Great Meadow Restoration Project

Environmental Assessment

March 2023

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Department of the Interior
National Park Service
Acadia National Park
Bar Harbor, ME

1 Chapter 1: Purpose and Need

1.1 Introduction

The National Park Service (NPS) proposes to implement actions to improve the ecological health of the Great Meadow in Bar Harbor, Maine, by restoring natural function to the wetland and Cromwell Brook (Figure 1). The 116-acre Great Meadow is the largest freshwater wetland complex in Acadia National Park (ACAD) and is located within the center of the 3-square mile Cromwell Brook watershed. It is one of the most-visited areas of the park including sections of the Park Loop Road, Sieur de Monts Spring cultural landscape, historic trails system, and community connector trails.

This Environmental Assessment (EA) presents background information, outlines the proposed action, describes current conditions and NPS management actions (the "No Action" alternative), and analyzes an action alternative for the restoration of the Great Meadow and Cromwell Brook.

This document has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, regulations of the Council on Environmental Quality (40 Code of Federal Regulations [CFR] 1500-1508.9), and the NPS *Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making* (NPS 2011) and its accompanying NPS NEPA Handbook (NPS 2015).

Note to Reviewers and Respondents:

Participation by the public is important to the success of this project. The NPS is seeking public review and comments on the proposal. If you wish to comment on this EA you may mail comments within 30 days to the address below or you may post them electronically to the document webpage (https://parkplanning.nps.gov/GreatMeadow). Before including your address, phone number, email address, or other personal identifying information in your comment, you should be aware that your entire comment, including your personal identifying information, may be made publicly available at any time. While you can ask in your comment to withhold your personal identifying information from public review, the NPS cannot guarantee that it will be able to do so.

Superintendent
Acadia National Park
Attn: Great Meadow Restoration Project EA Comments
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1.2 Purpose and Need for Action

The purpose of the Great Meadow Restoration project is to:

- restore wetland ecosystem function,
- improve wildlife passage and connectivity along Cromwell Brook,
- improve downstream channel morphology,
- build resiliency and ecological adaptability to the ecosystem,
- enhance the recreational experience for visitors, and
- reduce damage and maintenance to infrastructure and facilities.

The action is needed because past development and current use continues to impact the natural hydrologic function and species composition of the Great Meadow wetland system. This past development included the culvert outlet at the Park Loop Road, legacy ditches within the Great Meadow, abandoned raised roadbeds, and historic hiking trails. The existing culvert restricts the natural flow of Cromwell Brook and migration of aquatic species. During high-intensity rain events, floodwaters back up upstream of the culvert where they contribute to flooding of Sieur de Monts Spring cultural landscape and historic site. Current use in and adjacent to the Great Meadow increases stress on the wetland system and adds to the spread of disturbance-tolerant and nonnative invasive plant species.

1.3 Project Area and History

1.3.1 Project Area

The project area encompasses approximately 200 acres of wetlands and uplands within the Great Meadow and primary channel of Cromwell Brook subwatersheds (Figure 1). The Great Meadow lies between Dorr Mountain to the west and Strawberry Hill to the east. Cromwell Brook flows from the historically dammed wetland known as the Tarn, north through the Great Meadow. Sieur de Monts Spring and its natural springs lie on the southside of the Great Meadow and contain several small tributaries that feed into Cromwell Brook. Approximately a half mile after exiting the Great Meadow, Cromwell Brook merges with Kebo Brook, which is the second largest stream in the watershed and flows from sections of Cadillac Mountain and Champlain Mountain. Cromwell Brook outlet is in the Town of Bar Harbor, where it then flows into Cromwell Cove.

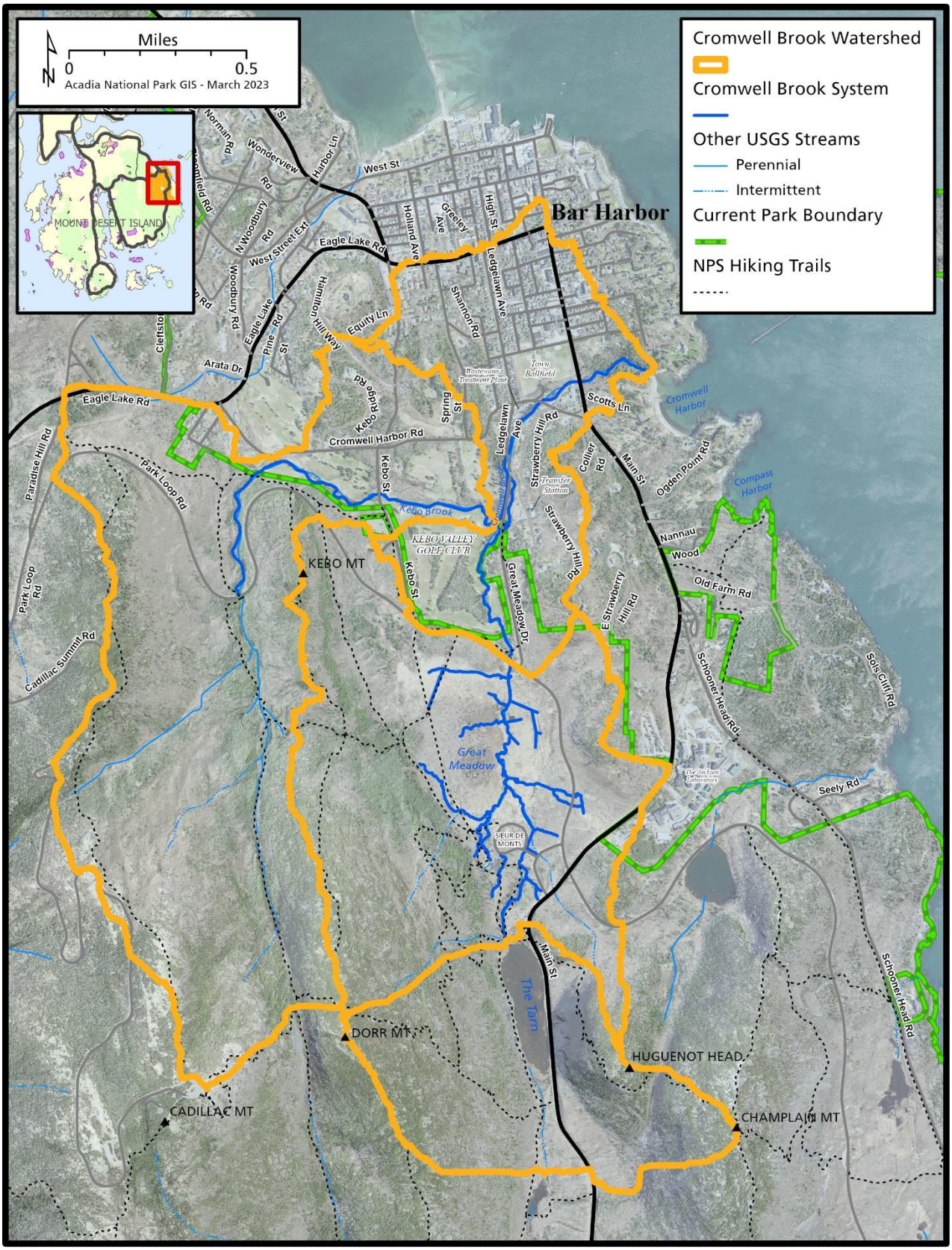

Figure 1. Map of the Cromwell Brook and subwatersheds.

1.3.2 Land Ownership History

For generations prior to European colonization the area was inhabited by numerous indigenous groups that are today collectively known as the Wabanaki. Sieur de Monts Spring and Great Meadow may have been a location for drinking water and a carry trail, providing passage through the mountains and dense forests of the island (Brown 2006).

George Bucknam Dorr purchased the natural spring and the surrounding ten acres in 1909 and named it Sieur de Monts Spring after the French aristocrat who was commissioned Lieutenant Governor of New France by King Henry IV in 1603. Dorr built the octagonal-shaped spring canopy building and carved "The Sweet Waters of Acadia" on a nearby rock. Dorr had the vision for a future park with the spring area south of the Great Meadow as the central attraction. Access to the site expanded as Dorr, with the assistance of the Bar Harbor Village Improvement Association (VIA), developed trails and paths connecting the spring area to the surrounding mountains.

ACAD was initially established as Sieur de Monts National Monument in 1916 with the donation of 5,000 acres of land to the federal government by Dorr and the Hancock County Trustees for Public Preservation. However, Dorr did not include the Sieur de Monts Spring parcel and Great Meadow lands in the donation. Instead, he transferred that land to his Wild Gardens of Acadia Corporation for further development. The lands were later donated to the park in 1930. The original Abbe Museum at Sieur de Monts Spring is an inholding and was built as a trailside museum to preserve Wabanaki art, history, and culture.

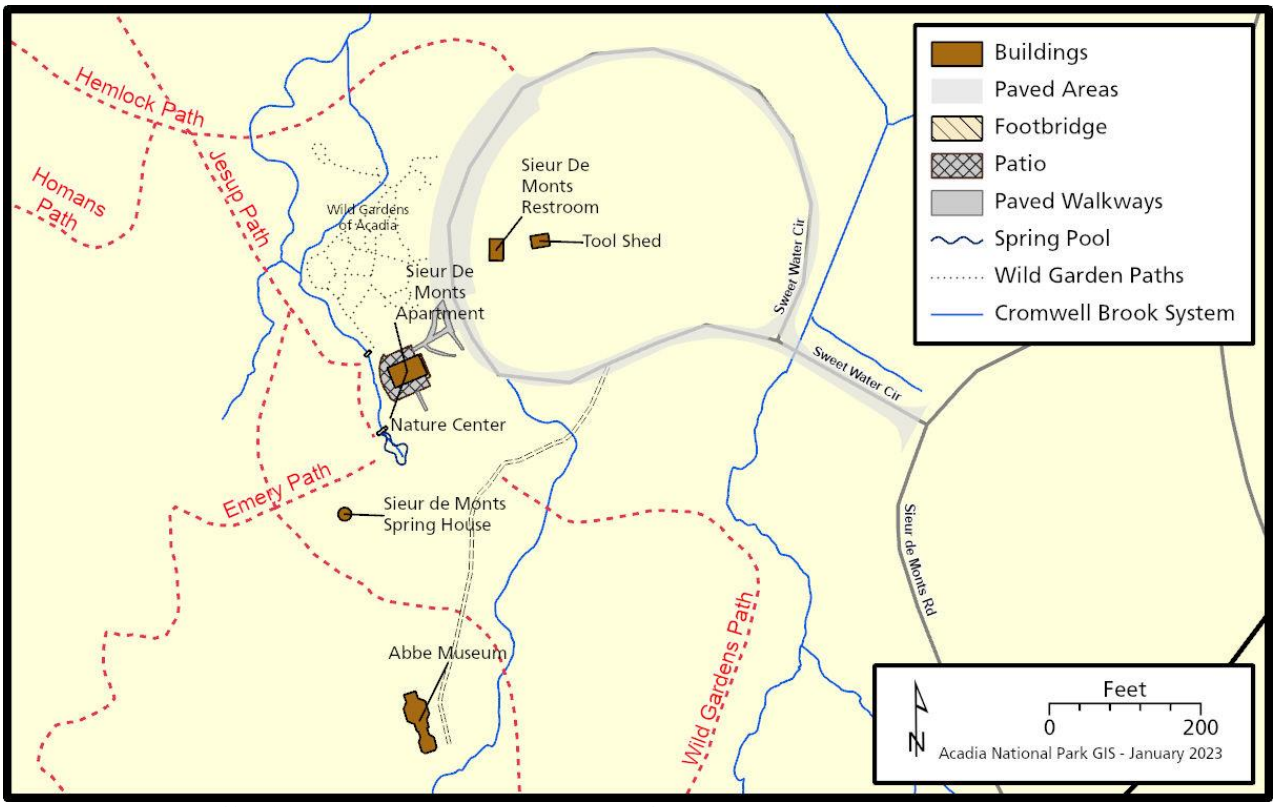

Figure 2. Layout of buildings, trails, roads, and natural features in the Sieur de Monts Spring area.

1.3.3 Development History

Many manipulations have been made to the landscape in the Great Meadow and Sieur de Monts Spring area that contribute to the current conditions. Ditches were dug in the Great Meadow to drain the wetland and keep roads and trails dry. These are extant today and continue to impact the hydrology of the wetland. Peat harvesting left large open areas, which are now populated by cattail (*Typha latifolia*) stands. There is evidence at Sieur de Monts Spring that streams were abandoned, rerouted, and straightened to accommodate infrastructure development. The area also has remnants of old roadbeds from changes to access and circulation by Dorr, the Olmstead Firm, and Civilian Conservation Corps (CCC). Both changes to the streams and construction of roadbeds continue to contribute to the altered hydrology and function of the wetland.

1.4 Impact Topics

The NPS, stakeholders, and consulting parties identified potential issues and concerns with the proposed action and no action alternatives that could impact the surrounding environment. The potential impact issues retained for detailed analysis are described in section *Impact Topics Retained* (pg.6) and analyzed in Chapter 3: Affected Environment and Environmental Consequences. Issues that do not have the potential for significant impacts are dismissed from further analysis and the rationale is given in section *Impact Topics Dismissed* (pg.7).

1.4.1 Impact Topics Retained

Four issues were identified for further analysis – wetlands, vegetation, wildlife habitat, and cultural landscapes.

1.4.1.1Wetlands

The NPS Northeast Temperate Network (NETN) began monitoring ACAD's permanent freshwater wetlands in 2011 for status and trends in vegetation, hydrology, soil, and water quality. The wetlands vital signs for the Great Meadow indicate it is in poor condition due to hydrological disturbance. Stressors impacting the hydrology of the Great Meadow were identified as trails, culverts, old roadbeds, ditches, paved and impervious surfaces, and roadways. Due to the potential impact on hydrology by management of park infrastructure within the wetland, this topic is retained for further analysis.

1.4.1.2Vegetation

The 2004 Invasive Plant Species Distribution and Abundance in Acadia National Park (Greene 2004) report noted the highest concentrations of invasive plant species in the park were in the area around Great Meadow and Sieur de Monts Spring. While management of species such as glossy buckthorn (*Frangula alnus*) is currently at a high maintenance level, human or natural disturbance within the Great Meadow and surrounding watershed may lead to increased invasive species cover. For that reason, vegetation is retained for further analysis.

1.4.1.3Wildlife Habitat

Cromwell Brook is fragmented by culverts, bridges, and a dam that were designed to allow water to pass at intersections with roads and trails but were not designed for aquatic organism passage. According to an assessment of structural barriers, the stream has a strong degree of fragmentation with several crossings that can be considered barriers to fish (Navarro 2007). Additionally, manipulations of the landscape within the Great Meadow have altered the hydrology and plant species composition, further reducing the diversity of wildlife and their habitat. Management of infrastructure within the wetland may impact wildlife habitat and its connectivity and is therefore retained for further analysis.

1.4.1.4Cultural Landscapes

Portions of ACAD's historic motor road and hiking trail system lie within the Great Meadow and Sieur de Monts Spring (Figure 13). George Dorr and the VIA constructed the Jesup Path as the main pedestrian entrance between Bar Harbor and the spring area and mountain trails. The Jesup Path, Hemlock Road and Wild Gardens Path were designed to lead walkers through botanically interesting areas in and adjacent to the Great Meadow. The Kebo Mountain Road and Kebo Mountain Road Extension segments of the Park Loop Road were developed by John D. Rockefeller Jr. in collaboration with the NPS between 1935 and 1940. These segments of the traverse

from the north to the east side of the Great Meadow and contain planned vistas of the park to be enjoyed from a vehicle. The motor road and trail systems within and adjacent to the Great Meadow are significant cultural resources, and because management of the wetland impacts these cultural landscapes, it is retained for further analysis.

1.4.2 Impact Topics Dismissed

Topics related to air quality, water quality, threatened and endangered species, and visitor access and safety were dismissed from detailed analysis because they:

- do not have environmental impacts central to the proposal or of critical importance, and/or
- do not require a detailed analysis of environmental impacts to make a reasoned choice between alternatives.

1.4.2.1Air Quality

Monitoring trends in ozone, particulates, mercury deposition, acid rain, visibility, and meteorology have shown improving air quality conditions. However, atmospheric deposition continues to be an issue at ACAD. This contributes to acidification of the park's ponds and streams and is harmful to many of the park's plants, such as the red maple (*Acer rubrum*), found within the Great Meadow.

Airborne mercury from activities such as burning coal enters the park's ecosystems in precipitation and biomagnifies in the food chain. Elevated levels of mercury have been detected in park biota, potentially leading to impairment of the reproductive and neurological systems in wildlife.

While the park cannot change the atmospheric inputs, restoring function to the Great Meadow wetland may indirectly aid in the capture of carbon and reduce the methylation of mercury. Additional factors of air quality were considered, such as vehicle idling at the Great Meadow vista and emissions by construction equipment for sitework. Restoring function to the Great Meadow wetland may have indirect benefits to air quality by aiding in the capture of carbon and reducing the methylation of mercury. Neither alternative produces a long-term impact on air quality. The issue is not central to the proposed action nor critical for the decision making about which alternative to implement and is therefore dismissed from further analysis.

1.4.2.2Water Quality

Water quality is an important measurement of wetland condition and function. Surface water samples were taken in the Great Meadow as part of the 2011 and 2016 Environmental Protection Agency National Water Condition Assessment. Evaluations of pH, conductivity, and Total Phosphorus in the Great Meadow suggest that water quality is in better condition than hydrology and vegetation (Miller 2017).

Algal blooms within the Sieur de Mont Spring spring pool were an issue in the 1990's because of high concentrations of nitrate, ammonia, and orthophosphates in surface

waters. Studies indicated that the wastewater treatment system in the center of Sweet Water Circle was the most likely source for nutrients that caused the algal blooms (Reeve, Slater, Comas 2008). In 2016, ACAD removed the septic system and installed a sewer line from the NPS restrooms to the Town of Bar Harbor Wastewater Treatment Facility. The septic site was rehabilitated by removing invasive plants and contaminated soils and creating a forested wetland resembling the surrounding environment.

New culverts and other wetland restoration efforts have the potential for short-term impacts to water quality during and immediately following construction. Over their lifetime, the new culverts would reduce runoff and sediment discharges to the wetland. Neither alternative would directly nor indirectly impact water quality within Great Meadow to a great extent. As a result, water quality is dismissed from further analysis.

1.4.2.3Threatened and Endangered Species

The U.S. Fish and Wildlife Service identified three threatened, endangered, or candidate species that have the potential to be affected by activities within the boundary of the project area. However, the Great Meadow Restoration project is not located within any critical habitats.

The project area includes habitat for the federally endangered Northern Long-eared Bat *(Myotis septentrinalis)* and candidate Tricolored Bat (*Perimyotis subflavus*), and state listed Little Brown Bat *(Myotis lucifugus)*. There has been an 86% decline in bat populations within the park since the detection of white nose syndrome in 2011-2012 (Wofford 2018). This project may affect but likely not adversely affect bat species, as cutting of trees greater than 3 inches diameter breast height (dbh) would occur outside the active season of the northern long-eared bat. Wetland restoration and hydrologic stabilization of the Great Meadow may have indirect improvements in habitat for Myotis bats.

The 8 endangered Atlantic salmon *(Salmo salar)* is an anadromous fish species migrating from the ocean to their natal rivers and streams to spawn in October and November. Atlantic salmon are not present within Cromwell Brook or within the 43 streams sampled with ACAD (Havird et al. 2011).

The monarch butterfly *(Danaus plexippus)* is a federal candidate species. During the breeding season, monarchs lay their eggs on their obligate milkweed host plant. Common milkweed *(Asclepias syriaca)* is present along select locations within the project area and is often co-located with bigleaf lupine *(Lupinus polyphylus)*, a nonnative invasive species. While the flowering lupine may provide food for the adult monarch butterfly, it is also known to outcompete native milkweed. Restoration of native plant communities would have minor impact to monarch butterfly habitat.

Timing of project activity would not affect critical habitat or breeding for the aforementioned species. Restoration efforts within the project area would have minor,

indirect impacts on Endangered Species Act listed or candidate species and their habitat. Neither alternative produces an impact of significant intensity and the topic is therefore dismissed from further analysis.

1.4.2.4Visitor Access and Safety

Sieur de Monts Spring is a hub for a variety of visitor experiences. The site provides significant trail access, ample parking, restrooms, room for tour buses, and an Island Explorer stop. Sieur de Monts Spring offers many visitor resources such as the Wild Gardens of Acadia, the Nature Center, Abbe Museum, and an open landscape utilized for park programming.

The vista along the Park Loop Road provides the first expansive view into the park from the road. At the pullout visitors stop to experience the panoramic view across the Great Meadow towards Sieur de Monts Spring and the mountains to the south and west. The action alternative formalizes parking and adds elements such as crosswalks and traffic signs to increase visitor safety at this popular location.

Adjacent to the roadway, the Great Meadow Loop provides pedestrian access to ACAD's trail system from downtown Bar Harbor. Developed as a community connector, allowing visitors to access the park without their vehicle. The trail is managed by ACAD, and crosses park, town, and private lands. The action alternative proposes changes in alignment and additions to the Great Meadow Loop to enhance accessibility and increase visitor safety. The Great Meadow Loop is not a historic trail.

The no action alternative continues current management and access of the recreational resources within Sieur de Monts Spring and Great Meadow. The action alternative proposes slight variations in alignment and treatment but does not change access to the trail system. The action alternative proposes minor changes to the Park Loop Road to increase pedestrian safety. Neither alternative changes access to recreational opportunities or visitor safety within Sieur de Monts Spring and the Great Meadow to an extent that necessitates further analysis.

Figure 3. View overlooking the Great Meadow from Homans Path on Dorr Mountain.

2 Chapter 2: Alternatives

The alternatives evaluated in this EA were developed as a result of civic engagement, internal scoping, a focused discussion with park stakeholders, and interagency consultation. The NPS carried forward two alternatives for detailed evaluation: a no-action alternative, which is a continuation of current management conditions, and an action alternative, which would satisfy the purpose and need for the project.

2.1 Alternative A – No Action

The no-action alternative would be a continuation of the existing management conditions, visitor access, and visitor use at the Great Meadow and surrounding project area. Under the no-action alternative, the existing Park Loop Road culvert at the outflow of Great Meadow would remain. No action would be taken to restore habitat connectivity or ecological function to the Great Meadow, so the existing poor-quality wetland would persist. The NPS would continue to monitor the vital signs and track trends of the wetland condition through cyclic monitoring.

ACAD staff would continue to bring heavy machinery into Great Meadow to remove debris blocking the 36-inch culvert when time and staffing allows. The Great Meadow Loop community connector trail would remain unfinished, forcing pedestrians onto the motor road to access the park. No formal visitor use infrastructure would be developed at the Great Meadow Park Loop Road Vista. Visitors wishing to stop at the Great Meadow vista would park their cars within the travel lanes of the Park Loop Road.

Figure 4. Current visitor use at Great Meadow outflow culvert at Park Loop Road.

ACAD would continue invasive plant management in the Great Meadow through a system of cyclic surveillance, early detection, and rapid response for new nonnative invasive species. ACAD's Invasive Plant Management Team would continue to manage existing populations to prevent their spread and reduce their populations to maintenance threshold levels. Mechanical and herbicide treatments would continue as the primary methods of control. Conditions within the wetland would continue to favor disturbance-tolerant native and nonnative plant species. Due to time and personnel constraints under current management, the entire project cannot be managed on a yearly basis. Percent cover of species like glossy buckthorn would continue to increase.

2.2 Alternative B – Proposed Action and NPS Preferred Alternative

The Proposed Action includes (see Figure 5 for project component locations):

- Replacing the Park Loop Road culvert at the outflow of the Great Meadow with a larger crossing that has a more natural stream design;
- Rehabilitating the Great Meadow Loop community connector trails by developing missing segments to meet accessibility standards, rerouting them to connect with the Great Meadow vista, improving wayfinding, and adding educational waysides;
- Implementing targeted restoration projects to return natural function to the 116-acre wetland;
- Restoring the Cromwell Brook stream channel and constructing a grade control weir at the transition from the Great Meadow to the stream channel to mitigate high flow flood events; and
- Expanding invasive plant management and restoration with native plantings.

2.2.1 Culvert Replacement

ACAD proposes to replace the existing 36-inch diameter concrete Park Loop Road culvert at the outflow of the Great Meadow with a 12-foot-wide box culvert constructed in the Acadia, rustic Design-style to the east of the existing culvert headwalls. The existing culvert at the Park Loop Road would be abandoned in place and buried. The project would build a new 10-foot-wide stream simulation channel using aquatic organism passage design. A restored vegetated floodplain area bounding the newly aligned channel and nature-like grade control weir upstream are included as part of the overall design and function of the new culvert (Figure 6). The proposed culvert and wetland outlet grade control would be designed to improve water retention in the Great Meadow for smaller rain events while reducing peak flood elevations from the Great Meadow from large rain events. Further east on the Park Loop Road, other historic culverts would be modified to allow water to slow down and meander as it crosses from the east side of the Park Loop Road to the Great Meadow.

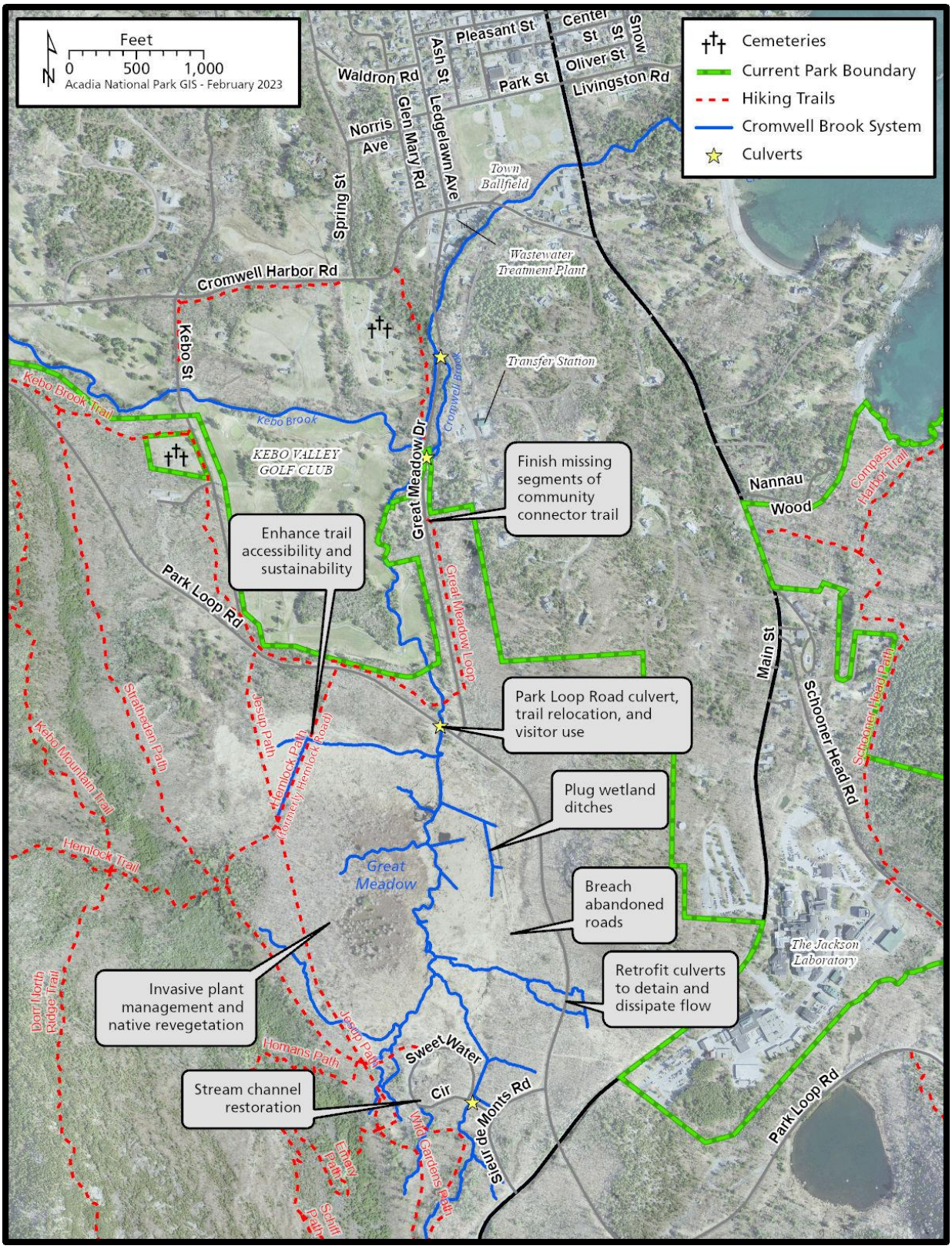

Figure 5. Map of Project Area: Project Components and Location.

Figure 6. Visualization of Great Meadow with nature-like weir, vegetated floodplain, and realigned stream channel.

2.2.2 Trail Improvements

The project proposes repairs to the tread of the Great Meadow Loop to make it accessible (2015 Architectural Barriers Act Standards, Chapter 10, Section 1017 "Trails"), while adding approximately 1,500 feet of new community connector trail. This work would provide accessible trail connections from downtown Bar Harbor to Sieur de Monts Spring and allow hikers to link to the park's extensive trail system. The Hemlock Road trail (also referred to as Hemlock Path) would be rehabilitated to reduce flooding, erosion, and sedimentation while allowing greater wetland connectivity and water flow in the Great Meadow. Enhanced wayfinding and educational waysides would be developed along the trails, which would interpret the need and purpose of the wetland rehabilitation and infrastructure adaptation project.

Great Meadow Loop Trail

- Trail Extension 1: Along Great Meadow Drive, the gravel trail would be extended from its current terminus north to the boundary of the park, keeping pedestrian use out of the vehicle travel lanes. ACAD would coordinate the trail segment

with the Town of Bar Harbor to connect with the pedestrian bridge and sidewalk at the town's Cromwell Brook bridge.

- Trail Extension 2**:** The second extension would be at the southern end of the trail from its current pedestrian crossing at Great Meadow Drive to the south with a crosswalk at the Park Loop Road. The Great Meadow Loop would then be linked to the Great Meadow vista, allowing trail access from downtown to the site. Visitors would access the vista on the developed pedestrian walkway alongside the Park Loop Road and the adjacent wetlands bordered by fence and revegetated with native plantings.
- Trail Extension 3: The missing segment of the Great Meadow Loop along Kebo Street crosses both park land and the Kebo Valley Golf Course. ACAD would consult with Kebo Valley to coordinate development of the trail connection.
- Trail Realignment: The southern segment of the Great Meadow Loop would be realigned for safe and accessible use and to connect to the Hemlock Road and Jesup Path. All locations where the Great Meadow Loop crosses a vehicle road would have crosswalks with road markings and traffic signs to enhance visitor safety.

Hemlock Road Trail

- The 18 undersized rusted metal culverts would be upgraded with box culverts with natural stream bottoms.
- Additional purges would be constructed in locations of wetland flow, small tributaries, and low areas along the trail consisting of raised wooden walkways.
- The entire 3/4 -mile trail tread would be rehabilitated to allow accessible use and connect the Great Meadow Loop to Sieur de Monts Spring

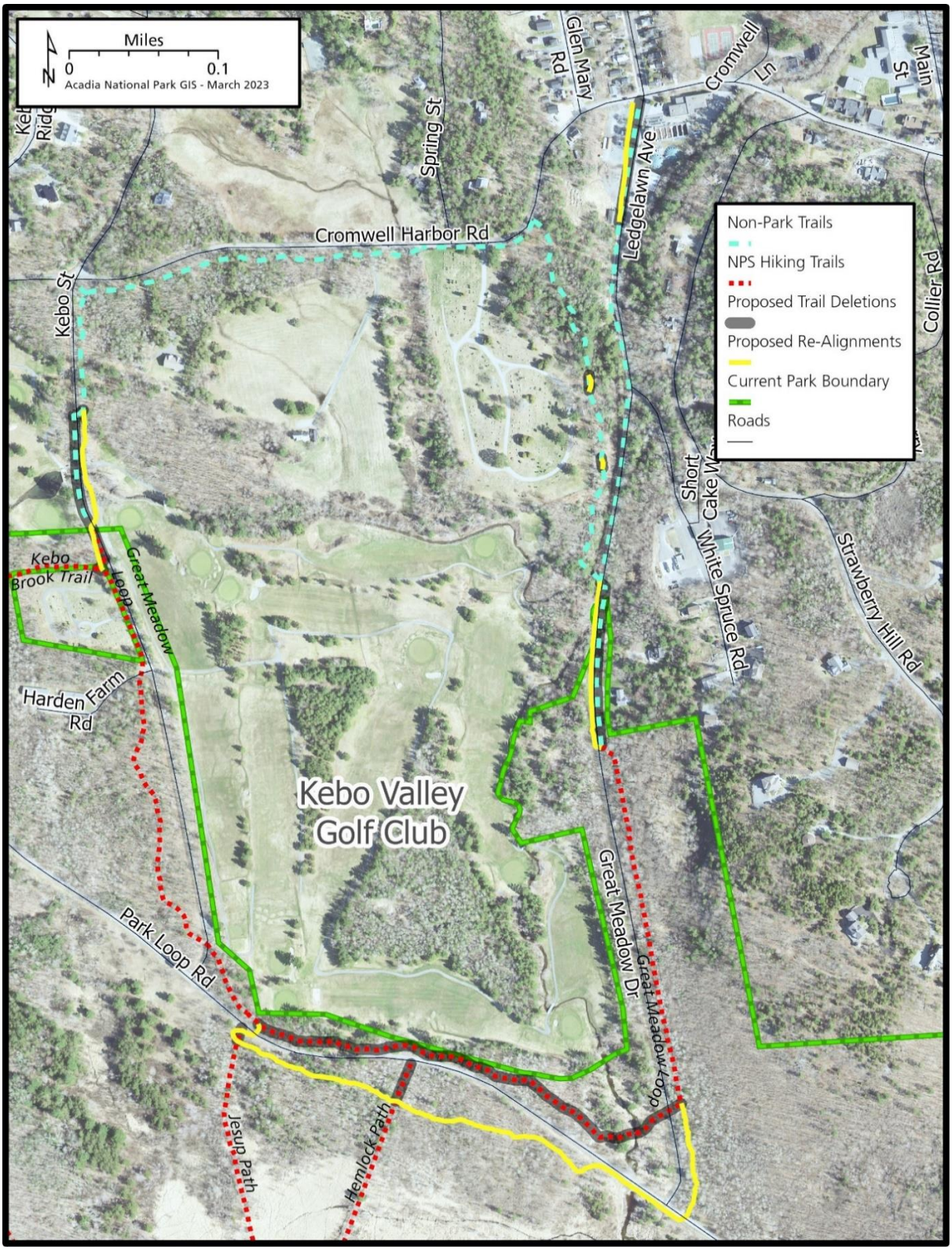

Figure 7. Aerial view of the Kebo Golf Course area, Great Meadow Loop trail, and proposed changes.

2.2.3 Wetland Rehabilitation

The proposed wetland restoration is aimed at improving hydrology and ecology throughout the Great Meadow by increasing retention of water from small rain events. To accomplish this, the project would:

- Plug legacy ditches to reduce water flow velocities and improve retention time.
- Create openings in abandoned roadbeds to dissipate concentrated runoff flows, improve sheet flow, and reduce discharge of suspended sediments. This includes placing natural bottom culverts approximately every 50 feet on the north end of the Hemlock Road and several large openings would be placed on the Gorge Path Road.
- Retrofit 12 Park Loop Road culverts on the eastern side of Great Meadow to detain, dissipate, and infiltrate stormwater runoff.
- Rehabilitate manipulated intermittent stream channels south of Sieur de Mont Spring. Currently, overground water flow is collected and directed towards an undersized stormwater system by the Nature Center. The proposed action would redirect the flow back toward the abandoned Abbe Branch tributary channel.

Figure 8. Currently abandoned Gorge Road Path and associated ditch within Great Meadow, c.1935

2.2.4 Stream Channel Restoration

The proposed culvert replacement would be concurrent with realignment of the upstream stream channel and expand the floodplain. Stream channel restoration would repair the muddy sedimented area upstream of the culvert with a hydrologically sized sinuous bankfull channel with natural stream bed materials, boulder and woody channel habitat features, and grass meadow floodplain. The corridor downstream from the

culvert includes a scour pool with eroded channel banks. It would be rehabilitated by adding more sinuosity, restoring banks, removing the old roadbed and associated wooden bridge that is currently used as part of the Great Meadow Loop, and rehabilitating the floodplain to reduce peak flooding elevations.

2.2.5 Invasive Plant Management and Native Plant Restoration

This project proposes native plant restoration as an additional method of invasive species management in Great Meadow.

- Initial Treatment: Areas of infestation within the Cromwell Brook watershed would be treated by foliar herbicide application, cut stump herbicide, and manual pulling.
- Native Plant Restoration: To suppress secondary invasion, ACAD staff would plant mature native vegetation to shade out regrowth of nonnative seedlings and restore natural diversity and function to the ecosystem. Soil cores from within the Great Meadow would be taken, and the seeds within the seedbank propagated to understand what is currently present. The composition of plant species from the soil bank would be compared to what is currently present above-ground. This information would inform what native species could be used for revegetation, and what potential future invasions of nonnative plants could occur. Plantings would be sourced from propagation of native seeds found within the seedbank collected from Great Meadow or transplanted from local sources within the park. The composition of the plantings would be based on surveys of Great Meadow and modelled after conditions in healthier wetlands such as Gilmore Meadow.
- Rehabilitation of Disturbed Sites: Localized revegetation is also proposed for areas of construction disturbance around the culvert, trails, and wetland restoration projects. Invasive species are likely already present in the seedbank and would be favored by the soil disturbance. ACAD would continue to monitor and treat those locations after project completion.
- Tribal Co-management: In addition to ACAD's and NETN's vegetation surveys and monitoring, the park would conduct an ethnobotanical survey and consult with affiliated federally recognized tribes concerning plants of cultural significance. If species of cultural value were identified, the park would collaborate with the Tribes to consider opportunities for revegetation and restoration in the Great Meadow.

2.3 Mitigations and Best Management Practices in Alternative B

The Organic Act and its associated *Management Policies 2006* task NPS with preventing impairment of park resources. This mandate gives the NPS the authority to adopt mitigation measures. The proposed action includes mitigations that will help to avoid and/or minimize adverse impacts of the project to natural and cultural resources.

Resource	Issue	Mitigation, Best Management Practice, Etc.
Cromwell Brook	Stream Crossings	• Time-of-Year Work Restrictions. Oct 1st – July 14th • Abutments 1.2 bankfull stream width. • Stream smart crossing design. • Vegetation stabilization and living shorelines. • No impounding of water. • Erosion and sediment controls. • Equipment does not operate in water.
Great Meadow Wetland	Restoration	• Avoid and minimize adverse effects to wetlands. • Use heavy equipment with low ground pressure. • Stabilize disturbed soils with native plants.
Trail System	Wetland Crossings	• Culverts minimum of 2'x3', closed bottom, embedded at least 6" to allow for natural bottom.
	Shoreland Zoning	• Erosion and sediment controls. • Work during low water with silt and turbidity control.
	Cultural Landscape	• Preserve alignment, character, and experience.
Park Loop Road	Cultural Landscape	• Culvert to match park's Rustic Design-style. • New features do not interfere with historic vista.
Northern Long-Eared Bats	Threatened and Endangered Species	• No tree cutting greater than 3 inches diameter breast height (dbh) during the active season.
Glossy Buckthorn	Nonnative Invasive Plants, Soil Disturbance	• Pre and post construction treatment. • All equipment thoroughly washed off-site.

Table 1. Resource Impact Mitigations

3 Chapter 3: Affected Environment and Environmental Impacts

3.1 Introduction

The affected environment discussion describes baseline conditions and trends for each resource topic that could be affected by implementation of the alternatives and describes other actions that may contribute to cumulative impacts on the same resources. The analysis of environmental impacts assesses the potential effects from implementing the alternatives.

3.2 Methodology for Analyzing NEPA Impacts

This EA describes both adverse and beneficial effects in terms of direct, indirect, and cumulative impacts for each resource topic carried forward. The duration of impacts is measured in short-term impacts, those that occur during implementation of the action and the first three to five years following, and long-term impacts occurring over the time it takes for ecological or landscape change which can be decades up to 100 years. Measures to mitigate adverse impacts are described and incorporated into the impact analysis. The methods used to assess impacts vary depending on the resource being considered but are generally based on a review of pertinent literature and park studies, information provided by subject matter experts from consulting agencies, and the knowledge and insight of park staff.

3.3 Areas Retained for Further Analysis

3.3.1 Wetlands

3.3.1.1Affected Environment

The 116-acre Great Meadow wetland is comprised of Graminoid Shallow Marsh centered along Cromwell Brook, surrounded by shrublands and forested wetlands (Figure 10). A deteriorated 36-inch culvert brings Cromwell Brook under the Park Loop Road but is often blocked with debris. During heavy rain events, water is impounded behind the blockage. This floods areas in the wetland upstream. Park staff routinely unblock the culvert using heavy equipment that degrades wetland soil and increases sedimentation. When this happens, large amounts of impounded water move rapidly downstream eroding and scouring streambanks. These high flow events overwhelm undersized downstream culverts, flooding Kebo Valley Golf Course and town lands.

Stressors such as culverts, roads, trails, ditches, and channelization alter the natural hydrology in and around the Great Meadow. The constant backing up and rapid draining of water through the system degrades the wetland and causes changes to vegetation and poor soil composition, as described below. The manipulation of the landscape over time has led to higher-than-normal flooding extent and duration, and lower water levels and drier conditions in periods of drought. Buffer stressors add nutrients and sediment into the wetland and accelerate overland water flow contributing to the poor hydrology.

Hydrology – Water levels in the Great Meadow do not respond naturally to rain events because of past hydrological alterations from human manipulation of the landscape. Ditching and channelization of the stream likely drains the wetland faster and reduces the water holding capacity of the wetland while the trails that bisect the wetland impede flow (Miller 2007). The combined effects of the altered hydrology result in reduced water holding capacity, extreme drawdowns during dry periods, and extended high-water during precipitation events. These extreme fluctuations of surface water level dictate that mostly disturbance-tolerant plant species are present, thus reducing the diversity of species composition in the wetland. Water level during the growing season (June-September in ACAD) is the key driver of vegetation patterns in the Great Meadow (Miller 2017).

- Graminoid Shallow Marsh: The hydrology of the graminoid marsh is dominated by the loss of surface water to the main channel after flooding (Nielsen et al. 2006). Areas adjacent to the main channel of the meadow have a greater range of water level and longer period of prolonged surface water during the growing season (Miller 2017). It comprises 38% of wetland area.
- Alder Shrubland and Sweet Gale Shrubland: These areas have periods of short-term to no surface water during the growing season. They comprise 28% of the wetland area.
- Red Maple – Hardwood Swamp: The western and southern edges are associated with a depression in the topography. Surface water inflows from ground water, precipitation, overland flow, and upstream flow are the key hydrological drivers. These sites have limited surface water during the growing season and comprise 34% of the wetland area.

Soil – Minimally disturbed wetlands are acidic and nutrient poor and promote sphagnum (*Sphagnum spp.)* development. Sphagnum, also known as peat moss, is therefore a good indicator of wetland soil condition, water quality, and hydrologic function. Great Meadow has a low percent of sphagnum cover (Miller 2017), which is an indicator of a higher concentration of inorganic soil than would be present in a pristine wetland. Inorganic soil, composed mainly of mineral matter, allows water to move more quickly through it than organic soil. According to the NETN 2011-2016 Summary Report (Miller 2017), the bryophyte cover (mosses, hornworts, and liverworts) at sites in the Great Meadow is 11.7%, when it should be closer to 80.7% as at other healthier wetland sites in ACAD.

Trends – The NETN Freshwater Wetland Monitoring protocol (Miller 2017) measures conditions and stressors in the Great Meadow along with the trends in vegetation, hydrology, soil, and water quality. The multimetric indicators show that the Great Meadow is in "Poor" condition. Stressors in the Great Meadow, both internal and external, degrade hydrology, vegetation composition, and overall function. Internal

stressors include invasive species cover, culverts, abandoned roadbeds, trails, ditches, and stream channelization. External, or "Buffer" stressors, are those that impact a wetland's quality from outside of the wetland. Examples of external stressors include maintained lawns and gardens, roadways, parking lots, and invasive species.

Aging infrastructure has led to poor function and further deterioration of the wetland. Unmitigated, this will continue to exacerbate the poor hydrology. Overall, the trend in the wetland is higher-than-normal water levels and longer duration flooding events during wet periods, and lower than normal water levels and drier soil during drought. These opposing conditions make up a "flashy" system where the water surface fluctuates rapidly and dramatically. These adverse conditions select for more disturbance tolerant invasive species and inhabit organic soil development. Climate predictions indicate more frequent and intense weather events that would lead to even more extreme water fluctuations within the system and would exacerbate the degradation of existing conditions.

Cumulative Scenario – The following reasonably foreseeable future actions would impact wetlands with the project area:

- The Maine Department of Transportation (MDOT) is utilizing a temporary bridge to cross Cromwell Brook, just north of the intersection of Ledgelawn Avenue, Great Meadow Drive, and White Spruce Road. It will be replaced with a new permanent bridge and pedestrian passage.
- The Town of Bar Harbor Public Works Department is planning to replace another Cromwell Brook crossing that is just south of Ledgelawn Avenue/Great Meadow Drive/White Spruce Road intersection and right before its confluence with Kebo Brook. This crossing at Great Meadow Drive currently consists of three culverts placed side-by-side.
- The Town of Bar Harbor will replace the culvert that brings Cromwell Brook from Kebo Valley Golf Club across to town-owned land adjacent to the transfer station. This extremely undersized culvert impounds water and causes flooding upstream. It will be replaced with a stream smart crossing. (See Figure 5 for culvert locations. Culverts are identified on the map with a star.)

3.3.1.2Impacts of Alternative A – No Action

In the no action alternative, existing conditions affecting wetland health, as described in the affected environment section, would continue. The existing 36-inch Park Loop Road culvert would continue to be periodically blocked, causing flooding. In small rain events the culvert's low elevation would continue leading to rapid draining of the Great Meadow. Internal stressors such as the abandoned roadbeds, trails, ditches, and stream channelization would have direct, adverse impacts on hydrology and the health and resiliency of the wetland.

Hydrology – Ditching and channelization of the stream, along with the low elevation of the existing outlet culvert would continue to adversely impact the water holding capacity of the wetland in small rain events. Meanwhile, abandoned roads, trails, and failing culverts obstruct flow for large rain events. The existing condition model shows a relatively flat discharge hydrograph as the undersized Park Loop Road outlet culvert restricts outflow while flood water levels in the Great Meadow rise (VHB 2022). In a 100-year storm event, water at the culvert would rise over six feet and be sustained for greater than 24 hours due to the restriction in flow (Figure 11).

Soil – Under current management of the Great Meadow wetland, soil conditions would continue to decline. Sphagnum development would continue to be inhibited. The wetland soils would continue to have high bulk density and concentrations of inorganic mineral soil with little to no peat development. With the reduced ability to hold moisture, water in wetland soils would evaporate faster in the drier and warmer growing seasons expected with future climate scenarios.

Trends – Under current management, trends in hydrology and soil conditions would continue to be poor. This flashy system of inconsistent soil saturation would inhibit sphagnum development. As an indicator of wetland function under the NETN multimetric, a lack of sphagnum development suggests that there would be decreased wetland health and function moving forward. Wetland functions such as flood mitigation would decline, further adversely impacting infrastructure within the watershed.

Given further climate predictions of more frequent and intense weather events, extreme fluctuations in water levels would have long-term, direct adverse impacts on wetland function. The inconsistent soil saturation from prolonged flooding in large storm events and fast draining in small rain events would continue to reduce species diversity in the wetland.

Cumulative Analysis – Past, present, and reasonably foreseeable actions would have a long-term beneficial impact on hydrology downstream of the Great Meadow. When combined with the more substantial long-term adverse impacts associated with current conditions, the overall impact would be long-term and adverse.

3.3.1.3Impacts of Alternative B – Action Alternative

In the action alternative, outflow from the Great Meadow would be more consistent in the long-term. The 12-foot culvert would be less likely to be blocked with debris and retain water. New right-sized culverts, breached roadways, and the addition of sinuosity to the stream channel would restore hydrology throughout the system. Focused restoration of internal stressors would have direct, long-term beneficial impacts to the function, health, and resiliency of the Great Meadow.

Once the culvert is replaced, park staff would not have to use heavy machinery to clear it and release water backed up into and upstream of the wetland. Without the pulse of water from the release of the blockage, water during normal rain events would pass from the Great Meadow through the golf course and into the town-maintained Great Meadow Drive culverts unimpeded.

The proposed nature-like weir would maintain consistent flow during most rain events. The weir would be designed to retain in periods of low water. The weir, in combination with a higher stream bed elevation of the new culvert, would match peak discharge flows downstream of the Park Loop Road comparable to existing conditions in a 2-year (3.58 inches) rain event (VHB 2022) (Figure 9).

In typical storm events, there would be no increase in the extent of flooding downstream. During a 100-year rainfall event, also known as the 1% annual exceedance probability event, the preferred alternative would only marginally increase the extent of flooding (VHB 2022) (Figure 9). This increase would be due to the excessive water coming through the 12-foot Park Loop Road culvert traveling down Cromwell Brook through the golf course, then being backed up by the existing undersized town-maintained Great Meadow Drive culvert; however, the foreseeable action of replacing the undersized town culvert would alleviate this short-term increase in flooding, reducing impacts to Kebo Valley Golf Club and shortening the length of potential flooding at Sieur de Monts.

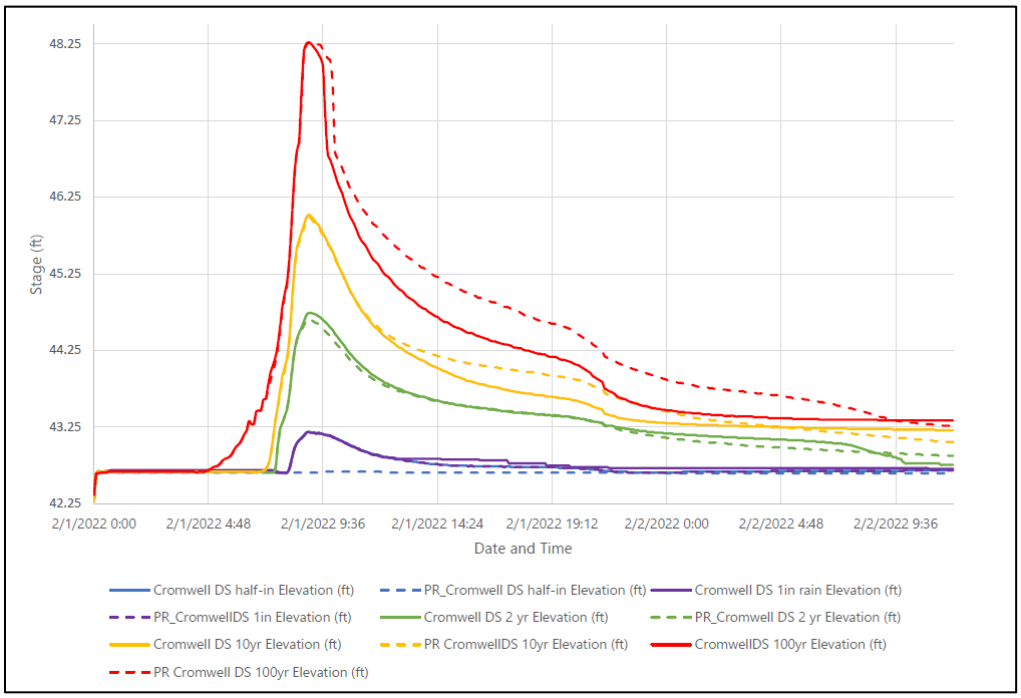

Figure 9. Modelled maximum surface water level over time at the confluence of Cromwell Brook and Kebo Brook, pre and post construction of the Great Meadow outlet culvert. Dashed lines are modelled surface water levels before project. Solid lines are modelled surface water levels after implementation of proposed project.

Hydrology – Construction of the 12-foot Great Meadow outlet and weir, along with other actions to restore the wetland hydrology, would have limited impact on total surface water elevation in each storm interval. However, the weir would retain water in more typical ½ to 1-inch (2-year or smaller) rain events within the Graminoid Shallow March (Figure 10). The larger culvert would expel water faster in larger events, reducing elevation and duration during a 10-year storm event by approximately 4 inches in a 24-hour period, and during a 100-year storm interval by upwards of 1.5 feet in a 24-hour period (Figure 11). The proposed actions would restore a more natural hydrology and have long-term benefits to the health of the Great Meadow and Cromwell Brook.

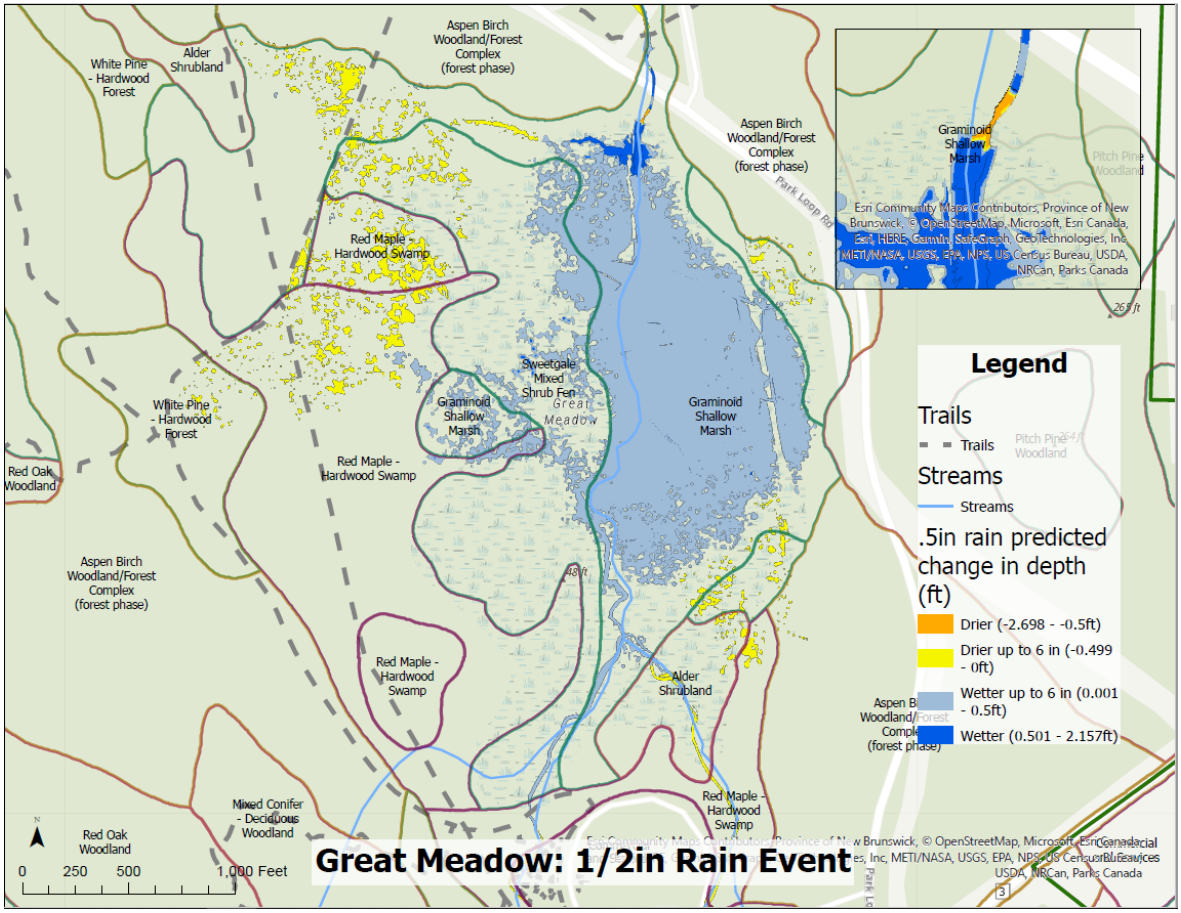

Figure 10. Projected differences in inundation levels following precipitation events between post-construction model and existing conditions.

Soil – Alternative B would result in long-term beneficial impacts through stabilized hydrology within the Great Meadow. Organic matter would accumulate in the soil and result in decreased bulk density, improved soil water holding capacity, and increased growth of sphagnum. Sphagnum acidifies the environment and retains water-limiting hydrologic fluctuation in the immediate area, further stabilizing hydrology and creating conditions for specialized plant species including insectivores (Little 2005). Stabilized

hydrology along with expansion of sphagnum cover would improve long-term wetland functions such as carbon sequestration.

Trends – Under the action alternative, right-sizing culverts and improving hydrology would help stabilize surface water level changes. Shorter floods and better soil saturation during drought would help build sphagnum over time. In such conditions, stress intolerant species such as bog plants would be able to grow, allowing for a healthier, more diverse distribution and composition of plant species. More consistent water levels would develop conditions in the long-term that would move multimetric indicators from poor to fair.

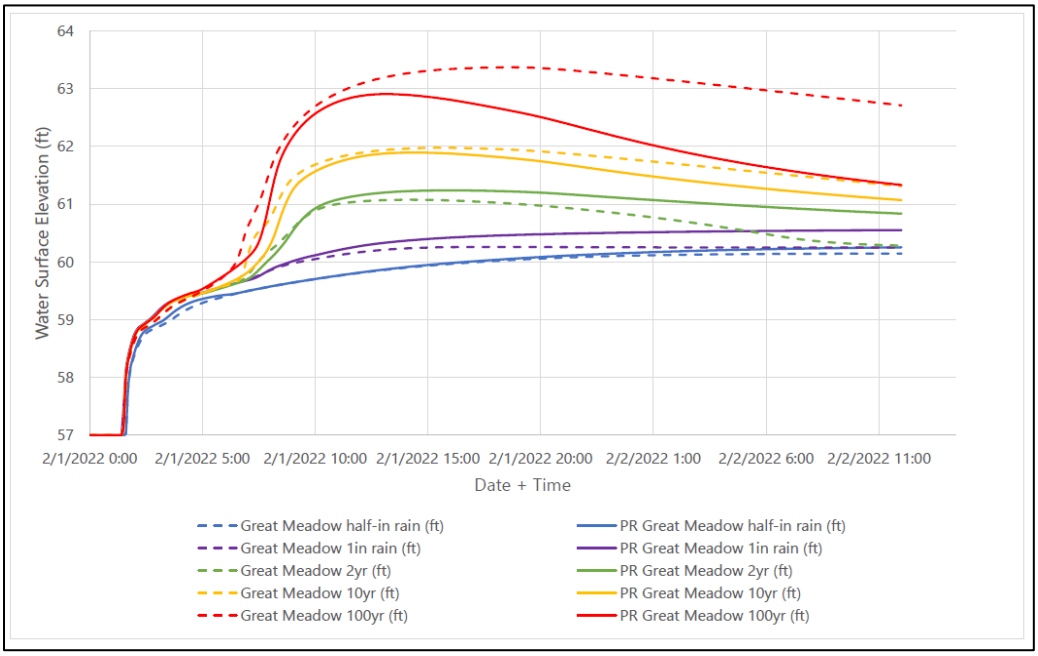

Figure 11. Great Meadow Surface Water Level Elevations Over Time, Pre and Post Culvert Replacement

Cumulative Analysis – Past, present, and reasonably foreseeable actions would have long-term beneficial impact on hydrology downstream of the Great Meadow. When combined with the beneficial impacts of Alternative B to the wetland, the cumulative impacts would be long-term and beneficial.

3.3.2 Vegetation

3.3.2.1Affected Environment

The Great Meadow and its surrounding subwatershed are dominated by disturbance-tolerant, nonnative invasive plants that outcompete native vegetation and reduce the overall species composition. All six NTEN monitoring sites within the wetland are rated as poor in the vegetation multimetric indicator, with one central site scoring 4.94 out of 100 due to the prevalence of glossy buckthorn (Miller 2017). Glossy buckthorn, a priority invasive shrub for ACAD, has many negative impacts on its surrounding environment. The shrub's density can inhibit native plants' light intake (Knight et al.

2007) and may be tied to amphibian mortality and malformation (Sacerdote & King 2014).

Management Plans for Invasive Plant Species of Acadia National Park (Webber 2007) identified nine invasive plant species within the Great Meadow and fourteen along the three quarters of a mile Ledgelawn Avenue/Great Meadow Drive corridor (Table 2). Like the Great Meadow, the Outer Ledgelawn area has an extensive history of human disturbance. Additionally, the Great Meadow Loop connector trail travels through the area, and has been identified as a possible route for dispersal of invasive plant seed from foot traffic.

Common Name	Scientific Name	Great Meadow	Outer Ledgelawn
Amur maple	*Acer ginnala*	X	
Norway maple	*Acer plananoides*		X
Garlic mustard	*Alliaria petiolate*		X
Japanese barberry	*Berberis thunbergia*	X	X
Common barberry	*Berberis vulgaris*	X	X
European bittercress	*Cardamine impatiens*		X
Oriental bittersweet	*Celastrus orbiculate*	X	X
Canada thistle	*Cirsium arvense*		X
Japanese knotweed	*Fallopia japonica*		X
Glossy buckthorn	*Frangula alnus*	X	X
Shrubby St. Johnswort	*Hypericum prolificum*	X	
Honeysuckle species	*Lonicera spp.*	X	X
Forest woodrush	*Luzula luzuloides*	X	
Ninebark	*Physocarpus opulifolius*	X	X
Black locust	*Robinia pseudoacacia*		X
Multiflora rose	*Rosa multiflora*		X
Bittersweet nightshade	*Solanum dulcamara*		X

Table 2. Invasive species sites, *Management Plans for Invasive Plant Species of Acadia National Park* (Webber 2007).

ACAD designates an Invasive Plant Management Team (IPMT) to monitor invasive species presence, develop treatment plans, and implement strategies to reduce invasive plant populations. The IPMT aims to reduce invasive plant cover in Great Meadow to benefit native plant communities. Invasive plant removal decreases competition with native plant species, allowing for improved wildlife habitat and greater pollinator diversity.

The Plant Management Program uses management status to measure the current level of effort required for invasive plant management and project the future effort required. Management status identifies high, medium, and low maintenance levels. High level is defined as 100 person hours per year, while low maintenance levels range from no treatment to 30 hours per year.

Year	Work Hours
2022	114.50
2021	145.44
2020	94.23
2019	161.35
2018	263.48
2017	275.00

Table 3. IPMT Work Hours within the Great Meadow by Year

Glossy buckthorn has shown persistence despite continued treatment over the last 7 years. In the ACAD Vegetation Program 2021 Annual Report (Wheeler 2021), surveys of the Great Meadow found thick buckthorn growth near the Jesup Path just south of the Park Loop Road (Figure 12) even though it had been treated multiple times over the previous five years. Glossy buckthorn also persisted in the Jesup Path despite treatment in 2015, 2016, and 2018. The 2021 report listed buckthorn management status as high level of effort. Looking forward, soil disturbance from construction, maintenance, hydrologic changes, and human disruption in the meadow may lead to an increase in the presence of buckthorn and other invasive species.

Cumulative Scenario – The following reasonably foreseeable future actions would impact vegetation in the project area.

- The Maine Department of Transportation (MDOT) is planning to replace the bridge of Ledgelawn Avenue that crosses Cromwell Brook.
- The Town of Bar Harbor is planning to replace the culverts along Great Meadow Drive.

3.3.2.2Impacts of Alternative A – No Action

Under Alternative A, glossy buckthorn in Great Meadow would continue to demand a significant degree of management effort. As recently observed by the IPMT, glossy buckthorn would continue to regrow from cut stumps, even after up to five years of foliar treatment (Wheeler 2021). Precent cover would also continue to increase from new shoots in existing roots systems and new sprouts from within the Great Meadow seedbank. The impact from the invasives outcompeting native vegetation would have long-term adverse impacts to the composition of the plant species and the wetlands' ability to adapt to hydrologic changes.

Known populations of invasive plants are located along Cromwell Brook north of the park boundary. Soil disturbance would encourage growth of invasive plants found within the seedbank. The reproductive seeds could then be transported via the Great Meadow Loop from outside the park to the Great Meadow. This would increase seed distribution, increase new stem growth, and increase precent coverage. The lack of management of invasive species outside the park would continue to adversely impact the natural vegetation composition of the Great Meadow. Alternative A would have short-term adverse impacts to the spread of invasives during the 2-3 years construction is occurring along Great Meadow Drive.

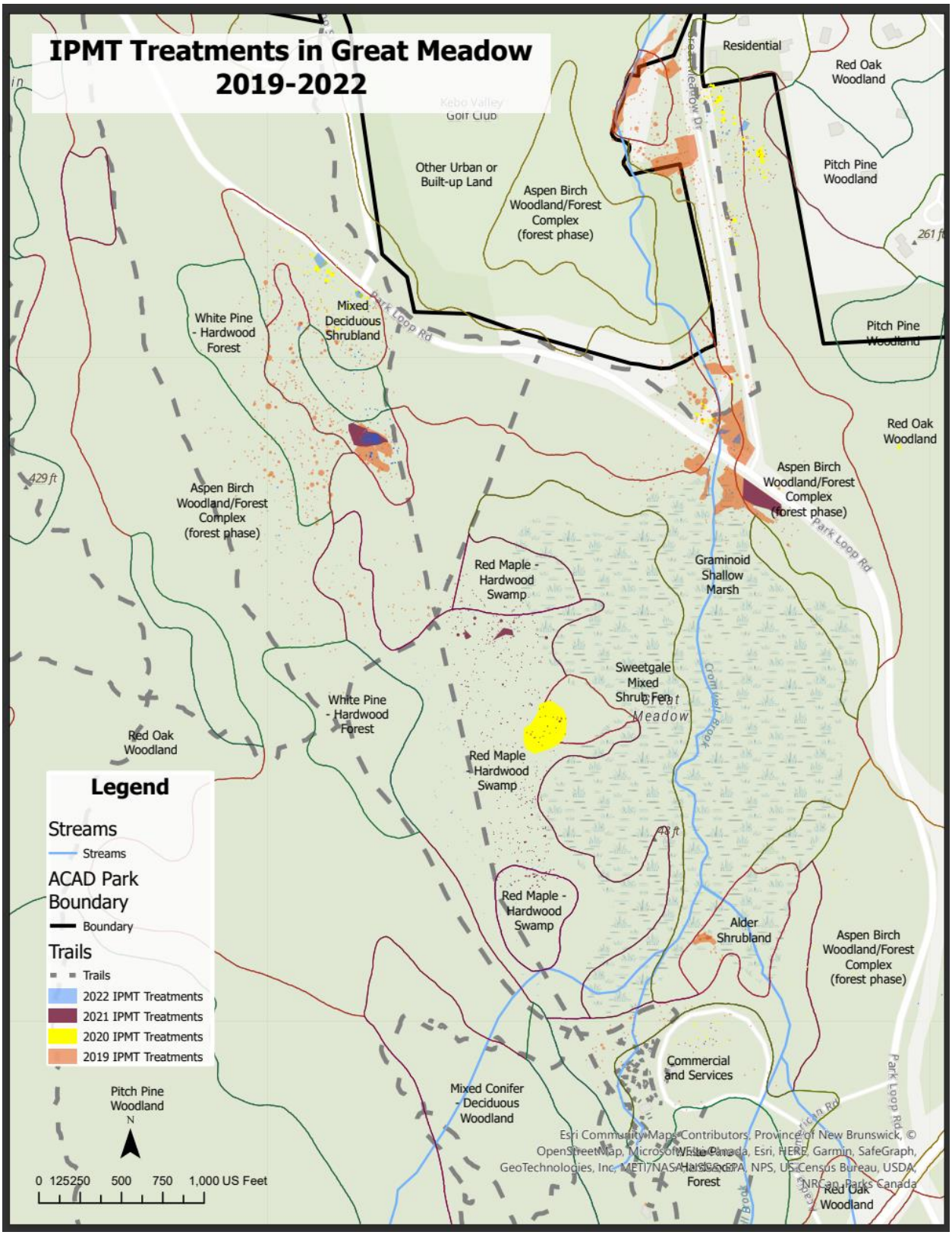

Figure 12. Great Meadow Treatment Areas 2019-2022

Trends – Under the no action alternative, the Great Meadow would continue to experience high surface water levels and flooding during high precipitation events and would experience lower surface water levels and drier conditions during drought. These continued harsh conditions and poor wetland function would directly promote the growth of more stress tolerant, nonnative invasive plant species. Soil disturbance from routine maintenance of park infrastructure would create conditions for increased spread of invasive species.

Cumulative Analysis – Impacts from past, present, and reasonably foreseeable projects would have both long-term adverse and beneficial impacts on the health of the vegetative community within Great Meadow. When these relatively small impacts are added to the beneficial impacts of invasive species management and the more severe long-term impacts of fluctuating water levels, maintenance activities in the wetland, and social trails that promote growth of invasive species over native species, the cumulative impact would be overall long-term and adverse.

3.3.2.3Impacts of Alternative B – Proposed Action and NPS Preferred Alternative

Native Plant Restoration: Under the preferred alternative, the IPMT would continue a method of mechanical and herbicide removal of invasive plant species. To suppress reinvasion of nonnative plants from seeds already in the soil, the park would revegetate treated areas with native plants. As a result, Alternative B would see a long-term reduction in new growth of invasives with low maintenance level management required by the IPMT.

The preferred alternative uses soil core data to inform which native species to use for revegetation. The long-term resiliency of the Great Meadow would benefit from having greater composition of native plants. ACAD would use adaptive management to evaluate how well initial restoration management is working and improve on them so that the wetland would retain a fair to good condition assessment.

Rehabilitation of Disturbed Sites: Implementing Alternative B would create disturbance that could encourage future invasion of nonnative species growth during construction and for the first three to five years after construction. To reduce the likelihood of invasion, the IPMT would rehabilitate disturbed soils with native vegetation propagated from local sources.

Sites in need of native plantings for restoration include social trails and trampling at the Great Meadow vista at the Park Loop Road (1,600 square feet), restored streambanks (5,200 square feet), and the weir built near the culvert (8,000 square feet). The impacted landscape at the sites following construction and use of heavy machinery, trail work from realigning the Great Meadow Loop (11,900 linear feet), and culvert installation at the Hemlock Road (3,900 linear feet) would also require locally sourced revegetation. Planting mature native vegetation in disturbed areas would have the short-term benefit of shading out new sprouts from disturbance tolerant, nonnative invasive species in the first three to five years after construction.

Tribal Co-management: The ethnological survey would identify if there were plants present that could provide cultural value to the Wabanaki. It would also identify plants for traditional use in the region that are not currently present in the Great Meadow, but could provide ethnobotanical value in the future, especially plants that might be resilient to climate change. Co-management of wetland provides long-term benefit for the composition of the vegetative communities as well as long-term benefit to indigenous people.

Trends – Alternative B addresses the trend in post treatment regeneration of glossy buckthorn by combining existing mechanical and herbicide treatment and targeted restoration of native plants. This action would slow the regrowth of invasive species within the Great Meadow and increase the composition of native plants, resulting in a long-term benefit to wetland health and resiliency.

Anticipated changes in water level following implementation of the preferred alternative may stress existing vegetation communities, allowing for invasion of nonnative species. This would be mitigated in the long-term by the more regulated water levels within the system, which would provide better conditions for sensitive native species.

Cumulative Analysis – Impacts from past, present, and reasonably foreseeable projects would have both adverse and beneficial impacts on the health of the vegetative community within Great Meadow. When these relatively small impacts are added to the substantial benefits related to the implementation of Alternative B, the cumulative impact would be long-term and beneficial for promoting native plant species and decreasing nonnative invasive plant populations.

3.3.3 Wildlife Habitat

3.3.3.1Affected Environment

Cromwell Brook is one of the richest and most diverse streams in ACAD because it contains several habitats, from cold water springs and warmwater impoundments, to its outflow into the saltwater of Cromwell Cove. The Great Meadow wetland also contains a broad range of habitats required for different life stages of wildlife. However, roads, trails, and increasing vehicle traffic all lead to mortality as herptiles move between breeding and foraging habitats (Brotherton 2005). Additionally, the Great Meadow's outlet culvert is not designed for aquatic species passage and impedes fish migration.

According to studies of Cromwell Brook, spring peeper *(Pseudacris crucifer),* wood frog *(Lithobate sylvatica),* American toad *(Anaxyrus americanus),* spotted salamander *(Ambystoma maculatum),* and four-toed salamanders *(Hemidactylium scutatum)* all move from wetland habitats following the breeding season, foraging and hibernating in the uplands (Brotherton 2005). While wetland protection is critical to their survival, the complex habitat needs of these species make protection from vehicle mortality similarly important. When flooding of the Great Meadow impedes wildlife passage following intense rain events, amphibian movement is often redirected above ground and across the Park Loop Road.

Cromwell Brook is also an important passage for brook trout *(Salvelinus fontinalis)*. Brook trout presence was documented as early as the 1920's in the Tarn (Batchelder 1927) and at the southern edge of the Great Meadow in the 1940's (Fiske 2012). However, human-made features on the landscape have changed the habitat over time by slowing water and causing the stream bottom to silt over, become shallow, and grow vegetation. Slower water movement through culverts has also caused much of the stream to become too warm for a viable brook trout habitat (Connery 1998, Fiske 2012). Despite this, the cold-water springs found in Sieur de Monts Spring act as a refuge for the remaining population.

According to *Restoration of Stream Integrity: Assessment of Potential Structural Barriers to Passage of Aquatic Organisms in Mount Desert Island Streams* (Navarro 2007), the culverts along Cromwell Brook hinder the connectivity of the stream from the wetland at Great Meadow to its mouth at Cromwell Harbor and are considered a permanent barrier to aquatic organism passage.

Great Meadow and Cromwell Brook have supported numerous active beaver dams and lodges for decades (Connery 1998). A 2018 survey of beaver presence showed that inactive structures abandoned for over 10 years were still present and impacting landscape (Long 2018). The arrangement of active and inactive beaver sites creates heterogeneity in the landscape and provides habitat for a diversity of species and connectivity, especially important for amphibians (Cunningham 2006). Other mammals using riparian corridors along Cromwell Brook include river otter (*Lontra canadensis*) and mink *(Neovison vison)*.

Trends – Vehicle traffic is often cited as a significant contributor to amphibian and reptile mortality where populations are traveling across fragmented habitat (Fahrig et al. 1995; Gibbs & Shriver 2002). In Acadia, spotted salamanders and four-toed salamanders were found crossing the Park Loop Road at Great Meadow in April and May (Petranka 1998). In 2011 those months saw 191,027 recreational visits to ACAD, and in 2021 it more than doubled to 434,750. Increased visitation, specifically in the shoulder seasons when these species are migrating between habitats, is likely having an increasing impact on the population.

Cumulative Scenario – The following reasonably foreseeable future action would impact wildlife habitat in the project area:

- The Town of Bar Harbor is planning on replacing the two Cromwell Brook culvert crossings along Great Meadow Drive.

3.3.3.2Impacts of Alternative A – No Action

Under the no action alternative, the blockage of the culvert at the Park Loop Road would continue to impede animal movement along Cromwell Brook. This habitant fragmentation would adversely impact long-term wildlife passage and population health. Accumulated vegetation, sediment, and ice blockage would continue to obstruct

routes for fin fish traveling through the culvert. The flooding caused by the culvert would completely submerge the pipe, removing passage routes for other animals (Figure 14). Herptiles such as salamanders, toads, and turtles, as well as semi-aquatic species such as otter and mink, would all be limited to above ground passage across the Park Loop Road, leading to mortality.

Trends – Under the no action alternative the Park Loop Road culvert would continue to impede or block animal migration. Prolonged flooding would occur following intense rain events, while the low elevation of the culvert would cause rapid draining during drought. The frequent and swift fluctuation of water level and conditions would impact the survivability and success of wildlife accessing breeding and forage habitats. When considering predicted climate change trends, the no action alternative would see further indirect impacts. Increased intensity and frequency of flood and drought would cause frequent flooding and/or dewatering. Dry spells, warmer temperatures, and freezing would erode soils, and redeposit vegetation into the undersized culvert at the outlet.

The Park Loop Road would continue to be a barrier to wildlife. The park would continue to see increased visitation in the shoulder seasons increasing vehicular traffic on the Park Loop Road and causing higher risk of mortality to migrating animals. Long term, amphibian populations could continue to decline in ACAD (Brotherton 2007).

Cumulative Analysis – Past, present, and reasonably foreseeable actions would have a beneficial impact on aquatic organism passage downstream of the Great Meadow. When added to the long-term adverse impact of the no action alternative, which is expected to worsen over time, the cumulative impact of the no action alternative would be long-term and adverse for habitat connectivity and aquatic organism passage in Cromwell Brook.

3.3.3.3Impacts of Alternative B – Proposed Action

Under the preferred alternative, the culvert replacement at the Park Loop Road would have a long-term beneficial impact on habitat fragmentation in Cromwell Brook. Improved flow would allow for better migration of Brook Trout and other fin fish. Elevated 2-foot interior channel banks along the proposed 60-foot box culvert would allow for herptiles and small animal passage, likely lowering the use of the Park Loop Road as a route for passage when breeding and foraging. These factors would likely offer long-term beneficial impact on overall population health of wetland species.

The introduction of a nature like weir and restored stream channel would likely promote beaver activity in the Great Meadow for dam building. The increased beaver presence at the project site would have short-term adverse impact. Long-term, the impact of beavers on the landscape would reflect natural conditions, contributing to predictability and stabilization of water levels in the Great Meadow.

Trends – The changes made in the preferred alternative would allow for a more stable environment suitable for healthy wildlife populations. Water level fluctuations would be less extreme, with shorter flooding periods and better water retention during drought. Wetland animal species would experience increased success and survivability during breeding seasons.

Cumulative Analysis – Past, present, and reasonably foreseeable actions would have a beneficial impact on fish passage downstream of the Great Meadow and wildlife passage between wetland habitats when breeding and foraging. When added to the impacts of the preferred alternative, the cumulative impact would be long-term and beneficial.

3.3.4 Cultural Landscape

3.3.4.1Affected Environment

Sieur de Monts Spring – The Sieur de Monts Spring cultural landscape is a developed area at ACAD and is listed as locally significant in the National Register of Historic Places for its association with George B. Dorr and the early establishment of the park. Dorr acquired the property in 1909 and built the spring canopy and spring pool set in an open glade within the surrounding forests and mountains. Dorr and the Bar Harbor VIA developed the area with picnic grounds, paths, trails, roads, and later a spring building and other small structures. The Wild Gardens of Acadia is within the Sieur de Monts Spring cultural landscape boundary but is not a historic resource or a contributing factor to the landscape. Due to intense flooding, the visitor-use infrastructure and formal landscaping associated with Sieur de Monts Spring is repeatedly impacted, requiring ongoing maintenance.

Several historic buildings are located within the boundaries of the Sieur de Monts Spring cultural landscape. The spring building (Nature Center), restroom, and spring canopy are all considered contributing features to the cultural landscape. Recent and repeated flooding has damaged both the exterior and interior of these structures. Prolonged flooding during the winter months turns to ice that prevents access to the structures leaving them unattended for long periods of time posing further risk to the structures and their mechanical systems.

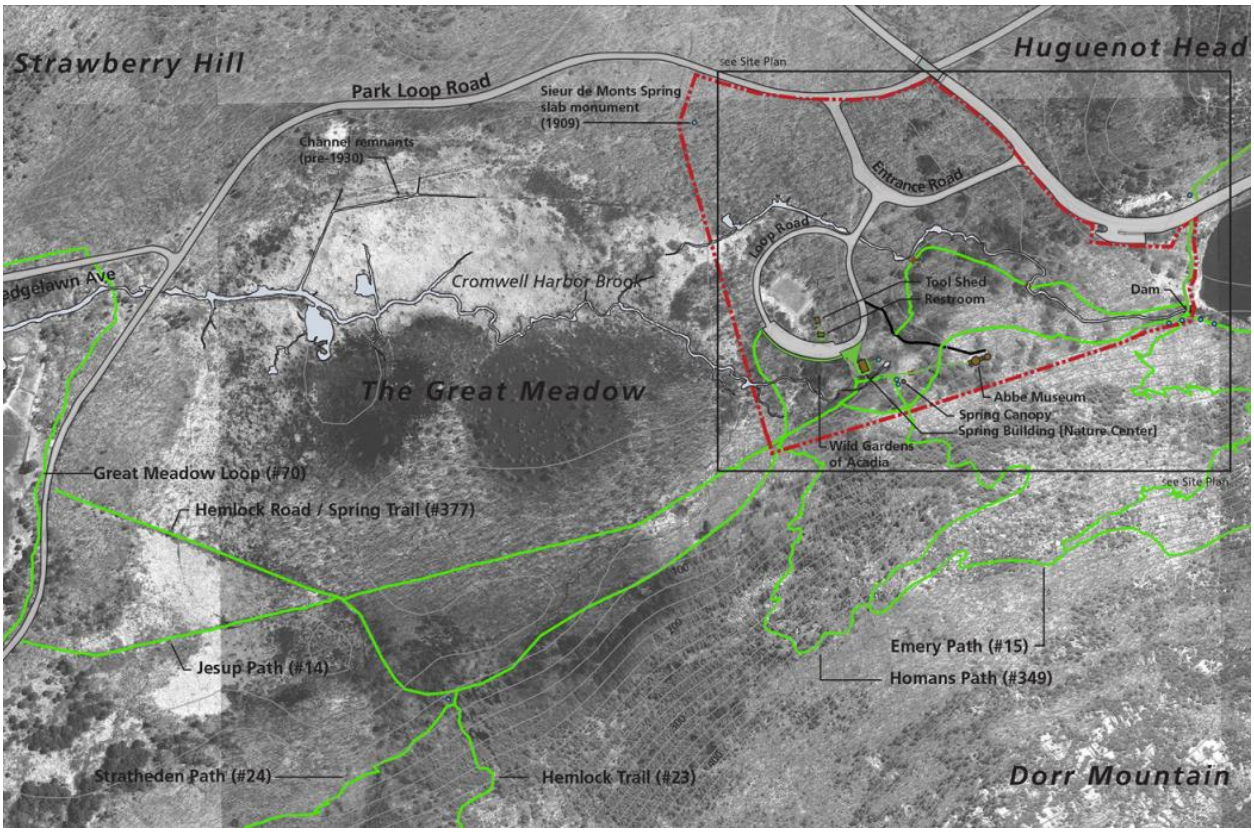

Figure 13. Map showing the boundary of the Sieur de Monts Spring cultural landscape and the surrounding landscape which includes historic hiking trails and the Park Loop Road. Cultural Landscape Inventory, 2009.

Park Loop Road – The historic motor road system is listed as nationally significant in the National Register of Historic Places for its design and construction style and for its association with John D. Rockefeller, Jr. and his contributions to conservation and philanthropy at Acadia National Park. A vista at the outlet of the Great Meadow was historically designed to be part of the motor road driving experience and provides a view southwest across the Great Meadow and towards Champlain and Dorr mountains (Foulds & Killion 2015). This vista is a contributing feature to the historic motor road. Over the years, an informal parking area has developed from visitors pulling off the road. This has increased the number of people stopping to enjoy the vista.

The existing 36-inch culvert and dry laid stone headwalls are also contributing features of the Park Loop Road. The outlet headwall has been frequently damaged from repeated clearing of debris (Figure 14). The park drives heavy machinery below the road shoulder to remove the debris, and by doing so the machinery leaves vehicle track marks in the soft soil. These repeated trips have left permanent depressions in the landscape, damaged vegetation, and distract from the vista of the meadow.

Hiking Trails – Acadia's hiking trail system is listed as nationally significant in the National Register of Historic Places for its association with early recreation,

development, and conservation of Acadia National Park and for its design and construction. Key characteristics for the trails include the route, alignment, destination, and use. The alignment of the Hemlock Road, also historically called the Spring Road, follows the west side of the Great Meadow from Sieur de Monts Spring to the Park Loop Road. The road contains steel corrugated pipe culverts without headwalls and intersects the Jesup Path moving on the west side of the Great Meadow. The Jesup Path's designed alignment traverses a low and flat contour along the landscape (Barter 2006), bisecting the Great Meadow wetland. Dorr envisioned the Jesup Path as a gateway to the park from Bar Harbor, and a "garden path" where pedestrians passed through areas of botanical interest (Brown 2006).

These gravel tread trails lie within the wetland and are impacted from repeated flooding. Flood water that flows over the top of the trails erodes gravel and fine sediments of the treadway. They also erode the shoulder of the trail, further damaging the structural integrity of the causeway they form. Water that pools on the trail surface softens the structure, allowing for foot traffic to further deteriorate the trail. Flooded trails also lead to the creation of side trails that impact sensitive vegetative communities in the Great Meadow.

Kebo Valley Golf Club – Sharing its southern boundary with ACAD, Kebo Valley Golf Course was initially established in 1888 as Kebo Valley Golf Club. The golf course is not affiliated with ACAD but is considered eligible for the National Register under Entertainment/Recreation areas of significance for its association with Bar Harbor's social and recreational history and for its relatively well-preserved links course layout. Kebo Valley Golf Course is the oldest golf course in Maine and the eighth oldest in the country.

The streams passing through and around the Kebo Valley Golf Course experience flooding due to the culvert failures upstream in the Great Meadow and downstream in the town of Bar Harbor (see Figure 5 for culvert locations). Undersized culverts in town flood the Cromwell Brook stream up to and within the Kebo Golf Course during intense rainfall and weather events. When blockage at the Great Meadow culvert is cleared, the released water either contributes to the flooding at the golf course or creates new flooding once the new water hits the undersized culverts in Bar Harbor.

Trends – According to the U.S. Geological Survey hydrologic and hydraulic study of the Great Meadow (Lombard 2017), the Park Loop Road culvert at the outflow of the wetland exacerbates flooding from large storm events with recurrence intervals of 10 years or greater. These storms have become more frequent, leading to increased damage to the cultural landscapes found within the Cromwell Brook watershed. These storms are expected to increase in number and intensity as a result of ongoing climate change. The Park Loop Road drainage system has also been overwhelmed by the amount of water associated with repeated large rain events. Increased precipitation has

caused damage to headwalls, culverts, and road surfaces, a trend that is expected to continue.

The culturally significant landscapes in ACAD have seen double the visitor use in the past decade, impacting their condition. According to statistics compiled by the NPS, the number of recreational visitors to ACAD in 2011 was 2,374,645 and in 2021 was 4,069,098. Increased visitation and increased precipitation associated with climate change has exacerbated erosion from unmanaged runoff and visitor side-trailing to avoid wet tread surfaces.

Traffic counter information collected by the NPS along the Park Loop Road shows that the total number of vehicles using the historic motor road system has increased from 267,797 in 2011 to 468,632 in 2021. The increased use can be seen throughout the system by the expansion of unofficial parking areas throughout the system, such as those located at the Great Meadow vista location.

The Great Meadow Vista has seen increased use leading to degradation from social trails that impact the wetland, harm sensitive vegetation, compact soils, increase erosion, and detract from the historic view. This is exacerbated by increased precipitation associated with climate change that has caused visitors to use social trails to avoid flooded and eroded surfaces.

Cumulative Scenario – The following reasonably foreseeable future actions would impact cultural landscapes in the project area:

- ACAD will be milling and repaving the Park Loop Road from the beginning of the one-way near Cadillac Mountain, to the entrance station near Sand Beach. This project is expected to be done in the next 2-3 years. This includes the sections adjacent to Great Meadow and Sieur de Monts Spring. Work along the five-mile stretch will include replacing select culverts, repairing drainage ditches, and restoring road shoulder grades.
- ACAD is planning for a new wastewater treatment system at the Harden Farm housing parcel. One alternative being considered is running a sewer line from the property, down the shoulder of the Park Loop Road, and connecting with the existing system from Sieur de Monts Spring. This connection would be made at the intersection of the loop road and Great Meadow Drive. To connect, the new line would need to cross the culvert at Cromwell Brook.
- Downstream culvert and bridge work (described in section 3.1.1 of this EA) to be implemented by the town to alleviate water backup at undersized culverts.

3.3.4.2Impacts of Alternative A – No Action

Under the no action alternative, flooding of Sieur de Monts Spring, the Park Loop Road, and hiking trails cultural landscapes would continue, as the undersized concrete pipe culvert at the Park Loop Road continues to be blocked (Figure 14). The intensified

stream and wetland flooding at the culvert site would threaten to erode the Park Loop Road and damage the historic landscape features and buildings upstream at the Sieur de Monts Spring area. Flooding would further damage the headwall at the culvert site and undermine the shoulder of the Park Loop Road, threatening the long-term sustainability of the roadway.

Figure 14: Damaged culvert site at the outlet of the Great Meadow.

Sieur de Mont Spring – The no action alternative would see periodic flooding in Sieur de Monts Spring from blocked, undersized culvert at the outlet of the meadow (Figure 14). Overland flow from south of the site would continue to flood historic structures including the Nature Center, Spring Canopy, restrooms, parking lot, hiking trails, and formal plantings. For reference, ACAD spent approximately $200,000 in 2020 adapting visitor infrastructure in the Sieur de Monts Spring to accommodate the increase in flooding, and similar maintenance would be repeated in the no action alternative. The continued flooding of the no action alternative would have long-term adverse impact on the cultural resources at Sieur de Monts Spring.

Park Loop Road – Under the no action alternative, frequent repairs at the culvert site and Park Loop Road would continue. In 2021 alone, ACAD budgeted $150,000 for culvert maintenance and road shoulder repairs. The debris clearing activities in response to flooding would continue damaging the headwall, culvert, and road. The required equipment would leave permanent depressions in the landscape and damage vegetation, while debris and unsightly materials would impact the recreational use of the vista. This repeated use of heavy machinery at the culvert site for maintenance would have long-term adverse impact to the natural resources surrounding the site, degrading the cultural landscape. Informal visitation to the site would have similar long-term adverse impacts, damaging vegetation through use of social trails and trampling landscape within the intended view of the Great Meadow.

Hiking Trails – The trail conditions of Hemlock Road, Jesup Path, and Great Meadow Loop would see long-term adverse impacts under the no action alternative. The NPS spent $650,000 at ACAD conducting emergency repairs to trails, including the Jesup Path, from flooded and washed trails due to one intense storm. As climate change predictions suggest increased storm intensity and frequency (Fernandez et al. 2020), flooding and further erosion of tread material would worsen under the no action alternative. At the north end of Hemlock Road, an existing spillway allows water to flow over and under the trail and would continue to contribute to the damage to the tread (Figure 15).

Kebo Valley Golf Club – The no action alternative would have a short-term adverse impact on the Kebo Valley Golf Club. Water would continue to back up from the town-maintained culverts in Bar Harbor and onto the golf course impacting the 8th and 9th hole. Water released from the Great Meadow culvert when blockages are cleared would contribute to flooding at the golf course. This condition would continue until the foreseeable action of the town replacing the undersized culverts alleviate the flooding.

Figure 15: NPS clearing Park Loop Road culvert at the outflow of Great Meadow, 1996.

Figure 16: The spillway section of The Hemlock Road is submerged under water during a precipitation event.

Trends – The combined impacts of increased flooding and high visitor use of the historic trail system will have long-term adverse impact to trails. Trails would see increased erosion. Visitor-created parking areas and social trails would continue to develop along the Park Loop Road, further adversely impacting the intended design of the Great Meadow vista. Flooding at Sieur de Monts Spring and downstream at Kebo Valley would also expect to increase in intensity and duration as storms increase. ACAD would have to spend more time and money on restoration of these culturally significant features.

Cumulative Analysis – The past, present, and reasonably foreseeable actions affecting cultural landscapes would have a long-term beneficial impact on cultural landscapes. The no action alternative would add a substantial, long-term adverse impact on the landscapes that would increase as time goes on due to projected increased storm events. When the impacts of the no action alternative are added to the cumulative actions, the effect would be long-term and adverse.

3.3.4.3Impacts of Alternative B - Action Alternative

Under the action alternative the duration and impacts of flooding from large rain events would decrease at Sieur de Monts. Additionally, restoring the small tributary stream and removing overland flow south of Sieur de Monts from the developed area would reduce flooding to historic structures in smaller rain events. These actions would have long-term benefit to protecting these historic sites.

Sieur de Monts Spring – Under alternative B, overland flow captured in the Abbe Branch Stream (a tributary to Cromwell Brook) would be moved away from the Nature Center and be relocated to its natural course. Changing the drainage would have long-term benefits by reducing flooding of the Nature Center in smaller rain events. Additionally, replacing the outlet culvert would reduce the extent and duration of flooding in large rain events at the entire Sieur de Monts Spring cultural landscape, resulting in long-term benefits for preservation of existing features.

Park Loop Road – In the preferred alternative, replacing the historic Park Loop Road culvert with a 12-foot box culvert would not adversely affect contributing features to the motor road system cultural landscape because the existing culvert would remain, although non-functional, and the new culvert would be designed in a compatible style. The new culvert would have long-term benefit to protecting the structure and historic use of the Park Loop Road. Modifications to historic culverts farther east on the Park Loop Road would be below the shoulder of the road, not visible, and would have negligible impact on the historic integrity of the road.

The new visitor access pathway introduced next to the Park Loop Road and vista site would allow for visitor appreciation of the wetland from a sustainable surface and allow for the closure of social paths into the wetland. Additions of signage and crosswalks along the Park Loop Road at the project site would not adversely impact the cultural landscape because these types of signs are expected along the road.

Upstream of the Park Loop Road culvert, the design of the nature-like weir would allow for the stream to meander while holding back water in low flow conditions. The weir would be designed to blend seamlessly into the landscape over the long-term and, due to its natural design, would be unlikely to distract visitors from the overall vista in the short term while vegetation is being established.

Hiking Trails – Replacing the culverts on the southern half of the Hemlock Road would preserve the original alignment and tread surface of the road while improving hydrology of the area. The preferred alternative would have overall long-term beneficial impacts due to a reduction in flooding and erosion of the trail tread.

Adding box culverts with wood decking to the Hemlock Trail to increase water connectivity would preserve the historic alignment and the visitor experience. Proposed changes to the tread and purge treatments would improve long-term sustainability of the trail, designed and maintained so as to not impact the location, setting, feeling, and association of the trail. Long-term adverse impacts to the trail materials and workmanship would be offset by the beneficial impacts from a reduction in flooding and erosion of the trail tread.

Kebo Valley Golf Club – The preferred alternative has potential for short-term adverse impacts on the golf course during high rain events because water flow would increase, but the water flow would be steadier than the sudden releases that happen under the no action alternative. In the long term, flooding would be expected to decrease when downstream town-maintained culverts are undersized, and increase flooding up Cromwell Brook into Kebo Golf course are enlarged.

Trends – Because the new culverts would be designed with climate change in mind, impacts to historic structures from large rain events would decrease. Erosion of tread along the Hemlock Road, Jesup Path, and Great Meadow Loop would decrease, mitigating increased visitation impacts and providing for the maintenance of these trails in accordance with accessibility standards. Formalized visitor use features at the Park Loop Road vista site would minimize the adverse effects of social trails and expanded parking.

Cumulative Analysis – The past, present, and reasonably foreseeable actions affecting cultural landscapes would have a long-term beneficial impact on cultural landscapes. The preferred alternative would add substantially to this long-term beneficial impact through the reduction of flooding events, more even flow of water out of the system, and reduction in resource damage due to a combination of maintenance and social trailing activities. The preferred alternative would add some adverse impacts to Kebo Valley Gold Club that would be reversed by reasonably foreseeable actions to be taken by the town within 2-3 years. When the impacts of the action alternative are added to the cumulative actions, the effect would be long-term and beneficial.

4 Chapter 4: Consultation and Coordination

This section summarizes the agency consultation and coordination, and public involvement that occurred during the preparation of this environmental assessment.

Law, Statute, or Authority	Regulated Resource	Agency
Section 401 and 404 of the Clean Water Act, EO 11190 and EO 11198	Freshwater wetlands and streams	U.S. Army Corps of Engineers
Section 7 of the Endangered Species Act	Federally listed threated and endangered species	U.S. Fish and Wildlife Service
Section 106 of the National Historic Preservation Act	Cultural resources	Maine Historic Preservation Office
Coastal Zone Management Act	Freshwater wetlands and streams	Maine Coastal Program and Maine Department of Environmental Protection

Table 4. Agency Consultation and Coordination

The following partners, stakeholders, and agencies were contacted to participate in scoping of the project:

- Friends of Acadia
- Schoodic Institute
- Kebo Valley Golf Club
- Town of Bar Harbor
- Penobscot Nation
- Passamaquaddy Tribe at Indian Township and Sipayik
- Houlton Band of Maliseet
- Aroostook Band of Micmacs

ACAD held a public scoping meeting on November 16, 2022, at the YWCA of Mount Desert Island, in the town of Bar Harbor. Public comments on the proposed Great Meadow Restoration were collected from November 11, 2022, through December 10, 2022.

5 Chapter 5: References

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