossings includes only three character-states: no obstruction, bridge, or culvert. Even if more fine-grained gradations of culverts were added to the data set (i.e., culverts smaller than 24 inches, culverts 24 to 48 inches, culverts wider than 48 inches) the likely change in IEI values would be negligible, given that IEI values are in the scale of acres.

CAPS is also not an appropriate tool for evaluating the effects of mitigation measures such as wetland creation, wetland restoration, or habitat protection/preservation. Because the model assesses landscape-level changes in physical conditions, a change from unprotected land to protected land does not change the IEI status of a particular area.

In addition, CAPS as applied to this project does not account for the effects of the existing railroad grade on overall landscape condition. The railroad grade has had a demonstrable impact on fragmentation, as witnessed by the fact that Atlantic white cedar habitat is confined to the west side of the right-of-way, whereas the east side is nearly monotypic red maple. This attests to the effects of the grade on hydrology and the resultant vegetation that has emerged on either side over the past century. In addition, although current use of the corridor by pedestrians and ATVs is by no means as intense as a highway with motor vehicles, these uses do have a measurable impact on the ecology of the system – most notably through ATVs leaving the corridor and crossing through vernal pools and the Atlantic white cedar swamp, on circuitous or serpentine routes. These frequent uses of the existing grade itself also serve to maintain at least a partial canopy gap, particularly north of the existing power line and also adjacent to portions of the existing Raynham Park racetrack. The CAPS analysis does not account for these effects and instead assumes that Hockomock Swamp in its current condition is one unfragmented, continuous, uniformly intact habitat. Thus while it provides a measure of the potential benefits of the trestle, CAPS seemingly overestimates and overstates the existing ecological integrity of Hockomock and Pine swamps, and thus likewise overestimates the effects of South Coast Rail on ecological integrity.

4.14.3.5 Summary of Impacts by Alternative

Each of the alternatives evaluated in this chapter would have direct effects on biodiversity associated with the loss of natural, vegetated areas, particularly wetlands or areas within important wildlife habitats. These alternatives could also have indirect impacts, particularly from constructing new tracks or restoring abandoned or out-of-service rights-of-way. These alternatives also offer opportunities to improve wildlife passage and reduce fragmentation by reconstructing existing bridges or culverts.

No-Build (Enhanced Bus) Alternative

The No-Build Alternative would not impact natural communities or biodiversity.

Stoughton Electric Alternative

The Stoughton Electric Alternative includes improvements to existing active freight or rail lines from Canton Junction to Stoughton Station, and on the two Southern Triangle segments (the Fall River Secondary and New Bedford Main Line), as well as restoring out-of-service rail line from Stoughton Station to Longmeadow Street in Taunton. This alternative would include constructing a trestle through part of the Hockomock Swamp to reduce impacts to wetlands, biodiversity, and rare species.

Areas of concern for biodiversity impacts (north of the Southern Triangle) have been identified as the Bird Street Conservation Area in Stoughton, the Hockomock Swamp, and Pine Swamp. Potential impacts could include direct loss of habitat, fragmentation (either by creating a canopy gap or reducing the ability of wildlife species, including state-listed rare species, to cross the rail bed), introduction of invasive species, or increased noise.

As shown in Table 4.14-29, the Stoughton Electric Alternative would result in the loss of approximately 182.27 acres of upland habitat and 12.3 acres of wetland habitat. This segment of the Stoughton Electric Alternative would increase habitat fragmentation (the existing rail bed, although out-of-service, has fragmented habitats and acts as a barrier to some organisms) within the Hockomock Swamp ACEC and the Pine Swamp. This barrier may affect several vernal pool complexes.

Stoughton Diesel Alternative

The Stoughton Diesel Alternative would result in similar impacts to biodiversity as the Stoughton Electric Alternative. Because it would not require electrical power substations, the Stoughton Diesel Alternative would require 3.49 acres less upland habitat loss, and 0.01 acre less wetland habitat loss when compared to the Stoughton Electric Alternative.

Whittenton Electric Alternative

The Whittenton Alternative includes improvements to existing active freight or rail lines from Canton Junction to Stoughton Station, along the Attleboro Secondary through downtown Taunton, and on the two Southern Triangle segments (the Fall River Secondary and New Bedford Main Line), as well as restoring out-of-service rail line from Stoughton Station to Raynham Junction on the Stoughton Line and along the out-of-service Whittenton Branch in Raynham and Taunton. This alternative would include constructing a trestle through part of the Hockomock Swamp to reduce impacts to wetlands, biodiversity, and rare species.

Table 4.14-29 Stoughton Electric Alternative–Summary of Impacts

	Upland Habitat Loss	Wetland Habitat Loss	Fragmentation[1]	Vernal Pool Habitat Loss	Loss of Supporting Vernal Pool Upland Habitat[2]
Total	182.27	12.3	Yes	1.43	43.40

1 Stoughton Line north of Weir Junction to Raynham Junction.
2 Loss of supporting vernal pool upland habitat includes loss of buffer habitat defined as loss of forested wetland within 100 feet of VHP, and includes loss of upland habitat defined as upland habitat loss calculated for forested upland habitat between 100 and 750 feet of a vernal pool.

Areas subject to biodiversity impacts (north of the Southern Triangle) have been identified as the Hockomock Swamp, and the Bird Street Conservation Area in Stoughton. Potential impacts could include direct loss of habitat, fragmentation (either by creating a canopy gap or reducing the ability of wildlife species, including state-listed rare species, to cross the rail bed), introduction of invasive species, or increased noise.

As shown in Table 4.14-30, the Whittenton Electric Alternative would result in the loss of approximately 187.98 acres of upland habitat and 11.2 acres of wetland habitat. This segment of the Whittenton Electric Alternative would increase habitat fragmentation (the existing rail bed, although out-of-service, has fragmented habitats and acts as a barrier to some organisms) within the Hockomock Swamp ACEC. This barrier may affect several vernal pool complexes.

The Hockomock Swamp ACEC is the only ACEC that would be impacted by the Whittenton Alternatives. Approximately 0.14 acre of vernal pool habitat, 2.31 acres of buffer habitat, and 6.12 acres of upland habitat would be impacted within the Hockomock Swamp ACEC.

Table 4.14-30 Whittenton Electric Alternative–Summary of Impacts

	Upland Habitat Loss	Wetland Habitat Loss	Fragmentation[1]	Vernal Pool Habitat Loss	Loss of Supporting Vernal Pool Upland Habitat[2]	Other
Total	187.98	11.2	Yes	0.8	41.61	—

Stoughton Line north of Weir Junction to Raynham Junction.

1 Includes impacts (fill) to vernal pools and to any wetland area within 100 feet of the boundary of a vernal pool, where the pool is within a wetland.

2 Loss of supporting vernal pool upland habitat includes loss of buffer habitat defined as loss of forested wetland within 100 feet of VHP, and includes loss of upland habitat defined as upland habitat loss calculated for forested upland habitat between 100 and 750 feet of a vernal pool.

Whittenton Diesel Alternative

The Whittenton Diesel Alternative would result in similar impacts to biodiversity as the Whittenton Electric Alternative. Because it would not require power substations, the Whittenton Diesel Alternative would require 4.11 acres less upland habitat loss, and 0.01 acre less wetland habitat loss, when compared to the Whittenton Electric Alternative.

The CAPS analysis evaluated the loss of IEI units (Index of Ecological Integrity) as a means of assessing the biodiversity effects of the alternatives. As shown in Table 4.14-31, the analysis compared the Stoughton Alternative north of Weir Junction with the Whittenton Alternative north of Weir Junction. The Whittenton Alternative would result in the direct loss of 0.1 IEI Unit more than the Stoughton Alternative, and would have a total indirect loss of IEI Units 7.2 more than the Stoughton Alternative. The CAPS analysis indicates that the Whittenton Alternative would have a greater effect on habitat connectivity and biodiversity than the Stoughton Alternative, in the segment that includes Pine Swamp.

Table 4.14-31 Loss of Index of Ecological Integrity Units

Segment	Excluding Common Route Units	Total Direct	Total Indirect
Stoughton Alternative (with trestle)	302.0	17.6	456.9
Whittenton Alternative (with trestle)	309.3	17.7	464.1
Difference	7.3	0.1	7.2

Comparison of Alternatives

A comparison of the effects of the South Coast Rail alternatives on biological diversity (plant, wildlife and fish communities and habitats) is shown in Table 4.14-32. As discussed in detail in Section 4.14.3.2 of this chapter, all Build Alternatives would result in the loss of upland habitat, wetland habitat, and vernal pool habitat (including direct and indirect impacts to vernal pools as well as supporting upland habitat used by vernal pool amphibians). All Build Alternatives, would result in habitat fragmentation and would create or exacerbate a barrier to wildlife movement.

Table 4.14-32 Summary of Environmental Consequences

Alternative	Upland Habitat Loss	Wetland Habitat Loss	Fragmentation	Vernal Pool Habitat Loss	Loss of Supporting Vernal Pool Upland Habitat
Stoughton Electric	182.27	12.3	Yes	1.43	43.40
Stoughton Diesel	178.78	12.3	Yes	1.43	43.40
Whittenton Electric	187.98	11.2	Yes	0.8	41.61
Whittenton Diesel	183.87	11.2	Yes	0.8	41.61

Stoughton Line north of Weir Junction to Raynham Junction.

Notes: Includes impacts (fill) to vernal pools and to any wetland area within 100 feet of the boundary of a vernal pool, where the pool is within a wetland.

Loss of supporting vernal pool upland habitat includes loss of buffer habitat defined as loss of forested wetland within 100 feet of VHP, and includes loss of upland habitat defined as upland habitat loss calculated for forested upland habitat between 100 and 750 feet of a vernal pool.

Diesel Alternative would result in 0.03 acre less wetland habitat loss for both the Stoughton and Whittenton Alternatives.

The Whittenton Alternative would have less wetland loss (11.2), and the least impacts to vernal pool wetland habitat (0.8 acre).

Each of the rail alternatives would result in habitat fragmentation and associated indirect effects on natural communities. The Stoughton Alternatives would fragment wetland and upland communities, particularly through the Hockomock Swamp and Pine Swamp, although the barrier effect would be reduced by constructing a trestle. The Whittenton Alternatives would fragment wetland and upland communities, particularly through the Hockomock Swamp and along the Whittenton Branch, although the barrier effect would be reduced by constructing a trestle in the Hockomock Swamp.

4.14.3.6 Mitigation

This section discusses strategies and measures that could be used to mitigate for impacts to biological diversity. Although there are no state or federal regulatory programs that establish mitigation requirements for impacts to biological diversity, the discussion below considers whether impacts to biodiversity could be avoided or minimized, and whether mitigation measures could be incorporated into the alternatives to mitigate for unavoidable impacts. No mitigation is proposed specifically for impacts to non-regulated plant, wildlife or fish communities. Mitigation for impacts to regulated resources such as wetlands, waterways, and threatened and endangered species would incorporate measures to protect and enhance the biodiversity of these resources.

Avoidance

Avoidance evaluates whether there are alternatives, or modifications to alternatives, that would avoid impacts to biodiversity.

No-Build Alternative

The No-Build Alternative, because it does not require any new construction, would avoid any impacts to plant communities, wildlife, or fisheries.

Stoughton Alternatives

The Stoughton Electric and Stoughton Diesel Alternatives require several construction elements that would impact plant communities, wildlife, or aquatic communities. Restoring the out-of-service Stoughton Line will adversely affect plant and wildlife communities, particularly in the Hockomock Swamp and Pine Swamp. The Stoughton Alternatives use the existing New Bedford Main Line and Fall River Secondary to reduce impacts to natural communities. Minor losses of vegetation and wildlife habitat along the edges of these existing rail lines cannot be avoided if the tracks are upgraded to current standards.

Whittenton Alternatives

The Whittenton Electric and Whittenton Diesel Alternatives require several construction elements that would impact plant communities, wildlife, or aquatic communities. Restoring the out-of-service Stoughton Line and Whittenton Branch will adversely affect plant and wildlife communities, particularly within the Hockomock Swamp. The Whittenton Alternatives use the existing Attleboro Secondary, New Bedford Main Line and Fall River Secondary to reduce impacts to natural communities. Minor losses of vegetation and wildlife habitat along the edges of these existing rail lines cannot be avoided if the tracks are upgraded to current standards.

Station Sites and Layover Facility Sites

Station and layover facility sites were selected to avoid impacts to sensitive biological resources, as documented in Chapter 3. Station and layover sites were placed in previously-developed upland areas wherever feasible. Where a previously-developed site was not available, these facilities were sited in upland areas that did not contain sensitive or uncommon plant communities, mapped rare species habitats, or vernal pools. Stations and layovers were located to avoid construction in unfragmented forest habitats.

Minimization

Where avoidance is not possible, impacts would be minimized to the best extent practicable. Measures to minimize direct and indirect impacts to biodiversity (plant, wildlife, and aquatic communities) will be developed as part of the mitigation for impacts to wetlands, threatened and endangered species, and water resources. In addition to other minimization measures not yet identified, these measures would include:

- Adjusting the grading to reduce the loss of plant or wildlife communities.
- Evaluating all culverts to determine whether replacing a culvert could adversely impact, or benefit, biodiversity.
- Using retaining walls to reduce the loss of unique natural communities.
- Replanting disturbed areas.
- Developing and implementing an invasive species control plan.

The Stoughton and Whittenton Alternatives were designed with specific measures to minimize habitat fragmentation. Both the Stoughton and Whittenton Alternatives include the proposed Hockomock trestle, extending for approximately 8,500 feet. The trestle would maintain habitat connectivity for small terrestrial and aquatic vertebrates and other wildlife and thus minimize impacts to biodiversity. The Whittenton Alternative would further minimize impacts to biodiversity by avoiding the Pine Swamp area in Raynham, which would be crossed by the Stoughton Alternative.

Specific Mitigation Measures

Measures to mitigate for unavoidable direct and indirect impacts to biodiversity (plant, wildlife, and aquatic communities) will be developed for the least environmentally damaging practicable alternative (LEDPA). Specific measures to mitigate for impacts to state-listed rare species are described in Chapter 4.15, *Threatened and Endangered Species.* These measures are anticipated to benefit a wide range of species in addition to the targeted species (Blanding's turtle, eastern box turtle, blue-spotted salamander). The wildlife crossings constructed along the MBTA's Greenbush Line have been shown to be used by numerous species, reducing the barrier effect of the rail.[73] Specific measures to mitigate for impacts to wetlands would be designed to enhance the ability of wetlands to provide wildlife habitat, protect fisheries, and provide aquatic habitat. In addition to other mitigation measures not yet identified, these measures could include:

- Constructing wildlife crossings.
- Enhancing or replacing habitat.
- Preserving important habitat areas.
- Developing construction phasing schedules to protect species.

Each of the alternatives presents opportunities to improve wildlife habitat, particularly by reconstructing existing culverts or bridges to improve wildlife or fish passage and reduce fragmentation. In addition, the CAPs model can be used as a tool to contribute to the optimization of mitigation by enhancing the area of land with high IEI values and connectedness.

Fisheries

With the exception of the Taunton River and Cedar Swamp River bridges, all of the existing bridges are single-span bridges supported on stone abutments. Most of these bridges will be replaced by installing new abutments behind (landward) of the existing abutments to widen the bridge opening and provide an upland shelf for wildlife passage. Some replaced bridges will use new abutments at existing abutment locations. In-water work is restricted to removing the existing abutments and adding riprap, if necessary to stabilize the new shoreline. Erosion and sediment controls will be used to protect water quality. The Taunton River and Cedar Swamp River Bridges are multi-span bridges supported by steel pilings or piers in the river. Replacing these bridges will require that the new abutments be replaced by installing new abutments behind (landward) of the existing abutments to widen the bridge opening and provide an upland shelf for wildlife passage. New piers or pilings will be installed to support the new bridge structure, and the existing pilings will be removed. At the current conceptual design stage, it has not

[73] Pelletier SK, Carlson L, Nein D and Roy RD. 2006. Railroad crossing structures for spotted turtles: Massachusetts Bay Transportation Authority– Greenbush rail line wildlife crossing demonstration project. IN: Proceedings of the 2005 International Conference on Ecology and Transportation, Eds. Irwin CL, Garrett P, McDermott KP. Center for Transportation and the Environment, North Carolina State University, Raleigh, NC: pp. 414-425.

been determined if new pilings would be driven (from cranes located on shore or on barges) or if coffer dams would be required to install caissons. In-water work would be required for these bridges, as well as the in-water work needed to remove the existing abutments and add riprap, if necessary to stabilize the new shoreline. Erosion and sediment controls, including in-water sediment booms, will be used to protect water quality.

With the exception of the Taunton River, the applicant will generally be expected to observe the TOY restrictions recommended by the DMF for in water work as shown in Table 4.14-33. In general, these TOY restrictions would preclude in-water work from March 15 to June 30. Work outside of the waterway (on the bridge superstructure or on the new abutments) would not be subject to TOY restrictions. No TOY restrictions would be applicable to the Rattlesnake Brook bridge, which crosses over Route 24 (Rattlesnake Brook is below Route 24) or to Queset Brook, where bridge work would replace the superstructure only. DMF's suggested TOY restrictions for the Taunton River would allow only a 2-month, winter, work period for reconstruction of each of the four Taunton River bridges. This short construction period does not allow sufficient time to complete the installation of bridge supports. The applicant will coordinate with DMF to identify TOY restrictions and/or construction methods for the Taunton River that is adequate to protect fish spawning while allowing bridge construction to be completed.

Table 4.14-33 Massachusetts Division of Marine Fisheries-Recommended Time-of-Year Restrictions on In-Water Work

Waterway	Proposed Construction	Diadromous Fish Species	Time of Year Restriction
Assonet River	Reconstruct bridge – replace abutments to provide wider opening for fish and wildlife	Alewife, American eel, blueback herring, rainbow smelt, white perch	Jan. 15 to Nov. 15
Cedar Swamp River	Reconstruct two bridges – replace abutments to provide wider opening for fish and wildlife	American eel	March 15 to June 30
Cotley River	Reconstruct bridge – replace abutments to provide wider opening for fish and wildlife	American eel	March 15 to June 30
Fall Brook	Reconstruct bridge – replace abutments to provide wider opening for fish and wildlife	Alewife, American eel, blueback herring, white perch	March 15 to June 30, Sept. 1 to Nov. 15
Terry Brook Pond	Replace culvert to maintain hydrology and improve fish passage	American eel	March 15 to June 30
Black Brook	Construct new bridge (where old culvert washed out); replace 2 culverts. Design to improve fish passage.	American eel	March 15 to June 30
Mill River	Reconstruct bridge – replace abutments to provide wider opening for fish and wildlife	Alewife, American eel, blueback herring	Feb. 15 to June 30, Sept 1 to Nov. 15
Pine Swamp Brook	Reconstruct bridge – replace abutments to provide wider opening for fish and wildlife	American eel	March 15 to June 30
Rattlesnake Brook	Replace bridge over Route 24, no work in or adjacent to water	Alewife, American eel, blueback herring, rainbow smelt	None required – no work in water.

Waterway	Proposed Construction	Diadromous Fish Species	Time of Year Restriction
Queset Brook	Reconstruct bridge – retain existing historic abutments	American eel	None required – no work in water
Taunton River	Reconstruct four bridges – replace abutments to provide wider opening for fish and wildlife, reduce number of piers in the waterway.	Alewife, American eel, American shad, Atlantic sturgeon, blueback herring, rainbow smelt, white perch	Jan. 15 to Nov. 15
Whitman Brook	Reconstruct bridge – replace abutments to provide wider opening for fish and wildlife	American eel	March 15 to June 30

Breeding Bird Diversity

The National Migratory Bird Treaty is cited in the Secretary's Certificate as the trigger for mitigation measures to protect nesting birds. The Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712, as amended) states that, unless permitted by regulations, it is illegal to "pursue, hunt, take, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer for purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time or in any manner, any migratory bird, included in the terms of this Convention … or any part, nest, or egg of such bird." As the U.S. Fish and Wildlife Service (USFWS) states, "we regulate most aspects of the taking, possession, transportation, sale, purchase, barter, exportation, and importation of migratory birds."

The USFWS does not, through the Migratory Bird Treaty Act, explicitly prohibit or regulate the incidental take of birds, bird nests, or bird eggs caused by land clearing. However, in response to the Secretary's Certificate, the applicant will not undertake vegetation removal in critical areas (Pine Swamp, Hockomock Swamp, Assonet Swamp, Acushnet Swamp) during the nesting season for migratory birds (May 1 through July 15).

Vernal Pools

Impacts to vernal pools and to their associated habitat created by the South Coast Rail project include direct fill of some vernal pools and decreases in vernal pool habitat, buffer habitat, and surrounding upland habitat. This section summarizes the potential avoidance, minimization, and mitigation measures to offset the impacts to vernal pools. During final design, additional field data will be collected to determine whether Potential Vernal Pools actually support breeding pool species, better define the limits of actual breeding pools, and refine the potential to make existing pools larger or create new pools near those it be impacted.

Avoidance—One of the most practicable ways to avoid impacts, particularly at locations where direct fill to vernal pools is small, is by slope modification in the final design phase of the project. Slope modification could include redesign of grading to create steeper slopes, including retaining walls, or a combination of both.

One of the largest avoidance measures of the South Coast Rail project is the trestle portion of rail (approximately 8,500 feet long) over the majority of Hockomock Swamp. The trestle would avoid direct and indirect impacts to 9 vernal pools in Easton. In addition, the trestle would avoid impeding wildlife, including small amphibians, moving between pools across the existing berm. The trestle will avoid fragmentation of two clusters of pools in Easton: a cluster of five pools (CVPs 1660 through 1664) at the northern edge of the Hockomock Swamp area, and an additional cluster of three pools (CVPs 1665 and 1710, NHESP 2) just to the north of the first cluster.

Minimization—Where avoidance is not possible, impacts would be minimized to the maximum extent practicable. Minimization efforts generally employ the same strategies as avoidance; final design for the project would include some of the same design elements to minimize impacts such as steeper slopes and retaining walls where practicable.

Wildlife Passage—One of the most effective ways to mitigate for habitat fragmentation caused by constructing new tracks and widening existing berms is to construct wildlife crossings and replace existing culverts to allow for the passage of small amphibians across the right-of-way. These wildlife crossings and culvert upgrades can help to reconnect pools that are likely to experience fragmentation from a larger cluster of pools, such as VP 13 in Easton (Figure 4.14-7c). Wildlife crossings and culvert upgrades can also serve to reestablish former connectivity between areas where existing culverts have failed or collapsed, such as between EA-1 and EA-2 in Easton (Figure 4.14-7c). Crossings would be placed in areas where habitat fragmentation is most likely to occur, at or near areas where clusters of vernal pools exist.

Protection—Potential mitigation measures also include purchasing land containing vernal pools or placing a conservation restriction on land containing vernal pools. These areas, as well as any associated vernal pool habitat, buffer habitat, and surrounding upland habitat, would be protected from further encroachment by these measures. This type of mitigation would likely be most effective if a cluster or highly active area of vernal pools were purchased or placed under protection. For example, a cluster of vernal pools in Easton is present on land owned by the Southeastern Regional Vocational Technical High School; this cluster includes pools CVPs 1660, 1664, and 1661. Land on the opposite side of the right-of-way is owned by the Town of Easton and includes CVPs 1663 and 1662. Another cluster of pools including PVP 7222, CVP 2152, PVP 7233, and VP 10 is present in North Easton on land under private ownership. The applicant will work with these adjacent landowners to protect vernal pools adjacent to the right-of-way at these locations through conservation restrictions or similar measures.

Protecting existing vernal pool areas can also come through discouraging public abuse of the area. Impacts to vernal pools along the right-of-way are currently occurring as a result of human use of the right-of-way, particularly on abandoned portions of track. Human traffic along trails around vernal pool areas can affect the use of pools by obligate vernal pool species. In particular, ATV users ride through vernal pool areas late in the season when the pools become shallower and begin to dry out. This can increase mortality both of the developing young amphibians in the pool and juveniles leaving the pool. Much of this ATV use occurs along the abandoned portion of track in Easton. The trestle will discourage ATV riders from using that portion of the berm, since the physical presence of the trestle will make riding along that section of the berm impossible. ATV use has also damaged vernal pools on the Southeastern Regional School and Town of Eason land south of Foundry Street. The applicant will work with these landowners to identify protection measures, potentially including fencing, to protect these pools.

Habitat Enhancement—Impacts to vernal pools and their associated habitats can also be mitigated by enhancing remaining habitats and creating new habitats. For pools that are filled completely, new pools can be created, where feasible, in nearby areas. For example, VP 13 in Taunton lies in the right-of-way and would be completely filled. The two adjacent parcels on either side of the right-of-way consist of undeveloped land under the same private ownership. As with placing existing pools under protection, the applicant would work with adjacent landowners to identify and pursue constructing these replacement areas where appropriate.

Properly-constructed vernal pools will replicate the hydrology and functions of a filled pool in most cases,[74] and field techniques exist for simulating hydrological conditions when constructing pools, such as through the use of liners in more permeable soils.[75] The substrate of the vernal pool to be filled contains much of the organic matter that supports the food web associations of the pool. When creating a new vernal pool, the substrate of the existing pool can be taken from the pool before it is filled and transplanted to the new pool to aid in its establishment.

Expansion of existing vernal pools that would receive fill is one potential option for mitigating vernal pool impacts. Conceptually, vernal pool enlargement would expand the area of potential breeding habitat for vernal pool species including individual animals displaced by the fill. However, creating the expanded area would require either the disturbance (at least temporarily) of additional vernal pool habitat wetlands, or existing upland buffer. In addition, it would be necessary to ensure that vernal pools are constructed/expanded well-removed from developed areas where vernal pool species are more susceptible to predation by raccoons and domesticated animals. In general, it is expected that this option would be applied on a limited basis, and that the resulting constructed vernal pools would be closely monitored to ensure their ultimate success as viable habitats for vernal pool-dependent fauna.

Plantings around pools can help maintain healthy vernal pool ecosystems. New shrub and tree plantings in areas where pools would receive impact would help native vegetation reestablish itself. Once mature, areas of plantings would contribute additional leaf litter and other detrital inputs, and would help shade the pool and regulate its temperature. Plantings would be especially appropriate in areas where the existing surrounding vegetation contains invasive or other low-value species, such as purple loosestrife or common reed. These areas would benefit from plantings that would return the area to a more natural vernal pool habitat such as a red maple swamp, shrub swamp, or emergent marsh. As a possible example, VP 10 in Easton (Figure 4.14-7b) is a vernal pool that would receive direct fill, but that has both upland and wetland habitats adjacent to it and within 100 feet of its boundary. The wetland area surrounding VP 10 is a forested wetland associated with Whitman Brook to the south. Plantings at the edge of disturbance of this pool consistent with a forested wetland – for example, red maple would be potentially appropriate. Plantings would need to be consistent with vegetation management policies maintained by the railway operators. For example, trees should not be planted at the edge of a berm where, when mature, they would encroach upon the right-of-way. In the example of VP 10 above, as an alternative to red maple trees, areas at the edge of the right-of-way could be planted with native shrubs such as buttonbush (Cephalanthus occidentalis) to enhance the habitat of the area.

[74] De Weese, J.M. Vernal Pool Construction Monitoring Methods and Habitat Replacement Evaluation. *Ecology, Conservation, and Management of Vernal Pool Ecosystems – Proceedings from a 1996 Conference*. California Native Plant Society, Sacramento, CA, 1998 pp. 217-223.

[75] Biebighauser, T.R. 2002. *A Guide To Creating Vernal Ponds*. USDA Forest Service.

Fish and Wildlife Passage

This section describes the methodology for assigning mitigation and the recommended mitigation measures to enhance biodiversity by improving certain South Coast Rail bridges and culverts to facilitate wildlife and fish passage through the railroad bed.

Types of Wildlife and Fish Crossings—Wildlife and fish crossings vary according to the species addressed and the physical characteristics of the crossing locations. Wildlife, being more broadly mobile than fish, can use a wide range of crossing types. Depending on an animal's mobility, it may cross directly over the tracks unimpeded (but at risk for collision with trains), cross over tracks on overpasses, or cross under the tracks at bridge, culvert or trestle locations. Physical size or behavioral characteristics can affect animals' ability to use these crossings. Large mammals such as deer are unable to fit through small structures or those filled with water, and generally unwilling to enter structures that they cannot see through. Overpasses or large-opening underpasses are the best types of crossings for these animals. Small reptiles such as turtles may be blocked by rails (or become trapped between two rails) or unable to negotiate culverts with rapidly flowing water. Culverts that duplicate natural stream conditions, or tunnels that provide dry passage, are the best types of crossings for these animals. Between-tie open-top crossings at the ground surface may allow trapped reptiles to escape. Drift fences may prevent direct track crossing or guide turtles and other animals to crossing locations.

Fish are constrained to rivers, streams, and ponds, and therefore must use crossings that convey water through or under the railroad bed (e.g., culverts or bridges) at appropriate depths and flow rates. Culverts that mimic up- and downstream conditions of slope, substrate, and water volume provide the best crossings through the railroad bed for fish. Bridges do not typically affect fish passage.

Numerous guidance documents about structures that facilitate fish and wildlife passage across linear facilities (whether roads or railroads) have been prepared by or for federal and state fish and wildlife, land management, and transportation agencies. The *Massachusetts River and Stream Crossing Standards,* [76] developed by a partnership of agencies and other stakeholders, are most applicable to the bridges and culverts along the Stoughton Alternative. The *Wildlife Crossing Structure Handbook* [77] (the Handbook) provides guidance on amphibian tunnels and drift fences that is useful for between-tie structures. Guidelines for bridges and culverts, tunnels, and drift fences from these sources are summarized in the next sections. Wildlife overpasses have generally been used more frequently in the west, and are not appropriate for the South Coast Rail project because large mammals (moose, elk, bighorn sheep) are not present and wildlife that are present can use culverts or bridges, or cross tracks directly with little danger from the infrequent South Coast Rail trains.

[76] River and Stream Crossing Partnership. 2011. *Massachusetts River and Stream Crossing Standards*. The University of Massachusetts- Amherst (College of Natural Sciences), The Nature Conservancy, Massachusetts Division of Ecological Restoration- Riverways Program, American Rivers, and others. August 2004; revised March 1, 2006; revised March 1, 2011; corrected January 31, 2012.

[77] US Federal Highway Administration. 2011. *Wildlife Crossing Structure Handbook: Design and Evaluation in North America*. Publication No. FHWA-CFL/TD-11-003. Lakewood, CO: US Department of Transportation, Federal Highway Administration, Central Federal Lands Highway Division.

River and Stream Crossing Standards for Bridges and Culverts—The Massachusetts River and Stream Crossing Standards[78] (the Standards) are intended for fish-bearing streams but can be applied to other areas where wildlife species that use riparian habitat are present. The Standards seek to achieve:

- fish and other aquatic organism passage;
- river and stream continuity; and
- wildlife passage.

The Standards state that full "aquatic organism passage" is achieved when a crossing allows unrestricted movement of all aquatic organisms indigenous to the water body. "Aquatic organism" means fish and the aquatic life stages of other vertebrates (amphibians), and aquatic invertebrates including small benthic fauna that typically reside within the stream substrate. "Unrestricted movement" means that all individuals and all life stages are able to move through the structure as freely as they can through the natural stream channel and without delays or obstructions caused by the crossing structure. Crossing structures that achieve full aquatic organism passage are expected to maintain natural river hydrology and transport sediment and woody debris.

The Standards acknowledge that it is impractical to use a species-based approach for designing stream crossings because the ideal design for one species may differ from the ideal for another species occupying the same habitat. It is more practical to recreate natural stream conditions and allow resident species to use the crossing as if it were an unaltered segment of the stream. The Standards therefore use a "Stream Simulation" [79] approach for crossing design. According to the Standards,

> "Stream Simulation is an ecosystem-based approach that focuses on maintaining the variety and quality of habitats, the connectivity of river and stream ecosystems, and the essential ecological processes that shape and maintain these ecosystems over time. Stream Simulation is a design approach that avoids flow constriction during normal conditions and creates a stream channel that maintains the diversity and complexity of the streambed through the crossing. Crossing structures that avoid channel constriction and maintain appropriate channel conditions (channel dimensions, banks, bed, and bed forms) within the structure should be able to accommodate most of the normal movements of aquatic organisms, and preserve (or restore) many ecosystem processes that maintain habitats and aquatic animal populations. The goal is to create crossings that are essentially "invisible" to aquatic organisms by making them no more of an obstacle to movement than the natural channel."

General or Optimum standards are provided to balance the cost and logistics of crossing design with the degree of river/stream continuity warranted in areas of different environmental significance. General standards are applicable for crossings on rivers or streams (including intermittent streams) serving as habitat for fish and semi-aquatic wildlife that typically live within stream channels (salamanders, turtles). These crossings should at least pass most fish species, maintain river/stream continuity, and facilitate passage for some wildlife. The Optimum standards are applicable for stream crossings in areas

[78] River and Stream Crossing Partnership. 2011. Massachusetts River and Stream Crossing Standards. The University of Massachusetts- Amherst (College of Natural Sciences), The Nature Conservancy, Massachusetts Division of Ecological Restoration- Riverways Program, American Rivers, and others. August 2004; revised March 1, 2006; revised March 1, 2011; corrected January 31, 2012.

[79] US Forest Service. 2008. *Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings.* Available on the internet at http://www.stream.fs.fed.us/fishxing/aop_pdfs.html.

of particular statewide or regional significance for their contribution to landscape level connectedness. In addition to the aquatic species benefits provided by the General standards, the Optimum standards better accommodate terrestrial wildlife.

The General standards are:

- Spans (bridges, 3-sided box culverts, open-bottom culverts or arches) that preserve the natural stream channel are strongly preferred over structures with a closed bottom.
- If the crossing is a box culvert (with a closed bottom), then it should be embedded:
  - A minimum of 2 feet below the substrate for all culverts, and
  - A minimum of 2 feet below the substrate and at least 25 percent of the total area for round pipe culverts.
- When embedment material includes elements greater than 15 inches in diameter, embedment depths should be at least twice the D84 (particle width larger than 84 percent of particles) of the embedment material.
- The structure should span the channel a minimum of 1.2 times the bankfull width in order to avoid channel constriction during normal bankfull flows. The bankfull width should be measured at straight sections of the channel outside the influence of existing structures and unusual channel characteristics.
- The substrate within the structure should match the characteristics of the substrate in the natural stream channel (mobility, slope, stability, confinement) at the time of construction and over time as the structure has had the opportunity to pass significant flood events.
- The structure floor should be designed with appropriate bed forms and streambed characteristics so that water depths and velocities are comparable to those found in the natural channel at a variety of flows.
- The structure should have an openness ratio of greater than 0.82. The openness ratio is the cross-sectional area of a structure opening divided by its length. For structures with multiple cells or barrels, openness is calculated separately for each cell or barrel, at least one of which should meet the appropriate openness standard. The embedded portion of a box culvert is not included in the calculation of cross-sectional area for determining openness.
- Banks should be present on each side of the stream matching the horizontal profile of the existing stream and banks. All constructed banks should have a height to width ratio of no greater than 1:1.5 (vertical: horizontal) unless the stream is naturally incised. The banks should be designed and constructed so as not to hinder riverine wildlife use of the streambed and banks for passage.

The Optimum standards' application to areas of particular statewide or regional significance recognizes their contribution to landscape level connectedness. The Optimum standards define these significant areas as including rivers or streams and associated riparian areas that serve as corridors or connecting habitat-linking areas of significant habitat (greater than 250 acres) in three or more towns. Although not directly comparable to the IEI values represented by the CAPS analysis, the Optimum standards' concept of significant areas as large tracts of minimally altered landscapes is similar. The Optimum standards have three modifications of the General standards:

- Bridges are specified, instead of open spans. (The "embedded culvert" standard is omitted from the Optimum standards, as it is not needed for bridges.)
- A minimum height of 8 feet (2.4 meters) and openness ratio of 2.46 should be maintained if conditions are present that significantly inhibit wildlife passage (high traffic volumes, steep embankments, fencing, Jersey barriers or other physical obstructions). If conditions that significantly inhibit wildlife passage are not present, a minimum height of 6 feet (1.8 meters) and openness ratio of 1.64 should be maintained.
- Banks should be present on each side of the stream matching the horizontal profile of the existing stream. The portion of the structure over the banks should have sufficient headroom to provide dry passage for semi-aquatic and terrestrial wildlife.

Both the General and Optimum standards are applicable for constructing new and replacing existing culverts and bridges, depending upon the landscape as described above. Culvert replacement offers a better opportunity to integrate the Standards. The Standards' recommendations for replacing existing culverts are summarized in the following paragraphs.

Replacement culverts should meet the design guidelines for either General standards or Optimum standards unless:

- Doing so would result in significant stream instability that cannot otherwise be mitigated;
- Meeting the Standards would create a flooding hazard that can't otherwise be mitigated; or
- Site constraints make it impossible to meet the Standards.

If it is not possible to meet all of the applicable Standards, replacement crossings should be designed to avoid or mitigate the following problems:

- Inlet drops – occur where water level drops suddenly at an inlet, causing changes in water speed and turbulence. In addition to the higher velocities and turbulence, these jumps can be physical barriers to fish and other aquatic animals when they are moving upstream and are unable to swim out of the culvert.
- Outlet drops – occur when water drops off or cascades down from a structure outlet, usually into a receiving pool. This may be due to the original culvert placement, erosion of material at the area immediately downstream of the culvert, or downstream channel adjustments that may have occurred subsequent to the culvert installation. Outlet drops are barriers to fish and other aquatic animals that can't jump to get up into the culvert.
- Flow contraction that produces significant turbulence – occur when a culvert or other crossing structure is significantly smaller than the stream width the converging flow creates a condition called "flow contraction." The increased velocities and turbulence associated

with flow contraction can block fish and wildlife passage and scour bed material out of a crossing structure. Flow contraction also creates inlet drops.

- Tailwater armoring – consist of concrete aprons, plastic aprons, riprap or other structures added to culvert outlets to facilitate flow and prevent erosion.

- Tailwater scour pools – are created downstream from high flows exiting the culvert. The pool is wider than the stream channel and banks are typically eroded. Some plunge pools may have been specifically designed to dissipate flow energy at the culvert outlet and control downstream erosion.

- Physical barriers to fish and wildlife passage – these barriers include any feature that physically blocks fish or wildlife movement through a crossing structure as well as features that would cause a crossing structure to become blocked. Beaver dams, debris jams, fences, sediment filling a culvert, weirs, baffles, aprons, and gabions are examples of structures that might be or cause physical barriers. Weirs are short dams or fences in the stream that constrict water flow or fish movements. Baffles are structures within culverts that direct, constrict, or slow down water flow. Gabions are rectangular wire mesh baskets filled with rock that are used as retaining walls and erosion control structures. Steeply sloping channels within a structure resulting in shallow flows and/or high velocity flows can also inhibit movement of fish and other aquatic organisms.

Other design guidelines for replacing culverts are:

- Avoid pipes that are too smooth (as defined by the Standards) so as to facilitate upstream migration of aquatic organisms.

- As indicated by long profiles, scour analyses, and geomorphological assessments, design the structure and include appropriate grade controls to ensure that the replacement will not destabilize the river/stream.

- To the extent practicable conduct stream restoration upstream and/or downstream of the structure as needed to restore river/stream continuity and eliminate barriers to aquatic organism movement.

Guidelines for Other Crossing Structures—Tunnels (similar to small culverts but without a hydrologic function) and between-tie crossings provide crossing opportunities for small mammals, reptiles, and amphibians in upland locations where culverts or bridges are not located. Between-tie crossings also allow animals that become entrapped between rails to enter the structure and escape underneath the rails.

Reptiles and amphibians have special requirements for wildlife crossing design since they are unable to orient their movements to locate tunnel or between-tie crossing entrances. Drift fences play a critical function in intercepting amphibians and reptiles, directing them to the crossing structures. The Handbook provides guidance on tunnel and drift fence design for structures underneath roadways; the guidelines, as adapted for railroad beds and applied to between-tie crossings, are:

- Large tunnels provide good airflow and natural light conditions for reptiles and amphibians to pass through in a natural-appearing environment.

- Tunnels and between-tie crossings should be sited in known routes of seasonal migration, dispersal or other movement events for the target species. Reptiles and amphibians are not likely to use these structures unless they are located in migratory routes, within preferred habitat, or in general area where dispersal events may occur.

- Continuous habitat or vegetative cover leading to the structure should be provided. The area may need to be re-vegetated after construction to restore habitat conditions and provide important cover during migrations and other movement events.

- The floors of the structures should be covered with native soil (sandy loam if possible) to provide a more natural substrate for travel, placed in continuity with the ground surface in the area. In migration route areas, the distance between tunnels or between-tie crossings should be 150 feet (45 meters) or less, but a 200 foot (60 meter) distance could be used if drift fences are funnel-shaped to guide amphibians to the structure, as described in the following section. The structures should be level and designed to conform to local topography, but drainage should be directed away from the structures to prevent flooding within.

- Tunnels may be rectangular or circular in cross-section; between-tie crossings are rectangular in cross-section. Prefabricated rectangular and square/box designs are preferred because vertical walls facilitate the movement of amphibians and reptiles through the structure. Pipes are not desirable because the animals may attempt to climb the slope of the wall instead of proceed through the structure. The cross-section of an amphibian and reptile tunnel should increase with tunnel length, as recommended in Table 4.14-34. Surface materials may be prefabricated concrete or polymer. Metal is not desirable because of its high thermal conductivity and resulting coldness, especially during spring migratory periods.

Table 4.14-34 Tunnel Dimension Recommendations

	Tunnel Length (feet)				
Type	**<65**	**65-100**	**100-130**	**130-165**	**165-200**
Rectangular (width X height)	3.2 X 2.5	5.0 X 3.2	5.75 X 4.0	6.5 X 5.0	7.5 X 5.75
Circular (diameter)	3.2	4.5	5.25	6.5	8.0

Source: US Federal Highway Administration. 2011. Wildlife Crossing Structure Handbook: Design and Evaluation in North America.

- Between-tie crossings are open-top to allow animals trapped between rails to escape underneath the rails in a 7- to 8 inch deep trough. These structures should be rectangular and include a natural material bottom. The dimensions of between-tie crossings are constrained by the distance between the ties and limited to the length of the ties.

- Funneling walls of limited length should be constructed to direct animals to between-tie crossings. Lengthy drift fences (as described below) would not be associated with between-tie crossings; there would be a risk that animals could get trapped between the drift fence and the rails. For the same reason, between-tie crossings would not be installed where drift fences are associated with tunnels or culverts.

Recent experience on the MBTA's Greenbush Line provides insight on between-tie crossing value for turtles. In association with the Greenbush Line Commuter Railroad Restoration Project, the MBTA initiated a demonstration project in spring of 2003 to determine the effectiveness of a proposed railroad crossing structure in an urbanized landscape.[80] Three identical, open-air prototypes were positioned in the right-of-way of a former railroad bed between adjacent wetlands known to support turtles. Each structure was linked with temporary funneling barriers along the track edges.

To evaluate the effectiveness of the structures, remote photographic stations were established at each crossing, and radio telemetry was used to track turtle movements. Study results demonstrated that turtle crossing patterns and frequency through the right-of-way during the monitoring period were similar to those prior to when the barrier was constructed. The crossings were also used by other wildlife species, including reptiles (eastern garter snake [*Thamnophis sirtalis*]) , amphibians (green frog [*Rana clamitans*]), birds (wood duck [*Aix sponsa*], mallard [*Anas platyrhynchos*]), and mammals (coyote [*Canis latrans*], gray fox [*Urocyon cinereoargenteus*] , muskrat [*Ondatra zibethicus*], longtailed weasel [*Mustela frenata*], eastern cottontail [*Sylvilagus floridanus*], raccoon, striped skunk [*Mephitis mephitis*], opossum [*Didelphis virginiana*], eastern grey squirrel [*Sciurus carolinensis*], eastern chipmunk [*Tamias striatus*], mouse species). The demonstration project concluded that the location and design of the crossing structures provided an effective means of maintaining habitat connectivity for a variety of wildlife species, including turtles (spotted, snapping, and painted turtles). As part of the Conservation and Management Plan developed for the Greenbush Line, 45 wildlife crossing structures, with funneling walls, were installed at key locations along the right-of-way. The type of crossing structure used on the Greenbush Line is largely open to ambient conditions and, therefore, most effective in mimicking the natural conditions typically encountered by turtles (e.g., substrate, moisture, temperature, light).

Guidelines for Drift Fences—Drift fences are used to prevent small animals (reptiles and amphibians in particular) from entering the track area and to direct them to crossing locations. The following design guidelines offered by the Handbook have been adapted to the specific characteristics of a railroad such as the South Coast Rail.

- Drift fences should be installed at the base of the railroad bed slope, tied into the culvert or tunnel entrance and avoiding any surface irregularities that might impede or distract movement towards the entrance.
- Wing walls should angle out from each end of the culvert or tunnel at approximately 45 degrees to orient animals that move away from the structure towards natural environment.
- Drift fences should be 1.25 feet (0.4 meter) high and must be entirely opaque, of smooth fabric (rigid plastic, polythene, canvas) and with vertical walls. Fences made of translucent material or wire mesh are not recommended because some amphibians try to climb over them instead of moving towards the structure. Bowed or curved walls can obstruct the travel of some amphibians moving towards the structure. Stakes should be placed on the railroad side of the drift fence and not the opposite, which would obstruct amphibian movement.

[80] Pelletier SK, Carlson L, Nein D and Roy RD. 2006. Railroad crossing structures for spotted turtles: Massachusetts Bay Transportation Authority– Greenbush rail line wildlife crossing demonstration project. IN: Proceedings of the 2005 International Conference on Ecology and Transportation, Eds. Irwin CL, Garrett P, McDermott KP. Center for Transportation and the Environment, North Carolina State University, Raleigh, NC: pp. 414-425.

- To prevent breaching by climbing amphibians and reptiles, fence designs that are concave or create an overhang or lip have been used successfully. Fencing should be clear of obstructions and vegetation. Overhanging vegetation close to the fence has resulted in animals climbing over the fence onto the railroad.

The bottom section of the drift fence should be secured to ground, not leaving any gaps.

Methodology for Assigning Mitigation—Each of the bridge and culvert locations was reviewed to determine the ecological value of the passage and the suitability of applying the Standards and other mitigation measures, taking into consideration the engineering constraints described previously for the proposed bridge and culvert replacements. The proposed mitigation measures for the bridges considered in this evaluation were assigned based on the structure's location over water or over land. As described previously, bridges over water would be replaced to meet the Standards unless site-specific constraints prevent, while bridges over land would be replaced in kind.

The broad range of culvert locations warranted a more detailed analysis. The criteria used to identify appropriate culvert sites warranting mitigation measures were:

- Surrounding land development density should be rural or, in rare instances, suburban in the general vicinity of the structure.
- Surrounding land use should be open space, with other uses permissible if other site characteristics result in unique ecological value at the structure location.
- CAPS results should indicate an IEI value of 50 percent or higher for forests or freshwater wetland and aquatic landscapes on both sides of the railroad at the structure location, (culverts found between areas of high ecologic integrity (see Appendix 4.14-B); and
- Rivers, streams, ponds, wetlands, and uplands should have suitable habitat for fish and wildlife.

Based on these criteria, a decision tree (Figure 4.14-42) was developed to assist in determining mitigation recommendations for each culvert. As previously described, mitigation measures for the culverts would be:

- replace to meet the Standards;
- replace in kind;
- daylight; or
- subject to hydraulic analysis to determine if the structure is providing hydrologic control, (i.e., maintaining ambient hydrology in a functioning wetland, the alteration of which could cause unintended adverse consequences to the wetland), resulting in a range of recommended outcomes.

Criteria for additional tunnel and between-tie crossings (discussed in more detail below) include:

- Known ranges for rare species (e.g., Blanding's turtle, blue-spotted salamander, Eastern box turtle)

- Migration routes for rare species
- Presence or absence of culverts or bridges in the vicinity of migration routes
- Presence of vernal pools

Proposed Mitigation Measures

Bridges—The Stoughton Alternative includes only one new bridge (replacing a washed-out culvert) and one new trestle (above several existing culverts); there will be no new river or stream crossings. The new bridge, trestle, and all replacement bridges will use existing or replacement abutments at or near current abutment locations. The bridges over rivers, perennial streams, and abandoned farm roads will be replaced as previously described (see Table 4.14-18). Most of the bridges over rivers and streams will be designed to meet Standards, in particular including shelves on the waterfront banks to allow for wildlife passage (Figure 4.14-42). This will be accomplished in part by constructing new abutments behind existing abutments, and then partially or fully removing the existing abutments. In some cases, the existing abutments will not be replaced, or will be replaced at the same location, to preserve historic structures or meet spatial constraints. In these cases, the bridge would not incorporate wildlife crossing features. Bridges with several spans will be replaced with single or dual-span structures, reducing or eliminating impediments to fish passage in the river or stream.

Constructing the bridges over rivers or streams will take into consideration the DMF's recommendations for time-of-year restrictions for diadromous fish to the extent practical or use construction techniques (e.g., containment structures) that do not affect fish passage or use of spawning riffles (see Section 4.14.3.2).

A few of the bridges considered in this biodiversity assessment are in upland locations, and do not span rivers or streams. As previously noted, some of these structures accommodate flood flow, particularly near the Taunton River in Fall River, where Land Subject to Coastal Storm Flowage is mapped. These upland bridges may provide open passage to non-aquatic species, principally mammals and reptiles, but are generally in locations with low biodiversity. For these reasons, in-kind replacement is recommended.

An 8,500-foot long trestle will be constructed over a portion of the Hockomock Swamp, above the abandoned railroad bed. The trestle would be elevated three to four feet above the existing railroad berm to provide for large animal passage underneath. As noted below, existing culverts within this segment of the railroad will be "daylighted" (top section removed) to enhance their ecological value.

On the Whittenton Branch alignment piers or pilings supporting the existing Mill River Bridge would be replaced by a single pier at the center of a two-span structure, minimizing impacts to stream hydrology and fish habitat. Existing piles would be removed and one new cast-in-place concrete pier would be constructed in the center of the span. New cast-in-place concrete abutments would be constructed behind the existing abutments, which would then be partially removed to an elevation equal to the river's average seasonal high water elevation to improve wildlife passage

Culverts—Mitigation recommendations for each culvert along the Stoughton Alternative are summarized in Table 4.14-35 and described below.

Table 4.14-35 Recommendations for Culverts

	Meet Standards	Hydraulic Analysis	Daylight	Replace in Kind	Eliminate
Stoughton Line	20	3	6	20	1
New Bedford Main	10	6	0	12	0
Fall River Secondary	3	5	0	18	1
Total	33	14	6	50	2

As shown in the decision tree (Figure 4.14-42), of the 105 culverts 77 connect areas of high biodiversity while 28 do not. The functional analysis of the 77 culverts determined that 53 of these culverts did provide a water-body related service while 24 do not. For the 53 culverts that provide a water-body related function connecting areas of high biodiversity, each was evaluated to determine if the culvert provides hydrologic control of an upstream wetland. Thirty-three of these culverts were determined to not provide hydrologic control; these culverts would be replaced to the Standards to the extent practicable (that is, taking into consideration the engineering constraints described above). The 33 culverts recommended for replacement to the Standards would meet the General standards, in particular the 1.2 times bankfull width, open bottom, and 0.82 openness ratio requirements. None of the culverts would be replaced with bridges to meet Optimum standards (e.g., spans) because the expense of that level of upgrade is not warranted. Table 4.14-36 lists the 33 culverts that would be replaced to meet the General Standards, facilitating fish and wildlife passage through culverts that convey perennial streams and wildlife passage (including aquatic species) through all other culverts.

A typical culvert cross-section meeting the Standards is depicted in Figure 4.14-43. The actual specifications for each structure will be determined on a location-specific basis during preliminary design, meeting the General standards and taking into consideration the engineering constraints as appropriate. As an example, a 40-foot long culvert would have a 32 square foot opening, likely 8 feet wide and 4 feet high.

A preliminary engineering review of the 33 culverts recommended to meet the Standards, based on these example specifications, determined that 20 of those culverts did not have sufficient cover to accommodate a 4-foot high structure. Raising the track bed to meet this cover requirement is not practicable due to the elevation change constraints of a high-speed commuter railroad. Actual specifications for each culvert will be determined during final design; the 0.82 openness ratio will be incorporated if feasible. Smaller openness ratios may be necessary to accommodate the cover requirements. The river and stream crossing standards for bridges and culverts, as described above, include provisions if it is not possible to meet all of the applicable Standards. Replacement of any of these structures will take into consideration other specifications of the General standards to the extent practical.

Table 4.14-36 Culverts Recommended to Meet General Massachusetts River and Stream Crossing Standards[81]

Culvert	Figure Number	Existing Structure Description	Hydrologic Function
CV-ST 6.45	4.14-11b	4'X2.5' stone box culvert, 75' long	Intermittent stream conveyance
CV-ST 6.69	4.14-11b	3'X3' stone box culvert, 70' long	Wetland equalizer
CV-ST 6.83	4.14-11b	3.5 X5' stone box culvert, 30' long	Intermittent stream conveyance
CV-ST 7.06	4.14-11b	2.5'X2' stone box culvert, 40' long	Intermittent stream conveyance
CV-ST 7.21	4.14-11b	2.7'X2' stone box culvert, 50' long	Intermittent stream conveyance
CV-ST 7.23	4.14-11b	2'X2.8' stone box culvert, 55' long	Intermittent stream conveyance
CV-ST 9.35	4.14-11c	2'X2' stone box culvert, 50' long	Wetland equalizer
CV-ST 9.65	4.14-11c	2'X2' stone box culvert, 50' long	Intermittent stream conveyance
CV-ST 10.05	4.14-11c	2'X2' stone box culvert, 40' long	Wetland equalizer
CV-ST 10.90	4.14-11c	12" CMP culvert, 50' long	Wetland equalizer
CV-ST 10.95	4.14-11c	5'X5' stone box culvert, 40' long	Perennial stream conveyance
CV-ST 11.11	4.14-11c	18" CIP culvert, 30' long	Wetland equalizer
CV-ST 11.59	4.14-11c	3'X3' stone box culvert, 50' long	Wetland equalizer
CV-ST 11.61	4.14-11c	36" CMP culvert, 50' long	Wetland equalizer
CV-ST 11.65	4.14-11c	12" CMP culvert, 40' long	Wetland equalizer
CV-ST 11.91	4.14-11c	5'X9' stone/rail box culvert, 25' long	Intermittent stream conveyance
CV-ST 13.83	4.14-11d	6'X6' stone box culvert, 50' long	Wetland equalizer
CV-ST 14.02	4.14-11d	3.5'X4' stone box culvert, 30' long	Wetland equalizer
CV-ST 16.00	4.14-11d	4'X4' stone box culvert, 25' long	Wetland equalizer
CV-ST 16.73[1]	4.14-11d	3'X3' stone box culvert, unknown length	Perennial stream conveyance
No number[1]	4.14-11e	2.5'X2' stone box culvert, unknown length	Wetland equalizer
CV-NB 14.52	4.14-12a	3.5'X3.5' stone box/36" CMP culvert, unknown length	Perennial stream conveyance
CV-NB 16.89	4.14-12a	1.5'X2' stone box/12" CIP culvert, 40' long	Wetland equalizer
CV-NB 17.89	4.14-12a	36" CMP culvert, 25' long	Perennial stream conveyance
No number	4.14-12b	Unknown	Wetland equalizer
CV-NB 20.37	4.14-12b	2'X3' stone box culvert, 45' long	Wetland equalizer
CV-NB 20.89	4.14-12b	2.5'X4' stone box culvert, 42' long	Wetland equalizer
CV-NB 21.51	4.14-12b	Two 3'X3' stone box culverts, unknown length	Wetland equalizer
CV-NB 21.68	4.14-12b	4'X3' concrete and stone box culvert, 35' long	Intermittent stream conveyance
No number	4.14-12b	7'X7' stone box culvert, 30' long	Intermittent stream conveyance
CV-FR 0.58	4.14-13a	8" CMP culvert, 20' long	Upland drainage
CV-FR 2.71	4.14-13a	18" CMP/2.5'X1.5' stone box culvert, unknown length	Intermittent stream conveyance
CV-FR 5.79	4.14-13b	3'X5' stone box culvert, unknown length	Wetland equalizer

1 Culvert not associated with Whittenton Alternative

[81] River and Stream Crossing Partnership. 2011. Massachusetts River and Stream Crossing Standards. The University of Massachusetts- Amherst (College of Natural Sciences), The Nature Conservancy, Massachusetts Division of Ecological Restoration- Riverways Program, American Rivers, and others. August 2004; revised March 1, 2006; revised March 1, 2011; corrected January 31, 2012

Of the remaining 20 culverts that have a water-body related function and appear to provide hydrologic control of a wetland, hydraulic analysis is recommended for 14. If the culvert is not providing hydrologic control, it would be replaced to the Standards as described for the 33 culverts above. If the culvert is providing hydrologic control, it should either not be replaced (if replacement is not necessary for engineering reasons) or be replaced without altering the local hydrology (if replacement is necessary for engineering reasons). This could be accomplished by installing a weir on the upstream side of the culvert, albeit fish passage (if any) could be compromised by such an approach.

The last six culverts within this group lie within the segment of the Stoughton Line that would be traversed by the new trestle; these culverts would be daylighted. These particular structures will be beneath the trestle within the abandoned railroad bed. These culverts would function more effectively for reptile and amphibian passage across the railroad bed if they have open tops. Removing the layer of railroad ballast above the existing culverts and the top member of the stone or stone/rail box culverts is recommended for these structures.

Two of the 28 culverts that do not connect areas of high biodiversity could be eliminated because they do not appear to have any hydrologic or ecologic value. These two culverts (an un-numbered culvert in Easton immediately south of Foundry Street [Figure 4.14-11c] and CV-FR 8.97 in Fall River [Figure 4.14-13b]) are currently entirely plugged.

The remaining 26 culverts in that do not connect areas of high biodiversity, combined with the 24 culverts that do not have a water-body related function, result in 50 culverts that may be replaced in kind according to engineering requirements of the South Coast Rail project.

Tunnels and Between-Tie Crossings—Tunnels and between-tie crossings would be sited within known habitat for turtles and salamanders at upland locations where there are no existing culverts or bridges, such as within the Hockomock Swamp, Pine Swamp, Assonet Cedar Swamp, and Acushnet Cedar Swamp. An adequate number and density of crossings would be placed at vernal pool complexes and near grade crossings to allow turtles that wander onto the railroad or get stuck between the tracks to escape. Potential locations for these structures are depicted in Figures 4.14-11a through 4.14-13c and listed in Table 4.14-37. However, the actual type of wildlife crossing would be determined during final design, based on topography. The between-tie crossings would be designed in accordance with the Handbook recommendations described above; a typical structure is depicted in Figure 4.14-44.

Mitigation recommendations for each culvert along the Whittenton Alternative are summarized in Table 4.14-38. For culverts that appear to have some hydraulic control over wetland areas (i.e., are wetland equalizers), mitigation would begin with a hydraulic analysis to determine whether culverts should be replaced in kind (with no change to hydraulic function) or replaced according to the Massachusetts River and Stream Crossing Standards to the extent practicable (which could alter the hydrology of some areas). Daylighting of culverts to facilitate animal passage could be performed on culverts that connect areas of wildlife habitat.

Tunnels and between-tie crossings are likely to have little effect on areas of the Whittenton Branch north of Warren Street since the eastern side of the tracks contains little undeveloped land. South of Warren Street, in the vicinity of Wetlands TWB 05 through TWB 01, both the western and eastern sides of the tracks have large areas of undeveloped land that could benefit from daylighted culverts or other crossing measures.

Table 4.14-37 Proposed Tunnel and Between-Tie Crossing Locations

Crossing Type	Location	Connects	Figure Number
Type To Be Determined	Stoughton Line: South of North Easton Station site, Easton	CVPs and PVPs	4.14-11b
(2) Between-Tie	Stoughton Line: Easton Country Club Golf Course, Easton	Blanding's turtle habitat	4.14-11c
Tunnel	Stoughton Line: North of Foundry Street, Easton	Blanding's turtle habitat	4.14-11c
(3) Type To Be Determined	Stoughton Line: North of Bridge Street, Raynham	High-integrity forest on east and west sides	4.14-11d
Tunnel[1]	Stoughton Line: Pine Swamp, Raynham	High-integrity swamp on east and west sides	4.14-11d
Between-Tie	Stoughton Line: North of Raynham/ Taunton municipal boundary, Raynham	PVPs	4.14-11e
Between-Tie	Stoughton Line: South of Raynham/ Taunton municipal boundary, Taunton	PVPs	4.14-11e
Tunnel	New Bedford Main Line: South of Taunton Depot Station site, Taunton	PVPs	4.14-11e
Between-Tie	New Bedford Main Line: South of Malbone Street, Lakeville	High-integrity forest on east side and swamp on west side	4.14-12a
Type To Be Determined	New Bedford Main Line: North of Lakeville/ Freetown municipal boundary	High ecological integrity forest on east and west sides	4.14-12b
Between-Tie	New Bedford Main Line: North of Braley Road	Eastern box turtle habitat; high ecological integrity forest on west side	4.14-12c
Between-Tie	Fall River Secondary: South of Elm Street	High ecological integrity forest and PVP on east side; pond on west side	4.14-13a

1 Measure not associated with Whittenton Alternative

Table 4.14-38 Recommendations for Culverts–Whittenton Alternative

	Meet Standards	Hydraulic Analysis	Daylight	Replace in Kind	Eliminate
Stoughton Line – Canton, Stoughton and Easton	16	2	6	18	1
Whittenton Alternative – Raynham and Taunton	4	7	0	0	0
New Bedford Main	10	6	0	12	0
Fall River Secondary	3	5	0	18	1
Total	33	17	6	48	2

While there are no complexes of vernal pools along the Whittenton Branch, animals may still cross over the right-of-way moving to and from individual pools, wetlands, or upland areas.

In addition to replacement of the culverts in this section to facilitate wildlife passage, up to two additional culverts have been proposed in the DEIS/DEIR in this section of the Whittenton Branch to maintain wildlife habitat that exists on both sides of the tracks.

This section of the right-of-way is also in eastern box turtle habitat and would facilitate the crossing of turtles under the tracks, since constructing the tracks would create a barrier to movement across the currently inactive right-of-way.

Much of the area on both sides of the tracks in this section has been identified as wetlands; however, there is a stretch of approximately 200 feet between Wetlands TWB 04 and TWB 02 on the eastern side of the tracks, and Wetlands TWB-03.1 and TWB 01 on the western side of the tracks that are uplands. This area would be the preferred location for additional wildlife passage or passages under the right-of-way.

Design of culverts and other crossing measures would be as described in the Biodiversity Technical Report for the Stoughton Alternative. Treatments of culverts and bridges along the remainder of the Whittenton Alternative (from Canton to Raynham Junction and south of Weir Junction) would be the same as for the Stoughton Alternative.

Timing and Methods of Construction—Timing of construction may affect the extent of impacts to fish and wildlife species. Disturbance of habitat during the breeding season is likely to have greater short-term or individual effects on reproductive success, though short-term effects are not likely to have long-term repercussions unless the species population is already unstable. To avoid potential short-term effects to breeding wildlife, all efforts will be taken to avoid construction during the breeding season (April through June) in Hockomock and Pine Swamps. In all cases construction would be limited to normal daylight hours.

Construction impacts to aquatic resources will be mitigated by the appropriate use of erosion and sedimentation controls to minimize and eliminate sedimentation of wetlands and waterways. Erosion and sedimentation controls would be installed before construction begins, properly maintained, and removed after disturbed areas have stabilized.