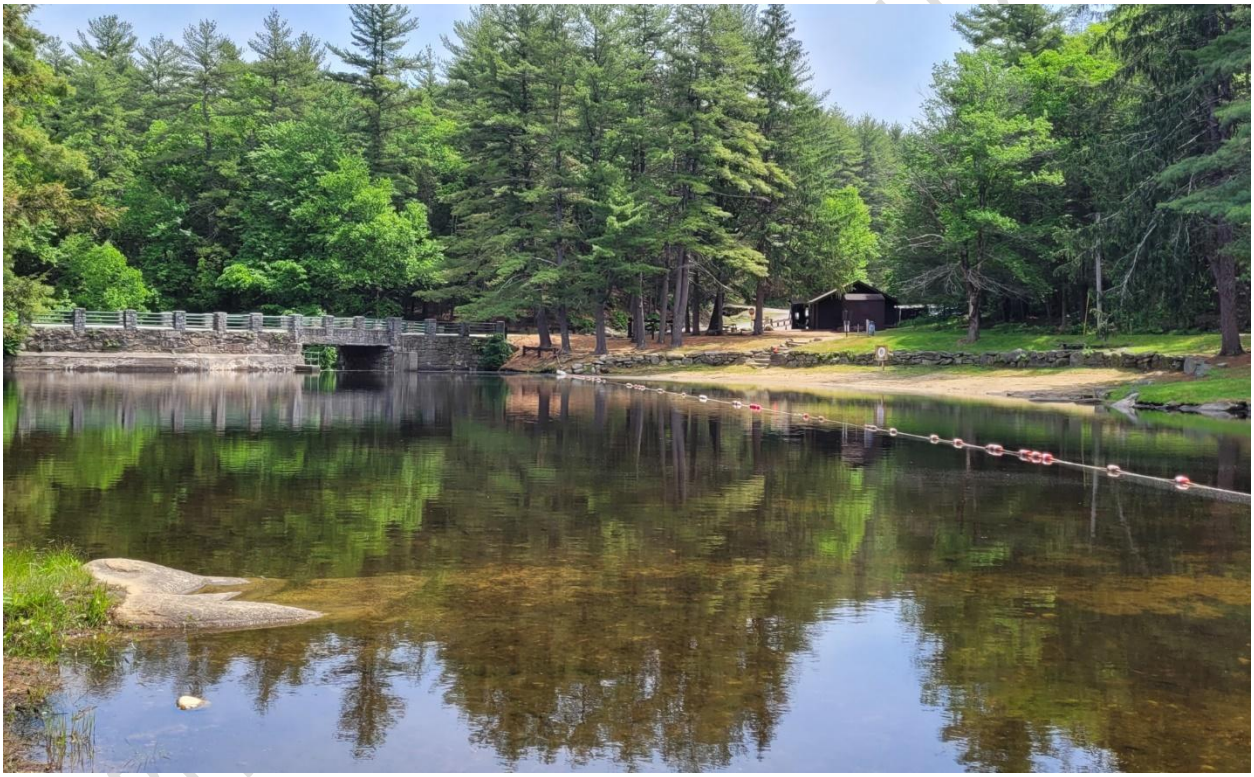
dcr
Massachusetts

Resource Management Plan
Willard Brook State Forest



Adopted by the DCR Stewardship Council Month, 2025

Massachusetts Department of Conservation and Recreation
Division of Conservation and Resource Stewardship
Office of Cultural Resources

Maura T. Healey, Governor
Kimberley Driscoll, Lieutenant Governor
Rebecca L. Tepper, Secretary
Nicole LaChapelle, Commissioner

Purpose

Resource Management Plans (RMPs) are foundational documents that identify a park, forest, or reservation's defining natural, cultural, and recreational resources and identify potential threats and opportunities to guide DCR's continued stewardship of the property and to inform future decisions about the property in a way that celebrates and preserves its identity.

RMPs are prepared for "all reservations, parks, and forests under the management of the department" (M.G.L. c. 21, § 2F). These plans "shall include guidelines for the operation and land stewardship of the aforementioned reservations, parks and forests, shall provide for the protection and stewardship of natural and cultural resources and shall ensure consistency between recreation, resource protection, and sustainable forest management." DCR finalizes RMPs following a public process and adoption by the DCR Stewardship Council. The contents of this RMP represent the best available information at the time of adoption by the Stewardship Council.

Mission and Core Principles

The Massachusetts Department of Conservation and Recreation, an agency of the Executive Office of Energy and Environmental Affairs, oversees 450,000 acres of parks and forests, beaches, bike trails, watersheds, dams, parkways, and over 100 National Register listed properties. The agency's mission is to protect, promote, and enhance our common wealth of natural, cultural, and recreational resources for the well-being of all.

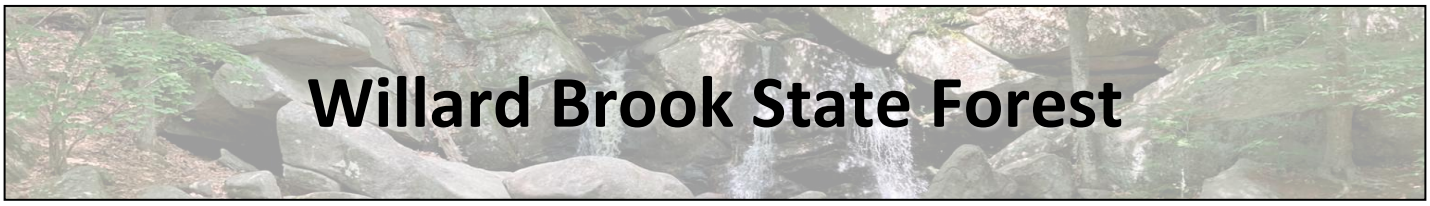
DCR strives to be an exemplary leader in conservation and recreation. DCR's staff is passionate, dedicated, and continuously employs best practices, expertise, and a sense of place in carrying out the mission. The following core principles ground the agency in its work. For the benefit and well-being of all—people and the environment—DCR pledges to:

- Provide access to a diversity of outdoor recreational experiences and unique landscapes that is equitable, inclusive, and welcoming.
- Conserve lands, water, and forests by integrating science, research, and technical expertise into the management of our natural resources.
- Advance climate change mitigation and adaptation efforts by implementing sustainable practices and advancing resiliency across our infrastructure, assets, and resources.
- Support healthy communities by providing places for people to connect with nature and each other.
- Inspire generations of stewards by recognizing and honoring our legacy through partnerships, public engagement, and education.

Stewardship

DCR honors Indigenous peoples for their care, throughout many generations, of the land that DCR now stewards on behalf of the people of the Commonwealth. DCR embraces this legacy of stewardship, fostering a sense of shared responsibility by all people for protection of the waters, lands and living things for the enjoyment and appreciation of all.

To learn more about the DCR, its facilities, and programs please visit us at www.mass.gov/dcr. Contact us at mass.parks@mass.gov.



Willard Brook State Forest

https://www.mass.gov/locations/willard-brook-state-forest

1. Property Overview

Characteristic	Value
Date Established	1930
Location	Ashby, Fitchburg, Lunenburg, Townsend
Ecoregion	Worcester Plateau
Watershed	Nashua
DCR Region	Central
DCR District	Central Highlands
DCR Complex	Otter River
Management Forestry District	Northeast
Fire Control District	North Middlesex
Size (acres)	2,832.2
Boundary Length (miles)	24.7
Elevation - Minimum (feet)	320.2
Elevation - Maximum (feet)	1,068.1
Environmental Justice (acres)	0.0
Estimated Annual Attendance (2023)	120,000
Interpretive Programs (# programs, 2023)	80
Interpretive Programs (# attendees, 2023)	363

2. Landscape Designations

Designation	Acres
Parkland	2,719.2
Reserve	0.0
Woodland	0.0
No Designation	113.1

3. Regulatory Designations

Designation	Acres
Area of Critical Environmental Concern – Squannassit	2,748.3
Outstanding Resource Waters – Squannacook River	2,806.7
Priority Habitat (MESA)	221.0
Squannacook and Nissitissit Rivers Sanctuary (M.G.L. Chap. 132A, Sec. 17)	Unk.

4. Long-Term Agreements

Agreement	Expiration Year
None Identified	N/A

5. Concessions

Concession Type
Juniper Farms

6. Partners & Friends

Group(s)
Lunenberg Snow Riders
Student Conservation Association

7. Features of Interest

Feature
Damon Pond and Dam
Trap Falls
Willard Brook
Vinton Pond

8. Natural Resources

Resource	Value
Tree Canopy (acres)	2,762.1
Rivers and Streams (miles)	12.6
Open Water (acres)	3.0
Wetlands (acres)	87.2
Certified Vernal Pools (#)	9
Potential Vernal Pools (#)	8
State-Listed Species (# Regulatory)	2
State-Listed Species (# Non-Regulatory)	1
Federally Listed Species (#)	0
Aquatic Invasive Plants (# known species)	0
Terrestrial Invasive Plants (# known species)	15

9. Forest Management (Since 2012)

Management Objective	Acres
Reduce the risk and long-term impacts of severe disturbances	53.0

10. History of Wildfires and Conditions Influencing Future Wildfires

Wildfire Attribute	Value or Characteristic
Number of wildfires on property; 2019–2023	0
Acres burned by wildfires on property; 2019–2023	0.0
Number of wildfires in Fire Control District; 2019–2023	253
Acres burned by wildfires in Fire Control District; 2019–2023	250.0
Type of Wildland-Urban Interface	Intermix
Predicted rate of spread, based on Fire Behavior Fuel Model 13	Moderate to Quick

11. Natural Hazards

Hazard Type	Acres
Flood (1.0%-chance)	83.2
Flood (0.2%-chance)	96.0
Hurricane Inundation (Cat. 1)	N/A
Hurricane Inundation (Cat. 4)	N/A

12. Climate Change (By 2070)

Type of Change	Amount of Change
Increase in annual days over 90° F	>30
Change in annual maximum daily rainfall (inches)	>10
Massachusetts Coastal Flood Risk Model area of inundation (acres)	N/A

13. Cultural Resources

Resource Type	#
Archaeological	0
Historic - Total MACRIS Listed	5
Historic - National Register Listed	0
Historic - National Historic Landmark	0

14. Recreation Resources

Resource	#
Campground	1
Damon Pond Waterfront	1
Pavilion	1
Picnic Area	2
Trail System	1

15. Recreation Activities

Activity
Bicycling, mountain
Camping
Canoeing/Kayaking
Dog walking, on-leash
Educational programs
Fishing, fin fish
Geotourism
Hiking/Walking
Horseshoe pitching
Hunting
Nature study/Photography
Orienteering
Picnicking
Running/Jogging
Skiing, cross-country
Snowmobiling
Snowshoeing
Swimming/Sunbathing
Wildlife viewing

16. Roads and Trails

Metric	Value
Roads - Unpaved (miles)	1.5
Roads - Paved (miles)	4.9
Forest Roads - Unpaved (miles)	14.1
Forest Roads - Paved (miles)	0.1
Trails - Unpaved (miles)	16.3
Trails - Paved (miles)	0.0
Trails - Unauthorized (miles)	12.4
Trail Density (miles/acre)	0.015
Area of Impact (acres)	2,075.8

17. Parking

Parking Resources	#
Lots	12
Parking Spaces - Total	113
Parking Spaces - Accessible (HP)	0
Parking Spaces - Other	113

INTRODUCTION

Willard Brook State Forest (Willard Brook, or the Forest) is in the rural and exurban communities of Ashby and Townsend, with a small proportion (approximately 5%) in the adjacent communities of Lunenberg and Fitchburg. The Forest is located approximately 22 miles west of Lowell and 4 miles from the Massachusetts-New Hampshire state line. Pearl Hill State Park (see associated RMP and historical discussion below) lies entirely within the Forest. Townsend State Forest and Squannacook Brook State Forest are both within 2.5 miles of Willard Brook. Parcels neighboring the Forest are developed with suburban-type residential properties, seasonal "camps," and light industrial facilities.

The Forest is on land shaped by generations of Indigenous and non-Indigenous inhabitants. Past and present Indigenous residents embody fluid, relational connections to the places and spaces now known as Willard Brook State Forest. Groups and individuals, including Indigenous peoples known as the Nipmuc, Pawtucket, and Pennacook, are recorded in available documentation (Native Land Digital 2023) as having relationships to this place over seasons and generations. Ponds and rivers in the Forest's immediate area were likely used as resource gathering areas. Following Indigenous peoples' dispossession, lands that would become Townsend and Ashby were granted to settlers in 1719 and 1753, with incorporation in 1732 and 1767, respectively (Massachusetts Historical Commission (MHC) 1984a and 1984b). The Massachusetts General Court (MGC) authorized creation of Willard Brook in 1929 "for preserving the forest growth on that area lying on both sides of the state highway [now Route 119] along the Willard brook in the towns of Ashby and Townsend…" and land acquisition commenced in 1930 (MGC 1929). Due to the land's desirability with respect to natural scenery and forestry, the MGC lifted its normal $5 per acre price cap. Civilian Conservation Corps (CCC) workers from camps in Leominster (Camp S-13) and Townsend (Camp S-82) completed forestry work, fire hazard mitigation, and recreational improvements in the Forest. CCC-built recreational infrastructure consisted of the Damon Pond campground, four cabins, the Damon Pond dam and beach, and the Trap Falls viewing area. A fire later destroyed the four cabins. Rt. 119 was improved to create a parkway-like experience, although not by the CCC (Berg 1999: 53–54). Multiple MGC Acts appropriated additional funds for expansion of the Forest. Willard Brook's camping and beach facilities were heavily used after World War II, leading the Commonwealth to undertake a 1953–1962 recreational expansion along Pearl Hill Brook. This area became Pearl Hill State Park circa 1971 (see Pearl Hill State Park RMP for additional information). In 2006, DCR purchased Camp Kirby, a former Girl Scout facility, around Vinton Pond and incorporated it into the Forest.

Willard Brook encompasses rocky uplands, including Fort Hill and Rattlesnake Hill, as well as portions of the valleys and lowlands along Willard, Trap Fall, and Pearl Hill brooks. Mixed northern hardwoods, white pine, and hemlock stands, along with some red pine plantations, cover this terrain, which is interspersed with several natural and artificial ponds. Bedrock outcrops and coarse glacial deposits create numerous small cascades and falls on Willard and Trapfall brooks, while alluvial deposits create a more placid character for Pearl Hill Brook. Diverse recreational resources for swimming, camping, picnicking, and passive recreation are organized around and leverage these natural resources. The highlight of these are the Damon Pond Campground and the Damon Pond Day Use Area with its waterfront (see cover photo). Route 119 runs through Willard Brook valley along the north edge of the Forest. The Wares/Stewart Road corridor creates a boundary along much of the Forest's southwest edge and the New West Townsend/New Fitchburg Road corridor runs through the Forest's southeast periphery. A cleared utility

easement runs through the east side of the Forest. The Forest's acreage is contiguous except for three small land tracts totaling approximately 48 acres. These three tracts are the Wright Pond Tract, the Pearl Hill Brook Tract, and the Off Lunenberg Road Tract (see Land Stewardship Zoning Map, page 27). These tracts are not developed with any recreational infrastructure. The Wright Pond and Off Lunenberg Road Tracts are "landlocked" (no direct access from public ways), while the Pearl Hill Brook Tract fronts New West Townsend Road. Wright Pond Tract is contiguous with City of Fitchburg Water Supply Land. DCR holds conservation restrictions on this parcel and abutting Fitchburg Rod & Gun Club property.

PARK IDENTITY

Willard Brook provides developed areas for camping and swimming with extensive trail-based passive recreation opportunities for residents of north-central Massachusetts and beyond. The Forest's identity is largely derived from scenic qualities of the Willard Brook corridor (including Trapfall Brook) and the dense collection of recreational resources along this corridor, particularly the campground, day use waterfront and picnic areas, and Trap Falls viewing site (a small waterfall with a cleared picnic area). All future activities and improvements should focus on continued provision of high-quality overnight and day use experiences to visitors while protecting the Forest's natural and cultural resources in a manner consistent with the Parkland Landscape Designation.

DEFINING RESOURCES AND VALUES

Resources and values that define the Forest are related to its recreational use and its setting within brook valleys and neighboring uplands. They include:

- Willard Brook, Pearl Hill Brook, and Trapfall Brook. These waterways have high scenic and recreational value and are organizing geographic features around which recreation and transportation infrastructure are arranged. The importance of these waterways for habitat, recreation, and water supply are recognized through:
  - Designation as Outstanding Resource Waters (314 CMR 4.06).
  - Protection by the Squannacook and Nissitissit Rivers Sanctuary (M.G.L. c. 132A, § 17).
  - Inclusion within the Squannassit Area of Critical Environmental Concern (ACEC, Secretary of Environmental Affairs 2002).
  - Identification as Coldwater Fish Resources (Massachusetts Bureau of Geographic Information (MassGIS) 2021).
- The Forest provides habitat for two species protected under the Massachusetts Endangered Species Act (MESA): one reptile identified as a Species of Special Concern and one reptile designated as Threatened by the Natural Heritage & Endangered Species Program (NHESP). This habitat is also designated as Priority Habitat.
- Historical recreation infrastructure built by the CCC:
  - The Damon Pond Dam and Bridge (see cover photo), waterfront area with retaining walls, picnic area, and campground.
  - The Trap Falls viewing area's picnic grills (no longer used) and levee wall along the Trapfall Brook (Berg 1998a, 1998b).

- Excellent recreational infrastructure that is near residents of the Boston Metropolitan Area and Merrimack Valley communities (including southern New Hampshire) and is also used by visitors from outside this region:
  - The Damon Pond Day Use Area with its waterfront area and picnic area.
  - The campground.
  - Picnic areas along Trapfall Brook and Willard Brook.
  - Willard Brook Trail, the highlight of an extensive trail network supporting a range of passive recreation activities.
- Picturesque scenery along Willard Brook Valley and Trapfall Brook. There are numerous small falls and cascades along Willard Brook, as well as the Trap Falls on Trapfall Brook. The historical Valley Road and an associated 19th-century stone arch bridge are former Town of Ashby roads that have been identified as important heritage landscapes for the Town of Ashby (DCR and Freedom's Way Heritage Association 2006: 9, 24).

STATEMENTS OF SIGNIFICANCE

Statements of Significance describe the importance or distinctiveness of a place and its resources (National Park Service 1998). These statements reflect current scholarly inquiry and interpretation and go beyond a simple listing of resources to include contextual information that makes the facts more meaningful. When developing significance statements, the following criteria are considered:

- The property's significance at the time of its establishment.
- How the property, or society's understanding of the property, has changed since its acquisition that makes it significant or unique within the state park system today.
- The property's role in recreation and its importance to the community it supports, particularly regarding activities that are unique to that property.

For park planning, these statements focus management actions on the preservation and enjoyment of those attributes that most directly contribute to the importance of the place. For interpretive planning, they comprise the information upon which the interpretive themes and overall program are built.

The following Statements of Significance have been identified for Willard Brook State Forest. The sequence of these statements does not reflect their level of significance.

- In the 1930s, the commissioner's reports indicated that Willard Brook State Forest was likely the most heavily visited State Forest. Accordingly, work done by the Forest staff and the CCC focused on enhancing the recreational areas as well as conducting typical forestry operations.
- As part of the larger Squannassit ACEC, the Forest has been identified as part of a broader area of special recognition because of the quality, uniqueness, and significance of its natural and cultural resources. The significance of the Forest includes its part of a larger grouping of protected land, providing a contiguous block for plant and animal habitat.
- A stretch of Priority Habitat (PH2035) that continues into Pearl Hill State Park follows Pearl Hill Brook and the associated streams and wetlands. This designation indicates land that is known to be the geographic extent of habitat for state-listed species. These species are either at risk, or may become at risk, of extinction.

- The Massachusetts State Forest system was founded on the principles of scientific forest management. These practices contrasted with ongoing unmanaged destructive practices throughout the country. This effort focused on the long-term cultivation of forests to achieve a sustainable harvest. Foresters worked to maximize production and provide a sustained yield over time, aiming for long-term stewardship over short-term profits. The State Forests were also meant to serve a model for private landowners, who the state foresters assisted in this endeavor.

UNIFYING THEME

The Unifying Theme is a statement that ties a property's stories together and shapes the overall interpretive message that DCR wants to share with visitors in their experience at the property. The theme provides an overarching conclusion for visitors to contemplate (Ham 2013) and answers the question "so what?" The theme guides all interpretation for the park, both personal (i.e., formal and informal interactions with visitors) and non-personal (e.g., exhibits, signage, brochures).

The Unifying Theme for Willard Brook State Forest is:

> Nature is not static.

VISITOR EXPERIENCE

Willard Brook State Forest provides a variety of visitor experiences, including the following:

- **Virtual Experience.** Potential visitors will find information about Willard Brook State Forest on DCR's web site. The Forest has its own web page that provides potential visitors information needed to plan a visit (https://www.mass.gov/locations/willard-brook-state-forest).
- **Entering the Park.** Route 119 provides the major point of access to the Forest. Visitors entering the Forest in vehicles via this route are greeted with Main Identification Signs along the state highway shoulder at the easterly and westerly edges of the property. Continuing along Route 119, the road follows a scenic, sinuous layout on the north slope of the Willard Brook valley. A Site/Facility Identification Sign is located at the entrance to the Damon Pond recreation area. Road Marker/Lead-In Signs for the Trap Falls parking area are sited on the Route 119 shoulder just east and west of Trap Falls.

  There are numerous pull-offs along Route 119 that visitors may use to access scenic portions of Willard Brook. Secondary points of access via trail heads and forest roads are dispersed along the Wares/Stewart Road corridor and the New West Townsend/New Fitchburg Road corridor. The Wright Pond Tract, the Pearl Hill Brook Tract, and the Off Lunenberg Road Tract are land-locked and have no access via public trails or forest roads.
- **Damon Pond Recreation Area.**
  - **Day Use Area.** Visitors can engage in multiple recreational activities from this waterfront complex on the south side of Route 119 in Ashby. Popular pastimes include fishing, canoeing/kayaking, swimming, sunbathing, and picnicking. A gravel parking area, pavilion, and multiple picnic sites with grills and tables are located in a grove on the north shore of Damon Pond. A contact station, paved parking lot, waterfront area with two beaches, bathroom, and additional picnic areas are located on the south shore of the pond, off of Hosmer Road. This facility was established by the

CCC, but the only remaining major CCC-built structure here is the Damon Pond Dam and Bridge (Berg 1998a).

  - **Campground.** This facility is located off Hosmer Road. Campers check in at a contact station on the south side of Damon Pond, then proceed up the road approximately 0.25 miles to the hilltop campground. The facility's 19 camp sites, 1 accessible yurt, and bathroom are located within a grove of red and white pines. Camping is available from Memorial Day to Labor Day and may be booked through the Reserve America website.

- **Trap Falls Area.** The Trap Falls area is located on the north side of Route 119 in Ashby, just north of the confluence of Trapfall Brook and Willard Brook. This scenic viewing and picnicking site is a short walk (approximately 0.7 miles) from the highway, with primary access from a small gravel parking lot on the north shoulder of Route 119. Trap Falls is an approximately 15–20-ft high cascade over a bedrock outcrop and boulders. Visitors may stand at multiple vantage points for a view of the falls, including on a wood bridge that crosses Trapfall Brook just downstream of the falls. A bathroom at this area is permanently closed. Downstream of the falls, the curving eastern bank of the brook is armored with a revetment wall that was constructed by the CCC and there are several CCC-built grills (no longer in use).
- **Trail-based Passive Recreation.** Visitors seeking other recreational opportunities may access a large trail network that offers connections to Pearl Hill State Park. Over 30 miles of official trails and forest roads follow the Forest's brooks and ascend to hilltop summits. These trails offer year-round passive recreation on foot, bike, snowshoes, or skis.
- **Trail-based Motorized Recreation.** In the winter, visitors may snowmobile on approved roads and trails in the Forest's trails network.

THREATS AND OPPORTUNITIES

The following information identifies potential threats to the park's natural and cultural resources and identifies opportunities to enhance their protection and stewardship. Although recreation is not considered a resource under statute (M.G.L. c. 21, § 2F), it is included below because recreation is an important part of the park-going experience, helps define a park's values, and is a key part of assessing the consistency of activities taking place in the Commonwealth's forests, parks, and reservations.

Threats and opportunities identified below are used to inform the development of management recommendations. Potential recommendations must meet prioritization criteria to be included in the Priority Recommendations table (Table 19, page 31).

Natural Resources

Threats

- The Town of Townsend's most recent Open Space and Recreation Plan (expired 2020) seeks to generate revenue by selling town-owned land (Town of Townsend 2013: 69). Sales of town-owned land, some of which abuts the Forest, may threaten forest connectivity and natural resources.
- Willard Brook State Forest is located in a watershed with a Total Maximum Daily Load (TMDL) report to address water quality impairments (per Massachusetts Department of Environmental Protection (MassDEP) 303d list) to Pearl Hill Brook (Assessment Unit (AU) ID MA 81-80) and Willard Brook (AU MA 81-79). Although the waterbody is listed as requiring a TMDL (Category 5 of the 303d list) a TMDL

has not yet been developed. Designers of future projects should focus on addressing identified impairments, in accordance with the DCR Stormwater Design Handbook (VHB 2022).

- There are two public water supply wells with accompanying Zone I protective areas in the Forest. Water quality may be threatened at the Headquarters well (no. 2299002) because the wellhead is unsecured and vehicle parking occurs within the Zone I Wellhead Protection Area. These conditions are inconsistent with MassDEP guidance and Best Management Practices (BMPs) for wellhead protection (MassDEP 1995; 2011).
- People often relieve themselves in the woods adjacent to Trap Falls because the bathroom at this popular area is closed (see additional discussion in Recreational Threats, below). This behavior pattern, which occurs year-round, may threaten the water quality of Trapfall Brook, which is a significant and protected water resource (see Park Identify and Significance Section, above).
- Visitors have created multiple desire paths along the shores of Trapfall Brook and Willard Brook, leading to erosion, possible water quality issues, and degradation of the Trapfall Brook levee walls (see Cultural Resources threats, below).
- Heavy recreational use and consequent erosion in riparian areas and on slopes may cause sedimentation of adjacent streams, wetlands, and habitats. In particular, erosion of a sandy bank along Pearl Hill Brook, and trail crossings of streams and wetlands, need erosion controls and stream crossing structures.
- Forest visitors have created a large network of unauthorized trails. Some of these trails lead onto adjacent private property and conserved lands. Construction of trails without authorization or applicable regulatory review may threaten MESA-protected species' habitat, natural communities, and ecosystem functions.
- The following 15 invasive species have been identified at Willard Brook: autumn olive, black locust, burningbush, fig buttercup, garlic mustard, Japanese barberry (planted at the contact station), Japanese knotweed, Louise's swallow-wort, multiflora rose, Norway maple, Oriental bittersweet, purple loosestrife, reed canarygrass, showy fly honeysuckle, and yellow iris (BSC Group 2017: 32, 33). Invasive species may negatively impact both the ecological integrity and biodiversity of the Forest.
- A lack of management of non-native tree plantations threatens forest health. For example, the red pine plantation within the campground is aging, diseased, and needs to be cut. If not managed, some trees in this stand will become hazard trees.
- The forest's past history of small brush fires has been interrupted, leading to increased possibilities of larger wildfires that could negatively impact natural communities, species populations or habitat, and recreational infrastructure. In particular, fire exclusion is resulting in the mesophication of historically fire-influenced natural communities (i.e. oak woodlands and probably barrens) (Leddick 2024a).
- There are multiple unapproved geocaches in the Forest, some of which are located away from trails. Inappropriately located geocaches may threaten sensitive natural resources or species habitats.

Opportunities

- Approximately 113.1 acres of the Forest has no Landscape Designation (DCR 2012). Assigning Landscape Designations to these portions of the Forest could help with management of associated natural resources and ensure management consistent with DCR properties statewide.

- The Town of Townsend's most recent Open Space and Recreation Plan (expired 2020) seeks to generate town revenue by selling town-owned land. Where appropriate to DCR conservation objectives, acquisition of town-owned land may be an opportunity to further the Commonwealth's and DCR's conservation goals.
- There are opportunities to protect Forest resources, improve recreational experiences, and enhance management of the Forest by acquiring private inholdings and parcels that would provide connectivity to non-contiguous Forest tracts.
- There are opportunities to correct discrepancies between DCR GIS data and Town of Townsend assessor data at the following locations: intersection of New Fitchburg and Vinton Pond Road, south of Bayberry Hill Road, west of Lunenburg Road, and along Stewart Road. At these locations, DCR boundaries, as shown in the Open Space data, extend onto assessor lots that appear to be privately owned and are developed with residential buildings.
- Willard Brook is within the Squannassit ACEC, which encompasses valuable water supply, wildlife habitat, open space, cultural, and water body resources. ACEC designation offers an opportunity to enhance and collaborate on resource protection within and around the Forest (Secretary of Environmental Affairs 2002).
- Providing restroom facilities at the Trap Falls area could enhance the water quality of Trapfall Brook.
- There is an opportunity to resolve trail erosion and sedimentation problems through implementation of BMPs for trail construction, as well as closures of unnecessary trails and desire paths.
- Portions of the Forest contain Priority Habitat for a Threatened reptile species. There may be future opportunities to protect this habitat through habitat management, including restoring and promoting fire influenced natural communities, and forestry controls that follow NHESP guidelines.
- Portions of the Forest contain Priority Habitat for a reptile Species of Special Concern that is vulnerable to human disturbance. There is an opportunity to protect this habitat by restricting recreational development in this habitat.
- In addition to Priority Habitat in the Forest (i.e., Regulatory Habitat), there is also Non-Regulatory habitat for one MESA-protected insect species, designated a Species of Special Concern. Unlike Regulatory Habitat, which is based on verified records of state-listed species and has associated mapped Priority Habitat, Non-Regulatory Habitat is based on the presence of suitable habitat and there is no associated mapped Priority Habitat. On state lands, both Regulatory and Non-Regulatory Habitat are protected under MESA (321 CMR 10.00). Requesting pre-filing consultation with NHESP for "all works, projects, or activities" in the Forest, regardless of location in or out of Priority Habitat, will ensure continued protection of this habitat and compliance with the MESA.
- There is an opportunity to conduct prescribed fires to maintain forest structure and diversity, enhance resilience and biodiversity, restore oak woodlands, and limit the hazard of larger uncontrolled wildfires (Leddick 2024a). The NHESP has made similar comments concerning Pearl Hill State Forest (see associated RMP), indicating that there may be opportunities for continuous areas of habitat restoration across the two properties (Leddick 2024b).
- Use of prescribed fire in the Forest could benefit Non-Regulatory habitat for the previously referenced insect species. (Non-Regulatory habitat is based on the presence of suitable habitat for

state-listed species; there is no associated mapped Priority Habitat. On state lands, both are protected under MESA (321 CMR 10.00).)

- There is an opportunity to mitigate fire hazards in the Forest by thinning or removing red pine stands (and replacing with fire-influenced natural communities, as appropriate), reclaiming fire roads and maintaining their culverts, maintaining water holes, and conducting prescribed burns.
- Some of the Forest's eight potential vernal pools may "support rich communities of vertebrates and invertebrates" (Massachusetts Division of Fisheries and Wildlife (MassWildlife) 2009) and serve as important habitat components for other wildlife, including the Forest's Threatened reptile species. Surveying and certifying these pools (DCR (n.d.a) and MassWildlife (2009)), as appropriate, may help better protect these animals.
- The DCR Office of Natural Resources is currently working on annual treatments to abate invasive plant species in the Forest. There is an opportunity to continue this work in accordance with guidance in the Invasive Plant Management Plan: Central Region (BSC Group 2017).

Cultural Resources

Threats

- Erosion due to natural weather events, flooding of Willard Brook, and human recreational activities (hiking, mountain biking, camping, geocaching, snowmobiling) poses a threat to archaeological resources in the Forest.
- There are multiple unapproved geocaches in the Forest, some of which are located away from trails. Inappropriately located geocaches may threaten sensitive cultural resources.
- Construction and use of the previously mentioned unauthorized trails may disturb areas of the Forest that have potential archaeological resources.
- Heavy visitor use and general wear and tear are eroding the Damon Pond waterfront, leading to displacement of the stonework in the historical CCC retaining walls.
- The Damon Pond Dam and Bridge (Dam No. MA02518), designated a High Hazard Dam, is in poor condition and has multiple deficiencies: deterioration to the stone masonry walls, leakage at the interface between the training walls and stone masonry wall at the spillway, vegetation growth through the masonry wall at the spillway, trees and brush within 20 feet of the dam abutments, and deficiencies in the bridge deck, superstructure, and substructure (Tighe & Bond 2022). Failure to address these concerns could pose a threat to recreation facility operations, downstream safety, and to the historical integrity of this important CCC resource.
- The Trapfall Brook levee wall, built by the CCC, is deteriorating and may be further damaged by patrons climbing down the structure to access the brook.
- The Damon Pond Dam and Bridge and the Trapfall Brook levee wall are exposed to 1.0%-chance flood events.

Opportunities

- Approximately 113.1 acres of the Forest has no Landscape Designation (DCR 2012). Assigning Landscape Designations to these portions of the Forest could help with management of associated cultural resources and ensure management consistent with DCR properties statewide.

- Historic archaeological sites such as cellar holes and mill foundations are located within the Forest. Ancient (12,000–450 years before present) archaeological resources may also be present. Conducting an archaeological reconnaissance survey in cooperation with municipal, tribal and non-profit partners would provide an opportunity to better protect and interpret these resources for the public.
- Stone features have been identified in the Forest; their origins and cultural significance remain undetermined. Assessing, inventorying, and preserving these resources are a high priority for DCR.
- There is an opportunity to protect continued operation of the Damon Pond Waterfront, visitor and downstream safety, and cultural resources by proceeding with the Damon Pond Dam Repairs currently under development in the Office of Dam Safety (Tighe & Bond 2022). Applying the Secretary of the Interior's Standards for Historic Rehabilitation (Birnbaum n.d.) will ensure that the historical integrity of the dam structure is protected through rehabilitation.
- Rehabilitation of the Trap Falls levee wall would provide an opportunity to preserve the historical integrity of this resource while enhancing Trapfall Brook's water quality.
- Many actively used buildings in the Forest are over 50 years old and in "adequate" condition. These include the Damon Pond contact station, campground bathroom, and headquarters building. Such buildings should be maintained according to the agency's Historic Building Maintenance BMP (DCR n.d.b). In the future, conducting an architectural resources survey of the Forest would provide an opportunity to better steward and interpret these resources.
- There is an opportunity to enhance the visitor experience at the Forest by expanding existing interpretation of the CCC history at Trap Falls and Damon Pond. In particular, the upcoming CCC centennial provides a means to celebrate the protection and continued use of these important resources.
- There may be future opportunities to partner with the Town of Ashby on the identification and protection of scenic landscapes and associated historical structures in the Forest, such as Valley Road and its associated 19th-century stone arch bridge.
- All Town of Townsend public roads bordering the Forest are designated Scenic Roads under Townsend General Bylaws, c., as authorized under M.G.L. c. 14, §15C (Town of Townsend n.d.). DCR's preservation of forest edges (i.e. buffer strips) and stone walls maintains the scenic character of these public ways. (No public roads in Ashby or Lunenberg that are adjacent to the Forest are Scenic Roads, as June 2025.)

Recreation

Threats

- Many actively used buildings in the Forest are over 50 years old and their condition is categorized as "adequate". Their condition, outdated design, and lack of accessibility (see discussion below) limits visitor enjoyment and staff efficiency. In particular, the condition of the Damon Pond pavilion, contact station, campground bathroom, and headquarters building could be improved.
- The closure (in 2013 due to water supply issues) and slated demolition of the Trap Falls Bathroom threatens the visitor experience at the falls. The Trap Falls area's use levels may justify provision of

a bathroom at this location. Visitors at this spot often use the adjacent woods to relieve themselves, creating unsanitary and unsightly conditions.

- A recent accessibility assessment identified issues forest-wide (Institute for Human Centered Design (IHCD) 2022). Noteworthy issues include insufficient accessible (HP) parking spaces at the Damon Pond, Headquarters, and Trap Falls lots (among others); non-accessible restrooms at the Campground and Day Use areas; no accessible water spigots in the campground; and lack of accessible routes and facilities to/in the Damon Pond waterfront and picnic area.
- A lack of sand at the Damon Pond waterfront area impinges on user enjoyment of this important recreational resource.
- Accumulated sediment and vegetation growth in Damon Pond are negatively affecting visitors' enjoyment of the waterfront area and pond.
- Excessively high Enterococci bacteria counts, as well as other safety concerns, have resulted in multiple waterfront area "postings" (advisories against swimming) at Damon Pond, limiting visitor enjoyment of this facility. Between 2012 and 2021, the most recent 10-year period for which there are data, there were 91 single sample exceedances (i.e., levels of bacterial contamination in excess of regulatory standards) (Department of Public Health (DPH) 2013–2022). A 2006 water quality study could not trace the exceedances to a single source and recommended installation of a water circulation device for remediation purposes, as well as a comprehensive spatial sampling program to isolate potential pollution sources (MassDEP 2012: 28). The recommended water circulation device was installed in 2021 but was unsuccessful in solving this threat.
- A footbridge across Willard Brook within the Damon Pond Day Use Area washed out in 2016, it was not replaced. Loss of this resource impinges on recreational use of the facility because it provided an important secondary circulation route within the recreation area and around Damon Pond.
- Many of the Damon Pond Campground sites are perceived by visitors as being very close together. This threatens visitor's ability to enjoy a tranquil camping experience and is a source of visitor complaints. Google and Yelp reviews contain language such as: "Unfortunately, the campsites are all *extremely* close together…"; "…a little tight if looking for privacy…sites are close together…"; "…kind of close quarters (you see everyone next to you)…"; "…very little natural boundaries between some of the tent sites…", and "…sites are incredibly close together".
- The Damon Pond Day Use Area's popularity and consequent high visitation levels sometimes hinder enjoyment of the facility by patrons and increases wear and tear on park infrastructure. High visitation levels may also contribute to degradation of water quality in Damon Pond.
- The official trail map for the Forest is outdated and incomplete: the Trap Falls trail is not shown, nor are the many newer authorized trails.
- Deferred maintenance and heavy usage of the roads and trails system is leading to degradation of these assets. Forestry and Fire Control has used existing staff and equipment for roads and trails maintenance. Additional resources to purchase and install earth materials (i.e., gravel and stone) for continued maintenance would provide an opportunity for Forest Fire Control to improve and expand its maintenance capabilities.
- Several elements of the Forest's recreational infrastructure within the Pearl, Trapfall, and Willard brooks drainages are exposed to 1.0%-chance flood events: the Valley Road bridge and parking area;

the Damon Pond waterfront area with its contact station and dam (an Office of Dam Safety High Hazard structure); approximately 0.3 acres of the Trap Falls picnic and viewing area with levee wall and bridge; and approximately 0.25 miles of forest road and trails.

- The Willard Brook Trail sometimes floods, causing maintenance and access issues.
- The Trap Falls area and the Valley Road portion of the Forest are sometimes used outside of official hours of operation by visitors engaging in depreciative behaviors. These visitors sometimes have to be expelled from the Forest by DCR and/or law enforcement personnel.

Opportunities

- There is an opportunity to resolve threats to Damon Pond water quality by 1) conducting studies of beach carrying capacity; 2) implementing a program to identify upstream pollutant sources; and 3) installing a water circulation device for remediation (MassDEP 2012: 28).
- There may be opportunities to improve Damon Pond watershed health by working with the Town of Ashby and private landowners on nutrient limiting activities.
- Neither of the day use parking lots has a welcome wayside sign. There is an opportunity to enhance visitors' experience and understanding of Forest resources and recreation opportunities by developing and installing these signs.
- A wayside sign is located adjacent to Damon Pond that interprets the history of the CCC. This sign's graphics panel is in poor condition.
- As a High Hazard Dam, the Damon Pond Dam (Dam No. MA02518) is provided with an Emergency Action Plan (EAP). The EAP provides detailed information on how park operations personnel are to respond to dam safety issues, from minor issues to impending failure (GZA 2018). There is opportunity to increase awareness of this EAP among agency staff and local first responders, thereby increasing public safety.
- Implementing accessibility improvements identified in the Program Accessibility Assessment (IHCD 2022) would increase use and enjoyment of the Forest.
- There is an opportunity to meet state and federal requirements for accessible parking at Damon Pond Recreation Area's day use parking lot by adding a single parking spot that meets accessibility standards, as envisioned in design for the Damon Pond Dam Repairs, which are currently under development in the Office of Dam Safety (Tighe & Bond 2022).
- A campground condition and risk exposure assessment was conducted for Willard Brook State Forest in 2015 as part of a state-wide wide Comprehensive Campground Assessment (Arcadis U.S., Inc. 2015). The assessment determined that the bathroom at the Forest's Damon Pond day use area and the bathroom in the campground were in "Very Poor" condition. Based on a risk analysis using each building's condition and potential consequences of failure, these two buildings were determined to be high risk assets that should be evaluated for capital replacement (Arcadis U.S., Inc. 2015: 1-6; 30-1–30-5). There is an opportunity to improve the recreational experience of the campground and to reduce the risks associated with asset failure by evaluating these buildings for renovation or capital replacement. In particular, there is an opportunity to replace the Damon Pond Campground bathroom (currently slated for demolition in CAMIS) with a new bathhouse that meets accessibility standards and contains showers.

- Additional yurts could afford the possibility of a winter camping program at the Forest that leverages the site's popularity for winter recreation.
- The increasing popularity of mountain biking at Willard Brook offers opportunities to partner with the New England Mountain Bike Association or other party to maintain or improve authorized trails and prevent the creation of unauthorized trails.
- There is an opportunity to conduct a review of the Forest's trail system for sustainability, user experience, and accessibility and identify recommended improvements to enhance the system while protecting sensitive natural and cultural resources.
- Removal of red pines in Damon Pond Campground offers an opportunity to replant the site with native species, as well for an expanded project that revitalizes the campground landscape, ameliorating issues of campground proximity, poor quality camping experience, and ground compaction.
- Repair or replacement of the Damon Pond contact station, campground bathroom, and headquarters, could improve visitor services and staff efficiency.
- The headquarters building is currently heated with propane. There is an opportunity to replace this heating equipment with fossil fuel-free heating equipment once it reaches the end of its useful life, consistent with the directives of Executive Order 594 and the Commonwealth's greenhouse gas emissions reduction goals.
- Willard Brook is located within the Freedom's Way National Heritage Area, offering opportunities for agency partnerships, grants, and potentially higher visibility for the Forest (Freedom's Way National Heritage Association, Inc. 2015).

CLIMATE CHANGE

Climate change impacts nearly every aspect of DCR's properties, from ecosystem health, to infrastructure, to recreation. (See DCR 2024 for an overview of these impacts.) The Department is actively working to mitigate and adapt to current and future impacts through such actions as forest management; decarbonizing DCR's buildings, vehicles, and power equipment; protecting wetlands; and using nature-based solutions to minimize stormwater impacts. Information on these, and other, efforts is incorporated into RMPs as available and appropriate.

Any discussion of climate change requires a shared understanding of terminology. Because of this, this RMP section adopts commonly accepted terms to the greatest extent possible. In general, climate-related technical terms used in this RMP are as defined in the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2021). Exceptions to this are the terms Adaptation, Risk, and Sensitivity, which are used as defined in DCR's Climate Change Vulnerability Assessment (CCVA; Weston and Sampson 2022).

DCR manages its forests to provide a range of ecosystem services such as recreation, clean water, wood commodities, and wildlife habitat (DCR 2020). For ecosystems under its management, DCR carefully considers both their vulnerability to climate change and their ability to mitigate the effects of climate change by storing carbon in ecosystems and harvested wood products. Several approaches are used to monitor DCR forests and to design forest management strategies to adapt to climate change and provide ecosystem services. (See Swanston et al. (2016) for information on adaptation strategies and approaches

associated with DCR's forest management.) Established in 1957, DCR's Continuous Forest Inventory (CFI) system uses a network of more than 2,000 permanent plots on which repeated measurements are taken on an ongoing basis. The CFI measures the status, size, and health of over 100,000 trees; other vegetation; down woody material; and the forest floor. (See DCR 2022 for additional information on the CFI system.) This information helps DCR understand at a strategic scale the current character, condition, and trends of forest ecosystems under its care. DCR also uses operational inventory to help plan specific treatments and evaluate their outcomes. Using these different scales of information, remotely sensed data, and local and regional external expertise, DCR plans projects that help its stands, forests, and other lands adapt to climate change and mitigate greenhouse gas emissions. The conservation and science-based management of forest lands are an essential element to ensuring crucial carbon storage and advancing climate change resilience (Massachusetts Executive Office of Energy and Environmental Affairs (EEA) 2024). For additional information on the relationship between DCR's forest management practices and climate change, please see pages 77–85 in Massachusetts Forest Action Plan 2020 (DCR 2020) and Managing Our Forests…For Carbon Benefits (DCR 2023).

The Department is actively assessing and addressing the vulnerability of its properties and facilities to the impacts of climate change. In 2022, DCR conducted a CCVA (Weston and Sampson 2022). Findings from this CCVA are being used by DCR to enhance park operations and maintenance, inform resilient investment, and provide a framework for hazard mitigation and climate adaptation for natural resources, cultural resources, recreational activities, buildings, facilities, and other infrastructure. Property-specific climate change information from the CCVA is included in the Climate Change (by 2070) table (Table 12) at the beginning of this RMP. An overview of the impacts of climate change on DCR facilities and operations is presented in the DCR Climate Impacts Story Map (DCR 2024).

Climate Exposure and Impacts

A summary of the ways in which the Commonwealth's natural, cultural, and recreational resources may be impacted by climate change is provided below. During the preparation of RMPs some resources may be identified as having particularly high exposure and/or sensitivity to the anticipated hazards or consequences of climate change. When this occurs, these resources and the projected impacts to them are described. In some instances, the potential impacts of climate change on a given resource are not well understood. When this occurs, only exposure is discussed.

Natural Resources—General Impacts

Climate change affects temperature, precipitation, and atmospheric and ocean chemistry, which in turn directly and indirectly affect the natural environment, including the plants, animals, and natural communities of DCR's forests, parks, and reservations.

Climate is known to influence the presence, absence, distribution, reproductive success, and survival of both native and non-native plants (Finch et al. 2021). Native northern and boreal species, including balsam fir, red spruce, and black spruce may fare worse under future conditions, but other species may benefit from the projected changes in climate (Janowiak et al. 2018). Some non-native invasive species will be affected by climate change while others will remain unaffected, and some non-invasive non-native species are likely to become invasive (Finch et al. 2021). In general, elevated temperature and CO_2 enrichment associated with climate change increases the performance of non-native plants more strongly than the performance of native plants (Liu et al. 2017). Climate change may result in the

presence of new non-native invasive plants on a property, and changes to the distribution and/or abundance of invasives already present on a property.

Exposure to a changing climate affects wildlife in a variety of ways. For animals that live in or near aquatic environments, "changes in habitat and hydrological regimes are expected to shift their abundance and distribution" (Isaak et al. 2018: 89). Impacts to terrestrial animals are expected to be highly variable (Halofsky et al. 2018) but may be considered to fall into the following four categories: 1. habitat loss and fragmentation; 2. physiological sensitivities (i.e., innate characteristics that influence the ability to cope with changing temperature and precipitation conditions); 3. alterations in the timing of species' life cycles; and 4. indirect effects (e.g., disruption of ecological relationships) (Friggens et al. 2018). Although all Northeast wildlife are exposed to hazards associated with climate change, some groups, "including montane birds, salamanders, cold-adapted fish, and freshwater mussels, could be particularly affected by changing temperatures, precipitation, sea and lake level, and ocean processes" (MassWildlife 2015: 357). In addition, it is the position of the NHESP that state-listed species and Priority Natural Communities are likely to be highly sensitive to climate change and that all state-listed species will be negatively affected by hydrologic changes, changes in water, soil, and air temperature, and changes in forest composition.

Natural Resources—Property-Specific Exposure and Impacts

Three of the Forest's streams have been identified as Coldwater Fisheries Resources by MassWildlife. These are: Pearl Hill Brook (including an unnamed tributary), Trapfall Brook, and Willard Brook, for the brooks' entire lengths within the Forest. Such streams provide important habitat for coldwater species, which are typically more sensitive than other species to alterations in stream flow, water quality, and temperature (MassGIS 2021).

Climate change may cause some vernal pools to dry earlier in the season than they have historically, potentially interfering with amphibian life cycles (Cartwright et al. 2022). Because of this, some of the Forest's pools and associated wildlife may be negatively impacted. Similar impacts may occur at potential vernal pools that function as vernal pools.

Eastern newts have been reported in the Forest. Populations of these amphibians may be threatened by the impacts of climate change.

Responses of Massachusetts' invasive plants (i.e., those categorized as Invasive by the Massachusetts Invasive Plant Advisory Group (MIPAG) (n.d.)) to a changing climate are largely unknown. However, sufficient information exists to project the likely future trend of garlic mustard, Japanese barberry, and Oriental bittersweet. Climate change will negatively impact garlic mustard, reducing "establishment of a currently prolific invader…driven by poor demographic performance in warmer climates" (Merow et al. 2017: E3276). Projected future climate change "may mitigate" garlic mustard's "invasion in southern New England while reducing otherwise prolific population growth in some parts of northern" New England (Merow et al. 2017: E3279). Because of this, it is anticipated that garlic mustard populations at Willard Brook State Forest will decrease under climate change. Climate change facilitates invasion by Japanese barberry "because of higher growth and germination in warmer climates" (Merow et al. 2017: E3276). Because of this, it is anticipated that barberry will further spread at Willard Brook. "Available data suggest that bittersweet is likely to benefit from the warming and increased precipitation that are predicted for the Northeast" (Rustad et al. 2012), resulting in expansion throughout New England. Areas

where the forest canopy or forest floor has been disturbed are particularly susceptible (McNab and Loftis 2002). Because of this, it is anticipated that Oriental bittersweet will continue to expand within Willard Brook in response to climate change.

Cultural Resources—General Impacts

Climate change may negatively affect cultural resources, their preservation, and maintenance (EEA 2022a; International Council on Monuments and Sites (ICOMOS) Climate Change and Cultural Heritage Working Group 2019; Rockman et al. 2016: 3, 18; United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Center 2007). In Massachusetts, cultural resources may be exposed to the following natural phenomena that are correlated with adverse impacts: higher annual average temperature (especially in winter), increased numbers of freeze-thaw cycles, increased precipitation intensity, higher relative humidity, higher wind speeds, an increase in severe storm events, increased numbers and severity of wildfires, more severe seasonal droughts, increase in number and severity of inland flood events, increased coastal flooding and erosion, increased probability of landslides, changes in groundwater levels, shifts in native and invasive species distribution, performance, and phenology; and changes in oceanic and atmospheric chemistry (Rockman at al. 2016; Commonwealth of Massachusetts 2023: 5.1-31–5.1-61).

The phenomena listed above may produce a variety of adverse impacts to Massachusetts' cultural resources. Sensitivity and potential impacts vary based on resource category (i.e., archaeological sites, cultural landscapes, ethnographic landscapes and sites, and buildings and structures). Resource-specific factors such as location, design, materials, condition, etc. will also influence sensitivity and consequent impacts. All categories of cultural resources may be subject to complete or partial destruction through wildfire, inland flooding, sea level rise, storm surge, or landslides. Additionally, these resource categories may be subject to other types of impacts, as follows. Archaeological sites may have site stratigraphy disrupted by changes in hydrography, may suffer accelerated decomposition of artifacts and features, and may be impacted inadvertently during disaster response. Cultural landscapes may lose plantings due to a variety of stressors (e.g., drought or flood, pests, soil salinity), may be infiltrated by invasives, may be eroded by surface runoff, may experience more rapid deterioration of hardscaping and site furnishings, and may be damaged by high wind or heavy snow events. Ethnographic landscapes, traditional cultural places, and associated communities (including Indigenous peoples) may suffer both tangible and intangible impacts such as loss or diminishment of natural species used for food, ceremony, or medicine; alterations in timing of hunts, etc.; increased difficulty of vulnerable subgroups (e.g., the elderly) to perform outdoor tasks; and a loss of cultural knowledge associated with resources and practices. Buildings and structures may be damaged or destroyed by high wind or heavy snow events, suffer accelerated deterioration through a variety of mechanisms (e.g., elevated humidity, chemical reactions, destructive pests and organisms), may be destabilized by hydrological changes, or be damaged by inadequate gutters or drainage systems (ICOMOS Climate Change and Cultural Heritage Working Group 2019: 73–89; Rockman et al. 2016: 20–24). (See Rockman et al. 2016: 19–24 for a detailed assessment of the potential impacts of climate change on cultural resources.)

Cultural Resources—Property-Specific Exposure and Impacts

The Forest's known cultural resources with high exposure to climate change hazards are the CCC-constructed Damon Pond Dam and Bridge and the Trapfall Brook levee wall, which are within the most recent Federal Emergency Management Agency (FEMA) 1.0%-chance flood zone (MassGIS 2023).

(Precipitation changes due to climate change (see EEA 2022b and Weston and Sampson 2022) are not factored into FEMA flood plain modeling. Climate change may result in additional exposure to and impacts from flooding for cultural resources in the future. A FEMA-contracted report (AECOM 2013) finds that: "For the riverine environment, the typical 1% annual chance floodplain area nationally is projected to grow by about 45%, with very large regional variations ... approximately 70% of the 45% (or 31.5%) growth in the 1% annual chance floodplain is due solely to climate change" (AECOM 2013: ES6–ES7). Site-specific projections for future floodplain areas were not available at the time this RMP was prepared.)

Recreation—General Impacts

Outdoor recreation and park visitation are dependent on weather and climate and will be affected by a warming climate (Wilkins and Horne 2024). Higher temperatures positively affect participation in most outdoor activities, except snow-based activities (Wilkins and Horne 2024). "Winter is warming substantially faster than other seasons, and winter warming is especially pronounced in the...Northeastern United States" (Wilkins and Horne 2024: 15). Exposure to this climate change phenomenon is projected to significantly reduce the length of winter recreation seasons for downhill skiing, cross-country skiing, and snowmobiling, decreasing recreational opportunities and causing substantial economic impacts (Wobus et al. 2017). Whitewater rafting, primitive area use, and hunting are also projected to be negatively impacted by exposure changing weather patterns associated with climate change (Askew and Bowker 2018). Although "coldwater fishing habitat is expected to decline under a warming climate, which will likely result in fewer fishing days," overall fishing participation in the Northeast is projected to rise "due to the more favorable temperatures" (Wilkins and Horne 2024: 11). Horseback riding on trails, boating, swimming, and visiting interpretive sites are also expected to see higher participation in the Northeast under climate change (Askew and Bowker 2018). Temperature preferences of campers indicate that the "number of ideal days" for camping will also increase (Wilkins and Horne 2024: 13). Participation in biking is also projected to increase, especially in the winter and shoulder months (Wilkins and Horne 2024: 13). Climate change may also impact outdoor recreation through increased impacts to recreation infrastructure (e.g., flooding impacts), and increased exposure to disease vectors (e.g., mosquitoes and ticks), longer pollen seasons, and heat-related illnesses (O'Toole et al. 2019).

Recreation—Property-Specific Exposure and Impacts

Recreation activities at the Forest likely to be negatively impacted by exposure to weather changes resulting from climate change include hunting and snow-dependent sports (i.e., cross-country skiing, snowmobiling, and snowshoeing). Other recreation activities may see increased participation, especially those associated with the waters of Damon Pond. Fishing, swimming, and other water-based activities may experience increased participation due to the anticipated increase in temperature (i.e., more than 30 additional days with temperatures over 90° F; Table 12).

Recreation infrastructure with exposure to increased precipitation and flooding associated with climate change include the Valley Road bridge and parking area; the Damon Pond waterfront area with its contact station and dam; approximately 0.3 acres of the Trap Falls picnic and viewing area with levee wall and bridge; and approximately 0.25 miles of forest road and trails. (As noted above, precipitation changes due to climate change are not factored into FEMA flood plain models and projections for future floodplain areas were not available at the time this RMP was prepared.)

APPLIED LAND STEWARDSHIP ZONING

DCR assesses the appropriate uses and stewardship of its properties at two spatial scales: the landscape level and the property level.

Landscape Designation

In 2012, DCR engaged in a comprehensive system-wide assessment of lands managed by its Division of State Parks and Recreation, designating them as Reserve, Woodland, or Parkland. (See Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines (DCR 2012) for details.) Multiple Landscape Designations may apply to individual properties with diverse resources and levels of development. All of Willard Brook State Forest was designated Parkland. Identification of Land Stewardship Zones within Willard Brook was performed in the context of the Parkland Landscape Designation.

The following Land Stewardship Zoning is recommended to guide management and any future development. (See Figure 1. Land Stewardship Zoning Map, page 27, and the Land Stewardship Zoning layer on DCR's Stewardship Map: https://dcrsgis-mass-eoeea.hub.arcgis.com/.)

Zone 1

Zone 1 areas have highly sensitive ecological and/or cultural resources that require additional management approaches and practices to protect and preserve these special features and their values (DCR 2012). The following areas of Willard Brook State Forest have been designated Zone 1.

- The Pearl Hill Brook corridor, including its unnamed tributary. This Zone 1 area recognizes the presence of Priority Habitat for a reptile that is a MESA-listed Species of Special Concern, as well as the recognition and protection of Pearl Hill Brook (and associated wetlands) as an important water resource under the following legislation and environmental programs: Outstanding Resource Water (314 CMR 4.06), the Squannacook and Nissitissit Rivers Sanctuary (M.G.L. c. 132A, § 17), the Squannassit ACEC (Secretary of Environmental Affairs 2002), and Coldwater Fish Resource (MassGIS 2021). North of Vinton Pond Road, Zone 1 is defined as coterminous with Priority Habitat No. 2035. South of Old City Road, Zone 1 utilizes Priority Habitat No. 2035, then protects additional identified species habitat and surface waters between New Townsend Road and an unnamed forest road west of the brook, extending south to the terminus of the wetlands.

Zone 2

Zone 2 areas provide for a balance between resource stewardship and recreational opportunities that can be appropriately sustained. They include stable yet important cultural and natural resources. These areas provide a buffer for sensitive resources, recharge areas for surface and groundwaters, and large areas where existing public recreation activities can be managed at sustainable levels (DCR 2012). The following areas of Willard Brook have been designated Zone 2.

- All areas not identified as Zone 1 or Zone 3, including the three non-contiguous tracts.

Zone 3

Zone 3 areas include altered landscapes in active use and areas suitable for future administrative, maintenance, and recreation areas (DCR 2012). The following areas of Willard Brook are currently

developed, appropriate for potential future development, or intensively used for recreation. They have been designated Zone 3.

- The headquarters area.
- The Trap Falls area.
- The Damon Pond Day Use Area and campground.
- Developed picnic areas and associated parking areas along Route 119 within the Willard Brook Valley.

Significant Feature Overlay

Significant Feature Overlays provide precise management guidance in order to maintain or preserve recognized resources features regardless of the zone in which they occur. The following Significant Feature Overlays were developed for Willard Brook.

- **Area of Critical Environmental Concern (ACEC) Overlay.** The Squannassit ACEC, designated 2002, encompasses over 37,000 acres of the Nashua River's watershed (Secretary of Environmental Affairs 2002). A majority of Willard Brook falls within the ACEC. Projects and activities within ACECs must minimize adverse effects on sensitive resources and are guided by a variety of regulations and programs that are summarized in the ACEC Guide to State Regulations and Programs (DCR 2017).
- **Wellhead Protection Area Overlay.** This overlay includes two Zone I Wellhead Protection Areas. Within this overlay, activities should be consistent with Wellhead Protection Tips (MassDEP 1995) and MassDEP Guidance (MassDEP 2011).

DCR Stewardship Map Tool

This RMP should be viewed in conjunction with DCR's Stewardship Map, a GIS-based tool that allows users to view a property's natural, cultural, and recreational resources. The Stewardship Map tool is dynamic, and information continues to be updated after adoption of an RMP. Guidance for using the tool, as well as BMPs for resource stewardship, are located on the Stewardship Map site: https://dcrsgis-mass-eoeea.hub.arcgis.com/.

Because authorized trails are located within State-Listed Species Habitat on this property, managers should consult an additional GIS-based tool, the NHESP 2022 Guidance Codes for DCR Trail Maintenance Map. (https://mass-eoeea.maps.arcgis.com/home/item.html?id=cb252e8df40d408c81fe8fcf690e14f6) This tool allows users to select specific trail segments and identify restrictions and regulatory review associated with performing 10 common trail maintenance activities on these segments. Because site-specific rare species information is confidential under Massachusetts law (M.G.L. c. 66, § 17D), access to this tool is restricted.

Consistency Review

Resource Management Plans "shall ensure consistency between recreation, resource protection, and sustainable forest management" (M.G.L. c. 21, § 2F). For planning purposes, an activity is considered consistent with resource protection if it has no significant, long-term, adverse impact on resources. To this end, a series of indicators were developed to evaluate the impacts of recreation and forest management on natural and cultural resources.

Many activities with the potential to negatively affect resources are already subject to agency and/or regulatory review (e.g., forest management activities, projects within Priority Habitat). For these activities, compliance with state regulations, regulatory authority guidance, DCR policies and processes, and BMPs is considered an indicator of consistency between park use and resource protection. New indicators were generated for activities not subject to agency or regulatory review, and are based on available data, information readily identifiable via aerial imagery or site visits, assessments by DCR subject matter experts, or the property manager's knowledge of park conditions and use. (See Table 18, page 28.)

Indicators are applied during the RMP planning process in order to ensure a standardized assessment of consistency across all properties in the DCR system. Inconsistencies identified via the application of indicators are used to inform the development of management recommendations.

The status of indicators (Yes, No, Unknown, and N/A) were accurate at the time this RMP was prepared and were used for planning purposes. However, they represent a snapshot in time and may not reflect future conditions. In addition, the status of indicators will change as recommendations get implemented.

MANAGEMENT RECOMMENDATIONS

Twenty-nine priority management recommendations were developed for this property. They are presented in Table 19, page 31. All recommendations are of equal importance.

Priority management recommendations derive from Threats, Opportunities, and Consistency Assessment information presented in this RMP. For a recommendation to be considered a priority and listed in the table, it must meet one or more of the criteria listed below. Maintenance and management needs not meeting one or more of these criteria are not included in the table but are identified in the Threats and Opportunities sections.

The following types of recommendations are considered priority:

- Natural resource stewardship and restoration activities consistent with park identity and intended to improve ecological function and connectivity.
- Cultural resource management activities consistent with park identity and intended to prevent the loss of integrity of significant cultural resources.
- Improvements consistent with park identity that are needed to support intended park activities.
- Actions required for regulatory compliance or compliance with legal agreements.
- Activities that prevent or ameliorate threats to the health and safety of park visitors and employees.
- Activities that address inconsistencies among recreation, resource protection, and sustainable forest management, as identified through use of the Consistency Assessment checklist.

Progress toward implementing priority recommendations is tracked through the use of DCR's Capital Asset Management Information System (CAMIS). The property manager should enter each recommendation listed in Table 19 (page 31) into CAMIS as a separate work order, noting "*RMP" in the description field. Non-traditional work orders (e.g., volunteer trail work, posting of DPH Fish Consumption Advisory posters, certification of vernal pools) should be closed out by the property manager, once the recommendation has been implemented.

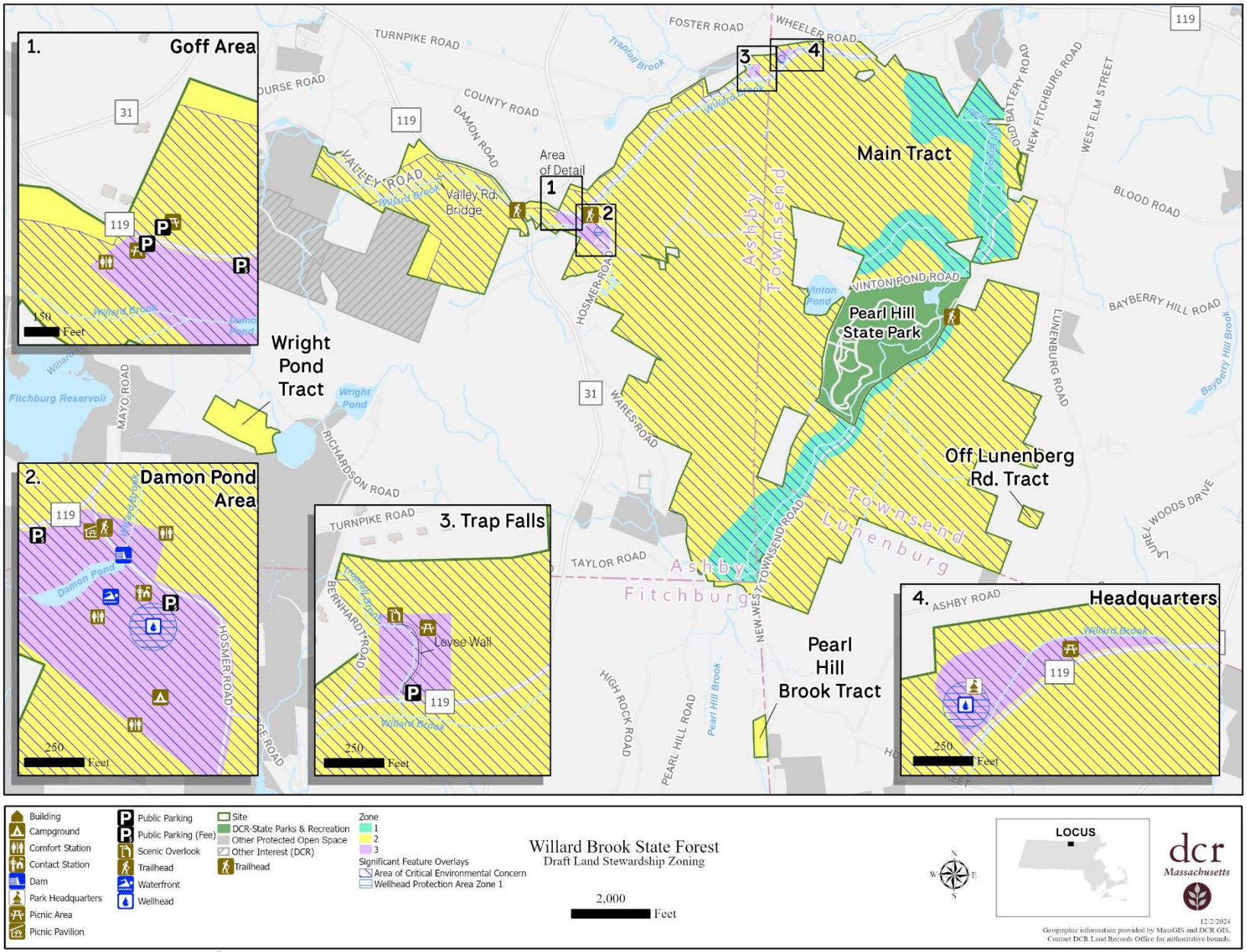


Figure 1. Land Stewardship Zoning Map.

Table 18. Consistency Assessment. This assessment represents a snapshot in time and may not reflect future conditions.

Category	Metric	Status
Landscape Designation	1. All development and uses of the park since 2012, or currently planned for the park, are consistent with its Landscape Designation(s).	Yes
Natural Resources	1. All projects (normal maintenance activities, special projects, volunteer projects) conducted within Priority Habitat were reviewed and approved through DCR's internal review process and by NHESP for potential impacts to rare species and their habitats.	Yes
Natural Resources	2. All projects conducted within areas subject to state and/or federal wetlands or waterways regulations were reviewed and approved through DCR's internal review process; reviewed and approved through the appropriate, local, state, and/or federal review process; and were carried out in accordance with the terms of a valid permit.	Yes
Natural Resources	3. Sensitive resource areas, such as steep slopes, riverbanks, streambanks, pond and lakeshores, wetlands, and dunes are free of desire paths and other user-created trails.	No
Natural Resources	4. Aquatic areas adjacent to beaches, boat ramps and launches, roads, and hiking trails are free of eroded sediments.	No
Natural Resources	5. The extent of exposed soil in campground and/or picnic sites is stable or decreasing.	No
Natural Resources	6. The extent of native vegetation in campground and/or picnic sites is stable or increasing. (As assessed by property manager.)	Yes
Natural Resources	7. Area of trail impacts in Reserves is less than 50% of total area. (See Naughton (2021) for information on primary area of trail impacts.)	N/A
Natural Resources	8. Congregations of breeding, migratory, or wintering wildlife are protected from disturbance by temporary (e.g., seasonal) restrictions on recreational access.	N/A
Natural Resources	9. Geocaches, letterboxes, orienteering control locations, and other discovery destinations are located outside sensitive natural resource areas and their locations have been reviewed and approved by park personnel. (As assessed by property manager.)	No
Natural Resources	10. Zone I wellhead protection areas are free of vehicle parking, chemical storage, or concentrated recreation.	No

Category	Metric	Status
Natural Resources	11. All boat ramps and launches have cleaning stations and/or educational signs and materials on preventing the spread of aquatic invasive organisms. (As assessed by property manager.)	N/A
Natural Resources	12. For each barrier beach there is a current, approved Barrier Beach Management Plan and all beach-related activities are conducted in accordance with this plan.	N/A
Cultural Resources	1. All maintenance activities and projects with the potential to cause sub-surface disturbance are being reviewed by the DCR archaeologist for potential impacts to archaeological resources.	Yes
Cultural Resources	2. All maintenance activities and projects affecting historic properties (buildings, structures, and landscapes over 50-years-old) are being reviewed by the Office of Cultural Resources to avoid adverse impacts.	Yes
Cultural Resources	3. Historic buildings, structures, and landscapes are being used, maintained, and repaired in a manner that preserves their cultural integrity and conveys their historic significance to park visitors.	No
Cultural Resources	4. Recreational activities such as hiking, biking, and boating are not eroding cultural properties such as archaeological sites or historic landscapes through creation of desire lines, rutting in the landscape, damage to historic built features, or excessive scouring (erosion) of coastal and shoreline areas.	No
Cultural Resources	5. Geocaches, letterboxes, and other discovery destinations are located away from sensitive cultural resources, and their locations have been reviewed and approved by park personnel.	No
Cultural Resources	6. Historic buildings, structures, landscapes, archaeological sites, and concentrations of historic resources are located outside of areas predicted to be subject to flooding, storm surge, or sea-level rise.	No
Recreation	1. Types of recreation, levels of recreational use, and types and extent of recreation infrastructure are consistent with the park's identity statement.	Yes

Category	Metric	Status
Recreation	2. Trail density is consistent with the park's Landscape Designation(s). (See Trails Guidelines and Best Practices Manual (DCR 2019) for density thresholds.)	Yes
Recreation	3. All authorized trail construction was performed in accordance with an approved Trail Proposal Form.	No
Recreation	4. Over 90% of the park's official trails network is classified as being in Fair or better condition.	Yes
Recreation	5. Recurring use by OHVs is restricted to authorized trails. (As assessed by property manager.)	No
Recreation	6. There is a high level of compliance with dog leash regulations and policies. (As assessed by property manager.)	No
Recreation	7. Athletic fields are free of recreation-caused impacts (e.g., bare spots) to turf. (As assessed by property manager.)	N/A
Recreation	8. Water-based recreation is consistent with "Uses Attained" designation as identified by MassDEP in its most current integrated list of waters (e.g., MassDEP 2023); DPH fish consumption advisories; and/or water quality testing at waterfront areas.	Yes
Recreation	9. Recreation facilities are located outside of areas subject to flooding, storm surge, or sea-level rise.	No
Sustainable Forest Management	1. Forestry activities are consistent with Landscape Designation and associated forestry guidelines.	Yes
Sustainable Forest Management	2. Forestry activities are consistent with current Forest Resource Management Plan.	N/A
Sustainable Forest Management	3. Tree cutting is performed in accordance with an approved cutting plan, if required under the Massachusetts Forest Cutting Practices Act (M.G.L. c. 132, §§ 40–46).	N/A

Table 19. Priority Recommendations for Willard Brook State Forest. All recommendations are of equal importance. When multiple agency parties are responsible for implementing a recommendation, the lead party, or parties, are identified parenthetically in the Implementation column. Property managers should enter these recommendations as work orders in CAMIS to ensure their tracking and implementation.

Category	Recommendation	Implementation
Natural Resources	Apply Landscape Designations to those portions of the Forest currently lacking such designations.	Management Forestry (Lead), GIS Program
Natural Resources	Monitor for Town of Townsend initiatives to deaccession or otherwise sell open space parcels appropriate for inclusion in the Forest, or other opportunities to acquire lands for habitat protection or recreational use.	Land Protection Program (Lead), Park Operations
Natural Resources	Confirm Forest boundaries at intersection of New Fitchburg and Vinton Pond Road, south of Bayberry Hill Road, west of Lunenburg Road, along Stewart Road.	Contractor, Management Forestry (Lead)
Natural Resources	Following internal review and permitting, design and implement trail Best Management Practices solutions and trail closures as needed to resolve erosion and wetland/stream crossing issues.	Office of Natural Resources, Park Operations (Co-Lead), Trails & Greenways Program (Co-Lead),
Natural Resources	Review and implement MassDEP Wellhead Protection Tips and Guidance (MassDEP 1995, MassDEP 2011) within the Forest's Zone I Wellhead Protection Areas.	Park Operations
Natural Resources	Continue implementation of the annual invasive treatments devised in accordance with the Invasive Plan Management Plan: Central Region (BSC Group 2017) for aquatic and terrestrial plants. Maintain actions as needed.	Office of Natural Resources (Lead), Park Operations
Natural Resources	Manage red pine plantation within Damon Pond Campground for public safety and aesthetic considerations.	Forest Health (Lead), Landscape Architecture

Category	Recommendation	Implementation
Cultural Resources	Conduct an archaeological reconnaissance survey (950 CMR 70) in cooperation with municipal, tribal and non-profit partners. Complete appropriate Massachusetts Historical Commission archaeological site forms for identified archaeological resources.	Partners, Consultant, Office of Cultural Resources (Lead)
Cultural Resources	Work with Indigenous peoples partners to inventory, document, conserve, and interpret Indigenous resources and Indigenous history within the Forest.	Office of Cultural Resources (Lead), Partner
Cultural Resources	Clear vegetation from cellar holes in accordance with DCR Best Management Practices and redirect paths around these resources.	Office of Cultural Resources, Park Operations (Lead), Volunteers
Recreation	Develop and install kiosks with Welcome Wayside panels at both day use area parking lots.	Interpretive Services (Lead), Park Operations
Recreation	Implement the "Key Recommendations" from the 2022 Accessibility Assessment (IHCD 2022).	Architecture Section, Contractors, Facilities Engineering, Universal Access Program (Lead)
Recreation	At such time as the headquarters building's propane heating system reaches the end of its useful life, replace this system with fossil fuel-free heating equipment, consistent with the directives of Executive Order 594 and the Commonwealth's greenhouse gas emissions reduction goals.	Contractors, Facilities Engineering
Recreation	Add parking spot that is compliant with accessibility standards to the Damon Pond Recreation Area's day use lot by completing the Damon Pond Dam and Bridge rehabilitation project (Tighe & Bond 2022).	Accessibility Program, Consultant, Contractor, Office of Cultural Resources, Office of Dam Safety (Lead)
Recreation	As recommended in previous study (MassDEP 2012:28), improve waterbody health and ensure consistent swimming access by conducting requisite study(ies) to identify and abate bacterial loads in Damon Pond and/or Willard Brook.	Contractor, Lakes and Ponds Program (Lead)

Category	Recommendation	Implementation
Recreation	Conduct a needs analysis/assessment for a restroom facility at Trap Falls.	Architecture Section (Lead), Lakes and Ponds Program, Park Operations
Recreation	Following appropriate environmental review and permitting, proceed with Damon Pond Dam and Bridge rehabilitation project (Tighe & Bond 2022).	Consultant, Contractor, Office of Cultural Resources, Office of Dam Safety (Lead), Office of Natural Resources
Recreation	Replace critical footbridge over Willard Brook within the Damon Pond Day Use Area.	Office of Natural Resources, Park Operations (Lead)
Recreation	Stabilize, repair, and reconstruct (where necessary) the Trapfall Brook levee wall, including vegetation restoration adjacent to the wall.	Architecture Section, Contractor, Facilities Engineering (Co-Lead), Office of Cultural Resources (Co-Lead)
Recreation	Repair the Damon Pond pavilion.	Architecture Section (Lead), Contractor, Office of Cultural Resources
Recreation	Repair and reconstruct (where necessary) the Damon Pond waterfront walls and restore the beach.	Contractor, Facilities Engineering (Lead), Office of Cultural Resources
Recreation	Increase awareness of the Emergency Action Plan for the Damon Pond Dam (GZA 2018) among Forest staff and local first responders.	Office of Dam Safety, Park Operations
Recreation	In accordance with the findings and recommendations of the Comprehensive Campground Assessment (Arcadis U.S., Inc. 2015), conduct facilities study to evaluate the bathrooms at Damon Pond Day Use Area and Campground for capital replacement.	Architecture Section (Lead), Contractor, Facilities Engineering

Category	Recommendation	Implementation
Recreation	Prepare a Master Plan for the Damon Pond Campground to resolve issues of camp site spacing and privacy, accessibility compliance, bathroom improvements, and aging forest stands.	Architecture Section (Co-Lead), Consultant, Landscape Architecture Section (Co-Lead), Management Forestry, Office of Cultural Resources, Office of Natural Resources, Park Operations
Recreation	Develop a comprehensive Trails Plan consistent with DCR Trails Guidelines and Best Practices (DCR 2019) to enhance resource protection and improve the visitor experience for all trail-based recreationists.	Park Operations (Co-Lead), Trails & Greenways Program (Co-Lead), Universal Access Program (Co-Lead)
Recreation	Resolve trail-related threats and opportunities identified in this RMP, in accordance with Trails Guidelines and Best Practices (DCR 2019, or update), through the following actions: • Maintain authorized trails, as identified in the DCR Trail Data Layer provided to the Natural Heritage and Endangered Species Program in 2021, and in accordance with the Recreational Trail Maintenance and Biodiversity Conservation 2021 update. • Evaluate trail segments for discontinuation or active closure, including those that are: unauthorized, unsafe, connecting to privately-owned property, located in environmentally or culturally sensitive areas, or otherwise inconsistent with DCR Trails Guidelines and Best Practices. Provide an updated trail data layer to the Natural Heritage and Endangered Species Program. • Establish new trails, as warranted, following regulatory review. Provide an updated trail data layer to the Natural Heritage and Endangered Species Program.	Management Forestry, Office of Natural Resources, Park Operations (Co-Lead), Partners, Trails and Greenways Section (Co-Lead)
Recreation	Following the trails system review, create new trail map with all authorized trails and location of Trap Falls viewing area.	GIS Program, Interpretive Services, Trails and Greenways Section (Lead)

Category	Recommendation	Implementation
Recreation	Create or enhance formal partnership with the New England Mountain Bike Association.	Park Operations, Trails and Greenways Section (Co-Lead)
Recreation	Work with the geocaching community to ensure that caches located in sensitive natural and cultural resources are relocated out of those areas and that any new geocaches are placed outside of sensitive areas and with the approval of the property manager.	Office of Cultural Resources, Office of Natural Resources, Park Operations (Lead)

REFERENCES

AECOM. 2013. The impact of climate change and population growth on the National Flood Insurance Program through 2100. Prepared for Federal Insurance and Mitigation Administration and Federal Emergency Management Agency.
https://aecom.com/content/wp-content/uploads/2016/06/Climate_Change_Report_AECOM_2013-06-11.pdf (PDF)

Arcadis U.S., Inc. 2015. Comprehensive Campground Assessment: Massachusetts Department of Conservation and Recreation, Division of State Parks (MassParks). Final Report, December 2015. Prepared for the Department of Conservation and Recreation, Boston, MA, by Arcadis U.S., Inc., Wakefield, MA.

Askew, A. E., and J. M. Bowker. 2018. Impacts of Climate change on outdoor recreation participation: Outlook to 2060. Journal of Park and Recreation Administration 36: 97–120.
https://www.srs.fs.usda.gov/pubs/ja/2018/ja_2018_bowker_001.pdf (PDF)

BSC Group, Inc. (BSC). 2017. Invasive Plant Management Plan: Central Region. Produced in association with: DCR Ecology & ACEC Program, June 2017.

Berg, S. P. 1998a. Willard Brook State Forest – Damon Pond (ASY.C). Massachusetts Historical Commission Form A – Area Form. On file, Massachusetts Historical Commission, Boston, MA.
https://mhc-macris.net/details?mhcid=ASY.C

Berg, S. P. 1998b. Willard Brook State Forest – Trap Falls (ASY.D). Massachusetts Historical Commission Form A – Area Form. On file, Massachusetts Historical Commission, Boston, MA.
https://mhc-macris.net/details?mhcid=ASY.D

Berg, S. P. 1999. The Civilian Conservation Corps, shaping the forests and parks of Massachusetts. A statewide survey of Civilian Conservation Corps resources. Prepared for the Department of Environmental Management, Boston, MA, by Shary Page Berg, Landscape Preservation Planning and Design, Cambridge, MA.
https://archives.lib.state.ma.us/handle/2452/835790

Birnbaum, C. A. n.d. The Secretary of the Interior's standards for the treatment of historic properties with guidelines for the treatment of cultural landscapes.
https://www.nps.gov/crps/tps/landscape-guidelines/index.htm

Cartwright, J., T. L. Morelli, and E. H. Campbell Grant. 2022. Identifying climate-resistant vernal pools: Hydrologic refugia for amphibian reproduction under droughts and climate change. Ecohydrology 2022, 15, e2354.
https://onlinelibrary.wiley.com/doi/epdf/10.1002/eco.2354 (PDF)

Commonwealth of Massachusetts. 2023. ResilientMass Plan: 2023 Massachusetts State Hazard Mitigation and Climate Adaptation Plan. ResilientMass Action Team, Boston, Massachusetts.
https://www.mass.gov/doc/resilientmass-plan-2023/download (PDF)

Finch, D. M., J. L. Bitler, J. B. Runyon, C. J. Fettig, F. F. Kilkenny, S. Jose, S. J. Frankel, S. A. Cushman, R. C. Cobb, J. S. Dukes, J. A. Hicke, and S. K. Amelon. 2021. Effects of Climate Change on invasive species. Chapter 4 *in* T. M. Poland, T. Patel-Weynand, D. M. Finch, C. F. Miniat, D. C. Hayes, and V. M. Lopes (Editors) Invasive species in forests and rangelands of the United States: A comprehensive science synthesis for the United States forest sector. Springer.
https://library.oapen.org/bitstream/handle/20.500.12657/46792/2021_Book_InvasiveSpeciesInForestsAndRan.pdf?sequence=1&isAllowed=y (PDF)

Freedom's Way Heritage Association, Inc. (FWHA). 2015. Freedom's Way National Heritage Area management plan.
https://freedomsway.org/wp-content/uploads/2021/10/FWNHAmanagementplan.pdf (PDF)

Friggens, M. M., M. I. Williams, K. E. Bagne, T. T. Wixom, and S. A. Cushman. 2018. Effects of climate change on terrestrial animals. Pages 264–315 *in* Halofsky, J. E., D. L. Peterson, J. J. Ho, N. J. Little, and L. A. Joyce (Eds.). Climate change vulnerability and adaptation in the Intermountain Region. Gen. Tech. Rep. RMRS-GTR-375. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Part 2. pp. 199–513.
https://www.fs.usda.gov/rm/pubs_series/rmrs/gtr/rmrs_gtr375_2.pdf (PDF)

Halofsky, J. E., D. L. Peterson, J. J. Ho, N. J. Little, and L. A. Joyce (Eds.). 2018. Climate change vulnerability and adaptation in the Intermountain Region. Gen. Tech. Rep. RMRS-GTR-375. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Part 2. pp. 199–513.
https://www.fs.usda.gov/rm/pubs_series/rmrs/gtr/rmrs_gtr375_2.pdf (PDF)

GZA. 2018. Emergency Action Plan for Damon Pond Dam, Ashby, Massachusetts. National I.D. Number MA02518. Prepared by GZA in February 2014 for the Massachusetts Department of Conservation and Recreation, Boston, MA. Updated by Office of Dam Safety, May 1, 2018.

Ham, S. H. 2013. Interpretation: Making a difference on purpose. Fulcrum Publishing, Golden, CO.

Institute for Human Centered Design (IHCD). 2022. Willard Brook State Forest, West Townsend and Ashby, MA: Program Accessibility Assessment. Boston, MA. Prepared for the Department of Conservation and Recreation, Boston, MA.

Intergovernmental Panel on Climate Change (IPCC). 2021. Annex VII: Glossary [Matthews, J.B.R., V. Möller, R. van Diemen, J.S. Fuglestvedt, V. Masson-Delmotte, C. Méndez, S. Semenov, A. Reisinger (eds.)]. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 2215–2256, doi:10.1017/9781009157896.022.
https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_AnnexVII.pdf (PDF)

International Council on Monuments and Sites (ICOMOS) Climate Change and Cultural Heritage Working Group. 2019. The Future of our Pasts: Engaging Cultural Heritage in Climate Action. ICOMOS, Paris, France.
https://civvih.icomos.org/wp-content/uploads/Future-of-Our-Pasts-Report-min.pdf (PDF)

Isaak, D. J., M. K. Young, C. Tait, D. Duffield, D. L. Horan, D. E. Nagel, and M. C. Groce. 2018. Effects of climate change on native fish and other aquatic species. Pages 89–111 *in* Halofsky, J. E., D. L. Peterson, J. J. Ho, N. J. Little, and L. A. Joyce (Eds.). Climate change vulnerability and adaptation in the Intermountain Region. Gen. Tech. Rep. RMRS-GTR-375. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Part 1. Pp. 1–197.
https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd578946.pdf (PDF)

Janowiak, M. K., A. W. D'Amato, C. W. Swanston, L. Iverson, F. R. Thompson, III, W. D. Dijak, S. Matthews, M. P. Peters, A. Prasad, J. S. Fraser, L. A. Brandt, M. J. Butler-Leopold, S. D. Handler, P. D. Shannon, D. Burbank, J. Campbell, C. Cogbill, M. J. Duveneck, M. R. Emery, N. Fisichelli, J. Foster, J. Hushaw, L. Kenefic, A. Mahaffey, T. L. Morelli, N. J. Reo, P. G. Schaberg, K. R. Simmons, A. Weiskittel, S. Wilmot, D. Hollinger, E. Lane, L. Rustad, and P. H. Templer. 2018. New England and northern New York ecosystem vulnerability assessment and synthesis: A report from the New England Climate Change Response Framework project. Gen. Tech. Rep.NRS-173. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 234 p.
https://www.fs.usda.gov/nrs/pubs/gtr/gtr_nrs173.pdf (PDF)

Leddick, J. 2024a. Re: Draft Willard Brook State Forest Resource Management Plan. Massachusetts Division of Fisheries and Wildlife, correspondence with Paul Cavanagh, Department of Conservation and Recreation. May 17, 2024.

Leddick, J. 2024b. Re: Draft Pearl Hill State Park Resource Management Plan. Massachusetts Division of Fisheries and Wildlife, correspondence with Paul Cavanagh, Department of Conservation and Recreation. May 17, 2024.

Liu, Y., A. M. O. Odour, Z. Zhang, A. Manea, I. M. Tooth, M. R. Leishman, X. Xu, and M. Van Kleunen. 2017. Do invasive alien plants benefit more from global environmental change than native plants? Global Change Biology (2017), doi: 10.1111/gcb.13579.
https://www.researchgate.net/profile/Xingliang-Xu/publication/310902903_Do_invasive_alien_plants_benefit_more_from_global_environmental_change_than_native_plants/links/5a20bb30a6fdcccd30e032dc/Do-invasive-alien-plants-benefit-more-from-global-environmental-change-than-native-plants.pdf (PDF)

Massachusetts Bureau of Geographic Information (MassGIS). 2021. MassGIS data: MA Wildlife Coldwater Fisheries Resources. February 2021.
https://www.mass.gov/info-details/massgis-data-ma-wildlife-coldwater-fisheries-resources

Massachusetts Bureau of Geographic Information (MassGIS). 2023. FEMA National Flood Hazard Layer. July 2023.
https://www.mass.gov/info-details/massgis-data-fema-national-flood-hazard-layer

Massachusetts Department of Conservation and Recreation (DCR). n.d.a. Best Management Practices: Vernal pool certification on DCR lands. Office of Regional Planning, Boston, MA. https://www.mass.gov/doc/vernal-pool-certification-on-dcr-lands/download (PDF)

Massachusetts Department of Conservation and Recreation (DCR). n.d.b. Best Management Practices: Historic Building Maintenance. Office of Cultural Resources, Boston, MA. https://www.mass.gov/doc/historic-building-maintenance/download (PDF)

Massachusetts Department of Conservation and Recreation (DCR). 2012. Landscape designations for DCR parks & forests: Selection criteria and management guidelines. Boston, MA. https://archives.lib.state.ma.us/handle/2452/200210

Massachusetts Department of Conservation and Recreation (DCR). 2017. ACEC guide to state regulations and programs. https://www.mass.gov/doc/acec-guide-to-regulations-programs/download (PDF)

Massachusetts Department of Conservation and Recreation (DCR). 2019. Trails guidelines and best practices manual. Updated July 2019. https://www.mass.gov/doc/dcr-trails-guidelines-and-best-practices-manual/download (PDF)

Massachusetts Department of Conservation and Recreation (DCR). 2020. Massachusetts State Forest Action Plan 2020. Executive Office of Energy & Environmental Affairs, Department of Conservation and Recreation, Massachusetts Bureau of Forest Fire Control and Forestry. https://archives.lib.state.ma.us/handle/2452/840801

Massachusetts Department of Conservation and Recreation (DCR). 2022. Manual for Continuous Forest Inventory field procedures. Bureau of Forestry, Division of State Parks and Recreation. Rev. March 2022.

Massachusetts Department of Conservation and Recreation (DCR). 2023. Managing our forests…for carbon benefits. https://www.mass.gov/info-details/managing-our-forests-for-carbon-benefits

Massachusetts Department of Conservation and Recreation (DCR). 2024. DCR Climate Impacts. Story Map series highlighting the expected impacts caused by climate change across the DCR's facilities and operations in Massachusetts. https://storymaps.arcgis.com/collections/666258ae0e3543efa3612b9bf380bb30

Massachusetts Department of Conservation and Recreation (DCR) and Freedom's Way Heritage Association. 2006. Ashby Reconnaissance Report. Freedom's Way Landscape Inventory, Massachusetts Heritage Landscape Inventory Program. Department of Conservation and Recreation, Boston, MA. https://www.mass.gov/doc/ashby/download

Massachusetts Department of Environmental Protection (MassDEP). 1995. Wellhead protection tips for small public water supply systems. https://www.mass.gov/files/documents/2016/08/op/welltips.pdf (PDF)

Massachusetts Department of Environmental Protection (MassDEP). 2011. Implementation of Zone I requirements. DWP Policy 94-03. Effective Date: 3/10/2008. Amended Date: 5/01/2011. https://www.mass.gov/files/documents/2016/08/qs/9403a.pdf (PDF)

Massachusetts Department of Environmental Protection (MassDEP). 2012. Report to the Senate and House of Representatives on water quality at beaches under the care and control of the Department of Conservation and Recreation. DEP, Boston, MA. https://www.mass.gov/doc/appendices-to-beach-report/download (PDF)

Massachusetts Department of Environmental Protection (MassDEP). 2023. Final Massachusetts integrated list of waters for the Clean Water Act 2022 reporting cycle. CN. 568.1. May 2023. Massachusetts Department of Environmental Protection, Bureau of Water Resources, Division of Watershed Management, Watershed Planning Program. Worcester, MA. https://www.mass.gov/doc/final-massachusetts-integrated-list-of-waters-for-the-clean-water-act-2022-reporting-cycle/download (PDF)

Massachusetts Department of Public Health (DPH). 2013. Marine and freshwater beach testing in Massachusetts. Annual report: 2012 season. May 2013. https://archives.lib.state.ma.us/handle/2452/432274

Massachusetts Department of Public Health (DPH). 2014. Marine and freshwater beach testing in Massachusetts. Annual report: 2013 season. June 2014. https://www.mass.gov/doc/2013-annual-beach-report/download (PDF)

Massachusetts Department of Public Health (DPH). 2015. Marine and freshwater beach testing in Massachusetts. Annual report: 2014 season. May 2015. https://www.mass.gov/doc/2014-annual-beach-report/download (PDF)

Massachusetts Department of Public Health (DPH). 2016. Marine and freshwater beach testing in Massachusetts. Annual report: 2015 season. May 2016. https://www.mass.gov/doc/2015-annual-beach-report/download (PDF)

Massachusetts Department of Public Health (DPH). 2017. Massachusetts freshwater beaches [2017]: Water quality data for public and semi-public beaches. https://www.mass.gov/doc/2018-freshwater-beach-data/download (PDF)

Massachusetts Department of Public Health (DPH). 2019. Massachusetts freshwater beaches [2018]: Water quality data for public and semi-public beaches. https://www.mass.gov/doc/2018-freshwater-beach-data/download (PDF)

Massachusetts Department of Public Health (DPH). 2020. Massachusetts freshwater beaches [2019]: Water quality data for public and semi-public beaches. https://www.mass.gov/doc/2019-freshwater-beach-data/download (PDF)

Massachusetts Department of Public Health (DPH). 2021. Massachusetts freshwater beaches [2020]: Water quality data for public and semi-public beaches. https://www.mass.gov/doc/2020-freshwater-beach-data-0/download (PDF)

Massachusetts Department of Public Health (DPH). 2022. Massachusetts freshwater beaches [2021]: Water quality data for public and semi-public beaches.
https://www.mass.gov/doc/2021-freshwater-beach-data-0/download (PDF)

Massachusetts Division of Fisheries and Wildlife (MassWildlife). 2009. Guidelines for the certification of vernal pool habitat, March 2009.
https://www.mass.gov/doc/guidelines-for-the-certification-of-vernal-pool-habitat/download (PDF)

Massachusetts Division of Fisheries and Wildlife (MassWildlife). 2015. Massachusetts State Wildlife Action Plan 2015. Westborough, MA.
https://www.mass.gov/info-details/state-wildlife-action-plan-swap

Massachusetts Executive Office of Energy and Environmental Affairs (EEA). 2022a. 2022 Massachusetts Climate Change Assessment, Volume II – Statewide Report. Executive Office of Energy and Environmental Affairs, Boston, MA.
https://www.mass.gov/doc/2022-massachusetts-climate-change-assessment-december-2022-volume-ii-statewide-report/download (PDF)

Massachusetts Executive Office of Energy and Environmental Affairs (EEA). 2022b. Massachusetts Climate and Hydrologic Risk Project (Phase 1) – Stochastic Weather Generator Climate Projections Data. Downscaled temperature and precipitation projections for Massachusetts under high emissions scenarios for 2030, 2050, 2070 and 2090. December 12, 2022.
https://mass-eoeea.maps.arcgis.com/home/item.html?id=1ce2fd14191b48789a36f344f4df52d3#

Massachusetts Executive Office of Energy and Environmental Affairs (EEA). 2024. Response to the report of the Climate Forestry Committee.
https://www.mass.gov/doc/forests-as-climate-solution-response-to-cfc-report/download (PDF)

Massachusetts General Court (MGC). 1929. Chapter 355 of the Acts of 1929. An Act providing for the establishment of the Willard Brook State Forest in the Towns of Ashby and Townsend.
https://archives.lib.state.ma.us/handle/2452/69088

Massachusetts Historical Commission (MHC). 1984a. Massachusetts Historical Commission Reconnaissance Survey Report: Ashby. Boston, MA.
https://www.sec.state.ma.us/divisions/mhc/preservation/survey/town-reports/asy.pdf (PDF)

Massachusetts Historical Commission (MHC). 1984b. Massachusetts Historical Commission Reconnaissance Survey Report: Townsend. Boston, MA.
https://www.sec.state.ma.us/divisions/mhc/preservation/survey/town-reports/tow.pdf (PDF)

Massachusetts Invasive Plant Advisory Group (MIPAG). n.d. Plants voted as: Invasive.
https://www.massnrc.org/mipag/invasive.htm

McNab, W. H., and D. L. Loftis. 2002. Probability of occurrence and habitat features for oriental bittersweet in an oak forest in the southern Appalachian Mountains, USA, Forest Ecology and Management 155(2002): 45–54.
https://www.srs.fs.usda.gov/pubs/ja/ja_mcnab006.pdf (PDF)

Merow, C., S. T. Bois, J. N. Allen, Y. Xie, and J. A. Silander, Jr. 2017. Climate change both facilitates and inhibits invasive plant ranges in New England. Proceedings of the National Academy of Sciences E3276–E3284.
https://www.pnas.org/doi/pdf/10.1073/pnas.1609633114

National Park Service (NPS). 1998. Planning for interpretation and visitor experience. Prepared by the Division of Interpretive Planning, Harpers Ferry Center, Harpers Ferry, WV. 1998.
https://www.nps.gov/subjects/hfc/upload/interp-visitor-exper.pdf (PDF)

Native Land Digital. 2023. Native Land Digital.
https://native-land.ca/

Naughton, M. 2021. Wildlife and recreation: Understanding and managing the effects of trail use on wildlife. Prepared for Vermont Fish and Wildlife and Vermont Forests, Parks, and Recreation. November 2021.
https://anr.vermont.gov/sites/anr/files/2023-01/wildlife_and_recreation_%20M_naughton_2021.pdf (PDF)

O'Toole, D., L. A. Brandt, M. K. Janowiak, K. M. Schmitt, P. D. Shannon, P. R. Leopold, S.D. Handler, T. A. Ontl, and C. W. Swanston. 2019. Climate adaptation strategies and approaches for outdoor recreation. Sustainability 2019, 11, 7030.
https://www.mdpi.com/2071-1050/11/24/7030/pdf (PDF)

Rockman, M., M. Morgan, S. Ziaja, G. Hambrecht, and A. Meadow. 2016. Cultural Resources Climate Change Strategy. National Park Service, Cultural Resources, Partnerships, and Science and Climate Change Response Program, Washington, D.C.
https://www.nps.gov/subjects/climatechange/upload/NPS-2016_Cultural-Resoures-Climate-Change-Strategy.pdf (PDF)

Rustad, L., J. Campbell, J. S. Dukes, T. Huntington, K, F. Lambert, J. Mohan, and N. Rodenhouse. 2012. Changing climate, changing forests: The impacts of climate change on forests of the northeastern United States and eastern Canada. Gen. Tech. Rep. NRS-99. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station.
https://www.fs.usda.gov/nrs/pubs/gtr/gtr_nrs99.pdf (PDF)

Secretary of Environmental Affairs. 2002. Designation of the Squannassit Area of Critical Environmental Concern. Executive Office of Environmental Affairs, designated December 11, 2002.
https://www.mass.gov/service-details/squannassit-acec

Swanston, C. W., M. K. Janowiak, L. A. Brandt, P. R. Butler, S. D. Handler, P. D. Shannon, A. Derby Lewis, K. Hall, R. T. Fahey, L. Scott, A. Kerber, J. W. Miesbauer, L. Darling, L. Parker, and M. St. Pierre. 2016. Forest adaptation resources: Climate change tools and approaches for land managers, 2nd ed. Gen. Tech. Rep. NRS-GTR-87-2. U.S. Department of Agriculture, Forest Service, Northeast Research Station. Newtown Square, PA.
https://www.fs.usda.gov/nrs/pubs/gtr/gtr_nrs87-2.pdf (PDF)

Tighe & Bond. 2022. Project Notification Form and correspondence: Damon Pond Dam Repairs and Area Improvements. Submitted to the Massachusetts Historical Commission, September 9.

Town of Townsend. n.d. Town of Townsend General Bylaws, Chapter 106: Scenic Roads. https://www.townsendma.gov/planning-board/pages/bylaws-rulesregulations

Town of Townsend. 2013. Townsend Open Space and Recreation Plan, 2012. Townsend, MA.

United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Center. 2007. Climate Change and World Heritage. Report on predicting and managing the impacts of climate change on World Heritage and strategy to assist States parties to implement appropriate management responses. World Heritage Reports 22. UNESCO World Heritage Center, Paris, France. https://whc.unesco.org/uploads/activities/documents/activity-474-1.pdf (PDF)

VHB. 2022. DCR Stormwater Design Handbook. October 19, 2022. Prepared for the Massachusetts Department of Conservation and Recreation. https://www.mass.gov/doc/dcr-stormwater-design-handbook/download (PDF)

Weston and Sampson. 2022. Climate change vulnerability assessment. September 2022. Report prepared for Massachusetts Department of Conservation and Recreation.

Wilkins, E. J., and L. Horne. 2024. Effects and perceptions of weather, climate, and climate change on outdoor recreation and nature-based tourism in the United States: A systematic review. PLOS Climate 3(4): e0000266. https://journals.plos.org/climate/article?id=10.1371/journal.pclm.0000266 (PDF)

Wobus, C., E. E. Small, H. Hosterman, D. Mills, M. Rissing, R. Jones, M. Duckworth, R. Hall, J. Creason, and J. Martinich. 2017. Projected climate change impacts on skiing and snowmobiling in the United States. Global Environmental Change. 45(2017) 1–14. https://www.sciencedirect.com/science/article/am/pii/S0959378016305556 (PDF)