

Assabet River National Wildlife Refuge

Transportation Study Report

Submitted to
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Transportation Study Report

Prepared For: Federal Highway Administration
Eastern Federal Lands Highway Division

U.S. Fish and Wildlife Service
Northeast Region

Prepared By: Vanasse Hangen Brustlin, Inc.

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1

Introduction

1.1 Refuge Overview

The Assabet River National Wildlife Refuge (ARNWR) is one of eight refuges comprising the Eastern Massachusetts National Wildlife Complex. The locations of the ARNWR and the other refuges are shown in Figure 1.1. The refuge is relatively new. It was established in 2000 and first opened to the public in 2005.

The refuge is located in the communities of Hudson, Stow, Maynard and Sudbury, Massachusetts. The property had been under the control of the U.S. Army since 1942 and used for a variety of training and research purposes until it was transferred to the U.S. Fish & Wildlife Service (USFWS) in 2000 as a result of the Base Closure and Realignment Act of 1990.

The refuge was established for the purpose of having “particular value in carrying out the national migratory bird management program.” The large areas of wetlands and forest that comprise the refuge provide feeding and breeding areas for migratory birds as well as other wildlife.

As detailed in the *Assabet River National Wildlife Refuge Comprehensive Conservation Plan*,¹ the refuge is home to more than 135 bird species, 25 mammals, 20 reptile species, and 20 fish species, as well as over 650 different plant species.

Figure 1.2 depicts the two primary areas comprising the Assabet River National Wildlife Refuge. The refuge contains about 2,300 acres. The north tract is approximately 1,900 acres and the south tract is approximately 300 acres. There are also some parcels along the nearby Assabet River that are part of the refuge.²

The north tract contains 12.5 miles of trails, the Visitor Center, parking areas, a canoe launch and a fishing area. The main entrance to the refuge is along Hudson Road. The south tract of the refuge is undeveloped and has 2.7 miles of trails.

¹ *Assabet River National Wildlife Refuge, Comprehensive Conservation Plan*, U.S. Fish & Wildlife Service, January 2005.

² Those outlying parcels are excluded from this transportation study and are not shown on Figure 1.2.



TRANSPORTATION STUDY
ASSABET RIVER NATIONAL WILDLIFE REFUGE

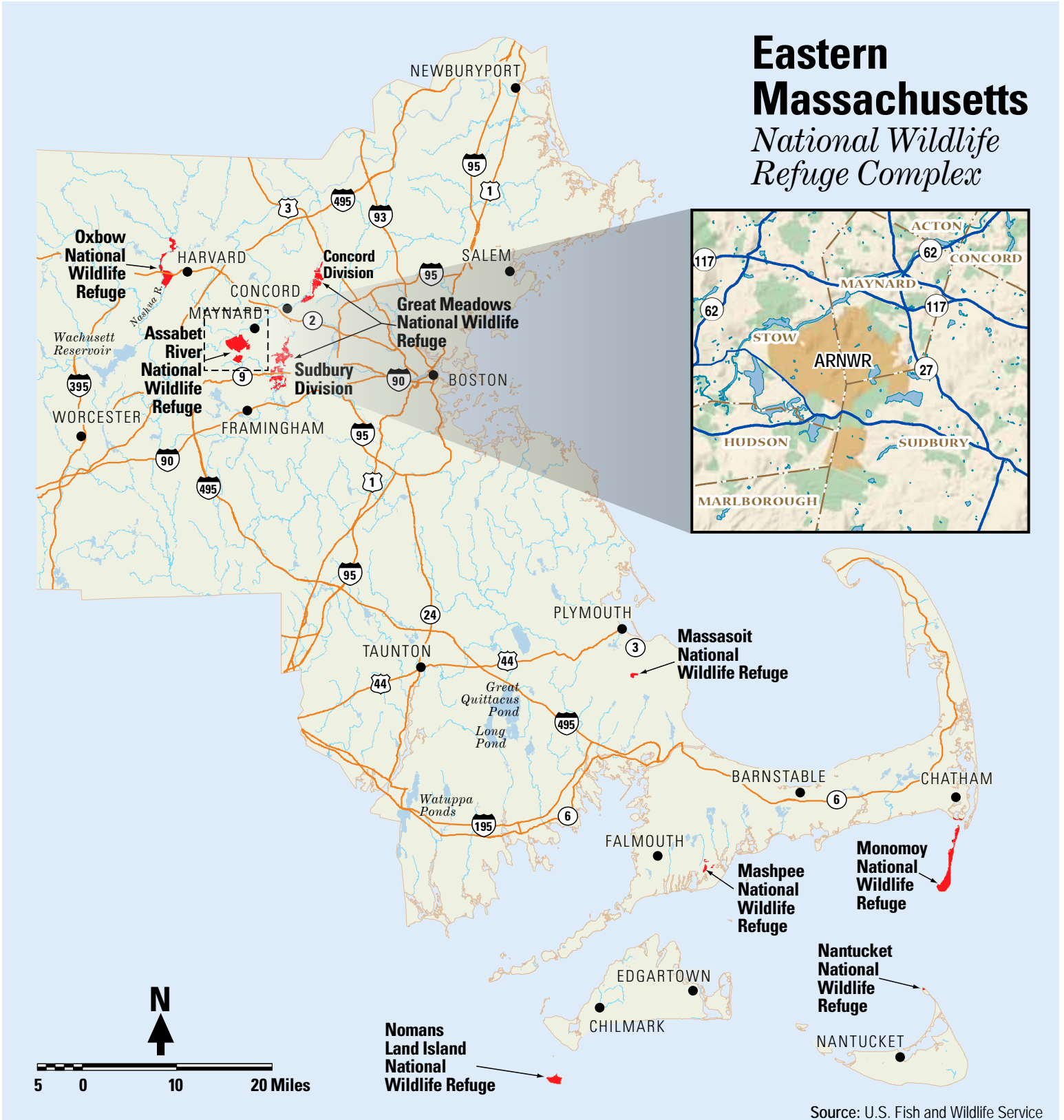


Figure 1.1
Project Location



TRANSPORTATION STUDY ASSABET RIVER NATIONAL WILDLIFE REFUGE

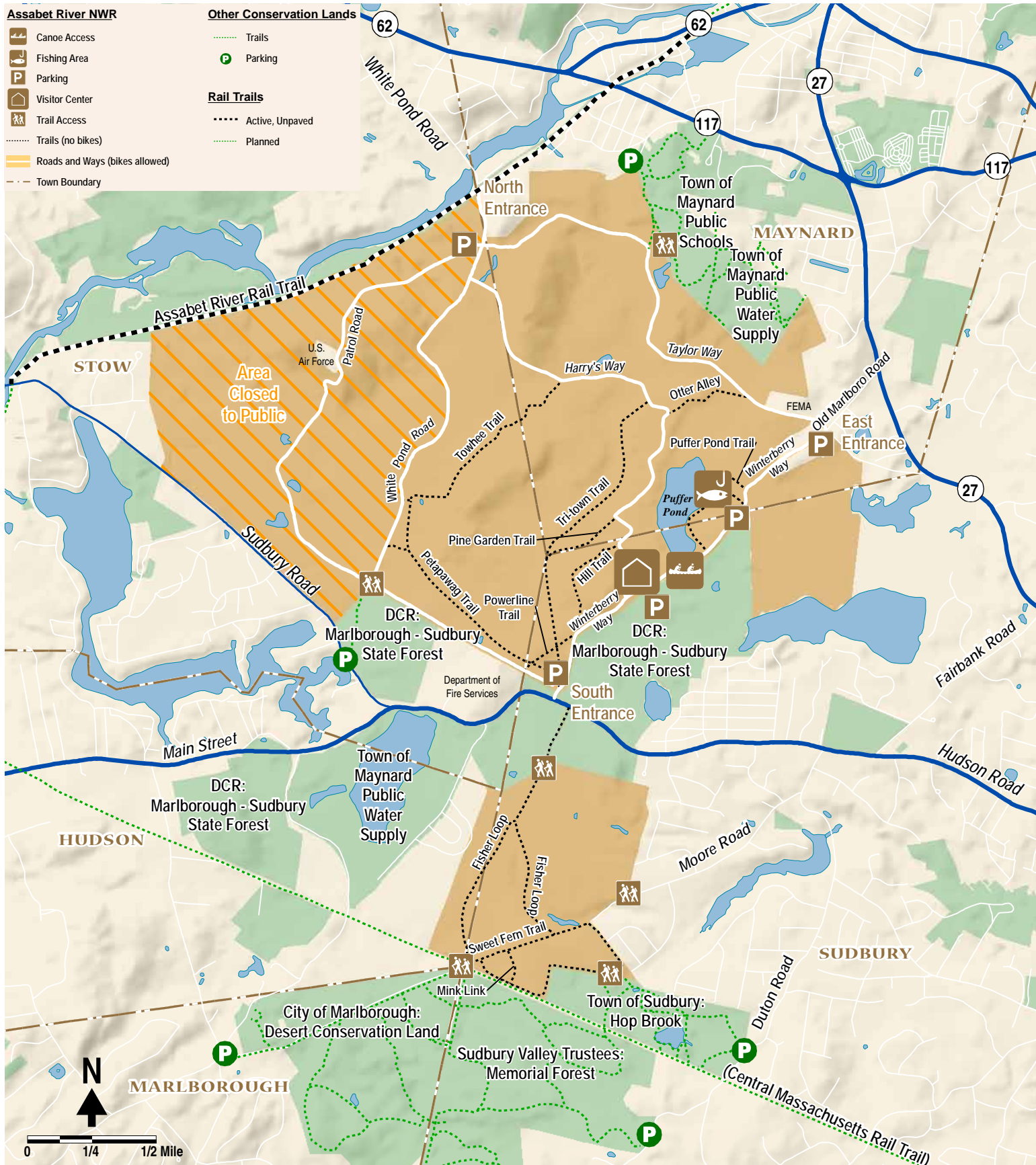


Figure 1.2
Study Area





The first settlers on the refuge lands were Native Americans.³ European settlement in the area began around 1650. For more than 200 years the lands were used primarily for farming.

By the start of the 20th century some of the farms were being replaced by smaller homesteads and a few decades later vacation home lots were being developed along the shores of Puffer Pond. In 1942 the military era of the lands began when the private properties were acquired through eminent domain by the U.S. Army to support the war effort.

The original purpose of the military facility was to store ammunition that was transferred between the site and the port of Boston via the Central Massachusetts Rail Line. Some fifty ammunition bunkers, and a series of railroad spurs to those bunkers, were constructed. New roadways, notably the perimeter Patrol Road, were built.

For almost 50 years, the property was used for a variety of training and research purposes by the Army. During that time many of the original houses and farm buildings were removed, a few adapted for Army use, and some new Army buildings constructed.

Management of the Army property was transferred in 2000. Most of the property was transferred to the USFWS. A small parcel inside what is now the ARNWR was transferred to the U.S. Air Force and used until recently as a weather station. Some of the Army property was transferred to the Federal Emergency Management Agency (FEMA) and FEMA parcels now abut the refuge near the refuge's north and east entrances.

Despite the impact of the Army activity, the long period of military ownership and restricted access allowed the lands to remain undeveloped, unlike much of the land in the adjacent suburban towns. During the past 10 years, there was environmental remediation of the site and most of the Army facilities, including the railroad lines, were removed. Only the ammunition bunkers remain.

The refuge's current trail network was created primarily on old road and rail beds. Paved surfaces remaining from the Army era were generally left as is, but substantial work was done to clear and upgrade all trails for use by the public.

Two major construction projects, the Visitor Center and Winterberry Way, were completed in 2010. New parking lots at the north and east entrances were constructed in 2012.

1.2 U.S. Fish and Wildlife Service Mission and Goals

The U.S. Fish & Wildlife Service is a bureau within the Department of the Interior. The mission of the U.S. Fish and Wildlife Service is to:

“work with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.”⁴

The goals of the USFWS are aimed at fulfilling this mission. Primary USFWS goals are to:

- Sustain fish and wildlife populations including migratory birds, endangered species, anadromous fish, and marine animals.

³ Information about the history of the Refuge is taken from the *Comprehensive Conservation Plan*.

⁴ National Policy Issuance 99-01, United States Department of the Interior, Fish and Wildlife Service, 6/15/1999.



- Conserve a network of lands and waters, including the National Wildlife Refuge System.
- Provide Americans opportunity to understand and participate in the conservation and use of fish and wildlife resources.

1.3 National Wildlife Refuge System Mission and Goals

The mission of the National Wildlife Refuge System is to:

*“administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, plant resources and their habitats within the United States for the benefit of present and future generations of Americans.”*⁵

The primary goals of the National Wildlife Refuge System are to:

- Preserve, restore, and enhance threatened and endangered species in their natural ecosystems.
- Perpetuate the migratory bird resource.
- Preserve a natural diversity and abundance of fish and wildlife ecology.
- Provide the public an understanding and appreciation of fish and wildlife ecology.
- Provide visitors with wildlife-dependent recreation.

Legislative history recognizes the importance of providing for wildlife-oriented recreation for people on national wildlife refuges. The Refuge Recreation Act of 1962 provided guidance for the USFWS to provide wildlife-oriented recreational opportunities for the public if deemed compatible with the primary purpose of the refuge. The National Wildlife Refuge System Improvement Act of 1997 specified that the refuge system must focus on wildlife, and it defined the following six wildlife-dependent recreational uses as priority public uses of refuge lands.

- Hunting
- Fishing
- Environmental education
- Environmental interpretation
- Wildlife observation
- Wildlife photography

1.4 Purpose of the Transportation Study

The purpose of this study is to evaluate the existing transportation system and infrastructure to understand current conditions and use, and to develop a plan of near-term and long-term projects to improve access to, and mobility within, the Assabet River National Wildlife Refuge.

The need for the study arises from several factors. One is the desire to determine the best means to accommodate the growing amount and changing type of visitation experienced since the opening of the refuge in 2005 and the Visitor Center in 2010. Another reason for the study is that many of the then existent trails, roads and travelways in the refuge were in disrepair at the time the property was transferred to the USFWS in 2000 and the roadway

⁵ The National Wildlife Service Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997.



surfaces have deteriorated further since. In addition, the refuge lands were isolated from the surrounding communities in the decades they were used by the Army and there are opportunities for better connectivity to the adjacent neighborhoods and communities.

1.5 Study Area

The primary project study area for purposes of mobility within the Assabet River National Wildlife Refuge encompasses the entirety of the ARNWR's north tract and south tract. The ARNWR outlying parcels along the Assabet River are excluded from this transportation study.

An important element of the study is consideration of potential improvements to the existing pedestrian and bicycle access between the refuge and the host communities of Stow, Sudbury, Maynard, and Hudson. The study area for pedestrian and bicycle access focuses on routes that provide a reasonable length of travel path to the ARNWR Visitor Center. The pedestrian evaluation includes access via trails in adjacent conservation and recreation properties. The evaluation of bicycle access considers connections to the Assabet Rail Trail, the Bruce Freeman Rail Trail, and the Central Mass Rail Trail.

The study area includes roadways external to the refuge that provide direct access to existing or proposed entrances and parking areas. This includes White Pond Road, Old Marlboro Road, and the Sudbury Road/State Road/Hudson Road corridor.

1.6 Study Schedule

Data collection and the evaluation of existing conditions at the refuge began during the fall of 2011. The assessment of existing conditions included a public open house in November 2011 to

introduce the project and gather feedback on how visitors experience the refuge, what issues they might have, and what ideas they have. The review of existing conditions also included input from a group of key stakeholders. These stakeholders included representatives from the host communities of Maynard, Stow, Sudbury and Hudson; representatives of agencies with abutting parcels, including FEMA, the state Department of Recreation and Conservation, the state Department of Fire Services, and the Sudbury Valley Trustees; and the Friends of the Assabet River National Wildlife Refuge. The findings regarding existing conditions were presented in the *Assabet River National Wildlife Refuge Transportation Study Existing Conditions Report*, finalized in April 2012.

The development of potential transportation improvement and enhancement projects involved participation by the public and the stakeholders. A public involvement meeting was held in February 2012 to introduce the potential projects that were developed in response to the initial public and stakeholder comments and the refuge's issues and challenges identified during the existing conditions assessment. Several stakeholder meetings were held, during which additional participants included representatives from rail trail organizations and regional planning agencies. The *Assabet River National Wildlife Refuge Transportation Study Preliminary Candidate Alternatives Report*, finalized in September 2012, presents details of the initial screening of potential projects.

A more detailed evaluation of candidate projects, and the prioritization of recommended projects, was conducted during the summer and fall of 2012. The results are included in this report.



2

Activities and Visitation

2.1 Activities

The Assabet River National Wildlife Refuge is open daily, from sunrise to sunset. The refuge offers opportunities for walking, bicycling, canoeing, fishing, hunting, as well as educational activities at the Visitor Center.

2.1.1 Visitor Center

The 5,000 square foot Visitor Center opened in the fall of 2010. The Visitor Center houses interactive educational exhibits and is used for a variety of refuge-sponsored events throughout the year. Such events include talks, film nights, and nature walks and tours. The Visitor Center also serves as a meeting venue for local organizations.

Educational outreach programs are an important and growing element of the refuge's visitation. There are programs for schools, scouting groups, and similar organizations.



Educational exhibits in the Visitor Center

2.1.2 Walking and Bicycling

The refuge has more than 15 miles of trails. Use of those trails reflects the refuge's and USFWS's missions of supporting compatible wildlife-dependent public use. Most of the trail system is restricted to walking and hiking.

Bicycles are permitted in the north tract of the refuge, along more than seven miles of roads and ways (Winterberry Way, White Pond Road/Patrol Road, Harry's Way and Taylor Way). Bicycles are not permitted in the south tract of the refuge.



Except for Winterberry Way, which provides access to the Visitor Center and several parking areas, the refuge is closed to motorized vehicles. Horses and dogs are not allowed in the refuge.

2.1.3 Hunting and Fishing

Hunting and fishing are allowed in accordance with refuge, state and federal regulations. Hunting is allowed in much of the refuge, including a section west of White Pond Road that is not otherwise open to the public.

Table 2.1: 2011 Hunting Seasons

Activity	Open Season
White-tailed Deer	
Archery	Oct. 17-Nov. 26
Shotgun	Nov. 28-Dec. 10
Primitive Firearms	Dec. 12-Dec. 31
Ruffed Grouse	Oct. 15-Nov. 26
Gray Squirrel	Sept. 12-Jan. 2, 2012
Rabbit	Jan. 1-Feb. 28, Oct. 15-Feb. 29, 2012
Woodcock	Oct. 5-Oct. 29, Oct. 31-Nov. 19
Turkey	Apr. 25-May 21

Source: 2011 Massachusetts Guide to Hunting, Freshwater Fishing and Trapping: Quick Reference List; MassWildlife Migratory Bird Regulations for 2011-12 Season

Catch-and-release fishing is allowed on Puffer Pond. There is a designated fishing area located at the end of Carbary's Trail.



Handicapped accessible fishing pier on Puffer Pond

2.1.4 Other Activities

During the winter, cross-country skiing and snowshoeing are allowed on the trails. This includes the section of Winterberry Way north of the Visitor Center. That part of the road is closed during the winter and left unplowed.

Canoeing and kayaking is allowed on Puffer Pond. Access to the pond is located at Sandbank Trail, approximately 500 yards north of the Visitor Center.



The canoe launch site on Puffer Pond is unimproved and not handicapped accessible.



2.2 Visitation Summary and Profile

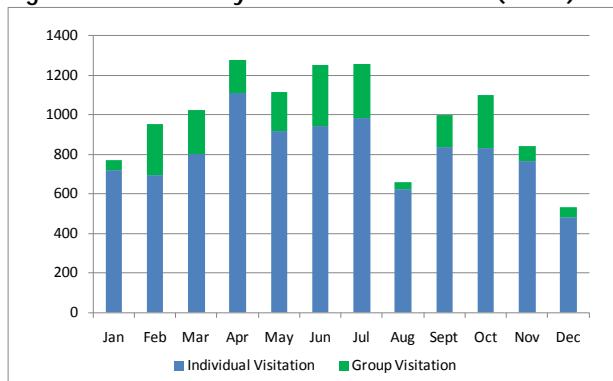
Counts are made by refuge staff and volunteers of people who enter the Visitor Center. These counts include individuals and families who enter the Visitor Center during their visit to the refuge and those attending organized group activities hosted at the Visitor Center.

Actual visitation levels at the refuge are undoubtedly higher than the visitation recorded at the Visitor Center. The Visitor Center counts include only people who enter the Visitor Center, which is only open Thursdays through Sundays from 10:00 am to 4:00 pm. Yet, the refuge is open from dawn to dusk seven days a week. In addition, even on days when the Visitor Center is open many visitors simply walk or bicycle among the trails and never enter the Visitor Center.

2.2.1 Seasonal Visitation Patterns

The visitation at the Visitor Center in calendar year 2011 was 9,717. The monthly totals are illustrated in Figure 2.1. April was the busiest month, with May, June and July all above average. The months of March, September, October and November were each near the monthly average of about 800 visitors at the Visitor Center.

Figure 2.1: Monthly Visitation Patterns (2011)



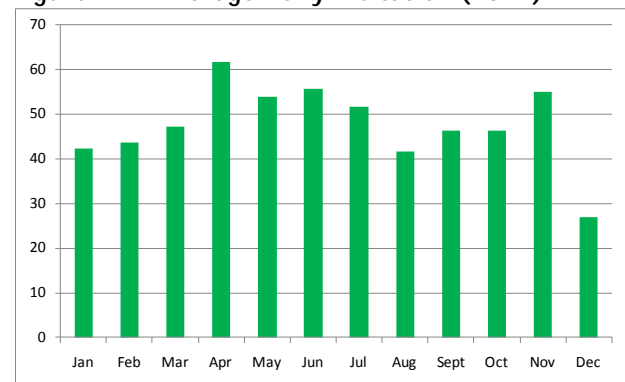
Source: USFWS, ARNWR Visitor Center counts

Included among the 9,717 visitors at the Visitor Center in 2011 are 2,051 attendees among 81 events and group visits.

2.2.2 Daily Visitation Patterns

Average daily visitation for each month in 2011 (at the Visitor Center) ranged between 42 and 62. The only exception is for December when visitation averaged 27 people per day. As shown in Table 2.2, most of the refuge visitation occurs on weekend days.

Figure 2.2: Average Daily Visitation (2011)



Source: USFWS, ARNWR Visitor Center counts

Table 2.2: Average Daily Visitation at ARNWR Visitor Center (2011)

Day of Week	Visitors
Thursday	16
Friday	22
Saturday	62
Sunday	77

Source: USFWS, ARNWR Visitor Center counts



3

Regional Demographic and Socioeconomic Characteristics

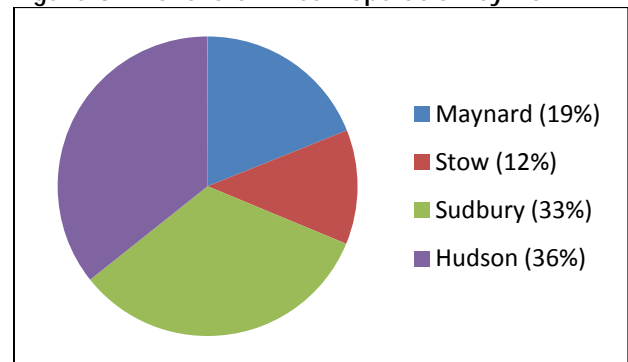
The Assabet River National Wildlife Refuge is located in Middlesex County, Massachusetts, and covers parts of the towns of Maynard, Stow, Sudbury, and Hudson. Demographic data for the county and the towns from the 2000 and 2010 Census were reviewed and are presented in the sections that follow.

3.1 Demographic Profile

Hudson, with a population of 19,063 in 2010, is the largest of the four towns. Sudbury has 17,689 residents and Maynard has 10,106 residents. Stow is the smallest of the four towns and as of 2010 had a population of 6,590 residents.

Despite having a relatively small population, the Town of Maynard has the highest population density, 1,929 residents per square mile, among the four communities. Population density in Hudson is 1,656 residents per square mile. Sudbury and Stow have a much lower population density at 725 and 374 residents per square mile, respectively.

Figure 3.1: Share of Area Population by Town



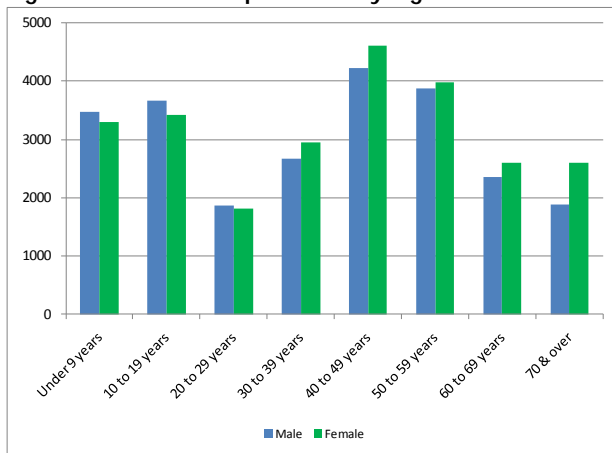
Source: 2010 census data.

The population of the area has seen modest growth during the past decade. As a whole, the four towns saw a total of 4.2% growth in population from 2000 to 2010. Despite the relatively low population growth rate among the four towns, it exceeded that for Middlesex County and the Commonwealth of Massachusetts. Middlesex County had a population of 1,503,085 in 2010, which is a 2.6% increase from 2000. The Commonwealth of Massachusetts had a population of 6,547,097 in 2010, up from 6,349,097 in 2000, a 3.1% increase.



The distribution of the population among the four towns by age and gender is shown in Figure 3.2. The towns have a combined population of almost 50,000 persons. The distribution by age and gender is similar to the county and state data. Among the four towns there are almost 14,000 people (28%) under the age of 20 and almost 9,500 (19%) over the age of sixty.

Figure 3.2: Area Population by Age and Gender



Source: 2010 Census data for Hudson, Stow, Sudbury and Maynard

3.2 Socioeconomic and Community Features

The socioeconomic and community features described in this section include households, education, employment, and income.

3.2.1 Households

Area housing statistics shown in Table 3.1 are illustrated by town and by occupant type. Occupants are categorized as either owners or renters. The towns of Maynard and Hudson each have the highest rates of renter occupancy at 29% and 28% of households, respectively. The towns of

Stow and Sudbury have rates of renter occupancy at 11 % and 8%, respectively

Table 3.1: Area Housing by Occupant Type

	Owner Occupied	Renter Occupied	Total Households
Hudson	5,454	2,074	7,528
Maynard	3,018	1,221	4,239
Stow	2,158	271	2,429
Sudbury	5,327	444	5,771
Total	15,957	4,010	19,967

According to the 2010 Census, the four towns had 19,967 total housing units with an average household size of 2.55 persons per household. Among the households, 14,628 dwellings (73%) were considered “families” while the remaining 27% of households are considered “nonfamily.” Twenty-two percent of households are one-person households, 32% of households are two person households, 17% are three person households, and 19% are four person households.

3.2.2 Education

Within the four study area towns, nine percent of the adult population does not hold a high school diploma. Twenty-two percent have a high school diploma or equivalent. Fourteen percent of the population has some college education while 34% have an associate or bachelor’s degree and 21% have an advanced educational degree. Men and women have comparable levels of education with 21% of men and 24% of women holding a high school diploma or equivalent, and 33% of men and 34% of women holding associate or bachelor’s degrees.

The levels of education in the four towns are comparable to those in Middlesex County. In the county, 23% of the population has a high school diploma or equivalent (23% of men, 22% of



women), 30% have an associate or bachelor’s degree (29% of men, 30% of women), and 20% have an advanced degree (22% of men, 18% of women).

3.2.3 Employment

Twenty-eight percent of the total population in the study area age 16 and over were not in the labor force in 2000. The percentage of women not in the labor force was greater than the percentage of men (18% of men, 37% of women).

Table 3.2 shows the unemployment rates for each town in 2000 and in 2011. The unemployment rate in Maynard exceeded the average for Middlesex County in both years, and the unemployment rate for Hudson exceeded the county average in 2011.

Table 3.2: Unemployment Rate

Town	Unemployment Rate	
	2000	2011
Maynard	2.6%	5.8%
Stow	1.9%	3.9%
Sudbury	1.3%	4.1%
Hudson	2.0%	6.0%
Middlesex County	2.4%	5.1%

Source: 2000 Census data and 2011 data from the Massachusetts Executive Office of Labor and Workforce Development

In 2000, 26,777 workers in the study area were 16 years or older and commuted to work; of which 77% worked in Middlesex County, 22% worked in Massachusetts but outside of Middlesex County, and less than two percent worked outside of Massachusetts.

As shown in Table 3.3, the category of “Education, Health and Social Services” presented the largest single employment sector at 18.1%, followed closely by “Professional, scientific, management,

administrative and waste management services” at 15.8%, “Manufacturing” at 15.7% and “Retail Trade” at 14.3%. These four employment categories collectively represent approximately 64% of the total employment of area residents.

Table 3.3: Employment by Industry

Industry	Employed Population
Agriculture, forestry, fishing and hunting, and mining	0.4%
Construction	5.7%
Manufacturing	15.7%
Wholesale trade	2.2%
Retail trade	14.3%
Transportation and warehousing, and utilities	1.9%
Information	3.6%
Finance, insurance, real estate, and rental and leasing	7.1%
Professional, scientific, management, administrative, and waste management services	15.8%
Educational, health and social services	18.1%
Arts, entertainment, recreation, accommodation and food services	4.8%
Public administration	4.3%
Other services	6.2%
Total	100.0%

Source: 2010 Census data for Hudson, Stow, Sudbury and Maynard

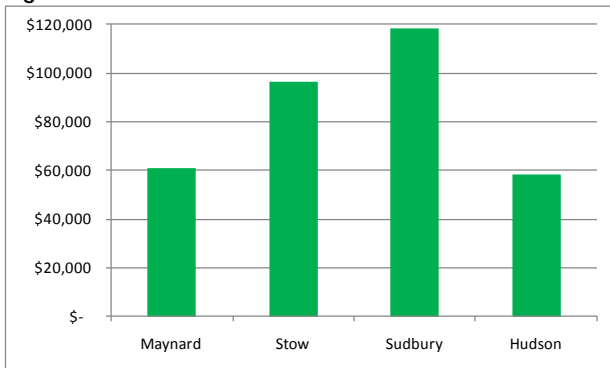


3.2.4 Household Income

The 2010 median household income was \$60,800 for Middlesex County and \$61,700 for the Commonwealth of Massachusetts. The 2010 median household income for the four towns was \$80,800.

The median household income for Sudbury was close to double that for the county and state. The household income for Stow was more than 50% above the county and state averages. The median household income for Maynard and Hudson were essentially the same as for the state and county. Figure 3.3 shows how the median household income compares by town.

Figure 3.3: Median Annual Household Income



Source: 2010 Census data.



4

Habitat and Cultural Resources

The following information regarding habitat and cultural resources in the refuge is taken from the *Assabet River National Wildlife Refuge Comprehensive Conservation Plan*.

4.1 Habitat

The Assabet River National Wildlife Refuge contains a diversity of wetland and upland habitat. The mix of habitat supports a wide variety of birds, mammals, reptiles and amphibians.

In the 18th and 19th centuries, the refuge lands were dominated by farms and pastures. Since then much of the area has succeeded back to forest. Most of the refuge is now forested, with mixed white pine and oak hardwoods dominating. Only a few meadow areas remain.

As shown on Figure 4.1, much of the refuge, particularly in the north tract, is forested and emergent wetland habitat. Due principally to beaver activity, the amount of wetlands has increased since the property was transferred to the Fish and Wildlife Service.



The one-time Army Taylor Drop Zone is now the largest area of grassland habitat in the refuge. The forested hill in the background was once pastureland.

The refuge contains a significant amount of priority wildlife habitat. Approximately 50 vernal pools have been identified on the refuge. The vernal pools are critical breeding habitat for amphibians. Large sections of the refuge are designated as Priority Habitats of Rare Species under the Massachusetts Department of Fisheries and Wildlife's Natural Heritage & Endangered Species Program. The entire Assabet River NWR has been designated as a Massachusetts Important Bird Area due to the habitat it provides to breeding, wintering and migratory birds.



TRANSPORTATION STUDY
 ASSABET RIVER NATIONAL WILDLIFE REFUGE

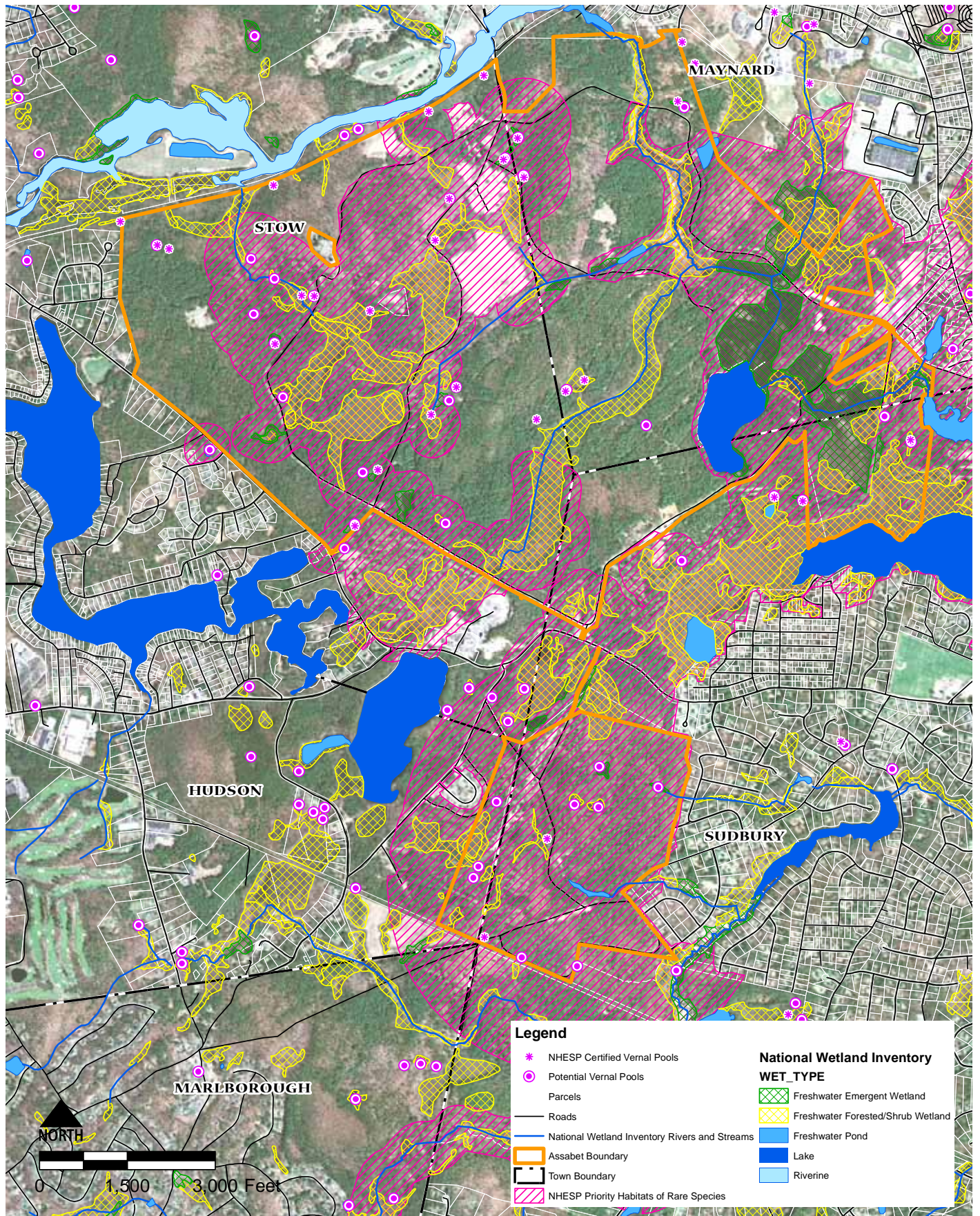


Figure 4.1
 Habitat





The refuge is home to more than 135 bird species, 25 mammals, 20 reptile species, and 20 fish species, as well as over 650 different plant species.

There are no federally listed threatened or endangered species known to be in the refuge. State-listed birds, amphibians and reptiles at the refuge are shown in Table 4.1. Among them are the Blanding’s Turtle, a State-listed threatened species. A repatriation program involving transplanting hatchlings from the nearby Oxbow NWR is underway at the Assabet River NWR.

Table 4.1: State-listed Birds, Amphibians and Reptiles

Common Name	Status
Blue Spotted Salamander	Special concern
Spotted Turtle	Special concern
Eastern Box Turtle	Special concern
Blanding’s Turtle	Threatened
Sharp-shinned Hawk	Special concern
Cooper’s Hawk	Special concern
Blackpoll Warbler	Special concern
Northern Parula	Threatened

Source: Assabet River Comprehensive Conservation Plan

4.2 Cultural Resources

Some prehistoric sites have been identified in the refuge and there is a likelihood of others. Although no buildings remain, the historic period of European settlements dating from the mid-1600s through the mid-1900s is evident in the many stone walls running throughout the refuge and the occasional building foundation or chimney remnants.

Most buildings and facilities from the military period have been removed, but the military period from 1942 through 2000 is readily apparent in the network of roadbeds and rail beds that remain.

Figure 4.2 and Figure 4.3 present USGS mapping of the area shortly before and after the acquisition of the property by the Army. Comparison of the two illustrates the railway network and additional roads constructed by the Army.

The most visible of all the historic resources are the former ammunition bunkers. Figure 4.4 shows their locations. Many are along trails that were once the rail spurs to the ammunition bunkers. The 75 foot by 40 foot concrete bunkers were heavily earth covered and that cover now supports trees, bushes, and other vegetation. Some of the bunkers are opened occasionally for public tours. A few of the ammunition bunkers are being used for bat habitat.



TRANSPORTATION STUDY
ASSABET RIVER NATIONAL WILDLIFE REFUGE



--- ARNWR Boundary

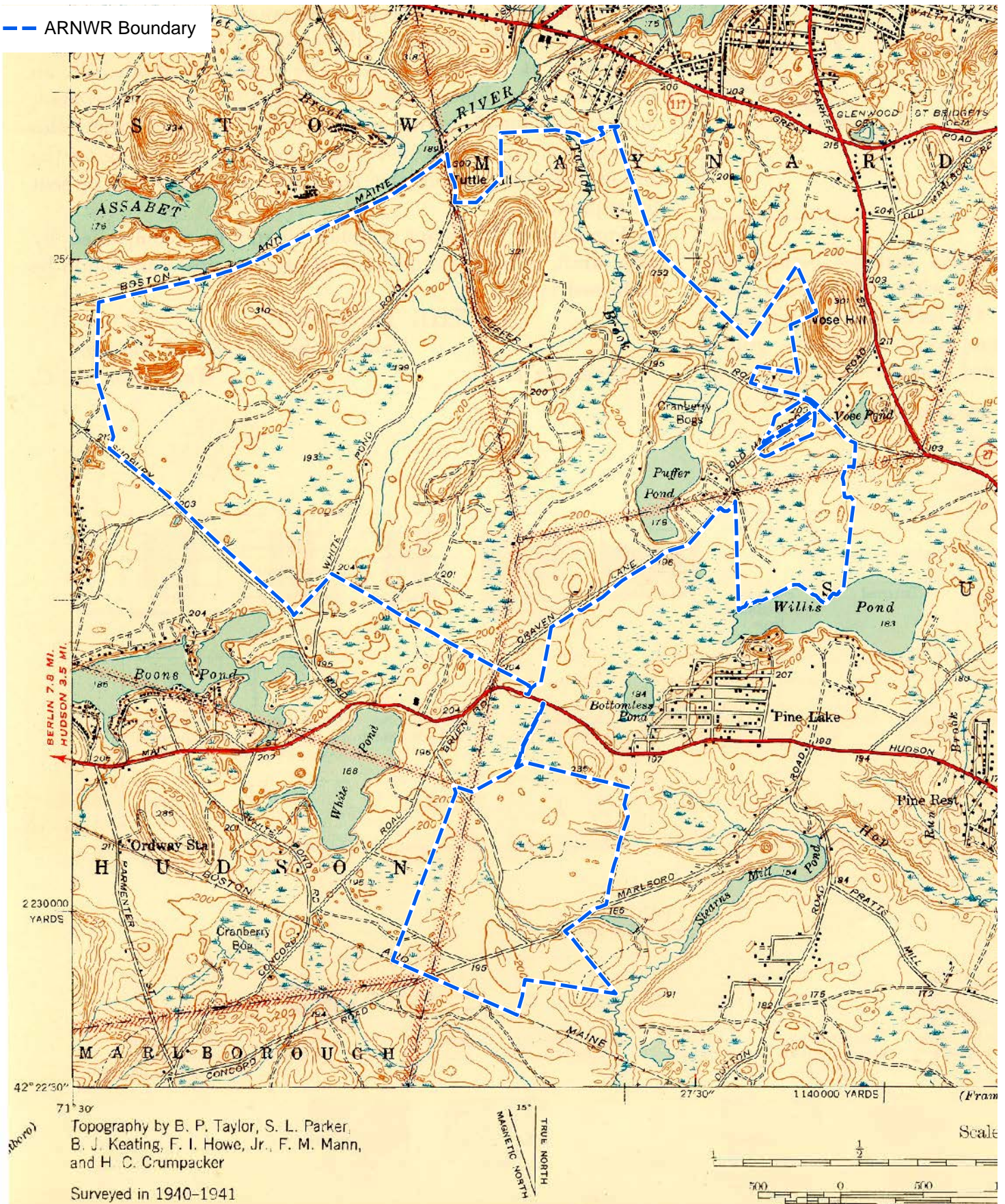


Figure 4.2
Historic USGS 1940-1941 (pre-military era)





TRANSPORTATION STUDY
ASSABET RIVER NATIONAL WILDLIFE REFUGE



--- ARNWR Boundary

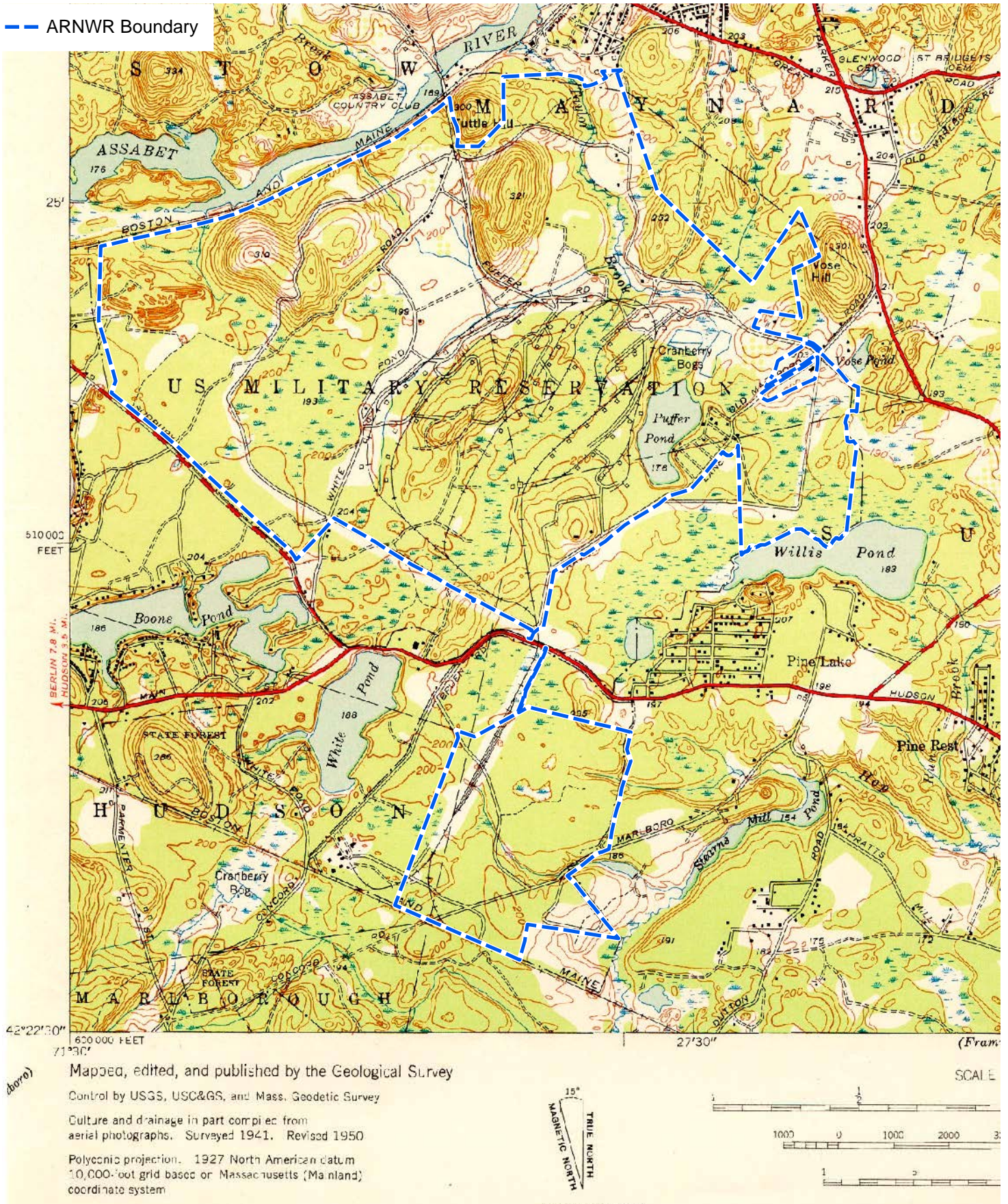


Figure 4.3
Historic USGS 1950 (military era)



TRANSPORTATION STUDY ASSABET RIVER NATIONAL WILDLIFE REFUGE

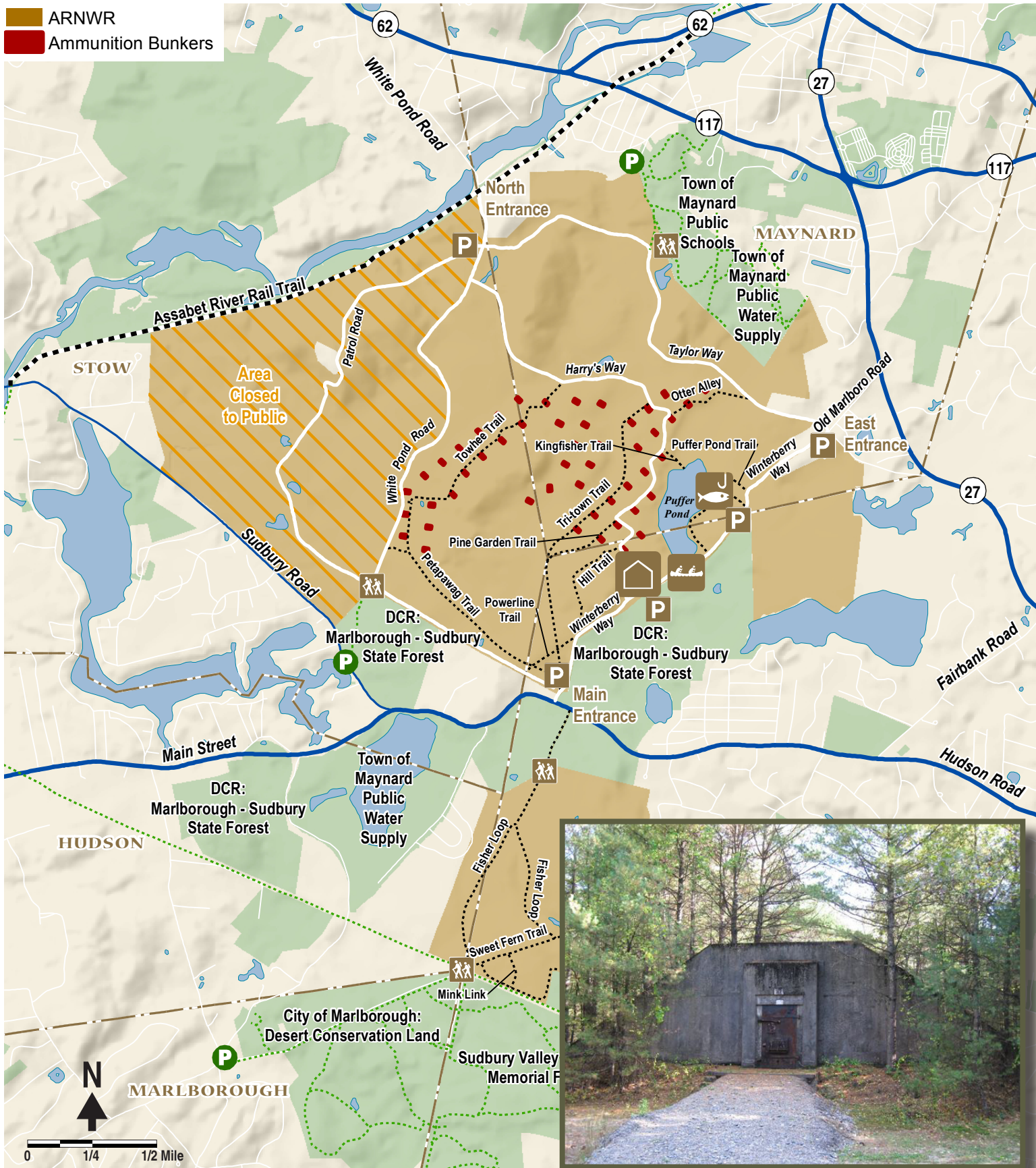


Figure 4.4
Ammunition Bunkers





5

Existing Transportation Conditions

This chapter describes existing transportation conditions at the Assabet River National Wildlife Refuge. The evaluation covers external access, internal circulation and internal transportation infrastructure.

5.1 Adjacent Land Uses

Much of the refuge is adjacent to other conservation properties. The other adjacent land uses are several single-family residential neighborhoods and two institutional properties.

5.1.1 Adjacent Conservation Lands

Figure 1.2, presented earlier, shows conservation lands adjacent to the refuge. The north tract of the refuge is bounded to the northwest by the Assabet River and the Assabet River Rail Trail, to the north by some Town of Maynard properties, and to the south by the Marlborough-Sudbury State Forest. Both the Town of Maynard and state forest properties have walking trail systems that connect with the refuge's trail system.

The south tract of the refuge is bounded to the north by a section for the Marlborough-Sudbury State Forest. The trail connection between the refuge's north and south tracts travels through the state forest.

The south tract of the refuge is adjacent at the south boundary to three conservation areas. One is managed by the Town of Marlborough, one by the Town of Sudbury, and the third by the Sudbury Valley Trustees, a non-profit environmental organization. The south tract of the refuge is also adjacent to the proposed Central Massachusetts Rail Trail, the property of which is controlled by the Massachusetts Department of Conservation and Recreation under a 99-year lease from the MBTA.

5.1.2 Other Adjacent Lands

Figure 5.1 shows the various types of non-conservation land uses near to the refuge. The highest density of land uses is to the north in Maynard. Downtown Maynard is approximately one mile from the refuge's North Entrance, at White Pond Road.



TRANSPORTATION STUDY
 ASSABET RIVER NATIONAL WILDLIFE REFUGE



- Refuge Boundary
- Residential
- Commercial/Industrial
- Participation Recreation
- Urban Public/Institutional

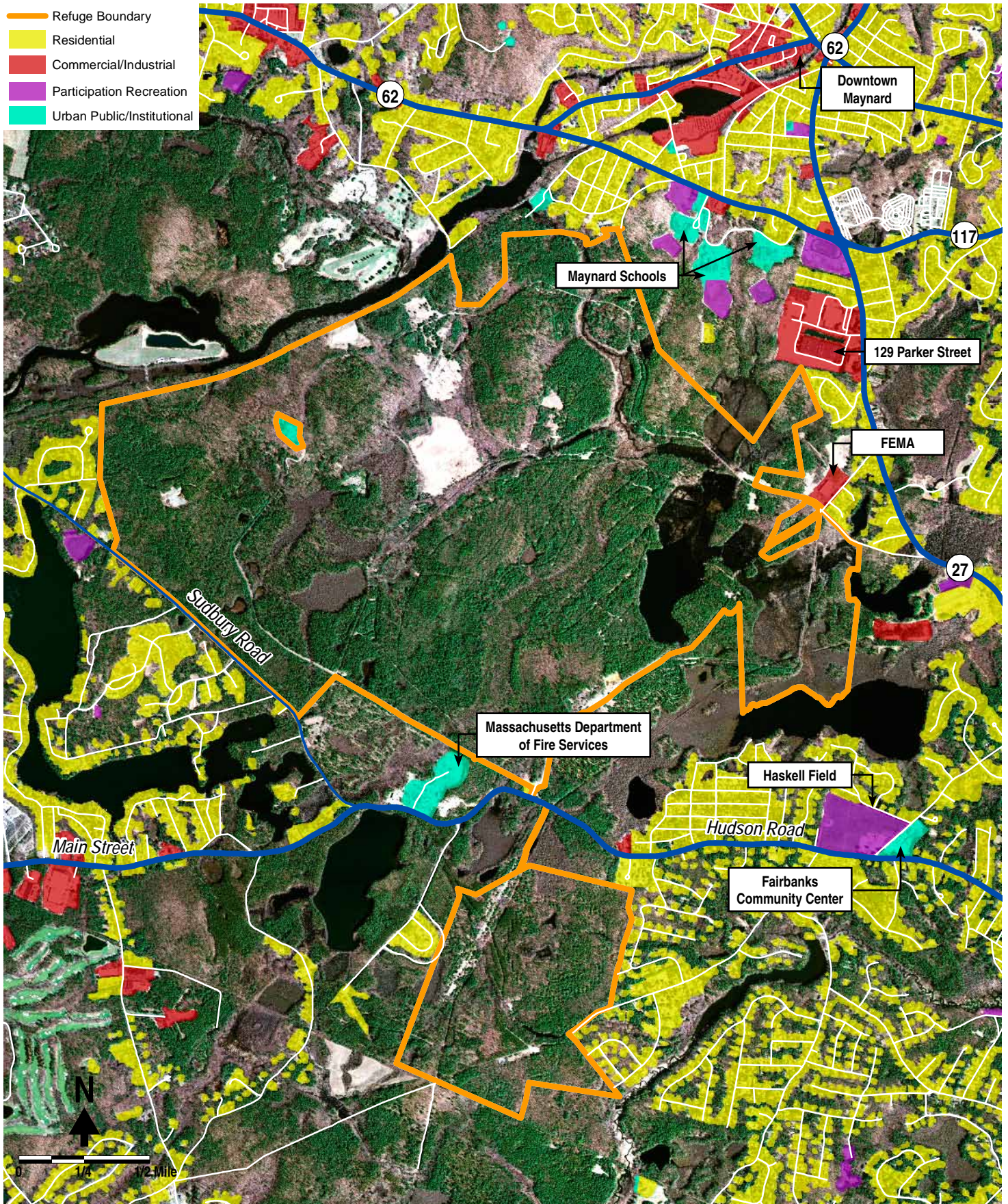


Figure 5.1
 Nearby Land Uses





To the east of the refuge, in Sudbury, is primarily single-family housing. The density of housing in Stow, to the west and northwest of the refuge, is much lower than in Maynard or Sudbury.

There are two institutional properties that are adjacent to the refuge. There is a Federal Emergency Management Agency (FEMA) facility at refuge's East Entrance on Old Marlboro Road. The Massachusetts Department of Fire Services campus is located adjacent to the refuge's Main Entrance on Hudson Road.

5.1.3 Future Development Projects

Given the large amount of conservation and other protected properties, and the established residential land uses in the area around the refuge, there is little opportunity for future significant land development projects that might have a noticeable impact on the refuge.

The Massachusetts Department of Fire Services campus has expanded in recent years, but there are no active plans to expand further. The Federal Emergency Management Agency facility may add warehousing space in the future but this would have little impact on traffic.

The development projects with the most direct impact on the refuge may occur in Maynard. In 2010, the town rezoned a large office property in the downtown to allow retail and hotel uses, and up to 200 live-work residential units. There are no plans proposed for the development at this time, but the residential units in particular could have a strong relationship to the refuge. Downtown Maynard is only one mile away from the refuge via the Assabet River Rail Trail. The other potential development in Maynard is at 129 Parker Street (Route 27). This 50-acre commercial property is located less than one mile from the refuge's East

Entrance and has been vacant for approximately 15 years. Several years ago, the property was rezoned to allow mixed-use office, retail and residential uses. However, there are no current proposals for development being considered.

5.2 Entrances to the Refuge

The refuge has three primary entrances, each with vehicle parking and all on the north tract (see Figure 1.2 for locations). Visitors can also enter the refuge via several formal walking trail connections on both the south and north tracts of the refuge.

5.2.1 Main Entrance

The Main Entrance, located along the southern border of the north tract, provides access via Winterberry Way to the Visitor Center. It is located on Hudson Road in Sudbury near the Sudbury/Stow town line. There is a small parking area adjacent to the gate. The Visitor Center is located approximately one-half mile up Winterberry Way from the gate.



Assabet River NWR sign at Main Entrance (Hudson Road)



5.2.2 North Entrance

The North Entrance is located on White Pond Road at the Stow/Maynard town line. White Pond Road is accessed via Route 62/117 (Great Road) in Stow. The entrance to the refuge is about one mile down White Pond Road from Route 62/117. The North Entrance is adjacent to the Assabet River Rail Trail.

A parking area is located about one-quarter mile inside the refuge. There is no public vehicle access beyond the parking area. The Visitor Center is located approximately two miles from the North Entrance via the Harry's Way trail.



North Entrance at White Pond Road. The parking area is located approximately one-quarter mile up the road.

5.2.3 East Entrance

The East Entrance is located in Maynard on Old Marlboro Road off Parker Street (Route 27). The entrance is the end of Old Marlboro Road, about one-quarter of a mile down from the Parker Street intersection.

The East Entrance is approximately one mile from the Visitor Center via Winterberry Way. There is no public vehicle access into the refuge at the East Entrance. A small parking lot was constructed in 2012 at the entrance and drivers no longer have to

park on the public street next to the Federal Emergency Management Agency facility.



East Entrance at the end of Old Marlboro Road, looking from within the refuge (Fall 2011). The FEMA fence line is visible to the left

5.2.4 Other Entrances

In the north tract of the refuge, there are trail connections to the Town of Maynard properties to the north and to the state forest lands to the south.

There is no vehicle access to the south tract of the refuge. There are several trail connections with the conservation properties and rail trail alignment to the south, as well as an entrance via Moore Road for the Sudbury neighborhood to the east. The north and south tracts of the refuge are connected via a trail through the state forest.



Entrance to Assabet River NWR south tract via a trail through the Marlborough-Sudbury State Forest

5.3 Visitor Travel Mode

The proximity of the refuge to neighborhoods and rail trails allows many visitors to access the refuge by foot or bicycle, in addition to by car. There is no public transit access to the refuge.

A sample of the visitor travel mode is provided by data collected between dawn and dusk on each day of the three-day Columbus Day weekend in 2011. Cameras were used to record the mode of travel for those entering the refuge at the three primary entrances. The data are summarized in Table 5.1.

Although private automobiles are the dominant travel mode, accounting for about 72% of total observed visitation during this survey time period, bicycle and pedestrian access of, respectively, 17% and 11% were notable for a suburban destination. Indeed, at the North Entrance, 36% of all observed entering visitors used a bicycle and another 16% walked in, in contrast to only 48% arriving by car. At the East Entrance, the auto, bike, and walk access percentages were more balanced at 37%, 32% and 31%, respectively.

Table 5.1: Visitor Travel Mode

	No. of Visitors	Access Mode		
		Car	Bike	Walk
Main Entrance	460	377	51	32
North Entrance	100	48	36	16
East Entrance	65	24	21	20
	625	449	108	68

	No. of Visitors	Access Mode		
		Car	Bike	Walk
Main Entrance	460	82%	11%	7%
North Entrance	100	48%	36%	16%
East Entrance	65	37%	32%	31%
	625	72%	17%	11%

Source: Data collected by VHB on October 8-10, 2011 from 6:30 am to 6:30 pm.

5.4 Pedestrian Access to the Refuge

There is generally good pedestrian access to the refuge. However, the number of people who walk to the refuge is limited by the total distance they would need to travel when also considering walking distances within the refuge.

5.4.1 North Entrance

There are neighborhoods in both Stow and Maynard near the North Entrance. From Stow, the refuge can be reached via White Pond Road. There are no sidewalks along the road but traffic volumes are low and people routinely walk along the road. However, vehicle speeds are a concern voiced by some residents at the project’s first public meeting.

Pedestrian access from Maynard to the North Entrance is via a section of the Assabet River Rail Trail. The rail trail extends directly to downtown Maynard, one mile away, and passes through several established neighborhoods.



5.4.2 East Entrance

The East Entrance has pedestrian access from the small neighborhood along Old Marlboro Road. Other, larger neighborhoods are located north the Old Marlboro Road/Route 27 intersection, but there are currently no sidewalk connections. Fortunately, the Town of Maynard is planning to construct 1,200 feet of sidewalk on the east side of Route 27 between Old Marlboro Road and Vose Hill Road. This project will connect Old Marlboro Road to a sidewalk network stretching into downtown Maynard.

5.4.3 Main Entrance

The Main Entrance for the refuge is located on Hudson Road. There is no sidewalk along Hudson Road west of the entrance, but there are very few residential properties within reasonable walking distance to the west.

There is a considerable amount of single-family housing in Sudbury starting about a half-mile east of the Main Entrance. There is an extensive sidewalk network in those neighborhoods and there is a paved path along the south side of Hudson Road that terminates at the refuge. Unlike the sidewalks within the residential areas, the path along Hudson Road near the refuge is not maintained during the winter.

5.4.4 Sudbury Road

Sudbury Road runs along the southwest boundary of the refuge's north tract. There is a trail connection from Sudbury Road through the state forest that is within walking distance to a low-density neighborhood off Sudbury Road, but walking is not practical due to a lack of sidewalks and high vehicle speeds of cut-through traffic.

5.4.5 South Tract of Refuge

The south tract of the refuge has an entrance at Moore Road that is accessible to pedestrians. Moore Road does not have any sidewalks but there are few vehicles on the road. Other pedestrian connections are via the trails among the conservation properties at the south end.

The most important pedestrian access to the south tract is the trail from Hudson Road through the state forest. Residents from nearby Sudbury neighborhoods can access the trail directly from the path along the south side of Hudson Road. Refuge visitors can walk from the north tract to the south tract via an unsignalized crosswalk on Hudson Road. During the public involvement process some people noted concerns with using the crosswalk due to the volume and speed of cars on Hudson Road, as well as vegetation obscuring walkers waiting to cross from the view of approaching drivers.

5.5 Bicycle Access to the Refuge

Bicycles are permitted only in the north tract of the refuge. The pedestrian routes to the east, north, and main entrances are also used by bicyclists. More regional bicycle access will be available once nearby rail trails are fully constructed. There are three rail trails near the refuge. The status and potential relationship to the refuge are summarized below. The rail trails are shown on Figure 5.2.



TRANSPORTATION STUDY ASSABET RIVER NATIONAL WILDLIFE REFUGE



Rail Trails

- Active, Paved
- Active, Unpaved
- Planned, Under Design
- Proposed

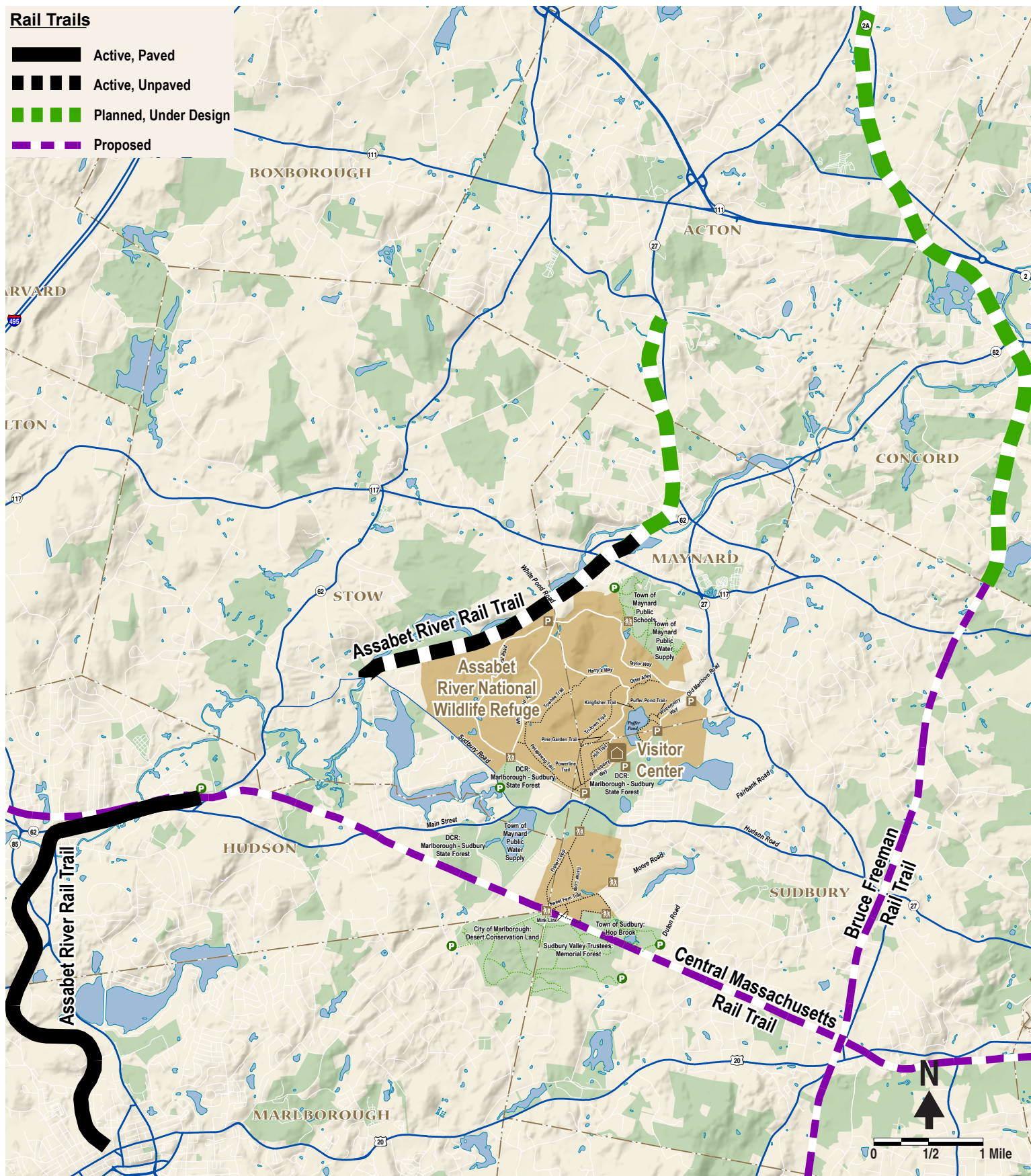


Figure 5.2
Rail Trails



5.5.1 Assabet River Rail Trail

The Assabet River Rail Trail (ARRT) runs along the northwest boundary of the refuge and will ultimately connect Marlborough to Acton via Hudson, Stow, and Maynard. Currently, a six-mile segment from Marlborough to Hudson is complete. The trailhead nearest to the refuge is almost five miles from the North Entrance and four miles from the Main Entrance.

Design of the section in Maynard, from the refuge’s North Entrance through Maynard to South Acton, is underway. A one-mile section between the North Entrance and downtown Maynard is currently unpaved but is maintained and is actively used by bicyclists. This section of the ARRT provides quick and convenient access to the refuge for bicyclists from most parts of Maynard.

An easement for the ARRT through Stow, from the refuge’s North Entrance to Sudbury Road, has been obtained. The trail is unpaved but usable, and provides a connection between the refuge and some low-density residential areas.



Assabet River Rail Trail near the North Entrance

There is one segment of the ARRT for which an easement has not been obtained and at present little

likelihood that one will be obtained in the near term. That segment is the missing connection between the sections already constructed between Marlborough and Hudson, and the existing unpaved sections in Stow and Maynard.

5.5.2 Central Mass Rail Trail

The proposed Central Mass Rail Trail (CMRT) would extend some 100 miles through Massachusetts, from Northampton to Boston. The Massachusetts Department of Conservation and Recreation controls the segments of trail near the refuge. There are currently no funding commitments for design or construction, but initial environmental permitting the eastern segment of the CMRT is underway. The DCR is preparing and Environmental Notification Form that will identify the extent of additional environmental review required.

The Central Mass Rail Trail intersects with the Assabet River Rail Trail at the trailhead in Hudson. *If bicycle use in the south tract were permitted*, the CMRT would provide the safest and most direct means to reach the refuge from that trailhead. The CMRT would also provide bicycle access to the refuge from neighborhoods in Sudbury to the east.



Central Mass Rail Trail adjacent to south tract



5.5.3 Bruce Freeman Rail Trail

The Bruce Freeman Rail Trail is proposed to follow a 25-mile route from Lowell to Framingham, and will pass through Sudbury. The northerly seven miles of the trail have been constructed, and the next 13 miles, down to the Concord/Sudbury town line, is under design.

The remaining section, through Sudbury and into Framingham, continues to be advocated for by the Friends of the Bruce Freeman Rail Trail and others, but right-of-way acquisition is incomplete and no design work is underway.

Unlike the ARRT and the CMRT, the Bruce Freeman Rail Trail alignment is not adjacent to the refuge. The closest it will be to the refuge is about 3.5 miles. It does, however, connect with the Central Mass Rail Trail and would thus provide additional connectivity to the refuge for bicyclists.

5.6 Vehicle Access to the Refuge

Some local visitors access the refuge via the North Entrance or the East Entrance, but most visitors arriving by car access the refuge via the Main Entrance on Hudson Road in Sudbury.

Those arriving from the northeast tend to be directed by the ARNWR website and brochures, the Friends group website, and by on-line and GPS mapping services, to travel south on Route 27 to Fairbank Road in Sudbury and then to Hudson Road. Those traveling from the northwest are directed down Route 62 to connect with Sudbury Road and then to Hudson Road.

Visitors arriving from the southeast are generally directed up Route 27 to where it splits from Hudson Road in Sudbury and then west along Hudson

Road. Visitors arriving from the southwest are typically directed up Route 62 to where it splits from Main Street in Hudson and then west along Main Street.

Regional visitors from the east using Route 2 are directed south to Route 62 and then Route 27. Those using Route 20 are directed north on Route 27. Those arriving from the west on Route 2 are directed south along Route 27. Regional visitors arriving from Route 495 to the west of the refuge must travel via a series of local roads to reach Hudson Road.

5.6.1 Roadway Classifications

All of the roads near the refuge are owned by the local communities. Roads such as Route 27, Route 117 and Route 62 are state-numbered roads, but are not owned by the state. Table 5.2 lists the functional classification of the roads based on the Massachusetts Department of Transportation (MassDOT) functional roadway classification system.

Table 5.2: Roadway Classifications

Road	Classification
Route 117 (Great Road)	Urban Principal Arterial
Route 27 (Parker Street)	Urban Principal Arterial
Route 62 (Gleasondale Road/Wilkins Street)	Urban Principal Arterial
Main Street	Urban Minor Arterial
Sudbury Road	Urban Minor Arterial
State Road	Urban Minor Arterial
Hudson Road	Urban Minor Arterial
Fairbank Road	Urban Collector
White Pond Road	Local

Source: MassDOT



5.6.2 Daily Traffic Volumes

MassDOT maintains a database of traffic volume data for state roadways in Massachusetts. Annual Average Daily Traffic counts for Route 117 (Great Road), Route 27 (Parker Street), and Route 62 (Wilkins Street) were available. Additional traffic counts were conducted for this study on Sudbury Road, Hudson Road, and Winterberry Way.

Weekday traffic

As shown in Table 5.3, the weekday (two-way) traffic volumes on Hudson Road at the Main Entrance to the refuge averages 9,600 vehicles. That is substantially higher than nearby on Route 62, and comparable to volumes nearby on Route 27. Weekday vehicle traffic into the refuge is light, with an average of about 125 vehicle trips into and out of Winterberry Way.

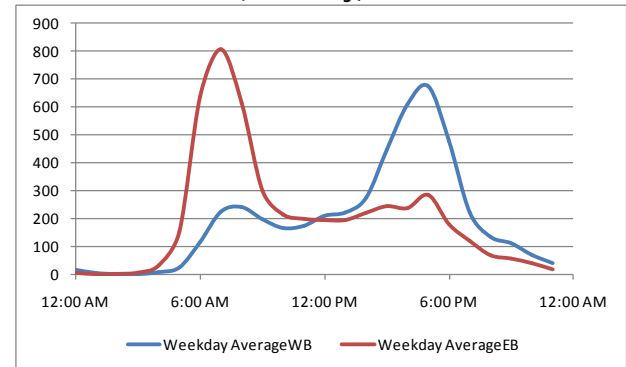
Table 5.3: Average Daily Traffic Volume (Weekday)

Road	Town	ADT (year)
Maynard Road (Rte 27)	Sudbury	10,200 (2004)
Parker Street (Rte 27)	Maynard	10,800 (2004)
Great Road (Rte 117)	Maynard	12,500 (2008)
Wilkins Street (Rte 62)	Hudson	5,000 (2008)
Sudbury Road	Stow	1,700 (2011)
Hudson Road	Sudbury	9,600 (2011)
Winterberry Way	ARNWR	125 (2011)

Source: Traffic data from 2011 collected by VHB November 12-18, 2011. All other data from MassDOT.

Figure 5.3 illustrates the influence of commuter traffic on Hudson Road. Not only do (two-way) traffic volumes spike to more than 1,000 cars per hour during peak commuting times, but the traffic is directed principally eastbound in the morning and westbound in the evening.

Figure 5.3: Hourly Traffic Volumes on Hudson Road (Weekday)



Source: Data collected by VHB November 12-18, 2011.

Weekend Traffic

Table 5.4 lists average daily traffic counts that were collected on a busy weekend in November.⁶ The traffic volumes on the roads abutting the refuge were considerably less on the weekend days than the weekdays, while the traffic volume on Winterberry Way was higher on the weekend days compared to weekdays.

Table 5.4: Average Daily Traffic Volume (Weekend day)

Road	Town	ADT (year)
Sudbury Road	Stow	1,400 (2011)
Hudson Road	Sudbury	5,600 (2011)
Winterberry Way	ARNWR	225 (2011)

Source: Traffic data collected by VHB November 12-18, 2011

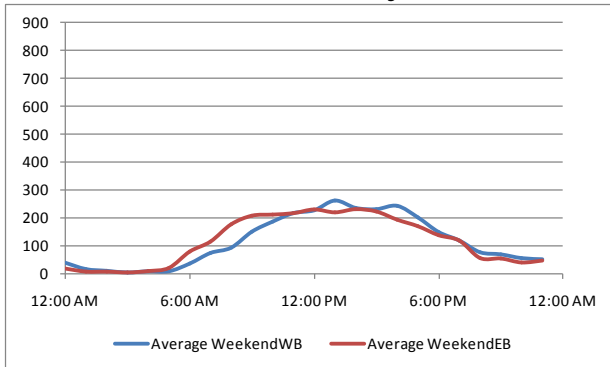
The traffic distribution and peaking patterns also differ on weekends compared to weekdays. Figure 5.4 illustrates that the traffic on Hudson Road is generally evenly distributed by direction over the course of a weekend day and that the hourly volume is more consistent on a weekend day than on weekdays. The hourly (two-way) traffic

⁶ The playing fields nearby in Sudbury were fully used, and apple orchard businesses in Stow were still very active.



volume on Hudson Road ranged narrowly from 400 to 485 during the six hours from 10:00 am to 4:00 pm when the Visitor Center was open.

Figure 5.4: Hourly Traffic Volumes on Hudson Road (Weekend day)



Source: Data collected by VHB November 12-18, 2011.

5.6.3 Motor Vehicle Crash Summary

Motor vehicle crash data were reviewed for the intersections at the refuge entrances, at nearby intersections used by visitors traveling to the refuge, and along Hudson Road near the refuge’s Main Entrance. The motor vehicle crash data were obtained from the most recent MassDOT database, which covers the years of 2007 through 2009, and from accident reports for 2010 and 2011 obtained from the Hudson Police Department.

The crash data were reviewed to determine the magnitude, type and frequency of crashes. The metric for the frequency of crashes is a “crash rate” calculated as crashes per million vehicles entering an intersection. To assess the relative safety at a location, crash rates are used to determine how the particular location compares to the average crash rate for that area. MassDOT calculates the average crash rates for intersections and roadway segments in various areas of Massachusetts.

Entrances to Refuge

Table 5.5 shows the history of motor vehicle crashes at the Main Entrance, and at the intersections leading to the North Entrance and East Entrance. The number of crashes is low, and the average annual crash rates at all three locations of 0.09, 0.26, and 0.00 accidents per million vehicles, respectively, are significantly lower than the overall average rate of 0.66 accidents per million vehicles recorded at all similar intersections in this part of Massachusetts.

Table 5.5 Crash Frequency at Entrances to ARNWR

	Winterberry Way at Hudson Road	Old Marlboro Road at Route 27	White Pond Road at Route 117
Year			
2007	0	2	0
2008	1	1	0
2009	0	0	0
Total	1	3	0
Crash Rate	0.09	0.26	0.00
Areawide Crash Rate = 0.66			

Source: VHB analysis of MassDOT Statewide Crash Data

There were no reported crashes at the unsignalized intersection of Route 117 at White Pond Road. White Pond Road provides access to the North Entrance of the refuge.

There were three crashes reported for 2007 to 2009 at the unsignalized intersection of Route 27 and Old Marlboro Road. Old Marlboro Road leads to the East Entrance of the refuge. One of the crashes was an angle collision between two vehicles and one was a single vehicle crash. There are no data on the type for the third crash. One crash resulted in a non-fatal injury; the remaining two were property damage only crashes.



There was a single crash reported from 2007 through 2009 at the Main Entrance (Winterberry Way) on Hudson Road. The crash was an angle crash that resulted in property damage only. It should be noted that the Visitor Center was not open during those years. However, a review of accident reports for 2010 and 2011 show no other crashes.

Intersections Near the Refuge

Table 5.6 shows the history of motor vehicle crashes at four (unsignalized) intersections near the refuge through which most visitors travel.

- Sudbury Road at State Road is located three-quarters of a mile west of the refuge’s Main Entrance. Visitors arriving from the west travel through the intersection
- Hudson Road at Route 27 is located about three miles from the Main Entrance and visitors from the south and east travel through the intersection.
- Fairbank Road connects Route 27 to Hudson Road and is used by visitors arriving from north of the refuge. Crash data for both intersections were reviewed.

Table 5.6: Crash Frequency at Key Intersections

Year	Hudson Road at Fairbank Road	Hudson Road at Maynard Road	Maynard Road at Fairbank Road	Sudbury Road at State Road
2007	3	6	1	2
2008	2	0	2	1
2009	2	3	4	0
Total	7	9	7	3
Crash Rate	0.63	0.52	0.59	0.27
Areawide Crash Rate = 0.66				

Source: VHB analysis of MassDOT Statewide Crash Data

All of the intersections have a crash rate that is less than the average for that area of Massachusetts. The number of accidents at the intersections ranges from one to three per year. Of the 26 crashes among the four intersections, only three involved a personal injury. Two of those occurred at the intersection of Route 27 at Fairbank Road, and one at the intersection of Route 27 (Maynard Road) at Hudson Road.

Hudson Road/Sudbury Road/State Road Corridor

The Hudson Road/Sudbury Road/State Road corridor near the Main Entrance is a heavily traveled, two-lane road. Motor vehicle crash data for the corridor within one mile of the Main Entrance was reviewed.

In the three years from 2007 to 2009 there were 16 crashes along the corridor to the west of the Main Entrance, and 23 crashes to the east. The crash rates were 1.96 and 2.03, respectively and both are below the average crash rate of 3.73 for similar road segments in that area of Massachusetts. There were no crashes reported within 1,000 feet of the Main Entrance.

5.6.3 Sight Distance at the Main Entrance

Intersection sight distance (ISD) and stopping sight distances (SSD) were measured at the Main Entrance intersection of Winterberry Way and Hudson Road. As shown in Table 5.7, all sight distances were within acceptable ranges.

At this intersection, stopping sight distance is the distance required for a vehicle on Hudson Road to perceive a situation, react, and come to a complete stop. Intersection sight distance is the distance necessary for a driver exiting Winterberry Way onto Hudson Road to do so safely.



Table 5.7: Sight Distances at the Main Entrance

	Desirable (feet)	Observed (feet)
Intersection Sight Distance		
Looking West	375	440
Looking East	430	1,250
Stopping Sight Distance		
Traveling Eastbound	290	420
Traveling Westbound	290	1,210

Note: Desirable sight distances are as per A Policy on Geometric Design of Highways and Streets (AASHTO, 2004) for the observed speed of 39 mph.

5.6.3 Planned Area Transportation Improvement Projects

The State Transportation Improvement Plan (STIP) was reviewed for projects planned near the refuge. There are no roadway projects currently on the STIP that would likely have a noticeable impact on the traffic network near the refuge.

5.7 Mobility and Transportation Infrastructure within the Refuge

The refuge contains 15.4 miles of trails and roads open to the public, including 7.7 miles on which bicycles are allowed. There are 1.3 miles of road open to private vehicles and several miles of roads restricted for use by USFWS and two easement holders. In addition, most of the trails are occasionally, but routinely, traveled by USFWS motor vehicles for administrative and management purposes.

5.7.1 Parking

There are five designated public parking areas within the refuge providing a total of 111 parking spaces. All have been constructed within the past three years and are in excellent condition.

There is a 9-space parking lot at the Main Entrance, 48 spaces near the Visitor Center, and 15 spaces at the end of Winterberry Way near Carbury’s Trail. All three parking areas were constructed in 2009.

The parking for the North Entrance had been at a graveled area off of Patrol Road. It was replaced in 2012 by a larger, paved parking lot off White Pond Road. A simultaneous construction project was an eight-space gravel parking lot at the East Entrance. Before the new parking lot was built there had been no designated parking at the East Entrance and visitors parked on street at the end of Old Marlboro Road.

Table 5.8: Parking Inventory

Parking Lot	Standard Spaces	Accessible Spaces	Total Spaces
North Entrance	29	2	31
Main Entrance	8	1	9
Visitor Center	46	2	48
Carbury’s Trail	14	1	15
East Entrance	7	1	8
Total	104	7	111

Occupancy of the parking areas along Winterberry Way (Main Entrance, Visitor Center, Carbury’s Trail) was recorded using time-lapse cameras during an 11-day period in October of 2011 to better understand how the parking lots are utilized.

Table 5.9 shows the maximum parking occupancy for each of the lots on each of the 11 days. It should be noted that during this period the refuge hosted some events for the public including a Bunker Tour (10/15/2011), a Birding Walk (10/16/2011), a Nature Walk (10/23/2011), and a Historical Tour by bus (10/23/2011).



**Table 5.9: Peak Parking Lot Occupancy,
October 13-23, 2011**

	Main Entrance	Visitor Center	Carbary's Trail
Thursday	4	X	2
Friday	2	X	1
Saturday	8	27	3
Sunday	8	30	4
Monday	9	16	4
Tuesday	8	13	4
Wednesday	1	22	2
Thursday	5	11	3
Friday	4	22	3
Saturday	9	31	3
Sunday	7	45	6
Max Occupancy	9	45	6
No. of Spaces	9	48	15
% of Capacity	100%	94%	40%

Note: Occupancy counts were recorded by camera from dawn to dusk each day. No counts are available for the first two days at the Visitor Center due to rain and fog.

The parking at Carbary's Trail never had more than four of the 15 parking spaces occupied. Parking at the Visitor Center, which included USFWS vehicles and those of staff and volunteers, was never more than half full on weekdays and typically never more than two-thirds full on weekend days. The only time the Visitor Center parking was almost full was the Sunday when there was a historical tour with 50 participants.

The 9-space parking lot at the Main Entrance reached capacity (excluding the handicap parking space) on five of the 11 days. However, the parking lot was full only 3.5 hours over the 11 days.

The information recorded by the cameras also allowed the parking duration of the cars in the Main Entrance lot to be quantified. The average parking duration on a weekday was 1.0 hours and the

average parking duration on a weekend day was 1.4 hours.

5.7.2 Motor Vehicle Circulation

Most of the trails in the refuge are occasionally traveled by USFWS motor vehicles for administrative and management purposes, but motor vehicle circulation is generally limited to the roads and ways in the north tract.

Roads Open to Private Vehicles

The refuge has 1.32 miles of roads that are open to public vehicles. This consists of a 0.28-mile section of White Pond Road that provides access to the parking area at the North Entrance and a 1.04-mile section of Winterberry Way from the Main Entrance, past the Visitor Center, to Carbary's Trail. Winterberry Way was constructed in 2009/2010 and is in excellent condition. The segment of White Pond Road was noted in a 2010 study⁷ as "poor" and in need of rehabilitation.

Traffic volumes on the public roads are relatively low. Table 5.10 shows the daily two-way traffic volumes for a sample week in November.

**Table 5.10: Winterberry Way Daily Traffic
Volumes, November 12-18, 2011**

Day of Week	Two-way Traffic Volume
Saturday	86
Sunday	139
Monday	66
Tuesday	58
Wednesday	78
Thursday	53
Friday	65

⁷ *The Road Inventory of the Assabet River National Wildlife Refuge, September 2010. Federal Highway Administration, Central Federal Lands.*



Other Roads

Patrol Road, White Pond Road, Harry’s Way, Taylor Way, and Winterberry Way are routinely travelled by USFWS motor vehicles for management purposes. Some of the roads are also occasionally used by the U.S. Air Force, the Federal Emergency Management Agency (FEMA), and by a twice-yearly bus tour.

Figure 5.5 depicts the access easements provided to the Air Force and FEMA. The Air Force owns a small property within the refuge and has an easement along the length of Patrol Road and the section of White Pond Road near the North Entrance. FEMA has one easement along Harry’s Way, part of White Pond road and part of the old Trail B, and a second easement along parts of Winterberry Way and Puffer Pond Trail.

The use of the roads by the easement holders is minimal. The Air Force has recently dismantled the weather station on their property and FEMA has not used the Harry’s Way easement recently. The Winterberry Way easement is used by FEMA occasionally for maintenance purposes.

Bus tours of refuge’s historical sites have been conducted for more than 10 years – even before the public opening of the refuge. The tours are operated by the Friends of the Assabet River NWR. Tours are conducted once in the spring and once in the fall. A single tour trip of 40 people is made using a standard school bus. The bus tour route is along Patrol Road, White Pond Road and Harry’s Way.



The twice-yearly bus tours sell out quickly. The 2 ½ hour tour includes stops at old home site locations and one of the ammunition bunkers.

The conditions of the restricted roads (those used by vehicles other than private vehicles) are depicted on Figure 5.6. The conditions vary from good to poor. There are also some sections among those roads that are subject to seasonal flooding. One is on Taylor Way near Otter Alley and the other is the gravel section of Winterberry Way between the East Entrance and Puffer Pond Trail. Water levels adjacent to a segment of White Pond Road have risen substantially in the past few years due to beaver activity, but the road is not currently subject to flooding.



Concrete sluice on Taylor Way between two wetland areas.



TRANSPORTATION STUDY
ASSABET RIVER NATIONAL WILDLIFE REFUGE

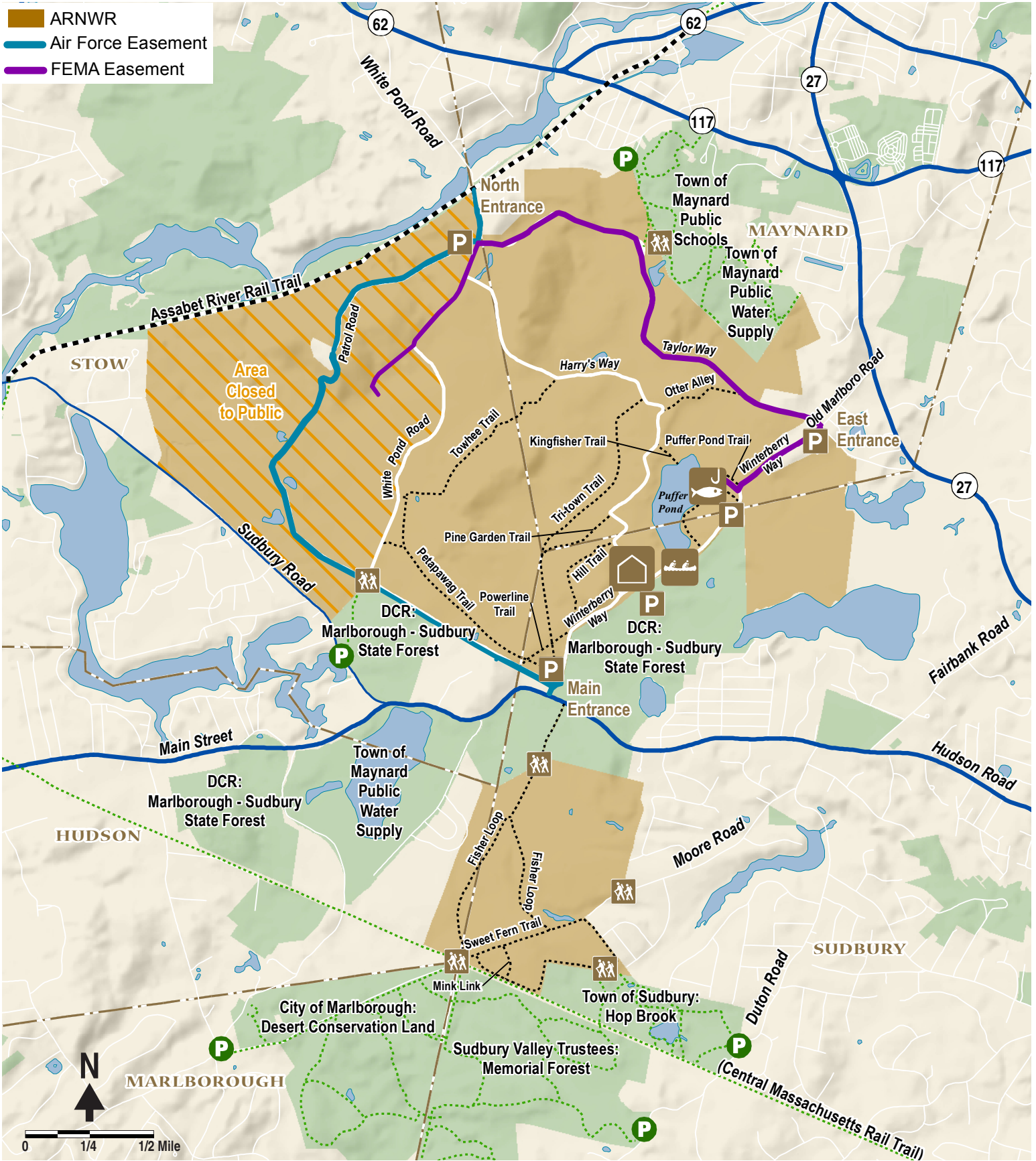


Figure 5.5
Access Easements



TRANSPORTATION STUDY
ASSABET RIVER NATIONAL WILDLIFE REFUGE

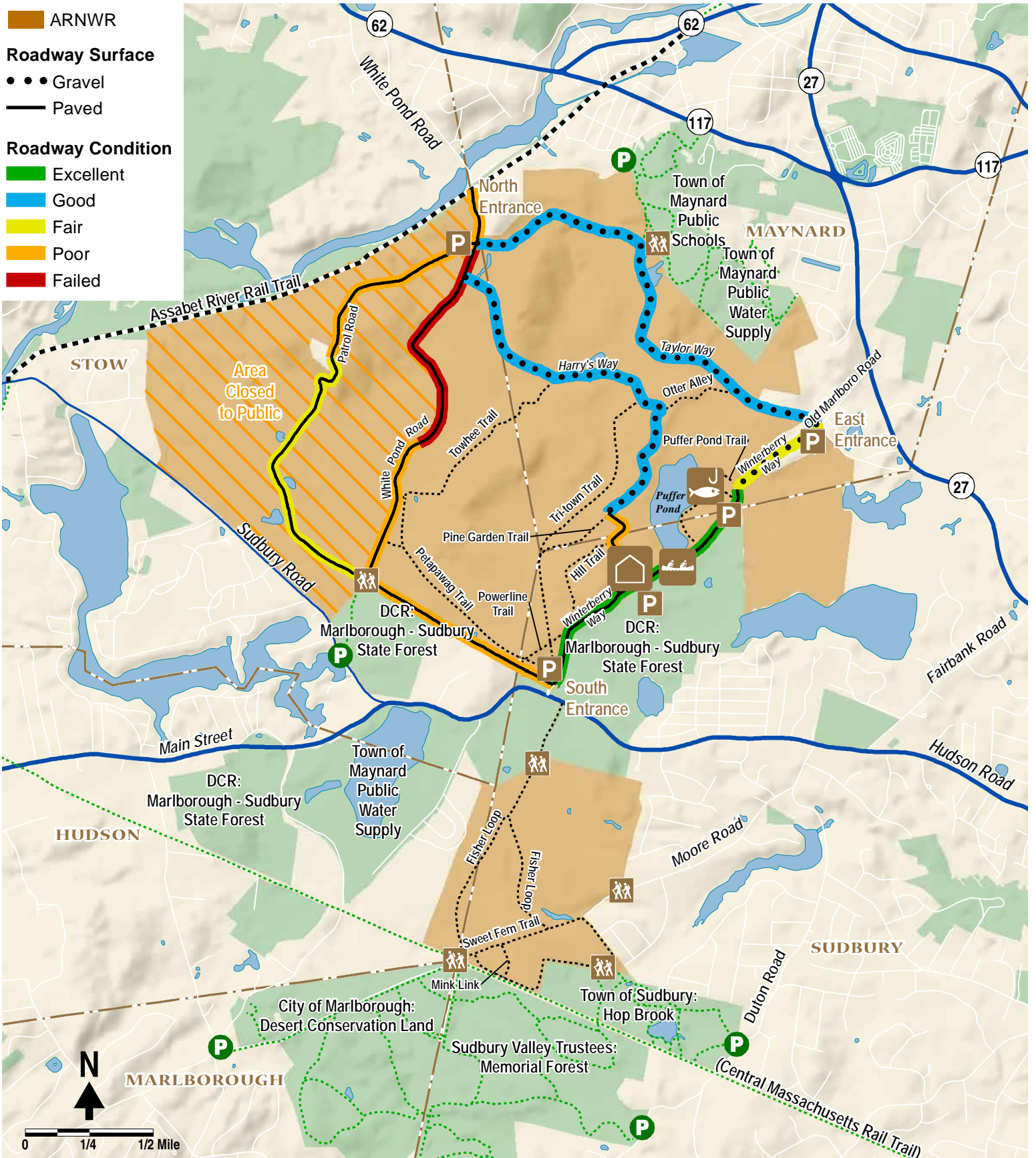


Figure 5.6
Roadway Condition





Although conditions on the restricted roads are often graded as “fair” or “poor” as part of standard pavement management evaluations, the conditions have little day-to-day impact on the circulation of vehicles. The roads are infrequently used and the vehicles that travel the roads tend to be heavy-duty service vehicles capable of operating on even native surfaces if need be.

The most significant issue with the roadways is not that it is difficult for USFWS and other vehicles to travel upon them, but that many of the roads are shared with walkers and bicyclists and during wet conditions even occasional vehicles can cause ruts and other damage. The resulting ponding and uneven surfaces can inconvenience both walkers and bicyclists.



Ponding in tire ruts along Otter Alley.

5.7.3 Bicycle Circulation

Bicycles are allowed on some roads and ways to encourage travel to the refuge by bicycle, and to enhance access within the refuge to wildlife-dependent uses. All the roads and ways where bicycles are allowed are in the north tract of the refuge.

Table 5.11: Roads and Ways on which Bicycles are Allowed

Name	Length (miles)		Total
	Paved	Unpaved	
Winterberry Way	1.0	0.5	1.5
Taylor Way		1.8	1.8
Harry’s Way	0.4	1.5	1.9
White Pond Road	1.7		1.7
Patrol Road*	0.8		0.8
Total	3.9	3.8	7.7

* Between White Pond Road and Winterberry Way

Note: Distance and surface from The Road Inventory of the Assabet River National Wildlife Refuge.

Bicycling is a popular activity at ARNWR. On the three-day Columbus Day weekend in October 2011 more than 100 people arrived at the refuge by bicycle (see Table 5.1). Others drive to the refuge, park, and then bicycle around the refuge. The parking lot at the Main Entrance is the most popular parking location for those visitors. Observations indicate that most of the bicyclists who park near the Main Entrance travel on Patrol Road toward White Pond Road. Some, particularly those with small children, use the path along Winterberry Way.

The trails used by bicyclists are a mix of paved and unpaved surfaces. The trail conditions are such that the trails are generally appropriate for casual bicycle use, even by families with young children, but they are not suitable for fast road-bike travel.

The paved surfaces, except for Winterberry Way, have not been maintained since long before the property was transferred to the U.S. Fish and Wildlife Service. The paved surfaces are heavily cracked, often heaved and rutted, and sometimes potholed.

The unpaved surfaces on most of the trails are rutted and uneven due to the impact of vehicles and



bicycles during wet conditions. Trails are generally at least 10 feet wide, which is typical of a multiuse path, but the rutting and other trail conditions sometimes makes it difficult for bicyclists to pass walkers without the walkers stepping aside.

The most difficult bicycle surface conditions are experienced along Taylor Road and the segment of Winterberry Way between the East Entrance and Carbary’s Trail. The same seasonal flooding conditions that affect motor vehicle circulation affect bicyclists. In addition, there are some sections of Taylor Way where the surface is a soft, sandy soil.



Taylor Way near the North Entrance is a section of soft sandy soil that is difficult to bicycle.

5.7.4 Hiking and Walking

The refuge has 15.4 miles of trails open to the public. The majority, some 12.7 miles, are located in the north tract. Table 5.12 lists the length of the trails and whether the trails are also used by bicyclists and motor vehicles.

Table 5.12: Walking Trails in the ARNWR

Name	Length (miles)	Shared with Bicycles	Shared with Cars*
North Tract			
Winterberry Way	1.5	No	No
Taylor Way	1.8	Yes	Yes
Harry’s Way	1.9	Yes	No
White Pond Rd	1.7	Yes	No
Patrol Road	0.8	Yes	Yes
Puffer Pond Trail	0.4	No	Yes
Carbary’s Trail	0.1	No	No
Petapawag Trail	0.9	No	No
Towhee Trail	1.0	No	No
Otter Alley	0.3	No	No
Powerline Trail	0.2	No	No
Sandbank Trail	0.1	No	No
Tebassa Trail	0.1	No	No
Tri-Town Trail	1.2	No	No
Pine Garden Trail	0.3	No	No
Hill Trail	0.4	No	No
Total North Tract	12.7		
South Tract			
Fischer Loop	2.3	No	No
Mink Link	0.1	No	No
Sweet Fern Trail	0.3	No	No
Total South Tract	2.7		
Total	15.4		

* Refers to cars associated with easements held by FEMA and the U.S. Air Force. There is no private vehicle access on these trails. USFWS vehicles use all trails occasionally for management purposes.

Note: Lengths of trails from The Road Inventory of the Assabet River National Wildlife Refuge and the ARNWR Trail Guide.

The trail network provides access to a wide variety of forest and water habitats, the Visitor Center, the fishing area, and many of the ammunition bunkers. Most of the trails are along old roadbed and rail



beds and about five miles of the trails have some paved surface.

Some trails are affected by seasonal flooding. These include Otter Alley, a section of Taylor Way near Otter Alley, and a section of Winterberry Way near the north section of Puffer Pond Trail.

The paved surfaces of trails that are along old roadbeds have not been maintained since they were used by the military and all of them have drainage problems. The crowning of the surface has deteriorated and there are usually ruts that retain stormwater. This not only inconveniences those walking on the trail, it also hastens the deterioration of the trail surface.



Example of ponding on Harry's Way

5.7.4 Handicap Accessibility

The refuge provides many opportunities for those who are mobility impaired, albeit in a limited area of the refuge. The Visitor Center is handicapped accessible; the one-mile path parallel to Winterberry Way is accessible and travels along woods and offers views of Puffer Pond; and there is a section of Harry's Way that provides an accessible route from the Visitor Center to one of the ammunition bunkers.

On the other hand, while the pier at the Barron Fishing Access site is fully accessible, the 500' path to it is not. Nor is the canoe launch at Puffer Pond handicap accessible.

One handicap accessibility issue has been addressed by the construction of new parking areas at the North Entrance and East Entrance. Previously, there was no accessible path past the gates at those locations. Visitors using wheelchairs could not enter the refuge at either entrance. The new parking lots include accessible paths from the parking areas into the refuge.

The chief issue with handicap accessibility at the refuge is providing accessibility to more areas and to a wider variety of habitats. There is currently no handicap accessibility to the edge of a pond or wetlands and the accessible trails are typically accessed via the Main Entrance. The trails near the East Entrance are rough, and although there are some segments of accessible trails near the North Entrance, they are not linked and there is no opportunity for a fully accessible loop.

5.8 Major Transportation Issues and Challenges at the Refuge

Many of the major transportation issues and challenges at ARNWR were identified by USFWS prior to this study and have been reviewed as part of the existing conditions work, and other issues have been identified during the existing conditions phase of work by stakeholders and the public. A summary of those issues and challenges follows.

5.8.1 Visitation Data

Visitation data are collected only at the Visitor Center, which is only open Thursday through Sunday. Vehicle counters for Winterberry Way and



the parking lots, and trail counters for key locations, would provide more accurate information on the number of visitors and their pattern of use. This will enable future transportation and program planning to better meet the needs of the visitors and the refuge in a cost-effective way.

One element of visitation data is scheduled to be addressed in 2012. Assabet River National Wildlife Refuge was selected to be part of the USFWS Visitor Use Survey, which should provide some useful information about visitor use and experience.

5.8.2 Maintenance of Trails, Roads and Ways

The maintenance of the trails, roads and ways in the refuge is the most challenging of the transportation issues. Except for Winterberry Way, none of the trail surfaces have been maintained since long before the refuge was established. Paved surfaces have deteriorated and unpaved surfaces are rutted. The loss of the crowning of the surface profile, as well as the loss of drainage swales, has hastened the damage by water flow.

Some trails are protected by tree cover, and others are appropriately maintained as a native surface, but those roads and ways used by bicycles and motor vehicles require extensive rehabilitation or reconstruction.

Financial resources for construction and maintenance of the roads and ways are limited. The financial constraints will affect decisions about investments in roads and ways to support bicycle use and handicap accessibility.

5.8.3 Parking

Construction projects were completed in 2012 that approximately doubled the capacity of public parking areas at the North Entrance and the East

Entrance. This appears to be appropriate for accommodating reasonable expectations of future visitation levels at the refuge.

Parking utilization data collected in 2011 show that parking at the Main Entrance is sometimes full and that parking at the Visitor Center may sometimes nearly reach capacity during larger events. Construction of additional parking is one means of addressing existing and future parking shortfalls. The amount of new parking required can be mitigated by policies such as encouraging non-automobile access to the refuge, parking management during events, and making better use of parking on adjacent state forest lands.

5.8.4 Wayfinding

Wayfinding is a challenge for some visitors traveling to the refuge. There has never been any wayfinding signage external to the refuge. The installation of appropriate wayfinding signs will provide better guidance for first-time visitors, as well as make those other drivers who see the signs aware of the refuge.

The issue of wayfinding extends into the refuge. Some visitors do not understand that the Visitor Center is located a half-mile from the Main Entrance and instead see only the small parking lot. At the North Entrance, some visitors are unaware that the parking area is a quarter-mile inside the refuge.

There are also opportunities to provide visitors with more information about exploring the refuge by providing brochure and map information at additional kiosks and digitally by the use of QR Code tags at trailheads.



5.8.5 Transportation Safety

The speed and volume of traffic on, and character of, Hudson Road create some safety concerns at the refuge's Main Entrance. There are issues with pedestrians crossing the road to travel between the north and south tracts or to neighborhoods in Sudbury, and with eastbound vehicles entering the refuge. The relatively low volume of traffic entering the refuge can result in through-traffic drivers being unprepared for vehicles slowing to turn left into the refuge.

The options for addressing safety concerns range from near-term projects of signage, lighting and maintenance of roadside vegetation, to long-term projects such as constructing a left-turn lane or relocating the entrance.

5.8.6 Handicap Accessibility

Providing handicap accessibility to the canoe launch and the fishing area at Puffer Pond is a priority for the refuge. There are also many other opportunities to enhance the experience at the refuge for all those who are mobility impaired.

Some of these opportunities may be achieved through policy changes such as where disabled hunters may take their cars. Others could be realized through education outreach programs oriented to those who are physically disabled. A mobility-assistance shuttle service would increase access within the refuge for many visitors.

Some opportunities can be achieved by physical improvements. Rehabilitation of the existing trails to eliminate ruts and uneven surfaces would benefit all persons with mobility disabilities. Some trails could be reconstructed to be fully handicap-accessible, particularly those in areas that provide access to a wider variety of habitats than provided the existing accessible trail network.

5.8.7 Community Connections

The refuge benefits from the existing pedestrian and bicycle connections with nearby neighborhoods. They facilitate visitation while mitigating the need for additional on-site motor vehicle parking.

The North Entrance and the Main Entrance have good pedestrian access, and a sidewalk is planned by the Town of Maynard on Route 27 that will fill a missing link in the neighborhood sidewalk network near the East Entrance.

Bicycle access from Maynard and parts of Sudbury is also good and there are opportunities to improve bicycle access from other sections of Sudbury and from Stow and Hudson by connecting to regional rail trail projects. Completion of the Assabet River Rail Trail through Maynard will improve connectivity with the area of highest population density near the refuge. The proposed Central Mass Rail Trail is promising for its connection to Sudbury neighborhoods and to the trailhead for the Hudson section of the Assabet River Rail Trail. However, project implementation is uncertain and undoubtedly long term.

5.8.8 Educational Outreach

Educational outreach is an important objective of the refuge and a significant part of the current visitation. Transportation strategies can support educational outreach efforts in a variety of direct and indirect ways. An electric charging station provides educational opportunities. A shuttle vehicle could be available to transport school groups to learning sites within the refuge, or a shuttle service could be implemented to provide regular tours for all visitors.



6

Preliminary Conceptual Alternatives

This chapter presents the initial screening of potential projects identified during the evaluation of existing conditions and through the project’s public outreach process, including consultation with refuge staff. The purpose of the initial screening was to determine the conceptual project alternatives to advance for further, detailed evaluation, and to document those potential projects dismissed from further consideration.

6.1 Screening Criteria

General and comparative screening criteria were used for determining which of the conceptual project alternatives were advanced for further evaluation as candidate alternatives. The general criteria include consistency with the mission and policies of the National Wildlife Refuge System and the Assabet River National Wildlife Refuge. Criteria used to screen preliminary project concepts that addressed similar purpose and need included comparative factors such as the transportation benefits provided by the project, environmental and cultural impacts, constructability, cost, and the overall feasibility for implementing the project. In

addition, all conceptual projects were screened for readily apparent design or operational “fatal flaws”.

All projects advanced as candidate alternatives are consistent with the mission of the National Wildlife Refuge System to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. This includes supporting the six wildlife-dependent recreational uses defined as priority public uses of refuge lands – hunting, fishing, environmental education, environmental interpretation, wildlife observation, and wildlife photography.⁸ Policies set forth in the refuge’s Comprehensive Conservation Plan and other planning documents set some parameters for the types of transportation projects considered for further evaluation. For example, the refuge’s system of roads, trails and ways was carefully developed and no new or relocated roads, trails or ways, except for connectivity purposes, were considered in conjunction with this study.

⁸ National Wildlife Refuge System Improvement Act of 1997.



Some of the conceptual projects are “competing” projects that are alternative ways of addressing the same transportation issues. Among the factors considered in the comparative screening were the following.

- **Transportation Benefits provided by the project** – Which project alternative best achieves the identified needs for access to, and mobility within, the refuge.
- **Environmental and Cultural Impacts** – Which project alternative is best for protecting and enhancing wetlands, wildlife habitat, and historic elements.
- **Constructability** – For projects with similar benefits, which project alternative is most likely to be effectively implemented. This takes into account not only the physical constraints of the project location, but also the complexity of required permitting, number of partnerships, and the likely time frame for implementation.
- **Cost** – Which project alternative is the most cost-effective.

6.2 Preliminary Conceptual Alternatives

This section presents the preliminary conceptual alternatives identified through the existing conditions data gathering process, stakeholder input, and public outreach process. The potential projects are listed among the general categories of External Access, Internal Infrastructure, and Internal Circulation and Mobility. It is noted that often an issue can overlap with two of the main areas.

6.2.1 External Access

Based on a review of existing and projected future conditions, the following external access improvements were considered for the refuge study area.

Vehicular wayfinding signage to the refuge.

There has never been any wayfinding signage external to the refuge. Installation of appropriate wayfinding signs will provide better guidance for first-time visitors, as well as market the refuge to passing drivers. Most of the signage would be on arterial and collector roads and would lead visitors to the Main Entrance and the Visitor Center. Additional signs would be on the local roads that lead to the North Entrance and to the East Entrance. This project was advanced as a candidate alternative for evaluation.

Improve visibility of Hudson Road crosswalk.

This crosswalk is used by visitors walking or bicycling to the refuge from Sudbury via the sidewalk path along the south side of Hudson Road, and by visitors traveling between the refuge’s north and south tracts. The project is to trim vegetation near the crosswalk to make people waiting to cross more visible to approaching drivers, and to use an in-street pedestrian crossing sign on busy days. This project was advanced as a candidate alternative for evaluation.

Encourage use of existing state forest parking on Sudbury Road.

Making better use of parking on adjacent conservation and recreation lands by visitors to the refuge would provide an alternative to constructing additional parking in the refuge. The best opportunity for doing so is with the state forest parking lot on Sudbury Road. The parking lot can accommodate about a dozen cars and a short walk from the lot through the state forest property leads to the interior of the refuge at the intersection of



Patrol Road and White Pond Road. The parking lot is well used during hunting season, but it is rarely used other times of the year. This project was advanced as a candidate alternative for evaluation.

Additional parking at the Main Entrance. The 9-space parking lot at the Main Entrance is a popular location for visitors who are walking or biking on the trail networks. The parking lot is usually full at some point during busy days. Several options for creating additional parking were identified.

1. One option is to expand the existing parking area by 10 parking spaces by adding a second row of parking. This project was advanced as a candidate alternative for evaluation.
2. Another option is to create a new parking area on the adjacent gravel parking area owned by the Massachusetts Department of Fire Services. This alternative was dismissed from further consideration since the Department of Fire Services plans to re-grade and pave the parking area to accommodate continued growth in training activity.
3. A third option is to create a new parking area on the state forest land adjacent to the entrance drive, where the sign and flagpole are located. This project could provide up to about 35 parking spaces. The land would have to be obtained from the Massachusetts Department of Conservation and Recreation, and this would require action not only by the agencies involved, but also by the state legislature. This alternative was dismissed from further consideration due to the comparative advantages of the first option. The first option can be implemented without land acquisition, at a lesser cost, and provides for a better visual entrance to the refuge than would a large

parking area remote from the Visitor Center. Although the first option provides only 10 additional parking spaces, they would be sufficient on most days and additional parking capacity for the few busiest days each year is available at the Visitor Center.

Support rail trail connections. Facilitating non-motorized access to the refuge is a high priority of the refuge and is consistent with the USFWS efforts to reduce its carbon footprint. There are three rail trail projects in the refuge’s host communities that provide various levels of opportunities to enhance connectivity. They are the Assabet River Rail Trail, the Central Mass Rail Trail, and the Bruce Freeman Rail Trail.

The support for the rail trail projects involves marketing of how the trails provide access to the refuge and advocacy to support current efforts to move the trail projects through the state planning, design and funding process. For example, the recent Boston MPO FY13-FY16 Transportation Improvement Plan⁹ deferred the construction funding for the northerly section of the Assabet River Rail Trail and instead made it a “first tier” priority project for the MPO should additional funding become available. The refuge could support efforts to restore the previous funding schedule.

Signage at Main Entrance. An issue regarding uncertainty by first-time visitors as to whether they should proceed through the gate on Winterberry Way or park in the adjacent parking lot was identified through the study process. The issue arises from the Visitor Center not being visible from the gate and concern as to when the gate will be closed at the end of the day. Project elements to

⁹ Draft Federal Fiscal Years (FFYs) 2013–16 Transportation Improvement Program (TIP), Boston MPO, May 2012.



address this issue include more explicit signage directing to the parking and trails at the Visitor Center, and signs indicating when the gate will close that day. This project was advanced as a candidate alternative for evaluation.

Improved safety at Main Entrance. The speed and volume of traffic on, and character of, Hudson Road create some safety concerns at the refuge’s Main Entrance related to eastbound vehicles entering the refuge. The relatively low volume of traffic entering the refuge can result in through-traffic drivers being unprepared for vehicles slowing to turn left into the refuge. There have been no accidents at that location, but the refuge is relatively new and increased visitation is a goal. Four alternatives were identified to address the issues.

1. **Signage at Main Entrance.** Because of the lack of visibility of the Winterberry Way driveway drivers sometimes slow suddenly for the turn into the refuge, or miss the turn altogether. Advance signs for the entrance, an entrance sign closer to the road, and removing some vegetation obscuring the existing ARNWR monument sign from westbound drivers are ways to improve visibility. Reflective signs would improve conditions at night for those attending meetings at the Visitor Center. This project was advanced as a candidate alternative.
2. **Move the entrance road to the east.** This option is to relocate the refuge entrance road about 300 feet to the east onto state forest property, to where the crosswalk on Hudson Road is at present. The new alignment would be on the old rail track corridor now used for the sidewalk path from Hudson Road. The project would include reconfiguration of the crosswalk and the sidewalk path. The land would have to

be obtained from the Massachusetts Department of Conservation and Recreation, subject to approval by the state legislature. This project was advanced as a candidate alternative.

3. **Move the entrance road to the west.** This option is to relocate the refuge entrance road about 700 feet to the west, near to the Sudbury/Stow town line. The entrance road alignment would use an existing utility corridor through Department of Fire Services land and along Powerline Trail in the refuge. A sight distance analysis of this location showed that there would be little improvement over the existing location, essentially mitigating issues with the eastbound approach by creating similar issues with the westbound approach. Because the benefits are less than relocating the entrance to the east, and because it is a more costly and complex project, this project was dismissed from further consideration.
4. **Create an eastbound left-turn lane pocket.** Widening Hudson Road to provide a left-turn lane would allow through traffic to pass cars waiting to turn into the refuge. This project was advanced as a candidate alternative.

Construct parking in state forest along Hudson Road. A potential project was identified to construct a small dirt parking lot on state forest land along Hudson Road near the refuge’s main (Winterberry Way) entrance. The parking would be similar to the state forest parking lot on Sudbury Road. Several locations were considered, but all were dismissed from further consideration. Locations on the south side of Hudson Road are not practical due to proximity of wetland areas or because driveway locations on the south side would create similar safety concerns with sight distance and turning vehicles as now exist at the Winterberry Way driveway. Locating parking on the north side



of Hudson Road, to the east of the crosswalk, is constrained by wetlands and an easement for a high-pressure natural gas pipeline.

Other potential external access projects dismissed from further consideration are links to transit and connections to waterways. Supporting access by means other than private automobiles is an important goal of the National Wildlife Refuge System and the ARNWR already achieves considerable access by bicyclists and walkers. Connections to waterways and transit links are also desirable but impractical for the ARNWR. There are no public transit systems operating in the host communities and none planned. The Assabet River does not provide any practical water access since the section of river adjacent to the refuge (the Ben Smith dam impoundment) is where kayaks and canoes are put in rather than a destination from other locations along the river.

6.2.2 Internal Infrastructure

Based on a review of existing and projected future conditions, the following internal infrastructure improvements were considered for the refuge study area.

Reconstruct the North Entrance access road (White Pond Road). This 1,000-foot long section of roadway extends from the refuge boundary at the end of White Pond Road at the Assabet River Rail Trail, to the newly constructed parking area near the North Entrance gate. The 14-foot wide paved roadway is in “poor” condition based on a 2010 roadway inventory conducted by the Federal Highway Administration – Central Federal Lands Division¹⁰ and has an estimated service life of less

than five years. This project was advanced as a candidate alternative.

Reconstruction of Roads and Ways. The reconstruction and future maintenance of the roads and ways in the refuge is the most challenging of the transportation issues. Except for Winterberry Way none of the trail surfaces have been maintained since long before the refuge was established. Paved surfaces have deteriorated and unpaved surfaces are rutted. The loss of the crowning of the surface profile, as well as the loss of drainage swales, has hastened the damage by water flow.

The following projects were advanced as candidate alternatives.

1. **Patrol Road**, between Winterberry Way and White Pond Road. This 0.8-mile section of paved roadway is used not only by bicyclists and walkers, but it also provides primary vehicle access to the Air Force site in the west section of the refuge. The project would reconstruct the paved road at a reduced width.
2. **White Pond Road.** This paved road is 1.7 miles long and used by bicyclists and walkers. It is the most popular bicycle route in the refuge. The project would reconstruct the paved roadway.
3. **Harry’s Way.** This trail is used by bicyclists and walkers. It is 1.9 miles long, of which 1.5 miles is gravel and 0.4 miles is paved. The paved section connects with the Visitor Center and is handicap accessible. The project would reconstruct the paved and gravel segments separately.

¹⁰ *The Road Inventory of Assabet River National Wildlife Refuge*, Federal Highway Administration – Central Lands Division, September 2010.



4. **Taylor Way.** This 1.8 mile gravel trail is used by bicyclists and walkers. The project would reconstruct the trail with a gravel surface.

Install a charging station at the Visitor Center.

An electric vehicle charging station is in keeping with the education mission of the refuge and the carbon-footprint reduction goals of the USFWS. The ARNWR is well suited for an electric vehicle charging station due to the demographics of the gateway communities and the fact that the typical duration of visit to the refuge is about two hours and thus a single charging station might accommodate multiple vehicles each day. This project was advanced as a candidate alternative.

Traffic counters at entrances. Vehicle, pedestrian and bicycle counters at the entrances to the refuge would provide more accurate information on the number of visitors and their pattern of use. This will enable future transportation and program planning to better meet the needs of the visitors and the refuge in a cost-effective way. This project was advanced as a candidate alternative.

Electronic kiosk at Visitor Center. A park use management software system, including an electronic kiosk at the Visitor Center, would provide visitors with information when the Visitor Center is closed, allow the refuge to collect information about visitor characteristics and experiences, and provide a means to manage the fishing and hunting activities at the refuge. Like the traffic counters, the park use management system would provide data to be used for future transportation and program planning. This project was advanced as a candidate alternative.

Kiosk at the northern end of Winterberry Way.

For this project a standard informational kiosk would be installed at the terminus of public vehicle access (paved) section of Winterberry Way. It was

observed that when many of the visitors reach that location they are unsure of where they might enjoy going from there. This project was advanced as a candidate alternative.

Maintenance of Sandbank Trail canoe launch. A canoe launch for Puffer’s Pond is located off the Sandbank Trail. There is a short, unimproved path leading from Sandbank Trail down to the water’s edge. The slope down to the water is relatively steep and erosion along the path and at the shoreline is a maintenance issue. An articulating concrete block mat system would stabilize the shoreline and path. This project was advanced as a candidate alternative.

Accessible canoe launch. Providing handicap accessibility to the canoe launch is a priority for the refuge. Making the existing canoe launch location handicapped accessible was dismissed from further consideration because of grade issues that would require construction of an extensive and intrusive ramping system. There is a drop of about 10 feet to the water and this would require more than 200 feet of ramping for handicap accessibility.

The most practical means of providing an accessible canoe launch is to provide it at the Barron Fishing Access Site located at the end of Carbury’s Trail. The dock could be expanded to include additional dock platform and an accessible transfer system. This project was advanced as a candidate alternative.

6.2.3 Internal Circulation and Mobility

The conceptual project alternatives addressing internal circulation and mobility reflect the study guideline that since the refuge’s system of roads, trails and ways has been carefully developed and no new or relocated roads, trails or ways are to be considered except for connectivity purposes.



Accordingly, the conceptual projects focus on enhancing mobility among the existing travelways rather than constructing new trails.

Improve handicapped accessibility along Puffer Pond Trail and Carbury’s Trail. This is an opportunity to enhance the experience at the refuge for all those who are mobility impaired. Reconstructing Carbury’s Trail would provide an accessible trail from the parking at the end of Winterberry Way to the Barron Fishing Access Site. Reconstructing Puffer Pond Trail southerly from Carbury’s Trail to Winterberry Way would create an accessible trail along the water, something not now available in the refuge. These projects were advanced as a candidate alternatives.

Procure electric shuttle vehicle. Procuring one or more multi-passenger shuttle vehicles was identified as a means of expanding access to sites in the refuge for visitors who have mobility impairments, transporting school groups to learning sites within the refuge, and providing tours for all visitors. A multi-passenger vehicle could also be used as a parking shuttle to accommodate large meetings and events. This project was advanced as a candidate alternative.

Circulation and mobility concept alternatives dismissed from further consideration include accommodating unrestricted bicycle access on the south tract and consolidating bicycle routes within the north tract. The refuge has carefully considered both issues in the past and the current policies reflect the findings and recommendations of those analyses. Reducing the number of trails open to bicyclists in the north tract would be contrary to the compatibility determination for bicycle use in the north tract. Reducing the number of trails open to bicyclists would reduce mobility in that large area, would diminish visitor’s access to a variety of habitats, and could dissuade non-automobile access

to the refuge. Conversely, the south tract is small and easily walkable, it does not provide a unique visitor experience for bicyclists, and bicycle use in the south tract does not facilitate non-automobile access to the refuge.

Undefined future projects. There are two potential, but not certain, events that could significantly affect circulation within the refuge. The first is the construction of the Central Mass Rail Trail. For that project to facilitate non-automobile access to the refuge would require connectivity for bicyclists through the south tract and to the Visitor Center. The second potential event is the possible transfer of the Air Force easement and buildings to the USFWS. If that transfer were to occur, it would change how Patrol Road in the area of the refuge closed to public access might be used and thus affect options for roadway capital and maintenance investments.

There is no guarantee that either event will ever occur and, due to their potentially broad impacts on the refuge, if they were to happen any subsequent planned projects and policy changes would likely first need to be evaluated as part of the refuge’s next Comprehensive Conservation Plan (CCP) update. The first CCP for ARNWR was done in 2005 and they are typically updated every 15 years. Regardless of the uncertainty and long-term time frame, the significant changes to circulation that could arise should those events occur make it useful to understand how the existing transportation infrastructure might be maintained in order to not preclude later transportation planning options.

1. **Bicycle connectivity between the Central Mass Rail Trail and Visitor Center.** The proposed Central Mass Rail Trail would provide additional non-automobile access to the refuge, but since the trail connects to the refuge’s south tract there would need to be a



bicycle-usable connection through the south tract to the Visitor Center. Bicycle use in the south tract is not currently allowed and a determination of compatibility would need to be approved if the current policy were to change. The south tract is relatively small, is level and is easily walkable using the existing trail system. It also does not offer habitat significantly different than elsewhere in the refuge and so it is reasonable to assume that any determination of compatibility of bicycle use would focus on the connectivity to the Visitor Center rather than mobility within the south tract.

The most direct route is along a 1.14 mile stretch of the Fisher Loop trail that includes a segment through the adjacent state forest land. The trail surfaces include native (0.25 mile segment), gravel (0.29 miles), and asphalt (0.6 miles, most of which is within state forest land). Although the asphalt is in poor condition all of the trail surfaces are suitable for their current use as walking trails and no heavy maintenance or reconstruction would be necessary to continue use as a walking trail. On the other hand, if bicycles were to be accommodated then the entire length of the trail would need to be reconstructed as a stabilized gravel path or a paved path. The cost of doing this would exceed half a million dollars.

No infrastructure investment on the Fisher Loop trail is necessary unless the Central Mass Rail Trail is constructed and construction of the trail is uncertain. Preliminary rail trail design has recently been initiated, but there is no funding commitment and there are many other rail trail projects in the state that have been waiting 10 or more years for funding and still have no funding commitment. Nonetheless, it would be appropriate for the refuge to

coordinate with the Massachusetts Department of Conservation and Recreation (DCR) about the Fisher Loop trail and the rail trail project planning and design. The DCR not only controls the rail trail right of way, but it owns the state forest land adjacent to the refuge through which part of the Fisher Loop trail traverses.

2. **Public access to the restricted-access section of the north tract.** The section of the north tract west of White Pond Road is closed to public access. The northerly part of Patrol Road bisects the area and there has until recently been an Air Force weather monitoring facility located there. The Air Force has discontinued use of the facility and it is hoped that the land and roadway easements will be transferred to the USFWS. However, the time line for any transfer is uncertain, in part due to the buildings on site and the evaluation of options for removal or renovation.

If that transfer were to occur the options for capital investments and maintenance of Patrol Road would vary according to future administrative and public access requirements. Following are some initial findings regarding possible roadway projects.

- A preliminary review of potential circulation options should public access be restored found that most circulation options would not require transportation infrastructure projects of the types applicable to this study. Pedestrian access along Patrol Road does not require reconstructing the road, and reopening of native-surface walking trails, such as old Trail B, would also not require construction work. Accommodating bicycles on Patrol Road would require reconstruction of the



roadway, but bicycle access in the now-closed area is not necessary. The primary reason is that White Pond Road is preferred for bicycle travel over the closed section of Patrol Road. White Pond Road is level and provides access to a variety of habitats whereas Patrol Road does not offer access to any new habitats and is hilly. One section, which has a grade of about 12%, would be extremely difficult and potentially unsafe for many bicyclists, particularly the families with small children that are an important part of current visitation.

- If the area was maintained for administrative use there are many options for using the roadways and they depend on the proposed administrative use. For example, there is a gravel pit off Patrol Road that can be accessed by retaining the southerly section of Patrol Road, or by upgrading old Trail B and accessing the area via White Pond Road instead of Patrol Road. Access to the Air Force parcel could be maintained from either or both direction on Patrol Road. In addition, it may be desirable to retain the northerly section of Patrol Road to provide access to the utility line paralleling the roadway or to provide access to a planned equipment/maintenance facility. In all cases it may be desirable to decommission part of the roadway either passively by installing barriers or actively by removing the pavement and restoring the landscape.



7

Candidate Alternatives

The candidate alternatives remaining after the initial screening of the conceptual alternatives are summarized in Table 7.1. This chapter presents the conclusions of further evaluation of those alternatives. The evaluation of the alternatives includes preliminary cost estimates for implementation and ongoing operations; required coordination with municipalities and state agencies; and, as applicable, environmental issues. The findings contribute to the recommended transportation plan of prioritized projects presented in Chapter 8.

7.1 External Access Projects

The candidate alternatives related principally to external access to the refuge range from policy actions to large construction projects.

Provide vehicular wayfinding signage to the refuge. The recommended wayfinding signage plan is described in a separate technical memorandum (see appendix). The wayfinding signs cover three categories – wayfinding access from local roads to the ARNWR Main Entrance on Hudson Road, wayfinding from regional highways to the ARNWR Main Entrance on Hudson Road, and signs for the refuge’s secondary entrance.

There would be about 30 signs and the cost for materials and installation, including some police details, is estimated to be about \$10,200. If some of the signs were installed by refuge staff the cost would be lower. Ongoing maintenance costs would be limited to the occasional replacement of signs. The project requires coordination of efforts with the communities in which signs would be installed, i.e., Stow, Maynard, Sudbury, and Hudson.

Improve visibility of the Hudson Road crosswalk. This project to trim vegetation at the crosswalk near the entrance driveway and to use an in-street pedestrian crossing sign at the crosswalk. The in-street pedestrian crossing sign would be similar to that used by the Town of Sudbury at crosswalks farther east on Hudson Road near Haskell Field. The project needs to be coordinated with the Town of Sudbury as the road is owned by the town. The cost of a pedestrian crossing sign is about \$300 and annual replacement of the sign due to damage by vehicles should be expected.





Encourage use of state forest parking on Sudbury Road to access the refuge. The trail connection to the refuge can be highlighted on park mapping and parking information. Although no improvements would need to be made to the parking area, a few small directional signs would be needed at the parking lot and along the trail connection through the state forest. The project would need to be coordinated with the owner of the land, the Massachusetts Department of Conservation and Recreation. Most significantly, the trail and parking lot would need to be maintained. As with routine trail maintenance within the refuge, volunteers could be used for the project. Accordingly, both the implementation cost and annual cost are estimated to be less than \$500.

Expand parking lot at the Main Entrance. As shown in Figure 7.1, this project expands the existing parking area by 10 parking spaces by adding a second row of parking. The proposed location of the new parking spaces was landscaped as part of the original parking lot construction; however, the plantings have been destroyed by unsanctioned parking in that area when the existing parking spaces are full.

The project is located entirely on refuge lands. The project would use permeable pavement, as was done for the existing parking spaces. Design and construction costs are estimated to be \$31,000. Annual maintenance costs for the new parking are estimated to be \$500. The project is not in a floodplain and does not affect wetland areas. The project would increase the amount of paved area by less than 25 square yards.

Support rail trail connections. The three rail trail projects and their relationship to enhancing access to the refuge are as follows.

1. **Assabet River Rail Trail.** A section of Assabet River Rail Trail (ARRT) runs along the northwest boundary of the refuge. A one-mile section between the refuge's North Entrance and downtown Maynard is currently unpaved but is maintained and is actively used by bicyclists and walkers. The final design of that section and the design of its extension farther north through Maynard and into Acton is underway. This Maynard section of rail trail travels through the highest density of populations near the refuge and provides the best connectivity to the refuge of the three rail trails.

There is an existing, paved segment of the ARRT in place between Hudson and Marlborough. The trailhead in Hudson is about five miles from the refuge's North Entrance and four miles from the Main Entrance. Connectivity to the North Entrance is unlikely since a segment of the old rail line between the Hudson trailhead and the refuge's North Entrance is privately owned, but connectivity to the Main Entrance via the Central Mass Rail Trail alignment may be possible in the long term.

2. **Central Mass Rail Trail.** The proposed Central Mass Rail Trail is promising for its connectivity with Sudbury neighborhoods to the southeast of the refuge, and to the trailhead for the Hudson section of the Assabet River Rail Trail. The segments of Central Mass Rail Trail alignment near the refuge are controlled by the Massachusetts Department of Conservation and Recreation. Initial environmental permitting investigations of the rail trail has recently begun; however, there are no funding



Table 7.1: Candidate Alternatives

Description	Transportation Issues and Challenges	Benefits of Implementation	Partners	Implementation Cost	Annual O&M Cost
Provide wayfinding signage to refuge Install directional signs on area roadways	There has never been any wayfinding signage external to the refuge.	Provide better guidance for first-time visitors. More awareness of the refuge for other drivers.	Sudbury, Stow, Hudson, Maynard	\$10,200	\$100
Improve visibility of the Hudson Road crosswalk Trim vegetation and use in-street pedestrian sign	Drivers' view of pedestrians is limited.	Provide a safer environment for pedestrians.	Sudbury, DCR	\$300	\$300
Encourage use of state forest parking on Sudbury Road to access the refuge Mark trail connection to Patrol Road/White Pond Road intersection. Note parking on refuge maps.	There is limited parking within refuge.	Quick access to the interior of refuge. Lessens need to construct parking.	DCR	<\$500	<\$500
Expand parking lot at Main Entrance Add second row of parking spaces	Popular parking area sometimes fills to capacity.	Additional parking capacity (10 spaces) in busy area of refuge.	Sudbury	\$31,000	\$500
Support rail trail connections - Assabet River Rail Trail Advocate for construction of ARRT in Maynard and Acton. Market access via existing (unpaved) sections.	Multimodal access to refuge	Facilitates non-motorized access. Connectivity with downtown Maynard and South Acton.	Acton, Maynard, ARRT friends group	Negligible	Negligible
Support rail trail connections - Central Mass Rail Trail Advocate for planning, design and construction of CMRT in Sudbury	Multimodal access to refuge	Facilitates non-motorized access. Connectivity with Sudbury neighborhoods to east. Link to ARRT trail head parking in Hudson.	Sudbury, Stow, Hudson, CMRT friends group	Negligible	Negligible
Support rail trail connections - Bruce Freeman Rail Trail Advocate for planning, design and construction of BFRT in Sudbury and Framingham	Multimodal access to refuge	Facilitates non-motorized access. Connectivity with Central Mass Rail Trail.	Sudbury, Framingham, BFRT friends group	Negligible	Negligible
Modify signage at Main Entrance gate Replace existing signs. Install new ARNWR sign.	Visitor Center not readily apparent to first-time visitors. Visitors unsure of when gate closes.	Reduces visitor confusion at gate. Better awareness of Visitor Center and trail opportunities.		\$4,800	Negligible
Provide advance entrance signs on Hudson Road Install ARNWR sign at entrance and advance signs on both approaches	Entrance driveway is not readily visible, particularly at night. Safety concerns for drivers turning into refuge.	Improved safety at entrance. Fewer sudden turns by vehicles entering refuge. Reflective signs make it easier to see entrance at night.	Sudbury, Stow	\$2,000	Negligible
Move entrance driveway at Hudson road to the east Construct new driveway and sidewalk path where path is currently. Remove existing driveway pavement.	Safety concerns for drivers turning into refuge.	Improved sight distance for drivers eastbound along Hudson Road and for drivers exiting refuge.	Sudbury, DCR	\$270,000	No change from existing
Create eastbound left-turn land pocket at entrance road driveway Widen Hudson Road and create turn lane	Safety concerns for drivers turning into refuge.	Allows through traffic on Hudson Road to bypass vehicles turning into refuge.	Sudbury, DCR, DFS	\$155,000	None
Reconstruct North Entrance access road Complete reconstruction and widening of road from entrance to parking area (1,000')	Road surface not maintained since before refuge established and is in "failed" condition. Road provides only access to newly constructed parking area.	Improved access to parking area. Better accommodation of bicyclists, walkers, and vehicles.	Sudbury, Maynard	\$235,000	\$4,000
Reconstruction of Roads and Ways - Patrol Road Reconstruct 0.8 miles of paved road at reduced width	Surfaces of roads and ways not maintained since before refuge was established.	Maintains usability for bicyclists. Maintains vehicle access to Air Force parcel.	Stow, Sudbury	\$280,000	\$11,000
Reconstruction of Roads and Ways - White Pond Road Reconstruct 1.7-mile paved road	Surfaces of roads and ways not maintained since before refuge was established.	Maintains usability for bicyclists.	Stow	\$670,000	\$20,000

DCR = Massachusetts Department of Conservation & Recreation

DFS = Massachusetts Department of Fire Services



Table 7.1: Candidate Alternatives (continued)

Description	Transportation Issues and Challenges	Benefits of Implementation	Partners	Implementation Cost	Annual O&M Cost
Reconstruction of Roads and Ways - Harry's Way Reconstruct paved (0.4 mile) and gravel (1.5 mile) segments separately	Surfaces of roads and ways not maintained since before refuge was established.	Maintains usability for bicyclists.	Stow, Maynard, Sudbury	\$580,000	\$35,000
Reconstruction of Roads and Ways - Taylor Way Reconstruct 1.8-mile gravel road	Surfaces of roads and ways not maintained since before refuge was established.	Maintains usability for bicyclists.	Maynard	\$480,000	\$38,000
Install electric vehicle charging station at Visitor Center Charging station for visitor vehicles		Encourages visitation, provides educational opportunity, and is consistent with USFWS goals to reduce carbon footprint.	Maynard	\$11,6000	Negligible
Vehicle, bicycle, and pedestrian count system Software and 10 portable counters	There are no data for utilization of trails and parking. Visitation is recorded only at Visitor Center, which is open 4 days per week.	Provides information on magnitude and pattern of use for trails, parking, and roads. Provides more accurate count of visitation.		\$6,000	\$200
Electronic kiosk at Visitor Center Install i-Sportsman system	Lack of data about visitation and visitor experiences.	Provides visitors information when Visitor Center is closed, collects information about visitor characteristics, and helps manage hunting activities.		\$15,000 - \$40,000	\$1,500
Kiosk at the northern end of Winterberry Way Construct standard information kiosk	Location of trail crossings, and arrival location for many first-time visitors.	Provides visitor information at key location.		\$2,000	\$100
Maintenance of Sandbank trail canoe launch Install block mat system	Erosion is an ongoing maintenance issue.	Maintenance issue eliminated.	Sudbury	\$15,000	Negligible
Accessible canoe launch at Barron Fishing Access Site Add dock and EZ Launch system to existing fishing dock	Existing canoe launch is not handicap accessible .	Expands the refuge experience for visitors who are mobility impaired.	Maynard	\$31,000	\$100
Improve handicap accessibility along Carbury's Trail Construct 10' wide permeable concrete path	No accessible route to Barren Fishing Access Site.	Expands the refuge experience for visitors who are mobility impaired.	Maynard	\$85,000	\$600
Improve handicap accessibility along Puffer Pond Trail Construct 6' wide permeable concrete path	Limited accessible routes in refuge near water.	Expands the refuge experience for visitors who are mobility impaired.	Maynard, Sudbury	\$150,000	\$1,100
Procure electric shuttle vehicle Purchase multi-passenger, accessible electric vehicle for on-refuge use	There is no mobility assistance service available at refuge. Options for transporting school groups to learning sites within refuge is limited.	Provides option for mobility assistance. Enhances opportunities for educational outreach to school groups.		\$32,000	\$500



Figure 7.1
Additional Parking at Main Entrance





commitments for construction at this time and any substantial use of the rail trail for accessing the refuge should be considered a long-term potential. It is important to note that the Central Mass Rail Trail is located along the south boundary of the refuge's south parcel and bicycling is not a permitted use in the south tract. To provide access for bicyclists to the Visitor Center in the north tract, accommodation for bicyclists in the south tract would need to be considered.

- Bruce Freeman Rail Trail.** The Bruce Freeman Rail Trail is proposed to follow a 25-mile north-south route from Lowell to Framingham. The northerly section has been constructed and the southerly section is under design. The remaining section, through Sudbury, continues to be advocated for by the Friends of the Bruce Freeman Rail Trail and others, but right-of-way acquisition is incomplete and no design work is underway. Unlike the other two rail trails, the Bruce Freeman Rail Trail would not be adjacent to the refuge. Should the Sudbury segment be constructed, the closest it will be to the refuge is about 3.5 miles via streets with no dedicated bicycle lanes. Nonetheless, the Bruce Freeman Rail Trail does connect with the Central Mass Rail Trail and would thus provide additional connectivity to the refuge for bicyclists.

Advocacy for the advancement of the planning and design of the Assabet River Rail Trail, the Central Mass Rail Trail, and the Bruce Freeman Rail Trail is generally supported by the public, refuge partners, and refuge staff as a means of connecting to nearby neighborhoods and encouraging non-motorized access to the refuge. They have no physical impact on the refuge and no direct operational costs.

Some marketing opportunities exist today with the Assabet River Rail Trail connections and more will exist once the rail trail projects are fully realized. Brochures for the refuge can be provided at rail trail kiosks, and access to the refuge from the rail trails can be highlighted in the refuge's informational materials.

Modify signage at Main Entrance gate.

Recommendations to address signage issues at the Main Entrance gate are detailed in a separate technical memorandum (see appendix). The primary purpose of the signs is to reduce the uncertainty by first-time visitors as to whether they should proceed through the gate on Winterberry Way or park in the adjacent parking lot. The cost of the project is estimated to be \$4,800 with nominal costs for annual operations and maintenance. All of the work would be on USFWS property and no coordination with other agencies would be required.

Provide advance entrance signage on Hudson Road. This is one of three options to address safety concerns at the refuge's Main Entrance related to through-traffic drivers on Hudson Road being unprepared for vehicles slowing to turn left into the refuge. The project consists of an entrance sign where Winterberry Way meets Hudson Road, and advance signs (e.g., ASSABET RIVER WILDLIFE REFUGE, NEXT LEFT) on both approaches.

Details of the sign recommendations are provided in the memorandum that also discusses recommendations for signs at the Main Entrance gate. The cost for designing, manufacturing, and installing the reflective signs is estimated to be \$2,000. The project would involve working with the Town of Stow and the Town of Sudbury since the signs would be in public rights of way.



Move the entrance driveway at Hudson Road to the east. This second option for addressing safety concerns at the main Entrance is illustrated by Figure 7.2. The project would relocate the refuge entrance road about 300 feet to the east onto what is currently state forest property, to where the crosswalk on Hudson Road is at present. The new alignment would be along the old rail track corridor now used for the sidewalk path from Hudson Road. A new sidewalk path of pervious pavement would be constructed and the crosswalk relocated. The pavement for the old driveway section would be removed and the area revegetated.

The land for the new entrance road would have to be obtained from the Massachusetts Department of Conservation and Recreation, subject to approval by the state legislature as well as the agencies involved. The project would also involve the Town of Sudbury as the project covers a section of the Hudson Road right of way.

The project would affect up to 0.6 acres of acres of upland forest during construction, although once construction is complete the net additional paved area would only be about 500 square yards. The project would require coordination to maintain access for walkers/bicyclists and vehicles during construction. The cost of the project is estimated to be about \$270,000. The costs for maintaining the new driveway and path would not be significantly different than are the costs for the existing driveway and sidewalk path.

Create an eastbound left-turn lane pocket at the Hudson Road entrance driveway. This project provides a third option for addressing safety concerns at the Main Entrance at Hudson Road. As shown by Figure 7.3, a left-turn lane could be constructed by widening Hudson Road for about 650 feet to account for the storage area and taper for the lane.

A topographical survey is required to be certain, but it is unlikely that the widening could be accommodated entirely within the existing Hudson Road right of way. The project would thus involve some minor land taking from either the Department of Fire Services land on the north side of the road or the state forest land on the south side of the road. The project would not be in a floodplain and is not anticipated to have any impacts on wetlands although there are some wetland areas south of the road that would have to be marked and protected during construction.

The project would require traffic management to maintain traffic flow along Hudson Road during construction. The total project cost is estimated to be \$155,000. There would be no ongoing maintenance cost for the refuge since the road is owned by the Town of Sudbury. The timeframe for the project would be long range, not because of the time for planning and construction, but because of the need to meet volume-based justification criteria. MassDOT standards for left-turn lanes are generally based on the volume of turning vehicles and the volume of opposing traffic flow and current traffic volumes are not high enough to meet those warrants.¹¹

This project is an alternative to moving the entrance road to the east. Because constructing a left-turn lane accomplishes the same objective as moving the entrance, but is less costly and does not requires as extensive a land acquisition process, this project is the preferred of those two options.

¹¹ See Technical Memorandum #3 for analysis of volume-based warrants.



TRANSPORTATION STUDY
ASSABET RIVER NATIONAL WILDLIFE REFUGE



Figure 7.2
Relocate Entrance Road



TRANSPORTATION STUDY
ASSABET RIVER NATIONAL WILDLIFE REFUGE



Figure 7.3
Left-turn Lane at Main Entrance





7.2 Internal Infrastructure Projects

There are 11 internal infrastructure projects, ranging from installing a standard informational kiosk, to reconstruction of miles of trails for bicycle and pedestrian use.

Reconstruct the North Entrance access road (White Pond Road). The recent project to construct a new parking lot at the North Entrance did not include replacing the 1,000-foot long roadway leading to the parking lot. The roadway is in extremely poor condition and the project would completely reconstruct the road. The existing paved roadway surface is about 14-foot wide. As shown in Figure 7.4, the road would be widened to 18 feet to better accommodate the mix of vehicle traffic to the parking lot and those entering the refuge on foot or by bicycle. The widening would increase the paved area by about 450 square yards.

The roadway is along the Maynard/Stow town line and is close to the Assabet River. The project is estimated to cost \$235,000. Average annual costs for maintenance are estimated to be about \$4,000, to account for routine preventive maintenance such as crack filling.

Reconstruction of Roads and Ways – Patrol Road. The section of Patrol Road between Winterberry Way and White Pond Road is used by bicyclists and walkers and also provides primary vehicle access to the Air Force parcel in the section of the refuge closed to the public. This project would reconstruct the 0.8-mile segment by adding an overlay to the existing pavement. The roadway is currently 18' wide but the project would pave only 12' of width and use the remainder of the existing roadway as a shoulder. The roadway would still be able to accommodate the occasional use of the road by administrative vehicles that now occurs.

All of the work is within the existing roadway area, but parts of the road are adjacent to wetland areas and it is likely that some culvert work would also be required. Most of this stretch of Patrol Road is located in Stow, with a short segment at the southeasterly end located in Sudbury. The estimated cost of the project is \$280,000. Average annual costs for operations and maintenance are about \$11,000.

Reconstruction of Roads and Ways - White Pond Road. White Pond Road is used by bicyclists and walkers. It is a paved road that is nominally 12' wide but the footprint of the original road was wider and additional pavement exists under a thin cover of soil and plant materials. The conditions of the pavement vary along the length of the 1.7-mile road. The northerly mile of pavement was designated as “failed” by the FHWA during the 2010 road inventory and the rest of the pavement was designated as “poor”.

The entirety of White Pond Road is located in Stow. Much of the road abuts wetlands and is in floodplain areas. The paving work would remain within the existing 12' road width, but the project is likely to include work on several culverts. The project cost is estimated to be \$670,000. This assumes a full depth construction of the “failed” section and milling and overlay of the “poor” section. Average annual maintenance costs are estimated to be \$20,000.

Reconstruction of Roads and Ways – Harry’s Way. Harry’s Way is used by bicyclists and walkers. It is 1.9 miles long, of which 1.5 miles is gravel and 0.4 miles is paved. The paved section runs from the Visitor Center to some of the ammunition bunkers. The project would extend the paved section about a quarter-mile to Kingfisher Trail and would maintain the remainder of Harry’s Way as a gravel surface.



TRANSPORTATION STUDY
ASSABET RIVER NATIONAL WILDLIFE REFUGE

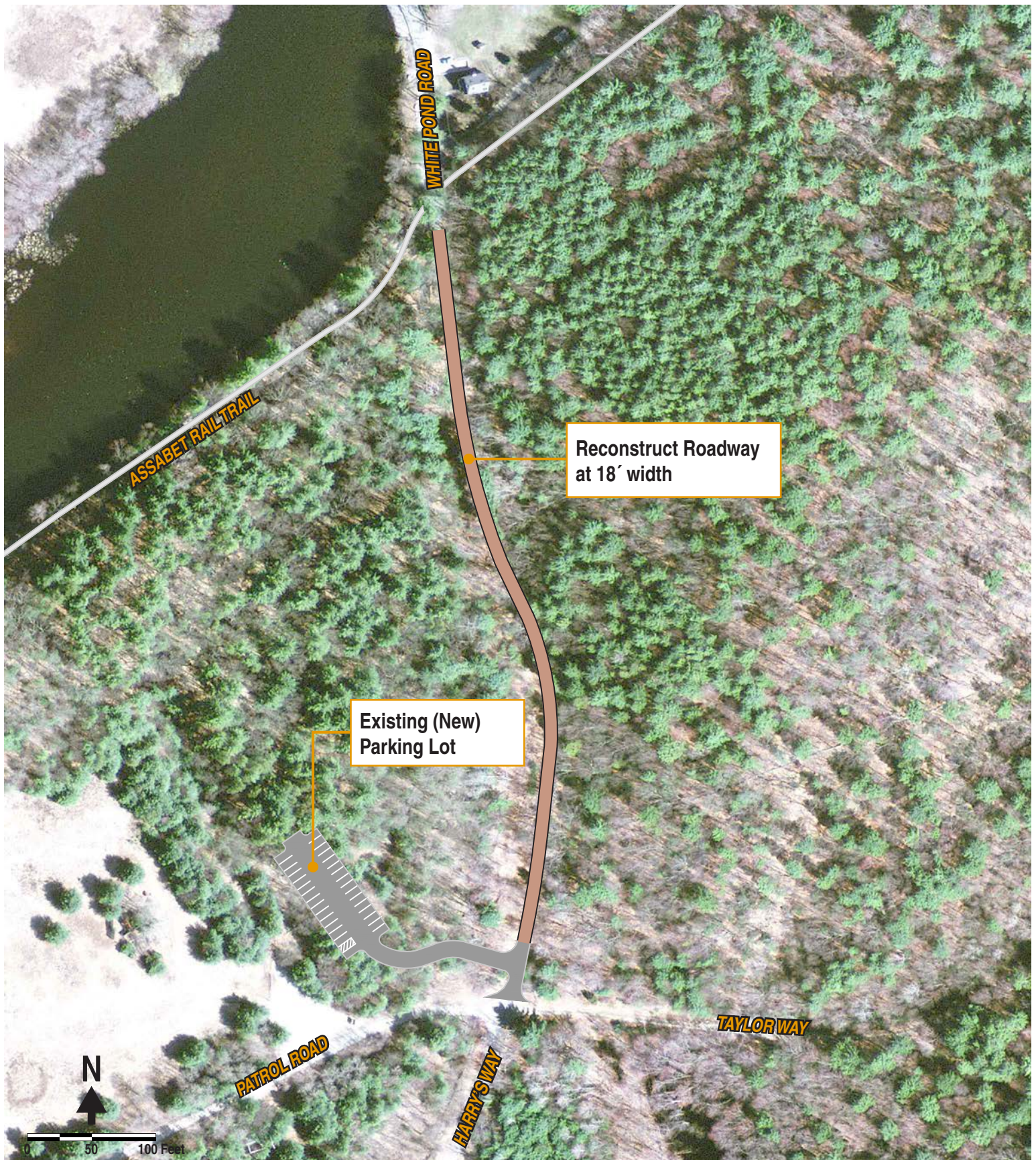


Figure 7.4
Reconstruct North Entrance Access Road





Most of Harry's Way is located in Maynard. Small sections at the north and south ends are located in Stow and Sudbury, respectively. There are two stream crossings along the gravel section and other parts of the gravel section abut wetland areas. The project is estimated to cost \$580,000. Average annual maintenance costs are estimated to be \$35,000, most of which is for the maintenance of the gravel section.

Reconstruction of Roads and Ways – Taylor

Way. Taylor Way is entirely graveled and wholly located in Maynard. There are two stream crossings and a section passes through a large wetland area. The project would reconstruct the gravel surface for the entire 1.8-mile length. The project cost is estimated to be \$480,000, with annual maintenance costs averaging \$38,000.

Install an electric vehicle charging station at the Visitor Center. A charging station at ARNWR is likely to be well used due to the demographics of the gateway communities. The cost for installing a charging station is estimated to be \$11,600 and there would be negligible operating costs if a fee were assessed for use of the charging station. The Visitor Center is located in the Town of Maynard and partnership opportunities may become available since the town is part of the state's Green Communities program.

Vehicle, bicycle, and pedestrians count system.

The data collection system for the refuge need not be overly complex to operate and maintain. Nor does the system need to provide real-time data. The TrafX vehicle and trail counter system used at some other refuges is a flexible data-logging system using small, battery operated counters and on-line software. The same counter can be used to count vehicles or bicycles, and adding an infrared sensor allows them to be used to count trail use. The vehicle/bike counters are designed to be buried

along or in a road, and the counters can quickly be repositioned as necessary. Battery life is approximately one year and the counters have can store a year's worth of hourly counts.

The cost for the basic package of software and three counters is \$2,300. Additional counters are \$525. A system of 10 counters would cost about \$6,000. The annually operating cost, primarily for the software subscription, is about \$200.

Install electronic kiosk at Visitor Center. Park management systems such as i-Sportsman are web-based and provide options for kiosk or smart phone use by visitors. The systems can provide visitors with updated information about the refuge, print maps or informational flyers, collect polling data about visitor activities, and manage the issuance of permits and revenue collection. The cost of the systems depend on the customization of the services desired. The implementation costs can range from \$15,000 to \$40,000, and annual costs for software updates and modification are estimated to be about \$1,500.

Install kiosk at the northern end of Winterberry Way. Kiosks are located at the parking lots near the three vehicle entrances to the refuge, but some visitors travel directly to the terminus of the public vehicle access (paved) section of Winterberry Way, especially when the Visitor Center is closed. The cost to install a standard kiosk is estimated to be about \$2,000 and would be less if done by volunteers.

Maintenance of Sandbank Trail canoe launch.

The path leading from Sandbank Trail down to the water's edge is relatively steep and erosion along the path and at the shoreline is a maintenance issue. One option would be to install along the path a layer of crushed gravel and several water bars. However, the shoreline erosion is more effectively



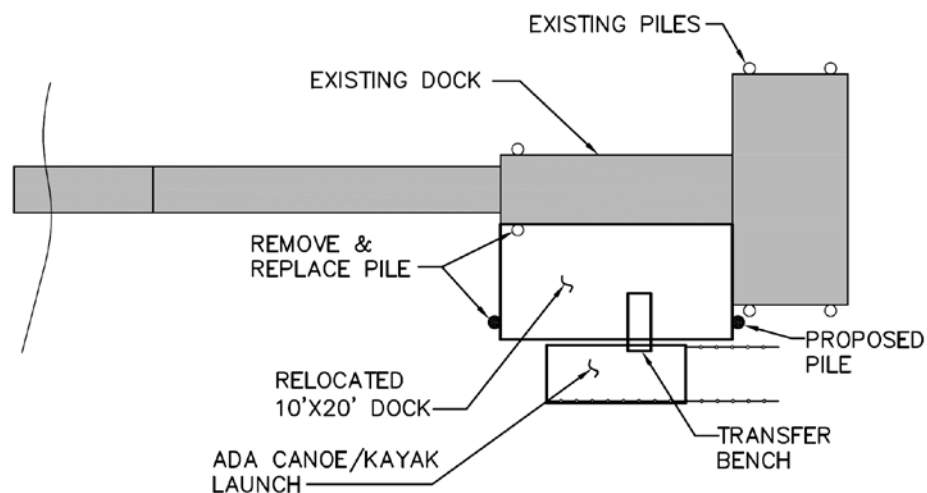
addressed by using an articulating concrete block mat system. The project would involve coordination with the Town of Sudbury. The cost for the project is estimated to be upwards of \$15,000. Annual maintenance costs would be negligible.

Add accessible canoe launch at Barron Fishing Access Site. The figure below depicts the addition of an accessible canoe launch to the existing fishing pier. A system such as the prefabricated EZ-Launch would be used. The accessible transfer system includes a sliding bench, grab bars, and a roller system to launch and land the canoe. The work involves relocating one of the existing piers and installing a new one. The project would involve coordination with the Town of Maynard.



Example of accessible EZ-Launch system

The cost for the dock work and canoe launch system is estimated to be about \$31,000. If the project were to be implemented Carbery’s Trail would need to be made accessible (see Figure 7.5). As noted in the section that follows, the cost to make Carbery’s Trail handicap accessible is approximately \$85,000.



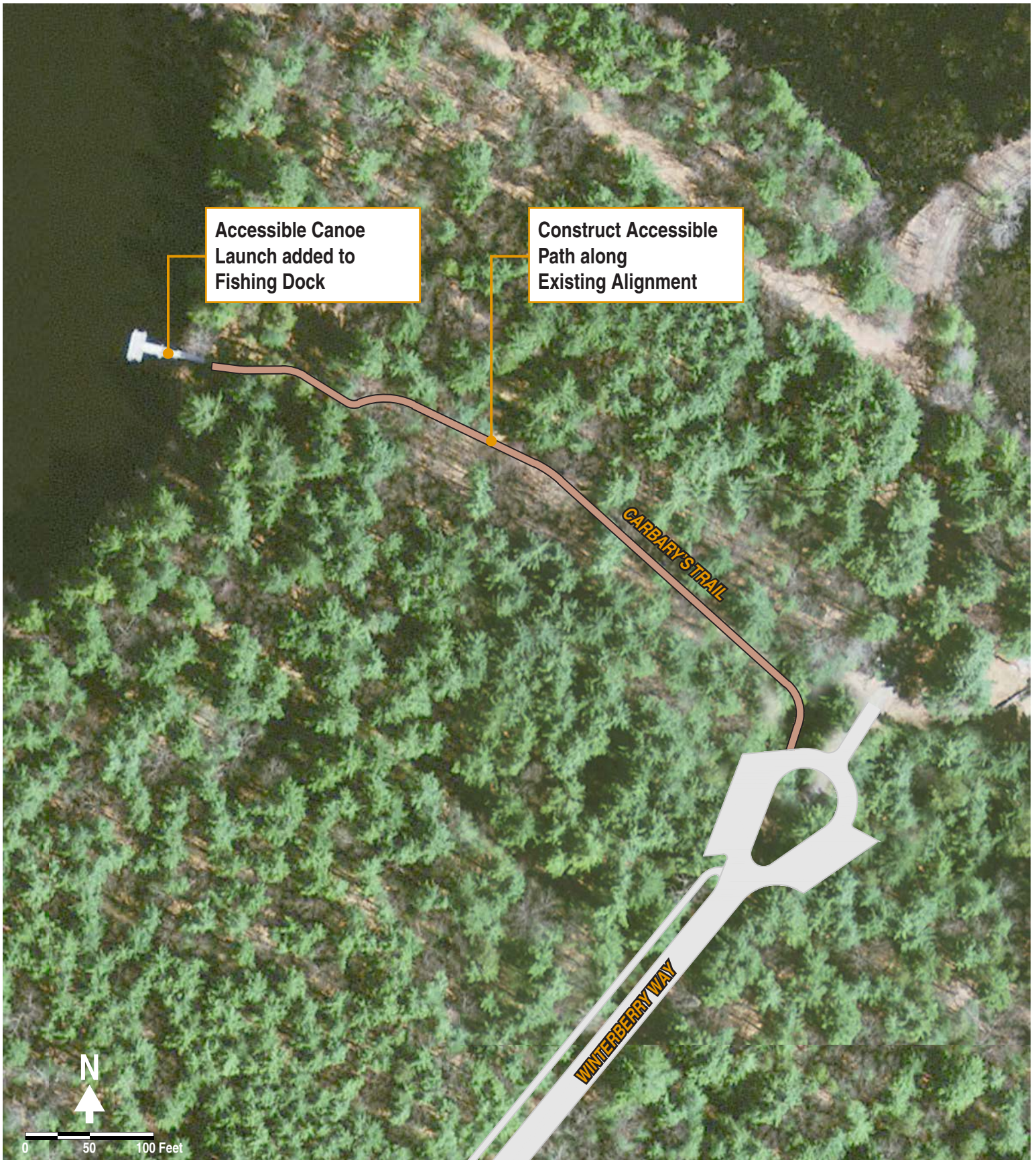


Figure 7.5
Accessible Canoe Launch



7.3 Internal Circulation and Mobility Projects

The alternatives addressing internal circulation and mobility focus on enhancements for those who are mobility impaired.

Improve handicapped accessibility along Carbary’s Trail. Carbary’s Trail is a 500’ long, native-surface trail leading from the parking area at the terminus of Winterberry Way to the Barron Fishing Access Site. Although the fishing pier is handicap accessible, the trail is not fully accessible. The project would create a 10’-wide permeable concrete path. The path would be permeable concrete rather than stabilized gravel or stone dust in order to minimize future maintenance issues and costs.

The new path would use the entirety of the existing 10’ trail width, rather than a minimum 6’ width, to allow for occasional use by vehicles if so desired. Because of the proximity of the path to the Winterberry Way parking area, a gate would be needed to prevent unauthorized access by motor vehicles and bicycles. Carbary’s Trail is located in Maynard and is near Puffer’s Pond. The project cost is estimated to be \$85,000. The annual maintenance cost is estimated to average \$600.

Improve handicapped accessibility along Puffer Pond Trail. Making both Carbary’s Trail and Puffer Pond Trail handicapped accessible creates an accessible trail along the water, something not now available in the refuge. The project would construct the accessible path along the section of Puffer Pond Trail to the south of Carbary’s Way. The northerly section of Puffer Pond Trail would not be part of the project.

The project for Puffer Pond Trail would be similar to the Carbary’s Trail project in that it would use permeable concrete, but the path would be only 6’ wide since it will be used by pedestrians only. The 1,600’ length of Puffer Pond Trail that would be part of the project is located partly in Maynard and partly in Sudbury. The project is estimated to cost \$150,000, with annual maintenance costs averaging about \$1,100.

Procure electric shuttle vehicle. The stakeholder process identified that priority uses of a shuttle would be for expanding access to sites in the refuge for visitors who have mobility impairments, transporting school groups to learning sites within the refuge, and providing tours for other groups rather than as a scheduled circulator or daily visitor tours. The preferred vehicle option is an electric shuttle that carries fewer than 16 passengers (due to driver licensing requirements) and provides handicap accessibility.

An example of such a vehicle is the Moto Electric Vehicle. It accommodates 13 passengers plus one wheelchair. The batteries provide 40 to 50 miles per charge and the range can be extended with an optional roof-mounted solar panel. Charging takes about 4 to 6 hours and uses standard outlets. Top speed is 25 mph and the shuttle can handle (while loaded) grades of 20 percent.



Example of Moto Electric shuttle vehicle

The shuttle is about the same size a large car and does not require any special licensing for the driver. The cost of the vehicle is about \$32,000, including delivery and options such as seat belts, solar panel, and a roll down vinyl enclosure. Annual operating costs would be about \$500, not including any costs for drivers.



Figure 7.6
Make Puffer Pond Trail and Carbarry's Trail Handicap Accessible



8

Transportation Improvement and Enhancement Plan

The purpose of this study is to identify near-term and long-term transportation enhancements and improvements to improve access to, and mobility within, the Assabet River National Wildlife Refuge. This chapter presents the recommended menu of projects and highlights those of higher priority. The projects are summarized in Table 8.1 and Table 8.2. The location of the projects on the refuge are depicted on Figure 8.1.

8.1 Near-term Opportunities

Near-term opportunities are projects targeted to be implemented within five years. They do not require extensive planning, do not have significant physical impacts on the refuge habitats, and do not involve extensive partnership coordination.

The highest priority projects include those that are safety-related, improve wayfinding, and the purchase of an electric shuttle vehicle. The cost for these projects totals \$45,000. The most expensive of the projects is the shuttle vehicle (\$32,000). The five highest priority projects are as follows.

- **Advance entrance signage on Hudson Road**
This project is an important initial step in addressing concerns about traffic safety at the Main Entrance. Reflective signs notifying drivers of the upcoming entrance turn would be installed on both approaches along Hudson Road, and a sign would be installed at the Winterberry Way driveway.
- **Improve visibility of Hudson Road crosswalk**
This project would make walkers and bicyclists more visible to drivers approaching on Hudson Road. Vegetation would be trimmed back and an in-street pedestrian sign purchased.
- **Vehicular wayfinding signage to the refuge**
There have never been any wayfinding signs directing drivers to the refuge. The project consists of some 30 signs providing wayfinding from local roads to the ARNWR Main Entrance and wayfinding from regional highways to the ARNWR Main Entrance as well as signs marking the refuge's secondary entrances.



- **Procure electric shuttle vehicle**

The shuttle would be used to expand access to sites in the refuge for visitors who have mobility impairments, transport school groups to learning sites within the refuge, and provide tours for other groups. It could also be used as a parking shuttle during larger events. The preferred vehicle would not require special charging infrastructure and would have fewer than 16 seats so as to not require special driver licensing.

- **Encourage use of existing state forest parking**

Use of the parking lot by refuge visitors will provide them with quick access to the interior of the refuge. The priority for this project is that it may defer the need to construct additional parking near the Main Entrance gate.

In addition to the priority projects, there are several projects that can be implemented at little or no cost. The following projects could be implemented for a combined cost of less than \$6,000.

- **Support rail trail connections**

The refuge can take a more active role in advocating efforts to move the Assabet River Rail Trail, the Central Mass Rail Trail, and the Bruce Freeman Rail Trail through the state planning, design, and funding process. As the trails progress, the refuge can market how the trails provide access to the refuge.

- **Kiosk at north end of Winterberry Way**

Installing a standard kiosk at the terminus of public vehicle access (paved) section of Winterberry Way will provide visitors with information about options for exploring the refuge from there.

- **Signage at Main Entrance gate**

Enhanced signage will reduce uncertainty by first-time visitors as to whether they should

proceed through the gate on Winterberry Way or park in the adjacent parking lot.

The remainder of the near-term projects are of somewhat higher cost and will have to be pursued opportunistically as funding permits. These projects are:

- **Additional parking at Main Entrance – Expand existing lot**

This project would double the amount of parking at the most popular parking area.

- **Maintenance of Sandbank Trail canoe launch**

Installation of a block mat system would address ongoing erosion problems.

- **Vehicle, bicycle and pedestrian traffic counters**

The use of portable counters will provide useful information not only on total visitation to the refuge, but also the utilization of specific trails, roads, and parking areas.

- **Electronic kiosk at Visitor Center**

This project will provide visitors information when the Visitor Center is closed, will collect information about visitor characteristics, and help manage hunting activities at the refuge.

- **Electric vehicle charging station**

This project relates well to the education mission of the refuge, the carbon-footprint reduction goals of the USFWS, and the socioeconomic characteristics of the adjacent communities.



8.2 Large-project Opportunities

There are many larger project opportunities that would benefit the ARNWR and its visitors, both current and future. These large-project opportunities involve substantial construction efforts, have high financial cost, and are therefore targeted for implementation long range, perhaps as long as 10 to 20 years.

The highest priority among the large project is to reconstruct the North Entrance access road. This project would improve access to the newly constructed parking lot serving that area of the refuge. The road is in extremely poor condition yet is well used by walkers, bicyclists, and drivers. The cost of this project is \$235,000.

Improving handicap accessibility is a priority. Three projects, improving accessibility along Carbury's Trail, improving accessibility along Puffer Pond Trail, and constructing an accessible canoe launch, are proposed. They have a total cost of \$266,000.

Projects to reconstruct White Pond Road, a section of Patrol Road, Harry's Way, and Taylor Way are important but have a high cost. They are the principal trails in the refuge and are used by bicyclists and walkers. The road surfaces have not been maintained since before the refuge was established and paved surfaces have deteriorated and unpaved surfaces are rutted. The cost to reconstruct all of the principal roads and ways is about \$2 million. The general priority for addressing the roads and ways is White Pond Road, then Patrol Road, followed by Harry's Way and Taylor Way.

The final large-project opportunity is to widen Hudson Road and construct a left-turn lane at the Main Entrance driveway. This is one of several

projects considered to address safety concerns related to sometimes high-speed through traffic drivers not anticipating the occasional vehicle slowing to turn into the refuge. It is the preferred choice among the construction options, but the project to install ARNWR signs along Hudson Road in advance of the driveway is the first step in addressing the safety concerns.



Table 8.1: Transportation Improvement and Enhancement Plan Projects: Near Term Opportunities

Map ID	Description	Benefits of Implementation	Partners	Implementation Cost	Annual O&M Cost	Comments
1	Provide advance entrance signs on Hudson Road Install ARNWR sign at entrance and advance signs on road	Improved safety at entrance. Fewer sudden turns by vehicles entering refuge. Reflective signs make it easier to see entrance at night.	Sudbury, Stow	\$2,000	Negligible	High priority
2	Improve visibility of the Hudson Road crosswalk Trim vegetation and use in-street pedestrian sign	Provide a safer environment for pedestrians.	Sudbury, DCR	\$300	\$300	High priority
3	Provide wayfinding signage to refuge Install directional signs on area roadways	Provide better guidance for first-time visitors. More awareness of the refuge for other drivers.	Sudbury, Stow, Hudson, Maynard	\$10,200	\$100	High priority
4	Procure electric shuttle vehicle Purchase accessible electric vehicle for on-refuge use	Provides option for mobility assistance. Enhances opportunities for educational outreach to school groups.		\$32,000	\$500	High priority
5	Encourage use of state forest parking on Sudbury Road to access the refuge Mark trail connection to Patrol Road/White Pond Road intersection. Note parking on refuge maps.	Quick access to the interior of refuge. Lessens need to construct parking.	DCR	<\$500	<\$500	High priority
6	Support rail trail connections - Assabet River Rail Trail Advocate for construction of ARRT in Maynard and Acton. Market access via existing (unpaved) sections.	Facilitates non-motorized access. Connectivity with downtown Maynard and South Acton.	Acton, Maynard, ARRT friends group	Negligible	Negligible	Immediate action item
7	Support rail trail connections - Central Mass Rail Trail Advocate for planning, design and construction of CMRT in Sudbury	Facilitates non-motorized access. Connectivity with Sudbury neighborhoods to east. Link to ARRT trailhead parking in Hudson.	Sudbury, Stow, Hudson, CMRT friends group	Negligible	Negligible	Immediate action item
8	Support rail trail connections - Bruce Freeman Rail Trail Advocate for planning, design and construction of BFRT in Sudbury and Framingham	Facilitates non-motorized access. Connectivity with Central Mass Rail Trail.	Sudbury, Framingham, BFRT friends group	Negligible	Negligible	Immediate action item
9	Kiosk at the northern end of Winterberry Way Construct standard information kiosk	Provides visitor information at key location.		\$2,000	\$100	Low cost, near-term action
10	Modify signage at Main Entrance gate Replace existing signs. Install new ARNWR sign.	Reduces visitor confusion at gate. Better awareness of Visitor Center and trail opportunities.		\$4,800	Negligible	Low cost, near-term action
11	Expand parking lot at Main Entrance Add second row of parking spaces	Additional parking capacity (10 spaces) in busy area of refuge.	Sudbury	\$31,000	\$500	Opportunistic, pursue as funding is identified
12	Maintenance of Sandbank trail canoe launch Install block mat system	Maintenance issue eliminated.	Sudbury	\$15,000	Negligible	Opportunistic, pursue as funding is identified
13	Vehicle, bicycle, and pedestrian count system Software and 10 portable counters	Provides information on magnitude and pattern of use for trails, parking, and roads. Provides more accurate count of visitation.		\$6,000	\$200	Opportunistic, pursue as funding is identified
14	Electronic kiosk at Visitor Center Install i-Sportsman system	Provides visitors information when Visitor Center is closed, collects information about visitor characteristics, and helps manage hunting activities.		\$15,000 - \$40,000	\$1,500	Opportunistic, pursue as funding is identified
15	Install electric vehicle charging station at Visitor Center Charging station for visitor vehicles	Encourages visitation, provides educational opportunity, and is consistent with USFWS goals to reduce carbon footprint.	Maynard	\$11,6000	Negligible	Opportunistic, pursue as funding is identified

DCR = Massachusetts Department of Conservation & Recreation



Table 8.2: Transportation Improvement and Enhancement Plan Projects: Large-project Opportunities

Map ID	Description	Benefits of Implementation	Partners	Implementation Cost	Annual O&M Cost	Comments
16	Reconstruct North Entrance access road Complete reconstruction and widening of road from entrance to parking area (1,000')	Improved access to parking area. Better accommodation of bicyclists, walkers, and vehicles.	Sudbury, Maynard	\$235,000	\$4,000	Highest priority among large projects. As funding is identified
17	Improve handicap accessibility along Carbury's Trail Construct 10' wide permeable concrete path	Expands the refuge experience for visitors who are mobility impaired.	Maynard	\$85,000	\$600	Priority, pursue as funding is identified
18	Improve handicap accessibility along Puffer Pond Trail Construct 6' wide permeable concrete path	Expands the refuge experience for visitors who are mobility impaired.	Maynard, Sudbury	\$150,000	\$1,100	Priority, pursue as funding is identified
19	Accessible canoe launch at Barron Fishing Access Site Add dock and EZ Launch system to existing fishing dock	Expands the refuge experience for visitors who are mobility impaired.	Maynard	\$31,000	\$100	Priority, pursue as funding is identified
20	Reconstruction of Roads and Ways - White Pond Road Reconstruct 1.7-mile paved road	Maintains usability for bicyclists.	Stow	\$670,000	\$20,000	Priority among roads and ways reconstruction projects. Pursue as funding is identified
21	Reconstruction of Roads and Ways - Harry's Way Reconstruct paved (0.4 mile) and gravel (1.5 mile) segments separately	Maintains usability for bicyclists.	Stow, Maynard, Sudbury	\$580,000	\$35,000	Pursue as funding is identified
22	Reconstruction of Roads and Ways - Patrol Road Reconstruct 0.8 miles of paved road at reduced width	Maintains usability for bicyclists. Maintains vehicle access to Air Force parcel.	Stow, Sudbury	\$280,000	\$11,000	Pursue as funding is identified
23	Reconstruction of Roads and Ways - Taylor Way Reconstruct 1.8-mile gravel road	Maintains usability for bicyclists.	Maynard	\$480,000	\$38,000	Pursue as funding is identified
24	Create eastbound left-turn land pocket at entrance road driveway Widen Hudson Road and create turn lane	Allows through traffic on Hudson Road to bypass vehicles turning into refuge.	Sudbury, DCR, DFS	\$155,000	None	Potential follow on project after evaluation of effectiveness of "Provide advance entrance signs on Hudson Road" project

DCR = Massachusetts Department of Conservation & Recreation

DFS = Massachusetts Department of Fire Services



TRANSPORTATION STUDY
ASSABET RIVER NATIONAL WILDLIFE REFUGE

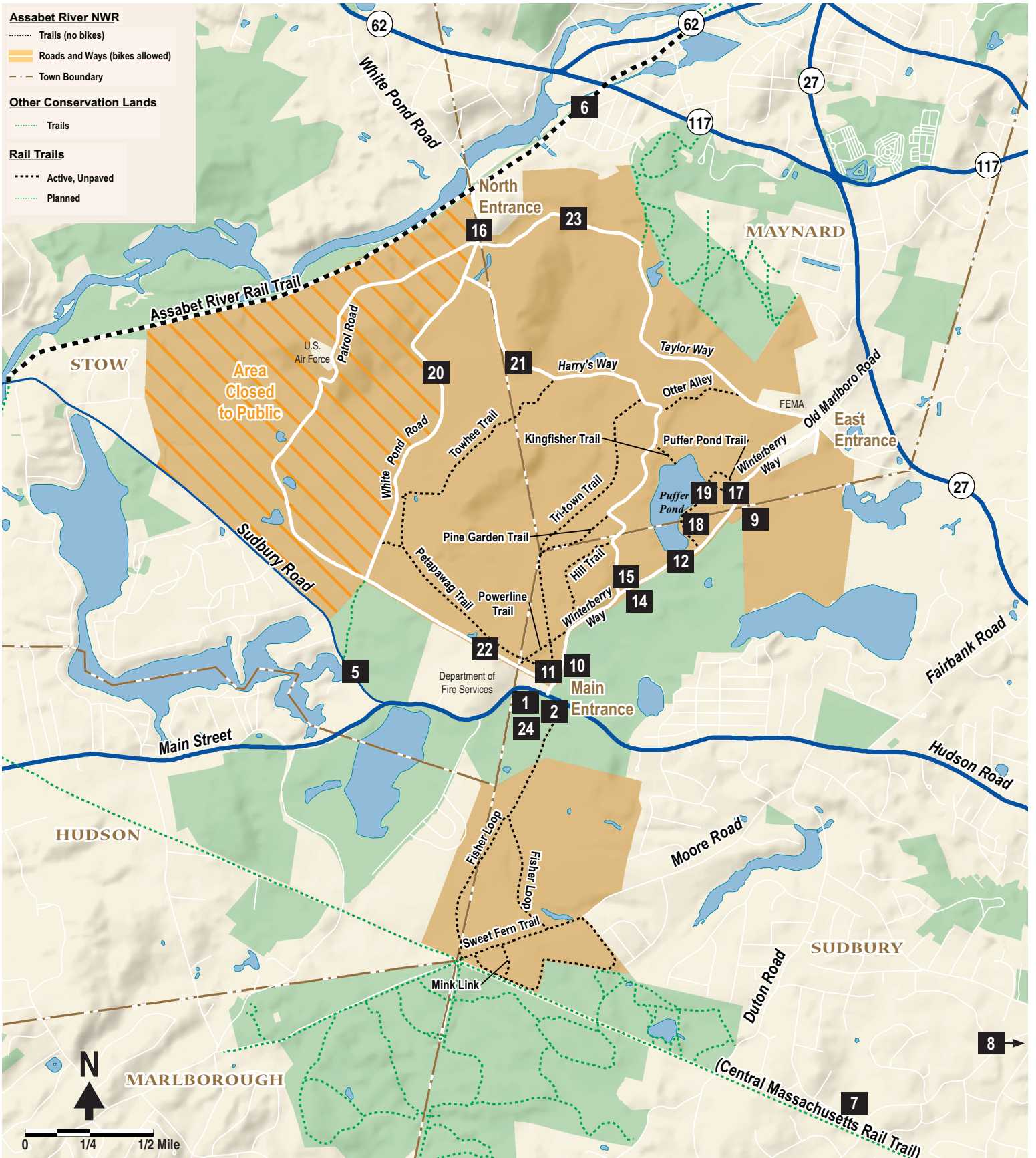


Figure 8.1
Project Locations



