



Climate Change Hazards Summary Report for Facility Investment Planning

Hawai'i Volcanoes National Park January 2021

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Introduction

Parks are required to complete a PARK Project Narrative Template for each proposed Great American Outdoors Act Facility Investment Plan (GFIP) project for Legacy Restoration Funding in fiscal years 2023-2025. Information provided in this report is intended to help parks consider climate change related hazards when addressing Question 16 of the narrative template.

Specifically: What risks or hazards (current and projected, e.g. effects of climate change) are likely to affect this project? If applicable, what adaptation strategies and/or resiliency measures have been identified for scenarios that pose high risks to project assets?

Step 1: Review summary information for known or potential hazards identified for Hawai'i Volcanoes National Park

- Review the list of potential hazards below and decide whether or not they apply to your specific GFIP project. NPS Climate Change Response Program (CCRP) staff attempted to identify potential hazards for the park; however, park staff and project planners have more information about hazards that are likely to be applicable to a specific project.
- The hazards below were selected from a longer list included in Appendix 1, which also indicates CCRP's 'best professional judgement' about the relevance of the hazard for this park. Note both lists serve as a "coarse filter" screening tool to help identify potential climate-related hazards for facility and asset planning.

Hotter average days and more very hot days

Extreme temperatures can increase weathering of structures, threaten park staff and visitor safety, and increase stresses for HVAC systems. If not addressed through building design or more efficient temperature control systems, the increased demand for complex air conditioning systems can add stress to building envelopes and can require significant alterations to a structure.

Annual temperatures are increasing at HAVO and are expected to continue to increase under both medium- and high-emissions scenarios from +3.4 to +6.6 °F by 2100 (+2.7 to +3.8 °F in mid-century [2040-2070]; Longman et al. 2020). Rising temperatures are expected to cause more intense heat waves (Stevens et al. 2017).

Park staff assessment – relevant to GFIP Project:

- ☐ Yes
☐ No

Altered precipitation patterns, and increased extreme precipitation

Changing precipitation can result in local flooding, encourage mold growth and wood decay, increase fire risk, and intensify drought conditions, depending on the pattern of change. Extreme precipitation events present a variety of threats to infrastructure and operations, including flooding of sites, sewage backup, accelerated decay of masonry, overcoming drainage systems, road wash out, cracks in building

infrastructure, destabilization of buildings and pipes, erosion of supporting ground around structures, among many other effects.

Annual precipitation in HAVO is highly variable from year to year, and is largely driven by the El Niño-Southern Oscillation (ENSO). ENSO changes precipitation and temperature patterns during wet and dry seasons with the direction and magnitude determined by the season, phase, and strength of the event (Longman et al. 2020). Despite this natural variability, annual rainfall has decreased over the past century, particularly in recent years (Stevens et al. 2017). The Island of Hawai'i has experienced significant long-term declines in annual and dry season rainfall, with annual total precipitation in Hilo decreasing almost 20 inches since 1950 (Stevens et al. 2017). While rainfall in Hawai'i has been decreasing, it has also become more extreme. Both extreme heavy rainfall events (causing increased runoff, erosion, and flooding) and droughts (causing water shortages) have become more common and number of consecutive wet days and the number of consecutive dry days are both increasing (Kruk et al. 2015, Keener et al. 2018).

Climate projections show decreasing rainfall in HAVO under medium- and high-emissions scenarios, however the amount is uncertain. Potential annual declines range from -38 to -7%, with more distinct changes occurring seasonally (dry season -56 to -2% change; wet season about -26 to -16% change). Mid-century (2040-2070) rainfall is decreasing -26% to -21% (dry season -39 to -29%; wet season -17 to +3%) (Longman et al. 2020). Climate change effects on ENSO remain unknown, but some climate models suggest a doubling in frequency of both El Niño and La Niña extremes in the 21st century, compared to the 20th century (Keener et al. 2018).

Park staff assessment – relevant to GFIP Project:

☐ Yes

☐ No

Increased drought frequency, intensity, magnitude, and duration

Rising air temperatures and changing precipitation patterns are exacerbating drought risk in many parts of the United States (Wehner et al. 2017). Changing drought conditions (frequency, severity, duration) can challenge a variety of infrastructure and operations (Department of Homeland Security 2015) in the NPS (e.g., water supply and wastewater systems), impair water quality (Mosley 2015), affect soil heaves and shrinkages (Fernandes et al. 2015), and will enhance other related risks such as wildfire (Halofsky et al. 2020).

Severe droughts are common in Hawai'i and lead to a lack of useable water and increased wildfire risks (Stevens et al. 2017). Water shortages due to droughts are one of the most significant climate-related risks in the region (Keener et al. 2018). Recent HAVO-specific analysis (Longman et al. 2020) shows that most severe drought conditions occur during the dry season during Strong El Niño phase. During the wet season, drought conditions are most severe during the wet season of La Niña phases. This analysis also showed that droughts have increased in frequency, duration, intensity, and severity over time. Climate

change projections of increasing temperatures and decreasing precipitation will further worsen drought conditions, particularly in high elevations (Stevens et al. 2017).

Park staff assessment – relevant to GFIP Project:

- ☐ Yes
- ☐ No

Increased wildfire frequency, intensity, magnitude, and duration

Wildfire is a natural part of many forest, woodland, and grassland ecosystems. Excessive fire, however, can damage ecosystems, kill people, and damage infrastructure. Climate change is intensifying the heat that drives wildfire (Jolly et al. 2015) and altering the distribution and density of vegetation that comprises the fuel for wildfires (Gonzalez et al. 2010). The effects of climate change on wildfire vary across landscapes. For areas where projected climate change increases fire risk, buildings, cultural landscapes, or other infrastructure located under or near tree canopies or dense grasslands are vulnerable to burning and destruction.

Wildfire frequency is increasing in Hawai'i (Trauernicht et al. 2015) and is most likely during ecological drought (Longman et al. 2020). Increasing wildfire occurrence is likely to occur from spring to summer in the year following an ENSO event (Chu et al. 2002). Increasing temperatures, combined with a growing human population, and expanding invasive grass cover, are likely to continue the increase in wildfire occurrence (Stevens et al. 2017).

Park staff assessment – relevant to GFIP Project:

- ☐ Yes
- ☐ No

Sea level rise and coastal storm surge

Global sea level is rising and will continue to increase (Tebaldi et al. 2012), with local variability. Sea-level rise in Hawai'i varies by island but on the Island of Hawai'i has risen 1.3 inches/decade since 1880 and is expected to rise another 1 to 3 feet by 2100 (Stevens et al. 2017). Higher relative sea level causes accelerated coastal erosion, landward migration of shorelines, and saltwater intrusion and changes in groundwater, and amplifies flooding caused by higher storm surges (Field et al. 2007). Sea level rise poses considerable risks to infrastructure, lighthouses, and other historic structures.

Park staff assessment – relevant to GFIP Project:

- ☐ Yes
- ☐ No

Riverine flood/Flash flood

Extreme precipitation events and the risk of flooding are expected to regionally intensify with a changing climate (Dethier et al. 2020, Tabari 2020). Floods threaten infrastructure and operations through a variety of mechanisms, including inundation of structures, enhanced erosional forces, road wash out, structural collapse from force of floodwaters, sewage backup, and damage to utilities, generators, and electrical systems. Post-flooding effects include increased rot, fungal/insect attack, mold and mildew, and physical deterioration of wood, brick and stone building materials.

Regionally, extreme rainfall events have become more frequent for the Island of Hawai'i (Stevens et al. 2017). Throughout the latter half of the 20th century, large precipitation events became more extreme on Hawai'i island, with a 20-year return event in 1960 becoming a common storm (3- to 5-year return). A positive relationship exists between growing precipitation events through time during La Niña years, and a negative relationship exists in El Niño years (Chen & Chu, 2014).

Park staff assessment – relevant to GFIP Project:

- ☐ Yes
- ☐ No

Hurricanes

Hurricanes are projected to increase in intensity and precipitation in a warmer world (USGCRP 2017). Storm surge can cause flooding and road wash outs. The combination of sea level rise and increased hurricane storm surge will flood structures that previously were outside of the floodplain. Flood and storm surge depths may be deeper than in previous storms. Flooding may occur in areas that had no flooding during past storms. Building standard guidance is based on base flood elevations of 2-3 ft above FEMA flood zones of 100-year (1%-annual chance) storms, depending on the building criticality. For existing buildings that are not above base flood elevation, adaptation measures to reduce flood impacts should be considered. Hurricanes also threaten structures via damage from wind, wind-blown rain and debris; their large temperature swings stress buildings through sudden thermal expansion and can crack pipes.

Hawai'i is susceptible tropical storms that bring heavy rains, high winds, and high waves with tropical cyclones occur most frequently during the dry season of El Nino years (Keener et al. 2018). It is projected that Hawai'i will see an increase in the frequency of tropical cyclones due to storm tracks shifting northwards (Stevens et al. 2017).

Park staff assessment – relevant to GFIP Project:

- ☐ Yes
- ☐ No

Pest infestation

Increased temperatures and CO₂, changes in precipitation, and disturbance due to extreme climate events can increase the survival, spread, growth, and establishment of pests (IPCC 2014). Rooting and burrowing mammals and termites have the potential to cause direct damage to power, water, transportation, and building facilities (Vissichelli 2018). Facilities may be impacted indirectly through other mechanisms exacerbated by climate change such as forest insect pest invasions or fluctuating ground water levels leading to increased tree mortality, hazard trees, and treefall.

Increased temperatures will result in redistribution of pests and intensification of pest outbreaks (Logan et al. 2003). Because temperature and other environmental conditions influence forest insect populations and outbreaks, climate change has and will continue to impact pest infestations (Pureswaran et al. 2018). Pests formerly confined to lower elevations may begin appearing higher up where they have not formerly occurred.

Park staff assessment – relevant to GFIP Project:

- ☐ Yes
- ☐ No

Invasive species

Increased temperatures and CO₂, changes in precipitation, and disturbance due to extreme climate events can increase the survival, spread, growth, and establishment of invasive species (IPCC 2014). Weeds and aquatic mussels have the potential to cause direct damage to power, water, transportation, and building facilities (Vissichelli 2018). Non-native species that may not currently impact facilities may become harmful due to changes in local climates (NRC 2002, IPCC 2014).

Warming accompanied by reduced rainfall will stress native plants and animals, particularly in high-elevation systems, increasing exposure to invasive species. Human-caused stressors (e.g., land use change, pollinator extinction, etc.) obstruct the ability of native species to adapt to shifting habitats. In some cases, invasive plant species will have a competitive edge over native species, as they disproportionately benefit from increased CO₂, disturbances from extreme weather and climate events, and an ability to invade higher elevation habitats as climates warm (Leong et al. 2014). Additionally, climate-related stress, combined with human population growth may expand invasive grass cover, altering fire regimes (Stevens et al. 2017).

Park staff assessment – relevant to GFIP Project:

- ☐ Yes
- ☐ No

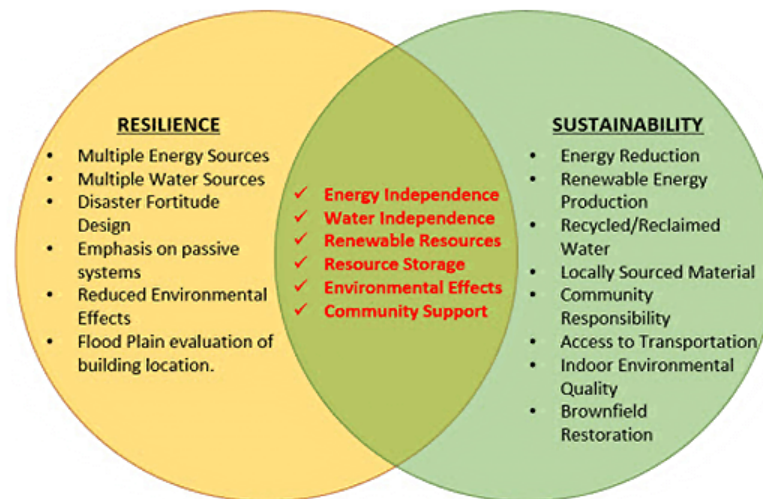
Step 2: Consider adaptation and resiliency strategies

- Review definitions of resiliency and adaptation strategies.
- Identify adaptation strategies that will help park resources respond to the hazards identified in Step 1.

Question 16 requires a screening for climate hazards followed by a review of adaptation and resiliency strategies that would be put in place to respond to these hazards. For the purposes of this report and investment planning, resilience is a property of a system or asset and generally refers to the ability of the system or asset to maintain its intended purpose following a temporary disturbance.

Adaptation strategies, in the context of built infrastructure, refers to the intentional management decision to identify, prepare for, and respond to observed or expected sustained changes in hazards, including climate change, to adjust to a sustained change in conditions.

It is important to note that resilient park operations can be supported through the use of green infrastructure such as sustainable landscaping, as well as sustainable energy, water, and building envelope solutions. The figure below illustrates this relationship.



Lists of adaptation strategies for different types of infrastructure projects in response to different hazards can be found here: [Incorporating Climate Change Adaptation in Infrastructure Planning and Design](#) (see Chapter 4, Tables 25-34). If used, these adaptation strategies will need to be modified for proposed park projects.

Buildings and assets within national parks may include cultural resources (e.g., historic and pre-historic buildings and structures). The adaptation and resiliency options for cultural resources often overlap with those defined for facilities; however, NPS has detailed specific strategies when dealing with cultural resources and climate change in national parks ([Cultural Resources Climate Change Strategy](#)). “Climate

change poses an especially acute problem for managing cultural resources because they are unique and irreplaceable — once lost, they are lost forever” ([NPS Policy Memorandum 14-02](#)).

Step 3: Develop an answer to Question 16 for your specific project and location, as well as strategies to address each hazard

- Three example responses to Question 16 are provided below. THESE ARE GENERIC EXAMPLES FROM OTHER PARKS.
- You will need to develop park specific answers based on the hazards identified in Step 1 and the adaptation strategies identified in Step 2 for your park and project. The park response should be as project-specific as possible.
- The NPS Climate Change Response Program (CCRP) and Sustainable Operations and Maintenance Branch (SOMB) are available to help evaluate climate change hazards and resiliency strategies for your specific projects. Requests should be sent to the NPS [GFIP Hazards and Risk Assistance email account](#); a member of the team will reply with support.

Question 16: What risks or hazards (current and projected, e.g. effects of climate change) are likely to affect this project? If applicable, what adaptation strategies and/or resiliency measures have been identified for scenarios that pose high risks to project assets?

Example from Minute Man National Historic Park: Restoring historic structures

Several climate change hazards may affect building-related projects at MIMA, including hotter average days, more extreme heat days, increased hurricane impacts from wind and flooding, altered precipitation patterns, and increased extreme precipitation. Adaptation and resiliency strategies for the expected hazards are described below:

- Hotter average days and more extreme heat days will increase demand and requirements for higher capacity air conditioning systems unless accommodated through modified building designs or other systems.
- Extreme heat and humidity can stress the building envelope and will require significant humidity control alterations for structures.
- Changes in building design or post-flooding dehumidification systems, in coordination with the NPS Historic Architecture, Conservation and Engineering Center or Historic Preservation Training Center, to avoid any increase in energy use.
- Hurricane force wind and wind-blown rain as well as damage from wind-blown debris or treefall will require wind resistant fortification of the structure. Addressing hazardous trees and retrofitting roof structures to be more wind resistant may also be required.
- Flooding from increased hurricane events, increased extreme precipitation, or in conjunction with altered precipitation patterns may require modifications to building infrastructure location and landscape drainage systems.
- Post-flooding effects may include increased rot, mold and mildew, and physical deterioration of wood, brick and stone building materials. Adaptation actions will include identifying appropriate

dehumidification and air handling systems and coordinating with the NPS Historic Architecture, Conservation and Engineering Center or Historic Preservation Training Center regarding alternatives and maintenance for historic structures.

Example from Grand Teton National Park: Road improvement project

Several climate change related hazards have been identified that may affect projects in GRTE, including hotter average days, more extreme heat days, increased drought frequency and intensity, altered precipitation and flooding patterns, increased wildfire, and increased invasive species abundance or distribution.

The primary hazards affecting this project are altered precipitation patterns and related changes to spring runoff. Expected warmer and wetter spring seasons are likely to result in rain over snow events, which lead to higher peak spring runoff volume and water velocity. The Gros Ventre River is a wide, braided river with active flow channels that frequently migrate. In recent years, unprecedented spring high water flows caused the main channels of the river to erode the bank adjacent to the Gros Ventre Road, and resulting in partial road collapse in 2017. Temporary fixes have a limited lifespan, particularly if spring runoff levels continue to change as predicted.

The proposed project would directly address these hazards by either armoring the riverbank or moving the roadway away from the river. Future studies (e.g. archeological, hydrologic, engineering, [etc.](#)), environmental analyses, and potential lifecycle cost analyses will take higher spring runoff levels into account in determining the preferred alternative. One noted benefit of moving the road away from the highly eroded river bank would be allowing the river to maintain a more natural course.

Other hazards that will be considered in future studies include:

- Increased temperatures and crack/heave damage in drier soils, which may contribute to pavement degradation.
- Precipitation increases or changes, which may cause increased soil moisture and affect the structural integrity of the roads and slopes. Slopes may need to be adjusted accordingly, as well as the installation of additional culverts.

Example from San Francisco Maritime National Historic Park: pier repair, historic building restoration, road repair, or water system project

Several climate change hazards may affect a (pier repair, historic building restoration, road repair, or water system) project at San Francisco Maritime National Historical Park, including sea level rise, storm surge, more frequent storms, San Francisco Bay flooding, increased street stormwater runoff, hotter temperatures, and increased insect pests. Possible adaptation and resiliency strategies include:

- Adoption of sea-level rise adaptation measures developed by Golden Gate National Recreation Area in a plan for Crissy Field ([CMG Landscape Architecture 2016](#)) that covers an area up to the western boundary of San Francisco Maritime National Historical Park.
- Natural shoreline features along Aquatic Park Beach to handle some inundation from sea level rise.
- Vegetated catch basins for urban street stormwater runoff.
- Drainage systems and culverts that could handle greater water flows.
- Relocation of any infrastructure from an area where a hazard cannot be avoided.

- Water conservation measures to reduce water use during droughts.
- Strengthening structures to prevent damage from extreme storms or treefall.
- Changes in building design or post-flooding dehumidification systems, coordinating with the NPS Historic Architecture, Conservation and Engineering Center or Historic Preservation Training Center and avoiding any increase in energy use, which would increase greenhouse gas emissions and exacerbate climate change.
- Changes in building design or building systems to maintain appropriate temperatures and humidity without increasing energy use, which would increase greenhouse gas emissions and exacerbate climate change. Energy conservation and renewable energy systems to prevent any increase in fossil fuel energy use.
- Early detection and removal of termites or other pests or hazards.

Step 4: Seek additional assistance if desired

- Additional resources for answering question 16 and related questions can be found in:
 - Appendix 1 below, which includes a full hazards checklist, providing additional links for supporting information related to each hazard.
 - The [GFIP Guidance and Logistics](#) folder under the [Resources to Assess Risks and Hazards tab](#) includes:
 - An Excel workbook labeled [T75 Parks GFIP NRSS Supporting Materials](#) that provides links to information for natural resources to be considered during project design and construction.
 - A [FAQs – Assessing Risks and Hazards](#) document that provides detailed guidance for answering Question 16.
 - A [Natural Hazard Assessment Webinar](#) recording that provides key information, definitions, and guidance for understanding natural hazards and related resources.
- The NPS Climate Change Response Program (CCRP) and Sustainable Operations and Maintenance Branch (SOMB) are also available for assistance in evaluation of climate change hazards and resiliency strategies as they relate to specific projects. Questions can be sent to the NPS [GFIP Hazards and Risk Assistance email account](#) and a member of that team will reply with support.

Appendix 1: The Climate-Related Hazard Checklist

This appendix provides an initial evaluation of climate hazards for **Hawai'i Volcanoes National Park** according to the hazard ratings identified below. The information used to identify hazards in the checklist is mostly from regional assessments. Park and project specific information was generally not available when assessing these hazards. NPS Climate Change Response Program (CCRP) staff made an initial attempt to identify potential hazards for the park broadly (see 'Best Professional Judgement' column); however, park staff and project planners have more information about hazards that are likely to be applicable to a specific project.

Explanation of Hazard Ratings

Known hazard: Conditions that cause the hazard are well documented in the area where the park occurs. If applicable to the project site, these hazards should always be addressed in the project plan.

Potential hazard: Conditions that cause or underlie the hazard are known to occur nearby or are likely to occur based on studies with conditions similar to the park. If applicable to the project site, these hazards should be considered for inclusion in the project plan.

Not applicable: No evidence *was identified* showing this hazard is relevant to the park. Note this is a coarse filter evaluation; local knowledge of a hazard(s) should be used, when available.

Table 1. Climate-related Hazards Checklist

Potential Climate Hazard	Best Professional Judgment	Examples of risk or secondary hazard	Sources of General Non-site specific Data
Hotter average days and more very hot days	Known Hazard ☒ Potential Hazard ☐ Not Applicable ☐	• Inadequate HVAC • Road surface degradation • Lack of water due to increased water for irrigation • Increased humidity • Danger to staff	• National Climate Assessment • State climate summary
Increased drought frequency, intensity, magnitude, and duration	Known Hazard ☒ Potential Hazard ☐ Not Applicable ☐	• Limited water supply for cooling, landscaping, structural fire suppression, other equipment • Increased competition for available water and water rights conflicts • Crack/heave damage in drier soils • Increased vulnerability to wildfire (below)	• Drought Monitor • National Integrated Drought Information Center • National Climate Assessment • State climate summary

Potential Climate Hazard	Best Professional Judgment	Examples of risk or secondary hazard	Sources of General Non-site specific Data
Increased wildfire frequency, intensity, magnitude, and duration	Known Hazard ☒ Potential Hazard ☐ Not Applicable ☐	• Damage to facilities and contents • Smoke damage • Air quality dangerous to staff and visitors • Increased runoff • Increased erosion • Damage to water treatment plants	• Barbero et al. 2015 International Journal of Wildland Fire
Altered precipitation patterns, increased extreme precipitation, and changing humidity	Known Hazard ☒ Potential Hazard ☐ Not Applicable ☐	• Local flooding • Mold growth • Wood decay • Drought • Fire • Groundwater change • Surface erosion • Floods (see below) • Water damage to structures from driven rain • Unstable saturated soils	• National Climate Assessment • State climate summary
Riverine flood/flash flood	Known Hazard ☐ Potential Hazard ☒ Not Applicable ☐	• Damage or destruction of infrastructure • Stream channel migration • Stream bank erosion/extreme erosion • Safety • Water quality diminished • Damage to water source and delivery infrastructure • Changing requirements for culvert flow capacity	• FEMA Flood map service
Sea-level change and coastal storm surge	Known Hazard ☒ Potential Hazard ☐ Not Applicable ☐	• Rising sea and lake levels • Rising water – wind driven (e.g. hurricane, nor'easter) • Saltwater intrusion • Vegetation damage	• NOAA SLR viewer • NOAA - Great Lakes Environmental Research Laboratory

Potential Climate Hazard	Best Professional Judgment	Examples of risk or secondary hazard	Sources of General Non-site specific Data
Lake and reservoir level change	Known Hazard ☐ Potential Hazard ☐ Not Applicable ☒		
Hurricanes and tornadoes	Known Hazard ☐ Potential Hazard ☒ Not Applicable ☐	• Building destruction • Flying debris • Storm surge • Tree fall (see other categories for associated intense rainfall and floods)	
Pest infestation	Known Hazard ☐ Potential Hazard ☒ Not Applicable ☐	• Historic/facility fabric loss • Vegetation loss • Disease vectors may increase • Termites and other woodboring pests expanding range with warming and increased humidity	• USFS Forest Health Program
Invasive species	Known Hazard ☐ Potential Hazard ☒ Not Applicable ☐	• Aquatic mussels – water intakes clogged • Vegetation (kudzu, vines) – damage buildings, kill trees, obstruct waterways	• National Invasive Species Council

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Disclaimer

Report Purpose and Scope:

Parks identified for Legacy Restoration Funding in fiscal years 2023-2025 are required to develop a Great American Outdoors Act Facility Investment Plan (GFIP). The intended use of this series of park-specific reports is to help parks address Question 16 of the narrative template: *What risks or hazards (current and projected, e.g. effects of climate change) are likely to affect this project? If applicable, what adaptation strategies and/or resiliency measures have been identified for scenarios that pose high risks to project assets?*

Each report compiled and summarized published information on a suite of climate change hazards. Each report included an analysis of each hazard, for which the report author assigned a 'hazard rating' as follows:

Known hazard: Conditions that cause the hazard are well documented in the area where the park occurs. If applicable to the project site, these hazards should always be addressed in the project plan.

Potential hazard: Conditions that cause or underlie the hazard are known to occur nearby or are likely to occur based on studies with conditions similar to the park. If applicable to the project site, these hazards should be considered for inclusion in the project plan.

Not applicable: No evidence was identified showing this hazard is relevant to the park. Note this is a coarse filter evaluation; local knowledge of a hazard(s) should be used, when available.

As articulated within the report (in an appendix of the hazard ratings) those ratings constitute the author's 'best professional judgement' about the relevance of the hazard for that park based on the reviewed literature (cited in the narrative text for the hazard & provided in the report bibliography).

The intended use of each report is to inform decisions for facility investment planning related to (i) potential hazards that a suggested facility investment concept would need to appropriately consider and avoid or mitigate and (ii) identifying facilities possibly at greater relative vulnerability due to the identified hazards. The level of information quality in the report was calibrated to those purposes, i.e. to inform development of questions for a facility investment scoping process to further explore.

Peer Review Process:

Each report was based on a template, which heavily relied on boilerplate text for the non-park specific elements. The boilerplate text underwent multiple rounds of informal peer review by assorted CCRP staff, including members of the Climate Science and Adaptation Team, the Communications Team, the Regional Climate Change Liaisons, and the Climate Change Liaison to Facilities and Planning. Each report was peer-reviewed by a member of CCRP to check interpretation, consistency in hazard ratings, improve narrative coherence, and flag priority additions/modifications. In situations where revisions were required, the peer reviewer then re-reviewed the final revised report to assure adequate resolution of the identified issues.