



# VULNERABILITIES ASSESSMENT

SUSTAINABILITY AND RESILIENCE STRATEGY FOR THE  
COLORADO CHAUTAUQUA NATIONAL HISTORIC LANDMARK



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THE CRAIG GROUP

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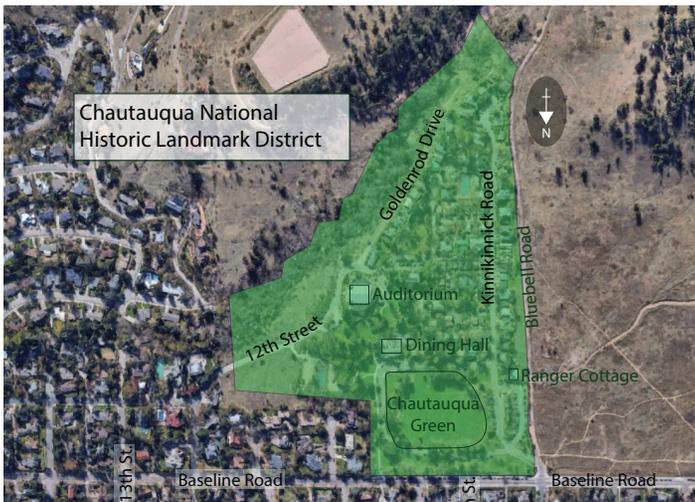
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## EXECUTIVE SUMMARY

This Vulnerabilities Assessment was conducted to identify the projected impacts of climate change at the Chautauqua National Historic Landmark District (NHL) and is the first step in developing mitigation and adaptation plans in a comprehensive Sustainability and Resilience Strategy for this cherished place.

## BACKGROUND

Chautauqua was established in 1898 and today recognized as one of the most historically and culturally significant places in Colorado. The Chautauqua NHL comprises 40 acres of land owned by the City of Boulder, 26 of which are leased to the Colorado Chautauqua Association (CCA). This collection of irreplaceable historic buildings, structures, objects and cultural landscapes is situated at the urban/wildland interface, presenting a unique set of vulnerabilities.



## VULNERABILITIES

This assessment is organized according to seven systems (built, cultural, ecological, economic, neighborhood, infrastructure, transportation) and places identified vulnerabilities into the context of systems they affect.

- Identified vulnerabilities include water & drainage, heat, fire, aging buildings & infrastructure, increased visitation and adjacency to open space land.
- Identified vulnerabilities are ranked (high, medium, low) with aging infrastructure, drainage, fire and increased visitation all categorized as high and requiring immediate attention.
- Preservation of the unique character of the Chautauqua NHL will present challenges and require creative thinking in developing options for mitigation and adaptation to identified vulnerabilities.

The results of the Vulnerability Assessment will help inform the second step of the project in developing options to mitigate risk and achieve long term sustainability and resilience at the Chautauqua NHL.

## DEFINITIONS

The current study incorporates numerous concepts which may have different definitions to different stakeholders. The most commonly used and significant terms used in the study are defined as they have been used by the team during the first phase of the study.

**Adaptation** – A change in design or usage practices or in the physical site specifically for the purpose of reducing or mitigating threats from climate change or other risks.

**Chautauqua National Historic Landmark District** – This is the term used for that area and the associated contributing and non-contributing resources within the geographic boundary identified in the Colorado Chautauqua NHL nomination.

**Cultural Landscape** – A geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person, or exhibiting other cultural or aesthetic values.

**Contributing Resource** – Any building, object or structure which adds to the historic integrity or architectural qualities that make the historic district, listed locally or federally, significant.

**Historic Integrity** – The authenticity of a property’s historic identity, evidenced by the survival of physical characteristics that existed during the property’s historic or prehistoric period. Qualities considered in determining integrity include location, design, setting, materials, workmanship, feeling and association.

**Historic Property / Historic Resource** – Any prehistoric or historic district, site, building, structure or object included in, or eligible for inclusion on the National Register of Historic Places, including artifacts, records and material remains related to such a property or resource.

**Landmark Alteration Certificate** – All exterior changes to a property designated as an individual landmark or located within a historic district requires review and approval through a Landmark Alteration Certificate (LAC).

The intent of the design review process is to ensure that proposed changes will not adversely affect or destroy their historic character or architectural integrity and that all changes are consistent with the spirit and purpose of the Landmark Preservation Ordinance.

**National Historic Landmark (District)** – A National Historic Landmark (NHL) is a building, district, object, site or structure that is officially recognized by the United States government for its outstanding historic significance. The Colorado Chautauqua National Historic Landmark District is significant as an outstanding representation of America’s first truly national mass educational and cultural movement.

**Non-Contributing Resource** – A property that, due to its date of construction, alterations or other factors, does not contribute to the district’s historic significance or character.

**Opportunities** – Changes in usage or context or perception that could be put in place to have a positive impact on the site.

**Resilience** – the ability of a community to prepare for and respond effectively to shocks and stressors.

**Secretary of the Interior Standards for Rehabilitation** – The Secretary of the Interior Standards are a series of concepts about maintaining, repairing and replacing historic materials, as well as designing new additions or making alterations to historic resources. “Rehabilitation” is defined as “the process of returning a property to a state of utility, through repair or alteration, which makes possible an efficient contemporary use while preserving those portions and features of the property which are significant to its historic, architectural and cultural values.”

**Sustainability** – Responsible interaction with the environment to avoid depletion or degradation of natural resources and allow for long-term environmental quality.

**Vulnerabilities** – Potential impacts to the site, individual structures, or usage that emanate from risks or threats (natural or man-made) to the site.

## INTRODUCTION AND SUMMARY

When a tourist, student or family member first arrives in Boulder and asks about the top places to see, the inevitable response always includes Chautauqua. Part community center, part educational facility and part residential neighborhood, The Colorado Chautauqua National Historic Landmark District (Chautauqua NHL District<sup>1</sup>) has been a gateway to both cultural events and the beautiful Colorado landscape since its founding in 1898. The Auditorium is host to the Colorado Music Festival every summer as well as a variety of theater, dance, film and lecture events. The Dining Hall serves breakfast, lunch and dinner year-round as well as holiday tea and catering for private events. Many of the cottages are available for both short and long-term rentals. Overlooking these historic buildings are the Flatirons, Boulder’s stunning rock formation that attracts both casual hikers and professional rock climbers to its faces.

The architecture of the Chautauqua NHL District provides a unique look into Boulder’s history. One of only twenty-five National Historic Landmarks in Colorado, the Chautauqua NHL District has been carefully preserved by the Colorado Chautauqua Association (CCA).

As detailed in the 2018 report, *The Impact of Climate Change: Projected Adaptation Costs for Boulder County*, Boulder is projected to be impacted by rising temperatures, greater intensity of precipitation events and a

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1 The official historic designation given to the Colorado Chautauqua is referenced by the National Park Service as The Colorado Chautauqua National Historic Landmark District. Other names listed include Texas-Colorado Chautauqua, Chautauqua Park, Texado Park. For clarity purposes this document will refer to the Chautauqua NHL District or Chautauqua as appropriate when referring to either the historic resource boundary area and Chautauqua when referring to the movement or the use.

greater risk of wildfires among other issues. The Chautauqua NHL District will not only incur these risks, but also is threatened by the vulnerability of its contributing historic resources<sup>2</sup>—the buildings, structures and objects—and associated archaeological site and landscape features. Established in 1898, the cottages and public buildings were designed with materials and systems that are vulnerable to the projected changes in the environment. Creating a comprehensive sustainability and resiliency strategy that not only accounts for these changes, but also provides realistic strategies for adapting to and accommodating these changes, is critical to the continued survival and success of the Chautauqua NHL District. Creating this strategy is complicated because the District is essentially a public park belonging to the residents of Boulder with a number of public and private entities operating within its boundaries. These include CCA, private cottage owners, the City of Boulder’s Parks and Recreation Department, and Open Space and Mountain Parks.

Since its establishment in 1898, the Colorado Chautauqua has been a place to connect with open space, have unique entertainment experiences and feel a connection with the past. The Chautauqua NHL District is not just a place, it is a piece of Boulder’s identity that is increasingly in danger of being “loved to death,” meaning the community needs to address the ever-increasing numbers of visitors to the Park.

The Sustainability and Resilience Strategy is a collaborative effort between the Colorado Chautauqua Association

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2 The Chautauqua NHL District is composed of historic resources which are both “contributing” (ie those buildings, structures or objects which add to the historic integrity or architectural qualities that make the district significant) and “non-contributing.”

and the City of Boulder with the specific goal of aligning and coordinating the various stakeholders in the historic district toward a common strategy for the Colorado Chautauqua NHL District.

The focus of this report, which comprises the first of three stages in the development of the Sustainability and Resilience Strategy, is to outline vulnerabilities within the Colorado Chautauqua NHL District identified by the Resilient Analytics team. The report details these vulnerabilities across a number of key categories; historic context, infrastructure, community, precipitation/flooding, fire and drought. These are placed within the context of climate projections indicating increases in extreme precipitation events, temperatures and droughts. This report will be followed by stage two: resiliency and sustainability solutions; and stage three: strategic planning and implementation.

## Historic Context

The Chautauqua movement began in 1874 with the New York Chautauqua Assembly on the shores of Lake Chautauqua, in upstate New York. This “Mother Chautauqua” served as an educational summer camp for Sunday school teachers as well as a hub for leisure activities. As more people migrated to big cities, the Mother Chautauqua served as a place where people could learn about and relax in nature. Within ten years, several daughter Chautauqua assemblies popped up across North America. These new chautauquas were all independent of each other, but they held the same core values of educating and entertaining the public in a natural setting.

In 1898, Texan investors founded the Texas-Colorado Chautauqua as a summer camp with cooler weather for

Texas teachers. The City of Boulder raised funds to purchase the land and construct the Dining Hall and Auditorium, while the Texas-Colorado Chautauqua Association provided the rest of the funds needed for daily operations. The inaugural summer of the Texas-Colorado Chautauqua featured no less than 94 speaking events, as well as music performances and lessons; classes in the sciences, languages and literature; motion pictures; burro and horseback rides; hikes along the Flatirons and stagecoach rides to other scenic areas around Boulder.

For its first summer, attendees lived in 12x14x6 ft tents because none of the cottages had been completed. For the next several years, cottages slowly replaced the tents until no temporary housing remained. The first cottages in 1899 were advertised as having “electric lights, gas, hot and cold water, sewer connections, stained floors and artistic corners.”

In 1924, the peak attendance year for chautauquas around the country, over forty million people visited various chautauqua locations. At that time, the Colorado Chautauqua held about forty evening musical programs during the summer season, as well as many lectures and motion pictures. However, with the Great Depression and World War II, at the advent of television and radio, the popularity of chautauquas began to decline. The number of summer programs decreased, and the deteriorating Auditorium mainly showed second-run films during the 1950’s. By 1974, the City of Boulder was planning to demolish the buildings and structures to make way for a new events center.

*Daily Camera* editor, Laurence Paddock, changed the Colorado Chautauqua’s fate by applying to list the Audito-

rium on the National Register of Historic Places. When the listing went through in 1978, the city changed its plans. Instead of demolishing Chautauqua, it would restore the property. In 1987, Colorado Music Festival was formed, and the Auditorium quickly became the festival's home. Over the next two decades, CCA and the City of Boulder worked to return Chautauqua to its early-20th-century roots. More live music and lecture events were added to Chautauqua's schedule and a children's summer camp was created for kids to learn about the outdoors. Second run films were discontinued in 1995, replaced with a silent film series featuring live piano accompaniment. Finally, the Dining Hall was restored, and the food service was contracted out to Three Leaf Concepts, turning the Dining Hall into the destination restaurant that it is today.

Once part of a thriving outdoor education movement, the Colorado Chautauqua is one of only a few chautauquas that has continuously operated since its founding. Despite the decline in popularity across the country, the heart of the chautauqua movement remains alive in Boulder.

Today, the Colorado Chautauqua serves a diverse group of stakeholders. The rental cottages remain a vibrant part of the Chautauqua NHL District, attracting visitors from around the country and owners of private cottages come back each summer to see old friends and to experience a Colorado Chautauqua summer. Concurrently, user demand for the Colorado Chautauqua NHL District, for picnics, hiking and school field trips continues to grow.

In response to the diverse group of stakeholders who use the Colorado Chautauqua, together with the extended history of the site, the ownership and governance structure of the site includes multiple entities. Specifically, the

City of Boulder owns the 40 acres of land underlying the Colorado Chautauqua NHL District, along with the Auditorium, the Dining Hall and the Academic Hall. The City has leased 26 acres of the land and those buildings to the Colorado Chautauqua Association (CCA)—the 501(c)(3) steward of the Chautauqua NHL District—since CCA's founding in 1898. CCA owns the Community House, the Missions House Lodge and the Columbine Lodge as well as 61 of the 99 cottages on the premises. The other 38 cottages are privately owned, with the land subleased to private individuals by CCA. All buildings are subject to Landmark Design Guidelines administered by the City of Boulder.

### *Historic Designation and Design*

The architectural and historic significance of the Chautauqua NHL District is formally recognized with national and local designations. The Auditorium was first listed individually on the National Register of Historic Places in 1974. The historic designation of the entire Chautauqua complex was expanded in 1978 when the property became a city of Boulder Landmark Historic District and a National Register of Historic Places District. In 2006, the nomination of the property as The Colorado Chautauqua National Historic Landmark District was accepted by the National Park Service.

Critical to this resilience and sustainability planning effort is the understanding of what resources are contributing to the historic significance and which are not. The Colorado Chautauqua NHL nomination lists a total of 137 resources on the property. Of those, 102 are identified as contributing and 35 are listed as non-contributing<sup>3</sup>.

<sup>3</sup> Contributing resources include 87 buildings, seven structures, seven

In considering alterations and additions to the site, the various review bodies apply the NHL period of significance which is 1898 to 1930.

The *Chautauqua Historic District Design Guidelines* (Chautauqua Design Guidelines) were adopted by the City of Boulder's Landmarks Board in 1989 to ensure the careful preservation of the Colorado Chautauqua NHL District as "a unique rural enclave on the edge of a dense urban grid." Amended several times over the years, the Chautauqua Design Guidelines encourage appropriate alterations to the historic resources and landscape features within the Chautauqua NH District. Supplemental to the Chautauqua Design Guidelines are the Landscape Guidelines developed by CCA "to promote good design for the site (hardscape, paving, etc.) and for plantings and to encourage participation by all parties to meet this vision." This document provides guidance on materials, sustainable practices, methods for rehabilitation of historic features and design of new improvements. Both documents provide helpful information for the City of Boulder, CCA and property owners within the Chautauqua NHL District, with the Design Guidelines establishing precedence in the application of the Secretary of the Interior's Standards for Rehabilitation.<sup>4</sup>

The City of Boulder's Landmarks Advisory Board (Landmarks Board) was established with the passage of the Historic Preservation Ordinance in 1974 "to protect,

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sites (archaeological), and one object. Noncontributing resources total 35 with 20 buildings, five structures, three sites, and seven objects.

<sup>4</sup> The Secretary of the Interior's Standards for Rehabilitation is used by the Landmarks Board in considering the appropriateness of an architectural treatment on a historic resource.

enhance and perpetuate buildings, sites and areas of the city reminiscent of past eras, events and persons important in local, state or national history..."<sup>5</sup> The Landmarks Board uses both the Chautauqua Design Guidelines and the *General Design Guidelines for Boulder's Historic Districts and Individual Landmarks* (General Design Guidelines) drafted in 2007 to review applications for any exterior changes.<sup>6</sup> CCA's Building and Grounds committee refers to the Chautauqua Design Guidelines in their review of alterations in the leasehold.

In recent years, CCA has prioritized making the Chautauqua NHL District environmentally sustainable. These efforts include upgrading building insulation and infrastructure, energy conservation and developing a robust waste diversion program including recycling and composting. The stated goal of CCA is to make Chautauqua the most sustainably operated National Historic Landmark in the country.

In considering the vulnerabilities of the Chautauqua NHL District to the various climate-related hazards associated with the property and the desire of CCA to prioritize

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<sup>5</sup> The full mission of the Landmarks Board is "to protect, enhance, and perpetuate buildings, sites, and areas of the city reminiscent of past eras, events, and persons important in local, state or national history or provide significant examples of architectural styles of the past... also ... to develop and maintain appropriate settings and environments for such buildings, sites, and areas to enhance property values, stabilize neighborhoods, promote tourist trade and interest, and foster knowledge of the city's living heritage."

<sup>6</sup> As stated in the General Design Guidelines, "the intent of the design review process is to ensure that proposed alterations of Landmark properties will not adversely affect or destroy their historic character or architectural integrity and that all changes are consistent with the spirit and purpose of the Landmark Preservation Ordinance."

environmental sustainability at the site, the City of Boulder, CCA and the cottage owners must take into account the opportunities presented for adaptation and how they will impact the historic character of the buildings, structures, objects and landscape features of the district. As well, the potential for disturbing potentially contributing archaeological resources within the 40-acre boundary will need to be considered with any project application to the city and CCA designated review bodies.

Of note is any change to the historic resource's location, elevation, material, form or any other alteration that may impact the individual resource's or the district's historic integrity.<sup>7</sup> A Landmark Alteration Certificate (LAC) is required for projects that may alter either the exterior of a historic resource or the district itself. The criteria for the Landmarks Board review of LAC applications proposed work on historic resources addresses the following:

- Does it preserve, enhance or restore and not damage or destroy the exterior architectural features?
- Does it not adversely affect the special character or special historic, architectural or aesthetic interest or value?
- Is the architectural style, arrangement, texture, color ... and materials compatible with the existing resource or the district?
- If demolition is proposed, would the new construction meet the above criteria?

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<sup>7</sup> Integrity is defined by the National Park Service as "the authenticity of a property's historic identity, evidenced by the survival of physical characteristics that existed during the property's historic or prehistoric period." Qualities considered in determining integrity include location, design, setting, materials, workmanship, feeling, and association.

- It is therefore essential that the opportunities proposed for adaptation and alteration of the individual buildings, structures and objects (and the associated environment of the site) within the Chautauqua NHL District be assessed with the same criteria as applied through the LAC design review process.

## Vulnerabilities Assessment

The first of three steps in developing the Sustainability and Resilience Strategy is the Vulnerabilities Assessment:

- Step 1. Vulnerabilities Assessment
- Step 2. Vision Refinement/Options Development
- Step 3. Development of Sustainability and Resilience Strategy

The goal of the Vulnerabilities Assessment is to provide an objective analysis of the current and projected vulnerabilities at Chautauqua. The assessment places identified vulnerabilities in the context of the systems that exist within the Chautauqua NHL District, both physical and virtual. Physical systems include transportation, energy, ecology and infrastructure and capture the threats to the physical operation and built environment. Similarly, virtual systems include the neighborhood and economic systems that influence and are in turn influenced by operations within the district.

The current study is not intended to replace the large number of existing studies that have been completed for the Chautauqua NHL District. Rather, it is intended to provide a forward-looking analysis of the potential threats

the site is facing and the potential opportunities for addressing these threats and placing them within an overall sustainability and resilience strategy. The study also builds upon efforts that are already underway at CCA to build resiliency and sustainability. CCA is actively working with the City of Boulder through the Climate Mobilization Action Plan, the Open Space Master Plan and Boulder County's Hazard Mitigation Plan.

The Vulnerabilities Assessment is critical to understanding and assessing vulnerabilities facing the Chautauqua NHL District and serves as base datum in developing options to mitigate the effects of climate change.

### Summary of Assessment

The Chautauqua NHL District is facing significant threats from projected climate change. Of concern are vulnerabilities from heat, fire, wind, increased precipitation and increased energy demand as a result of rising temperatures. The scenarios resulting from changes in each of these environmental factors project increased damage to the infrastructure supporting the district. Roads, pathways, drainage swales, electrical infrastructure, cultural landscape and ecological features are at risk as a result of projected changes in the local climate. Additionally, the historic resources are facing increasing pressure from changes in precipitation velocity and the potential for flood damage.

Multiple entities are responsible for upkeep and maintenance, including CCA, the City of Boulder's Parks and Recreation Department, Open Space and Mountain Parks, Public Works and the Historic Preservation Program. A key goal of the sustainability and resilience strategy is to

better align the priorities of these stakeholders in order to plan for the long-term preservation and use of the Chautauqua NHL District.

Finally, the property is challenged by increased use by local residents and out-of-town visitors. Recreational enthusiasts are increasing their presence in the facilities and along the adjacent trails. Demands for more public amenities are a potential threat to the historic "camp like" simplicity associated with Chautauqua. In response, CCA has been proactive in examining solutions to enhance sustainability of the site while meeting demands for greater access. The 100 Resilient Cities study identified key issues such as energy independence as foundational issues going forward. This focus on how to balance demand with sustainability is the starting point for Phase Two of the Resilience and Sustainability Strategy.

## ANALYTICAL FRAMING AND DEFINITIONS

### Systems Approach to Identification and Assessment

The assessment is based on a multi-component, systems approach that includes an analysis of both quantitative and qualitative information in addition to review of relevant Chautauqua NHL District studies and interviews with identified stakeholders. Although individual vulnerabilities form the foundation of the current study, to place these individual vulnerabilities in context, a systems approach to evaluation has been adopted for the overall analysis of the Chautauqua site. Individual issues identified are grouped within a context of the broader systems they support. A systems perspective provides an analytical framework that reflects the uses and support of the Chautauqua site. The following subsections outline the systems identified in the current study.

### Transportation System

The transportation system within the Chautauqua NHL District incorporates both the physical infrastructure that supports transportation and vehicular traffic. The transportation system also includes the non-motorized support for transport within the Chautauqua site which includes both bicycle traffic and pedestrian circulation. In terms of the physical infrastructure to support vehicular traffic, the road network both within Chautauqua and accessing Chautauqua are the essential components. Within Chautauqua, the road network includes the primary roads (Kinikinic Road, Morning Glory Drive and Goldenrod Drive), the secondary alleys and the main access roads (Baseline

Road and 12th Street). These roads support the primary vehicular traffic that approaches Chautauqua and moves within both the park and the Historic District. In addition to the primary road system, non-vehicular traffic brings in the addition of the primary walking and hiking trails adjacent to the District, Bluebell Road and Enchanted Mesa Trail. Finally, the popularity of bicycle traffic within Boulder places significant bicycle traffic in the Historic District along both the main vehicular Roads as well as the adjacent trails. Together, this network and its users comprise the Transportation System.

### Infrastructure System

Outside of the transportation system is the physical infrastructure that supports Chautauqua. This includes among others that support the site, the stormwater system, water distribution system, the power distribution system and the communication systems including both telecommunications and information systems. These systems combine to form the support network for the Chautauqua site and for the activities that occur within the District. These systems vary by age to include both historic power systems and more modern telecommunication systems and extensions of the stormwater system.

### Neighborhood System

While neighborhoods may seem unusual to include as a system perspective, the integration of Chautauqua with the surrounding neighborhoods comprise a key historic and demographic component within the city. From a geographic perspective, Chautauqua is integrated into the

western edge of the city. It combines with the early 20th Century neighborhoods adjacent to the District accessible from Baseline Road to form one of the original residential neighborhoods of Boulder. These neighborhoods include some of the most expensive areas within the city as well as some of the most publicly engaged neighborhood populations. Issues such as traffic (visitor and local) and Open Space protection are common elements that join the District with these neighborhoods. Additionally, these neighborhoods are tied together through their common risk from natural hazards including floods and wildfire. These common issues serve to join Chautauqua with the adjoining neighborhoods into a single Neighborhood System that must be addressed in terms of any proposed changes to the district.

### Economic System

The visits to the Open Space surrounding Chautauqua, the visitors to the Chautauqua public spaces including the auditorium and the dining hall, and the visitors to the Historic District that stay during the summer are all vital components of the economic system that Chautauqua anchors. As a magnet for out-of-town visitors as well as locals, the Chautauqua site is part of Boulder's economic engine. This perspective places the Chautauqua site within a broader system of the economics surrounding the city. As such, any proposed changes that may reduce the attractiveness of Chautauqua to either local visitors or out-of-town visitors must be considered within the context of a broader economic impact to the city.

### Ecological System

The ecology of the Chautauqua District has been altered over time just as the ecology within Boulder has been altered as the city has grown since its founding in 1859. Over the period of historic significance from 1898 through 1930, the ecology has been transformed from high prairie grasses to one which includes mature trees, lawns and gardens. These transformations have occurred alongside wildlife habitat that includes bear, deer and many small mammals as well as birds, insects, reptiles, and amphibians. The balance in this ecology and its susceptibility to impacts by both humans and natural events, is a factor that adds to the complexity of the Chautauqua site. Suggestions regarding potential changes to the ecology of the District consider this ecology as a delicate system.

### Cultural System

The location selected for the settlement of Chautauqua was prescribed for the movement as one to "be located in rural or semi-rural spots, in order to provide restful, healthy and inspiring surroundings."<sup>8</sup> Thus, historically this site represents a cultural system which both influences and reflects the city. The Chautauqua NHL district represents a subculture within its surrounding neighborhoods in Boulder.

The aesthetic character and use of the buildings, the gardens, the swales and even the materials used in the retaining walls combine to create a physical presence that

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<sup>8</sup> Andrew Reiser, *The Chautauqua Moment: Protestants, Progressives, and the Culture of Modern Liberalism* (New York: Columbia University Press, 2003), 221, 229. (As referenced in the Colorado Chautauqua National Historic Landmark nomination.

defines the cultural values of Chautauqua. The importance of understanding and protecting cultural systems is underscored by the National Park Service which refers to a “cultural landscape” as revealing “aspects of our country’s origins and development through their form and features and the ways they were used.”<sup>9</sup> Thus, identification of cultural values as expressed in the built and natural features of the site is referenced in the *Chautauqua Park Historic District Cultural Landscape Assessment and Plan*.

“The very nature of the Chautauqua as a seasonal establishment made the setting and grounds at Chautauqua Park very important to the Boulder community. From its beginnings, Chautauqua Park provided educational programs in a unique natural setting. Today, Chautauqua Park remains true to its historic purpose, offering outstanding programs in a spectacular setting. It continues to be home for many summer and winter residents who reside in its historic cottages.”

The purpose of knowledge acquisition and discovery on which the Chautauqua was founded, the continued cultural events presented in the Auditorium and the multi-generational tradition of visiting Chautauqua, have combined to create a cultural ecosystem that makes Chautauqua unique within the mountain west. This cultural system has been protected through design guidelines, historic designations and a strong commitment to the ideals around which Chautauqua was founded. Sustaining this cultural system requires a joint effort between the City of Boulder, CCA and the residents that utilize the site from

<sup>9</sup> Charles Birnbaum, ASLA, Preservation Brief 36: Protecting Cultural Landscapes: Planning, Treatment and Management of Historic Landscapes.

around the country and the globe.

## Built System

While the Chautauqua NHL District comprises several systems as described, the buildings and structures themselves create a system that works together to create a specific contextual feel. Specifically, the built system comprises historic resources that are contributing and non-contributing to the historic significance of the buildings, structures and objects. In terms of the former, the public buildings (auditorium, dining hall, community building) and the cottages combine to define the architectural context of the Chautauqua NHL District. These historic resources are character-defining elements which contribute to the historic significance of the property and support some of the key aspects of integrity including setting, design, materials, workmanship and historic association throughout the period of historic significance. Non-contributing buildings and structures such as the ranger station play a supporting role by providing additional service and access functions for the property. Together, the buildings, structures and objects form a Built System that represents the historic aesthetic of this National Historic Landmark District.

## Site Visits

A key component of the vulnerabilities study was the site visits that allowed the team to observe multiple aspects of the Chautauqua site. Individual visits focused on specific items including wildfire risk, flood risk, drainage, building risk, landscape opportunities, Open Space adjacencies and historic significance. These site visits enhanced ex-

isting knowledge by the team of the Chautauqua site. This last point is significant as the team comprises individuals with a combined knowledge of the Chautauqua site exceeding 70 years. This existing knowledge combined with specific knowledge gained from site visits with experts in individual areas provided the specific knowledge required to identify the vulnerabilities for the study.

### Interviews and Public Meetings

The broad scope of issues associated with the Chautauqua NHL District required the team to conduct a series of interviews with experts from different constituencies to provide key information required for the analysis. Experts from the City of Boulder Fire Department, Boulder County Open Space and the City of Boulder public works department as well as the Department of Transportation all provided key inputs for the study. Additionally, the team worked closely with employees of the Colorado Chautauqua Association to gain detailed knowledge of existing approaches to sustainability and resilience. The team will continue to conduct these interviews throughout the project to obtain information on specific issues as necessary.

In addition to interviews with experts, the team received moderate input from the public stakeholders to the project. In a series of public meetings with cottage owners as well as the general public, the team presented the study and initial results to obtain feedback. Comments including the scope of the project, specific areas of concern by the public, and timelines were taken into account as the vulnerabilities were detailed in this report.

### Review of Past Studies

A number of studies from the Colorado Chautauqua Association, the City of Boulder and Boulder County have been completed over the last several decades that provide foundational context for the current study. The team used these studies to obtain background and contextual knowledge for the current study. Key within these studies is the *Colorado Chautauqua Association Strategic Plan of 2015* which outlines the vision for Chautauqua in 2030. The vision statement articulates three key values—spirit, heritage and resiliency. Key to this planning effort are the last two.

Heritage references the blended community of cottagers and visitors and the role of Chautauqua in Boulder’s history. Resiliency envisions a Chautauqua which is “physically, environmentally and financially resilient” with “continuous reinvestment in Chautauqua’s historic buildings, beautiful grounds and critical infrastructure.” A property “devoted to increasingly sustainable practices, including fire and flood prevention, energy and water conservation and waste management [and] alternative energy sources” with the expectation that people come to Chautauqua “by free and frequent transit” to experience “pedestrian-friendly grounds...safe, accessible and welcoming to all.”<sup>10</sup>

CCA strategic focus areas which most directly relate to this sustainability and resilience study are historic preservation, buildings and grounds, environmental leadership, operational excellence and community partnerships. Specifically, this study attempts to balance the opportunities for sustainability and resilience adaptation against the

<sup>10</sup> *Colorado Chautauqua Association Strategic Plan*, November 16, 2015.

following strategic objectives:

- Preserve and protect the historic character of the 87 buildings, seven structure, seven sites (archaeological), and one object, together with 26 acres of historic grounds;
- Invest in and preserve buildings and grounds;
- Continue to improve infrastructure;
- Address access, circulation and parking issues;
- Implement best practices in sustainability of resources across all operations;
- Optimize building performance to further reduce resource consumptions;
- Explore opportunities for producing energy;
- Adapt in order to maintain resilience in the face of climate change;
- Actively sustain capital and non-capital investments;
- Implement best practices in sustainability of resources across all operations; and
- Work collaboratively with existing partners to ensure mutually beneficial objectives.

The Colorado Chautauqua National Historic Landmark Application, provides a description of the property’s historic significance, an assessment of the level of integrity and a brief narrative of each of the 102 contributing historic resources. The nomination specifically calls out a “high degree of integrity of location, design and setting” with evidence of “meticulous attention to workmanship and materials” contributing to the 1898-1930 period of

significance.<sup>11</sup> Character-defining features are specifically identified and include: stone gutters and swales, red-colored Lyons stonework, retaining walls in random rubble or ashlar pattern, one-story rectangular wood frame cottages with front porches and horizontal or vertical siding, simple gabled or hipped roofs of moderate pitch and double hung windows with plain surrounds.

In addition to CCA’s Strategic Plan and the National Historic Landmark nomination, the Collaborative Stewardship of the Colorado Chautauqua document in 2012 provided key guidelines describing how CCA and the City of Boulder are to collaborate on overseeing the Chautauqua, including the key concept of Collaborative Place Management.

Of specific relevance to the current project and the understanding of the vulnerabilities associated with the site are the reports focusing on the design elements of the site. These reports reflect both the needs of the site as well as the preferences laid out in the 1989 Design Guidelines for the site which highlight the physical attributes to be retained.

From a technical perspective, a key document in this study is the stormwater analysis conducted by Mundus Bishop Design in 2002 which identified many of the stormwater issues. Similarly, the City of Boulder Resilience Strategy (Resilience Strategy) authored in 2017 and funded by the 100 Resilient Cities effort, provides an initial look at the importance of resilience strategies to address issues such as flooding and wildfire which threaten the Chautauqua NHL District. The Resilience Strategy highlights the

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<sup>11</sup> Martha Vail, PhD. *Colorado Chautauqua National Historic Landmark Nomination* (September 2005) 4.

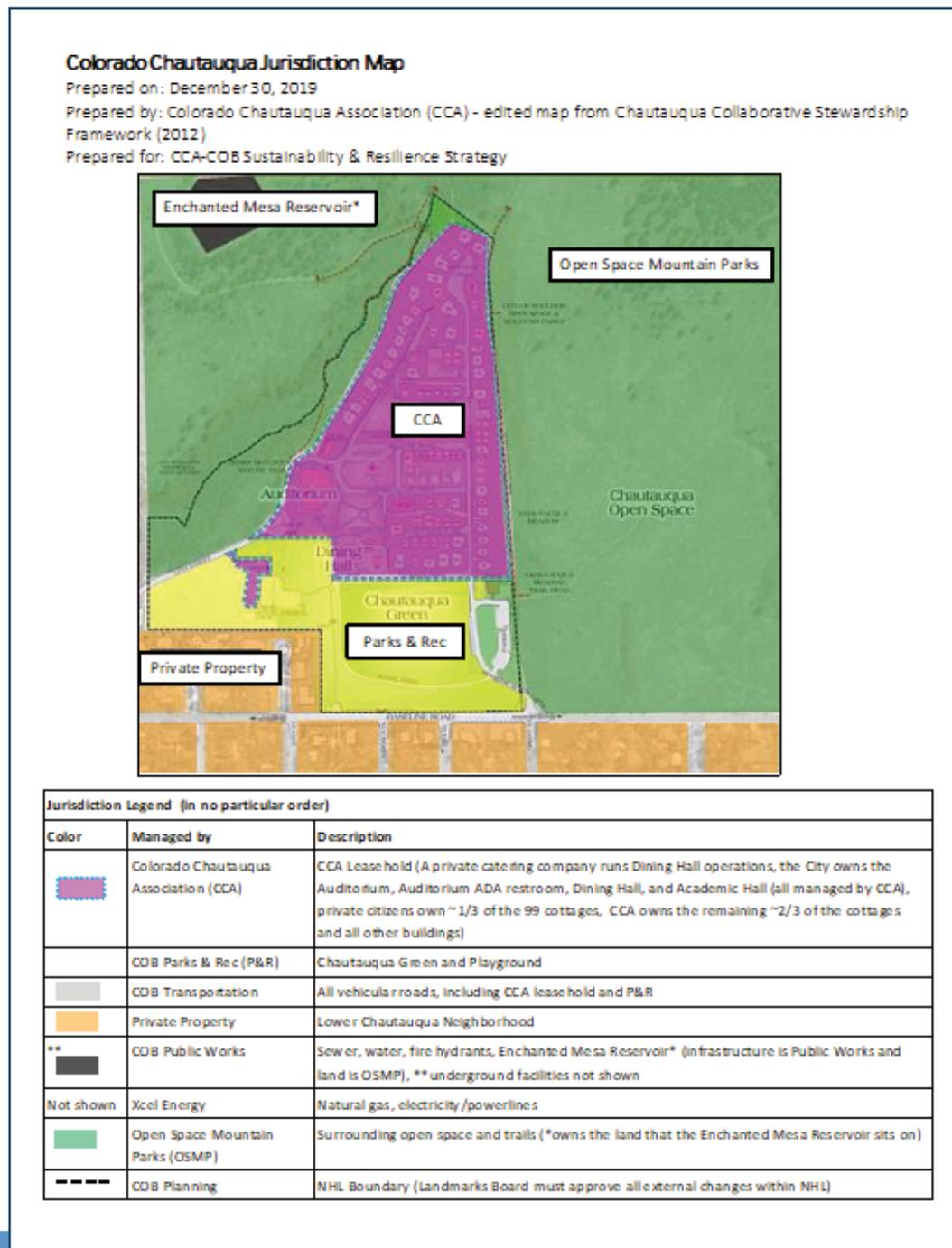
importance of Open Space conservation to the city as it states: “The roots of our community’s robust open space system date back to 1875 to 1929 when the city acquired over 5,000 acres, including Chautauqua, Buckingham Park (in Left Hand Canyon) and much of the mountain backdrop.”

The information, research and technical assessments of the combined studies provides the foundation for the current effort and provides a strong backdrop on which to move forward with resiliency and sustainability planning for the Chautauqua NHL District.

### Ranking of Vulnerabilities

The conclusion of this report provides a ranking of the vulnerabilities according to the potential impact of these vulnerabilities on the site as well as the timeline in which these risks may be realized. This ranking is based solely on the potential impact and risk. The ranking does not yet include the incorporation of stakeholder preferences or considerations of the impact on local and global tourism. Rather, the first ranking focuses on the threat to the site and its continued availability as a principal attraction within Boulder. Similarly, the opportunities are currently focused on the opportunity to address the risks identified in this first part of the study. The opportunities do not incorporate the political and stakeholder considerations that will be included in the final recommendations document.

Figure 1a: The Chautauqua NHL District sits between Open Space and City of Boulder neighborhoods.



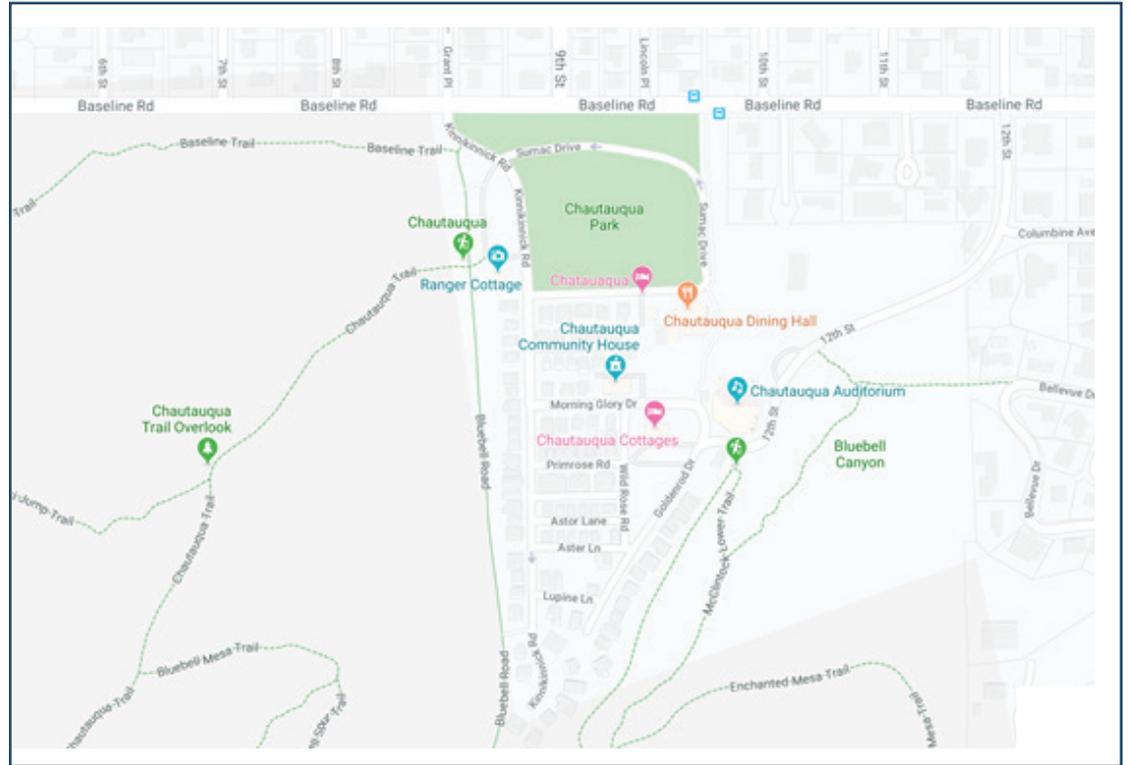
## CURRENT CONDITIONS

The Colorado Chautauqua has existed in its current location for more than a century. Over this time, the site has undergone a series of modifications in the landscape ecology. The site has transformed from a high prairie landscape to one that combines semi-arid conditions with highly curated gardens and lawns. Similarly, the buildings slowly transformed from tents to simple cottages to elaborate vacation homes in some cases during the period of historic significance. This transformation is reflected in the current conditions under which the vulnerabilities assessment study has been conducted. These conditions are summarized in this section.

### Location and Physical Attributes

As illustrated in Figures 1a and 1b, the Colorado Chautauqua is situated at the western edge of the Boulder. It is bordered on the west, south and southeast by Boulder County Open Space and Mountain Parks. On the northeast border and the northern border, the site is adjacent to Boulder neighborhoods. The neighborhoods themselves originating at the turn of the 20th Century. The neighborhoods provide historic context for the site in that it is located within the broader western historic area of the city. However, the Chautauqua site is self-contained within its borders which reflects its independent development and thus creates a design and ecological context that is unique to the site.

The City of Boulder owns the 40 acres of land underlying the Colorado Chautauqua NHL District, along with the Auditorium, the Dining Hall and the Academic Hall. Since its founding in 1898, the city has leased 26 acres of the land and those buildings to the Colorado Chautauqua



*Figure 1b: The Chautauqua site sits between Open Space and City of Boulder neighborhoods.*

Association (CCA)—the 501(c)(3) steward of the Chautauqua NHL District. CCA owns the Community House, the Missions House Lodge and the Columbine Lodge as well as 61 of the 99 cottages on the premises. The other 38 cottages are privately owned, with the land subleased to private individuals by CCA. All buildings are subject to Landmark Design Guidelines administered by the City of Boulder.

The site slopes from the high point at the southern tip down to the lower point at the northern edge of the site. There is a secondary slope from west-to-east which creates a natural flow pattern from the western edge of the

site down to the eastern edge and then north to natural flood basins within the Chautauqua NHL District.

City of Boulder Open Space land borders the western edge of the site with foothills that lead up to the Flatirons. The Open Space is characterized by meadow with few trees before reaching the higher elevations of the Flatirons. On the eastern edge, the site is bordered by Bluebell Canyon which has a seasonal stream that creates a riparian environment conducive to deciduous trees as well as wildlife. The topography drops down from the Chautauqua NHL District towards the bottom of Bluebell Canyon and then rapidly rises to the eastern side of the Canyon.

### General Conditions

The condition of the Chautauqua NHL District is remarkably good considering the age of the buildings, owing to regular maintenance and responsible stewardship by CCA and the City of Boulder.

The buildings can be divided between the public buildings and the cottages. The 99 cottages, 38 of which are privately owned, range from 65 to 120 years old, and vary from small one-bedroom cottages on raised foundations to larger buildings that in some cases have basements and enclosed porch areas. The cottages follow strict design guidelines and are generally, but not always, characterized by open eave roofs, fence-free yards and front porches. The cottages are in predominantly good condition given that they are wood construction. However, many of the cottages are showing the impact of exposure to water as well as extended exposure to freeze-thaw cycles. Much of this exposure appears to be superficial in nature and, in general, the cottages appear to have retained structural

integrity over time in large due to regular maintenance by CCA and most private property owners.

The public buildings are predominantly constructed of wood and show typical exposure to the Colorado climate. Several studies have been commissioned over time to examine the public buildings and they have made recommendations concerning structural and exterior improvements. These improvements are actively being reviewed and implemented by CCA as they conform to the historic Chautauqua Design Guidelines. However, there is still concern for the Auditorium, in particular, for its ability to serve as an entertainment venue with changing environmental conditions. Similarly, the Dining Hall and the Community House face challenges with changing conditions, but at this time appear to be in good condition.

While the buildings are in relatively good condition, the current conditions of the roads and paths are less favorable. Due to exposure to water and vehicular traffic and increased heat, the asphalt surface of the roads and pathways has deteriorated and, in some cases, should be considered as failed. Similarly, the historic stone drainage swales alongside the roads have significantly deteriorated over time due to soil movement and weather exposure. And finally, the drainage areas are seeing increased erosion due to precipitation and flooding events. Figures 2 through 4 illustrate the degradation of the infrastructure within the Chautauqua NHL District.

In contrast to the roads and formal pathways, the natural landscape is in good condition in the public



*Figure 2: The road surfaces within the Chautauqua site are being damaged by heat and precipitation.*

areas. The Chautauqua Green, one of the most important elements of the NHL District, is Boulder's oldest public park and remains a top attraction while the hiking trails are well cared for and well-used. The main garden areas are well cared for and remain a focal point. Similarly, the lawns and landscaping around the public buildings remain in good condition. In contrast to these landscape elements, the lawn areas adjacent to many of the cottages are in fair condition with challenges from increased precipitation events causing erosion around the natural areas.

Similar to some of the challenges faced by the landscape areas due to changing conditions, many of the retaining walls surrounding the district are failing due to increased water pressure from increased precipitation events.

As one of the first communities in the Boulder area to receive electric power, the electric power infrastructure at Chautauqua appears to be very old and significant investigation is needed to determine if it can meet future energy needs of the site. Currently, energy usage is met through energy generation by Xcel Energy who also owns the delivery infrastructure at Chautauqua NHL District. All the buildings are separately metered for natural gas and electrical consumption. Except for a few cottages, all buildings are heated with natural gas. There are currently no renewable energy sources employed. However, discussions continue as to whether energy independence is appropriate for the Chautauqua NHL District. Whether it is independence or augmentation, serious consideration must be given to the future energy needs of the site as increasing temperatures will result in greater demands for air conditioning and similar temperature control approaches.

### Cultural Landscape

Changes in the Colorado Chautauqua include not just the buildings but the cultural landscape including roadways, swales, formal and informal, paths, stairs, mature vegetation, gardens and associated structures including shelters, bridges and fountains. The landscape, its development and evolution over time, is a critical component to the history and human interaction with the environment at Chautauqua. The Colorado Chautauqua has had many influences that shaped the environment, including individual cottage owners, various community projects, as well as the paths that were created by the needs of the community. Any changes suggested must work with the community and the history that came before.

The Cultural Landscape Assessment (CLA) created for the Colorado Chautauqua Association, is an important reference document regarding the historic features of the landscape. It outlines the



*Figure 3 The Chautauqua site has a long history of battling water drainage issues with the historic stormwater system.*



*Figure 4: The retaining walls throughout the Chautauqua site are experiencing degrees of failure as increased water pressure, soil movement, and age are combining to threaten the stability of the walls.*

phases of construction of the property, the changes over time and recommends how to maintain the character defining features of the landscape. This plan does not outline the preservation issues with the physical structures found at Chautauqua, but is specific to the pathways, the gardens, the trees, the view corridors, the street grid, the drainage, etc. Adherence to the recommendations formulated throughout the CLA report allows the visitor to the property to experience the National Landmarked property as it was intended by the founders.

Changes over time are accounted for in the report, while those changes that have undermined the original intent have recommendations for remediation. While some of the recommended changes and restorations have happened since the date the CLA report was published in 2004, multiple items are still left to account for. This includes replanting trees in the locations recommended by the report, taking down trees that obscure view corridors, etc. The item that is specified with some detail as a character defining feature of the property, is the rebuilding of the historic stone drainage ways, also referred to as drainage swales. The stones need to be reset, asphalt from driveways and roads need to be removed and the swales require attention in general to allow them to function as they were originally intended. While the CLA is a lengthy document, the recommendations are limited and assist with maintaining the heritage that is paramount to the Colorado Chautauqua's longevity, viability and charm.

## Usage Profile

The long history of the Chautauqua has created a demand from users that extends from a short visit for a picnic or hike to stays that extend throughout the summer season to year-round residents. This demand is reflected in the high visitation rates experienced by the Chautauqua NHL District.

## Community Cohesion/Identity

The Chautauqua has a unique identity within the Boulder community. Arguably more than any other location in Boulder, the Chautauqua NHL District is viewed by locals as their own. Locals feel strongly that they have a voice in the future of the site and any changes that may be proposed. Similarly, cottage owners and seasonal visitors feel strongly about protecting the look-and-feel of the site and its commitment to its original goals of education and outdoor experiences. This identity is demonstrated through the strong participation in community events, community governance and in protecting the overall identity of the Chautauqua NHL District and its surrounding Open Space.

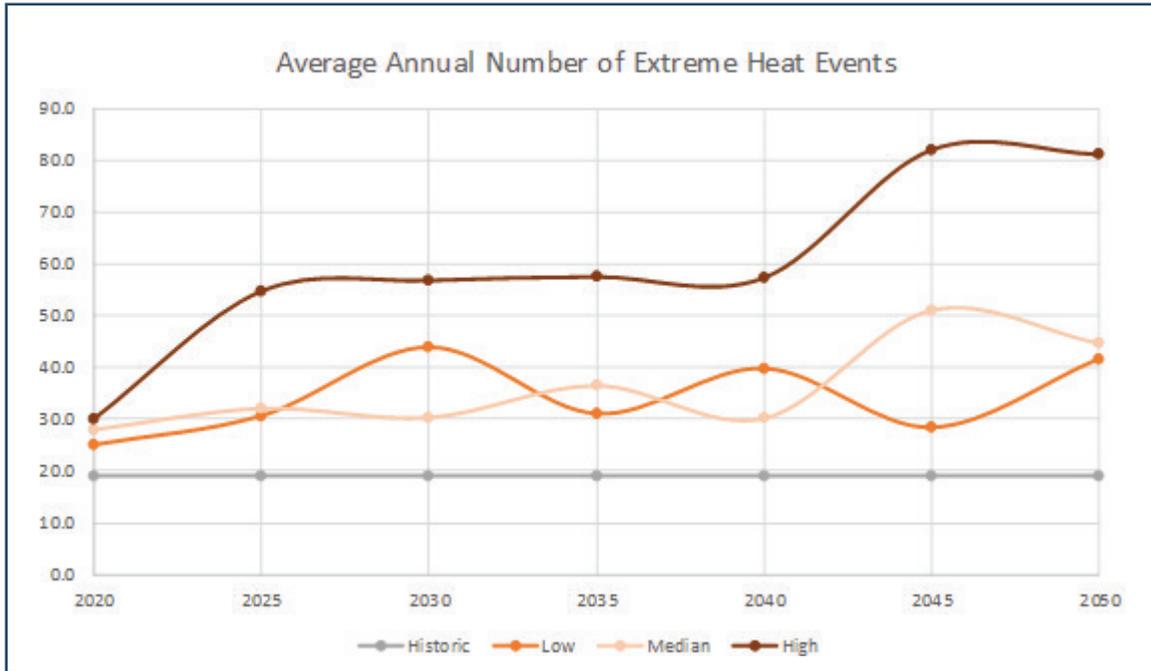
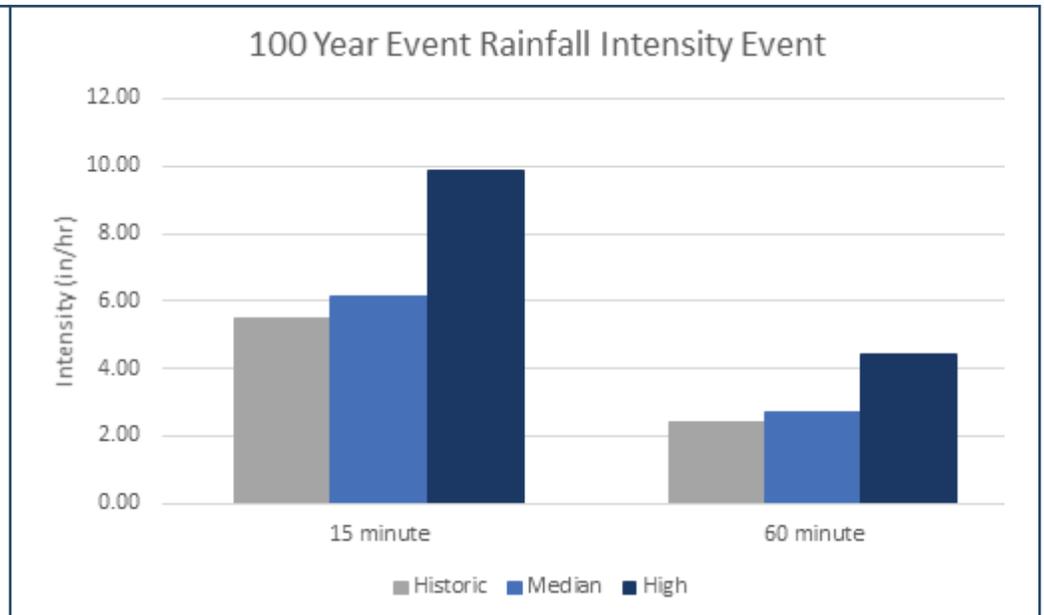
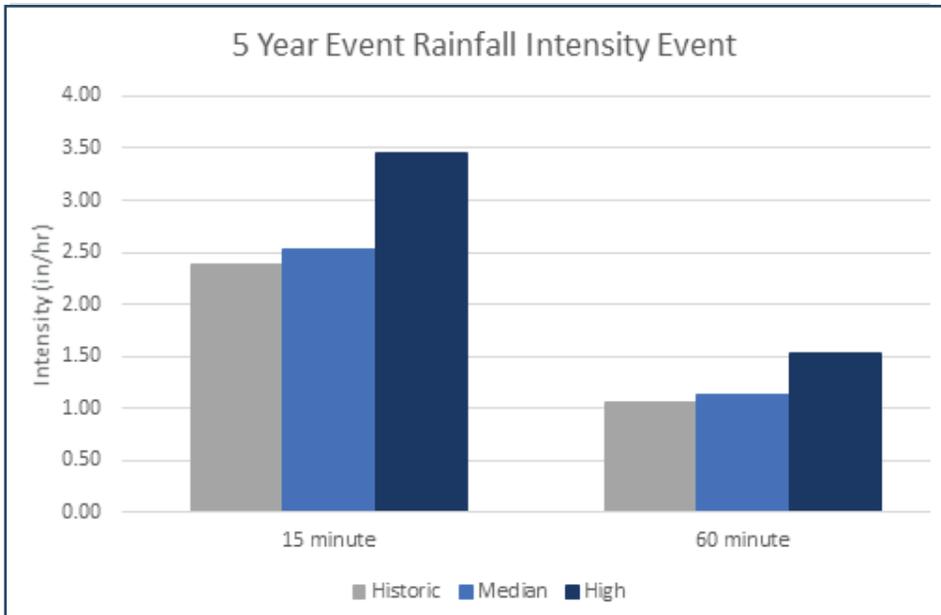


Figure 5: The climate models project an increase in extreme events (temperatures over 95 degrees) in the Chautauqua region over the next several decades.

Figure 6a (below left): The high climate models project an increase of approximately 45% in intensity of the 5-year precipitation event in the Chautauqua region over the next several decades.

Figure 6b (below right): The high climate models project an increase of approximately 80% in intensity of the 100-year precipitation event in the Chautauqua region over the next several decades.



### THE CLIMATE CONTEXT

The historic context of the Chautauqua NHL District is characterized by its wood buildings between 60 to 120 years in age. The buildings have remained in generally good condition through a century of Colorado winters and summers. These buildings are built out of wood and are more susceptible to environmental factors and hazards than those constructed of masonry. However, there are ways in which the buildings and structures may be made more resistant to fire, flooding and wind events through alterations consistent with the Chautauqua Design Guidelines and the Secretary of the Interior’s Standards for Rehabilitation. Guidance offered by the National Park Service Guidelines on Flood Adaptation for Rehabilitating Historic Buildings is an important opportunity as the City of Boulder, CCA and cottage owners work together to increase the property’s resilience.

The key climate factors for the Landmark are outlined in this section based on one-sixteenth-degree and one-quarter-degree downscaled IPCC fifth generation climate models and Representative Concentration Pathway (RCP) scenarios. Forty individual climate scenarios provide a broad perspective on the potential scenarios that will impact the Chautauqua NHL District. The following sections provide the key findings for the key climate indicators.

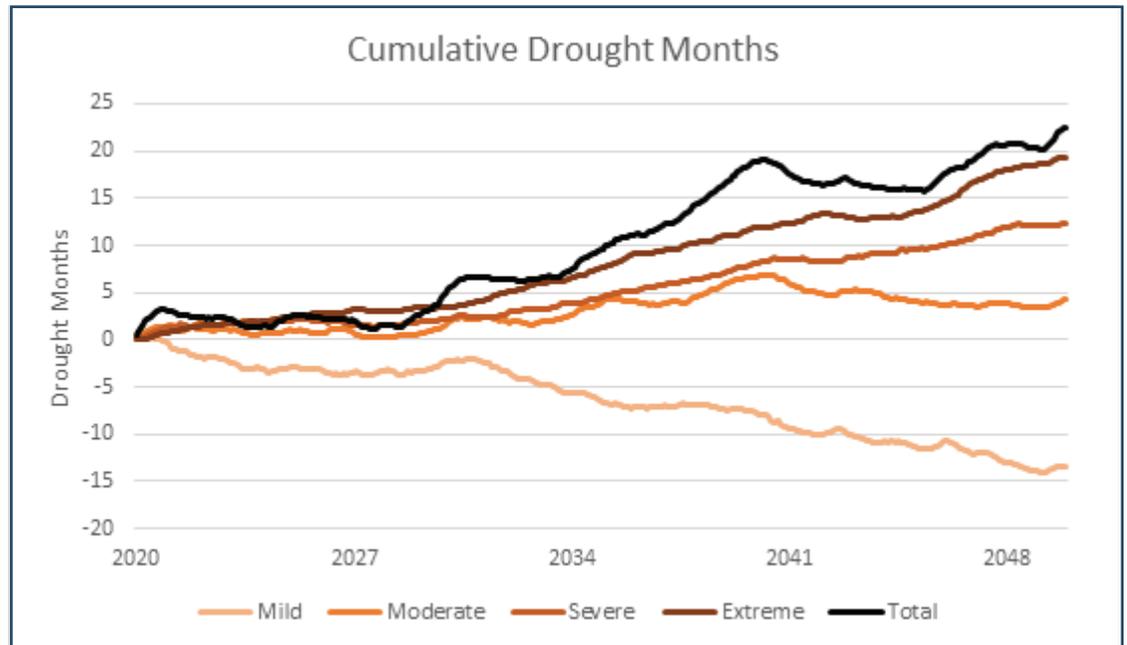
### Temperature

The first climate signature of interest in the study is temperature. As illustrated in Figure 5, there is a strong consensus among the climate scenarios that the number

Drought Category	Possible Impacts
Mild	Going into drought: short-term dryness slowing planting, growth of crops or pastures Coming out of drought: some lingering water deficits pastures or crops not fully recovered
Moderate	Some damage to crops, pastures Streams, reservoirs or wells low, some water shortages developing or imminent Voluntary water-use restrictions requested
Severe	Crop or pasture losses likely Water shortages common Water restrictions imposed
Extreme	Major crop/pasture losses Widespread water shortages or restrictions

Table 1: Possible impacts from each drought category according to the National Drought Mitigation Center

Figure 7 (below): The climate models project an increase in the number and type of drought events in the Chautauqua region over the next several decades.



of extreme heat days will increase over the next half-century. As illustrated, the Low and Median models indicate an increase in extreme heat days from 15 to 30 with a decade. The higher end models indicate this increase could result in over 50 days per year within a decade. When extended to mid-century, this number increases to over 40 days for the low and median models and to 80 days in the high models. The impact of this projection will be realized throughout the Chautauqua NHL District. Roads, vegetation, energy consumption and material weathering will each be altered as the temperature profile continues to emerge at the higher temperature levels.

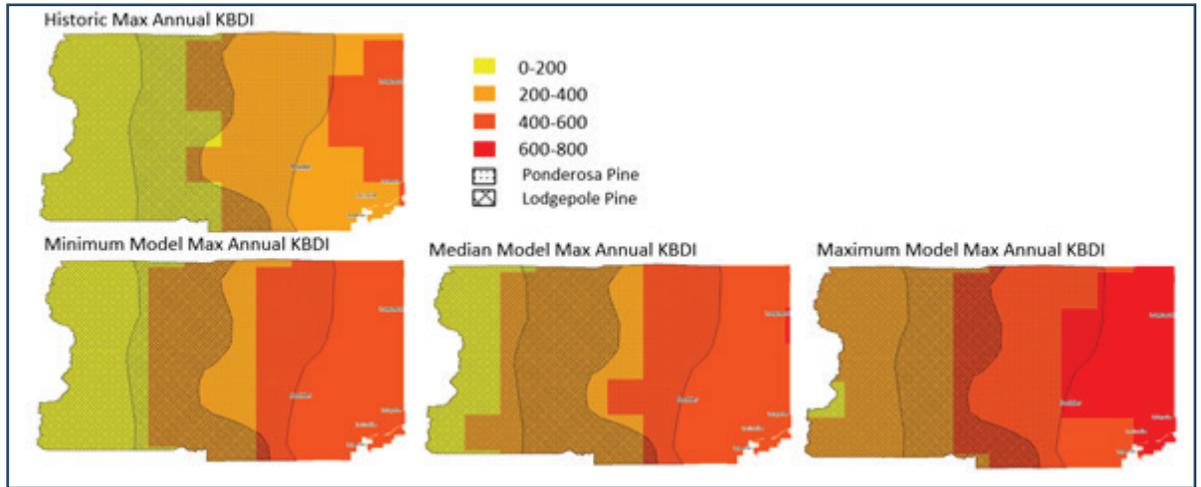


Figure 8 (above): The climate models project an increase in wildfire risk under all scenarios

### Precipitation Events

Precipitation in Boulder County in general and at the Chautauqua NHL District specifically is projected to remain essentially consistent over time in terms of overall amounts over a 12-month period. Although some models predict a general drying trend over time, there is greater variation between the climate projections than that seen in the temperature profiles. However, what does have more consistency is the projection of precipitation intensity in single events.

Figure 6a illustrates a 5-year precipitation intensity event at both 15-minute and 60-minute planning intervals. As seen, the historically in Colorado, based on precipitation measurements at numerous weather stations over the last 40 years, the 15-minute precipitation event is 2.4 inches per hour. This level is projected to increase to about 2.5 inches per hour and 3.5 inches per hour over the next 30 years for the median and high model respectively. This is a 5 percent to 45 percent increase over historic levels.

Similarly, Figure 6b illustrates the 100-year event for precipitation intensity. As illustrated, the historic level is 5.4 inches per hour in a 15-minute event and 2.4 inches per hour in a 60-minute event. Over the next 30 years, the median and higher end models indicate an 11 percent to 80 percent increase over these historic levels in the volume of water that will fall on the site in a 15-minute and 60-minute period.

The increase in precipitation intensity will have an impact on each of the vulnerability areas. Infrastructure, buildings, vegetation and fire risk are all impacted by the projected changes in precipitation. The following sections addressing the specific vulnerabilities will highlight the impact that these precipitation events will have on each area.

Table 2 (below): KBDI severity levels

KBDI Range	Fire Potential
0-200	Low
200-400	Moderate
400-600	High
600-800	Very High

### Drought Events

The combination of changes in temperature and precipitation result in changes in projected drought events. As illustrated in Figure 7, the type of drought events will change over the next 30 years in the region. Table 1 details the possible impacts for each drought category. The number of mild drought events will subside. However, these events will be replaced by severe and extreme drought events.

While these drought events are concerning on their own, it is the combination of drought with heat and precipitation events that will lead to concerns. Specifically, the cyclical nature of droughts and precipitation events will impact soils, foundations, roofing materials and vegetation. And these impacts will be increasingly negative as the cycles intensify.

### Wildfire

In the last 30 years Boulder County has witnessed numerous wildfires that have caused extensive damage to county lands and Boulder County structures. In total, wildfires have burned more than 16,000 acres and destroyed more than 260 structures. Under projected climate scenarios, extended periods of droughts and higher temperatures could lead to an increase in wildfire activity, which will make the area even more vulnerable to wildfires.

The Keetch-Byram Drought Index (KBDI) is used to analyze future fire risk. The KBDI is this the most widely used index for wildfire monitoring and prediction. The KBDI index is categorized into four different severity levels indicating the amount of risk for forest



Figure 9 (above): Drainage patterns at Chautauqua.

fires that exists for a given area (Table 2).

The historic and projected changes in KBDI for Boulder County are illustrated in Figure 8. As illustrated, the maximum KBDI increases for the majority of Boulder County under all climate models. This indicates that the level of threat for the County increases based on the projected changes from the climate models. The areas of ponderosa pine that are closest to the Chautauqua NHL District are especially vulnerable.

(Below) Equation 1

$$Q=C*I*A$$

Where:  
 Q = Rate of runoff (cfs)  
 C = Runoff coefficient (dimensionless)  
 I = Design rainfall intensity (in/hr)  
 A = Area (acres)

## VULNERABILITIES

### Water and Drainage

The Chautauqua NHL District sits in a location that is unequalled. The Flatirons sitting above it to the west and Boulder Valley lying at its base to the east, positions the Chautauqua NHL District in a special place in the city of Boulder. However, this same location is the root of its challenges. Specifically, in terms of water, the location of the district on a hillside with slopes falling away to the north and east creates a natural setting for water to rush down its paths, alleys and roads to evolve from a peaceful runoff to a damaging current. Although the site has been spared from significant flood damage until now, floods remain a concern. Both the Auditorium and the Community House took in water at their lowest levels in the 2013 flood and would likely be damaged in any future flood events.

Within the realm of water challenges, as evidenced by previous drainage studies such as the stormwater study in 2002, the overall theme that threatens the long-term sustainability of the Chautauqua NHL District is drainage. As illustrated in Figure 9, the drainage patterns that are dominant at the site are either directly downslope to the north out to the main lawn and further to Baseline Road or down through the alleys to the east and then north to the single stormwater inlet adjacent to the Auditorium.

The natural extents of the site determine that the grading is steep for effective stormwater management. Steep slopes are typically defined as greater than 25 percent. Currently the site is graded in a way that serves sheet flow across the site with the goal of concentrating water and diverting water at the low points of the site.



*Figure 10 (top row): Examples of drainage damage to roads and areas between cottages.*

*Figure 11 (bottom row): Examples of drainage damage to roads, areas between cottages, and retaining walls.*

These two paths not only follow the roads and alleys, but also extend through the areas between the cottages and through the open spaces. In each of these spaces, as well as the roads, water not only flows across the spaces, but it also brings debris with it to its final pooling area. In the case of the Chautauqua NHL District, this debris includes road surface material, soils, plant material, as well as oils and other liquids that exist on the various surfaces.

In 2002 a drainage assessment was conducted by Muller Engineering Company, Inc. The assessment identifies the Academic Hall, Community House and Dining Hall as the three most vulnerable buildings based on discussions with the maintenance staff and residents. The assessment calculates flow rates using the Rational Method for a variety of sub-basins in and around the site. The Rational Method equation can be seen below.

Equation 1 shows that the amount of runoff is directly proportional to the design rainfall intensity. An increase in rainfall intensity will proportionally increase the rate of runoff for each sub-basin. Therefore, the projected 5-year rainfall intensity increase of 5 percent and 45 percent and 100-year increase of 11 percent to 80 percent will result in an equivalent percent increase in the rate of runoff. This will result in more localized flooding as the current systems will not be able to handle the additional increases in flow.

As illustrated in Figures 10 and 11, these increases in flows is resulting in water damage at the site and is therefore a key vulnerability. As illustrated, the continuous draining of water leads to a slow destruction of the roads. The weakening of the subbase by the water creates a vulnerability that is exacerbated by the traffic running over the roads as well as the lack of alternative direction for the water to travel. For the alleys, the use of gravel as a surface material creates a vulnerability where the material is regularly washed away in intense precipitation events. Compounding this issue is the existence of the historic swales running alongside the roads. These rock lined swales are becoming increasingly uneven and eroded over time as the base is eroded beneath the swales.

The area between the cottages is an area where immediate attention is required as the increasing intensity of precipitation events is eroding soil and materials that are critically needed to retain water. In cases where the neighboring cottages are located on the slope of the site, primarily on the east and west sides of the neighborhood, the erosion has left neighboring down-slope cottages vulnerable to runoff from upslope cottages. This is resulting in dampness in the crawl spaces and subsequent challenges such as mold and rot. This vulnerability will continue to grow as increasingly significant precipitation events begin to occur



*Figure 12 (top left): The Chautauqua Auditorium lies at the junction of multiple drainage patterns creating a vulnerability to precipitation and flooding events.*

*Figure 13 (bottom left): The Chautauqua Community House lies at grade with exposed windows creating a vulnerability to precipitation and flooding events.*

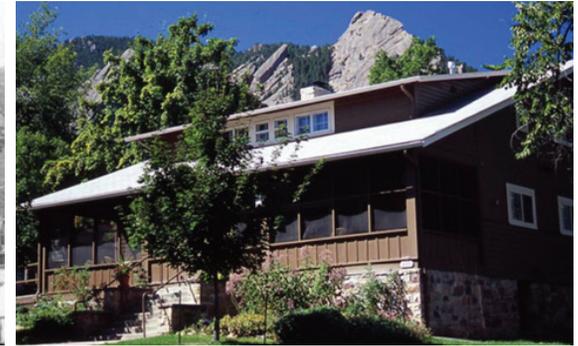
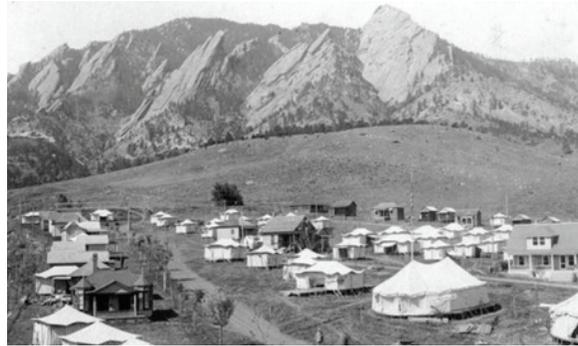
*Figure 14 (right): Increased pressure from water is causing the failure of retaining walls on the eastern side of the Chautauqua site.*

over the next decade.

The buildings and structures at Chautauqua have an additional vulnerability to these increasingly intense precipitation events. Specifically, as wood materials continue to age, they are more susceptible to swings in temperature and moisture that occur with changes in drought and heavy precipitation. At Chautauqua, this aging may result in subsequent cracking unless protection schemes are developed for the wood. Specifically, as wood ages, it can become more brittle and lose some ability to resist the stresses resulting from the expansion and contraction of temperature extremes. This potential issue is not limited to the cottages but will be significant in every building at the site. Of particular concern is the Auditorium, Community House and Dining Hall which are all situated at the bottom of the slope and likely to receive large amounts of water and materials originating higher up on the site.

In terms of the Auditorium, its location adjacent to the single stormwater inlet at the site (Figure 12) will likely cause a back-up of the stormwater system and cause localized flooding with increasingly intense precipitation events. The recipient of these floodwaters will be the Auditorium on its west side. This is a vulnerability that must be addressed before it leads to the damage of the building's foundation.

Similarly, the Community House is significantly at risk from increasing precipitation events as its southern side is at grade and the window wells will inevitably be exposed to water damage (Figure 13). Enhancing the effect will be the lawns that have been planted around the building that retain relatively small amounts of water. In essence, the site is currently funneling water and debris toward the



public buildings and is projected to increase this movement, which eventually will impact these buildings.

In addition to the buildings, the increasing movement of water at the site is resulting in retaining walls being threatened at multiple points as a result of hydraulic pressure from saturated soil, particularly around the upper tennis court area and along the eastern border (Figure 14). The increasing pressure being placed on these walls from trapped water as well as the failure of the soil from increasing cycles of drought and intense precipitation, are an immediate concern.

## Fire

The Chautauqua NHL District is threatened by fire from every side. The original high prairie ecosystem that existed prior to the establishment of the Chautauqua has slowly evolved over time due to human intervention. The open grasses and sparse trees at the site have been replaced by gardens, lawns, shrubs, shade trees, as well as hardscape. What once was a site that offered fuel for little other than a grass fire, now provides fuel for a broader and more intense wildfire scenario (Figure 15a). Additionally, the

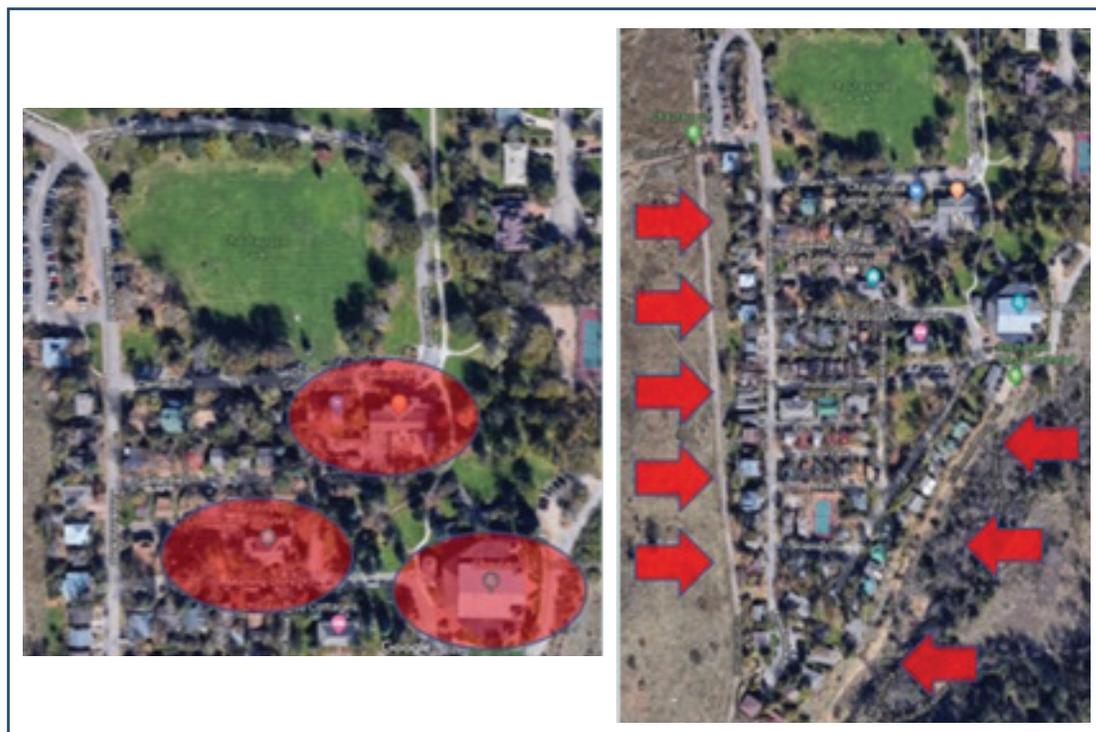
*Figure 15a: The Colorado Chautauqua location was once a high prairie environment with few trees or other vegetation besides prairie grass. Today, typical buildings are framed by landscape and vegetation. (Image left: courtesy of Boulder History Museum; image right: courtesy of Colorado Chautauqua Association)*

Open Space & Mountain Parks land property surrounding the property on three sides is overgrown with years of fuel and the neighborhood on the north side creates a continuous path for fire to burn through to the adjacent northern and eastern the neighborhoods (Figure 15b).

In addition to the wildfire element, the Chautauqua NHL District and surrounding neighborhoods have electric power infrastructure that is amongst the oldest in the city. With electric lighting dating back to the founding in 1898 and multiple electric poles dating back to at least 1910, the electricity infrastructure was designed for a different set of environmental conditions. This historic infrastructure raises concerns as to its fire safety considering projected increasing winds as well as interactions with the vegetation now surrounding the poles.

As illustrated in Figure 15b, no building at Chautauqua is safe from fire. Rather, a fire in any building or structure, with winds that accompany a fire event, could conceivably result in destruction of the Chautauqua NHL District. It would take planning for rapid response from the city to prevent such a disaster.

This is especially true now that the defensible area around the buildings is limited. Ideally, each building should have at least three feet of defensible space for firefighting, yet many buildings have almost no defensible space. Currently, there is no city or CCA regulation to enforce this criterion. On all sides of the site, the areas where firebreaks could occur, the defensible space is being reduced as vegetation continues to proliferate. Specifically, gardens are being extended to the west, trees are encroaching on properties to the south and vegetation is encroaching on the west. Slopes on the east side of



the neighborhood have accumulated leaf litter and other debris. Figure 14 illustrates how the natural landscape has intertwined with the buildings on the south side of the site. In all cases, the encroaching natural space is reducing potential response time from fire crews.

Some of the structural issues that increase fire risk include eaves without soffits. Rotten eaves, in particular, pose a fire risk from blowing embers.

### *Wildfire Risk from Surrounding Open Space*

From an Open Space perspective, the increasing usage patterns in Open Space (discussed separately below) is raising the potential for a human caused accidental fire.

*Figure 15b: The Chautauqua location is threatened by fire from every side. This threat impacts both the public and the private areas. The left figure indicates specific areas within the site that are of particular concern, while the right figure indicates threats from external sources,*

Additionally, the paths that form a divide between the open space on the east and west sides realistically are insufficient to serve as a fire break in the event of fire (Figure 16).

While no recent fires have occurred within the Chautauqua NHL District (although some have been geographically close to the area) wildfire mitigation has been minimal. The only known thinning occurred in the Enchanted Mesa area in 2009 and no prescribed burns have occurred in recent history (Wanner 2019). Wildfire mitigation activity by OSMP, guided by the city’s Forest Ecosystem Management Plan and the Wildfire Fuels Mitigation Officer, works to reduce the canopy and the tree density. While there is some fuel build up, high recreational use has a mitigating effect on wildfire because of “more eyes on the ground” which creates immediate reporting. Similarly, illegal camping and associated starts, is not a problem in the area. The relatively dense network of trails is helpful for potential firefighting.

The district is surrounded by grass land, deciduous vegetation in drainages and low elevation Ponderosa forest. The risk on each side of the district is distinct based on fuel type and fire breaks:

- West side – The grass fuels on the west side pose the lowest risk. Bluebell Road creates a fire break. OSMP has discussed resurfacing Bluebell Road to improve emergency access. Resident sometimes request mowing along Bluebell Road, but the city avoids that as it encourages weeds. Bluebell Mesa further west is hard to thin because there is no good access for tree removal and slash burns are not feasible.
- South side – This area is the weak point because



there are dense fuels and no fuel break. Some work has been done to create defensible space by both the city and private owners. Figure 17 illustrates how the natural landscape has intertwined with the buildings on the south side of the site.

- Southeast/Enchanted Mesa – The city did some prescribed burns in 1990 but currently it is too dense to burn and mechanical thinning needs to happen first. Some city staff believe that the likeliest fire that would affect the district would be a fire that started further south and driven by wind.

*Figure 16 (top left): Open Space adjacent to the Chautauqua site is reducing the natural fire break between the open space areas and the start of the historic district.*

*Figure 17 (top right): Natural vegetation encroaching on buildings is eliminating defensible areas around structures.*

*Figure 18 (bottom right): The wood interior and exterior of the public buildings is placing an extreme risk on the buildings from the threats of fire*

- East side – On the east side is the McClintock drainage. This area comprises mostly deciduous trees which do not pose significant fire threat. Emerald Ash Borer will soon kill the green ash, which will then need to be cleared to prevent fuel build up. The dead fuel on the ground (remaining from the 2013 flood) is not perceived as a threat because the embers are not as dangerous. The McClintock area has been thinned and restored with native woody shrubs (chokecherry).

As a final concern, the public buildings need to be critically analyzed for their ability to resist fire. The Auditorium, Dining Hall, Community House, are constructed of wood that has dried out over the decades and will be increasingly susceptible to fire especially during intensifying periods of drought. Because of their public functions and iconic representation, steps to address their fire risk in the near-term is of critical importance (Figure 18).

### Heat

The increasing temperature profile is creating new vulnerabilities for both the built and natural environment. In terms of infrastructure, the vulnerability of roads and buildings to heat is also exacerbated by the need for increased power. Similarly, the natural environment is fundamentally different to what existed during the 1898-1930 of historic period of significance.

### Infrastructure

The impact of heat on infrastructure is first highlighted by the impact on roads. Specifically, as illustrated in Figure 19, the asphalt on roads breaks down in extreme heat



events. With the increasing traffic and size of vehicles traversing these roads, the breakdown of the roads is accelerating.

This effect is seen in several areas. First, the area of the roads throughout the site that are adjacent to the rock-lined swales is failing as the cracking of the road surface is aggravated by the connection to a different material. Second, the heat is causing the surface of the roads to soften and result in severe cracking through-

*Figure 19 (top row): The increasing temperature profile at Chautauqua is causing roads to break down as asphalt surfaces are not design for the environmental conditions at the site.*

*Figure 20 (bottom row): Historic power lines at the Chautauqua site are creating increasing concerns about the ability provide increased power as well as the likelihood of a fire event from power lines sparking dry vegetatio*

out the site. While the move to shuttles has reduced some of the immediate issue in terms of the number of vehicles, there is still a level of traffic on the roads that was not factored in when the roads were changed from gravel and dirt surfaces to a paved surface. This is resulting in a breakdown at an increasing rate. And finally, the combination of cracking with increased precipitation events is resulting in potholing that is exacerbated by increased traffic.

The increased heat profile is not limited to damaging roads. The heat signatures are anecdotally increasing the rate at which wood is deteriorating on the buildings. Increased swings in temperatures between summer and winter are regularly in extremes of 100 degrees or more between the seasons.

The third area of infrastructure that is becoming increasingly at risk due to the heat signatures is the demand for power within the Chautauqua NHL District. As temperatures continue to rise in the summer, both visitors and residents will increasingly demand the ability to install air conditioning in buildings. Cooling degree days (CDDs) is a metric used to estimate the amount of cooling that is needed in a certain area. Historically this metric was low enough that cooling was not widely used. It is projected that the number of CDDs will increase 25 percent to 50 percent by 2030 and 60 percent to 100 percent by 2050. The increases in air conditioning installations coupled with these increases in energy needed to cool the buildings will create a very significant increase in power demand.

As illustrated in Figure 20, it's questionable as to whether the historic power distribution systems can handle increased power distribution requirements. Additionally, the interplay between the power lines and the

natural environment should be raising significant concerns about the potential for power lines to cause a fire incident. As seen in California, the demand for increased power combined with the increasingly harsh summer environment is leading to catastrophic consequences. Consideration must be given to how to reduce the threat from historic power lines that are exposed to the increasingly harsh elements.

### Natural Environment

The heat signatures in the 1930s were notably lower from those today and even more so when compared to those projected for the 2030s. From this perspective, the strict adherence to historic norms must be questioned. The site is naturally high prairie. While this is not an advocacy for a return to this environment, it is increasingly apparent that the natural environment today is not sustainable.

Figure 21 illustrates how the vegetation surrounding the site is increasingly stressed during the hot summer months and how that increases the threat to the site

An additional concern for the site is the extensive use of Kentucky bluegrass. Kentucky bluegrass (bluegrass) is the most widely used lawn grass across the United States and is seen in many common areas and between cabins across the Chautauqua NHL District. There was a time when bluegrass was used as the default planting medium. However, due to the high-water requirements, intolerance to hot and dry summers, maintenance needs and limited water absorption abilities, reconsideration has been given to the frequent use of bluegrass. There are better alternatives to



*Figure 21: Vegetation in the summer months creates fuel for possible fires as it dries out due to lack of water.*



bluegrass, especially on areas that are low-traffic; need improved filtration or water retention; have less than 6 hours of sun per day; or have difficult or unusual watering, mowing or fertilization requirements.

### Circulation

Chautauqua is adored by people throughout the Boulder region and even internationally. For those who live in the Boulder region, a trip to the Chautauqua NHL District is considered a benefit of residing in the area. However, this love of the site is causing significant issues from a circulation perspective. As illustrated in Figures 22 and 23, heavy traffic from the city and within the District is placing stress on the infrastructure that never considered in the original planning of the site.

From an off-site perspective, traffic from Boulder is impacting both the east and west sides of the site. From the west, increased usage of Open Space is placing increased pressure on the site from users entering and using the site. From the east, users walking along Open Space paths are creating interactions with neighbors that are likely to generate calls for limitations to the site from adjoining neighborhoods.

Increased traffic is directly leading to the degradation of roads, the increasing incursion of people and traffic into natural areas and the enhancement of drainage areas as natural flow patterns are interrupted by erosion from traffic. Of particular concern are the alleyways between the cottages and the limited parking areas throughout the site that are seeing usage from vehicles that are much

*Figure 22 (left): Circulation from surrounding areas is placing stress on the site on the east and west boundaries.*

*Figure 23 (right): Circulation within the Chautauqua site is leading to the degradation of roads and incursion into natural environments.*

larger and heavier than the roads and parking areas were designed to accommodate.

## Open Space

As the adjacency to Open Space is a specific concern, a few notes about this are warranted as a specific vulnerability. The Chautauqua NHL District is surrounded on three sides by municipally owned land. To the west, south and east lies open space which is managed by the City of Boulder Open Space and Mountain Parks (OSMP). This open space is the “crown jewel” and the most visited open space in the open space system. The trails immediately surrounding the District (Chautauqua Trail, Bluebell Road, McClintock Trail, and Enchanted Mesa) see more than 600,000 annual visits. The recent OSMP Master Plan identifies “Ecosystem Health and Resilience” as the first of five focus areas. Adjacency to this open space network affects vulnerability in two directions – open space poses risks for the Chautauqua NHL District and conversely the district poses risks for open space (Figure 24).

Adjacency to open space likely reduces flood risk. Being surrounded by permeable surfaces reduces runoff into the District. Erosion from trails is minimal and drainage patterns largely protect the Chautauqua NHL District. The Chautauqua Trail, the primary access to the west, has recently been redesigned and resurfaced to reduce erosion and runoff and staff have discussed resurfacing the Bluebell Road which borders the district to the west. The network of trails could cause some channeling in a storm event.<sup>12</sup>

<sup>12</sup> VanderWoude, D., Lezberg, A., & Cseke, J. (2015). Undesignated Trails On Open Space and Mountain Parks Lands Inventory Report.

While activity on open space poses threats to the district, conversely, threats from within the Chautauqua NHL District pose threats to the open space. For example, a fire within the built area poses a potential threat to the thousands of acres of adjacent open space. Additionally, damage to Chautauqua NHL District could reduce accessibility of the park via closed areas from fire and washed out roads.



*Figure 24: Adjacency to Open Space creates an increasing challenge for the Historic District as greater number of visitors arrive at the site each year.*

## SYSTEMS – PROJECTED IMPACTS

The vulnerabilities identified in this study, both from existing threats and from projected climate impacts, will have impacts on different timelines. To assist in understanding these impacts and the timelines in which these impacts will manifest in the Chautauqua NHL District, the following sections place the impacts in terms of their systems and an impact timeline. The timeline is divided into three broad categories; short-term which is defined as within the next five years, mid-term which is defined as five-to-twenty years and long-term which is beyond twenty years. This timeline is intended to be a guideline rather than a prescriptive set of tasks as climate impacts and local weather events may change the timelines.

### Transportation System

The transportation system, both within the Chautauqua NHL District and the access routes into the site, is facing significant challenges. As discussed previously, the current condition of the transportation system is poor in many areas and the projected climate impacts will make these conditions worse.

#### Short-Term

- Surface treatments – An immediate concern for the vehicular surfaces as well as the paved walking trails is to upgrade the surfaces. Vehicular traffic combined with weather events is rapidly eroding the road surfaces and subsequently eroding the subbase of the roads and trails.
- Access routes – The current level of heavy vehicular traffic such as garbage trucks is putting extreme

wear on the surface and base levels of the roads as the trucks are heavier than the original vehicular traffic that was expected.

#### Mid-Term

- Drainage systems – As precipitation events are projected to become more severe, the lack of sufficient drainage will become more apparent. As it pertains to the transportation system, the lack of sufficient drainage will lead to continued erosion of the sides and base of the roads.

#### Long-Term

- Alternative transportation – The continued pressure on the Chautauqua NHL District to accommodate more visitors is not projected to end any time in the foreseeable future. As such, serious consideration will need to be given to alternative transportation solutions, both within the site and accessing the site.

### Infrastructure System

The infrastructure system is arguably the weak link within the Chautauqua NHL District. Energy, water and communications systems are all at risk due to increased demand by visitors.

#### Short-Term

- Stormwater management system – Stormwater management must be reengineered to reduce the dependence on the single outlet system on Morning Glory Drive as well as the reliance on the Baseline Road stormwater system. While the Chautauqua NHL Dis-

trict was fortunate in the 2013 flood to have received minimal damage, the natural flow patterns in the site are leading to excessive potential for flooding of the Auditorium and other downhill sites within the overall district.

- Energy system – As energy demand from visitors and cottage owners increases and air conditioning is added to the cottages, the energy system should be analyzed with these considerations. Similarly, as usage patterns change due to temperature variations, considerations must be given as to when peak loads are encountered at the site.
- Energy and communication – Both of these systems are at risk from increasing wind events due to the above-ground location of the utilities. An engineering analysis of the vulnerability of these systems to extreme events should be conducted to ensure their reliability and resilience during event scenarios.

#### Mid-Term

- Alternative energy supply – The desire for sustainability and resilience must include a concern for the sustainability and resilience of the energy supply and potentially considering energy independence. This requires a thorough examination of the alternative energy sources that are available and the location where these sources can be located on the site. Consideration should be given to placement of alternative systems on non-contributing buildings, structures or sites or on contributing resources in a manner that is consistent with the Chautauqua Design Guidelines.
- Drainage system – The existing drainage system that

brings water to designated areas is outdated and insufficient for extreme events. CCA should investigate a redesign of the system and the installation of alternative conveyance systems throughout the site.

- Retaining walls – Many of the retaining walls throughout the site are showing signs of distress due to age and water pressure. Each of the retaining walls must be examined by an engineer to determine the need for reinforcement or rebuilding.

#### Long-Term

- Power distribution – The continued health and reliability of the energy system will require a complete redesign of the distribution system within the Chautauqua NHL District. Relying on century old power poles is neither sustainable nor safe.

#### Neighborhood System

Moving forward, the adjacent neighborhoods will need to collaborate closely as climate concerns are likely to impact both areas similarly.

#### Short-Term

- Transportation – CCA must continue to work with the local neighborhoods on transportation planning. The implementation of the Chautauqua Access Management Plan has provided initial relief for traffic while the realignment of Baseline Road has added parking and reduced some pressure on the site. However, this is only the first step. A longer-term transportation plan that addresses day-users, bicyclists and residents must be developed in conjunction with the neighborhoods.

As more events are considered for Chautauqua and more visitors are anticipated, continued collaborative governance of the site, including input from all stakeholders is appropriate.

#### Mid-Term

- Communication – The City of Boulder and CCA have a good working relationship, but the needs of the Chautauqua NHL District and the surrounding neighborhoods require greater attention in order to reduce the potential for conflict between the stakeholders.

### Economic System

The economic system associated with the Chautauqua focuses on the ability of visitors from all backgrounds and economic levels to enjoy the site. However, this economic basis may be changing as cottages are in greater demand, entertainment becomes more costly and demand for the site increases.

#### Short-Term

- Structure and safety – The economic dependence of Chautauqua on; 1) visitors who are paying for events at the Auditorium and other public buildings, 2) visitors to the Dining Hall and 3) visitors staying at the cottages, creates a scenario where these buildings must remain in good operating condition. Therefore, a review of all buildings that have not been analyzed within the last five years should be undertaken on a detailed level to determine necessary improvements from both a structural and a safety perspective.
- Fees – The need for upgrades to the Chautauqua NHL

District on multiple fronts should open the door to a discussion on whether usage fees would be appropriate in some instances on the site. For example, these could be fees at the Dining Hall or on top of ticket prices at the Auditorium. With a historic site that has a goal of resilience, the question of where the income will be derived is appropriate.

#### Mid-Term

- Transportation and parking – Chautauqua is a tourist attraction for the city of Boulder. It is a part of Boulder's history. Ensuring that visitors have access to the Chautauqua NHL District should be a priority for the city and will require carefully assessing transportation and parking requirements by CCA.

### Ecological System

The tasks associated with the ecological system are diverse in nature as the ecology of the Chautauqua NHL District incorporates multiple landscape and wildlife species. The protection of this ecology while considering appropriate changes to support the resilience of the site is paramount to long-term sustainability of the site.

#### Short-Term

- Planting alternatives – The areas between the cottages which are often planted with grass are under stress from drainage issues. A review of all areas between cottages where lawn could be replaced by other landscape alternatives should be undertaken. Concurrently, alternative planting palettes should be developed to provide cottage owners and CCA with planting alterna-

tives.

- Water runoff – Opportunities to implement rain gardens or other landscape alternatives that can assist in reducing water runoff should be explored and recommended to cottage owners.
- General landscaping – A redesign of public areas throughout the Chautauqua NHL District should be undertaken to explore opportunities for replacing existing planting and hardscape with a palette that reduces water requirements.
- Tree canopy – A second design effort should be undertaken that looks at the canopy and the potential for both retaining the existing canopy and expanding the canopy prior to the anticipated increase in temperatures. This may have a corresponding effect of increasing wildfire risk and this should be considered in that context.
- Wildfire – The threat of wildfire has been present at Chautauqua since its founding. While the professional opinion is that the primary wildfire threat is from the southern tip adjoining Bluebell Canyon, dry conditions in any adjacent Open Space poses a hazard. As such, a long-term plan should be developed that emphasizes defensible space around each structure and which explores fire suppression technologies for the public buildings.

#### Mid-Term

- Planting strategies – The plans that were developed in the short-term recommendations for landscape changes should be translated into specific planting projects in the mid-term. Of primary importance is the

implementation of planting strategies to reduce water runoff adjacent to roadways and pathways.

- Lawn replacement – The strategic replacement of Kentucky bluegrass with appropriate planting palettes in common areas where the replacement would not significantly alter the historic character of the Chautauqua NHL District should be considered for implementation.
- Historic and ecologic period – A long-term plan should be developed which establishes what is the historic period of concern for the site’s ecology. Given this decision, a plan for altering the site to meet this ecological period should be developed.
- Responsibilities – An agreement between the City of Boulder, Boulder County, CCA and the local cottage owners should be developed that specifically outlines responsibilities for addressing wildfire concerns.

#### Long-Term

- Drainage – An implementation of landscape alteration should be considered that utilizes site features to assist in the transport of water through the entire site.
- Planting palettes – A set of recommended and approved planting palettes should be produced that limits the options for landscape to those that will provide ecological benefits to the overall site.

#### Cultural System

##### Short-Term

- Historic resources – The period of historic significance at the Chautauqua NHL District extends over several decades and represents a significant evolution of

historic resources both within the district and in the city of Boulder. Determinations must be made regarding the prioritization of resources and of treatment strategies for individual historic properties and for the district to meet sustainability and resilience goals. Adaptation may require changes in design to the buildings, structures and site critical for their preservation. This decision will inform the historic preservation and resilience planning effort.

### Long-Term

- Independence – The question of whether the Chautauqua NHL District is a specific site independent of the rest of Boulder, or if it is an integral part of the overall culture of the city and the region is a question that should be determined to identify a path for the next century.
- Cultural landscape – The Cultural Landscape Analysis leaves gaps in terms of what needs to be addressed in terms of retaining the cultural landscape. However, there are also very specific components of the study that have not yet been implemented. A long-term analysis of this cultural landscape is an imperative to retain continuity for the site.

### Contextual Built System

The existing built environment of the Chautauqua NHL District contributes significantly to the property's historic significance. The iconic public buildings are synonymous with the city of Boulder. Similarly, the cottages have created a connection between generations of visitors. This historic context established by the built environment

creates an opportunity for identifying how resilience and sustainability may conflict with the historic preservation values of CCA and the City of Boulder and how that conflict can be resolved.

### Short-Term

- Public building – The public buildings are constructed of century old wood or older in some instances. A review of these structures in terms of the latest fire suppression techniques needs to be undertaken.
- Wildfire and severe precipitation – A review of the Chautauqua Design Guidelines should be undertaken with specific focus on vulnerability to wildfire and severe precipitation events. The result of this study should inform CCA as to whether alterations in these guidelines are necessary.
- Water damage – The cottages on the western edge should be reviewed for possible water damage and mold infiltration due to drainage issues below these cottages.
- Auditorium – A historic conditions assessment should be completed for the Auditorium should be to determine whether the materials on the exterior or the interior could be modified to enhance protection from the changing climate.
- Structures – The support structures within the district including drainage swales, retaining walls, power poles, picnic areas and parking lots, should be reviewed for opportunities to alter these structures. Are these structures of historic significance or are there opportunities for upgrades that will enhance the ability of the site to withstand changing climate conditions?

### Mid-Term

- **Modernization** – The increased demand for changes to the cottages including the integration of air-conditioning, alternative energy sources and the building of basements, may require CCA and the City of Boulder to revise existing guidelines to specifically address these changes.
- **Walkability** – The lack of sidewalks and alternative walking paths to the main roads is placing increased stress on the roadways and the drainage swales. A plan to increase the walkability of the Chautauqua NHL District should be developed.
- **Services** – The increased use of open space, trails and picnic areas is going to be accompanied by increased demands for services for day visitors. Consideration for adding these services should be undertaken prior to the demand increasing. With changing temperature profiles, need for services such as food and beverage availability, shade structures and bathrooms may increase.

### Long-Term

- **Competition** – As CCA enhances visitor facilities with hotels and new recreation opportunities, the Chautauqua NHL District will be challenged with what opportunities, if any, it intends to add to match competing park areas.
- **Adaptation** – The cottages are a key character-defining resource within the Chautauqua NHL District. Consideration needs to be given to what adaptation actions will be recommended to encourage the rehabilitation of privately-owned cottages to ensure greater fire

and flood resilience, if priorities for adaptation are assigned to specific CCA-owned cottages and how alternative materials might be considered in treatment strategies.

## EXISTING AND PROJECTED OPPORTUNITIES

The current analysis of vulnerabilities and the development of a forward-looking strategy for resilience and sustainability provides an opportunity to look at the projected opportunities for the district into the future. This section outlines some of these opportunities that should be examined as this effort moves forward and by CCA outside of and in addition to this effort.

### Sustainable and Resilient Practices

CCA has been actively pursuing issues of sustainability and resiliency over the last decade. Of note are the efforts to: address building envelope deficiencies, implement energy-saving air conditioning systems, explore alternative energy systems, investigate the structural integrity of the Auditorium, continuous reviews of wildfire threats, collaborative work on the Baseline Road redesign and review the stormwater system throughout the site. Each of these efforts is being undertaken with a focus on the future resiliency and sustainability of the Chautauqua NHL District.

Similarly, efforts to investigate new trail and road surfaces, new planting strategies and alternative transportation strategies is advancing thinking on how to protect the Chautauqua NHL District. The current effort is not a start of investigating resiliency and sustainability. Rather, it is a continuation of a series of strong efforts already underway by CCA and the City of Boulder and an opportunity to build upon these efforts to create a long-term sustainability and resilience action plan.

### Community Involvement

As outlined earlier, Chautauqua is considered by many to

be a part of Boulder and belongs to the residents of Boulder. As such, the community has always been actively involved in the decision making around the site. While some may consider this long history of community involvement an impediment to efficient decision-making, it is in fact a decision-making tradition that is closely guarded by many Chautauqua stakeholders. Building on this tradition, the potential to obtain valuable community involvement for the long-term sustainability and resilience of the Chautauqua NHL District is a notable opportunity going forward. Specifically, since the Chautauqua is considered such a valuable part of the Boulder legacy and community, the involvement of the community in getting commitment to the long-term resilience of the site is a necessity for the long-term success of any strategy.

### On-Site Power Generation

Energy systems are vulnerable to climate change impacts—both short-term events and changes over the longer term. This vulnerability presents both near-term and chronic challenges in providing reliable, affordable, equitable and sustainable energy services. At the same time, distributed energy generation is a large factor in developing resilience with clean energy technologies and solutions. The unique geographic position of the Chautauqua NHL District along with Boulder's commitment to renewable energy creates a distinct opportunity for CCA to explore on-site energy sources that support both climate and resilience objectives. The inclusion of distributed energy generation has been a priority of CCA's since 2008.

With the potential for increasing energy demand

associated with higher cooling loads from rising summer temperatures, along with increased consumption from the electrification of buildings and vehicles, CCA has a unique opportunity to examine the best way to meet both short- and long-term energy demands. On-site energy generation, if feasible, will help assure the sustainability of the site by reducing the reliance on the aging infrastructure, avoid potential disruptions in service, stabilize long-term costs and help set an example for other communities, not limited to historic sites, for the potential to integrate evolving clean energy technologies.

Any and all potential for on-site or nearby renewable energy systems should be thoroughly explored and evaluated for implementation. Integration of the most suitable technologies and locations will be explored, along with the technical, financial and legal feasibility of implementation. An additional challenge will be designing and locating the systems so that they are compatible with the Chautauqua Design Guidelines. The second phase of this study will explore these options further with the intent of providing a path forward for CCA.

### Governance and Jurisdiction

The governance of the Chautauqua NHL District is complicated. In addition to local governance by CCA, the City of Boulder also has a role in governance as the site's landowner. In addition, the City of Boulder's Open Space and Mountain Parks governs the property adjoining the site on the east, west and south and the City of Boulder Parks and Recreation Department manages the Chautauqua Green. Finally, wildfire concerns introduce additional jurisdictional issues. In response to this myriad of stakeholders,

the development of the long-term resilience and sustainability strategy provides an opportunity to reexamine the nature of these governance and jurisdictional issues. While CCA hosts regular monthly Chautauqua Coordinating meetings that include members of major City of Boulder departments to discuss issues affecting Chautauqua, this committee may need to be expanded to include other organizations with decision making authority, such as the fire department.

### Community Identity and Cohesion

The Chautauqua community identity has multiple definitions depending on how an individual interacts with the site and the community. In general, the community is a passionate advocate for keeping the property open for all users and for making improvements to ensure it meets the needs of the Boulder community. Most users advocate for the retention and protection of the historic properties and the continuation of the unique entertainment, learning and dining opportunities presented. As the development of the Sustainability and Resilience strategy for the site is undertaken, the opportunity exists for all stakeholders to unite with one voice for the long-term preservation and sustainability of the Chautauqua NHL District.

### Public Park

The Chautauqua NHL District has been a successful part of the Boulder greenspace for over a century. However, the "park" is often viewed independently from the overall district. Many individuals who use the park area know very little about the rest of the Chautauqua. Similarly, individuals who are frequent attendees at Auditorium events

may rarely use the park for other activities. While this may not be unusual for diverse parks and historic sites, it does leave open an opportunity for the future of the Chautauqua. Specifically, CCA could look at how to integrate the multiple components of the district into an integrated visitor opportunity that will ensure the long-term status of the site as a prime destination for locals and visitors alike.

### Education Center

The Chautauqua movement originated with underlying focus on knowledge and education. With the existence of a university minutes away from the Chautauqua NHL District, the opportunity exists to collaborate with the University of Colorado Boulder to establish education programs for individuals at all education levels.

## RANKING OF VULNERABILITIES

The identification of vulnerabilities at the Chautauqua NHL District, combined with an analysis of the impacts to the site's systems, provide the foundation for a ranking of the vulnerabilities in terms of requirements to address these vulnerabilities. The specific priority of the vulnerabilities is provided in a high, medium and low qualitative ranking. High priority should be considered as needing attention within the next year to at least develop an action plan. A medium priority vulnerability is one that should be placed on an action plan as soon as possible with a goal for developing an action plan within the next five years. And finally, a low priority vulnerability is one that requires attention within the next decade with a goal of an action plan within the next decade. This table summarizes these rankings.

System	Vulnerability	Source	Timeframe	Priority
Transportation	Surface Damage	Precipitation and Extreme Heat	Short-Term	High
Transportation	Drainage Improvements	Current and Projected Precipitation	Short-Term	High
Transportation	Road base Damage	Current traffic and future temperature changes	Mid-Term	Medium
Infrastructure	Stormwater System	Precipitation	Mid-Term	Medium
Infrastructure	Drainage Swales	Precipitation	Short-Term	High
Infrastructure	Energy Supply	Wind, temperature, precipitation	Mid-Term	Medium
Infrastructure	Retaining Walls	Precipitation	Mid-Term	Medium
Infrastructure	Power Distribution	Wind, Temperature	Long-Term	Low
Neighborhood	Over-Demand	User demand	Mid-Term	Medium
Neighborhood	Governance	Regulatory	Mid-term	Low
Neighborhood	Regulatory Control	Governance	Long-Term	Medium
Economic	Affordability	User Demand	Long-Term	Low
Economic	Ownership demand	User Demand	Mid-Term	Medium
Ecological	Cottage lawns	Temperature, precipitation	Short-Term	High
Ecological	Cottage drainage	Precipitation	Short-term	High
Ecological	Public Area Landscape	Temperature, precipitation	Mid-Term	Medium
Ecological	Wildfire Prevention	Temperature, Drought	Mid-Term	High
Ecological	Stormwater Runoff	Precipitation	Long-Term	Medium
Ecological	Wildfire Oversight	Temperature, Drought	Long-Term	Low
Ecological	Public Area Drainage	Precipitation	Mid-Term	Medium
Contextual Built	Cottage Structural Decay	Climate Change	Mid-Term	Medium
Contextual Built	Structure Fires	Drought, temperature	Short-term	High
Contextual Built	Water Damage	Precipitation	Short-term	High
Contextual Built	Public Building Failures	Climate Change	Mid-Term	Medium
Contextual Built	Walkway Erosion	Precipitation	Mid-Term	Medium
Contextual Built	Snow Loads	Climate Change	Mid-Term	High

## SUMMARY OF VULNERABILITIES ASSESSMENT

The conclusion of the vulnerabilities assessment phase of this study provides a foundation on which the options and solutions can begin to be generated. The assessment stage provides valuable findings on which to build and highlight key areas that need to be addressed beyond the current study.

In terms of the vulnerabilities, the issues of wildfire, drainage, precipitation events and ecological change are all ones that require immediate attention to assist in long-term resiliency. Additionally, the challenge of retaining the historic character while addressing deteriorating infrastructure is a challenge that brings in multiple challenges regarding sustainability of materials and energy usage. Finally, the issue of the Chautauqua NHL District being “loved to death” is one that will require collaboration from multiple stakeholders to fully address to retain the historic qualities of the site as well as the future sustainability of the site.

The combination of physical, historic and cultural vulnerabilities places the property at a crossroads in terms of resiliency and sustainability. Tough choices regarding the oversight and the context of the site will need to be made to address some of the pressing issues such as wildfire protection.

In terms of the opportunities, this assessment is illustrating the significant list of opportunities that are in front of CCA and the City of Boulder in terms of retaining its importance to Boulder. The buildings and structures are in relatively good condition, the City of Boulder has ambi-

tious climate goals that support CCA’s sustainability and resiliency objectives, the site is much-loved by the Boulder community, CCA is committed to ongoing sustainability and resilience efforts, including some form of renewable energy and the City of Boulder has the necessary preservation and technical expertise needed to support whatever initiatives may result from the Sustainability and Resilience Strategy. There are also opportunities to further enhance coordination between CCA, the City of Boulder and other stakeholders in the Chautauqua NHL District.

In Step 2 of this study, identified vulnerabilities will be addressed in terms of practical and actionable potential solutions that can be adopted by the City of Boulder and CCA. Utilizing the prioritization of the vulnerabilities, the options will be developed that incorporate the physical, jurisdictional, historic and cultural aspects of the site while taking economic, logistical and community-wide priorities into account.

Whereas the Vulnerabilities Assessment strives to identify questions to what and why the Chautauqua NHL District is vulnerable, the Options Development Step will open the door to how the identified vulnerabilities can be addressed to achieve long-term sustainability and resilience at the Chautauqua NHL District. Finally, the third step will bring these approaches together under a uniform vision in a comprehensive Sustainability and Resilience Strategy that can be practically and manageably implemented over the near and long-term.

