Chapter 3 Planning

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Considering climate change in park planning and management is required (Secretarial Order 3289; Executive Order 13653). Planning for climate change is especially important for coastal parks because sea level rise and increased flooding risks are likely to present tradeoffs between park resources and assets. Without planning and prioritization, responses will be reactive and potentially maladaptive. For example, "Chapter 9 Lessons Learned from Hurricane Sandy" describes potential barriers to adaptation such as the pressure to rebuild facilities and reopen storm-damaged areas quickly, instead of taking the additional time and funding to design new sustainable infrastructure, which may also entail considering more optimal locations. Advance planning can improve post-storm responses, such as anticipating and allowing a natural breach in a wilderness area to remain open (see other examples in "Chapter 9 Lessons Learned from Hurricane Sandy").

Some links in this chapter refer to internally available NPS documents. Externally available resources can be accessed at https://www.nps.gov/subjects/climatechange/coastalhandbook.htm.

Planning Framework

The new National Park Service (NPS) planning framework (figure 3.1) accommodates the flexibility needed for adaptive park planning and management within the context of a changing climate.

This planning framework introduces the concept of a dynamic park planning portfolio, which is the assemblage of the individual plans, studies, and inventories needed to guide park decision-making. The portfolio can be visualized as a loose-leaf binder, in which particular planning elements can be removed and updated, and new elements added, without revising the entire body of work. This flexibility is well suited to the needs of climate change adaptation as a rapidly evolving field with a growing list of processes and frameworks.

Foundation Document

The NPS planning framework begins with the Foundation Document (figure 3.1), identifying the park purpose, significance, and fundamental resources and values a park is committed to preserving and maintaining based on park legislation. The document includes an assessment and prioritization of park planning and data needs to provide direction for developing the overall park planning portfolio that guides park, regional, and national planning and information priorities. Over time, continued monitoring of the effectiveness of management decisions and incorporation of new information (e.g., new climate change projections, ecological responses) feeds back into the assessment and prioritization of park planning and/or data needs, informing adjustments in the park planning portfolio, as needed. Foundation documents have acknowledged climate change as a threat to important resources and values, a data need, and as a planning need (for example, see NPS 2012).

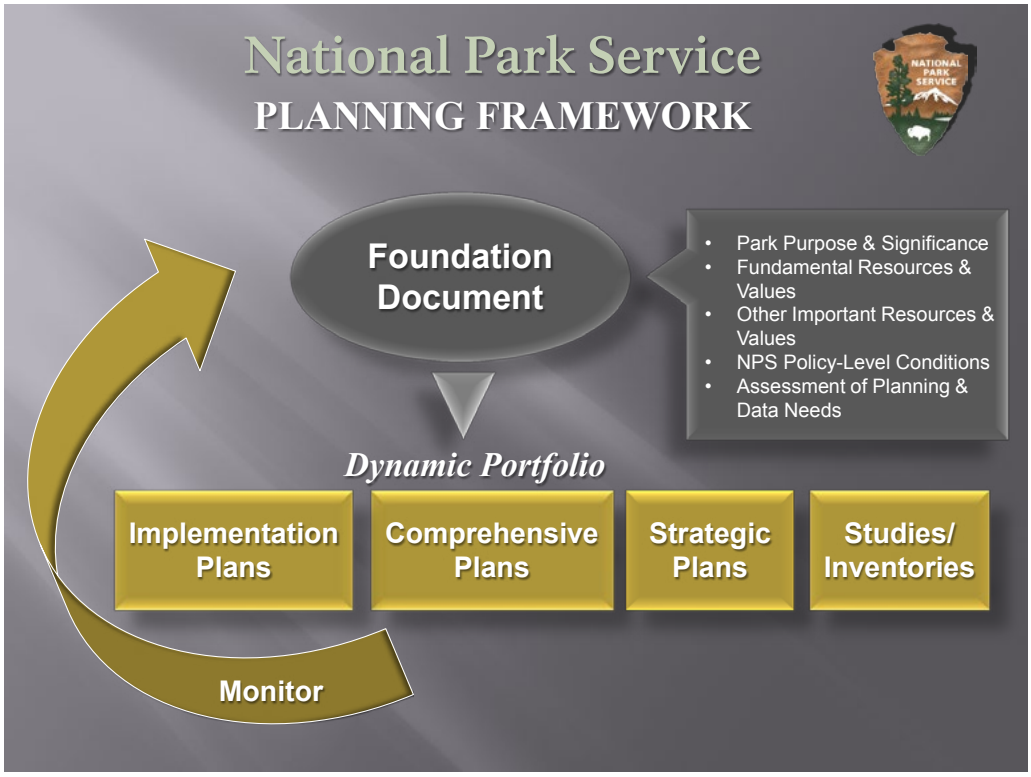

Figure 3.1. National Park Service Planning Framework.

The NPS Climate Change Response Program (CCRP) provides relevant climate change information to inform development of all park foundation documents; such information includes sea level change and storm surge observations and projections for coastal NPS units. Guidance for addressing climate change in foundation documents (*NPS internal access only*), (NPS 2014a) is available.

A component of the Foundation planning process is the Park Atlas (*NPS internal access only)*, a compilation of baseline GIS data for each park presented in an interactive web mapping site. Accurate spatial data, especially elevations for coastal resources vulnerable to sea level rise and flooding, are essential for many adaptation decisions. The park atlases and the underlying geodatabase provide valuable resources for pre-storm planning, incident response, and post-storm recovery.

General Management Plan

The General Management Plan (GMP) builds from the Foundation Document and is required for all park units under statute (National Parks and Recreation Act of 1978) and 2006 NPS Management Policies (§2.3.1). These plans address four legislated requirements:

- Management actions to preserve park resources
- Intensities of development
- Visitor capacity
- Boundary modification, if needed

The 2014 memo, *Guidance for Addressing Climate Change in ongoing General Management Plans* (NPS 2014b), outlines how and where climate change considerations should be incorporated into ongoing general management plans. When preparing a GMP, it is important for coastal parks to consider the implications of ongoing and projected sea level rise and lake level changes (coupled with storm effects, melting permafrost, and other coastal changes) on park infrastructure, resources, and visitor use, and anticipate decisions that may be required in the future. Examples of the needed flexibility for coastal climate change adaptation can be found in some of the more recent park GMPs (figure 3.2). A case study on "Incorporating Climate Change into a General Management Plan" is available at Schupp, Beavers, and Caffrey (2015; Case Study 23).

Resource Stewardship Strategy

The Resource Stewardship Strategy (RSS), (*NPS internal access only*) is the bridge between a park's Foundation Document and the everyday management of natural and cultural resources. A Resource Stewardship Strategy evaluates the major components of the park's priority resources (defined in the *Foundation Document*) that must be protected into the future; establishes science- and scholarship-based methods to evaluate success in protecting these priority resources and values; determines measurable targets for success; and includes prioritized strategies for achieving and maintaining those targets over time. Inclusion of current climate projections, plausible climate futures, and the associated range of effects in an RSS enables parks to develop flexible adaptation strategies that anticipate and can best respond to evolving conditions.

Figure 3.2. Excerpts from Draft General Management Plans from Two Parks Addressing Climate Change.

Tools for Climate Change Adaptation of Coastal Resources and Assets

This section summarizes some of the applied processes and available resources for climate change adaptation at coastal parks.

Processes

Vulnerability Assessment

A climate change vulnerability assessment is a crucial tool for understanding the effects of climate change on natural systems, cultural resources, and park assets, and is a critical element of setting the stage for effective adaptation planning. For this reason, a climate change vulnerability assessment is typically conducted early in the adaptation planning process (Stein et al. 2014).

Vulnerability to climate change refers to the "degree to which as system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes." (IPCC 2007, 2014). Vulnerability has three principal components: *sensitivity, exposure,* and *adaptive capacity* (figure 3.3). *Sensitivity* generally refers to innate characteristics of a specific resource, system, or asset and considers tolerance to changes in such things as temperature, precipitation, sea level rise, and storm frequency. Exposure in contrast, refers to extrinsic factors, focusing on the character, magnitude, and rate of change that the specific resource, system, or asset is likely to experience. *Adaptive capacity* addresses the ability of a specific resource, system, or asset to accommodate or cope with climate change impacts with minimal disruption (Glick, Stein, and Edelson 2011). Note that adaptive capacity may not be relevant to all types of resources or systems; for example, some cultural resources, and many types of infrastructure do not have inherent adaptive capacity.

Climate change vulnerability assessments provide two essential types of information needed for adaptation planning (Stein et al. 2014):

- Identifying which species, systems, or assets are likely to be vulnerable
- Understanding why they are vulnerable

An overview on climate change vulnerability is provided in Chapter 6 of Stein et al. (2014), with more comprehensive guidance provided in Glick, Stein, and Edelson (2011). A description of a vulnerability assessment approach specific to infrastructure in coastal park units is available in the *Coastal Hazards and Climate Change Asset Vulnerability Assessment Protocol* report (NPS 2016).

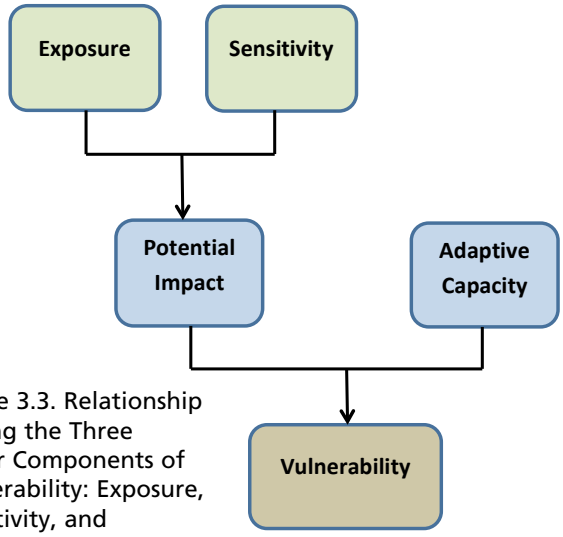

Figure 3.3. Relationship among the Three Major Components of Vulnerability: Exposure, Sensitivity, and Adaptive Capacity.

One example is the "Relative Coastal Vulnerability Assessment of National Park Units to Sea-Level Rise" project, created in partnership between the National Park Service and the US Geological Survey (USGS), which assessed and mapped hazards posed by future sea level change to NPS units. The result from this effort was the coastal vulnerability index assessment for many national park units, highlighting areas that are likely to be most affected by future sea level rise. This index was developed at a large, coarse scale and is useful as a screening tool. If a park is in a highly vulnerable location, more detailed analysis will be needed.

Outcomes from climate change vulnerability assessments logically feed into other planning and management processes. The National Park Service has made significant investment towards developing, training, and applying two processes that assist parks with planning and managing in uncertain climate futures: climate change scenario planning and climate-smart conservation.

Scenario Planning

Planning in the National Park Service has been based on experiences in the past and projecting that understanding into the future, resulting in a range of "desired conditions" for priority park resources and assets. This is often referred to as "forecast planning" (figure 3.4). When considering a changing climate in park planning and management, the forecast approach is limited by incomplete knowledge of highly consequential factors that are largely unpredictable and outside of management control, but that influence future park conditions. The far-reaching effects of climate change, coupled with high uncertainty about local impacts

(e.g., population growth, economic conditions), produce a range of plausible futures that park managers may encounter (figure 3.4).

Scenario planning is a continuous and adaptive process for developing a science-based decision making framework in the face of futures with high uncertainty and lack of control (figure 3.5). This continuous process helps parks and local stakeholders prepare for climate change and other relevant uncertainties by exploring and tracking several plausible scenarios that represent a range of relevant and challenging futures for a park or region. The resulting scenarios help managers assess relative risk, test important decisions, develop strategies or contingency actions (figure 3.6), and identify key indicators to monitor that validate the scenarios over time, making adjustments as needed.

Multiple methods exist to facilitate scenario development. The NPS handbook, *Using Scenarios to Explore Climate Change: A Handbook for Practitioners* describes a five-step scenario building process with detailed instructions on how to accomplish each step using the "matrix approach" (NPS 2013). An accompanying Addendum I was released in 2014 that introduces an alternative technique that requires less time to facilitate the five-step scenario building process (NPS 2014c). More information on the NPS approach to climate change scenario planning is available at http://www1.nrintra.nps.gov/climatechange/planscenarios.cfm (*NPS internal access only*). Further synthesis of additional scenario planning methods case studies is in *Considering Multiple Futures: Scenario Planning to Address Uncertainty in Natural Resource Conservation* (Rowland, Cross, and Hartmann (2014).

Climate change vulnerability assessments and climate change scenario planning integrate with the climate-smart process. The plausible climate change futures created through a scenario planning effort, along with climate-related vulnerabilities for select systems, resources, or assets, logically feed into the climate-smart step that assesses climate impacts and vulnerabilities. Table 3.1 provides a quick summary and reference link on these three processes.

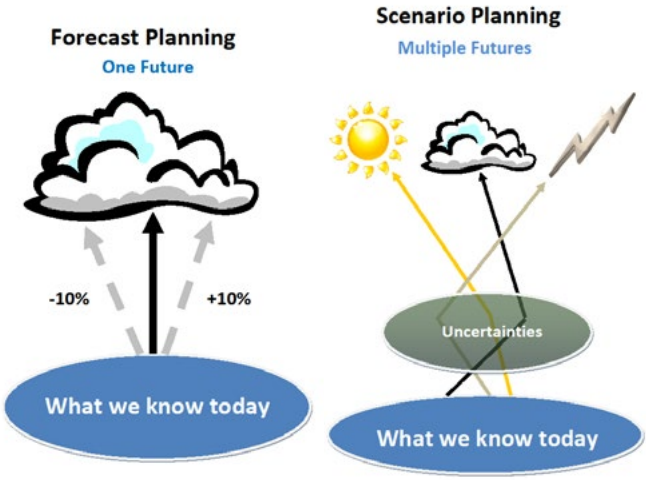

Figure 3.4. Forecast Planning differs from Scenario Planning. Figure 2 from Weeks, Malone, and Welling (2011).

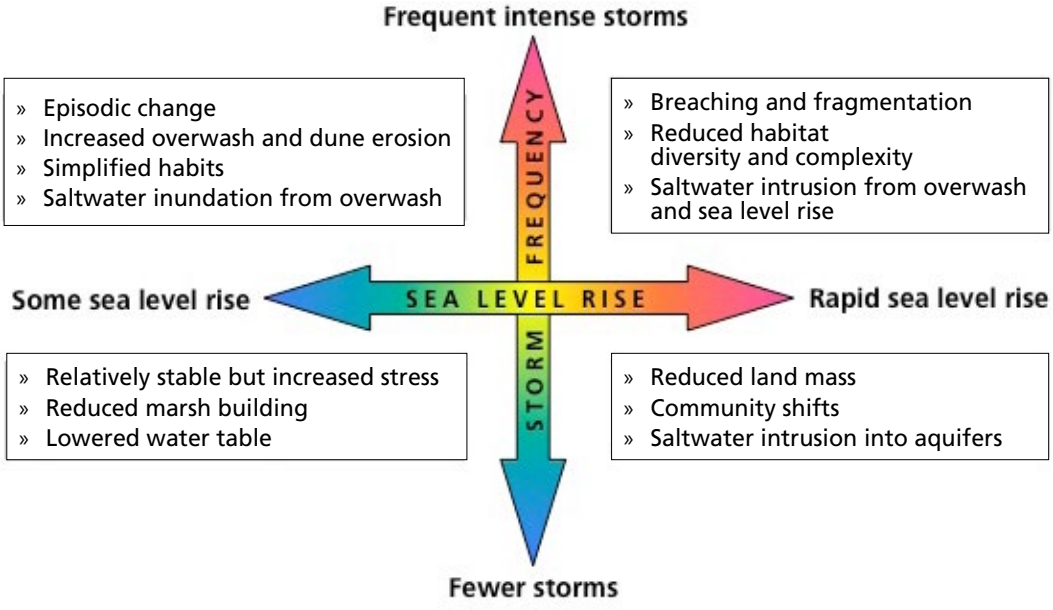

Figure 3.5. Scenario planning example from Assateague Island National Seashore.

Figure 3.6. Through climate change scenario planning at Assateague Island National Seashore, the increased vulnerability of the shallow freshwater aquifer on the barrier island due to sea level rise and salt water intrusion was identified. This freshwater supply is important in sustaining the wild horses on the island that visitors come to see. The park is working with the USGS to characterize this shallow aquifer to better assist with management decisions and future planning. Photograph by NPS.

Climate-Smart Conservation

Completed in 2014, the guidance document *Climate-Smart Conservation: Putting Adaptation Principles into Practice* describes a seven-step, iterative process for integrating concepts and tools of climate-smart conservation into existing work (Stein et al. 2014). The guidance is the product of an expert workgroup that included participants from the National Wildlife Federation, USGS, US Forest Service, National Oceanic and Atmospheric Administration, The Nature Conservancy, the National Park Service, US Fish and Wildlife Service, US Environmental Protection Agency, and others. While developed specifically for natural resources, the approach and principles included in the guidance are relevant for adaptation planning across the breadth of NPS stewardship responsibilities.

The principles of "climate-smart conservation" help to answer the question, "What should be done differently in light of climate change, and what actions continue to make sense?" This thinking helps to develop goals and strategies that are forward-looking, intentionally consider climate change, and manage for change, not just persistence (Stein et al. 2014). An important goal of climate-smart conservation is to help practitioners and policy makers understand what constitutes "good" climate adaptation, how to recognize those characteristics in existing work, and how to design new interventions when necessary.

The guidance highlights nine characteristics of climate-smart conservation:

- Link actions to climate impacts
- Embrace forward-looking goals
- Consider broader landscape context
- Adopt strategies robust to uncertainty
- Employ agile, informed management
- Minimize carbon footprint
- Account for climate influence
- Safeguard people and nature
- Avoid maladaptation

Table 3.1. Tools for Climate Change Adaptation of Coastal Resources and Assets

Tool	Climate Change Vulnerability Assessment	Scenario Planning	Climate-Smart Conservation
Summary	Offers guidance on the key components of vulnerability—sensitivity, exposure, and adaptive capacity—to identify which resources, systems, or assets are likely vulnerable and why they are vulnerable.	Offers a structured process designed for managing into futures with high uncertainty and lack of control (e.g., climate change). Rehearsing for multiple futures strengthens NPS and stakeholder ability to recognize, adapt to, and take advantage of changes over time.	Offers a structured process for linking climate adaptation actions to climate change impacts. Emphasis is placed on acting with intentionality while being transparent (show your work) in adaptation planning and implementation processes.
Link	http://www.nwf.org/pdf/-Climate-Smart-Conservation/-NWFScanningtheConservationHorizonFINAL92311.pdf	http://www1.nrintra.nps.gov/climatechange/planscenarios.cfm *(NPS internal access only)* https://www.fws.gov/home/climatechange/pdf/Scenario-Planning-Report.pdf	http://www.nwf.org/pdf/Climate-Smart-Conservation/NWF-Climate-Smart-Conservation_5-08-14.pdf

Resources

The CCRP provides climate change information specific to parks and assists in adaptive planning and management that incorporate this information. Adaptation is most effective when it is both (1) intentionally and deliberately designed and implemented, and (2) "mainstreamed" into an existing overall management approach alongside actions that address other issues (Stein et al. 2014). Guidance on mainstreaming climate adaptation into foundation documents (NPS 2014a), general management plans (NPS 2014b), and resource stewardship strategies needs to be flexible and periodically revisited and updated. Within the NPS planning framework, climate adaptation also needs to be incorporated into other park plans such as wilderness stewardship plans, invasive plant management, cultural landscape reports, and commercial services planning. The forthcoming NPS guide, *Planning for a Changing Climate*, builds on climate-smart principles, and provides a standard approach for incorporating climate change adaptation as a routine part of all park planning, including the variety of planning needs in coastal parks.

Lastly, revisions to the DO-12 Handbook and supplemental guidance (NPS in prep; CEQ 2016) for considering project contributions to greenhouse gases, as well as influences from climate change on project success, support parks in addressing climate change as part of National Environmental Policy Act (NEPA) analyses. Additional planning resources are available at http://www.nps.gov/subjects/climatechange/coastaladaptation.htm.

Disaster Planning and Preparing for Opportunities for Adaptation

Unfortunately natural disasters happen, and coastal zones are vulnerable because of coastal flooding, wave action, and high winds. It is more important now than ever for parks to plan ahead because climate change is increasing the risks of natural disasters (Field 2012; Smit and Wandel 2006; Smit et al. 2000). The National Park Service is steward to a variety of built resources that are vulnerable to climate change and natural disasters such as the storm surge, wave action, ice push, and high winds associated with coastal storm systems (e.g., hurricanes, typhoons, Northeasters), tsunami, and other sources of inundation. Some coastal storms could increase in intensity due to warmer ocean temperatures (Melillo, Richmond, and Yohe 2014). When a park is highly vulnerable to natural disasters, pre-incident planning can create post-incident adaptation opportunities, and the tools and resources described above can be applied to pre-planning efforts.

Parks in locations that are susceptible to natural disasters and include vulnerable infrastructure such as visitor centers, comfort stations, and historic buildings must plan for the risk associated with development in these locations. Where the risk is high, it may benefit a park to pre-plan for potential damage by identifying opportunities to restore infrastructure in a more sustainable manner and location.

The idea of pre-incident planning is compatible with Director's Order 80: PM 15-01 Addressing Climate Change and Natural Hazards for Facilities, (NPS 2015; see "Chapter 6 Facility Management"). The memorandum provides guidance to managers and their teams to proactively identify and document facility vulnerabilities to climate change and other natural hazards, which are most easily managed by planning for avoidance, resilience, or adaptation before events occur.

When developing new facilities, it is prudent to do so in lower risk locations. For facilities already located in a highly vulnerable place, pre-incident planning can facilitate post-incident adaptation actions. For example, if a park has a fixed boat dock that is destroyed by a hurricane, restoring the dock as a floating or removable dock may make it less vulnerable to sea or lake level change and destruction by storm surge.

A major component of adaptation planning focuses on disaster response and recovery. In order to understand adaptation and find plausible opportunities to adapt to upcoming changes, we need to study the disaster recovery timeline and look into each stage as a unique opportunity for adaptation. England (2005) developed a six-phase disaster recovery life cycle framework shown in figure 3.7. Each of these phases gives rise to distinctive priorities and goals as a context for decision making and can be evaluated as an opportunity for adaptation.

Disaster preparedness requires regular review and adjustment of existing plans to meet ever-changing situations. A good place to start is with analysis and assessment because it provides opportunities to identify vulnerabilities in systems, processes, and preparations. As a part of this stage, the current state of preparedness and the ability to respond effectively is assessed. Analysis is followed by remediation planning, which sets preparedness measures that help managers anticipate the response needs of a disaster. Prevention measures set in this stage help to avoid hazards and lessen the effects of events.

Once analysis and remediation has been completed, adaptation (referred to as mitigation in the emergency response community, such as in figure 3.7) can be used to take steps to lessen the impact of disasters and reduce loss of life. Effective adaptation requires that local risks are understood and addressed and often includes making hard choices and investing in the long-term well-being of park assets and resources. After the disaster hits, the extent of damage is evaluated at the impact assessment stage and reports to acquire funds used for recovery are developed. Reporting is followed by immediate steps to respond to the event and use recovery procedures to help restore visitor access to facilities and natural and cultural resources.

Throughout the disaster timeline cycle, the analysis and assessment stage is the stage where the most return can be made on an investment of time and money. Data collection, analyses, and assessment are the most important actions that can be taken today to adapt to future changes. For example, breach management plans must be prepared in advance of storm impacts, as was done for Fire Island National Seashore (see "Chapter 9 Lessons Learned from Hurricane Sandy"). Storm Response Plans are specific plans for coastal parks to implement strategies to prepare for adaptation opportunities by acknowledging that particular window as a time for change.

Figure 3.7. Phases of the Disaster Recovery Life Cycle. Figure from England (2005).

Opportunities for Adaptation

Being aware of pre- and post-event opportunities for adaptation and deliberately identifying opportunities can support adaptation of facilities and historic buildings. As discussed in "Chapter 9 Lessons Learned from Hurricane Sandy," disasters can be drivers of adaptation. Grannis et al. (2014) acknowledge that ideally, climate change adaptation actions are proactive and vulnerable communities anticipate and prepare for risks, but that in reality, adaptation actions are usually reactive, following a disaster. This highlights the importance of building in locations with lower vulnerability. Reactive adaptation is appropriate under some circumstances, considering that replacement of functional systems before a storm hits may incur as much damage and cost as much as post-storm replacement would. Ideally, plans for replacement or adaptation strategies are developed before a disaster, so that planners are better prepared to seize post-disaster opportunities to rebuild sustainably. It is also necessary to build support for adaptation strategies through stakeholder involvement in pre-event planning, so that there is less likely to be post-event resistance to implementation, as discussed in "Chapter 7 Communication and Education."

Leveraging opportunities to rebuild sustainably after disruptive events like hurricanes benefits from advance planning and stakeholder engagement. Examining the emergency response timeline and applying a selection of the planning tools and methods described above at the appropriate stages can identify potential future opportunities and position the park to leverage them for adaptation after a disruptive event takes place. See "Chapter 9 Lessons Learned from Hurricane Sandy," which describes how much of the planning and stakeholder engagement happened post-storm and continues through the recovery. In short, managers should try to prevent damage to resources but be prepared to rebuild or restore sustainably if those efforts fail.

Take Home Messages

- Adaptation is most effective when it is intentionally and deliberately designed as a response to anticipated effects associated with climate change.
- Climate change adaptation is not a stand-alone plan, but should be addressed in ongoing, routine planning processes such as foundation documents, general management plans, resource stewardship strategies, and preparedness planning.
- Adaptation strategies may require a series of decisions and actions that will change over time.
- Preparing for natural disasters includes planning for uncertainty and allows for adaptation opportunities post-incident.

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