

Trail Design, Construction and Maintenance in a Changing Climate

**A Jurisdictional Scan of Best Practices, Guidelines and
Standards**

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Introduction and Methodology

Climate change is impacting the outdoor recreation community and recreational infrastructure, and the impacts are expected to intensify going forward, necessitating the need for proactive and collaborative planning¹. This jurisdictional scan was completed by identifying and compiling documents available from various governmental and non-governmental sources that considered climate change in the context of recreational trail planning, construction, and management to inform strategic planning in Nova Scotia. The review was limited to publications in digital format and available on the internet. Restricted content (e.g., paywall, authorization requirements, available upon request) was not reviewed. All trail types were considered, both motorized (e.g., all-terrain vehicle (ATV) and snowmobile trails) and non-motorized (e.g., pedestrian, cycling, cross-country skiing and equestrian trails) as well as water trails (e.g., for canoeing and kayaking).

Government publications included those from municipal, provincial, and federal government repositories. Non-government publications included those published by community groups, trail societies and clubs (e.g., snowmobile clubs). Document searches generally targeted trail planning-, construction-, and/or maintenance-related publications which included strategy documents, best practices, plans, standards, guidelines, and reports. Documents were initially scanned for key words such as, but not limited to, “climate change”, “sustainability”, “adaptation”, and “resilience”. The results of the jurisdictional review are provided in the sections that follow.

¹ O’Toole, D., Brandt, L.A., Janowiak, M.K., Schmitt, K.M., Shannon, P.D., Leopold, P.R., Handler, S.D., Ontl, T.A. and Swanston, C.W., 2019. Climate change adaptation strategies and approaches for outdoor recreation. *Sustainability*, 11(24), p.7030.

Results and Discussion

Nova Scotia

Provincial

The Government of Nova Scotia Trails Strategy² was released in 2019 and reflects the shared vision and actions of the trails community, led by the Nova Scotia Trails Federation (NS Trails), businesses, landowners, the Mi’kmaq and various levels of government.

Strategic goals and proposed actions to achieve them are shown in the table below.

Table 1 Goals of the Shared Strategy for Trails in Nova Scotia. Source: Province of Nova Scotia 2019. Shared Strategy for Trails in Nova Scotia – Advancing Pathways to Discovery, Wellness and Community Connections.

Strategic Goal	Actions
1. Strengthen Alignment, Leadership and Collaboration of Trail Development	1.1 Establish a Trails Strategy Coordinating Group to support and coordinate the implementation of the strategy 1.2 Ensure provincial government contributions to trails are efficient and effective 1.3 Expand municipal government engagement in trails 1.4 Review the strategic positioning of the Nova Scotia Trails Federation 1.5 Clarify the roles, relationships, approaches and processes of the various organizations that make up the trails community
2. Expand Supports for Trail Development and Management	2.1 Collect, develop and share resources regarding effective trail development and management 2.2 Increase the number and capabilities of trail developers and managers in the regions 2.3 Diversify, enlarge and stabilize the financial base for trails
3. Improve the Planning of Trails	3.1 Identify, promote, and support adoption of the most effective model(s) for trail planning 3.2 Collect, develop and share resources that support trail planning 3.3 Secure access to lands and waterways for trails
4. Increase Trail Use	4.1 Promote our trails 4.2 Provide information /resources that support increased trail use 4.3 Engage youth in trails 4.4 Promote safe and responsible trail use and strengthen enforcement

² Province of Nova Scotia. 2019. Shared Strategy for Trails in Nova Scotia – Advancing Pathways to Discovery, Wellness and Community Connections. Available from: https://novascotia.ca/trailstrategy/docs/18-47600_SharedStrat_TrailsNS_Report_ENG_LoRes.pdf

The Nova Scotia Department of Communities, Culture, Tourism and Heritage (CCTH) helps to protect and promote Nova Scotia's culture and heritage by contributing to the creative and cultural wellbeing of communities and preserving, and providing access to, the province's culture, heritage, identity and languages³. Additional responsibilities of CCTH include:

- Providing funding programs for arts, culture and heritage, sport and recreation and cultural identity
- Working with partners and communities on services, programs and policies
- Overseeing the Nova Scotia Archives, Nova Scotia Museum and Nova Scotia Provincial Library
- Developing a long-term strategy for sustainable tourism in the province.

CCTH administers several trail funding programs⁴ including:

- **The Trail Maintenance Grant (TMG):** supports community trail groups by funding regular trail maintenance activities, allocates emergency funds for unforeseen events which require significant repair (e.g., fires, severe weather impacts)
- **The Trails Engineering Assistance Grant Program (TEAG):** provides financial assistance to trail builders and managers for hiring engineers to support construction, maintenance, and infrastructure inspections of multi-use, non-motorized trails
- **Community Trails Leadership Fund:** supports trail development through the provision of funds for leaders and organizational development and capacity building for community trail groups
- **Recreational Trail Expansion Grant Program (RTE):** assists municipalities and not-for-profit organizations in developing new recreational trails, expanding recreational trails, and making capital upgrades to existing infrastructure and connectivity.

³ Nova Scotia Department of Communities, Culture, Tourism and Heritage. nd. About us. Available from: <https://beta.novascotia.ca/government/communities-culture-tourism-and-heritage/about>

⁴ Nova Scotia Department of Communities, Culture, Tourism and Heritage. 2025. Trail Funding Programs. Available from: <https://cch.novascotia.ca/trail-funding-programs>

Municipal

Limited information relevant to this jurisdictional scan was available from Nova Scotia municipalities. The Municipality of the County of Richmond released the Richmond County Trail Strategy in 2022⁵. The document provides a high-level overview of trail development, a four-step process which includes plan, design, build, and maintain. The strategy does not reference climate change considerations in planning and design. Key planning considerations/activities such as stakeholder engagement, including Mi'kmaw engagement, are highlighted.

Non-Governmental

The Nova Scotia Trails Federation (NS Trails), Trails Manual⁶ is the provincial standard for trail projects and includes a comprehensive collection of trail planning, construction, and maintenance and management guidelines for recreation trails in Nova Scotia. The Manual is divided into six informative sections including: 1) Project Initiation; 2) Project Planning Process; 3) Development and Construction; 4) Signage; 5) Maintenance and Management; and, 6) Abandoned Rail Bridges. The document also includes appendices which provide information such as definitions of trail terminology, land information maps, a guide on identifying soils, tool and equipment descriptions, symbology used on signs and pamphlets for trail users, and a contacts directory. Presently, the Trails Manual does not consider recreational trail development and management through the lens of climate change adaptation and climate change-resilient infrastructure.

The Bras d'Or Lake Biosphere Reserve Association's (BLBRA's) guidance document titled Developing a Public Footpath within the Bras d'Or Lake Biosphere – A Community Toolkit for Getting Started⁷ provides useful information and resources for prospective trail builders. Particularly, the document emphasizes the critical importance of careful planning and

⁵ UPLAND Planning and Design. 2022. Richmond County Trail Strategy. Available from: <https://beta.novascotia.ca/government/communities-culture-tourism-and-heritage/about>
<https://www.richmondcounty.ca/documents/recreation/2214-richmond-county-trails-strategy/file.html>

⁶ Warren, N. M. nd. Trails Manual – Developing Recreation Trails in Nova Scotia. Nova Scotia Trails Federation. Available from: <https://nstrails.com/trails-manual/>

⁷ Bras d'Or Lake Biosphere Reserve Association. nd. Developing a Public Footpath Within the Bras d'Or Lake Biosphere – A Community Toolkit for Getting Started. Available from: <https://blbra.ca/wp-content/uploads/2023/05/BLBRA-Trail-Building-Toolkit.pdf>

obtaining community support. The document outlines a 9-step process for trail development that begins with forming a community trail group and culminates with construction etiquette. The toolkit does not provide specific construction specifications nor does it consider climate change resilience; however, it provides key considerations, such as best practices for protecting sensitive species and habitats as well as the importance of Indigenous knowledge.

Hike Nova Scotia is a nonprofit organization that promotes hiking and outdoor recreation in the province⁸. The organization provides a number of trail builder resources, including accessibility workshops and e-courses like the Foundations of Sustainable Trails published by American Trails⁹ who offer the course for free. No information relevant to this report was found.

The Annapolis Valley Trail Coalition (AVTC) was formed in 2007 and represents a partnership consisting of representatives from the CCTH as well as from two municipalities, seven towns/villages, and seven trail groups. The AVTC trail system includes 3,700 km of hiking, walking, biking, snowmobiling, cross-country skiing and ATV trails including the Harvest Moon Trailway (HMT) which represents 110 km of rails-to-trails from Grand Pre to Annapolis Royal¹⁰¹¹. AVTC services include mitigation and storm damage mitigation, audit and inspections, training and leadership, as well as yearly work plan and trail planning. No trail planning, construction/maintenance, management guidelines or best practices documentation was identified from AVTC for review in preparation of this report.

⁸ Hike Nova Scotia. 2025. About. Available from: <https://www.hikenovascotia.ca/about/>

⁹ American Trails is discussed in further detail in the scan of the United States, Northeastern Region

¹⁰ Town of Kentville. 2022. Town of Kentville Council Advisory Committee Agenda. Available from: <https://kentville.ca/sites/default/files/town-files/2022-07/00%20Full%20Meeting%20Package.pdf>

¹¹ Annapolis Valley Trails Coalition. nd. Annapolis Valley Trails Coalition Three Year Plan 2013/14 to 2015/16 Draft. Available from:

https://www.countyofkings.ca/upload/All_Uploads/Council/committees/TRAILS/AVTC%20-%20Three%20year%20plan.pdf

Newfoundland and Labrador

Provincial

The Government of Newfoundland and Labrador's Parks Division is responsible for the management, control, protection and development of provincial parks¹²; the two primary objectives of the division are to provide a diverse range of outdoor recreation opportunities for residents and visitors to discover and appreciate nature and to conserve biological diversity through the establishment and management of a system of provincial parks. The Government of Newfoundland and Labrador's Department of Environment and Climate Change, Policy, Planning and Natural Areas Division is responsible for administration and management of Wilderness and Ecological Reserves in the province including low-impact outdoor recreation which may occur in these areas¹³. No documents were available from provincial departments that were considered relevant for the subject report.

Municipal

The Province's capital of St. John's contains an extensive network of green spaces and trails. Within the city, trails are maintained by both City staff and the Grand Concourse Authority¹⁴. The Grand Concourse Authority is a non-profit charitable organization focused on community development projects¹⁵. During its conception, the Authority explored potential for the creation of a connected trail corridor in the Avalon Region of Newfoundland and by 2005 had created the Grand Concourse network containing approximately 125 kilometres of walkways, linkages and connecting sidewalk routes. The Grand Concourse offers planning and design services, although it is not clear whether these services incorporate strategic adaptation planning.

¹² Parks NL. nd. About Us. Available from: <https://www.parksnl.ca/about-us/>

¹³ Newfoundland and Labrador Department of Environment and Climate Change. nd. Natural Areas. Available from: <https://www.gov.nl.ca/ecc/natural-areas/>

¹⁴ City of St. John's. n.d. Parks, Playgrounds and Trails. Available from: <https://www.stjohns.ca/en/recreation-culture/parks-playgrounds-and-trails.aspx?mid=11391>

¹⁵ Grand Concourse. 2017. About Us. Available from: <https://www.grandconcourse.ca/about-us/>

The City of St. John's developed their Parks and Open Spaces Master Plan¹⁶ in 2014. Trail types were generally classified as either shared use, cross country ski trails, hiking trails, and mountain bike trails. The Plan briefly details municipal trail design guidelines, including drainage consideration; however, strategies pertaining to climate change adaptation and resiliency were not considered.

Portugal Cove -St. Philips is a municipality on the Avalon Peninsula of Newfoundland. The Portugal Cove – St. Phillips Trails Master Plan¹⁷ guiding principles include prioritizing sustainability, specifically referencing the need to consider trail maintenance and longevity during the trail planning process.

The City of Corner Brook, the largest municipality on Newfoundland's western coast, is known for four-season recreation attractions and its proximity to the impressive Gros Morne National Park¹⁸. Few examples of trail development strategy documents were available from municipal sources. The Great Trail Multi-Use Trail Study¹⁹ was implemented to explore opportunities to improve The Great Trail route through Corner Brook. The Great Trail is a national trail initiative to provide a contiguous trail network from coast to coast. Long-term sustainability was one of three focus points identified during the detailed analysis of the preferred route. The plan recognizes that "working with the land, carefully studying its features, patterns, and processes, and identifying opportunities and constraints will result in a more successful project and a higher-quality built environment.". Further, the report states that "Deeply understanding these inherent qualities of a site [referring to the attributes discussed above] will lead to development that limits long-term maintenance concerns, reduces risk, preserves critical environmental processes, and capitalizes upon such features such as views, solar access, and natural areas, thereby making a project more sustainable."

¹⁶ City of St. John's. 2014. St. John's Parks and Open Space Master Plan. Available from: <https://www.stjohns.ca/en/recreation-culture/resources/Documents/Open-Space-Master-Plan.pdf>

¹⁷ Portugal Cove – St. Phillips. 2022. Trails Master Plan. Available from: https://pcsp.ca/site/uploads/2022/11/PCSP-Trails-Master-Plan_Final-BW.pdf

¹⁸ City of Corner Brook. 2023. About Corner Brook. Available from: <https://www.cornerbrook.com/about-corner-brook/>

¹⁹ City of Corner Brook. 2019. The Great Trail Multi-Use Trail Study – Final Draft Report. Available from: <https://www.cornerbrook.com/wp-content/uploads/2022/03/Corner-Brook-Multiuse-Trail-Study.pdf>

Non-Governmental Sources

No relevant sources of information from non-governmental organizations in Newfoundland and Labrador were available during the jurisdictional review.

New Brunswick

Provincial

New Brunswick is home to two National Parks, Fundy National Park and Kouchibouguac National Park, and 12 designated Provincial Parks²⁰. As indicated in the Province of New Brunswick's Tourism, Heritage and Culture Annual Report for 2023-2024, the Tourism Development Branch assists with, guides and facilitates discussions with government stakeholder departments and industry members to develop a sustainably managed trail network throughout the province. The branch also supports the industry financially in building and maintaining motorized and non-motorized trail networks²¹. The province hosts an extensive network of hiking trails, mixed-use, ATV and snowmobile trails. The Province's Signature Trail Infrastructure Fund supports the development of trails with high tourism and recreational value²².

The province released The New Brunswick Trails Action Plan²³ in 2018 which included the following vision statement: "To implement a sustainable trails management program that will lead to an internationally competitive trail network that supports GNB's jobs and economic growth objectives, as well as lead to the improvement of residents' and visitors' quality of life, health and well-being.". The document focuses primarily on economic challenges and does not include climate change considerations.

²⁰ Tourism New Brunswick. 2025. Explore Our Parks. Available from: <https://tourismnewbrunswick.ca/parks>

²¹ Province of New Brunswick. 2024. Tourism, Heritage and Culture Annual Report 2023-2024. Available from: https://www.legnb.ca/content/house_business/61/1/tailed_documents/2024-12-09%20Tourism.%20Heritage%20and%20Culture%202023-2024.pdf

²² New Brunswick Tourism, Heritage and Culture. nd. Trail Infrastructure Fund. Available from: https://www2.gnb.ca/content/gnb/en/departments/thc/services/services_renderer.201344.Trail_Infrastructure_Fund.html

²³ New Brunswick Tourism, Heritage, and Culture. 2018. The New Brunswick Trails Action Plan. Available from: <https://www2.gnb.ca/content/dam/gnb/Departments/thc-tpc/pdf/Parks-Parcs/TrailsActionPlan20171.pdf>

The New Brunswick Department of Environment and Local Government released A Guide for Climate Change Adaptation Planning for New Brunswick Communities²⁴ in 2023. The publication considers climate change vulnerabilities within five general categories.

Recreation, which includes examples such as community buildings, parks, trails, equipment, is identified within the Infrastructure Vulnerabilities category. Examples of adaptation options identified in the Guide are generally broad recommendations and are not tailored to trail-specific vulnerabilities.

Municipal

Trail construction planning and/or maintenance literature which incorporated climate change adaptation considerations, including best practices and guidelines, from municipal sources were not available at the time of the jurisdictional scan.

Non-Governmental Sources

A search of relevant nongovernmental publications and resources did not yield information relevant for this scan. Examples of sources reviewed included JD Irving's Conservation Program²⁵, which includes the Irving Nature Park, a 600-acre site hosting seven walking trails, and the Sentier Napisiguit Mi'gmaq Trail Association, who manage the longest backcountry trail in the Maritimes (140 km).

Prince Edward Island

Provincial

The government of Prince Edward Island released the PEI Climate Change Risk Assessment in 2021²⁶. The document acknowledges the recent impacts of storm events on trail closure and damages and the coinciding impacts on the tourism economy. Further, the Minister's

²⁴ New Brunswick Department of Environment and Local Government. 2023. A Guide for Climate Adaptation Planning for New Brunswick Communities – Revised Version. Available from: [guide-for-climate-change-adaptation-planning.pdf](#)

²⁵ J.D. Irving. 2024. Conservation Program. Available from: <https://www.jdirvingconservation.com/>

²⁶ Prince Edward Island Department of Environment, Energy and Climate Action (EECA). 2021. Prince Edward Island (PEI) Climate Change Risk Assessment. Available from: https://www.princeedwardisland.ca/sites/default/files/publications/pei_ccra_2021.pdf

Report on Climate Change Risks and Progress Towards Targets for 2022-2023²⁷ highlighted the recent devastation of Hurricane Fiona and impacts on trail infrastructure, particularly in coastal areas. The PEI Active Transportation Fund supports trail development and improvement projects. No provincial government authored publications were found that provided relevant information for this scan.

Municipal

No information was available from municipal sources in Prince Edward Island during the scan.

Non-Governmental

The Prince Edward Island ATV Federation's ATV Environmental Code of Practice²⁸ (ATVECOP) is a guidance document that "outlines recommended practices to help ensure environmental responsibility for trail planning, construction and operation on PEI" and "provides environmental management guidelines for all environmental aspects of trail planning, construction, operation, and decommissioning". As described in the Code of Practice, a quality trail depends on the effective and equal application of five elements which include planning, designing, construction, maintenance, and management. This is demonstrated, for instance, in the environmental objective of the ATVECOP's trail planning section which states "To minimize potential adverse environmental effects by recognizing the areas of potential risk and proactively planning/designing the trail location and components to mitigate issues". The document also provides environmental management guidelines, including guidelines for vegetation clearing, trail surface preparation, bridge construction, culverts, water management, decking, and surface hardening.

The MacPhail Woods Ecological forestry project is a non-profit, charitable initiative of the Environmental Coalition of Prince Edward Island²⁹. The MacPhail Woods School of Woodland Ecology (SWE) has been offering a variety of educational workshops for more than 30 years.

²⁷ Prince Edward Island Department of Environment, Energy and Climate Action (EECA). 2023. Minister's Report on Climate Change Risks and Progress Towards Targets. Available from:

<https://www.princeedwardisland.ca/sites/default/files/publications/ministersreportclimate2023.pdf>

²⁸ PEI ATV Federation. 2021. Environmental Code of Practice. Available from: <https://ridepei.ca/wp-content/uploads/2023/01/Enviromental-Code-of-Practice.pdf>

²⁹ MacPhail Woods. nd. About the Project. Available from: <https://macphailwoods.org/about/overview>

MacPhail Woods SWE offers courses in ecological restoration techniques as well as outdoor recreation courses in trail making. A copy of the course curriculum was not requested during the preparation of this report.

Central Canada

Ontario

The *Supporting Ontario's Trails Act, 2016* was established to protect and enhance land and water trails in Ontario by³⁰:

- Providing the trails community with enhanced tools to effectively develop, operate and promote trails
- Removing barriers to help connect and expand trails across the province
- Increasing trail awareness and promoting local tourism by enabling the recognition of Ontario trails of distinction, supporting communities and jobs across Ontario
- Enabling the development of a classification system to help users find trails that match their interest and ability

Limited trail construction guidelines and/or best practices were available during this jurisdictional scan for Central Canada – Ontario and recent publications (e.g., since 2020) were generally absent. A longstanding guidance resource for Ontario trail practitioners is the *Ontario's Best Trails – Guidelines for the Design, Construction and Maintenance of Sustainable Trails for All Ontarians*, published in 2006³¹. The Guideline was developed by the Trails for All Ontarians Collaborative, a joint partnership with local regional and provincial organizations. The current status of the Collaborative could not be determined at the time of preparing this report. The Guideline supports the vision set forth in the Ontario Trails

³⁰ Government of Ontario. 2016. Province Passes Act to Support Ontario's Trails – New Legislation Takes Action to Protect and Enhance Trails System. Newsroom. Available from: <https://news.ontario.ca/en/release/39058/province-passes-act-to-support-ontarios-trails>

³¹ Trails for All Ontarians Collaborative. 2006. Guidelines and Best Practices for the Design, Construction and Maintenance of Sustainable Trails for All Ontarians. Available from: <https://cdn2.assets.servd.host/material-civet/production/images/documents/ontario-design-construction-maintenance-sustainable-trails.pdf>

Strategy³² and is designed for trail that permit human-powered uses. Key themes of the Guideline are sustainable (environmentally responsible) and universal (considers the needs, interests and abilities of everyone). The guidelines are broadly distributed among five sections, namely: Guidelines for Trail Design, Guidelines for Trail Construction, Best Practices for Trail Construction, Guidelines for Trail Maintenance, and Best Practices for Trail Maintenance. An appropriate level of caution should be taken to ensure that guidance is consistent with contemporary standards as certain specifications, including building codes, may have changed since the time of publication. In the absence of direct linkages to climate change resilience, the Guideline serves as a comprehensive standard for sustainable design, which will, inherently, be more resilient than projects that do not consider fundamental principles of sustainability (e.g., understanding the properties of the local soils, identifying the existing natural drainage patterns). The Guideline also acknowledges that sustainable trail design is a continuously evolving field and cautions practitioners against employing “the way we’ve always done it” approach. Further, maintenance regimes described in the Guideline, specifically the regular inspection and maintenance of drainage features and maintenance of the tread outslope, are important considerations for mitigating climate change-related events, such as the increased frequency of extreme precipitation events. Best practices for planning and conducting formal maintenance evaluations are comprehensive and relevant and serve as useful reference material.

The Township of Muskoka Lakes’ Design Manual for Parks and Trails in Muskoka³³ evolved from the 2022 Parks and Recreation Master Plan which necessitated the creation of a design manual to guide future development activities. The document is designed to function as a “comprehensive guide to the development and maintenance processes for parks, open spaces and trails throughout the Township” and “sets a high standard for the development of sustainable, high performance parks and trails landscapes within often sensitive ecologies.”. The local environment of the Township, with close proximity to water and the

³² Ontario Ministry of Health Promotion. 2005. Ontario Trails Strategy. Queen’s Printer for Ontario. Available from: <https://cdn2.assets-servd.host/material-civet/production/images/documents/OntarioTrailStrategy.pdf?dm=1620062748>

³³ Township of Muskoka. 2024. Design Manual for Parks and Trails in Muskoka. Available from: <https://www.muskokalakes.ca/en/resourcesGeneral/Documents/PlansReportsandStudies/Web-Copy--Design-Manual-for-Parks-and-Trails-in-Muskoka.pdf>

relationship between the community and their love of water, highlights the importance of calculated stormwater and spring meltwater management design. Best practices presented in the Manual reference the Dutch concept of “Leven met Water”, which translates to “Living with Water”, as well as a publication by the Boston Harbour Association in partnership with Sasaki titled “Designing with Water: Creative Solutions from Around the Globe”. The Manual, in collaboration with insights gained from these additional resources, describes designing for resilience, creating double-duty solutions, strengthening community resilience, and incentivizing and institutionalizing preparedness as key best practices for designing infrastructure around water which are relevant for multi-use trail infrastructure. These best practices are summarized in the table below. In addition to the potential effects of climate change on parks and trails infrastructure, the manual also considers the impacts of design and construction on the environment and provides guidance on implementing “Climate Positive Best Practices”. The best practices may include such things as minimizing hardscape and structures (e.g., plant more and pave less, reduce concrete, steel and aluminum), utilize low-carbon materials (e.g., wood and wood products, recycled materials), conserve and protect topsoil and topsoil biodiversity by minimizing grading and till and implementing design strategies that minimally impact soil, and design carbon-smart planting such as minimizing lawn, planting native species and selecting species and planting designs that maximize sequestration³⁴. Climate Positive Best Practices also include site management practices such as minimizing high-maintenance lawns, specifying electric and hand-powered equipment and minimizing pruning and retaining woody material on site.

³⁴ Ibid.

Table 2 Best practices for Designing for Stormwater and Spring Meltwater Management. Source: Township of Muskoka Design Manual for Parks and Trails in Muskoka³⁵.

Best Practice	Description
Design for Resilience	Resilience implies adapting to or bouncing back from a disturbance quickly. Resilient planning and design incorporates redundancy, and anticipates change over time. Examples include: Maintaining an awareness that the 100-year waterline can be surpassed, and including only elements and materials in the flood plain that have a relatively low replacement or touch-up time and cost associated. Limiting manicured areas to key features (E.g. beach and access trail) and placing a larger focus on natural and naturalized shoreline and riparian areas as recreational amenities unto themselves, with flood-resistant recreational trails and boardwalks. Limit parks buildings and built play structures to higher elevation areas, or consider elevating features on a platform construction, similar to typical Muskoka boathouse design or seaside hurricane architectural typologies.
Create Double-Duty Solutions	Double-duty solutions provide multiple benefits to maximize economic, ecologic and cultural gain. Example: The addition of a wet meadow area and naturalized shoreline areas form a buffer between manicured lawn and shoreline, and flank each end of a beach. The buffer areas serve to slow the movement of spring flood waters while also reducing the park maintenance area, increasing biodiversity and inviting new passive activities such as bird watching into a Township park.
Strengthen Community Resilience	Community resilience maintains and enhances the cultural identity that defines municipality through resilient networks and social support systems. Strategies that strengthen social resilience can both cost less and provide meaningful benefits to participants. Example: expand the reach of municipal assets and programming by encouraging use of assets by community members, groups and organizations, such as the provision of a storage building, change rooms and docks to serve a rowing club, triathlon open water swim training and volunteer-run SUP yoga classes. Partner with other agencies to run water, boating and ice safety courses.
Incentivize and Institutionalize Preparedness	Municipal and regional adaptation plans are necessary to guide resiliency efforts. Example: include flood management considerations in asset management planning reports. Seek updated information including evolving flood plain mapping data, insurance implications and consideration for new or emerging flood-resistant materials or techniques.

³⁵ Ibid

Parks Canada

The Parks Canada National Best Management Practices (BMPs) for Trail Maintenance and Modification was designed to support routine, repetitive projects or activities for existing trail projects where effects are well understood and predictable thus maximizing efficiency through “creation of a pre-approved impact assessment for the defined suite of projects to which standard mitigation and environmental management measures can be applied”³⁶. Sections 3 and 4 cover Bridge, Boardwalk and Culvert Maintenance, and Decommissioning and Rehabilitation, respectively. Supplementary Mitigations are covered in Section 5. The BMPs are generalized for national implementation and do not indicate regional considerations including, for instance, reference to climate change considerations. Other formal trail planning, construction, and maintenance standards, best practices and/or guidelines from Parks Canada were not available during this search. Below are examples Parks Canada Management Plans that consider climate change adaptation in the context of park infrastructure and assets.

Fundy National Park

The Fundy National Park of Canada Management Plan published in 2024 identifies four key strategies³⁷. These strategies and their corresponding objectives and targets focus on long-term vision for the park through an integrated and sustainable approach to park management. Key Strategy 4 concerns “Authentic, sustainable, memory-making experiences”. Objective 4-5 focuses on enhancing the trail network, focusing on “quality over quantity, to improve conditions for visitors. Targets of this objective include a trail assessment, taking climate change risks into consideration. Risks such as a rise in ocean elevation will be considered. The trail assessment is intended to guide the restoration, decommissioning and building of new trails by the year 2029.

³⁶ Parks Canada. 2016. Parks Canada National Best Management Practices Trail Maintenance and Modification. Available from: https://buyandsell.gc.ca/cds/public/2017/05/04/e3c17bf78a8937721363a5d4c20c0f9f/pca_-_trailsbmp.pdf

³⁷ Parks Canada. 2024. Fundy National Park of Canada Management Plan. Available from: <https://parks.canada.ca/pn-np/nb/fundy/parkmanagement-gestionduparc/plan>

Banff National Park

The Banff National Park Management Plan³⁸, 2022, advances the direction established in previous plans enhancing efforts towards respectful inclusion of Indigenous peoples, identification and management of cultural resources, planning and managing visitation in high-use areas, improving accessibility and inclusivity for services and facilities, and applying a climate change lens to the park's management approach. Specifically, this includes targets such as:

- Creating a 20-year Visitor Asset Sustainability Plan that details strategies, resources and actions necessary to optimize asset performance, climate change resiliency and sustainability for key facilities and supporting infrastructure.
- Collaboration with federal, provincial, municipal and local partners to identify sustainability and climate adaptation best practices for construction projects.

³⁸ Parks Canada. 2022. Banff National Park of Canada Management Plan 2022. Available from: <https://parks.canada.ca/pn-np/ab/banff/info/gestion-management/involved/plan/plan-2022#section-8>

United States – Northeastern Region

Literature published for the United States (US) Northeast Region was examined for this jurisdictional scan as the region presents a number of similarities to the Canadian Maritimes, specifically in terms of topography, climate, and climate change risk (e.g., sea level rise, increased precipitation). The northeast region includes the states Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, Delaware, Maryland, New Jersey, New York and Pennsylvania as well as the District of Columbia.

American Trails is a nationwide coalition of all types of trails organizations, agencies, and individuals (motorized and non-motorized) established in 1988 with the mission of “connecting and transforming communities through the power of trails”³⁹. American Trails provides free access to a number of trail-related resources including thousands of articles, documents, studies and webinars⁴⁰. Resources from American Trails were reviewed for relevance to this jurisdictional scan. Resources from the northeastern region were the focus of the subject review based on the rationale provided above. Some of these resources are highlighted in the sections to follow.

Maine

The Maine Department of Agriculture, Conservation, and Forestry – Bureau of Parks and Lands is responsible for protecting and managing the state’s parks, public lands, and historic sites⁴¹. The Maine Recreational Trails Program Advisory Committee was established in 1993 with the objective of assisting in the coordination of federal/state trails planning with other statewide, regional and local planning efforts establishing funding priorities for recreational trail program grants, assisting with planning trail corridors, providing representation of trail user groups in state trail programs, and assisting with implementation of goals and strategies from the Maine Statewide Comprehensive Recreation Plan (SCORP).

³⁹ American Trails. 2025. About Us. Available from: <https://www.americantrails.org/about-us>

⁴⁰ American Trails. 2025. Resources. Available from: <https://www.americantrails.org/resources>

⁴¹ Maine Department of Agriculture, Conservation and Forestry. 2021. Bureau of Parks and Lands – About Us. Available from: <https://www.maine.gov/dacf/parks/about/index.shtml>

The most recent Maine State Comprehensive Outdoor Recreation Plan for 2020 – 2024 was published in 2019⁴². The federal Land and Water Conservation Fund (LWCF) program provides matching funds for outdoor recreation planning and for acquisition and development of public outdoor recreation areas and facilities. The funding comes from federal off-shore oil and gas leases with grant funds administered through the National Park Service (NPS). States, municipalities, counties, and tribal councils are all eligible for funding. State participation in LWCF requires preparation of a SCORP and approval of the plan by the NPS. However, as stated, the Maine SCORP goes beyond the requirements of the LWCF program “in that it serves as an assessment of outdoor recreation issues and recommends priorities for a broad range of programs and actions related to outdoor recreation opportunities in Maine.”. Climate change is a key highlight of the plan. To this end, the plan states: “Climate change is requiring planning and infrastructure adapt to an evolving environment. Projects, acquisitions, and ongoing management of outdoor recreation resources will require forethought, constant learning and communication, and adaptability. The plan promotes thinking and projects that support the conservation and management of resilient sites well-suited to handle evolving recreational interests and realities as well as vulnerable species and ecosystems.”. This is captured further in Theme 4 of the plan which discusses prioritizing projects that thoughtfully address implications of climate change and that show likelihood of being resilient and adaptable to change. Within this theme, the plan discusses climate change resiliency for sites and physical infrastructure including designing potentially flood-prone structures with “mold-proof materials” and indicating that improving trail design and location will be critical as predicted increases in high-intensity storms will put stress on trails not designed to shed water as effectively.

The Maine Motorized Trail Construction and Maintenance Manual, updated in 2020, is the industry standard for trail projects in the state⁴³. The best practices document was published by the Department of Agriculture, Conservation and Forestry Bureau of Parks and

⁴² Maine Department of Agriculture, Conservation and Forestry. 2019. 2020-2024 Maine State Comprehensive Outdoor Recreation Plan. Bureau of Parks and Lands. Available from:

https://www.maine.gov/dacf/parks/publications_maps/docs/2020_ME_SCORP_final_1_2_2020.pdf

⁴³ Maine Department of Agriculture, Conservation and Forestry. 2020. Maine Motorized Trail Construction and Maintenance Manual. Bureau of Parks and Lands Off-Road Recreational Vehicle Office. Available from:

<https://www.atvmaine.org/wp-content/uploads/2022/05/Motorized-Trail-BMP-handbook.pdf>

Lands Off-Road Recreational Vehicle Division. The document provides an overview of trail impacts, landowner concerns, soil erosion considerations, and regulatory context. Trail construction topics include trail specs, flagging, slopes, climbing turns and switchback, water bar installation, ditches and filter strips, seeding and mulching, trail hardening, trails in wet areas and water crossings, culvert sizing, and bridges and bridge specs. Trail maintenance and trail closing practices are also discussed. The document provides detailed construction specifications and informative figures.

New Hampshire

The New Hampshire Department of Resources and Economic Development, Division of Parks and Recreation, Bureau of Trails published Best Management Practices for Erosion Control During Trail Maintenance and Construction in 2017⁴⁴. In addition to erosion and sediment control best practices, the document provides comprehensive guidelines for construction of water crossings, culverts, and bridges. The document doesn't directly speak to climate change adaptation; however, it provides guidelines for properly sizing culverts to accommodate flood events and evaluates the strengths and weaknesses of various water crossing structures.

New Hampshire Fish and Game's Trails for People and Wildlife, published in 2019, was designed to help landowners, conservation groups and natural resource professionals to develop trail networks that consider minimizing impacts to natural ecosystems and wildlife while providing trail users with opportunities to get outside and enjoy nature⁴⁵. The guide provides a high-level overview of potential impacts of trails and trail use on local wildlife species, including a trails "corridor of influence", before providing recommendations on how to locate and construct trails with wildlife in mind. This includes avoiding known locations of rare species such as known locations of bat roosts, and routing trails along "habitat edges"

⁴⁴ New Hampshire Department of Resources and Economic Development. 2017. New Hampshire Trail Construction and Maintenance Manual Best Management Practices for Erosion Control During Trail Maintenance and Construction. Division of Parks and Recreation; Bureau of Trails. Available from: <https://www.nhstateparks.org/getmedia/3c45de00-e174-4df0-b678-4670b254290d/Best-Management-Practices-For-Erosion-Control-During-Trail-Maintenance-and-Construction.pdf>

⁴⁵New Hampshire Fish and Game. 2019. Trails for People and Wildlife – A Guide to Planning Trails that allow People to Enjoy Nature and Wildlife to Thrive. Available from: <https://www.wildlife.nh.gov/sites/g/files/ehbemt746/files/inline-documents/sonh/trails-for-people-wildlife.pdf>

or the interface where structurally different habitats meet. The document showcases the Trails for People and Wildlife Location Tool, a mapping tool which employs a heat map to help trail planners determine which areas to avoid to mitigate impacts to wildlife (e.g., warmer colors indicate higher impacts on wildlife if a trail passes through). The Trail Location Tool is available through the University of New Hampshire’s online mapping service “GRANITView”. Although climate change adaptive strategies are not discussed, protecting wildlife and wildlife habitat, particularly habitat for rare or endangered habitat, may become increasingly more important as changing climate conditions impact habitat suitability for certain species, potentially leading to population declines and/or shifting habitat range.

Pennsylvania

The Pennsylvania Trail Design and Development Principles – Guidelines for Sustainable, Non-Motorized Trails is an extensive guideline published by the Pennsylvania Department of Conservation and Natural Resources (DCNR)⁴⁶. The guideline is specific to non-motorized trails with guidance on various trail classifications/intended uses including hiking trails, shared-use paths and rail trails, equestrian trails, cross-country skiing trails, snowshoeing and winter hiking trails, and accessible trails. Guidance pertinent to climate change considerations and challenges is lacking; however, the DCNR guidelines contain a wealth of information for sustainable trail planning and construction. The guideline features five chapters: 1) Planning, 2) User Characteristics & Design Requirements for Non-Motorized Trails, 3) Design Requirements for Sustainable Trails, 4) Construction and, 5) Management.

The city of Philadelphia was the subject of a 2019 publication that evaluated the vulnerability of bicycle trails in the city to sea level rise⁴⁷. The study used GIS tools to carry out a vulnerability assessment. Results of the study indicated over half of the city’s offstreet trail mileage was part of a sea level rise-affected link (i.e., at least one portion of the link was inundated) at a modelled sea level rise of 1.83 m.

⁴⁶ Pennsylvania Department of Conservation and Natural Resources. 2013. Pennsylvania Trail Design & Development Principles: Guidelines for Sustainable, Non-motorized Trails. Available from: <https://elibrary.dcnr.pa.gov/GetDocument?docId=1741679&DocName=Pennsylvania%20Trail%20Design%20and%20Development%20Principles.pdf>

⁴⁷ Oswald Beiler, M. R., and Miller, G. 2019. Sea-Level Rise Vulnerability of Bicycle and Trail Networks. Journal of Transportation and Engineering: Part A Systems. 145 (2) <https://doi.org/10.1061/JTEPBS.0000214>

Vermont

Climate change and its impacts on greenspaces and recreational infrastructure, including trails, is being realized perhaps on a greater scale in the state of Vermont than anywhere else in the northeastern region. Catastrophic flash flooding occurred early to mid-July 2023 and again, precisely a year later, in July 2024^{48,49}. During the 2023 event, nine inches of rainfall was reported over a 48-hour period for some regions of the state, while the 2024 event was reported to bring seven inches in some areas. For Vermont's snowmobile trails, this equated to over \$1 million in repairs⁵⁰.

The Vermont Trails and Greenways Council cites the U.S. Department of Transportation Federal Highway Administration's "Trails as Resilient Infrastructure Guidebook" as reference material for planning and building resilient trail infrastructure. The guidebook "examines the ways in which trails can be made more resilient and how trails can serve as resilient infrastructure, providing information and guidance to support these goals."⁵¹ The text covers chapters on planning and implementation, evaluating vulnerability, design and engineering for resilience, emergency response planning, and maintenance and management, as well as several case studies. The guidebook highlights the roles of trails in both climate mitigation (reducing greenhouse gas emissions through active transportation) and adaptation (trails are vulnerable to climate change impacts as many trails are located within riparian and coastal corridors, forests, or on slopes making them prone to flooding, fire erosion and landslides). According to the guidebook, and literature cited therein, a trail's vulnerability to climate change and extreme weather events can be seen as a function of a

⁴⁸ National Weather Service. 2023. The Great Vermont Flood of 10-11 July 2023: Preliminary Meteorological Summary. National Oceanic and Atmospheric Administration. Available from: <https://www.weather.gov/btv/The-Great-Vermont-Flood-of-10-11-July-2023-Preliminary-Meteorological-Summary>

⁴⁹ National Weather Service. 2024. The Significant Flooding and Severe Weather Event of 10-11 July 2024. National Oceanic and Atmospheric Administration. Available from: <https://www.weather.gov/btv/The-Significant-Flooding-and-Severe-Weather-Event-of-10-11-July-2024>

⁵⁰ Vermont Trails & Greenways Council. 2024. Vermont Snowmobile Trail Damages are up to \$1 Million in Repairs and Climbing. Available from: <https://vermonttgc.org/vermont-snowmobile-trail-damages-are-up-to-1-million-in-repairs-and-climbing/>

⁵¹ Ciabotti, J., Kelly, Q., Lauderdale, E., Lohse, K., Weyer, S., Hintze, M., Heuser, K., Camacho, C., Crumpton, J. & Detinger, E. 2023. Trails as Resilient Infrastructure Guidebook. US Department of Transportation Federal Highway Administration. Available from: https://www.fhwa.dot.gov/environment/recreational_trails/publications/

trail's, or trail network's, exposure, sensitivity and adaptive capacity. These three terms are generally defined, in the context of trail infrastructure, as the following:

- Exposure: this depends on whether a trail or trail network is located in an area experiencing direct effects of climate variability and extreme weather events.
- Sensitivity: refers to how the trail or trail network responds to or is affected by climate stressors.
- Adaptive capacity: this is the trail or trail network's ability to adjust, repair, or flexibly respond to damage caused by existing climate variability or future climate impacts.

In addition to vulnerability, risk is another important consideration. Risk is a measure that considers both the probability of an event occurring and the severity of the event should it occur⁵². Planning, construction, and maintenance guidelines presented in the guidebook are generally consistent with modern best practices and standards reported elsewhere; however, the document considers alternative strategies such as impermanent designs (temporary structures that mitigate the need to rebuild after storm events such as floating docks, portable piers) and emergency response planning and implementation as well as evacuation measures in the event of natural disasters.

The Vermont Agency of Natural Resources – Department of Forests, Parks and Recreation (FPR) is responsible for the conservation and management of Vermont's forest resources, the operation and maintenance of the State Park system, and the promotion and support of outdoor recreation for state residents and visitors⁵³. The most recent state recreation plan is the Vermont Statewide Comprehensive Outdoor Recreation Plan (SCORP) for 2019 – 2023⁵⁴. As mentioned previously, SCORP is a requirement for states receiving federal funding through the LWCF; however, the overarching intent of the plan is to outline priorities and objectives to guide outdoor recreation policies, programs, and investments to achieve objectives. Priority 1 of the Vermont SCORP pertains to stewardship of natural resources and

⁵² Ibid

⁵³ Vermont Department of Forests, Parks and Recreation. 2025. Department Home. Available from: <https://fpr.vermont.gov/>

⁵⁴ Vermont Department of Forests, Parks and Recreation. 2019. Vermont Statewide Comprehensive Outdoor Recreation Plan 2019 – 2023. Available from: https://fpr.vermont.gov/sites/fpr/files/Recreation/Vermont_SCORP_12_23%20-%20Split%20Pages%20-%20Edge%20to%20Edge.pdf

recreational assets. Discussed in the context of this priority is the need to consider the impacts of climate change and adaptive actions in planning and conservation efforts. Objective 2 of this Priority concerns Managing recreational assets and resources with a key strategy being “Plan for resilience of recreation infrastructure and the recreation economy in the face of climate change.”.

The Vermont Urban and Community Forestry Program is primarily a partnership between the University of Vermont Extension and Vermont Department of Forests, Parks and Recreation⁵⁵. The Vermont Town Forest Recreation Planning Toolkit, which includes the Vermont Town Forest Trail Design Guide, was an initiative of the Program to provide general guidance for designing and developing trails in town forests and elsewhere. The guide is a best practice document for developing trails that are physically, ecologically, and economically sustainable⁵⁶. According to the guide, high-level principles of sustainable trail building include:

- Features and structures are in scale with the natural environment
- The visual quality of the landscape or specific landscape features is not diminished
- Soil resources are protected from human-caused erosion
- The introduction of invasive species is avoided

The Green Mountain Club (GMC) was founded in 1910 with the goal of building a long-distance hiking trail that spans the length of Vermont’s mountains⁵⁷. Given the name The Long Trail, the trail was constructed as “a footpath in the wilderness” for hikers looking to experience the state’s natural beauty. The trail would serve as the inspiration for the construction of the Appalachian Trail. The club, including professional trail crews and volunteers, as well as partner organizations employ modern sustainable trail building techniques to manage over 500 miles of trail and backcountry shelters and privies. The club stated priorities for 2023 which included sustainable trail work, building an inclusive

⁵⁵ Vermont Urban and Community Forestry Program. nd. Projects – Town Forest Recreation Planning Toolkit. Available from: <https://vtcommunityforestry.org/projects/town-forests/town-forest-recreation-planning-toolkit>

⁵⁶ Vermont Urban and Community Forestry Program. 2020. Vermont Town Forest Trail Design Guide. Vermont Town Forest Recreation Planning. Available from: https://fpr.vermont.gov/sites/fpr/files/doc_library/FPR-VT-Town-Forest-trail-design-guide.pdf

⁵⁷ Green Mountain Club. 2025. About. Available from: <https://www.greenmountainclub.org/about/thegreenmountainclub/>

community, and adapting to climate change. In an article titled “Climate Change: Trail Management Strategies” published in the Spring 2019 Long Trail News⁵⁸, author Mike Debonis, Executive Director of the GMC and licensed professional forester, states that “It is essential to understand the magnitude and speed of climate change to predict how it might affect trails and the landscape.”. Further, Debonis explains that the GMC must take climate change into account in trail design and placement, bridge building, shelter siting, water control, and invasive species management. Examples included building bridges spanning large rivers higher, with the caveat that they are likely to be more expensive, and for bridges spanning smaller streams, designing them to float out of the way of floods on tethers and be reset on their piers afterward, saving cost of new material. He also indicates that climate change will impact the way in which people interact with trails, citing that more people are now hiking in the winter so there is greater need for winter safety education. Debonis indicates that the GMC’s climate change strategy is focused on three key areas which include:

1. Employing enough backcountry caretakers and educators to manage increased use and provide public education in a hiking season that may lengthen
2. Incorporating modern technology, science and best practices to ensure that trail work is durable and functional while not losing elements that diminish the quality of the hiking experience
3. Planning and funding, including the collection of information that aids in identifying and developing contingency plans for areas on the trail susceptible to extreme weather events and establishing more reliable revenue sources and robust financial reserves so that unanticipated extreme weather events can be responded to effectively.

The Green Mountain Club released their 2023-2028 strategic plan in 2023 indicating three prevailing themes. On the theme of “Protecting and Managing the Trail Resource”, a key

⁵⁸ Debonis, M. 2019. Climate Change: Trail Management Strategies. The Long Trail News Quarterly of the Green Mountain Club. Spring 2019. Available from: https://gmcmontpelier.org/Archive_Publications/LTN_Archives/LTN_YYYY_NN/2019_01_Spring.pdf

goal of the theme is “Protecting, maintaining, and improving the Long Trail and GMC-managed trails in the face of climate change and increased use.”⁵⁹.

The Vermont Mountain Bike Association (VMBA) published a document titled Best Management Practices for Mountain-Bike-Optimized and Multiuse Trail Construction and Maintenance in 2025⁶⁰. The BMPs are broadly categorized into Trail Construction and Trail Maintenance BMPs. Trail construction BMPs include Sustainability Principles, Tread Construction, Drainage, Stormwater, Water Crossings and Riparian Areas, and Trail Structures among other topics. In consideration of sustainable principles, the document states that “Trails should be constructed to be resilient to climate change, factoring in long-term projections for precipitation from severe weather events.”. Regarding drainage, the document indicates that “If culverts are necessary, select diameters that can accommodate extreme precipitation events observed more frequently due to climate change.”.

New York State

The Adirondak Mountain Club (ADK) is based out of the Adirondak Park in New York State and has been working to protect New York State wild lands and waters by promoting responsible outdoor recreation and building a statewide constituency of land stewardship advocates since 1922⁶¹. The organization specializes in modern, sustainable trail design in New York. ADK offers a number of skills workshops and events that provide volunteers with an opportunity to participate in active trail work projects. No publications by ADK were identified for review.

Massachusetts

The Appalachian Mountain Club (AMC) is based out of Boston, Massachusetts but is concerned with promoting conservation and recreation throughout the Appalachian region⁶².

⁵⁹ Green Mountain Club. 2023. 2023-2028 Strategic Plan. Available from:

<https://www.greenmountainclub.org/wp-content/uploads/2024/11/GMC-2023-28-Strategic-Plan-for-web.pdf>

⁶⁰ Vermont Mountain Biking Association. 2025. Best Management Practices for Mountain-Bike-Optimized and Multiuse Trail Construction and Maintenance. Available from: <https://vmba.org/document/best-management-practices-for-trail-construction-maintenance/>

⁶¹ Adirondak Mountain Club. nd. Mission & History. Available from:

<https://members.adk.org/members/about/mission-and-history.aspx>

⁶² Appalachian Mountain Club. 2024. About Us. Available from: <https://www.outdoors.org/about/>

The AMC published the AMC's Complete Guide to Trail Building and Maintenance: 5th Edition in 2021⁶³ for purchase. A copy of the publication was not reviewed for the purpose of this jurisdictional scan.

The Massachusetts Department of Conservation and Recreation's (DCR's) Trails Guidelines and Best Practices Manual was revised in 2014⁶⁴. Consideration of climate change resilience in trail construction standards was not an objective of the publication; however, the document emphasizes the need for sustainable construction practices. This is captured in a statement from the guideline which states, "Sustainable trails begin with thoughtful planning, good design, and meticulous layouts." and further "A sustainable trail will require little rerouting and minimal maintenance over extended periods of time.". The document highlights the importance of physical, ecological and economical sustainability in the context of trail planning and construction. According to the guideline, sustainable trails are characterised by the following conditions:

- Trail tread is stable and compacted, with constant outsloped grade preferred (the depression on a well-worn trail should average less than 3 inches (7.6 cm) in most soil types)
- Displacement of soils from the trail tread is minimal relative to the use and soil type (only limited berming on the outside of curves)
- Tread drains well with minimal to no signs of ongoing erosion
- Tread does not restrict site hydrology and impact surface- or groundwater quality, and
- Impacts to surrounding ecological systems is limited to the trail tread and directly adjacent clearance zone, with no bypassing and cross-country travel occurring

When building sustainable trails, the following criteria should be met, according to the guideline:

⁶³ Appalachian Mountain Club. 2021. AMC's Complete Guide to Trail Building and Maintenance: 5th Edition. Appalachian Mountain Club.

⁶⁴ Massachusetts Department of Conservation and Recreation. 2014. Trails Guidelines and Best Practices. Available from: <https://www.americantrails.org/resources/massachusetts-trails-guidelines-and-best-practices-manual>

- Connect positive, and avoid negative control points: sustainable trails will lead users to desired destinations (e.g., water features, historic sites) while avoiding wet areas, steep slopes, critical habitats and other culturally or environmentally sensitive areas.
- Keep water off the trail: erosion is the number one problem for sustainable trails. In New England, water is the primary erosive force; trails that collect water or channel water will be both environmentally and economically un-sustainable.
- Follow natural contours: trails lie on the land in three ways – along a fall-line (in the direction of the slope), on flat ground, or along the contour (perpendicular to the slope). Of these types of trails, only the contour trail on the side-slope easily sheds water and is therefore considered sustainable.
 - Further, sustainable contour trails should conform to five “rules”:
 1. Outslope: the trail should be outsloped by 5%.
 2. Grade reversals: a sustainable trail should reverse its grade often (from down to up and vice versa, described as “surfing the hillside”). This will reduce the watershed of any given section of the trail, prevent water from collecting and running down the trail, and reduce any erosion potential. Most trails should include grade reversals every 20 – 50 ft (6 – 15 m).
 3. Half rule: a trail’s grade should not be any greater than half the grade of the hillside that it contours along – this will allow water to flow across the trail, off the trail and continue down slope.
 4. Ten Percent Average Grade: an average trail grade of 10% or less will be most sustainable, on most soils and for most users. This does not mean that shorter sections can’t be steeper.
 5. Maximum sustainable grade: this is the steepest grade the trail will attain and should be determined early in the planning process. Typical maximum grades may vary, but this is site specific and depend on factors such as soils, rainfall, the half rule, grade reversals, user type, desired difficulty level, and number of users.
- Keep users on the trail: when users leave the trail tread, they widen it, create braided trails, and create social trails. These can cause environmental damage and raise

maintenance costs. Users leave the trail when it becomes eroded or wet, or when the trail does not meet their needs or expectations.

- Meet desired user experiences: sustainable trails and trail systems must meet different users' needs and expectations. If they do not, users may abandon the trails and/or create their own, less sustainable trails.

Ultimately, one of the principal rules of sustainable trails is to keep the trail away from water and the water off the trail. This principle remains significant in adapting to climate change as precipitation is anticipated to increase and will be a consistent natural force that trail managers must compete against to mitigate impacts to trails and reduce maintenance costs.

Closing

The present report attempts to characterize guidance material for practicing and prospective trail builders across various jurisdictions in both Canada and the northeastern United States with a focus on adaptive strategies for climate change impacts. Trail planning, construction, and maintenance best practices, guidelines and other resources, that incorporated elements of climate change adaptation/resilience were found to be limited, although it is recognized that this review is not to be considered exhaustive. In the absence of specific climate change adaptation recommendations, resources that incorporated themes of sustainability and resiliency were also highlighted. Appendix A presents a list of select sources of information that were reviewed in preparation of this report.

APPENDIX A – Sources Reviewed

Region	Type	Description	Reference
Newfoundland	Provincial	Newfoundland and Labrador Parks Division	https://www.parksnl.ca/about-us/
		Newfoundland and Labrador Department of Environment and Climate Change	https://www.gov.nl.ca/ecc/natural-areas/
	Municipal	Deer Lake Municipal Plan 2019-2029 (2019)	https://www.gov.nl.ca/ecc/files/LGLUP-Registry-Deer-Lake-MunPlan-2019-1.pdf
		Town of Portugal Cove – St. Philip’s Trails Master Plan (2022)	https://pcsp.ca/site/uploads/2022/11/PCSP-Trails-Master-Plan_Final-BW.pdf
		City of Corner Brook – The Great Trail Multi-Use Trail Study (2019)	https://www.cornerbrook.com/wp-content/uploads/2022/03/Corner-Brook-Multiuse-Trail-Study.pdf

Region	Type	Description	Reference
		Town of Conception Bay South – Recreation and Cultural Master Plan	https://www.conceptionbaysouth.ca/council/reports-publications/
	NGO	The Grand Concourse – Services	https://www.grandconcourse.ca/about-us/our-services/maintenance/
		Newfoundland and Labrador Snowmobile Federation	https://nlsf.org/
New Brunswick	Provincial	NB Natural Resources and Energy Development – Trails, Rivers, Parks	https://www2.gnb.ca/content/gnb/en/departments/erd/crown-lands/content/trails-rivers-parks.html
		A Guide for Climate Change Adaptation Planning for New Brunswick Communities	https://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Climate-Climatiques/guide-for-climate-change-adaptation-planning.pdf

Region	Type	Description	Reference
		Resource Management Plan Framework for New Brunswick Provincial Parks	https://cpawnsb.org/wp-content/uploads/2017/12/Resource-Management-Plan-Framework-for-New-Brunswick-Provincial-Parks-A-Guide-to-Management-Planning.pdf
		New Brunswick Parks	https://www.nbparks.ca/en
		Tourism, Heritage and Culture Annual Report 2023-2024	https://www.legnb.ca/content/house_business/61/1/taled_documents/2024-12-09%20Tourism,%20Heritage%20and%20Culture%202023-2024.pdf
		Recreation NB	https://recreationnb.ca/resources/
	Municipal	Climate Change Adaptation Plan City of Cambellton	http://www.campbellton.org/camp2/pdf/Public%20Notices/2020/09-17-2020-Climate-Change/Campbellton%20Adaptation%20Plan-final%20March%203-2020.pdf
		Fredericton Trails Coalition	https://www.frederictontrailscoalition.com/trails/
		City of Fredericton - Trails	https://www.fredericton.ca/en/recreation-culture/trails-cycling/trails
		Municipality of Grand Lake - Hiking	https://municipalityofgrandlake.ca/hiking/
		Town of Riverview - Parks and Trails	https://www.townofriverview.ca/parks-and-recreation/parks-and-trails

Region	Type	Description	Reference
		City of Moncton - Environment	https://www.moncton.ca/environment
		City of Moncton - Active Transportation Plan Phase Two Report	https://www5.moncton.ca/docs/plans/Active_Transportation_Plan_Phase2.pdf
		Miramichi - Parks and Trails Plans	https://www.miramichi.org/parks-and-trails
	NGO	Snowmobile New Brunswick	https://www.snowmobilenb.com/
		Hike New Brunswick	http://www.hikingnb.ca/
		J.D. Irving Conservation Program	https://www.jdirvingconservation.com/
		Sentier Nepisiguit Mi'gmaq Trail	https://www.migmaqtrail.ca/
		New Brunswick All Terrain Vehicle Federation	https://nbatving.com/
		Quad NB	https://quadnb.ca/

Region	Type	Description	Reference
		Fundy Hiking Trail Association	https://fundyhikingtrails.com/
		New Brunswick Equestrian Association	https://nbea.ca/Participants-Trail-Riding
Nova Scotia	Provincial	Province of Nova Scotia – Shared Strategy for Trails in Nova Scotia (2019)	https://novascotia.ca/trailstrategy/docs/18-47600_SharedStrat_TrailsNS_Report_ENG_LoRes.pdf
		Nova Scotia Department of Communities, Culture, Tourism and Heritage	https://beta.novascotia.ca/government/communities-culture-tourism-and-heritage
		Nova Scotia Department of Natural Resources – Construction Standards for Trail Bridges on Crown Land	https://novascotia.ca/natr/ohv/conditions-for-use.asp

Region	Type	Description	Reference
	Municipal	Halifax Regional Municipality – Parks, Trails & Gardens	https://www.halifax.ca/parks-recreation/parks-trails-gardens
		Halifax Regional Municipality – Municipal Design Guidelines Part A: Design Guidelines and Standards (2021)	https://cdn.halifax.ca/sites/default/files/documents/transportation/streets-sidewalks/Part%20A%20-%20Municipal%20Design%20Guidelines%202021.pdf
		Town of Berwick – Recreational Trail Strategy	https://www.berwick.ca/town-documents/441-trail-strategy-2020-final-sept-17/file.html
		Town of Chester	https://chester.ca/recreation-parks/trails
		Municipality of the District of Lunenburg – Trails	https://www.modl.ca/municipal-parks-and-trails.html
		Municipality of County of Kings – Trails	https://www.countyofkings.ca/visitors/todo/Parks-Trails

Region	Type	Description	Reference
		Municipality of Barrington – Trails	https://www.barringtonmunicipality.com/Visiting-Us/trails
		Municipality of East Hants – Parks, Playgrounds and Trails	https://www.easthants.ca/parks-playgrounds-trails/
		East Hants Recreation Services Master Plan (2019)	https://www.easthants.ca/wp-content/uploads/2024/01/PRC-Recreation-Services-Master-Plan.pdf
		Municipality of Argyle – Recreation	https://munargyle.com/recreation.html
		Municipality of the County of Richmond	https://www.richmondcounty.ca/trails.html
		Victoria County Trails Federation	https://victoriacounty.com/residents/community-development/trail-development/
	NGO	Hike Nova Scotia	https://www.hikenovascotia.ca/trail-builders-network-resources/
		Cobequid Eco-Trails Society – Risk Management Strategy and Handbook	https://www.cobequidecotrails.ca/pdf/RiskManagementStrategyHandbook_January2011.pdf

Region	Type	Description	Reference
		Cycling NS	https://cyclingns.ca/who-we-are-what-we-do/
		B.L.T. Rails to Trails	https://blttrails.ca/
		Cole Harbour Parks and Trails Association	http://www.chpta.org/p/about_12.html
		Crowbar Lake Wilderness Association	http://www.chpta.org/p/about_12.html
		Marine Riders Trail Association	https://www.marineriders.com/#ourtrails
		McIntosh Run Watershed Association	https://mcintoshrun.ca/building-resources/
		Musquodoboit Trailway Association	https://www.mta-ns.ca/
		Sackville Rivers Association - Recreation	https://www.sackvillerivers.ns.ca/projecto-2
		Saint Margrets Bay Rails-to-Trails	https://stmargaretsbaytrails.com/

Region	Type	Description	Reference
		Woodens River Watershed Environmental Organization	https://wrweo.ca/wp/
Prince Edward Island	Provincial	PEI Department of Environment, Energy and Climate Action – Climate Change Risk Assessment (2021)	https://www.princeedwardisland.ca/sites/default/files/publications/pei_ccra_2021.pdf
		PEI Department of Environment, Energy and Climate Action – Minister’s Report on Climate Change Risks and Progress Towards Targets (2023)	https://www.princeedwardisland.ca/sites/default/files/publications/ministersreportclimate2023.pdf
		Tourism PEI – Confederation Trail	https://www.tourismpei.com/what-to-do/outdoor-activities/confederation-trail

Region	Type	Description	Reference
	Municipal	City of Charlottetown – Trails and Active Transportation	https://www.charlottetown.ca/leisure___recreation/parks_and_trails/trails_and_active_transportation
		City of Summerside – Parks, Greenspaces & Active Transportation	
	NGO	Hiking PEI	https://www.hikingpei.ca/Trails/RedSandsShore/Charlottetown.html
		Island Trails	https://islandtrails.ca/trails/
		PEI ATV Federation	https://ridepei.ca/
		MacPhail Woods Ecological Forestry Project	https://macphailwoods.org/about/overview
	Central Canada – Ontario	Ontario	Strathroy-Caradoc – Recreational Trails Master Plan (2022)
Toronto Transportation Services Parks, Forestry & Recreation – Toronto Multi-Use			https://www.toronto.ca/wp-content/uploads/2017/11/96a5-TORONTO_TRAIL_DESIGN_GUIDELINES.pdf

Region	Type	Description	Reference
		Trail Design Guidelines	
		Ontario Trails Council	https://www.ontariotrails.on.ca/content/support/about-otc
		Ontario Ministry of Tourism, Culture, Gaming and Ministry of Sport	https://www.ontario.ca/page/ministry-tourism-culture-and-gaming-and-ministry-sport
		Ottawa Valley Recreational Trail	https://www.ottawavalleytrail.com/
		Hastings Trails	https://hastingstrails.ca/resources/
		The St. Lawrence Parks Commission	https://www.parks.on.ca/
		Trails for All Ontarians Collaborative – Guidelines and Best Practices for the Design, Construction and Maintenance of Sustainable Trails (2006)	https://cdn2.assets-servd.host/material-civet/production/images/documents/ontario-design-construction-maintenance-sustainable-trails.pdf

Region	Type	Description	Reference
		Bruce Trail Conservancy	https://brucetrail.org/
		Town of Muskoka – Design Manual for Parks and Trails in Muskoka (2024)	https://www.muskokalakes.ca/en/resourcesGeneral/Documents/PlansReportsandStudies/Web-Copy--Design-Manual-for-Parks-and-Trails-in-Muskoka.pdf
National	Parks Canada	Parks Canada National Best Management Practices – Trail Maintenance and Modification	https://buyandsell.gc.ca/cds/public/2017/05/04/e3c17bf78a8937721363a5d4c20c0f9f/pca_-_trailsbmp.pdf
		Parks Canada Agency – Departmental Sustainable Development Strategy 2020 – 2023 (2020)	https://parks.canada.ca/agence-agency/bib-lib/plans/docs2i/durable-sustainable-2020-2023
		Gros Morne National Park of Canada –	https://parks.canada.ca/pn-np/nl/grosmorne/info/plan/gestion-management-2019

Region	Type	Description	Reference
		Management Plan (2019)	
		Cape Breton Highlands National Park – Park Management	https://parks.canada.ca/pn-np/ns/cbreton/info/route-road
		Cape Breton Highlands National Park of Canada – Management Plan (2022)	https://parks.canada.ca/pn-np/ns/cbreton/info/plan/plan-2022
		Banff National Park of Canada – Management Plan (2022)	https://parks.canada.ca/pn-np/ab/banff/info/gestion-management/involved/plan/plan-2022#section-8
		Fundy National Park of Canada – Management Plan (2024)	https://parks.canada.ca/pn-np/nb/fundy/parkmanagement-gestionduparc/plan
Northeastern United States	Maine	Maine Department of Agriculture,	https://www.maine.gov/dacf/parks/about/index.shtml

Region	Type	Description	Reference
		Conservation and Forestry – Bureau of Parks and Lands	
		Maine Department of Agriculture, Conservation and Forestry – State Comprehensive Outdoor Recreation Plan (2019)	https://www.maine.gov/dacf/parks/publications_maps/docs/2020_ME_SCORP_final_1_2_2020.pdf
		Maine Department of Agriculture, Conservation and Forestry – Motorized Trail Construction and Maintenance Manual (2020)	https://www.atvmaine.org/wp-content/uploads/2022/05/Motorized-Trail-BMP-handbook.pdf
	New Hampshire	New Hampshire Department of Resources and Economic	https://www.nhstateparks.org/getmedia/3c45de00-e174-4df0-b678-4670b254290d/Best-Management-Practices-For-Erosion-Control-During-Trail-Maintenance-and-Construction.pdf

Region	Type	Description	Reference
		Development – Trail Construction and Maintenance Manual Best Practices for Erosion Control During Trail Maintenance and Construction (2017)	
		New Hampshire Fish and Game – Trails for Wildlife and People: A Guide to Planning Trails That Allow People to Enjoy Nature and Wildlife to Thrive	https://www.nhstateparks.org/getmedia/3c45de00-e174-4df0-b678-4670b254290d/Best-Management-Practices-For-Erosion-Control-During-Trail-Maintenance-and-Construction.pdf

Region	Type	Description	Reference
	Pennsylvania	Pennsylvania Department of Conservation and Natural Resources – Trail Design and Development Principles: Guidelines for Sustainable, Non-motorized Trails	https://elibrary.dcnr.pa.gov/GetDocument?docId=1741679&DocName=Pennsylvania%20Trail%20Design%20and%20Development%20Principles.pdf
	Vermont	Vermont Trails and Greenways Council	https://vermonttgc.org/resource-hub/
		Vermont Department of Forests, Parks and Recreation	https://fpr.vermont.gov/
		Vermont Department of Forests, Parks and Recreation – Vermont Statewide Comprehensive Outdoor Recreation	https://fpr.vermont.gov/sites/fpr/files/Recreation/Vermont_SCORP_12_23%20-%20Split%20Pages%20-%20Edge%20to%20Edge.pdf

Region	Type	Description	Reference
		Plan 2019-2023 (2019)	
		Green Mountain Club	https://www.greenmountainclub.org/about/thegreenmountainclub/
		Vermont Urban Community Forestry Program – Town Forest Trail Design Guide (2020)	https://fpr.vermont.gov/sites/fpr/files/doc_library/FPR-VT-Town-Forest-trail-design-guide.pdf
		Green Mountain Club – 2023-2028 Strategic Plan (2023)	https://www.greenmountainclub.org/wp-content/uploads/2024/11/GMC-2023-28-Strategic-Plan-for-web.pdf
		Vermont Mountain Biking Association – Best Practices for Mountain-Bike- Optimized and Multiuse Trail Construction and Maintenance (2025)	https://vmba.org/document/best-management-practices-for-trail-construction-maintenance/
	New York	Parks & Trails New York – Greenway	https://www.ptny.org/application/files/2417/0549/6204/Greenway_Trails_Development_Guide_Jan_16_2024.pdf

Region	Type	Description	Reference
		Trails Development Guide	
		New York State Snowmobile Association	https://nysnowmobiler.com/ride-ny-trails/
		Adirondak Mountain Club	https://members.adk.org/members/about/mission-and-history.aspx
	Massachusetts	Massachusetts Department of Conservation and Recreation – Trails Guidelines and Best Practices Manual	https://cdn2.assets-servd.host/material-civet/production/images/documents/MA-Trails-Guidelines-Best-Practices.pdf?dm=1620062740
		Appalachian Mountain Club	https://www.outdoors.org/about/
		City of Boston Parks and Recreation – Open Space and Recreation Plan	https://www.boston.gov/departments/parks-and-recreation/updating-seven-year-open-space-plan
		Massachusetts Department of	https://www.mass.gov/orgs/department-of-conservation-recreation

Region	Type	Description	Reference
		Conservation and Recreation	