



STATE OF THE PARK REPORT

Saugus Iron Works National Historic Site

Saugus, Massachusetts

April 2013

On the cover: The Turning Basin, Blast Furnace, Forge, and Rolling/Slitting Mill, Saugus Iron Works National Historic Site. (NPS)

Disclaimer. This State of the Park report summarizes the current condition of park resources, visitor experience, and park infrastructure as assessed by a combination of available factual information and the expert opinion and professional judgment of park staff and subject matter experts. The [internet version](#) of this report provides the associated workshop summary report and additional details and sources of information about the findings summarized in the report, including references, accounts on the origin and quality of the data, and the methods and analytic approaches used in data collection and assessments of condition. This report provides evaluations of status and trends based on interpretation by NPS scientists and managers of both quantitative and non-quantitative assessments and observations. Future condition ratings may differ from findings in this report as new data and knowledge become available. The park superintendent approved the publication of this report.

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EXECUTIVE SUMMARY

The mission of the National Park Service is to preserve unimpaired the natural and cultural resources and values of national parks for the enjoyment, education, and inspiration of this and future generations. NPS Management Policies (2006) state that “The Service will also strive to ensure that park resources and values are passed on to future generations in a condition that is as good as, or better than, the conditions that exist today.” As part of the stewardship of national parks for the American people, the NPS has begun to develop State of the Park reports to assess the overall status and trends of each park’s resources. The NPS will use this information to improve park priority setting and to synthesize and communicate complex park condition information to the public in a clear and simple way.

The purpose of this State of the Park report is to:

- Provide to visitors and the American public a snapshot of the status and trend in the condition of a park’s priority resources and values;
- Summarize and communicate complex scientific, scholarly, and park operations factual information and expert opinion using non-technical language and a visual format;
- Highlight park stewardship activities and accomplishments to maintain or improve the State of the Park;
- Identify key issues and challenges facing the park to help inform park management planning.

The purpose of Saugus Iron Works National Historic Site is to preserve and interpret the first sustained, integrated ironworks in British Colonial America, which operated on the Saugus River from 1646 to 1670.

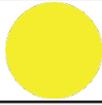
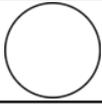
Saugus Iron Works National Historic Site is significant because:

- Saugus Iron Works is the best evidence and demonstration of the earliest development of iron manufacturing in colonial America.
- Established by John Winthrop, Jr. (son of Massachusetts Bay Colony’s first governor), the iron works was part of the Puritan vision for a self-reliant and self-determined colony—for what Governor Winthrop called “a city upon a hill.”
- The 1646 plant provided crucial iron commodities to the young colony and served as a training ground for skilled iron workers. Workers took the technology they learned here and established new iron works ventures throughout the northeast, thereby laying the foundation of America’s Iron and Steel Industry
- The park is also an important Native American estuary site as well as a prominent example of the colonial revival and historic preservation movement in the first half of the twentieth century.
- The cultural resources at Saugus Iron Works NHS provide opportunities for researchers from around the world to explore 17th century iron-making technology and waterpower design.

The summary table, below, and the supporting information that follows, provides an overall assessment of the condition of priority resources and values at Saugus Iron Works National Historic Site based on scientific and scholarly studies and expert opinion. The internet version of this report, available at <http://www.nps.gov/stateoftheparks/sair/>, provides additional detail and sources of information about the resources summarized in this report, including references, accounts on the origin and quality of the data, and the methods and analytical approaches used in the assessments.

The Status and Trend symbols used in the summary table below and throughout this report are summarized in the following key. The background color represents the current condition status, the direction of the arrow summarizes the trend in condition, and the thickness of the outside line represents the degree of confidence in the assessment.

Key to Condition Status Symbols

Condition Status		Trend in Condition		Confidence in Assessment	
	Warrants Significant Concern		Condition is Improving		High
	Warrants Moderate Concern		Condition is Unchanging		Medium
	Resource is in Good Condition		Condition is Deteriorating		Low

State of the Park Summary Table

Priority Resource or Value	Condition Status/Trend	Rationale
Cultural Resources		web
Archeological Resources		Approximately 60% of the park has been intensively surveyed for archeological resources, and 99.9% of recovered archeological materials have been cleaned, conserved, studied, cataloged, and properly stored. 90% of the sites that are documented in the NPS ASMIS archeological sites database are in good condition.
Cultural Anthropology		The park lacks an understanding of Native American use of the site, the families who trace their lineage back to the iron works at Saugus, or groups associated with the First Iron Works Association or Roland Robbins' excavations. Gaps in knowledge have been identified, but the park is unable to conduct the studies needed to fill them.
Cultural Landscapes		The historic context for the park landscape is based on the archeological efforts associated with the reconstruction and historic preservation during the early twentieth century. Existing documentation (1963 National Historic Landmark nomination) is focused on the historic structures and archeology and does not adequately address the landscape. A cultural landscape inventory study is planned for FY 2016.
Historic Structures		Many structures are insufficiently recorded in the National Register/National Historic Landmark documentation. 78% of the site's historic structures have been officially identified and evaluated.
History		78% of the cultural resources at SAIR (18 of 23 total resources) have been listed in the appropriate Service-wide inventories, including the National Register. No administrative history has been completed, but the park plans to do one in the future.
Museum Collections		The collections are accessioned and 99.9% cataloged, which represents a significant accomplishment for the park. The 1982 Historic Furnishings Report is out of date, and an update is needed to the 1995 Collections Management Plan. The overall condition of the museum collection is fair and improving steadily due to a condition survey and improvements to collections storage.
Natural Resources		web
Air Quality		For 2005–2009, estimated values for ozone and nitrogen and sulfur wet deposition in the historic site warrant significant concern based on NPS Air Resource Division benchmarks . Estimated average visibility warrants moderate concern for 2005–2009.
Water Quality		Organic enrichment and low Dissolved Oxygen levels were listed as impairments for the river segment upstream of the park from 1998 to 2006, but more recent observations indicate moderately good DO levels in the Saugus River at SAIR. Concentrations of heavy metals have been very low following the 2008 turning basin restoration. The EPA has continued to classify the Saugus River as impaired because of fecal <i>coliform</i> / <i>Escherichia coli</i> pathogens.
Riverbed and Marsh Sediments		The concentration of numerous pollutant metals in riverbed sediments decreased following the 2007–2008 Turning Basin restoration project, and all metals were below probable effect concentrations in 2008 and 2010 sampling. The project removed 1–3.5 feet of marsh sediments that contained pollutant metals and polycyclic aromatic hydrocarbons, although sampling is needed to quantify current pollutant levels.

State of the Park Summary Table continued

Priority Resource or Value	Condition Status/Trend	Rationale
Wetland Vegetation		Vegetated wetlands in the park include tidal fresh/brackish marsh, and freshwater seeps that occur above the Saugus River floodplain. Total vegetation cover in the restored marsh area has remained low, and the area has functioned more as a tidal mudflat than a vegetated marsh. The percent cover of non-native species in the tidal marshes was greater than 50% prior to the restoration of the turning basin, but since 2009 following the restoration, the percent cover of non-natives has fallen to < 2%.
Aquatic Vegetation		Submerged aquatic vegetation represents critical habitat to support fish and other nekton communities, providing forage, refuge from predation, and other functions. Prior to the turning basin restoration project in 2004, horned pondweed occupied just 1–5% of the tidal river bottom; in 2011 the cover had increased to 25%.
Upland Vegetation		More than 100 invasive Norway maple trees and numerous invasive shrubs have been removed from riparian forests of the park during the past decade. However, the West side forest remains dominated by Norway maple and the shrub and herb layers in all forested areas remain co-dominated by invasive non-native plants.
Aquatic Benthic Macroinvertebrate Community		Sampling of the benthic macroinvertebrate community has shown high variability, and thus no trend can be reported. It is uncertain if and when the community will stabilize following the 2007-08 restoration project. The preponderance of taxa has been pollution-tolerant, which indicates poor quality habitat.
Fish Community		The fish community at SAIR has been dominated by either pollution-tolerant or moderately pollution-tolerant species, although a consistent trend of increasing abundance of estuarine species since the removal of a downstream weir in 2009 indicates recovery of the fish community in the Saugus River at the Iron Works.
Avian Community		15 species of shorebirds, waders, and waterfowl have been observed using the newly restored wetland, open water, and tidal flats within the park.
Visitor Experience		web
Visitor Numbers		11,611 visitors in 2012 is consistent with the 5-year average of 11,294 visitors/year for 2008-2012. In 2007 the park changed its open season from 12 months to 7 months, resulting in a relative drop in visitation compared to the previous 5-years.
Visitor Satisfaction		The percent of visitors satisfied in FY12 was 99.0%, up from 97% and 98% for the two previous years.
Interpretive and Education Programs – Talks, Tours, and Special Events		The park offers regular interpretive tours, two types of curriculum-based education programs, conducted demonstrations and eighteen special events (2012). Programs and special events have been revised and expanded in past three years. This upward trend in public programming is dependent on sustained or increased funding levels to be maintained.
Interpretive Media – Brochures, Exhibits, Signs, and Website		An interim renovation in 2007 reconfigured a portion of the park's exhibits. Nonetheless, museum exhibits are in need of a complete redesign due to their 30+ year age. Waysides are in good condition, with an additional 3–4 new waysides needed. Unigrd is outdated and needs moderate revision. Website is well-designed, but needs additional resource content. Internal park signage is good, way-finding signage on roads leading to park needs upgrading and/or replacement.
Accessibility		Physical accessibility on-site has improved significantly since 2007 and the site is now largely accessible. Only a small portion of existing interpretive products (films, unigrd, etc.) are accessible for individuals with visual/auditory/language limitations.

State of the Park Summary Table continued

Priority Resource or Value	Condition Status/Trend	Rationale
Safety		The recordable incident rate is consistently low or non-existent. Operational Leadership training has been conducted for all employees. Site contains some safety hazards associated with fire, open water, and moving machinery.
Park Community: Volunteers and Partnerships		A small contingent of regular volunteers assists with park operations in Interpretation and Resource Management, with a current focus on Museum Collections management projects. New volunteers have joined the park to assist Natural Resources with habitat restoration. The park maintains partnerships with the Essex National Heritage Area, Saugus River Watershed Council, and Saugus Chamber of Commerce.
Park Infrastructure web		
Facility Condition Index (Overall FCI)		The overall Facility Condition Index for 35 assets at Saugus Iron Works NHS in FY 2012 is 0.075, which is Good based on industry and NPS standards.
Energy Consumption		Energy consumption (BTUs per gross square footage of buildings) in 2012 was 9.5% lower than the average for the previous 4 years (Source: NPS Annual Energy Report).
Water Consumption		Water consumption at SAIR in 2012 was 0.06 Million gallons, which represented a 57% reduction from the 4-year average for 2008–2011 (Source: NPS Annual Energy Report).
Park Carbon Footprint		Saugus Iron Works belongs to a network of parks nationwide that are putting climate friendly behavior at the forefront of sustainability planning. The Park is currently drafting a climate action plan to formalize its commitment to reduce emissions of greenhouse gases at the park by 2016. Emissions from park operations and visitor activities within the Park during 2012 are roughly equivalent to the emissions from the energy use of 6 households each year.

Summary of Stewardship Activities and Key Accomplishments to Maintain or Improve Priority Resource Condition:

The list below provides examples of stewardship activities and accomplishments by park staff and partners to maintain or improve the condition of priority park resources and values for this and future generations:

Cultural Resources

- Collection storage area
- Installed fire suppression system for museum collections
- Facilitation of use of scholarly collection by more than 200 researchers
- Cataloging the timbers
- Scanning and digitizing documents for the park archives
- Publication of Roland Robbins book
- Discovery and documentation of pre-contact (archeological) period site
- Purchased one of the seven known firebacks for use in park displays

Natural Resources

- Monitoring of multiple physical and biological natural resources in association with restoration of the tidal marsh and wetlands from the turning basin project is ongoing from 2008–2018.
- Control of invasive plants from the restored turning basin wetlands and riparian forest.
- Removal of more than 100 non-native Norway maple trees through an innovative partnership with the Olmsted Center for Landscape Preservation.
- Intensive study of *coliform* bacteria in the Saugus River completed in 2012.
- American eel and Rainbow Smelt are monitored in partnership with Massachusetts Division of Marine Fisheries and the Saugus River Watershed Council.
- Long-term monitoring of river water quality, forest breeding birds, and marsh vegetation by the Northeast Temperate Inventory & Monitoring Network.

Visitor Experience

- Enhanced junior ranger hands-on activities
- Iron pours
- Increased accessibility in museum and Iron Works House and throughout site, including paving of waterfront trail
- Education programs have been improved

Park Infrastructure

- Replaced Slitting Mill & Blast Furnace Sluiceways
- Replace Iron Works House roof
- Rehabilitate Parking area
- Modified Pathways to meet ADA requirements
- 230/232 Central Street rehabilitation (added climate controlled museum collections storage, added ADA accessibility to library for researches, and fire suppression.)
- Museum/Theater rehabilitation (added climate controlled museum collections storage, added ADA accessibility, and fire suppression.)
- Improved visitor Center (Moved from small contact station to Iron Works House Annex. Now meets ADA compliance.)
- Future Leaders Program (40 youth positions)
- Greening of site: Use reel mowers and battery powered weed-trimmers to maintain building area grounds
- Repaired forge hammer
- Operated waterwheels for interpretive programs

Key Issues and Challenges for Consideration in Management Planning

In preparation for the 100th anniversary celebration of the National Park Service in 2016, it is a great honor for Salem Maritime National Historic Site and Saugus Iron Works National Historic Site to have been selected as the nation's first historic sites to complete a State of the Park Report. To date, only a select collection of natural resource-based national parks have completed this exercise. In contrast, Salem Maritime and Saugus Iron Works National Historic Sites are small, urban national parks with predominately cultural and historical significance. The parks recently worked with a variety of experts in the fields of natural and cultural resources, interpretation, law enforcement, and facility management to develop a set of baseline assessments that can now serve as a model for other historical and cultural-oriented national parks across the country.

In this time of accelerated change and increasing fiscal challenges, our ability to plan ahead necessitates that we have objective baseline data to assess our park operations and to develop articulated plans to address the multifaceted needs of the parks. Global climate change, rising sea levels, and an increase in the frequency and severity of storms are forcing us to envision new ways of managing and protecting our park resources. Innovations in information technology and a streamlining of government procedures are bringing broad changes to our administrative and management systems. Fiscal constraints, changing visitor demographics, and a need to diversify our workforce are all ushering in complex challenges for our parks as we enter our second century. The State of the Park Report will help us strategically assess our operations, plan for the future, and clearly communicate current park conditions to the public.

Partnerships

Saugus Iron Works National Historic Site was created by a grassroots organization called the First Iron Works Association over 70 years ago. Since its administration by the NPS in 1968, the park has continued its history of positive, productive partnerships. Additional federal directives encourage the park to explore mutually beneficial partnerships to further our agency's mission and the park's enabling legislation, where and when appropriate.

Waterwheels

Saugus Iron Works National Historic Site is a reconstructed 17th-century industrial site that evokes the character of a working, water-powered, iron-making plant from the early Massachusetts Bay Colony. The working waterwheels and the equipment that they power bring the site to life for our visitors. Without the waterwheels, sluiceways and water pumps to engage machinery, the visitor experience is severely compromised. The trees that were originally used to make these wheels and shafts were "old growth" timber that was strong and resilient to the water and weather, but is not found in abundance anymore. The craftsmanship and knowledge of how to build the wheels and shafts, how to put them in place and turn them to perfection is scarce, but not yet lost. We must find new ways to recreate these wheels in a sustainable manner .

Parking Lot Rehabilitation

The current parking lot and maintenance facility buildings are failing and in need of major repairs. The existing parking lot's stormwater drain empties untreated, unfiltered runoff from the parking area directly into the Saugus River. A plan was developed in 2012 to rehabilitate the site by shrinking the footprint of the parking lot and creating a swale that can serve as both a groundwater recharging area and filter for the storm drainage before it flows down to the river.

Visitation and Visibility

Historically, Saugus Iron Works NHS was open year-round and welcomed an average of 40,000 visitors per year. In 1998, the park was administratively combined with Salem Maritime NHS and in 2006 it was closed to complete a major rehab of the river basin and to improve accessibility throughout the site. We need to reassess the value of the partial year closing from various perspectives: tourism and economic benefit, community impacts, educational opportunities for the schools, and the feasibility of management of both Salem Maritime NHS and Saugus Iron Works NHS within existing budget and staffing levels. Through creative dialogue with the community and our partners, we may be able to find a way to lengthen the visitor season, increase visitation, and make it easier for visitors to discover.

Park Planning

Although the site has a General Management Plan from 2002, it will be beneficial for us to now develop a modern Foundation Document and associated Resource Stewardship Strategy. The creation of both the Foundation Document and Resource Stewardship Strategy will guide the protection, preservation and public enjoyment of the site into the next century.

CHAPTER 1. INTRODUCTION

The purpose of this State of the Park report for Saugus Iron Works National Historic Site is to assess the overall condition of the park’s priority resources and values, communicate complex park condition information to visitors and the American public in a clear and simple way, and to inform visitors and other stakeholders about stewardship actions being taken by park staff to maintain or improve the condition of priority park resources for future generations. The State of the Park report uses a standardized approach to focus attention on the priority resources and values of the park based on the park’s purpose and significance, as described in the park’s Foundation Document or General Management Plan. The report:

- Provides to visitors and the American public a snapshot of the status and trend in the condition of a park’s priority resources and values.
- Summarizes and communicates complex scientific, scholarly, and park operations factual information and expert opinion using non-technical language and a visual format.
- Highlights park stewardship activities and accomplishments to maintain or improve the state of the park.
- Identifies key issues and challenges facing the park to inform park management planning.

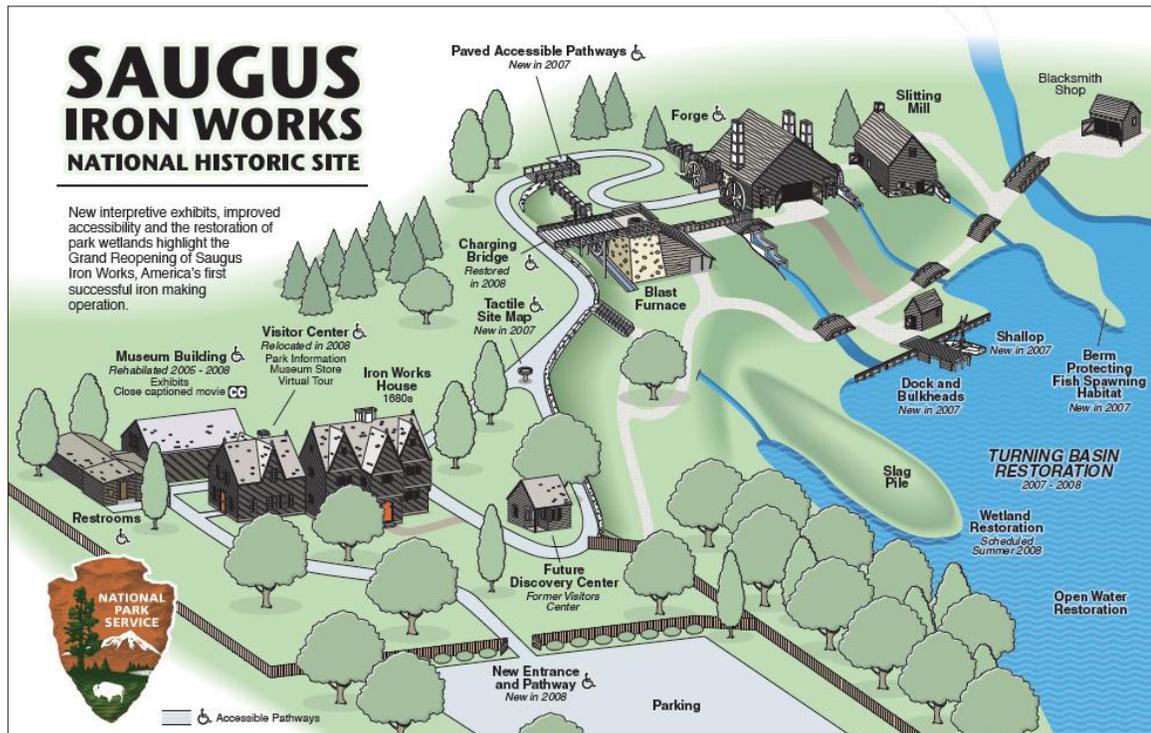
The process of identifying priority park resources by park staff and partners, tracking their condition, organizing and synthesizing data and information, and communicating the results will be closely coordinated with the park planning process, including natural and cultural resource condition assessments and Resource Stewardship Strategy development. The term “priority resources” is used to identify the fundamental and other important resources and values for the park, based on a park’s purpose and significance within the National Park System, as documented in the park’s foundation document and other planning documents. This report summarizes and communicates the overall condition of priority park resources and values based on the available scientific and scholarly information and expert opinion, irrespective of the ability of the park superintendent or the National Park Service to influence it.

The purpose of Saugus Iron Works National Historic Site is to preserve and interpret the first sustained, integrated ironworks in British Colonial America, which operated on the Saugus River from 1646 to 1670. Saugus Iron Works National Historic Site is significant because:

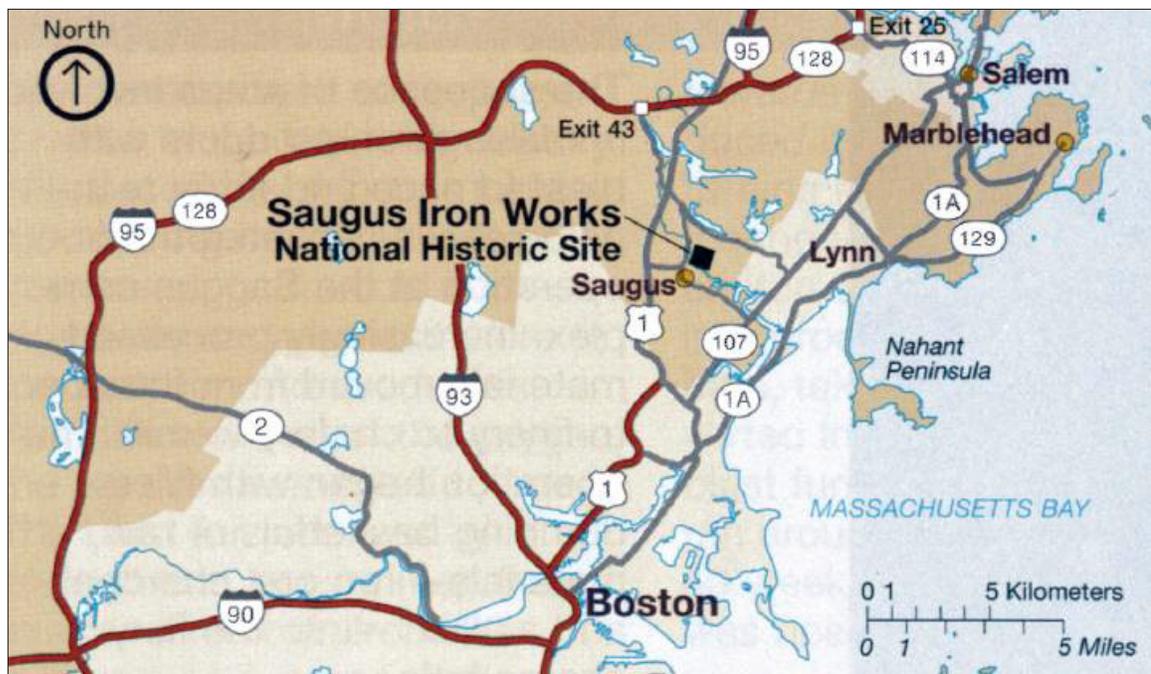
- Saugus Iron Works is the best evidence and demonstration of the earliest development of iron manufacturing in colonial America.
- Established by John Winthrop, Jr. (son of Massachusetts Bay Colony’s first governor), the iron works was part of the Puritan vision for a self-reliant and self-determined colony—for what Governor Winthrop called “a city upon a hill.”
- The 1646 plant provided crucial iron commodities to the young colony and served as a training ground for skilled iron workers. Workers took the technology they learned here and established new iron works ventures throughout the northeast, thereby laying the foundation of America’s Iron and Steel Industry
- The park is also an important Native American estuary site as well as a prominent example

of the colonial revival and historic preservation movement in the first half of the twentieth century.

The cultural resources at Saugus Iron Works NHS provide opportunities for researchers from around the world to explore 17th century iron-making technology and waterpower design.



Map of Saugus Iron Works National Historic Site. (NPS)



Regional Map showing the location of Saugus Iron Works National Historic Site. (NPS)

CHAPTER 2. STATE OF THE PARK

The State of the Park is summarized below for four categories— Cultural Resources, Natural Resources, Visitor Experience, and Park Infrastructure—based on a synthesis of the park’s monitoring, evaluation, management, and information programs, and expert opinion. Brief resource summaries are provided below for a selection of the priority resources and values of the park. Clicking on the [web4](#) symbol found in the tables and resource briefs below will take you to the internet site that contains content associated with specific topics in the report.

The scientific and scholarly reports, publications, datasets, methodologies, and other information that were used as the basis for the assessments of resource condition are referenced and linked throughout the report and through the [internet version of this report](#) that is linked to the NPS [IRMA data system](#) (Integrated Resource Management Applications). The internet version of each report, and the associated workshop summary report available from the internet site, provide additional detail and sources of information about the findings summarized in the report, including references, accounts on the origin and quality of the data, and the methods and analytical approaches used in data collection and the assessments of condition. Resource condition assessments reported in this State of the Park report involve expert opinion and the professional judgment of park staff and subject matter experts involved in developing the report. This expert opinion and professional judgment derive from the in-depth knowledge and expertise of park and regional staff gained from their being involved in the day-to-day practice of all aspects of park stewardship and from the professional experience of the participating subject matter experts. This expert opinion and professional judgment utilized available factual information for the analyses and conclusions presented in this report. This State of the Park report was developed in a park-convened workshop.



Saugus Iron Works National Historic Site (Curtis White).

2.1. Cultural Resources

Archeological Resources

Saugus Iron Works has been the focus of many archeological excavations throughout the years, yielding vast amounts of archeological resources. The first and most comprehensive of the excavations was Roland Robbins's five-year excavation, 1948–53, which uncovered the remains of the seventeenth-century iron works, along with thousands of artifacts and many structural features. Robbins archeological excavations were the basis for the reconstructed iron works complex. Subsequent excavations have located structural remains and artifacts around the Iron Works House and elsewhere within the park. These activities document the probable existence of relatively undisturbed archeological resources within park boundaries and could produce new evidence about the pre-contact populations, the ironworks industrial complex, the Iron Works house and its occupants, the workers' village of Hammersmith, and the Jenks complex.

Archeology is particularly important at Saugus Iron Works NHS, as it forms the basis for the reconstructed Iron Works. Approximately 60% of the park has been intensively surveyed, largely on the west side of the property. However, we are not confident that we have the whole archeological picture, and much work remains to be done.



View of iron Works complex archeological excavation work in 1952. (NPS)

Resource Brief: Archeology at Saugus Iron Works

The story of Saugus Iron Works actually begins long before it became a unit of the National Park Service. In the 1940s, the First Iron Works Association (FIWA), a core group of dedicated individuals formed to help manage the historic Iron Works House. The group was formed, from local supporters, to keep the house and grounds intact after it was nearly moved by Henry Ford to Greenfield Village in Dearborn, Michigan. The Reconstruction committee, a small subgroup of FIWA, led by Quincy Bent, a former vice president of Bethlehem Steel, embarked upon a multi-year project to research and reconstruct core elements of the original ironworks. The project was almost exclusively funded by the American Iron and Steel Institute (AISI). This site was to commemorate the birthplace of the American Iron industry. The FIWA reconstruction committee hired avocational archaeologist Roland W. Robbins to lead the archeological investigations on the site. Robbins worked tirelessly on the site for the next five years with mechanized equipment and a small crew of excavators. These excavations fueled the reconstruction efforts. FIWA also hired numerous specialists to aid in the reconstruction including historian E. Neil Hartley and the architectural firm of Perry, Shaw, and Hepburn, Kehoe and Dean among others. Millions of dollars later, the FIWA opened the doors in 1954 to a completely integrated and reconstructed Iron Works.

The site survived as a reconstructed ironworks for the next decade and a half, primarily because of the funding provided by the American Iron and Steel Institute. In the mid-1960s, however, AISI withdrew its support from the site and after several years of uncertainty and much negotiation and study the site became a unit of the National Park Service in 1968.



View of Iron Works complex archeological excavation work. (NPS)

Archeological Resources			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Percent of sites with known date ranges associated with a research theme		An estimated 80% of archeological sites within the park boundaries that are known have date ranges associated with a research theme. Major documentation includes the Archeological Overview and Assessment performed in 1997, and <i>Saugus Iron Works: The Roland W. Robbins Excavations, 1948–1953</i> edited by William Griswold and Donald Linebaugh, published in 2011.
Inventory	Percent of park intensively surveyed.		Approximately 60% of park has been surveyed, with approximately 40% remaining to be intensively surveyed.
Documentation	Percentage of known sites with adequate National Register documentation.		No sites have formally been determined to be eligible.
	Percent of backlogged curatorial work, percent of backlogged analysis. Adequate amount of site analysis for interpretation.		99.9% of recovered archeological materials have been cleaned, conserved, studied, cataloged, and properly stored, with 12 objects awaiting treatment.
	Number of park publications or interpretive programs		15 management documents, 8 public publications, 3 interpretive site tours per day; a majority of information has been disseminated within the strictures of availability/sensitivity.
Condition	Percentage of archeological resources in good condition		All sites are documented in ASMIS with 90% in good condition.

Cultural Anthropology

The area of the Saugus Iron Works was inhabited by a band of Pawtucket Indians prior to the arrival of Europeans, and archeological evidence indicates that the Saugus River estuary provided fish and other coastal resources and the Iron Works site was used for ceremonial purposes by the residents (Massachusetts Historic Commission). It is likely that these Indians were closely related to (or members of) the nearby community of Naumkeag, located at Salem. The Pawtucket were greatly affected by the early English settlements in the Massachusetts Bay area, and the final exile of these people is assumed to have occurred along with that of the other Pawtucket villages after King Phillip's War (1675–76), when the majority removed themselves to the north (Vermont and Canada).

Two Pawtucket Indians were employed as woodcutters for the Saugus Iron Works in the 1650s. The large-scale “iron works at Lin” (this part of Saugus was once part of the town of Lynn) was built in 1646 and continued operations until about 1670. Hammersmith village, housing the families of skilled ironworkers, was built in conjunction with the iron-making plant on the east side of the river. Along with advanced iron-making technology, the iron works brought non-Puritan English ironworkers and Scots prisoners-of-war into the staunchly Puritan Massachusetts Bay Colony.

In 1915–17, Wallace Nutting, a leading exponent of the colonial revival movement in America, purchased and restored the Iron Works House to its seventeenth-century appearance on the recommendation of William Sumner Appleton, founder of the Society for the Preservation of New England Antiquities. In 1946, the Parson Roby Chapter of the Daughters of the American Revolution, who acquired the property in 1938, donated the site to the First Iron Works Association. Beginning in 1949, the American Iron and Steel Institute began funding the archeological excavations begun



View of blacksmith at the forge finery. (NPS)

in 1948 by Roland Robbins and the reconstruction of the colonial plant. (2002 GMP, pp. 51–53)

The state of cultural anthropology at the park is best categorized as yellow and stable, with high confidence in the rating. The lack of substantive information about the peoples associated with this site is acknowledged. Research must be done to get a better understanding of the Native American cultural group that used the site, and to develop knowledge of the families that trace their lineage back to those who lived and worked at the Iron Works between 1646 and 1670, as well as the later groups associated with the First Iron Works Association and the Roland Robbins' excavations in the late 1940s.

Resource Brief: The Scots at the Iron Works

The waters of the Saugus River not only supplied power to operate machinery, but its tidal basin served as a shipping corridor that brought in raw materials and shipped out iron products for local and overseas trade. Human cargo also came up the river. In 1650, a group of Scottish prisoners-of-war sailed up the river to spend the next several years laboring at the iron works—one did not survive the trip. The company's accounting papers record a payment for a "Windeing [winding] sheet for Davison ye Scotts."

The trip up the Saugus River was just the last leg of terrible journey for these men. They were survivors of the infamous Battle of Dunbar, where 3000 Scottish soldiers were slaughtered on the battlefield. Forced to march with little food or water from Dunbar, Scotland to Durham, England, another 3,500 Scottish captives died of starvation or dysentery along the way or during their imprisonment in Durham Cathedral. Survivors were sold into indentured servitude and shipped across the ocean to various destinations in the New World.

In 1653, thirty-five Scots were listed as property on an iron works' inventory. They worked mostly as woodcutters, farmhands, or as "carters" bringing charcoal to the works. A few were trained as ironworkers. In 1651, Reverend John Cotton wrote of the Scottish prisoners: "The Scots, whom God delivered into your hands at Dunbarre, and whereof sundry were sent hither, we have been desirous (as we could) to make their yoke easy. Such as were sick of scurvy or other diseases have not wanted physick and chyrurgery. They have not been sold for slaves to perpetual servitude, but for 6 or 7 or 8 yeares, as we do our owne [indentured servants]..." (Old-Time New England: The Bulletin of The Society for The Preservation of New England Antiquities, Vol. XLIII, No. 3, Serial No. 151, Winter 1953, p. 60)

The Scots were considered outsiders in the Puritan Colony and faced many hardships. In 1657, the Scottish prisoners established the Scots' Charitable Society to support their fellow countrymen in times of need. The organization is still in existence.

Cultural Anthropology			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research exists to understand the relationship of the park's ethnographic resources and the historic contexts.		The park lacks an understanding of Native American use of the site, the families who trace their lineage back to the iron works at Saugus, or groups associated with the First Iron Works Association or Roland Robbins' excavations. This research is fundamental to the stewardship and interpretation of the site.
	Appropriate studies and consultations document ethnographic resources and uses with regards to the park.		Gaps in knowledge have been identified, as well as needed studies, but there are currently no plans in PMIS for execution of the plans.

Cultural Landscapes

Excluding the river and its wetlands, the cultural landscape of Saugus Iron Works National Historic Site is an 8.51-acre parcel located in the heart of Saugus, Massachusetts. Situated along the banks of the Saugus River, its recreated seventeenth-century setting includes archeological sites and historic and reconstructed structures associated with America's first sustained, integrated, and successful iron works venture. Based on the 2002 General Management Plan, the landscape has three major components: the Industrial Site Landscape, Saugus River Turning Basin, and Iron Works House Landscape. The landscape represents the 1954 First Iron Works Association's reconstruction and manipulation to reflect a 1650s appearance, while also serving as the setting for an important example of first period architecture (Iron Works House). The landscape is comprised of an upper terrace that contains the Iron Works House, museum, parking area, visitor contact station, picnic area, and maintenance area; a steep sloped area leading to the industrial complex on the west bank of the Saugus River consisting of reconstructed iron works buildings, a wharf and warehouse, slag heap, and turning basin; and a gently sloping land on the east bank of the Saugus River that includes a blacksmith shop, nature trail, picnic area, and maintenance areas.

Based on the need for additional documentation, research, and treatment objectives to guide management of the landscape, an overall condition rating is yellow. The condition is trending up with high confidence given the number the research projects planned for the next few years. An overall rating of yellow, but trending upward with high confidence reflects the fact that there are many cultural landscape studies either in progress or planned for the next few years.



View of the iron Works landscape from the east bank. (NPS)

Cultural Landscapes			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research exists to understand the relationship of the park cultural landscapes to the historic contexts of the park.		The historic context for the park landscape is based on the archeological investigations associated with the reconstruction and historic preservation during the early twentieth century. Sufficient research exists, yet the landscape has not been fully documented or evaluated.
	Adequate research exists to document and preserve the cultural landscape of the park.		A Cultural Landscape Assessment was completed in 1993 (Hohman) and a Cultural Landscape Report focused on circulation (to guide an accessibility project) was completed in 2002 (Killion). The park has identified the need for a Cultural Landscape Report (PMIS# 72117) and Cultural Landscape Inventory (planned for FY 2016).
Inventory	The scope of cultural landscapes in the park is understood and a determination has been made whether or not they are a fundamental resource.		The 2002 General Management Plan identified the landscape resources and indicated they were to be “managed as cultural resource.” Resources were not classified as “fundamental” in the plan, but the landscape is clearly seen as integral to preservation and interpretation. The plan called for a cultural landscape report to guide treatment and use. The development concept plan for the turning basin clearly recognized the significance of the landscape as part of the rehabilitation efforts.
	Percentage of landscapes eligible for the National Register with accurate, complete, and reliable Cultural Landscape Inventory (CLI) data.		0% of landscapes eligible for the National Register have accurate, complete, and reliable CLI data. The park CLI is scheduled for FY2016.
Documentation	Percentage of cultural landscapes with adequate National Register documentation.		0% of cultural landscapes have adequate National Register documentation. Existing documentation (1963 National Historic Landmark nomination) is focused on the historic structures and archeology and does not adequately address the landscape.

Historic Structures

The historic structures of Saugus Iron Works National Historic Site consist of two principal components: a First Period New England Frame House known as the Iron Works House (1681–1689) and a reconstructed iron works (1948–1953). The Iron Works House exemplifies the primary characteristics of a classic First Period dwelling. Built in the post-medieval style for Samuel Appleton, Jr., it was an impressive and imposing structure in seventeenth-century Massachusetts Bay Colony. Restored in 1915–1917 by antiquarian and colonial revivalist Wallace Nutting, today it is among the grandest of the surviving structures of its age and architectural style. Additionally, it is distinctive for its interpretation of the domestic life of Puritan gentry. In the late seventeenth century, Samuel Appleton, Jr., transformed the site of “America’s first sustained, integrated, and successful” iron works that existed adjacent to his house into “*the Ironworks Farm.*” One of the nation’s first industrial archeologists, Roland Robbins, would spearhead archaeological investigations of the site, from 1948–1954 for the First Iron Works Association (FIWA). His investigations informed a reconstruction of the iron-making plant that operated in that location on the Saugus River from 1646 to about 1670. Today, the NPS interprets the reconstructed blast furnace, forge, rolling and slitting mill, iron warehouse, pier and bulkhead, and associated waterwheels, sluiceways, tailraces, footbridges, and other features of the industrial complex, along with the restored house, the original slag pile, and un-restored ruins.

Ancillary structures to the two principal site components were built to assist with the interpretation and commoditization of the products and heritage that were being produced and promoted in the first half of the twentieth century. These ancillary structures include a 1917 Blacksmith Shop, which was converted to a Museum by the FIWA in ca. 1950; the enlargement of the Iron Works House’s west wing in 1917 for a site caretaker residence; and an annex to the Blacksmith Shop/Museum structure in 1952.



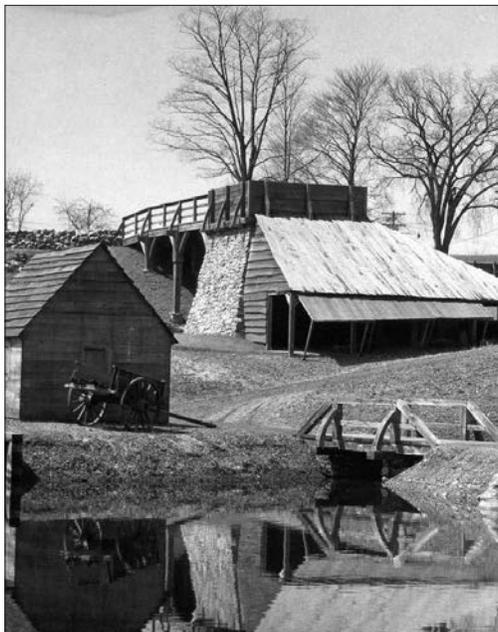
View of Iron Works House. (NPS)

The condition of the historic structures is considered to be yellow and stable. Reported with high confidence, there is an awareness of needed research, and many of the structures, while documented, have not been enumerated in nationwide documentation, such as a National Register update. Baseline documentation, such as Historic Structures Reports, is either outdated and/or not completed, and has not been programmed. Additionally, with upcoming retirements within the park itself, there will be a significant loss of institutional memory which contributes to the yellow rating.

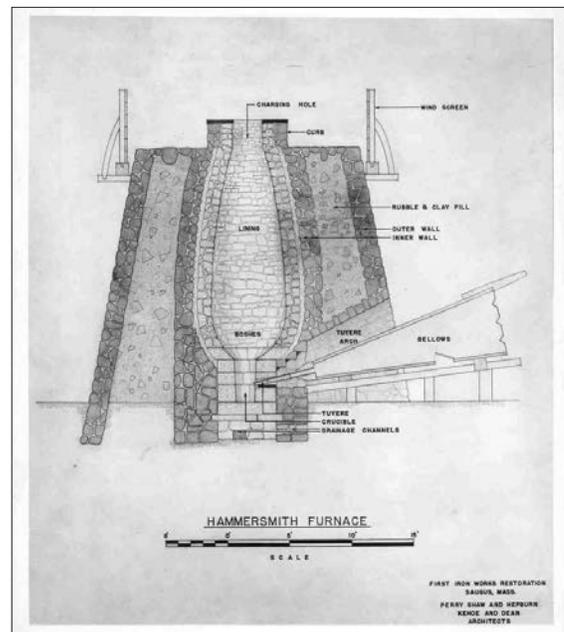
Resource Brief: The Blast Furnace

What was a colonial blast furnace? It was the smelting unit where raw materials were transformed into molten iron. The Blast Furnace at Saugus features a fieldstone chimney stack that stands 21ft. high and measures 26 ft. wide at its base. A wooden “charging bridge” extends from a bluff to a charging hole at the top of the chimney stack. This was where colonial ironworkers “charged” or loaded the furnace with the 3 ingredients needed to make iron: bog ore, a flux (here they used gabbro) and wood charcoal fuel. A wooden windscreen prevented gusts of wind from fanning the enormous flames that leapt up from the charging hole.

A wooden “casting shed” sits at the base of furnace. This shed provided shelter for a pair of giant bellows, an enormous wooden shaft that turned a 16’ waterwheel, and a sand floor many inches deep. As the waterwheel turned the shaft that operated the bellows, blasts of air raised temperatures to nearly 3,000 degrees. The raw materials melted and changed by means of a chemical process to form liquid iron. The casting shed was where workers tapped the furnace. Using long iron rods they broke a clay plug at the hearth to release rivulets of molten iron that ran into channels in the sand floor. The iron cooled and hardened within the channel to create pig bars. Workers also ladled the fiery liquid into molds to make pots, firebacks, salt pans, or other cast iron products.



Blast Furnace photo shows stone stack, wooden charging bridge and casting shed. (NPS)



Cross Section drawing of Blast Furnace interior. (NPS)

Historic Structures			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Percentage of historic structures evaluated using appropriate historical contexts.		78% of the site’s historic structures have been officially identified and evaluated using obvious and appropriate contexts, but the research is scattered among multiple studies that are in various stages of completion.
Documentation	Percentage of historic structures with adequate National Register documentation.		In spite of the fact that the historic structures have National Register status, they do not all have adequate documentation. National Register documentation is not up to date; however, sufficient Determinations of Eligibility exist to responsibly do Section 106 compliance.
	All historic structures have been recorded commensurate with their significance and mandated purposes.		Many structures are insufficiently recorded in the National Register/National Historic Landmark documentation. An update to National Register documentation is needed to ensure all structures have been recorded accurately and thoroughly, commensurate with their level of significance and mandated purpose, and with the benefit of current scholarship. The three Historic Structure Reports that have been generated thus far are incomplete, lacking approvals, and/or are dated.
Condition	Percentage of historic structures in good condition.		65% of historic structures are in good condition (15 of 23 in LCS, 3 of these are in shadow with condition evaluated); 22% in fair condition (5 of 23 in LCS, 2 of which are in shadow), and 13% in poor condition (3 of 23 in LCS).

History

Saugus Iron Works NHS was administratively listed on the National Register December 19, 1966 and designated as a National Historic Landmark in 1963. It is historically significant as an excellent demonstration of early iron manufacturing in colonial America. The reconstructed iron works demonstrates industrial technology employed at Saugus, beginning in 1646 and ending in 1670, that was later dispersed throughout the Thirteen Colonies and played a critical role in the development of the American iron industry and underscores the burgeoning independence of the British Atlantic colonies. This is reflected in the park's authorizing legislation, which mandates the preservation of "the first sustained integrated ironworks in the Thirteen Colonies..." Researchers frequently visit the park to view first-hand the working reconstructions and consult the parks' museum collections and archives. The Iron Works House is one of the few remaining high-style First Period (1620–1725) houses in the region and is a significant restoration effort during the preservation movement of the late-nineteenth and early-twentieth centuries. (2003 CLR)

The overall condition of the history component is yellow and going up with high confidence. We have the basic contexts to understand the significance of the site and the buildings and structures on it, but would like to better understand the site through the lens of the history of archeology and historic preservation, in particular the Wallace Nutting era (1911–1920), when the Iron Works House went through an extended restoration.



View of Iron Works complex. (NPS)

History			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research is conducted to understand significance of site.		We have identified the contexts and have disparate studies that cover the information but have not been compiled into a Historic Resource Study.
	Sufficient research is conducted to establish the reasons for park creation and site history.		No administrative history has been completed, but with future plans to do so. When one is done it should address the First Iron Works association as well as NPS stewardship history.
	Research at the appropriate level precedes planning decisions involving cultural resources.		NHL designation and NR are thorough, but not exhaustive. Need to be updated to clarify the period of significance of the site and reflect current condition of resources.
Inventory	Percentage of cultural resources listed in appropriate Service-wide inventories, including the National Register.		78% of the cultural resources at SAIR are listed (18 of 23 total resources).
Documentation	Percentage of historic properties with adequate National Register documentation or with Determinations of Eligibility.		National Register documentation is not up to date. We do have sufficient Determinations of Eligibility to responsibly do Section 106 compliance, but would have a broader knowledge base.

Museum Collections

The museum collection of 60,000 items includes pre-contact and contact Native American items, as well as major collections related to the colonial era of the iron works and the twentieth-century colonial revival and preservation movements. The collection consists of 19,000 archeological objects, 1,280 historic objects, including seventeenth-century and reproduction period furnishings and domestic objects, and 45,190 archival objects including archeological documentation, research, administrative management records, architectural drawings, and photographs. (2002 GMP, 55 and 2003 CLR for circulation, 1).

The museum collections and archives are considered to be in good condition, with an overall rating of stable green with a high level of confidence. While updates are needed for historic furnishings reports and other baseline documentation, the park has about 75% of what it needs in terms of documentation to appropriately care for the collections.



View of artifact in park collection. (NPS)

Resource Brief: Museum Collections at Saugus Iron Works NHS

With thousands of objects in its museum collections, ranging from a quarter ton cast-iron hammer head to fragile clay plugs that still bear workers' finger impressions, Saugus Iron Works National Historic Site provides rare insight into America's early industrial development. The majority of collection artifacts were archeologically recovered from the 1646 iron works site by Roland Robbins. From 1948–1953, Robbins uncovered the remains of the blast furnace, forge, slitting mill, warehouse, pier, the Jenks blacksmith shop, a charcoal house, and a company blacksmith shop. Finds included remarkably preserved tailraces, waterwheels, anvil bases, and hammer mechanisms. These collections provide an invaluable record of seventeenth-century iron-making technology, plant design, and water power engineering.

Along with the various building remains and waterway sites, Robbins unearthed thousands of objects, including saws, hoes, shovels, chisels, hammers, armaments, standard weights, ship's anchors, fish hooks, nail rods, etc. These objects tell us about work life at this site as well as the occupational trades of early settlers in Massachusetts Bay Colony.

Other artifacts document the domestic life surrounding the site. Hammersmith village, which housed the iron workers and their families, was a forerunner of America's factory towns. Collections of ceramics, glassware, leather shoe pieces, brass pins, tobacco pipes, iron pots, and other household wares give us insight into the home life and aesthetics of the era.

This site is also a significant Native American estuary site, containing evidence of Native American life from 8,000–10,000 years ago to the time of European settlement. The colonial



Robbins uncovers trip hammerhead. (NPS)



Remains of a waterwheel at the Jenkins site. (NPS)



An iron spade. (NPS)



A claw hammerhead decorated with incised lines. (NPS)



A brass wire brooch and an iron finger ring. (NPS)



Shoe toe cap with incised design. (NPS)



Arrow heads and a drill. (NPS)



A fully-grooved stone ax. (NPS)

iron making plant may have manufactured iron trade goods specifically targeted to Native American markets. Two Native People worked briefly at the site as woodcutters. Prehistoric collections include implements made from stone, shell, and bone. Objects include drills, gouges, mortars, pestles, and a variety arrowhead types that provide a record of evolving tool technologies.

Interestingly, recent archeological investigations uncovered an intact Native American site with thousands of waste flakes (chips removed when shaping a stone tool) concentrated in one area. Archeologists think that this site has been a center for tool manufacture—whether of stone or iron—for millennia.

Museum Collections			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory	The scope of museum collections in the park is understood. All resources have been surveyed to determine their appropriateness for inclusion in the museum/archive collection.		The park has received a recent archives and records management survey, but the records will need to be assessed on an on-going basis to insure that management-related documents are included in the museum archive.
	Percentage of objects accessioned and cataloged.		The collections are accessioned and 99.9% cataloged. This represents a significant accomplishment for the park.
Documentation	Furnishings in historic structures are documented in a historic furnishings report.		Historic Furnishings Report is out of date, produced in 1982, and does not represent the Secretary of the Interior's Standards for historic furnished structures.
Condition	Overall condition of the collection based on condition survey and improvements to storage.		Overall, condition is fair, and improving steadily, due to a condition survey and improvements to collections storage. Items needing treatment have PMIS statements.

2.2. Natural Resources

The original iron works was established in a setting selected for its natural resources—a location at the upper end of the Saugus River estuary, where navigable downstream water leading to the open ocean meets fast-flowing upstream river water that can be used to generate water power; nearby forests to provide wood for charcoal fires in the furnace and forge; and nearby bogs filled with iron-rich peat to use as the raw material for making iron. These same features remain as important natural resources at Saugus Iron Works NHS. The Saugus River today reflects the degradation from centuries of dense urban development and industrial uses, but also the value of a refuge for wildlife amidst dense development, and the promise of urban ecological renewal. A recovering Rainbow Smelt population uses riffle habitat within the park boundary for Spring spawning, and American Eel use the soft-bottomed habitat in the mudflats and eddies within the park. The restoration of tidal brackish mudflat and marsh habitats through the Turning Basin project in 2007-08 has re-established a critical foraging area for hundreds of migrating shorebirds in Spring and Fall. The riverside forest and freshwater wetland seeps within the park provide shady cover that cools the river and provide a diverse canopy and understory for forest songbirds, salamanders, and other wildlife. The NPS has been working with stakeholders and partners to comprehensively monitor the physical and biological features of the river corridor, in order to guide natural resource protection and management into the future.

Air Quality			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Ozone	Annual 4th-Highest 8-Hour Concentration		The estimated ozone level for 2005–2009 at Saugus Iron Works NHS was 76.3 parts per billion (ppb), which warrants significant concern based on NPS Air Resource Division benchmarks . Although Saugus Iron Works NHS does not fall within a county designated by the EPA as non-attainment for ground-level ozone standard of 8-hour average concentration of 75 ppb, the 8-hour average ozone frequently exceeded the EPA ozone standard in 10 of the 11 years where data are available (1998 to 2008) (US EPA 2010, air data website). For 2000–2009, ozone levels at the monitoring site representing Saugus Iron Works NHS remained unchanged (NPS ARD 2013). List of ozone-sensitive plant species .

Air Quality Table (continued)

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Wet Deposition	Sulfur Wet Deposition		For 2005–2009, estimated sulfur wet deposition was 4.6 kilograms per hectare per year (kg/ha/yr), which warrants significant concern based on NPS ARD benchmarks . The park may be highly sensitive to acidification effects (Sullivan et al. 2011a), including changes in water chemistry that impact aquatic vegetation, invertebrate communities, amphibians, and fish. Adequate data are not available to calculate the trend (NPS ARD 2013).
	Nitrogen Wet Deposition		For 2005–2009, estimated nitrogen wet deposition was 3.6 kilograms per hectare per year (kg/ha/yr), which warrants significant concern based on NPS ARD benchmarks . The park may be highly sensitive to nitrogen-enrichment effects (Sullivan et al. 2011b), which can affect biodiversity of certain vegetation communities, including wetland plant communities. Adequate data are not available to calculate the trend (NPS ARD 2013).
Visibility	Haze Index		For 2005–2009, estimated average visibility in Saugus Iron Works NHS was 6.9 deciviews (dv) above natural conditions, which warrants moderate concern based on NPS ARD benchmarks . For 2000–2009, visibility improved both on the 20% clearest days and 20% haziest days (NPS ARD 2013).

Water Quality			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Water Chemistry	Dissolved oxygen		In 1998, the tidal Saugus River had dissolved oxygen (DO) levels below the 5 mg l ⁻¹ standard for Class SB marine and coastal waters, although these data represent areas within and downstream of the park. Organic enrichment and low DO were listed as impairments for the river segment upstream of the park from 1998 to 2006 (James-Pirri et al. 2011). More recent “snapshot” monitoring and qualitative observations indicate moderately good DO levels in the Saugus River at SAIR. DO values >5 mg l ⁻¹ have been regularly observed as ancillary data associated with NPS long-term fish monitoring in 2004, and annually since 2008, and also as part of the NPS long-term water quality monitoring (sampling 1–2 days per year) since 2006 (Gawley 2012). In general, DO varies substantially within the park given the tidal dynamics and the variable stream velocity within the river corridor at the park. DO tends to be consistently above >5 mg l ⁻¹ in the moving waters within the active river channel, and varies widely in the still water by the dock (the “Turning Basin” area). In addition, there have not been any observed large scale fish die-offs in the river since at least 2004, which indicates that there have not been any substantial very low DO episodes. Overall, the condition of DO is rated as moderate concern, with no basis for determining a trend at this time.

Water Quality Table (continued)

Indicators of Condition	Specific Measures	Condition Status/ Trend	Rationale
Water Chemistry	Heavy metals		Zinc was the only priority pollutant metal detected in surface water samples collected as part of the Turning Basin post-restoration monitoring program in 2008 and 2010. In both years, the zinc concentrations were below the criteria for the protection of aquatic life.
	Mercury		Total mercury (THg) and methylmercury (MeHg) in the tidal river water were sampled twice during baseflow periods in 1998 and 2000. The values (~2.5 µg l ⁻¹ THg) were below the benchmark proposed for "reference" streams across the Northeast (<7.5 µg l ⁻¹), but values for THg and MeHg were greater than those proposed to be protective of wildlife (0.077 µg g ⁻¹). To more fully characterize Hg in river water, sampling during high-flow events would be necessary (James-Pirri et al. 2011), thus there is no basis for determining a trend at this time.
	Pathogens		The Saugus River segments that include SAIR have consistently been assessed as impaired by pathogens (fecal coliform/ <i>Escherichia coli</i>) since 1998 by the EPA (James-Pirri et al. 2011). An intensive study in 2012 of dry weather and post-storm coliform bacteria levels in the Saugus River at SAIR found that primary contact (e.g. swimming) bacteria levels are regularly exceeded in both dry and post-rainfall conditions, and that secondary (e.g. boating) contact standards are frequently exceeded following rainfall events of >0.5" (Aqua Analysis 2012).

Riverbed and Marsh Sediments			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Riverbed Sediments	Pollutant metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc)		Riverbed sediments have been sampled for heavy metals in 2004, 2008 and 2010. Sampling in 2004, prior to the turning basin restoration project, found lead levels that exceeded probable effect concentrations. In 2008 and 2010 all metals were below the pre-restoration levels and did not exceed probable effect concentrations. However, the 2010 samples show an increase in metal concentrations compared to 2008. This may reflect overall sediment quality in the watershed, as sediment is transported from upstream sources and deposited in the vicinity of the park, where the river gradient changes and becomes more depositional (CH2MHill 2011).

River and Marsh Sediments Table (continued)

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Marsh Sediments	Priority Pollutant Metals (PPMs) and Polycyclic Aromatic Hydrocarbons (PAHs)		Sampling prior to the turning basin restoration project in 2004 indicated detectable concentrations of PPMs and/or PAHs throughout wetland sediments, with six of the 20 sampling locations containing concentrations greater than recommended guidelines. However, concentrations were not unusually high for sediments in an urban river with a highly developed watershed, since these contaminants are common in surface water runoff from roadways and parking lots (CH2MHill 2004a). The restoration project included removal of 1–3.5 feet of surface sediments, which very likely removed the vast majority of contaminated wetland sediments in the marsh sediments. Post-restoration monitoring of contaminants is needed to quantify condition and trend. (James-Pirri et al. 2011).

Resource Brief: Saugus River Turning Basin Waterfront and Wetland Restoration

Although the First Iron Works Association (the park’s founding organization) restored the site’s harbor to an idealized version of its seventeenth-century appearance in 1954, disaster struck in 1957, when an upstream dam breach released several tons of silt into the recreated river basin. Over time the dock became mired in silt and surrounded by a sea of invasive plants. Under these conditions, visitors had difficulty envisioning the colonial iron works’ shipping operation, including the “turning basin” that was used by flat-bottomed vessels to drop off raw materials, turn around, and load up with finished iron products.

The turning basin restoration project was designed to enhance both the historic character of the cultural landscape and the natural resource values of the site by restoring open-water to the waterfront area, rebuilding decayed historic waterfront structures, and improving the river basin biodiversity by enhancing native plant, fish, and wildlife habitat. Working with the public, scientists, planners, and state and federal regulatory agencies, the National Park Service completed the work in 2007-08. In the park waterfront area, contaminated sediments around the dock were removed, the historic wooden pier and bulkhead were rehabilitated, and a cobble berm was built between the river channel and the turning basin. The berm serves to maintain active ‘riffles,’ or fast-water areas, where rainbow smelt spawn from February to June each year. In the downstream area, contaminated sediments and invasive weeds were removed, and 2.75 acres of tidal mudflat and marsh habitats were restored.

The rehabilitated Turning Basin allows visitors to clearly recognize the pivotal role that the Saugus River played in the iron works' operation and understand why America's earliest successful iron works was located at this site. In addition, the restored wetland is one of the only examples of restored freshwater tidal marsh and mudflat habitats in the state. The park now provides high quality nursery habitat for fish, eels, and invertebrates, valuable foraging habitat for shorebirds, and nest and den sites for a range of wildlife.



Degraded Saugus River landscape in 2004. (NPS)



View of rehabilitated turning basin and waterfront structures, and restored river environment (at high tide) in 2008. (NPS)

Wetland Vegetation		 web	
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Composition of the plant community	Species richness		<p>Vegetated wetlands in the park include tidal fresh/brackish marsh, and freshwater seeps that occur above the Saugus River floodplain. The tidal marshes are exposed to a broad range of salinity conditions due to freshwater discharge from the upstream river and seeps and occasionally high salinity estuarine water from downstream. This environmental variability means the park marshes should be able to support a diverse plant community. Tidal marsh vegetation has been sampled in 2004, and annually since 2008 in both long standing marsh areas and in areas targeted for marsh restoration through the turning basin restoration project. Species richness in the long standing marsh areas has averaged 27 species, and was 21, 14, and 23 species in 2009, 2010, and 2011 sampling, respectively, in the restored marsh (James-Pirri et al. 2011). However, total vegetation cover in the restored marsh area has remained low, and the area has functioned more as a tidal mudflat than a vegetated marsh. Species richness data in the freshwater seeps has not been collected, but these areas support many native species, and are known to provide habitat for Northern two-lined salamander.</p>

Wetland Vegetation Table (continued)

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Presence of non-native species	Percent cover		The turning basin restoration project and subsequent management has removed a vast majority of the invasive plant cover in both long standing marsh and restored marsh areas. In 2004, non-native species occupied over 50% of the tidal marshes, but with restoration the percent cover of non-natives fell to <2% in each of 2009–2011. Cover of invasive non-native species in the long standing marsh area averaged 8% from 2009–2011 (James-Pirri et al. 2011). However, propagules of many aggressive non-native invasive plants remain abundant throughout the park, and park staff and volunteers continue to struggle to keep up with control.

Aquatic Vegetation			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Composition of the plant community	Percent cover of horned pondweed – the native dominant species		Submerged aquatic vegetation represents critical habitat to support fish and other nekton communities, providing forage, refuge from predation, and other functions. Prior to the turning basin restoration project in 2004 horned pondweed occupied just 1–5% of the tidal river bottom; in 2011 the cover had increased to 25% (James-Pirri et al. 2011).

Upland Vegetation			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Presence of invasive species	Percent cover		Riparian forests comprise the upland vegetation in natural areas of the park. During the past decade substantial effort has been made to remove invasive non-native species, particularly on the East side of the river, where more than 100 Norway maple trees and numerous invasive shrubs have been removed. Nevertheless, the West side forest remains dominated by Norway maple, and the shrub and herb layers in all forested areas remain co-dominated by invasive non-native plants.

Aquatic Benthic Macroinvertebrate Community			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Composition of the invertebrate community	Hilsenhoff Biotic Index (HBI)		The macroinvertebrate community has been sampled within the park in 2004, 2008 and 2010 by CH2MHill (2004b, 2011). The variation among sample locations and years has been extremely high, which is not surprising given the tidal fresh to brackish conditions in the river at the park, and the dramatic changes to sediment composition and salinity following the turning basin restoration project. In general the preponderance of taxa have been pollution-tolerant, which indicates poor quality habitat. (James-Pirri et al. 2011). It is not clear if the benthic macroinvertebrate community is naturally highly variable in the park, or if it will stabilize at some point following the restoration project. Thus, there is no basis for determining a trend at this time.

Avian Community			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Waterbirds (shorebirds, waders, and waterfowl)	Species richness		Shorebirds, waders, and waterfowl observed in the park's wetland areas since the restoration of the turning basin waterfront and wetland has increased dramatically. Prior to the restoration, no shorebirds (e.g., sandpipers, plovers) and only a few waders (e.g., egrets, herons) and waterfowl (e.g., ducks), were observed. Since the restoration, a minimum of five species in each group have been observed annually. Shorebirds in particular have become abundant in late summer and early on the tidal flats (James-Pirri 2012).

Fish Community			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Composition of the fish community	Pollution tolerance		Based on sampling efforts from 1989–2007 and 2008–2011, the fish community at SAIR has been dominated by either pollution-tolerant or moderately pollution-tolerant species with very few intolerant species present (James-Pirri 2012). Of the 20+ fish captured, only 1 species was defined as pollution intolerant (brown trout); over 90% of the species captured were classified as pollution tolerant or moderately tolerant.
Rainbow Smelt abundance	Catch per unit effort (CPUE)		2008 Catch Per Unit Effort was 12:1 (James-Pirri et al. 2011). This raw number would rate as significant concern, however due to changes in river morphology associated with the turning basin restoration project, which changed the efficiency of the sampling net, it is difficult to compare data pre and post restoration, and a trend is therefore not reported. Annual monitoring of smelt at SAIR was discontinued in 2012. In 2012 the Massachusetts Division of Marine Fisheries lead smelt biologist considered the Saugus River smelt population to be relatively stable but still dramatically lower than levels observed prior to the mid-20 th century.
Rainbow Smelt spawning habitat	Habitat score		The 2006 spawning habitat score was 15, falling between the 50 th and 75 th quartiles when compared to all ranked rivers (James-Pirri et al. 2011). In 2011 and 2012 smelt egg deposition surveys showed that the total extent of smelt spawning habitat within the park has remained relatively stable over the past decade and that the egg deposition area has moved upstream, consistent with increased salinity in the river water following the removal of the downstream weir in 2009.

2.3. Visitor Experience

Visitor Numbers and Visitor Satisfaction web			
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Number of Visitors	Number of visitors per year		11,611 visitors in 2012 is consistent with the 5-year average of 11,294 visitors/year for 2008-2012. In 2007 the park changed its open season from 12 months to 7 months, resulting in a relative drop in visitation compared to the previous 5-years.
Visitor Satisfaction	Percent of visitors who were satisfied with their visit		Based on the standard visitor satisfaction survey conducted each year, the percent of visitors satisfied in FY12 was 99.0%, up from 97% and 98% for the two previous years. The FY12 satisfaction rate has increased over both the previous 5-year and the 10-year average.
Visitor Understanding	Percent of visitors who leave understanding the site's significance		Based on survey results, 85–87% of visitors leave with an understanding of core themes of park. This assessment is also based on informal evaluation of visitor understanding by interpretive staff.

Resource Brief: Special Events & Demonstrations

A roaring flame dances feverishly atop a steel furnace spewing molten iron into the angled ladle of an ironworker. A child's eyes brighten as they watch the ironworker pour the molten metal into their customized mold of compressed sand – a mold they carved by hand just moments earlier.

The iron pours, figure-casting, waterwheel, and blacksmithing demonstrations at Saugus are integral components of the park's interpretive and educational programs. Iron pours and figure-casting demonstrations take place on select dates throughout the season and are typically offered in conjunction with other special events. Visitors have the opportunity to create their own customized designs for 5"x5"x½" iron squares and can have small pewter figures of their choice cast for them.

Attending a live iron pour at Saugus is a vibrant, unforgettable event for park visitors. The sights, sounds, smells and heat of the live iron making process foster a deeper understanding (and appreciation) of the original 17th century operation at the iron works. The fire and heat of an open blast furnace provide visitors with a visceral experience that greatly enhances their understanding of the park's significance.



Iron is poured from a portable blast furnace into visitors' molds during a live iron pour. (NPS)

Interpretive and Education Programs – Talks, Tours, and Special Events			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Education Programs	Number and quality of programs; number of participants		In 2012, park interpreters presented 83 programs to 2,294 participating students. These measures both show a decrease from 2010, when there were 214 educational programs presented to 5,092 students. However, programs are now conducted only three days per week as opposed to five and the number of programs has been consolidated from five into two revised programs; while fewer in number, they are of higher quality.
Ranger Programs	Number and quality of programs and attendance		<p>There were 440 formal interpretation programs in 2011 resulting in 5,061 visitor contacts. This figure is down from the 395 formal interpretation programs in 2010, which resulted in 3,204 visitor contacts.</p> <p>The park also provided 573 demonstrations in 2012, with 6,012 visitor contacts. In 2011, there were 827 demonstrations and performing arts events, resulting in 9,815 visitor contacts – a significant increase relative to previous years. Visitor contacts and demonstrations fluctuate based on staff levels and availability of functioning waterwheels.</p>
Junior Ranger Programs	Number of programs and attendance		The park issued 505 Junior Ranger badges in 2012, down from 605 in 2011, but still an overall increase over five years. FY12 attendance included 755 visitors. The park operates a Junior Ranger station and hosts an annual Junior Ranger Day.
Special Events	Number of programs and attendance		The park conducted 19 special events in 2012. Events include iron pours, creating pewter castings, Founder’s Day and archaeology programs. The success of these programs has prompted staff to increase the number and frequency of special events in the last three years. Special event programming is highly dependent on adequate staffing and funding, which is anticipated to decrease.
Demonstrations and hands-on activities	Number of demonstrations and participation		Demonstrations are well-attended and successful; however, many are dependent on functioning waterwheels and the power they provide to other machines. All of the waterwheels need significant maintenance or replacement in order to operate reliably. Other demonstrations include blacksmithing, and demonstrations and explanations of preservation work done by staff (e.g., preservation of buildings).

Interpretive Media – Brochures, Exhibits, Signs, and Website  web			
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Wayside Signs	Condition and currency of signs		Content of signs would benefit from refreshing. Additional signs are needed; for example: welcome and introduction signage in parking lot, nature trail and turning basin signs, visitor center sign. Future waysides would benefit from QR codes. Production masters need digitalization.
Exhibits	Museum		Museum building has been renovated and expanded by park staff; small improvements have been made to exhibit panels. The overall visitor experience is good; however, major improvement is tentatively planned for museum exhibits in FY13–15.
	Nature trail		Trail has high potential to enhance visitor experience but is currently under-utilized and relatively unpublicized. Trail is largely unimproved, primitive and without any interpretive signage.
	Ironworks House		Exhibits could benefit from being refreshed as they are more than a decade old. The quality and scope of the exhibit content is good.
Visitor Center	Quality and condition of center		Visitor center and bookstore extensively overhauled and updated in 2007. Digital signage used to promote programs. Well-rounded selection of merchandise and interpretive materials in bookstore.
Print Media	Accuracy and currency of primary park publications		Unigrid publication is out-of-date (2001) and needs revision and corrections. Some site bulletins are no longer distributed; a high-quality site map is printed internally by staff.
Audio-visual Media	Orientation film		Current and high-quality. Available in 4 spoken languages, includes closed captioning. DVD film format could benefit from conversion to high-definition. Also available online via YouTube (1,200+ views in 2012).
Websites	Currency and scope of SAIR website; number of website visitors		Site received 16,723 unique visitors; 63,053 page views in FY12. The site is updated on a regular basis and continues to expand available content. NER recognized site for “design excellence” in FY12. Ample opportunity exists to post more historic/culture resource information on website.
	Social media: Facebook updates and “likes,” overall activity		Facebook page and YouTube channel established in FY12. Facebook page publishes park news, programming and current event information. Facebook has 454 likes, YouTube channel 1,500+ views. Staff participation in creating social media content is low due to limited interest, training, and time.

Resource Brief: Nature Trail

The Nature Trail draws visitors into the diverse natural landscape of the Saugus River and its surrounding riparian forest. The trail provides visitors the opportunity for exercise, quiet contemplation amidst the suburban/urban setting of the park, and for a deeper understanding of the natural landscape that influenced the early development of the Iron Works. The trail is notable for the extent that the natural surroundings contrast with the suburban/urban setting of the park.

The ½ mile long trail is a rough, undeveloped path 12–48” wide comprised of a mix of wood-chips, compacted soil and grass. While the nature trail has been a feature of the site since its designation, the trail has remained an underutilized resource by park visitors. The recent restoration of the park’s tidal basin prompted additional discussion of the future uses for the trail.

The trail has the potential to become an immersive outdoor exhibit to expose visitors to the variety of flora and fauna in the park – and to facilitate interpretive programs on the historic (and modern) role of the Saugus River watershed. In the summer of 2012 staff conducted an assessment of the trail and brainstormed future development of the trail, including the potential for:

- Adding 3–4 interpretive waysides to the trail to highlight significant natural and cultural resources
- Clearing a small area at the end of the trail to create an interpretive program area (i.e. natural amphitheater)
- Accessibility improvements for visitors with mobility concerns.
- Opening the gate at the south end of the trail to provide visitors with two-way travel and access to the trail/park.



View of turning basin showing the location of the nature trail. (NPS)



Nature trail. (NPS)

Accessibility  web			
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Mobility	ADA compliance		Virtual-reality tour is available in the Visitor Center for those who cannot physically access areas of the park. Paths and a lower-tier parking lot have increased wheelchair accessibility to exhibits. Automatic doors are needed in several locations and other accessibility improvements remain (e.g., access from the bus stop to park entrance).
Visual accommodation	ADA compliance		Still needed: more interpretive tools and content that are accessible to visually impaired visitors.
Auditory accommodation	ADA compliance		Film is captioned; however, no auditory assistance or amplification equipment is available. Content of ranger presentations is not transcribed.
Multi-lingual resources	Audio and print materials in multiple languages		Park has visitors that represent a range of countries and languages. Visitor Center auditorium film is available in four languages (English, Spanish, German, and French) but is currently not functional. Unigrid and other print materials are in English only. Translation assistance may be an excellent opportunity for volunteers' assistance.
	Bilingual staff		At least two staff members speak Spanish. Special events, in particular, could benefit from multi-lingual staff or volunteers.
Public transportation	Access to park via public transportation		Park entrance is immediately adjacent to bus stop (regular service six days per week, not Sundays or holidays). All buses are ADA accessible. New site parking lot project will improve accessibility in FY13-14.

Safety  web			
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Number of law enforcement incidents	Recordable incidents		LE staff is on-site for a limited number of hours each week, staff is shared and based out of Salem Maritime NHS. Local law enforcement resources are also available. Recordable incident severity and frequency is low. Response time from local agencies is five minutes.
Number of accidents or injuries	Recordable incidents		Few incidents in 2012 (less than 3) resulted in lost staff time or that are beyond basic first aid. Safety messages are part of every interpretive tour. Most staff and volunteers have completed first aid training. Many hazards are inherent to the park, e.g., charcoal fires, moving water, large objects, and uneven terrain. Operational Leadership training has been completed by all staff and safety is an ongoing focus.

Park Community: Volunteers and Partnerships  web			
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Volunteers	Number of volunteers and hours contributed		Saugus Iron Works volunteers contributed 2,519 hours in 2012. Volunteers provide essential services to the park, including natural resources assistance, archiving, and occasional interpretation support. Woodworkers, blacksmiths, and volunteer demonstrators also volunteer their time and expertise. Volunteer program could benefit from additional recruitment, outreach and internal management, but is limited by available time and staff resources.
Partnerships	Number of partners and level of involvement		Ongoing partnerships have been established with Saugus River Watershed Council, Saugus Chamber of Commerce, Essex National Heritage Area, Northeast Metropolitan Regional Vocational School, and the Iron Guild, to name a few. Partnerships result in collaborative programming and events, increased publicity, financial support, consultation and technical advice, and volunteers.

2.4. Park Infrastructure

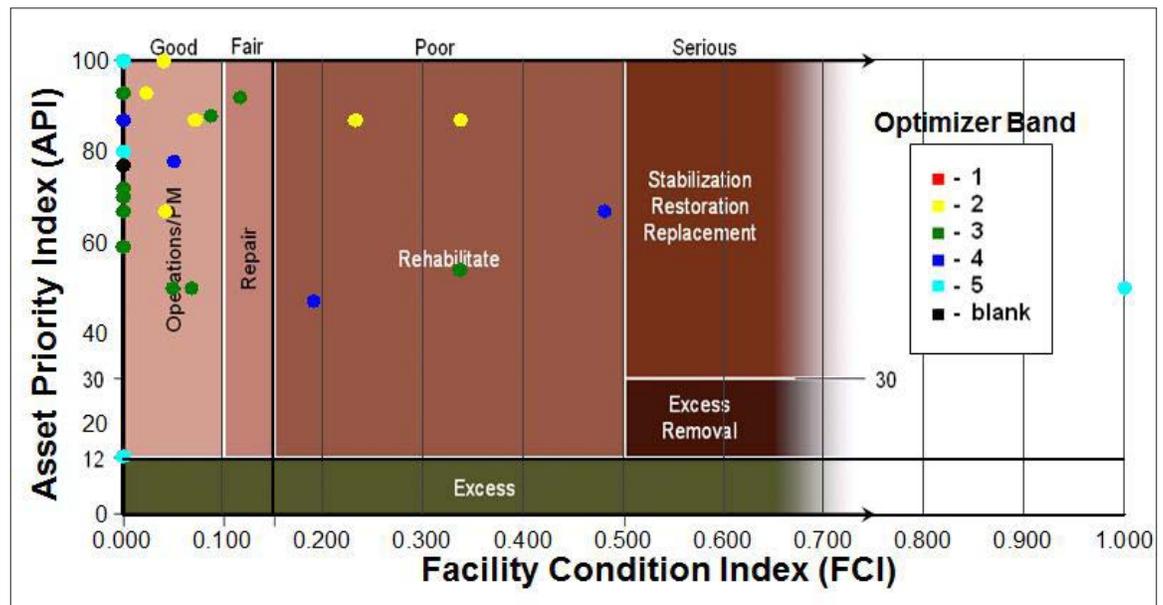
Facility Condition Index

The National Park Service uses a facility condition index (FCI) to indicate the condition of its facilities and infrastructure. FCI is the cost of repairing an asset, such as a building, road, trail, or water system, divided by the cost of replacing it. The lower the FCI number, the better the condition of the asset. The condition of the buildings and other infrastructure assets at each park is determined by regular facility inspections, or “condition assessments”, including daily informal inspections and formal yearly inspections. Deficiencies identified from these assessments are documented in the NPS Facility Management Software System and the cost for each repair determined. Repairs that cannot be completed within the year count against the condition of a structure. The total cost of these deferred repairs divided by the total cost to replace the structure results in the FCI, with values between 0 and 1 (the lower the decimal number, the better the condition). The FCI is assigned a condition category of Good, Fair, Poor, or Serious based on industry and NPS standards. Deferred maintenance projects that require additional funding are identified based on FCI. Planned preventive maintenance on critical components occurs during the year, using a park’s base budget. For additional information about how park managers use information about the condition of facilities and infrastructure to make decisions about the efficient use of funding for maintenance and restoration activities at the park, [Click here](#).

Overall Facility Condition Index				web
Asset Category	Number of Assets 2008 / 2012	FCI 2008 / 2012	Condition Status/Trend	Rationale
Buildings	14 / 14	0.174 / 0.141		Throughout the park’s industrial buildings, seven water wheel and shaft assemblies are needed. The forge building’s two sluiceways need to be replaced. A major rehabilitation of the Museum Building has been done in recent years to protect the archives and artifacts stored at the park, including installation of climate-controlled rooms and a fire suppression system. The Iron Works Maintenance Facility that is in disrepair is slated to be demolished. Maintenance operations will be centralized at current facilities on the east bank of the river.
Trails	2 / 6	0.245 / 0.043		The trails have recently been modified to meet ADA requirements throughout the park.
Paved Roads, Parking Areas, Bridges, Tunnels	5 / 1	0.452 / 0.481		Work has begun for a major redesign and construction of the parking lot area, which will include a bus stop and a pathway from the bus stop into the park.
All Others	8 / 13	0.082 / 0.000		The Saugus River Basin recently underwent a major rehabilitation. This project improved the condition of several locations throughout the park.

Another important facilities management planning tool used at a park is the Asset Priority Index (API). It identifies the importance of the various infrastructure components at a park. The API is determined using five criteria, and is calculated out of 100 possible points. The criteria are weighted based on their importance to NPS core priorities. They are distinct to ensure that each aspect of the asset is measured independently. As a result, most assets will not rate high in every category.

The scatterplot (below) for FY 2012 shows the FCI for each of the infrastructure asset types at Saugus Iron Works National Historic Site. It plots buildings, trails, roads, parking areas, and other infrastructure assets against its Asset Priority Index (API). Park managers and maintenance staff use the FCI and API data for each park asset to focus on preventive maintenance and repairs to facilities that are most critical to their parks.

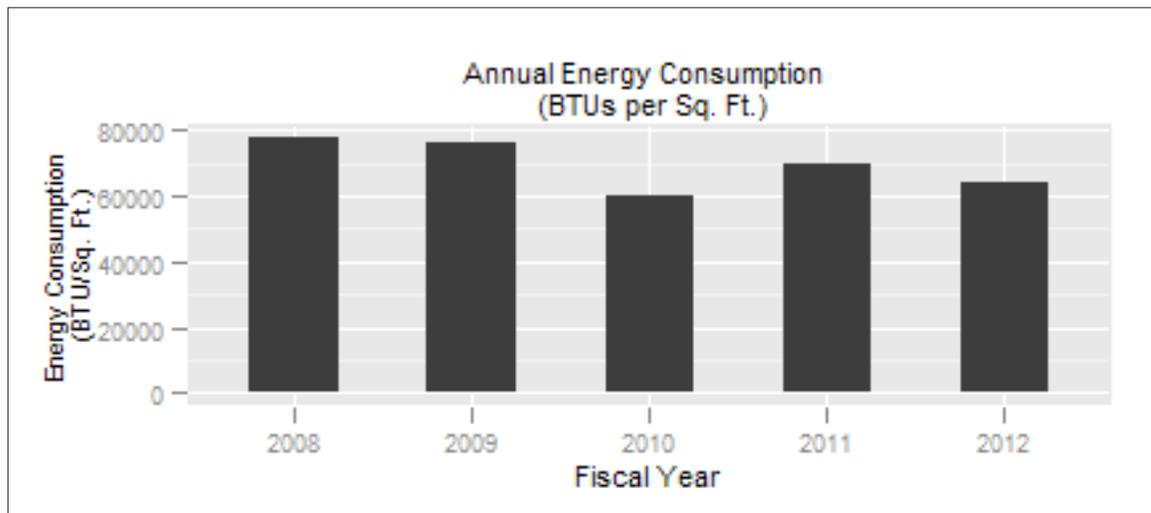


Optimizer bands—the color of the dots in the scatterplot—are assigned to each facility or asset as a tool to prioritize use of limited funding to maintain park infrastructure. Optimizer Band 1 includes those assets with the highest maintenance priorities. These assets are most important to the park—often linked to the park’s enabling legislation or have high visitor use—and usually are in the best condition. Band 1 assets receive the highest percentage of base funding for routine operations, preventive maintenance, and recurring maintenance to keep them in good condition with proactive, planned maintenance. These assets are important to park operations, but because fewer park base dollars are available after maintaining Band 1 assets, Band 2 assets receive a lesser percentage of remaining funds. Assets in the lower priority bands may only receive preventive maintenance for the most critical components or may require special projects or partner funding to maintain them. For additional information about optimizer bands and how park managers use them to make decisions about the efficient use of funding for maintenance and restoration activities at the park, [Click here](#).

Energy Consumption

The production of energy to heat, cool, and illuminate buildings and to operate water utility systems is one of the largest contributors to greenhouse gas emissions in the United States. The National Park Service is committed to improving facility energy performance and increasing its reliance on renewable energy sources. The National Park Service has a goal to reduce Servicewide building energy consumption per square foot of building space by 35% by 2016 from the baseline set in 2003 ([NPS Green Parks Plan 2012](#)).

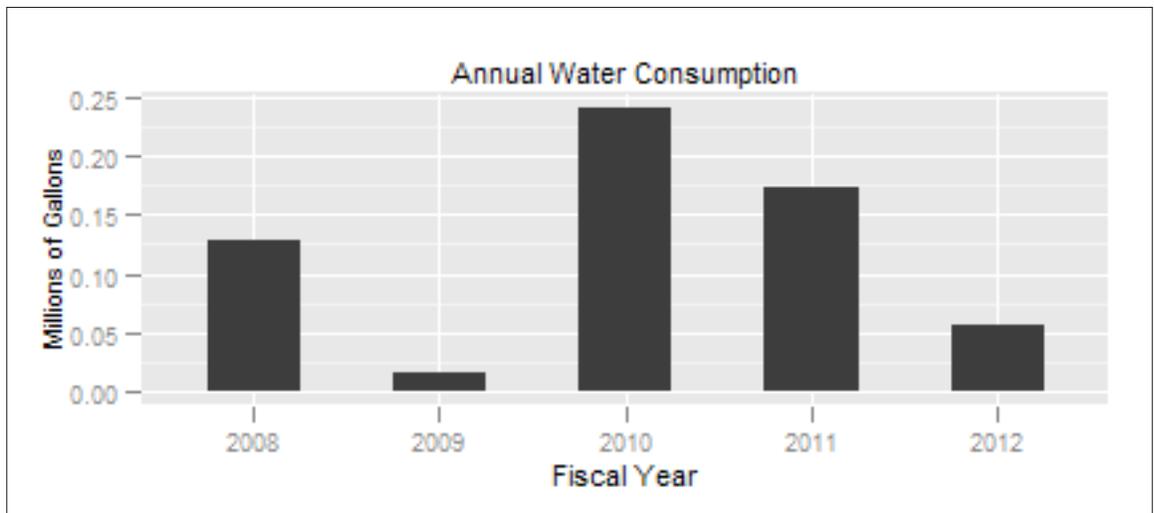
Energy Consumption			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
	BTUs per gross square footage of buildings		Energy usage (62,600 BTUs per gross square footage of buildings) in 2012 was 9.5% lower than the average for the previous 4 years (Source: NPS Annual Energy Report).



Water Consumption

The national and global supply of fresh water has diminished in recent decades, and this trend is likely to continue due to drought and other climatic changes. To contribute to the responsible use of freshwater supplies, encourage groundwater recharge, and protect water quality, the National Park Service is improving its efforts to conserve water, reuse gray water, and capture rainwater, and has set a goal to reduce non-irrigation potable water use intensity by 30% by 2020 from the baseline set in 2007 ([NPS Green Parks Plan 2012](#)).

Water Consumption			web
Indicators of Condition	Specific Measures	Condition Status/ Trend	Rationale
Water Consumption	Millions of gallons		Water consumption at SAIR in 2012 was 0.06 Million gallons, which represented a 57% reduction from the 4-year average for 2008–2011 (Source: NPS Annual Energy Report).



Park Carbon Footprint

As a participant in the Climate Friendly Parks program, Saugus Iron Works belongs to a network of parks nationwide that are putting climate friendly behavior at the forefront of sustainability planning. By conducting an emission inventory, setting an emission reduction goal, beginning the adaptation scenario planning process, developing an Action Plan, and committing to educate park staff, visitors, and community members about climate change, Saugus Iron Works strives to provide a model for climate friendly behavior within the Park Service.

Air quality and water quality are defining features at Saugus Iron Works and are an important resource. Future changes in air temperatures and precipitation patterns may alter park ecosystems, changing vegetation communities, habitats available for species, and the experience of park visitors. A relatively modest increase in temperature would affect precipitation and organism habitats in the local ecosystems. Increasing temperature and changing precipitation patterns could potentially result in a shift of specific habitat to higher elevations, local flora and fauna with specific needs and limited mobility could be locally extirpated, resulting in a possible decline of species diversity. A rise in sea-level could raise the mean height of the Saugus River, a river regularly affected by tidal and seasonal flows.

Greenhouse gas (GHG) emissions result from the combustion of fossil fuels for transportation and energy (e.g., boilers, electricity generation), the decomposition of waste and other organic matter, and the volatilization or release of gases from various other sources (e.g., fertilizers and refrigerants). At Saugus Iron Works, the main sources of energy for park operations are purchased electricity and fossil fuels for heating.

Park Carbon Footprint			web
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Greenhouse gas Emissions	Metric tons of CO ₂ equivalent (MTCO ₂ E)		Saugus Iron Works belongs to a network of parks nationwide that are putting climate friendly behavior at the forefront of sustainability planning. The Park is currently drafting a climate action plan to formalize its commitment to reduce emissions of greenhouse gases at the park by 2016. Emissions from park operations and visitor activities within the Park during 2012 are currently estimated to be 58 MTCO ₂ E, roughly equivalent to the emissions from the energy use of 6 households each year.

CHAPTER 3. KEY STEWARDSHIP ACTIVITIES AND ACCOMPLISHMENTS

Cultural Resources

- Collection storage area
- Installed fire suppression system for museum collections
- Facilitation of use of scholarly collection by more than 200 researchers
- Cataloging the timbers
- Scanning and digitizing documents for the park archives
- Publication of Roland Robbins book
- Discovery and documentation of pre-contact (archeological) period site
- Purchased one of the seven known firebacks for use in park displays

Natural Resources

- Monitoring of multiple physical and biological natural resources in association with restoration of the tidal marsh and wetlands from the turning basin project is ongoing from 2008–2018
- Control of invasive plants from the restored turning basin wetlands and riparian forest
- Removal of more than 100 non-native Norway maple trees through an innovative partnership with the Olmsted Center for Landscape Preservation
- Intensive study of *coliform* bacteria in the Saugus River completed in 2012
- American eel and Rainbow Smelt are monitored in partnership with Massachusetts Division of Marine Fisheries and the Saugus River Watershed Council
- Long-term monitoring of river water quality, forest breeding birds, and marsh vegetation by the Northeast Temperate Inventory & Monitoring Network

Visitor Experience

- Enhanced junior ranger hands-on activities
- Iron pours
- Increased accessibility in museum and Iron Works House and throughout site, including paving of waterfront trail
- Education programs have been improved

Park Infrastructure

- Replaced Slitting Mill & Blast Furnace Sluiceways
- Replace Iron Works House roof
- Rehabilitate Parking area
- Modified Pathways to meet ADA requirements
- 230/232 Central Street rehabilitation (added climate controlled museum collections storage, added ADA accessibility to library for researches, and fire suppression)
- Museum/Theater rehabilitation (added climate controlled museum collections storage, added ADA accessibility, and fire suppression)
- Improved visitor Center (Moved from small contact station to Iron Works House Annex. Now meets ADA compliance)
- Future Leaders Program (40 youth positions)
- Greening of site: Use reel mowers and battery powered weed-trimmers to maintain building area grounds
- Repaired forge hammer
- Operated waterwheels for interpretive programs

CHAPTER 4. KEY ISSUES AND CHALLENGES FOR CONSIDERATION IN MANAGEMENT PLANNING

In preparation for the 100th anniversary celebration of the National Park Service in 2016, it is a great honor for Salem Maritime National Historic Site and Saugus Iron Works National Historic Site to have been selected as the nation's first historic sites to complete a State of the Park Report. To date, only a select collection of natural resource-based national parks have completed this exercise. In contrast, Salem Maritime and Saugus Iron Works National Historic Sites are small, urban national parks with predominately cultural and historical significance. The parks recently worked with a variety of experts in the fields of natural and cultural resources, interpretation, law enforcement, and facility management to develop a set of baseline assessments that can now serve as a model for other historical and cultural-oriented national parks across the country.

In this time of accelerated change and increasing fiscal challenges, our ability to plan ahead necessitates that we have objective baseline data to assess our park operations and to develop articulated plans to address the multifaceted needs of the parks. Global climate change, rising sea levels, and an increase in the frequency and severity of storms are forcing us to envision new ways of managing and protecting our park resources. Innovations in information technology and a streamlining of government procedures are bringing broad changes to our administrative and management systems. Fiscal constraints, changing visitor demographics, and a need to diversify our workforce are all ushering in complex challenges for our parks as we enter our second century. The State of the Park Report will help us strategically assess our operations, plan for the future, and clearly communicate current park conditions to the public.

Partnerships

Saugus Iron Works National Historic Site was created by a grassroots organization called the First Iron Works Association over 70 years ago. Since its administration by the NPS in 1968, the park has continued its history of positive, productive partnerships. Throughout the 97 years of the National Park Service's existence, Congress has emphasized that the agency adhere to our primary mission as defined in the Organic Act of 1916 through the Redwood Act of 1978 to "provide for the preservation of our natural and cultural resources for the benefit of future generations and the public enjoyment thereof". Additional federal directives encourage the park to explore mutually beneficial partnerships to further our agency's mission and the park's enabling legislation, where and when appropriate.

The 2006 NPS Management Policies provide us with guidance for developing creative partnerships that ensure the public enjoyment of the park while simultaneously protecting our parks resources from commercialization, heavy-handed economic development, or policies favoring a specific group or individual over the interests of the general public. While we recognize the beneficial contributions from our existing partnerships, we must also reassess the role, value and appropriateness of our partnerships within the context of our agency's primary mission and the enabling legislation of the park.

Waterwheels

Saugus Iron Works National Historic Site is a reconstructed 17th century industrial site that evokes the character of a working, water-powered, iron-making plant from the early Massachusetts Bay Colony. Visitors tour three mill buildings where an elaborate system of waterwheels and sluiceways powers crude yet ingenious mechanical equipment that demonstrates the core operations of the colonial iron-making plant.

The working waterwheels and the equipment that they power bring the site to life for our visitors. With the sound and spray of water rushing through sluiceways, the clatter of turning shafts, the whoosh of giant bellows, the groan of massive cog wheels, and the deafening bang of a 500 pound trip hammer, visitors are able to experience some of what colonial iron workers felt as they labored at the original iron works. It is a highly sensory experience that resonates deeply in people's minds and memories.

Without the waterwheels, sluiceways and water pumps to engage machinery, the visitor experience is severely compromised. There are seven waterwheels in total. These, together with their long wooden shafts, must be replaced every ten to fifteen years as the New England weather wears at these pieces year-round.

The trees that were originally used to make these wheels and shafts were "old growth" timber that was strong and resilient to the water and weather, but is not found in abundance anymore. The craftsmanship and knowledge of how to build the wheels and shafts, how to put them in place and turn them to perfection is scarce, but not yet lost. We must find new ways to recreate these wheels in a sustainable manner and to cultivate a new generation of craftsmen and women to maintain these working components into the next century.

Parking Lot Rehabilitation

The current parking lot and maintenance facility buildings are failing and in need of major repairs. The existing parking lot's stormwater drain empties untreated, unfiltered runoff from the parking area directly into the Saugus River. A plan was developed in 2012 to rehabilitate the site by shrinking the footprint of the parking lot and creating a swale that can serve as both a groundwater recharging area and filter for the storm drainage before it flows down to the river.

As part of this project, a portion of the park's maintenance facilities will be removed and the landscape rehabilitated to create a green picnic space and overlook area for visitors to view the Saugus River and the recreated industrial site. This project will reduce the footprint of the parking lot, ensure ground water filtering to protect the river, eliminate unsightly maintenance buildings from the landscape, and create a recreational space for visitors to enjoy.

Visitation and Visibility

Historically, Saugus Iron Works NHS was open year-round and welcomed an average of 40,000 visitors per year. In 1998, the park was administratively combined with Salem Maritime NHS and in 2006 it was closed to complete a major rehab of the river basin and to improve accessibility throughout the site. After completing these projects, it was reopened for only a portion of the year (from April through November) and now welcomes an average of 10,000 visitors per year. The site is beloved by the community and all who visit.

We need to reassess the value of the partial year closing from various perspectives: tourism and economic benefit, community impacts, educational opportunities for the schools, and the feasibility of management of both Salem Maritime NHS and Saugus Iron Works NHS within existing budget and staffing levels. In addition, we also need to update the park's messaging, public relations and way-finding infrastructure (directional road signs) to increase public awareness and provide clearer access to the park. Through creative dialogue with the community and our partners, we may be able to find a way to lengthen the visitor season, increase visitation, and make it easier for visitors to discover.

Integrated Resource Management In a Cultural Landscape

The rehabilitation of the historic waterfront structures and restoration of ecological habitats and processes through the "Turning Basin" restoration project in 2007-08 has set the stage for a new era of integrated resource management at Saugus Iron Works NHS. The challenge going forward is to develop a sustainable program that preserves the cultural landscape features associated with the historic iron works while also preserving and enhancing the natural resource values of the river, forest, and wetland habitats.

Park Planning

Although the site has General Management Plan from 2002, it will be beneficial for us to now develop a modern Foundation Document and associated Resource Stewardship Strategy. The creation of both the Foundation Document and Resource Stewardship Strategy will guide the protection, preservation and public enjoyment of the site into the next century.

Conclusion

The Centennial celebration of the National Park Service in 2016 is a time for us to reassess how well we have met the mandates of our mission to protect, preserve and provide for the enjoyment of these nationally significant resources. In the past, management did not have a fully objective set of metrics that could be applied consistently to all of the National Park units across the country to evaluate their current conditions. The State of the Park process provides us with clear objective metrics for the first time.

This report will allow us to inventory and assess all our previous efforts and then evaluate how effective these efforts have been in accomplishing our mission. In areas where we are doing well, we can maintain our course; but, in realms where we have not met our mandate, we can identify where we have additional work to do and then plan accordingly to best utilize our available resources to address the greatest needs.

By establishing a standardized process that we can return to after one, three, five or ten years to re-evaluate where we stand, we can begin to manage our parks in a new way for the 21st century. We must be creative in developing new strategies, partnerships, and ways of doing park business to ensure that the preservation of and access to these significant resources continues for all the generations to come. This State of the Park Report will help us to achieve higher levels of service and resource stewardship as we approach our Centennial Anniversary in 2016.

REFERENCES

See the [State of the Park Report website](#) for a more complete list of references to documents and data sets upon which the assessments in this State of the Park report are based. References for several of the key documents cited in this report are as follows:

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See Also:

[Collection of General References](#)

[Collection of Cultural Resource-Related References](#)

[Collection of Natural Resource-Related References](#)

[Collection of Visitor Experience-Related References](#)

[Other Park Infrastructure-Related References](#)

GLOSSARY

See the [State of the Parks home page](#) for links to a complete glossary of terms used in State of the Park reports. Definitions of key terms used in this report are as follows:

Baseline Documentation	Baseline documentation records the physical condition of a structure, object, or landscape at a specific point in time. A baseline provides a starting point against which future changes can be measured.
Carbon Footprint	Carbon footprint is generally defined as the total set of greenhouse gas emissions caused by an organization, event, product or person.
Climate Friendly Park	The NPS Climate Friendly Park designation requires meeting three milestones: completing an application; completing a comprehensive greenhouse gas (GHG) inventory; and completing a Climate Action Plan, which is the actions, policies, programs, and measures a park will put into place to reduce its GHG emissions.
Cultural Landscape Inventory (CLI)	A Cultural Landscapes Inventory describes historically significant landscapes within a park. The inventory identifies and documents each landscape's location, size, physical development, condition, characteristics, and features, as well as other information useful to park management.
Curation	National parks are the stewards of numerous types of objects, field notes, publications, maps, artifacts, photographs, and more. The assemblage of these materials comprises a museum collection. Curation is the process of managing, preserving, and safeguarding a collection according to professional museum and archival practices.
Foundation Document	A park Foundation Document summarizes a park's purpose, significance, resources and values, primary interpretive themes, and special mandates. The document identifies a park's unique characteristics and what is most important about a park. The Foundation Document is fundamental to guiding park management and is an important component of a park's general management plan.
Fundamental and Other Important Resources and Values	Fundamental resources and values are the particular systems, processes, experiences, scenery, sounds, and other features that are key to achieving the park's purposes and maintaining its significance. Other important resources and values are those attributes that are determined to be particularly important to park management and planning, although they are not central to the park's purpose and significance. These priority resources are identified in the park Foundation Document and/or General Management Plan. The short-cut name that will be used for this will be Priority Resources.

Historic Integrity	Historic Integrity is the assemblage of physical values of a site, building, structure or object and is a key element in assessing historical value and significance. The assessment of integrity is required to determine the eligibility of a property for listing in the National Register.
Indicator of Condition	A selected subset of components or elements of a Priority Resource that are particularly “information rich” and that represent or “indicate” the overall condition of the Priority Resource. There may be one or several Indicators of Condition for a particular Priority Resource.
Interpretation	Interpretation is the explanation of the major features and significance of a park to visitors. Interpretation can include field trips, presentations, exhibits, and publications, as well as informal conversations with park visitors. A key feature of successful interpretation is allowing a person to form his or her own personal connection with the meaning and significance inherent in a resource.
Invasive Species	Invasive species are non-indigenous (or non-native) plants or animals that can spread widely and cause harm to an area, habitat or bioregion. Invasive species can dominate a region or habitat, out-compete native or beneficial species, and threaten biological diversity.
Museum Collection	NPS is the steward of the largest network of museums in the United States. NPS museum collections document American, tribal, and ethnic histories; park cultural and natural resources; park histories; and other aspects of human experience. Collections are managed by professionally-trained NPS staff, who ensure long-term maintenance of collections in specialized facilities.
Natural Resource Condition Assessment (NRCA)	A synthesis of existing scientific data and knowledge, from multiple sources, that helps answer the question: what are current conditions of important park natural resources? NRCAs provide a mix of new insights and useful scientific data about current park resource conditions and factors influencing those conditions. NRCAs have practical value to park managers and help them conduct formal planning and develop strategies on how to best protect or restore park resources.
Northeast Temperate Network (NETN)	One of 32 I&M networks established as part of the NPS Inventory and Monitoring Program . The Northeast Temperate Network comprises twelve parks in Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, and Vermont.
Priority Resource or Value	This term refers to the Fundamental and Other Important Resources and Values of a park. These can include natural, cultural, and historic resources as well as opportunities for learning, discovery and enjoyment. Priority Resources or Values include features that have been identified in park Foundation Documents, as well as other park assets or values that have been developed or recognized over the course of park operations. Priority Resources or Values warrant primary consideration during park planning and management because they are critical to a park’s purpose and significance.

Resource Management	The term “resources” in NPS encompasses the many natural, cultural, historical, or sociological features and assets associated with parks. Resource management includes the knowledge, understanding, and long-term stewardship and preservation of these resources.
Specific Measure of Condition	One or more specific measurements used to quantify or qualitatively evaluate the condition of an Indicator at a particular place and time. There may be one or more Specific Measures of Condition for each Indicator of Condition.