dcr
Massachusetts

Resource Management Plan
Purgatory Chasm State Reservation

Adopted by the DCR Stewardship Council February, 2025

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

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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 (DCR), 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 www.mass.gov/dcr. Contact us at mass.parks@mass.gov.

Purgatory Chasm State Reservation

https://www.mass.gov/locations/purgatory-chasm-state-reservation

1. Property Overview

Characteristic	Value
Date Established	1910
Location	Sutton
Ecoregion	Southern New England Coastal Plains and Hills
Watershed	Blackstone
DCR Region	Central
DCR District	Central Valley
DCR Complex	Blackstone
Management Forestry District	Mid-State
Fire Control District	South Worcester
Size (acres)	238.9
Boundary Length (miles)	6.7
Elevation - Minimum (feet)	388.8
Elevation - Maximum (feet)	620.3
Environmental Justice (acres)	0.0
Estimated Annual Attendance (2020)	117,295
Interpretive Programs (number of programs, 2023)	154
Interpretive Programs (number of attendees, 2023)	2,494

2. Landscape Designations

Designation	Acres
Parkland	93.5
Reserve	0.0
Woodland	56.6
No Designation	88.8

3. Regulatory Designations

Designation	Acres
Priority Habitat (MESA)	18.9

4. Long-Term Agreements

Agreement	Expiration Year
None identified	N/A

5. Concessions

Concession Type
Mobile Food Concession - Juniper Farms Ice Cream Co., Inc.

6. Partners & Friends

Group(s)
None

7. Features of Interest

Feature
Chasm and associated geologic features
Picnic facilities
Playground
Sliding Rock
Trail network
Visitor Center

8. Natural Resources

Resource	Number
Tree Canopy (acres)	235.0
Rivers and Streams (miles)	1.0
Open Water (acres)	0.0
Wetlands (acres)	5.7
Certified Vernal Pools (number)	2
Potential Vernal Pools (number)	2
State-listed Species (number Regulatory)	1
State-listed Species (number Non-Regulatory)	0
Federally Listed Species (number)	0
Aquatic Invasive Plants (number of known species)	0
Terrestrial Invasive Plants (number of known species)	1

9. Forest Management (Since 2012)

Management Objective	Acres
N/A	0.0

10. Climate Change (By 2070)

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

11. Natural Hazards

Hazard Type	Acres
Flood (1.0%-chance)	0.0
Flood (0.2%-chance)	0.0
Hurricane Inundation (Category 1)	N/A
Hurricane Inundation (Category 4)	N/A

12. Cultural Resources

Resource Type	Number
Archaeological - listed in the Massachusetts Cultural Resource Information System (MACRIS)	0
Historical - Listed in MACRIS	17
National Register-listed	0
National Historic Landmark	0

13. Recreation Resources

Resource	Number
Healthy Heart Trail	1
Pavilion	1
Playground	1
Playing field	1
Picnic areas	3
Visitor Center	1

14. Recreation Activities

Activity
Dog walking, on-leash
Field games
Hiking/Walking
Nature study/Photography
Picnicking
Playground use
Rock climbing (permit only)
Running/Jogging
Scenic vista viewing
Skiing, cross-country
Snowshoeing

15. Roads and Trails

Metric	Value
Roads - Unpaved (miles)	0.3
Roads - Paved (miles)	0.3
Forest Roads - Unpaved (miles)	0.9
Forest Roads - Paved (miles)	0.1
Trails - Unpaved (miles)	3.9
Trails - Paved (miles)	0.1
Trails - Unauthorized (miles)	1.2
Trail Density (miles/acre)	0.027
Area of Impact (acres)	205.0

16. Parking

Parking Resources	Number
Lots	4
Parking Spaces - Total	136
Parking Spaces - Accessible (HP)	6
Parking Spaces - Other	130

INTRODUCTION

Purgatory Chasm State Reservation (Purgatory or the Reservation) is located in Sutton (the Town), approximately 10 miles southeast of Worcester and 35 miles southwest of Boston. It is bounded on its north, west, and much of its south by Sutton State Forest. The Reservation's main attraction is a unique geological feature that has long attracted visitors, a one-quarter-mile long cleft in the earth with sheer cliffs up to 70 feet high. (See cover photo.)

The Reservation is on land shaped by generations of Indigenous peoples and non-Indigenous inhabitants. Past and present Indigenous residents embody fluid, relational connections to the places and spaces now known as Purgatory Chasm State Reservation. Groups and individuals, including Indigenous people known as the Nipmuc(k), are recorded in available documentation (Native Land Digital 2023) as having relationships to this place over seasons and generations. The hills and waterways of Sutton were important for resource collection, including stone quarrying. Today, Indigenous peoples maintain an ongoing presence in the region. Following Indigenous peoples' dispossession, many local Indigenous residents were brought into praying towns in the region. In 1704, the Massachusetts General Court (MGC) granted lands in what would become the Town to settlers; incorporation followed in 1714 (Massachusetts Historical Commission 1983). Purgatory Chasm was undoubtedly well-known to the Nipmuc(k) that inhabited the area and to early European settlers. The name "Purgatory" had been attached to the feature by 1793 and, by the 1800s, Purgatory Chasm had become a recreation destination. In the early 1900s, it was "attractive to large numbers of people, both inside and outside the State" (Shepard and Rane 1917). Visitors continue the tradition of thronging to the chasm for a day of recreation.

Purgatory Chasm State Reservation was established in 1919, so that the chasm would always be in the public trust. A narrative of the Reservation's early days is provided in Dudley (1952). As a State Reservation, Purgatory was owned by the Commonwealth but managed by the county. In 1924, over 200 acres of adjacent land was protected with the establishment of Sutton State Forest (Sutton). Management of Purgatory was transferred to the Commonwealth in 1974 (MGC 1974), bringing both Purgatory and Sutton under the management of the Department of Environmental Management, a predecessor to DCR. Although both are now DCR properties, Purgatory remains heavily influenced by its past as a county-run reservation and a recreation destination, and Sutton remains heavily influenced by its history as a state forest. Visitor activities in these parks differ, in large part due to these management histories.

Today, Purgatory is a heavily forested, irregularly shaped tract of rocky upland. Purgatory Road, the Reservation's entrance road, approximately bisects the Reservation on an east-west course. Rocky slopes descend southwest from the road towards Purgatory Brook and are bisected by the chasm itself. As a property with a long history of recreational use, there are a number of historical buildings, small-scale landscape features, and sites (including trails) that, in conjunction with the chasm itself, organize and help to define the visitor experience. Purgatory Chasm is contiguous with Sutton State Forest and the Reservation's recreation is best considered from the context of the two parks combined. (See the Sutton State Forest RMP for additional information on that property.) Purgatory Chasm has recreation facilities (e.g., picnic areas, visitor center, parking lots, water fountains, and a playground) that concentrate visitors. In contrast, recreation at Sutton State Forest is trail-based and dispersed. Together

these two DCR properties provide day-use visitors with modern park amenities, opportunities for trail-based recreation, and off-trail adventures.

PARK IDENTITY

Purgatory Chasm State Reservation is strongly identified with its namesake feature, a natural geological phenomenon that contains breathtakingly steep rock formations. In addition to the chasm, there are beautiful woodland trails, a picnic area, a playground, and a pavilion. All future activities and improvements should be consistent with Purgatory's identity as a destination to enjoy the chasm and its associated geologic features in a bucolic, woodland setting.

DEFINING RESOURCES AND VALUES

Resources and values that define the Reservation are largely associated with the chasm. They include:

- The chasm itself, with its "vertical walls of massive Milford gneiss" (Skehan 2001), is "one of the most unusual natural formations to be found in the Commonwealth" (Shepard and Rane 1917). There is no other place like it in Massachusetts and its romantic scenic qualities have made it an attraction of long-standing interest for tourists and sightseers.
- A widespread network of picnic areas with a pavilion, tables, and grills; a playing field; and playground.
- Two historic buildings and a historic structure with distinctive stone architecture: The Spring House (1926), Stone Rest Room (1933), and a Craftsman style pavilion (1935). These features were constructed while the property was a county reservation and differ markedly in materials and design from buildings on properties established as state parks or state forests. The entire reservation has been determined to be eligible for listing in the National Register of Historic Places (Meltsner and Binzen 2002), the two buildings and pavilion are contributing elements of the potential listing.
- Visitor Center with year-round displays and seasonal interpretive programming.
- A trail system established by early visitors and formalized and expanded over the years. Trails run through the chasm and around its rim; and connect to trails on Sutton State Forest.

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 Purgatory Chasm State Reservation. The sequence of these statements does not reflect their level of significance.

- Purgatory Chasm served as a local curiosity in the Town of Sutton long before becoming a state reservation. Early visitors marveled at the chasm's beauty and mysterious nature. These visitors established Purgatory Chasm's trail network as informal pathways; after 1919, these paths became the core of the Reservation's formal trail system.
- The most notable feature of the site is the chasm for which it is named. Geologists hypothesize a sudden release of glacial meltwater roughly 14,000 years ago formed the chasm, though this is still a matter of debate.
- The Commonwealth established the site as a County Commission park in 1919, to be run by the Worcester County Commissioners rather than by the state directly. As such, it is one of the oldest state-established conservation/recreation areas in Massachusetts outside of greater Boston. Its purpose was to preserve the chasm in its natural state and improve public access to the Reservation's recreational resources.
- The Hurricane of 1938 devastated the old growth forest that existed in the site, toppling most of the largest trees. After the storm, reservation staff and the Civilian Conservation Corps salvaged timber and transplanted thousands of red and white pines. Today we see forest succession in action, as the softwood forest gives way to a mixed hardwood/softwood forest while the remaining legacy trees stand out as giants.

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 Purgatory Chasm State Reservation is:

> Words cannot convey the wonders of some places. To see them is to experience them; and by their nature must be preserved for future generations to experience.

This theme is inspired by the closing line from the 1917 Report of the State Forest Commission to the Massachusetts General Court (Shepard and Rane 1917), "The Commission would recommend that some legislative committee make visit to Purgatory Chasm, as it is only fair to state that oral or written descriptions are inadequate to convey true conception of the wonders of the place."

VISITOR EXPERIENCE

Purgatory provides a variety of visitor experiences, including the following:

- **Virtual Experience.** Potential visitors will find detailed information about Purgatory Chasm State Reservation on DCR's web site. The Reservation has its own web page that provides potential visitors information needed to plan a visit. (https://www.mass.gov/locations/purgatory-chasm-state-reservation)

- **Entering the Park.** Most visitors arrive via Route 146 and enter the Reservation via Purgatory Road (i.e., Purgatory Chasm Road). Shortly after exiting the highway, visitors drive up a small hill toward the Reservation's main parking lot and Visitor Center. Along the way they are greeted by a Main Identification Sign, followed shortly thereafter by a sign informing them that they are Entering Purgatory Chasm State Reservation.
- **Visitor Center**. This modern facility, constructed in 1996–97, provides essential services and serves as the central point from which visitors obtain information before exploring the Reservation. The lobby's walls are covered in pictures of the Reservation. These displays prepare visitors for the sights that they will encounter during their day at Purgatory. The chasm's entrance is a mere 300 feet away from the Visitor Center, along a well-marked trail. In inclement weather, the Visitor Center's multi-purpose room is the site of interpretive programming.
- **Exploring the Chasm.** Visitors climb over, around, and among rocks and boulders as they traverse the chasm, visiting such evocatively named rock formations such as Fat Man's Misery, the Devil's Corn Crib, the Devil's Coffin, and the Devil's Pulpit. An accessible path and viewing platform near the chasm's entrance provide views into the chasm for those not hiking the chasm.
- **Rock Climbing.** The chasm's sheer rock walls provide opportunities for rock climbing, a relatively uncommon recreation activity at DCR parks. Rock climbing is regulated by permit and restricted to specific days.
- **Sliding Rock.** Sliding rock is a smooth, gently sloped rock outcrop located just outside the chasm. Sliding from the top of the outcrop to the smooth, level lawn below is a visitor tradition. Sliding Rock is heavily used by visitors, primarily children, for this purpose.
- **Picnic Facilities.** Many visitors come to Purgatory to enjoy a picnic; often associated with exploration of the chasm.
- **Playground.** A nature-themed playground, located beneath tall pines, provides recreation opportunities for young children.
- **Trail-based Passive Recreation.** Over 5-miles of official trails provide visitors the opportunity to get out on foot and explore the Reservation. The best-known trails are associated with the bottom and rim of the chasm.
- **Interpretive Programming.** Visitors may participate in interpretive programs developed to connect visitors to the Reservation's natural and cultural history. Approximately 7,000 visitors per year participate in these programs.

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 18, page 25).

Natural Resources

Threats

- Visitors have created countless access points from the pavilion and parking areas on the south side of Purgatory Road to the north chasm entrance. This has resulted in approximately one-quarter acre of exposed mineral soils with exposed rocks, and only scattered tufts of vegetation.
- Activities within the Zone I Wellhead Protection Area for the seasonally used well (i.e., not the well connected to the Visitor Center) are inconsistent with Massachusetts Department of Environmental Protection (MassDEP) guidance and best management practices for wellhead protection (MassDEP 1995, DEP 2011). This includes vehicle parking, seasonal equipment and vehicle storage in the pump house, and the maintenance of picnic areas within a Zone I.
- One invasive plant is known from the Reservation: Japanese barberry. This invasive plant is not considered and Early Detection Priority Species (BSC Group 2017) or known to be impacting rare species or Priority Natural Communities.
- Long-term use by hikers has eliminated much of the vegetation along the east rim of the chasm. Bare soil, exposed bedrock, and exposed tree roots are common. Most of the ground cover and shrub layer have been worn away, leading to little regeneration of canopy trees. Under the current trajectory, canopy trees will eventually die without being replaced, resulting in gaps in canopy and increased light into the chasm below.
- The portion of the Chasm Loop Trail where it exits the south end of the chasm has become hazardous and unsustainable. The surface of this steeply sloped trail bed consists of mineral soils, exposed rocks, and tree roots. Soil has eroded from beneath the tree roots leaving many of the roots several inches above the ground, creating a tripping hazard. Soils in this area are Chatfield-Hollis-Rock Outcrop, 15 to 35% slope, which is considered unfavorable for paths and trails.
- Inspections of Purgatory Chasm Dam (Dam No. MA02897) have identified multiple major deficiencies, maintenance issues, and remedial modifications that need to be addressed. Failure to address deficiencies could result in loss of the pond (Pare Engineering Corporation 2006). The small size of the dam and impoundment does not warrant a hazard rating for the structure. (See Figure 1. Land Stewardship Zoning Map for location of dam.)
- Hemlock Wooly Adelgid, a non-native insect that kills Eastern Hemlock, has already resulted in the death of many hemlocks at Purgatory and continues to threaten hemlocks in the Reservation's forests. In 2022, DCR's Forest Health Program treated 231 individual hemlocks in a 7-acre area (DCR 2022a).

Opportunities

- Some of the Reservation's two 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 one of the Reservation's state-listed species. Surveying and certifying these pools (DCR (n.d.) and MassWildlife (2009)), as appropriate, may help better protect these animals. Additional vernal pools, not captured in the Potential Vernal Pool data set, may exist in the Reservation. These pools may also be surveyed and certified, as appropriate, as encountered.

- Ensuring that activities and conditions within the Reservation's Zone I Wellhead Protection Areas are consistent with MassDEP Wellhead Protection Tips (MassDEP 1995) and Guidance (MassDEP 2011) would better protect the Reservation's drinking water.
- Taking the seasonally used well out of service by removing all drinking water connections, eliminating the use of the well's water for human consumption, and getting the well reclassified so that it is no longer a public water supply would eliminate the issue of non-compatible uses within the Zone I.
- Black bear populations are expanding eastward in Massachusetts, including into the Sutton area. The presence of dumpsters and food sources at Purgatory may attract bears, which may habituate to both the food source and the presence of people, becoming a nuisance for visitors and property managers. Installing bear-resistant dumpsters will not only prepare the Reservation for any occurrences of bears, but also reduce future negative interactions between bears and forest patrons. (See MassWildlife (n.d.) for additional information on living with black bears.)

Cultural Resources

Threats

- Power equipment, fuels, tools, and supplies are currently housed in two historic buildings, the Pump House Garage and the Ranger Station/Maintenance Building. The storage of flammable materials in historic buildings is not conducive to the preservation of their historical integrity and significance.

Opportunities

- A memorial trail that once extended through the John H. Dudley Memorial Forest section of the Reservation (donated to the Commonwealth in 1950) is no longer discernible. An opportunity exists to re-establish this memorial trail. However current trail density, which is considered Excessive for Parkland, must be considered in any decision to reestablish this trail.
- Masonry repairs to the historic Spring House and fire pits would help stabilize these features and contribute to interpretation of the area.
- The Stone Rest Room has been without purpose since the Visitor Center opened in 1997 and is not in use. Adaptive reuse of this building would help maintain this historic resource.
- A 1944 USGS topographic map indicates the presence of a dam at the current location of Purgatory Chasm Dam. This suggests that the current dam is likely a historic structure at least 79-years-old. Additional research into this dam could identify its date of construction, original intended purpose, and potential role in the development of the Reservation.

Recreation

Threats

- Over time, visitors accessing the north entrance of the chasm have worn away vegetation and topsoil, resulting in exposed rock and mineral soil. The aesthetics of the current condition detracts from the visitor experience and creates an unwelcoming approach to this natural treasure (e.g., Beta 2022).
- Along the southeast corner of the chasm, trails are heavily eroded from weather, overuse, and steep topography. These are neither sustainable nor safe for visitor use.
- The very nature of the chasm (i.e., steep topography and large stone obstructions) precludes making the Chasm Loop Trail, through the floor of the chasm, universally accessible.

- Trail density (0.027 miles/acre) is more than three times greater than the recommended maximum trail density for Parkland (DCR 2019).
- The southeast corner of Charley's Loop Trail is located outside the Reservation, on Whitinsville Water Company and privately-owned property.
- Information on Sutton State Forest is absent from the Visitor Center, trail signs, and internal navigation signs at Purgatory. This lack of information makes navigating the Reservation's trails more difficult.
- Circulation patterns in the Visitor Center parking lot are unclear, which contributes to poor traffic flow and congestion.

Opportunities

- Several aspects of the Reservation (i.e., pavilion appurtenances, playground, trails, and parking lots) are not constructed or positioned in a manner consistent with universal accessibility standards. Continuing to implement recommendations in the 2018 accessibility assessment (Institute for Human Centered Design (IHCD) 2018) would address these issues and improve universal access.
- Adding an interpretive video on the interior of the chasm to DCR's Purgatory Chasm web page would allow those unable to travel through the chasm to get a sense of its unique features.
- Opportunities exist to redesign the Visitor Center parking area to improve safety and circulation.
- Modernizing the visitor center's exhibits has the potential to enhance the visitor experience for the more than 100,000 people that enjoy the Reservation each year. Professionally designed and constructed exhibits, similar to those in visitor centers at Halibut Point State Park or George's Island, can better educate and inform visitors than do the current exhibits. Expanding the focus of the exhibits to include both Purgatory Chasm and Sutton State Forest would allow the visitor center to serve as a gateway to both properties.
- Improving connections between the Purgatory and Sutton trail systems and increasing the number of distance and direction signs along trails would enhance the visitor experience at both properties.
- Developing an updated trail map for the Reservation would encourage visitation, educate the public about the Reservation and its resources, encourage the use of authorized trails, and help protect resources.
- An opportunity exists to broaden the visitor experience by increasing physical and operational connections to Sutton State Forest.

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 2022b 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 Climate Change Vulnerability Assessment (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 10) 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 Massachusetts Natural Heritage and Endangered Species Program (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

In Massachusetts, temperatures are projected to increase significantly over the next century. The microclimate in the chasm has historically supported "icicles, and even solid bodies of ice" in the bottom of the chasm into June (Benedict and Tracy 1878). Increased temperature may affect the chasm's microclimate, thereby impacting both the ecology of the chasm and the visitor experience.

Purgatory's forest has changed greatly since the Reservation was established. Photos taken ca. 1910 show dense stands of eastern hemlock in and around the chasm. As recently as 2000, 250–350-year-old hemlocks with circumferences of up to 10 feet remained (Leverett 2000). Since then, many of the chasm's hemlocks have been lost to Hemlock Wooly Adelgid and subsequently removed as hazard trees. The loss of these hemlocks resulted in more light penetration into the chasm, increased temperatures, and altered growing conditions. Projected impacts of climate change, including increases in temperature, the frequency and intensity of storm events, and frequency of episodic droughts, will further impact forest resources both within and surrounding the chasm.

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.

Responses of Massachusetts' invasive plants (i.e., those categorized as Invasive by the Massachusetts Invasive Plants Advisory Group (2024)) to a changing climate are largely unknown. However, sufficient information exists to project the likely future trend for Japanese barberry. Climate change facilitates invasion by Japanese barberry "because of higher growth and germination in warmer climates" (Merow et al. 2017). Because of this, it is anticipated that barberry will further spread at Purgatory Chasm.

Cultural Resources—General Impacts

Climate change may negatively affect cultural resources, their preservation, and maintenance (EEA 2022; 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

No cultural resources with known elevated exposure or sensitivity to potential consequences of climate change were identified at this property.

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 Reservation likely to be negatively impacted by exposure to weather changes resulting from climate change are the snow-dependent sports (i.e., cross-country skiing and snowshoeing). The trail through the chasm is currently closed during the winter due to the presence of slip hazards (i.e., snow and ice). Temperature increases associated with climate change may result in a shorter seasonal closure of the chasm during winter months.

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 Purgatory Chasm State Reservation was designated Parkland. Identification of Land Stewardship Zones within Purgatory Chasm State Reservation 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 21, 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 Purgatory Chasm have been designated Zone 1.

- The southeast rim of the chasm, from the location of the existing Chasm Loop Trail to Charley's Loop has been designated Zone 1 due to excessively steep slopes with highly erodible soils at this location.

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 Purgatory Chasm have been designated Zone 2.

- All portions of Purgatory Chasm have been designated Zone 2, except for those areas identified as Zones 1 or 3.

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

- Visitor Center, parking lot, and playground.
- Group picnic and play field area.
- Existing recreational development west of Purgatory Road, from the Stone Rest Room northward to the Pump House Garage, including the following:
  - Stone Rest Room
  - Pavilion
  - Picnic sites
  - Paved parking lots
  - Pump House Garage
- Ranger Station/Maintenance Building, existing cleared footprint, parking area, and driveway.

- Existing forested area between the Ranger Station/Maintenance Building and the Visitor Center, within 300 feet of Purgatory Road. This area is reserved for ***potential*** future administrative, maintenance, or recreation areas. This does not include the portion of this area within the seasonal well's Zone I Wellhead Protection Area.

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 Overlay was developed for Purgatory Chasm:

- **Wellhead Protection Overlay.** This overlay includes two Zone I Wellhead Protection Areas, one northeast of the Visitor Center parking lot and the other (i.e., the seasonal well) south of Purgatory Road and west of the chasm. Within this overlay, activities must be consistent with MassDEP Guidance (MassDEP 2011) and should be consistent with Wellhead Protection Tips (MassDEP 1995).

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 Best Management Practices for resource stewardship, are located on the Stewardship Map site: https://dcrsgis-mass-eoeea.hub.arcgis.com/.

Because authorized trails are located within known habitat of state-listed species 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 Best Management Practices (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 17, page 22.)

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 priority management recommendations were developed for this property. They are presented in Table 18, page 25. 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 18 (page 25) into CAMIS as a separate work order, noting "*RMP" in the description field. Non-traditional work orders (e.g., volunteer trail work, posting of Massachusetts Department of Public Health (DPH) Fish Consumption Advisory posters, certification of vernal pools) should be closed out by the property manager, once the recommendation has been implemented.

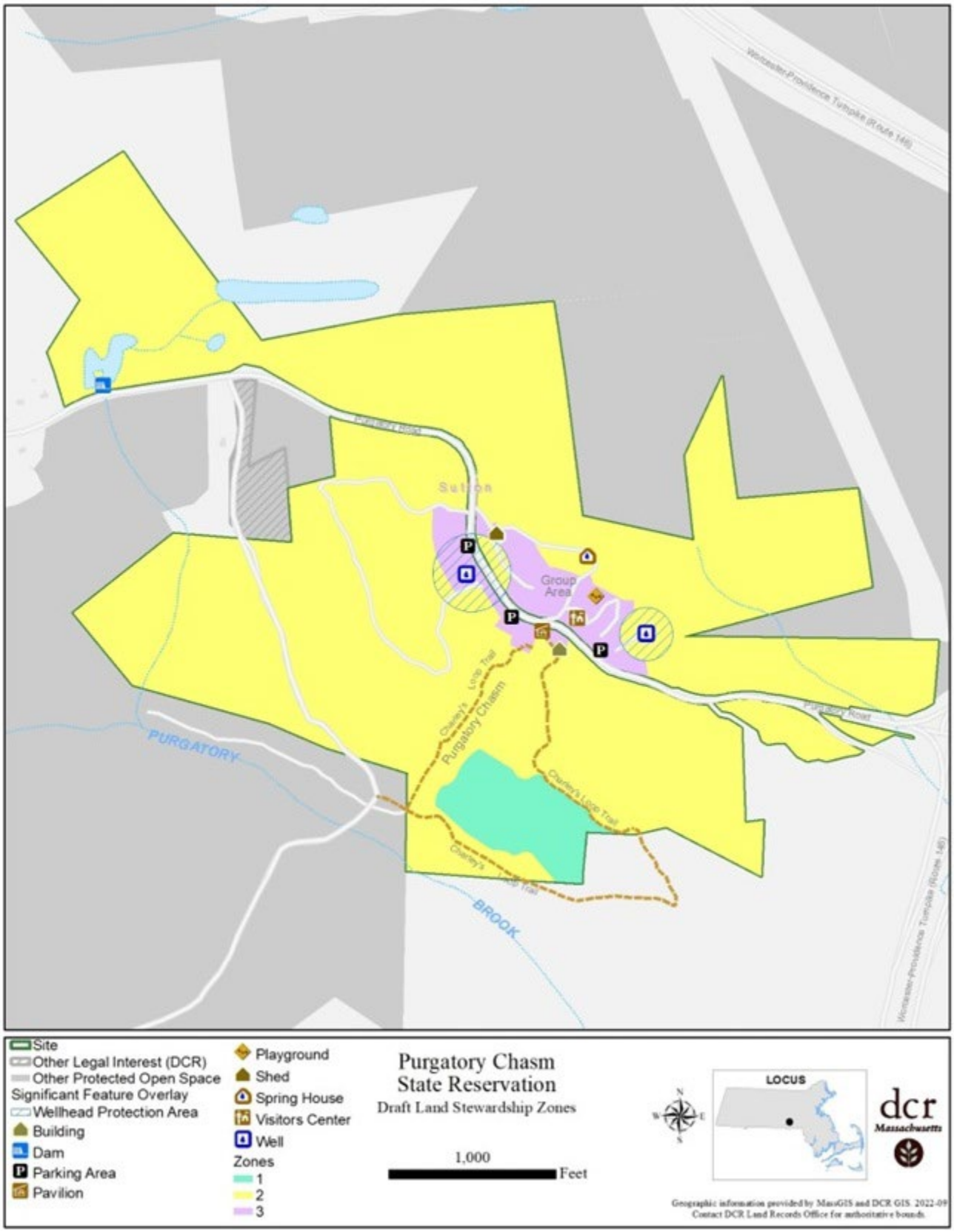

Figure 1. Land Stewardship Zoning Map.

Table 17. 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.	N/A
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.)	No
Natural Resources	7. Area of trail impacts in Reserves is less than 50% of 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.	Yes
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.)	No
Recreation	3. All authorized trail construction was performed in accordance with an approved Trail Proposal Form.	Yes
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.)	N/A
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.	N/A
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. Ch. 132, Sections 40–46).	N/A

Table 18. Priority Recommendations for Purgatory Chasm State Reservation. All recommendations are of equal importance. When multiple parties are responsible for implementing a recommendation, they 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	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	Remove and relocate picnic tables from within the existing Zone 1 Wellhead Protection Area.	Park Operations
Natural Resources	Assess the potential to disconnect the seasonal day-use area water fountains from the well near the Pump House Garage and connecting them to the Reservation's other public well.	Facilities Engineering (Co-Lead), Park Operations (Co-Lead)
Natural Resources	Assess the need for a new maintenance garage and shop in order to consolidate park maintenance equipment and supplies into a single building, and to end the practice of storing power equipment and fuels within a Zone I Wellhead Protection Area and multiple park buildings.	Contractor, Facilities Engineering (Lead), Park Operations
Natural Resources	Implement recommendations identified in the Phase I Inspection/Evaluation of the Purgatory Chasm Dam (Pare Engineering Corporation 2006). Integrate activities to be performed by Reservation personnel into the annual operations plan.	Contactor, Office of Dam Safety (Co-Lead), Park Operations
Natural Resources	Survey, document, and submit documentation to certify potential vernal pools that are in NHESP habitat of MESA-protected vernal pool obligate species, in accordance with DCR (n.d.) and MassWildlife (2009), as warranted.	Contractor, Office of Natural Resources (Lead), Volunteers
Natural Resources	Work with trash hauler to provide bear-resistant trash containers with self-locking lids.	Park Operations

Category	Recommendation	Implementation
Cultural Resources	Assess the potential of reestablishing the historic trail through the John H. Dudley Memorial Forest.	Office of Cultural Resources, Office of Natural Resources, Park Operation (Co-Lead), Trails and Greenways Section (Co-Lead)
Cultural Resources	Conduct masonry repairs on the historic Spring House and historic firepits.	Contractor, Office of Cultural Resources (Lead)
Cultural Resources	Develop a reuse plan for the historic stone restroom.	Contractor, Facilities Engineering (Lead), Office of Cultural Resources, Park Operations
Recreation	Conduct a design study for the Visitor Center parking lot to improve traffic flow and congestion.	Contractor, Landscape Architecture Section (Lead)
Recreation	Provide information about Sutton State Forest on Purgatory Chasm's kiosks and at the Visitor Center.	Interpretive Services (Co-Lead), Park Operations (Co-Lead)
Recreation	Assess the potential to modernize the visitor center through the addition of professionally designed and constructed interpretive exhibits on Purgatory Chasm State Reservation and Sutton State Forest.	Contractor, Interpretive Services (Lead), Office of Cultural Resources, Office of Natural Resources, Park Operations, Universal Access Program
Recreation	Develop a web-based interpretive video so that people of all abilities may be able to remotely experience the chasm's interior.	Director of Partnerships (Co-Lead), Interpretive Services (Co-Lead), Universal Access Program (Co-Lead)

Category	Recommendation	Implementation
Recreation	Implement the Program Accessibility Assessment (IHCD 2018) recommendations to meet accessibility standards at Purgatory Chasm, recommendations include: • Perform modifications to the Visitor Center and Pavilion. • Modify accessible parking space and access aisle striping at the Visitor Center and Pavilion parking lots and install appropriate signs. • Relocate kiosks and donation boxes to accessible routes near the Visitor Center and chasm entrances. • Convert at least six existing non-accessible picnic sites to fully accessible sites. Locate in different sections of park (e.g., near Chasm Entrance Area and Purgatory Reservation Pond) to allow for a variety of visitor experiences. Provide information on the accessibility of the reservation's facilities and trails on kiosks and at the Visitor Center.	Contractor, Facilities Engineering (Co-Lead), Office of Cultural Resources, Park Operations (Co-Lead), Universal Access Program (Co-Lead)
Recreation	Establish well-defined and well-marked travel corridors along the east (i.e., Chasm Loop Trail) and west (i.e., Charley's Loop) rim trails such that: • To the greatest extent possible, trails are located on bedrock. • Travel corridors have easily identifiable physical boundaries. • Areas outside defined travel corridor are restored to promote regeneration of native trees and shrubs. • Signs prompt hikers to stay on trails. • There are 1–2 official overlooks on each side of the chasm.	Trails and Greenways Section (Lead), Office of Cultural Resources, Park Operations
Recreation	Close and restore approximately 650 feet of the Chasm Loop Trail, from the bottom of the chasm to the existing scenic vista. Establish a new trail segment between existing scenic vista and the Charley's Loop Trail.	Office of Cultural Resources, Trails and Greenways Section (Lead), Park Operations

Category	Recommendation	Implementation
Recreation	Consider discontinuation and active closure of unauthorized trails in order to reduce trail density.	Park Operations (Lead), Trails and Greenways Section
Recreation	Work with geocaching community to ensure that caches are placed in locations within the chasm that may be safely reached by the public.	Park Operations
Recreation	Using existing trails and forest roads, establish a connector trail to Sutton State Forest and install signs from Visitor Center and Chasm Entrance Area to the Sutton State Forest trailhead along Mendon Road, Sutton.	Park Operations(Co-Lead), Trails and Greenways Section (Co-Lead)

REFERENCES

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)

Benedict, W. C., and H. A. Tracy. 1878. History of the Town of Sutton, Massachusetts, from 1704 to 1876. Published for the Town by Sanford & Company, Worcester, MA. https://archive.org/download/historyoftownofs00beneiala/historyoftownofs00beneiala.pdf (PDF)

Beta. 2022. Purgatory Chasm Entrance and Trail Improvements Project Phase I. Sutton, Massachusetts. Bid Set. DCR Project P20-3349-C1A. January 2022.

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)

Dudley, J. C. 1952. History of the Town of Sutton, Massachusetts. Volume II, from 1876 to 1950. Published by the Town of Sutton. https://archive.org/download/historyoftownofs2187sutt/historyoftownofs2187sutt.pdf (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)

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)

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

Institute for Human Centered Design (IHCD). 2018. Purgatory Chasm State Reservation, Sutton, MA. Program Accessibility Assessment. July 2018.

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)

Leverett, R. T. 2000. E-mail to Bill Rivers, Program Supervisor, MA Bureau of Forestry. April 3, 2000.

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 Department of Conservation and Recreation (DCR). n.d. Best Management Practices. Vernal pool certification on DCR lands.
https://www.mass.gov/doc/vernal-pool-certification-on-dcr-lands/download (PDF)

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

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). 2022a. Massachusetts forest health update 2022.
https://www.mwra.com/monthly/wscac/current%20events/2023/DCR%20Forest%20Health%20Program%202022%20Summary_public.pdf (PDF)

Massachusetts Department of Conservation and Recreation (DCR). 2022b. 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 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). 2023. Final Massachusetts integrated list of waters for the Clean Water Act 2022 Reporting Cycle. CN. 568.1. May 2023. Prepared by: Watershed Planning Program, Division of Watershed Management, Bureau of Water Resources.
https://www.mass.gov/doc/final-massachusetts-integrated-list-of-waters-for-the-clean-water-act-2022-reporting-cycle/download (PDF)

Massachusetts Division of Fisheries and Wildlife (MassWildlife). n.d. Living with wildlife: Black bears in Massachusetts.
https://www.mass.gov/media/10606/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). 2022. 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). 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). 1974. Chapter 806 of the Acts of 1974. An Act establishing an Executive Office of Environmental Affairs.
https://archives.lib.state.ma.us/handle/2452/34545

Massachusetts Historical Commission. 1983. Massachusetts Historical Commission Reconnaissance Survey Report: Sutton. Boston, MA.
https://www.sec.state.ma.us/mhc/mhcpdf/townreports/Cent-Mass/sut.pdf (PDF)

Massachusetts Invasive Plant Advisory Group (MIPAG). 2024. Species reviewed (listed by category) - Last updated 1/2024.
https://massnrc.org/mipag/speciesreviewed_category.htm

Meltsner, H., and T. Binzen. 2002. Purgatory Chasm State Reservation. MACRIS Form A – Area.
https://mhc-macris.net/#!/details?mhcid=SUT.O

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 (PDF)

National Park Service. 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 & 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)

Pare Engineering Corporation. 2006. Purgatory Chasm Dam. Phase I inspection/evaluation report.

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

Shepard, H. N., and F. W. Rane. 1917. Report of the State Forest Commission on the resolve providing for an investigation relative to the advisability of establishing a State Reservation at Purgatory Chasm in the Town of Sutton. House No. 148, 1917.
https://archives.lib.state.ma.us/handle/2452/469282

Skehan, J. W. 2001. Roadside Geology of Massachusetts. Mountain Press Publishing Company; Missoula, MT.

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)

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)

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)