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Measuring Up: The Performance of Historic Buildings Under the Leed-NC Green Building Rating System

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University of Pennsylvania

A Thesis in Historic Preservation Presented to the Faculties of the University of Pennsylvania in Partial Fulfillment of the Requirements for the Degree of Master of Science in Historic Preservation 2007.
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To Mom, Dad and Wally

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Preface

In recent months, the issue of global warming has captured the attention of the American public in a way not seen previously. It is too soon to understand why the United States has begun to take seriously the issue of global warming at this moment, though no doubt former Vice President Al Gore's movie and book "An Inconvenient Truth," has helped to raise consciousness.[1] More extreme weather events and the overwhelming scientific evidence that global warming is upon us also contribute to newfound attentiveness to the issue. Additionally, geopolitical concerns have introduced a new sense of urgency concerning the use of oil – one of the major factors contributing to global warming.

As producers of more than 43% of the nation's carbon emissions, buildings have an extraordinarily important role to play in addressing global warming and reducing the overall degradation of our environment.[2] In recognition of this fact, numerous sustainability rating systems have been developed in recent years to help reduce the ecological footprint of the built environment. By far the most popular of these systems in the United States is the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program. This program emphasizes the design, construction and operation of high performance "green" buildings.

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[1] Al Gore, An Inconvenient Truth : The Planetary Emergency of Global Warming and What We Can do About It (Emmaus, Pa: Rodale Press, 2006).

[2] Pew Center on Global Climate Change, Building Solutions to Climate Change (Washington, D.C: Pew Center on Global Climate Change,2006), http://www.pewclimate.org/docUploads/Buildings%2DInBrief%2Epdf (accessed April 21, 2007): 1.

The term “high performance” calls to mind sophisticated contemporary designs that employ cutting-edge new technologies to reduce environmental impacts through energy efficiency, use of materials with high recycled content, responsible storm water management, and other innovations. “High performance” is less often associated with “historic buildings” -- a term that likely conjures up images of stately and solidly constructed buildings, but structures that are oftentimes far less technologically sophisticated (and thereby perceived to be less green.)

This thesis examines efforts to incorporate “green” technologies into historic buildings under the LEED New Construction (LEED-NC) program. It examines the synergies and difficulties of integrating green building practices with historic preservation, and offers recommendations for ways in which the green building standards could be more accommodating of historic buildings. But more importantly, this research challenges the very notion of “high performance” as it is currently understood by the USGBC.

Under the LEED-NC program, promoting high performance largely means encouraging the operational efficiency of buildings, and to a lesser extent incorporating green materials such as rapidly renewable and recycled goods. Far less consideration is given to the vast amounts of energy needed to construct, maintain, and demolish buildings, and to the overall durability of buildings. These factors are extremely important in determining whether a building can indeed be labeled “high performance.”

This thesis also examines the USGBC's efforts to "green" buildings in the context of the larger discussion about sustainable development. Definitions of sustainability could fill volumes, but the most commonly accepted definition is that from the United Nations Bruntland Commission's 1987 report, *Our Common Future*. The document defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[3] Increasingly, four separate but interrelated tenets of sustainability are recognized, including environmental, economic, social and cultural sustainability.

The following chapters argue that the USGBC's efforts to promote green building techniques are largely concerned with the environmental aspect of sustainability, and as such must be viewed as only one component of efforts to promote overall sustainable development.[4] Preservation-based sustainability is offered as a more comprehensive approach to development, as it takes into consideration the environmental, economic, social, and cultural implications of buildings.

As the developers of the leading green building rating criteria, the USGBC is in the best position to advance the multifaceted goals of sustainable development through its rating systems. Admittedly, this is no easy feat given the difficulties of defining -- much less measuring -- the various aspects of

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[3] Gro Harlem Brundtland and World Commission on Environment and Development, Report of the World Commission on Environment and Development : "Our Common Future" (New York: United Nations, 1987).

[4] Donovan Rypkema, "Historic, Green and Profitable" (speech delivered at Traditional Building Conference in Boston, MA, March 8, 2007).

sustainability. But if the USGBC wishes to “enable an environmentally and socially responsible, healthy, and prosperous environment that improves the quality of life,” as is their stated mission, consideration and weight must be given to all aspects of sustainability. The approach preservationists take to restore historic buildings offers a helpful framework for this issue, and is explored in the following chapters.

Chapter 1
Preservation and Sustainability in Context: A Review of the Literature

In the United States, the connection between historic preservation and environmental conservation was first made nearly 35 years ago during the oil embargo and Iranian revolution. This chapter offers a review of the literature on the subject of historic preservation and environmental concerns, and looks at how the relationship between preservation and the green building movement has evolved throughout the years. After a brief overview of the subject, Part I of this chapter discusses the early sources on the topic, including those developed in the 1970s by Richard Stein Architects and others. Part II provides a brief overview of the subject of preservation and sustainability between the 1980s and the new millennium, a time when the issue evolved very little. Finally, Part III examines what has been written most recently on the subject of preservation and the wider conservation movement.

Preservation and Sustainability: An Overview

The link between historic preservation and energy conservation dates to the 1970s energy crisis, but discussions about the important role buildings play in conserving energy went nearly dormant when fuel prices stabilized at the end of that decade. By the early 1980s, the country had lost momentum in the development of alternative energy, and in efforts to conserve energy. In the United States, discussions about building conservation and environmental conservation would not re-emerge in a meaningful way until the late 1990s and early 2000s.

By the 2000s, however, the country's energy policy was again in question, and there were compelling reasons to revisit the relationship between historic preservation and environmental conservation for two reasons. First, in 2006 oil prices soared above $72 per barrel in 2006 – up from an average of approximately $30 a barrel in 2000, in part because of rising demand from China and India.[5] It became clear that the era of cheap oil would not last forever, and that the United States would need to develop a new energy policy -- one in which it was not so dependent on expensive imports from the Middle East and other politically unstable parts of the world.

Secondly, in addition to the increasing financial cost of oil, many began to argue for the geopolitical importance of reducing dependency on foreign oil. Noted *New York Times* columnist and author Thomas Friedman has been especially vocal on this subject, arguing that the United States must end its oil addiction because it leaves the United States beholden to corrupt Middle Eastern regimes. In an April 2007 piece for the *New York Times*, Friedman further argues that "green is the new red, white and blue, " explaining that in order for the United States to reassert its place in the world, it must take the lead in developing alternative energy sources.[6]

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[5] James L. Williams, "Oil Price History and Analysis," http://www.wtrg.com/prices.htm (April 20, 2007).

[6] Thomas Friedman, "The Greening of Geopolitics," New York Times Magazine, April 15, 2007, 42.

Finally, in the new millennium the United States began to take more seriously concerns about carbon emissions and global warming. Though the United States still has not ratified the Kyoto Protocol, an agreement under the United Nations Framework Convention on Climate Change to reduce greenhouse gasses that cause global warming, it has become increasingly difficult for skeptics of global warming to defend their position. In light of the preponderance of scientific evidence that global warming is a real phenomenon, there is an increasing consciousness about the reality and significance of global climate change.

Concerns about global warming have become mainstream, with frequent headlines in daily and weekly news sources. In early April 2007, both *Time* and *Newsweek* featured cover stories on the subject, providing a "survival guide" for global warming, and a profile of California Governor Arnold Schwarzenegger's efforts to green California, respectively.[7] Books on the subject of green living line bookstore shelves, with topics such as organic housekeeping, greening business, and green remodeling. The Discovery Channel will soon launch a 24-hour channel dedicated to environmentally friendly living – a testament to the market that now exits for information on the subject.[8]

In this context of increasing fears about climate change, rising energy prices and significant political instability in the mid-east, there is a renewed interest in the link between historic preservation and the wider environmental

[7] Jeffrey Kluger, "What Now for our Feverish Planet?" Time Magazine, April 9, 2007, http://www.time.com/time/covers/0,16641,20070409,00.html (accessed April 21, 2007). Karen Breslau, "The Green Giant," Newsweek, April 15, 2007, 51.
[8] Jeff Clabaugh, "Discovery Plans 'Green' Channel," Baltimore Business Journal, April 5, 2007.

conservation movement. The merits of preservation as a means of environmentally, economically and culturally sustainable development are clear.

First, there are numerous compelling reasons to believe that preservation of historic buildings is environmentally sustainable development. Historic buildings are often located in densely populated urban areas, where infrastructure and mass transit already exists, thereby eliminating the need for new infrastructure and encouraging alternative modes of transportation. Historic buildings are also typically constructed of durable, local materials, and are often sited in such a way as to take full advantage of their surrounding environment.

Furthermore, there is tremendous embodied energy in historic buildings, which is defined as "the sum of energy required to extract or harvest a raw material, manufacture and fabricate that material into a useful form, and transport it to its place of use."[9] According to the Environmental Protection Agency, the building construction industry consumes 36% of our energy annually, and contributes 136 million tons of waste to our landfills each year.[10] Leaving a building in place therefore conserves the embodied energy in the structure, reduces waste in landfills, and reduces the need for materials to construct a new structure.

Secondly, the economic benefits of preservation have been well documented. In the U.S., spending on new construction costs is allocated

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[9] Helena Meryman, "Structural Materials in Historic Restoration: Environmental Issues and Greener Strategies," APT Bulletin 36, no. 4 (2005): 31.

[10] United States Environmental Protection Agency, "Construction and Demolition (C&D) Debris Basic Information," http://www.epa.gov/epaoswer/nn-hw/debris-new/basic.htm (accessed April 22, 2007).

about 50% to labor, and 50% to materials. In renovation projects, however, approximately 60-70% of total costs are for labor, which is important as this directly funnels more money to local laborer and in turn stimulates local economies. Heritage conservation is also a key component of the economic revitalization of center cities, and historic buildings often serve as small business incubators.[11]

Finally, the cultural benefits of preservation also have merit. The very objective of preservation is to conserve cultural heritage. Increasingly, preservation of cultural heritage is seen as an important component of sustainability. Donovan Rypkema of Place Economics has argued that the role of heritage preservation is essential in the age of globalization. He notes that there is not one globalization, but two: economic globalization and cultural globalization. While economic globalization can produce many positive benefits, cultural globalization "has few if any benefits, but has significant adverse social and political consequences in the short term, and negative economic consequences in the long term."[12] According to Rypkema, cities' success in the era of globalization will be determined not just by how well they harness the benefits of the new economic order, but in their ability to curb the homogenizing effects of globalization on cultural heritage. Rypkema concludes that heritage conservation will play a vital role in cities' economic success, and in preservation of cultural heritage.

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[11] Donovan D. Rypkema, The Economics of Historic Preservation: A Community Leader's Guide (Washington, D.C: ,1994): 25.
[12] Ibid.

Preservation of our existing building stock is therefore seen as an important way to promote holistic sustainable development. Yet it is also of strategic importance to the preservation movement. To the extent that preservationists successfully make the link between sustainability and building conservation, the justification for preservation becomes all the more compelling.

I. Preservation as Resource Conservation: The Early Years (1970s-1981)

In 1976, Richard Stein Associates and researchers at the University of Illinois at Urbana-Champaign released *Energy Use for Building Construction*. This work became the foundation for the preservation-motivated arguments regarding the high embodied energy value in historic buildings. Today, Mike Jackson, Chief Architect of the Preservation Services Division of the Illinois Historic Preservation Agency, calls the report "still the most thorough evaluation of the embodied energy of building materials that has been produced in the U.S." [13] The report provides the typical embodied-energy values for multiple types of buildings, including residential, hotel, office, and warehouse buildings, among others. While the report was based on an evaluation of new construction, it is also useful in evaluating the embodied energy in historic buildings.

In a 2005 article, Jackson suggests that Stein's work likely undervalues the embodied energy in historic buildings. Jackson attributes this to older buildings having more volume (higher ceilings) and more materials (traditional

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[13] Mike Jackson, "Embodied Energy and Historic Preservation: A Needed Reassessment," APT Bulletin 36, no. 4 (2005): 47.

buildings often feature larger masonry load-bearing walls than those buildings in the latter half of the 20th century.) He cites the examples of schools, noting that a 1970 one-story concrete block school would have less embodied energy than an early 20th century masonry load-bearing school.[14] Furthermore, Jackson raises concerns that building material embodied energy values have changed since the study was completed because of increasing efficiency in manufacturing processes for steel and concrete.

In the late 1970s, the Advisory Council on Historic Preservation commissioned a study on the subject of energy conservation and historic preservation. The Council commissioned a study of the following:

1. Energy already existing in structures to be rehabilitated;
2. Energy needed for construction and rehabilitation;
3. Energy needed for demolition and preparation of a construction site; and
4. Energy needed to operate a rehabilitated or newly constructed building.[15]

The goal of the study was to produce formulas for each of the four requirements outlined above so that these formulas could be applied to any project to better evaluate the efficiency of building conservation and rehabilitation.

The consulting firm of Booz, Allen & Hamilton was selected to execute the study. The final report was entitled *Assessing the Energy Conservation*

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[14] Ibid., 48.
[15] Calvin W. Carter, "Assessing Energy Conservation Benefits: A Study" in New Energy from Old Buildings, ed. National Trust for Historic Preservation (Washington, D.C: Preservation Press, 1981):103-104.

Benefits of Historic Preservation: Methods and Examples. The researchers established embodied energy values in existing construction, energy required for demolition, and energy required for new construction. The study also looked at the energy required to operate both existing historic buildings and new construction. Three case studies were included in the report, including: Lockfield Garden Apartment in Indianapolis; the Grand Central Arcade in Seattle's Pioneer Square; and the Austin House in Washington DC, a carriage house that had been converted into three residential units.

The report concluded that 570 billion BTUs (British Thermal Units) were embodied in the Lockfield Garden Apartments, or the equivalent of 4.5 million gallons of gasoline. The staggeringly high energy values became an important element of the National Trust's campaign to save the building from demolition, which ultimately succeeded based in part on the embodied energy argument. The Booz Allen & Hamilton report also determined that Seattle's Grand Central Arcade embodied 17 billion BTUs, and that a new building of equivalent size would require 109 billion BTUs to construct. Preserving the Arcade would result in an energy savings of 92 billion BTUs, or 730,000 gallons of gasoline – "enough to power 250 automobiles for 60,000 miles."[16]

In the final case study, Booz, Allen & Hamilton looked at the rehabilitation of the Austin House in Washington, D.C. With only the shell intact, the house had been gutted, and converted to three residential units. The study concluded that even with an extensive renovation, preservation was still more energy

[16] Ibid.,106.

efficient. It took 370 million BTUs to complete the rehabilitation, but more than 1.4 billion BTUs would have been necessary to demolish and reconstruct an equivalent building. The study also demonstrated that operating the Austin House was 5% more efficient than operating a similar house of contemporary construction.

The Booz, Allen & Hamilton study therefore concludes that in all of the selected case studies, preservation is more energy efficient than demolition and reconstruction. This study, however, is also dated. While it no doubt makes use of the best available information of the time, material manufacturing has changed considerably since then, and as Jackson suggests above, embodied energy values based on studies of new construction in the 1970s do not accurately represent the amount of energy embodied in historic structures. Given the absence of updated information, it is impossible to understand the full energy consequences of demolishing a historic building and constructing a new structure in its place. This is an area in which more research is sorely needed.

Much of the Booze, Allen & Hamilton study was used in the National Trust for Historic Preservation's *New Energy from Old Buildings*, which was published in 1981.[17] *New Energy from Old Buildings* is by far the most comprehensive work available on the subject of preservation and energy conservation, but is limited in its scope. It was meant to be the beginning of a sustained effort to improve the energy performance of historic buildings, and more importantly, to promote policy that recognized the energy embodied in

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[17] Ibid., 49.

historic buildings. "The fact that preservation conserves energy must now be taken to our legislators, our corporate leaders, and our opinion molders," wrote Michael Ainslie, then President of the Trust. "It must become the foundation for national policy on the built environment. We must find, highlight and change the law, practices and misconceptions that have led us as a nation to treat buildings as simply mere disposable items, rather than the capital assets that they are."[18]

New Energy from Old Buildings is a fascinating portrait of a time in which it appeared that the end of cheap oil would forever change the way the United States would grow, and thereby change the role of preservation. In his introduction to the book, Neal Peirce declares energy conservation needs as a "windfall" for preservation, and that it was "a particularly auspicious time for all those interested in city revitalization and preservation."[19] He celebrates the "back-to-the-city movement," and cites shifting demographics and evolving lifestyle preferences as a boon for the preservation movement. Historic buildings would gain new appreciation as "repositories of embodied energy," and be valued for the energy efficiency qualities, since many historic buildings were more energy efficient than buildings constructed between 1940 and 1970.[20]

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[18] Diane Maddex and The National Trust for Historic Preservation, New Energy from Old Buildings (Washington, D.C: Preservation Press, 1981): 16.
[19] Neil R. Peirce, "Energy Conservation: Preservation's Windfall" in New Energy from Old Buildings, ed. National Trust for Historic Preservation (Washington, D.C: Preservation Press, 1981): 29.
[20] Ibid., 29.

The Trust furthers argues that federal policy must recognize the embodied energy concept, and notes the Advisory Council's three proposed objectives for federal recognition of the benefits of embodied energy.

1. To amend section 10 of Executive Order 11912, "Energy Policy and Conservation," to include embodied energy and demolition energy in the equation developed for estimating and comparing the life-cycle costs of federal buildings.
2. To further amend Section 10 of the same Executive Order to permit agencies that meet needs for new space through rehabilitation rather than new construction to apply the energy credit earned…against the 20 percent reduction in energy consumption they are required to make by 1985.
3. To incorporate the energy analysis developed by the Council into the environmental impact statement process for evaluation projects involving new construction or rehabilitation. [21]

Yet former National Trust President Michael Ainslie's call to arms to make embodied energy "the foundation for federal policy on the built environment" was never heeded, and the goals outlined above were never realized. In the same year that book was published, President Ronald Reagan took office, and energy concerns were tempered. As one journalist notes, under the new President, "the country was instructed to go back to doing what it did best:

[21] Carter, Assessing Energy Conservation Benefits, 110.

driving cars around and shopping."[22] By the new millennium, the shortsightedness of this strategy became apparent once again.

II. The Interim Years (1981-2000)

Despite the Reagan Administration's persistence in the belief that a steady oil supply could be secured indefinitely -- access to which would be protected by force if necessary -- many in the rest of the world began to have a more serious conversation about the impact of high consumption and exploitation of the earth's resources, especially fossil fuels. In 1987, the United Nations Bruntland Commission released *Our Common Future* which helped to define sustainable development and place it on the political agenda of both developing and developed nations.

A review of the available literature on the subject of preservation and sustainability suggests that in the United States, conversations about the linkage between preservation and energy conservation went nearly dormant during the interim years from 1981 to 2000. One significant work, however, was published during this time period. The National Park Service released its *Guiding Principles for Sustainable Design* in 1994. The document was the outgrowth of the 1991 National Park Service Vail Symposium, at which participants found that parks were under stress from a number of factors, including increased visitation of parks, environmental degradation, population

[22] Sonia Shah, Crude: The Story of Oil, (New York: Seven Stories Press, 2004): 37.

increases, demographic changes, and the lack of capable leadership.[23] The issue of sustainable development was raised frequently at the symposium, and the NPS's Sustainable Development Initiative was launched later that year.

The NPS's *Guiding Principles* are a component of that Initiative, and are "intended to direct park management philosophy." The goal of the Guiding Principles is "to provide a basis for achieving sustainability in facility planning and design, emphasize the importance of biodiversity, and encourage responsible decisions."[24] *Guiding Principles* are developed for nine topics, including cultural resources, site design, building design, energy management, water supply, waste prevention, and facility maintenance and operations.

The vast majority of principles provided in the document relate directly to the management of National Park sites, and address the challenges raised at the Vail Symposium. The role of historic buildings in the realm of sustainable development is given a nod in one short section of the document. It notes: "cultural resource preservation intrinsically is a form of sustainable conservation. The built environment represents the embodied energy of past civilizations. Where resources can have a viable continued use, preservation is conservation in every sense of the word."[25] The NPS goes further in saying that historic buildings should also be evaluated to improve efficiencies in heating and cooling.

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[23] National Park Service, Guiding Principles of Sustainable Design, http://www.nps.gov/dsc/d_publications/d_1_gpsd.htm (accessed April 19, 2007).
[24] Ibid.
[25] Ibid.

It was the National Park Service that again revived the issue of sustainable development and historic preservation (at least in written word) at the end of the decade. Writing in *Cultural Resources Management*, Sharon Park of the NPS argues that "the retention and careful reuse of existing buildings, particularly historic building which have a strong connection to our past, is an emerging focus of sustainability nationwide."[26] She notes that the Park Service is "beginning to publicize rehabilitation projects that reflect environmental awareness and sustainable design."[27] The Presidio of San Francisco is highlighted as an example of green design. Environmentally friendly materials were selected, and 75% of the waste removed from the site was recycled into new products.

Park's emphasis on green materials and energy efficiency improvements in rehabilitated buildings would foreshadow things to come. In 2000, the U.S. Green Building Council released its Leadership in Energy and Environmental Design (LEED) product, which provided a rating system for the sustainability of buildings. This system would focus on the changes that could be made to buildings – either in new construction or in rehabilitation – that would create energy efficiency and produce other environmental benefits. Yet the arguments made by preservationists in the 1980s about the embodied energy in buildings would play a far less important role, as would the economic, social and cultural sustainability of preservation projects.

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[26] Sharon C. Park, "Sustainable Design and Historic Preservation," <u>CRM: [Bulletin]</u> 21, no. 2 (1998): 13.
[27] Ibid., 14.

III. Everything Old is New Again: Resource Conservation and Preservation in the New Millennium

In the early 2000s, the discussion about historic preservation and sustainability re-emerged, but this time was dominated by the application of Leadership in Energy and Environmental Design (LEED) standards to preservation projects. To understand this discussion, a closer look at the evolution of LEED standards is helpful. In 1993, the U.S. Green Building Council (USGBC) was formed with the goal of promoting buildings that are "environmentally responsible, profitable and healthy places to live and work."[28] Shortly after its founding, the USGBC set to work developing a rating system for sustainable buildings. After pilot studies in the late 1990s, the LEED-NC (New Construction) standard was available for public use in 2000. Designers were encouraged to use LEED-NC for both new construction and major rehabilitations.

Under the LEED-NC criteria, points are awarded across six categories, including: Sustainable Sites, Water Quality, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, and Innovation points. A total of 69 points are available, and projects must receive a minimum of 27 points to earn LEED certification. Four ratings are given, including certified, silver, gold, and platinum. Since the program's inception, a number of LEED products have been developed, including LEED-EB (existing buildings); LEED-CS (core and

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[28] U.S. Green Building Council, "About USGBC," http://www.usgbc.org/DisplayPage.aspx?CategoryID=1 (accessed April 19, 2007).

shell); and LEED-CI (commercial interiors). Other products are in the pilot phase, including LEED-ND (neighborhood design), and LEED-H (home).

Approximately 4,400 projects are LEED-NC registered, and about 430 projects have been LEED certified since 2000. Registration is the first step in seeking LEED certification, and provides access to credit interpretation and other resources. To date, approximately 10% of registered projects have completed the LEED certification process, which requires project review and approval by USGBC staff.

By 2006, LEED was self-described by the USGBC as “the nationally accepted benchmark for the design, construction, and operation of high performance green buildings.” Indeed, LEED appears to have become the gold standard in sustainability criteria for the built environment in the United States. While other tools for evaluating the greening of buildings exist, such as Building Research Establishment’s Environmental Assessment Method (BREEAM), which is primarily used in the UK, and the Green Building Tool, which is also popular abroad, it is clear that LEED has become the de facto standard of sustainability for building design in the United States. After an extensive review of five sustainability criteria, the U.S. General Services Administration, for example, declared LEED the “most credible green building rating system,” noting its applicability to all of the GSA’s projects, use by many federal and state agencies, and that it is the “dominant system” in the United States.[29]

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[29] K. M. Fowler and E. M. Rauch, Sustainable Buildings Rating Systems Summary (Unknown Place of Publication: U.S. Department of Energy and General Services Administration, 2006): 28.

While the USGBC encourages designers to use LEED-NC for both new construction and significant rehabilitation, the vast majority of LEED-NC certified projects are new construction. By August 2006, only 32 historic buildings were LEED certified – less than 10% of the total number of certified buildings. Despite the relatively small number of LEED certified projects, the popular press, such as *Architectural Recor*d, has celebrated the synergies of sustainable building design and historic preservation, noting that preservationists and sustainability advocates were finally collaborating with each other despite "underlying tensions" between the two. These tensions are alleged to stem from fundamental differences in approaches to resource conservation. As the guardians of history, or at least in the built environment, preservationists advocate traditional methods of construction. Green building advocates, on the other hand, are typically more open to new technologies and innovations in building construction and design.[30]

Despite increased cooperation between preservationists and green building advocates, concerns have emerged regarding the adequacy of LEED standards with regard to historic resources. In 2004, the Association of Preservation Technology (APT) formed a Technical Committee on Sustainable Preservation. This committee was formed in part out of concern about limitations of sustainability criteria such as LEED when used to evaluate the rehabilitation of historic properties. Specific concerns were raised regarding the standard's failure to recognize "the performance, longer service lives, and

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[30] Nancy B. Solomon, "How is LEED Faring After Five Years in use?" Architectural Record 193, no. 6 (2005 June, 2005): 155.

embodied energy of historic materials and assemblies."[31] Preservationists also criticized LEED's focus on current and emerging building technologies, "neglecting how past experience helps to determine sustainable performance."[32]

Indeed, LEED has been accused of taking an overly-narrow approach to green building, focusing only on the environmental dimension of sustainability. This approach fails to acknowledge other equally important aspects of sustainability that have been recognized in recent years, including economic and cultural sustainability. Writing in the 2006 Special Issue on Sustainability and Preservation of the *APT Bulletin*, Andrew Powter and Susan Ross noted that "the emphasis on quantifiable values in existing sustainability rating systems makes it difficult to consider the qualitative values of heritage properties." They note that preservationists think of sustainability in much broader terms than the conservation of resources, but recognize "the role that building themselves play in fostering regional and local culture and traditions; supporting community life and the economy; and contributing to the texture and humanity of the built environment."

In October 2006, the Pittsburgh History and Landmark Foundation and the Green Building Alliance held a day-long workshop at which green building and preservation experts assembled to discuss strategies for integrating green building technologies into historic structures. The White Paper that emerged

[31] John D. Lesak, "APT and Sustainability: The Halifax Symposium," APT Bulletin 36, no. 4 (2005): 3.
[32] Ibid.

from this session cites a number of challenges in the use of LEED standards to rate historic building projects, including the incorporation of energy efficient technologies in historic buildings and difficulty in using new “green” materials because of conflicts with the Secretary of the Interior’s Standards for Rehabilitation.

This thesis will take a closer look at the issues identified at the Green Building Summit, as well as other concerns about LEED. After an overview of LEED-NC criteria in Chapter 2, Chapter 3 compares scorecard data for historic and non-historic buildings to identify trends in the way these projects accumulate LEED points. Special consideration is given to whether LEED-NC appears to favor or disfavor historic buildings in certain categories.

Chapter 4 follows with an evaluation of the application of LEED-NC criteria in two historic project case studies, the Cobb Building in Seattle, Washington, and the Lincoln Cottage Visitors Education Center in Washington, D.C. This section assesses the feasibility of applying LEED-NC to historic projects, with the objective of identifying specific areas of conflict between green building standards and the historic preservation practice.

Chapter 5 offers a non-LEED-NC certified case study assessment. The restoration and expansion of H.H. Richardson’s Trinity Church in Boston, Massachusetts is examined closely. Lessons are drawn from the preservation-based approach to sustainability undertaken in this project, which incorporates elements of environmental, economic, and cultural sustainability practices.

Finally, Chapter 6 offers a critical assessment of LEED-NC criteria based on findings related to scorecard data and case studies in Chapters 3 through 5. It provides specific recommendations for improving LEED-NC to better recognize the sustainable qualities of historic buildings, and suggestions for incorporating elements of the preservation-based approach to sustainability to promote better design in new construction projects.

Chapter 2: LEED Deconstructed

In order to provide readers with a sense of the point distribution under LEED-New Construction (LEED-NC), this chapter examines LEED-NC criteria. An assessment of the projected performance of historic buildings under the standard is also offered. This analysis is based on LEED-NC version 2.2, which was released by the U.S. Green Building Council in 2006, subsequent to the release of LEED-NC version 2.1 in 2002, and the first LEED-NC product in 2001. Where relevant, significant changes between LEED-NC 2.0 and LEED-NC 2.2 are noted.

Since the program's inception, LEED-NC has been intended for use in new construction projects, and for substantial rehabilitations of existing buildings. Between 2001 and August 2006, approximately 445 projects were certified under the LEED-NC program. While the vast majority of LEED-NC certified projects are new construction, at least 32 projects are known to be renovations of historic buildings.[33] LEED-NC is primarily used for rehabilitations of historic structures as defined by the Secretary of the Interior's Standards for Historic Preservation.[34] The Secretary of the Interior's Standards also offer guidance for three other approaches to historic buildings, including

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[33] See Chapter 3, pages 57-59 for the methodology used for determining which LEED-NC projects are historic.

[34] Morton, W. Brown. Hume,Gary L. and others, The Secretary of the Interior's Standards for Historic Preservation Projects : With Guidelines for Applying the Standards (Washington, D.C: U.S. Dept. of the Interior, Heritage Conservation and Recreation Service, Technical Preservation Services Division, 1979). **Rehabilitation** is defined as the act or process of making possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural, or architectural values.

reconstruction, restoration, and preservation. Research to date suggests that LEED-NC has not been used for reconstruction of historic buildings, as defined by the Secretary's Standards.[35] The use of LEED-NC would not be appropriate for projects entailing fewer changes to historic buildings, such as those that would fall under the preservation or restoration categories as defined by Secretary of the Interior.[36]

Each renovation project is unique, and each historic building likely possesses distinct advantages and weaknesses with regard to LEED-NC certification. Nonetheless, based on an analysis of the criteria required for LEED-NC certification, it should be possible to anticipate whether historic building rehabilitation projects would be likely to earn an individual credit. This chapter builds on that assumption, providing an assessment for how historic buildings are anticipated to perform for each credit.

Historic projects are given a projected performance rating of "strong," "average," or "weak." A rating of "strong" denotes that historic projects are more

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[35] Ibid. **Reconstruction** is defined as the act or process of depicting, by means of new construction, the form, features, and detailing of a non-surviving site, landscape, building, structure, or object for the purpose of replicating its appearance at a specific period of time and in its historic location.

[36] According to the Secretary of the Interior's Standards for Historic Preservation, **Preservation** is defined as the act or process of applying measures necessary to sustain the existing form, integrity, and materials of an historic property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction. New exterior additions are not within the scope of this treatment; however, the limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a preservation project. **Restoration** is defined as the act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period of time by means of the removal of features from other periods in its history and reconstruction of missing features from the restoration period. The limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a restoration project.

likely to earn a given point than a typical new construction project. A designation of "average" is given when historic projects are expected to perform in a manner consistent with new buildings. A rating of "weak" indicates that a historic project is unlikely to perform as well as a non-historic project.

This chapter assesses the project performance of historic buildings under LEED-NC and will be evaluated against the actual performance of historic and non-historic buildings in subsequent chapters. Together, these will inform the evaluation of the application of LEED standards to historic buildings examined in this thesis.

Chapter Overview

As noted in Chapter 1, LEED-NC points are awarded across five categories, including Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality (see Figure 1). LEED-NC also offers up to five Innovation points for performance that exceeds LEED standards, or categories that are not specifically addressed under the rating criteria.

These points are examined in some detail below, but more thorough explanations are available in the U.S. Green Building Council's LEED-NC version 2.2 Reference Guide. For the purposes of this thesis, the term "category" references one of the six major groupings of LEED-NC criteria, including Sustainable Sites, Materials & Resources, Innovation Points, etc. The term "subcategory" refers to a specific point within a category. For example, credit for brownfield development is a subcategory of the Sustainable Sites category.

In addition to credits under each category, LEED-NC also requires that all projects meet certain prerequisites. Under the Sustainable Sites category, for example, Prerequisite 1 requires that projects develop and execute an Erosion and Sedimentation Control Plan for all construction activities. These prerequisites will not be examined, since all LEED-NC projects must meet these basic standards in order to qualify for certification.

Readers familiar with the LEED-NC criteria may wish to skim this chapter only to take note of the anticipated performance of historic building rehabilitation projects, which is noted in shaded boxes. Finally, it must be noted that this chapter quotes very liberally, often verbatim, from the LEED-NC reference

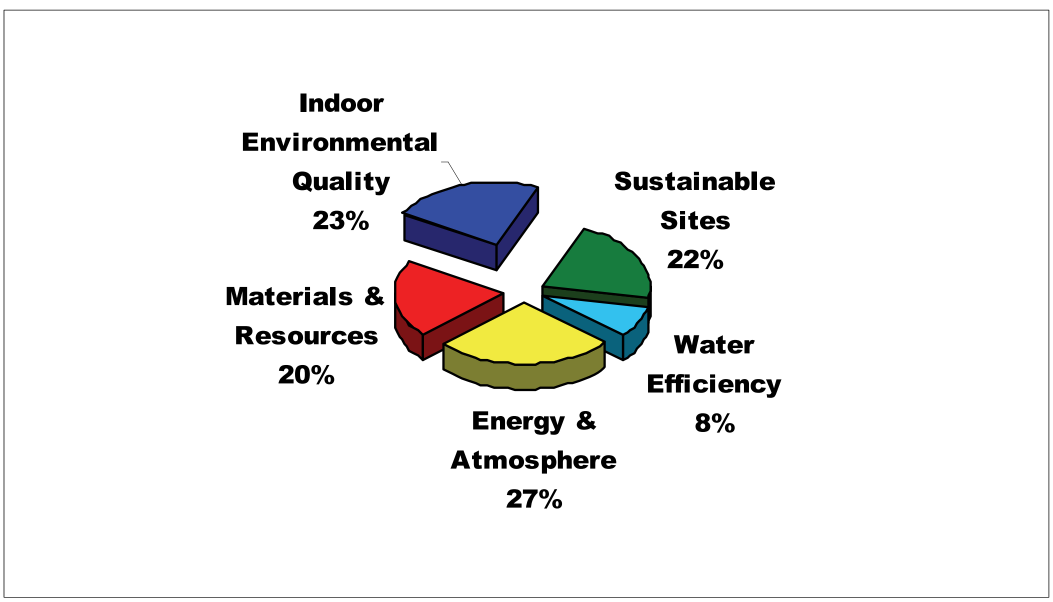

Figure 1: Graphic of Distribution of LEED-NC Points. (Courtesy of U.S. Green Building Council, http://www.usgbc.org).

guide. All information is taken from the LEED-NC version 2.2 Reference Guide unless otherwise noted.

I. Sustainable Sites (SS)

Out of a total possible 69 points, up to 14 points can be awarded to a project based on the sustainability of its site. The Sustainable Sites criteria is intended to recognize the importance of site selection in the development process, as the choice of land for construction has a significant impact on the ecological footprint of a building. Specifically, greenfield development consumes land, often driving out agricultural uses, or destroying habitats for plants and animals. Development of greenfields can also increase erosion and sedimentation resulting from erosion that can disrupt local waterways and reduce the quality of habitat for aquatic life. The USBGC therefore notes that preference should be given to buildings with high performance attributes in locations that enhance existing neighborhoods, transportation networks, and urban infrastructure.

In LEED-NC version 2.2, the USGBC explains that "establishing sustainable design objectives and integrating building location and sustainable features as a metric for decision making encourages development and preservation or restoration practices that limit the environmental impact of buildings on local ecosystems."[37] It is therefore expected that credits awarded

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[37] U.S. Green Building Council, New Construction Reference Guide Version 2.2, 2nd ed. (Washington, D.C: U.S. Green Building Council, 2006): 19.

under the Sustainable Sites category would tend to favor the reuse of historic buildings. After all, historic buildings are very often located in densely populated urban centers with access to existing infrastructure.

Under LEED-NC, Sustainable Sites points are distributed across eight categories, including Site Selection, Development Density, Alternative Transportation, Brownfields, Site Development, Stormwater Quality Control, Heat Island Effect, and Light Pollution. These are examined below.

(SS-1) Site Selection – 1 point: This point is intended to discourage the development of inappropriate sites and reduce the environmental impact that results from the location of a building on a site. Development of the following is discouraged: prime farmland; land lower than five feet above the elevation of a 100 year floodplain as defined by FEMA; habitat for endangered species; land within 50 feet of a water body; sites within 100 feet of wetlands; or public parkland.

SS-1 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Strong

Historic buildings are often located in existing urbanized areas (i.e. not prime farmland, habitat for endangered species, parkland, etc.)

(SS-2) Development Density – 1 point: This credit encourages higher density development and is intended to channel development to urban areas with existing infrastructure, protect greenfields, and preserve habitat and natural resources. There are two options under this credit. Developers can construct or renovate buildings on a previously developed site and in a community with a minimum density of 60,000 square feet per acre net. Alternately, developers can construct or renovate buildings on a previously developed site within ½ mile of a residential zone or neighborhood with an average density of 10 units per acre net. Under the latter scenario, the development must also be within ½ mile of basic services, and provide pedestrian access between the building and services.

> **LEED-NC 2.0 and 2.1:** Under the earlier criteria, the second option was not available (construction in residential zone.)
>
> SS- 2 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Strong
>
> Historic buildings are often located in existing urbanized areas.

<u>(SS-3) Brownfields – 1 point:</u> This credit encourages the development of brownfield sites, defined as "property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant."[38] One point is awarded for development on a contaminated site, or on a site defined as a brownfield by one or more levels of government. This credit can also be awarded for the removal of hazardous materials in existing buildings, such as asbestos and lead paint.

> SS-3 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Strong
>
> Brownfield re-development may be slightly more likely to include preservation of a historic building. In addition, historic buildings often include hazardous materials that require removal.

[38] Ibid., 41.

(SS-4) Alternative Transportation – 1-4 Points: The intent of these credits is to reduce pollution and land development impact from automobile use. A maximum of four points is available.

(SS-4.1) Access to Mass Transit – 1 Point: Locate project within ½ mile of an existing commuter rail, light rail or subway; or locate project within ¼ mile of one or more stops for two or more bus lines.

(SS-4.2) Bicycle Storage and Changing Facilities – 1 Point: For commercial buildings, provide bicycle racks and shower and changing facilities for 5% or more of all building users. For residential structures, provide bicycle cover storage facilities for 15% or more of building occupants.

(SS-4.3) Low Emissions and Fuel-Efficient Vehicles – 1 Point:

Option 1: Provide low-emitting and fuel efficient vehicles for 3% of occupants and provide preferred parking for vehicle.

Option 2: Provide preferred parking for LEV and fuel-efficient vehicles for 5% of total vehicle parking capacity of site.

Option 3: Install alternative fuel refueling stations for 3% of total vehicle parking capacity of the site.

(SS-4.4) Parking Capacity – 1 Point:

Option 1 (Non-Residential): Provide parking capacity not to exceed minimum local zoning requirements, and provide preferred parking for carpools or vanpools for 5% of total parking spaces.

Option 2 (Non-Residential): For projects that provide parking for less than 5% of FTE building occupants, provide preferred parking for carpools and vanpools for 5% of total spaces.

Option 3 (Residential): Provide parking capacity not to exceed minimum local zoning requirements, and provide infrastructure and systems to support shared vehicle use (carpool drop off sites, etc.)

Option 4: Provide no new parking.

LEED-NC 2.0 and 2.1: Under the earlier criteria, fewer options were available for Credits 4.3 and 4.4.

SS-4 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average-Strong

Given that historic buildings are often located in heavily urbanized areas and do not include extensive parking, preservation projects may be likely to score higher for credits 4.1 and 4.4 than typical projects. Average performance is expected for points 4.2 and 4.4, as there is little reason to expect that historic projects would be more likely to provide changing facilities and bike racks, or LEV vehicles.

(SS-5) Site Development – 2 points: The points are awarded to projects that conserve existing natural areas and restore damaged areas to improve habitat and promote biodiversity.

(SS-5.1) Protect or Restore Habitat – 1 Point: On greenfield sites, limit all site disturbance within a required distance from building. Or, on a previously developed site, restore and protect a minimum of 50% of site area with native or adapted vegetation.

(SS-5.2) Maximize Open Space – 1 Point: Provide a high ratio of open space to development footprint to promote biodiversity.

Option 1: Reduce development footprint and/or provide vegetated open space within the project boundary to exceed the local zoning open space requirement for the site by 25%.

Option 2: For an area with no local zoning requirements, provide vegetated open space area adjacent to the building that is equal to the building footprint.

Option 3: Where a zoning ordinance exists, but there is no requirement for open space, provide vegetated open space equal to 20% of the project's site area.

LEED-NC 2.0 and 2.1: Under the earlier criteria, fewer options were available to earn the credit.

SS-5 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Weak

Historic buildings may be challenged by existing location, which may be built out too close to the edge of lot-lines to achieve open space objectives.

(SS-6) Stormwater Design – 2 Points: These credits are designed to recognize projects that limit disruption of natural hydrology by reducing impervious cover, increasing on-site infiltration, and managing stormwater runoff.

(SS-6.1) Quantity Control -1 Point: There are two options under this credit. If existing impervious space is less than or equal to 50%, project developers can implement a stormwater management plan that prevents the post-development peak discharge rate and quantity from exceeding the pre-development peak discharge rate and quantity for the one and two year, 24-hour design storms. Alternately, if existing imperviousness is greater than 50%, the project team can implement a stormwater management plan that results in a 25% decrease in the volume of stormwater runoff from the two-year, 24-hour design storm.

(SS-6.2) Quality Control – 1 Point: Project teams must reduce or eliminate water pollution by reducing impervious cover, increasing on-site infiltration, eliminating sources of contaminants, and removing pollutants from stormwater runoff. The stormwater system must capture and treat the stormwater runoff from 90% of the average annual rainfall using acceptable best management practices.

LEED-NC 2.0 and 2.1 The earlier criteria for credit 6.1 allowed projects to earn points when there is no net increase in stormwater runoff from existing to developed conditions. Credit 6.2 was awarded for treatment systems designed to remove 80% of the average annual post development total suspended solids (TSS), and 40% of the average annual post development total phosphorous (TP), by implementing Best Management Practices (BMPs) outlined in EPA's Guidance Specifying Management Measures for Sources of Non-Point Pollution in Coastal Waters.

SS-6 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Weak

Historic buildings may be challenged by existing design of building, which may make achieving storm water quantity and quality control more difficult than in new construction.

(SS-7) Heat Island Effect – 2 Points: This credit is designed to reduce heat islands in order to minimize impact on microclimate and human and wildlife habitat. Two points are available.

(SS-7.1) Non-Roof – 1 Point: Project designers can provide any combination of the following strategies for 50% of the site hardscape: shade; paving materials with a Solar Reflectance Index (SRI) of at least 29; and/or open grid pavement system. Alternatively, a minimum of 50% of parking spaces can be placed under cover. Any roof used to shade or cover parking must have a solar reflective index of 29.

(SS-7.2) Roof – 1 Point: Three options are available to reduce the heat island effect associated with roofs. First, project designers can use roofing materials with a SRI equal to USGBC specifications. Second, a vegetated roof can be installed, so long as it covers at least 50% of the roof area. Finally, high albedo and vegetated roof surfaces that meet USGBC specifications can be installed.

LEED-NC 2.0 and LEED NC 2.1: The earlier criteria for 7.1 was less restrictive, requiring only 30% of hardscape be designed to minimize the heat island effect.

SS-7 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Weak

Depending on the site and significance of area immediately adjacent to a historic building, designers may not be able to alter non-roof elements in order to reduce Heat Island Effect. Achieving credit 7.2 may also directly conflict with efforts tomaintain the historic appearance of a building. If historic tax credits are sought, alteration of roofing materials may not conform to the Secretary of the Interior Standards for Historic Preservation.

(SS-8) Light Pollution Reduction – 1 Point: The intent of this credit is to minimize light trespass from the building and site, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction, and reduce development impact on nocturnal environments. All projects are designated as follows: park and rural settings; residential areas; commercial, industrial and/or high-density residential; and major city centers/entertainment districts. Lighting requirements vary based on designation.

For interior light, the angle of maximum candela from each interior luminaire as located in the building must intersect opaque building interior surfaces and not exit out through the windows. Alternately, all non-interior lighting must be automatically controlled to turn off during non-business hours. Exterior lighting should be lit only to the extent necessary for safety and comfort. Lighting must not exceed 80% of the lighting power densities for exterior areas and 50% for building facades and landscape features as defined in by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers Inc. (ASHRAE) and the Illuminating Engineering Society of North America (IESNA).

SS-8 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average

It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

II. Water Efficiency (WE)

The US Green Building Council notes that in the United States, 340 billion gallons per day of fresh water is drawn from steams, rivers and reservoirs. Surprisingly, these sources account for only one-quarter of the nation's supply of fresh water. Underground aquifers are an additional source of fresh water, but water levels have dropped more than 100 feet (on average) in the last 70 years. A variety of water-conserving measures can be undertaken, including low-flow toilets, sensored sinks, and the use of non-potable water for irrigation of landscaping. The LEED-NC Water Efficiency criteria are designed to encourage the conservation of one of the most precious resources. Water efficiency credits fall under three subcategories, including landscaping, innovative wastewater technologies, and water use reduction. These water conservation strategies are outlined in more detail below.

(WE-1) Water Efficient Landscaping – 2 Points: The intent of encouraging water efficient landscaping is to limit or reduce the use of potable water or other natural surface or subsurface water resources available on or near the project site for vegetation.

> (WE-1.1) Reduction of Potable Water Use -1 Point: To obtain this point, projects must reduce potable water consumption for irrigation by 50% from a calculated mid-summer baseline. Reduction must be attributed to any combination of the following items: plant species; irrigation efficiency; use of captured rainwater; use of recycled

wastewater; and use of water treated and conveyed by a public agency for non-potable uses.

(WE-1.2) No Potable Water Use or Irrigation – 1 Point: To earn this second point, projects must eliminate the use of potable water or other natural surface or subsurface water resources available on or near the project site for landscape irrigation. Use only captured rainwater, recycled wastewater, recycled graywater, or water treated and conveyed by a public agency for non-potable use. Install landscaping that does not require permanent irrigation systems.

WE-1 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average
It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

(WE-2) Innovative Wastewater Technologies – 1 Point: The goal of this credit is to reduce the generation of wastewater and potable water demand, while increasing the local aquifer recharge. Two options are available to obtain the points.

Option 1: Reduce potable water use for building sewage conveyance by 50% through the use of water conserving fixtures or non-potable water.

Option 2: 50% of wastewater is treated on-site to tertiary standards. Treated water must be infiltrated or used on-site.

WE-2 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average
It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

(WE-3) Water Use Reduction 1-2 Points: Two credits are available under this category. This standard encourages building designers to maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems. One credit is available to projects that employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements. Calculations are based on estimated occupant usage and include the following fixtures: water closets, urinals, lavatory faucets, showers, and kitchen sinks. An additional credit is available to projects that employ water conservation strategies to achieve a 30% reduction in water usage.

WE-3 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average
It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

III. Energy and Atmosphere (EA)

According to the U.S. Department of Energy, buildings consume 36% of the energy and 68% of the electricity generated in the United States. [39] The United States' dependence on fossil fuel for energy is cause for concern for a number of reasons, including the production of carbon dioxide emissions that contribute to global warming. Improving the energy performance of buildings therefore presents an enormous opportunity to reduce the country's overall energy consumption. The LEED-NC program offers 17 possible points in this category, the most of any category, which no doubt reflects the importance of energy efficiency in sustainable buildings. Points are offered in the following areas: Optimizing Energy Performance; On-site Renewable Energy; Enhanced Commissioning; Enhanced Refrigerant Management; and Measurement and Verification.

(EA-1) Optimizing Energy Performance - 1-10 Points: Up to ten points are awarded for improved levels of energy performance above the baseline standard to reduce environmental and economic impacts associated with excessive energy use.

> Option 1: Whole Building Energy Simulation - Demonstrate percentage improvement in the proposed building performance rating compared to the baseline building performance rating per

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[39] Unknown Author, "Building Energy use and Carbon Management," Oak Ridge National Laboratory Review 33, no. 2 (2000), http://www.ornl.gov/info/ornlreview/v33_2_00/building.htm (accessed April 21, 2007).

ASHRAE/IESNA Standard by a whole building project simulation using the Building Performance Rating Method provided by USGBC. Points are awarded based on level of efficiency as follows (note the different standards for new and existing buildings):

New Buildings	Existing Building	Renovations Points
10.5%	3.5%	1
14%	7%	2
17.%	10.%	3
21%	14%	4
24.5%	17.5%	5
28%	21%	6
31.5%	24.5%	7
35%	28%	8
38.5%	31.5%	9
42%	35%	10

Table 1: EA-1 Points for Optimizing Energy Performance

Option 2: Comply with the prescriptive measures of the ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004. (Four Points Possible)

Option 3: Prescriptive Compliance Path. Comply with the Basic Criteria and Prescriptive Measures of the Advanced Buildings Benchmark Version 1.1 (1 Point Possible)

LEED-NC 2.0 and 2.1: The earlier criteria was more restrictive, requiring that existing buildings achieve a minimum of a 10% improvement in energy performance for two points, and achieve 50% improvement in performance to earn all 10 credits.

EA-1 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Weak

Because of traditional building techniques, it may be difficult for historic buildings to achieve the levels of energy efficiency prescribed by LEED-NC, even with lower standards for existing buildings.

(EA-2) On-Site Renewable Energy 1-3 Points: Up to three points are awarded to encourage and recognize increasing levels of on-site renewable energy self-supply. These points are awarded for use of on-site renewable energy systems to offset building energy cost. One point is awarded for use of 2.5% renewable energy; 2 points are awarded for renewable energy use between 2.6% and 7.5%; and 3 points are awarded for renewable energy use up to 12.5%.

LEED-NC 2.0 and 2.1: The earlier criteria were more restrictive and required the following: 5% renewable energy– 1 point; 10% renewable energy – 2 points; 20% on site renewable energy – 3 points.

EA-2 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Weak

On-site renewable energy typically includes the use of solar, wind or other sources of environmentally friendly energy. As these alternative sources are likely to alter the appearance of historic buildings, and perhaps be prohibitively costly to incorporate in an existing structure, it is expected that historic buildings performance will be weak in this category.

(EA-3) Enhanced Commissioning – 1 point: The opportunity to earn this point encourages project designers to begin the commissioning process early in the design process and execute additional activities after systems performance verification is complete. In order to earn this point, an independent commissioning authority must be designated to lead, review and oversee the commissioning process. The commissioning authority is required to conduct a commissioning design review of the owner's project requirements, basis of design, and design documents prior to mid-construction documents phase and back-check the review comments in the subsequent design submission. A systems manual must be developed by the commissioning authority to ensure that the future building staff understands how to operate the building systems, and appropriate training must be provided. Building operation must be reviewed after 10 months of substantial completion, and a plan must be developed to address any commissioning-related concerns.

> **EA-3 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average**
>
> As renovations of historic buildings may often involve improvements to HVAC and other operating systems, it is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

(EA-4) Enhanced Refrigerant Management – 1 Point: This point recognizes and rewards the reduction of ozone depleting products. Two options are offered: no use of refrigerants, or select refrigerants and HVAC&R that minimize or eliminate the emission of compounds that contribute to ozone depletion and global warming.

> **LEED-NC 2.0 and 2.1:** The earlier criteria required that no ozone depleting product be used; no provision for minimizing emissions was provided.
>
> **EA-4 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average**
>
> Because many historic buildings are naturally ventilated and do not have systems that use refrigerants, this point may be easy to obtain. Conversely, many older buildings may have aging systems that include use of these refrigerants, making it difficult to obtain this credit. On balance, performance is expected to be average.

(EA-5) Measurement and Verification – 1 Point: This point is awarded to projects that provide for the ongoing accountability of building energy consumption over time. Project designers must develop and implement a Measurement & Verification (M&V) Plan consistent with established standards provided by USGBC. The M&V period must cover a period of no less than one year of post-construction occupancy.

EA-5 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average
It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

(EA-6) Green Power- 1 Point: This point is intended to encourage the development and use of grid-source, renewable energy technologies on a net zero pollution basis. This point is offered to projects that obtain at least 35% of the building's electricity from renewable sources by engaging in at least a two-year renewable energy contract. Renewable sources are defined by the Center for Resource Solutions Green-e products certification requirements. This can be achieved by purchasing at least 35% of power from a Green-e certified power provider, or purchasing Green-e accredited Tradable Renewable Certificates.

EA-6 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average
It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

IV. Materials and Resources (MR)

The USGBC's LEED-NC Reference guide notes that construction and demolition waste account for a staggering 40% of the solid waste stream in the United States. Minimizing this waste is therefore an important component of the USGBC's efforts to promote sustainability in buildings, and a total of 13 points are available in this category. Special emphasis is placed on the re-use of existing buildings. The USGBC notes in the LEED-NC version 2.2 Reference Guideline that "maintaining occupancy rates in existing buildings reduces redundant development and the associated environmental impact of producing and delivering all new materials." They further note that "reuse of existing buildings, versus building new structures, is one of the most effective strategies for minimizing environmental impacts."[40] The use of salvaged materials, local materials and rapidly renewable materials is also encouraged. Because of the USGBC's strong emphasis on building reuse, it is expected that historic buildings will generally outperform new construction in this category.

(MR-1)Building Reuse – 1-3 Points: Building reuse is intended to extend the life cycle of the existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as they relate to materials manufacture and transport. One point is awarded for projects that maintain at least 75% (based on surface area) of an existing building's walls, floors and roof (not including removal of hazardous materials.)

[40] U.S. Green Building Council, New Construction Reference Guide Version 2.2, 233.

If the project includes an addition to an existing building, this credit is not applicable if the square footage of the addition is more than two times the square footage for existing building. A second point is available to projects that maintain 95% of existing walls, floors and roofs.

An additional point is available to projects that use existing interior non-structural elements (such as walls, doors, floor covering and ceiling systems) in at least 50% of the completed building, including additions. If the project includes an addition to an existing building, this credit is not applicable if the square footage of the addition is more than two times the square footage for existing building.

LEED-NC 2.0 and 2.1: The earlier criteria were more restrictive. A second point was awarded only if 100% of the building floors, roof and walls were maintained. The third point was available only to projects that maintained 100% of the existing building, and maintained at least 50% of interior non-load bearing structures.

MR-1 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Strong

As the MR-1 credits only apply to existing buildings, historic buildings will necessarily out-perform new construction in this subcategory.

<u>(MR-2) Construction Waste Management – 1-2 Points:</u> These points are intended to help divert construction and demolition debris from disposal in landfills and incinerators. This can be achieved through redirecting recyclable recovered resources back to the manufacturing process and redirecting reusable materials to appropriate sites. One point is available to projects that recycle and/or salvage at least 50% of non-hazardous materials construction

and demolition debris. A second point is available to projects that recycle and/or salvage at least 75% of non-hazardous materials construction and demolition debris.

MR-2 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average
It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

(MR-3) Materials Reuse – 1-2 Points: Materials reuse is encouraged to reduce demand for virgin materials and to reduce waste, thereby limiting impacts associated with the extracting and processing of virgin resources. One point is awarded if 5% of total building materials are from salvaged, refurbished or reused sources (based on total cost of materials). An additional point is available for projects that make use of at least 10% salvaged, refurbished, or re-used materials.

It is noteworthy that this credit requires the use of salvaged materials from another building, or requires that salvaged materials from the project building be used in a different way. For example, it is not possible to earn a credit for reuse of an existing building's doors or windows.[41]

MR-3 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average
It is not anticipate that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

[41] Nancy Henderson, (architect, ArchEchology), e-mail message to author, April 16, 2007.

(MR-4) Recycled Content – 1-2 Points: In addition to reducing demand for new resources, the inclusion of recycled content in LEED-NC certified buildings is intended to increase demand for building products that incorporate recycled content materials. One point is available when materials with post-consumer recycled content plus one-half of the pre-consumer content constitute at least 10% (based on cost) of the total value of the materials in the project. An additional point is available when projects meet a 20% or greater threshold.

> **LEED-NC 2.0 and 2.1:** The earlier criteria were more restrictive, requiring that a minimum of 25% of materials contain at least 20% recycled content. A second point was awarded to projects that specified 50% of materials be of recycled content.
>
> MR-4 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average
>
> It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

(MR-5) Regional Materials – 1-2 Points: A maximum of two points are available to projects that incorporate a percentage of materials that are extracted, processed or manufactured regionally. This is intended to increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation. One point is available to projects that use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site for a minimum of 10% of the total materials value. An additional point is available to projects that meet a 20% or greater threshold.

LEED-NC 2.0 and 2.1: The earlier criteria were more restrictive, requiring that 20% of materials come from regional sources for one point, and that 50% off materials be local to earn a second point.

MR-5 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average

It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

(MR-6) Rapidly Renewable Materials – 1 Point: This point is intended to reduce the use and depletion of finite raw materials and long-cycle renewable materials by replacing them with rapidly renewable materials. One point is awarded to projects that use rapidly renewable building materials and products (made from plants that are typically harvested within a ten-year cycle or shorter) for 2.5% of the total value of all building materials and products used in the project, based on cost.

LEED-NC 2.0 and 2.1: The earlier criteria were more restrictive, requiring that 5% of materials come from rapidly renewable sources.

MR-6 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average

It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

(MR-7) Certified Wood – 1 Point: The USGBC encourages the use of certified wood to promote environmentally responsible forest management. One point can be obtained when projects use a minimum of 50% of wood-based materials and products that are certified in accordance with the Forest Stewardship Council's Principles and Criteria for wood building components. These components include, but are not limited to, structural framing and general dimensional framing, flooring, sub-flooring, doors, and finishes.

MR-7 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average
It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

V. Indoor Environmental Quality (EQ)

The final category for LEED-NC awards points for addressing indoor environmental quality issues. The USGBC's Reference Guide notes that Americans spend up to 90% of their time indoors, where pollution levels can run as much as 100 times higher than outdoor pollution levels. The LEED-NC standards make use of recent advances in promoting indoor environmental quality, noting that problems with indoor air quality are often much easier to prevent than they are to treat. Emphasis is placed on using materials with lower levels of off-gassing, sequencing of construction, protection of air handling systems during construction, and building flush out prior to occupancy. A maximum of 15 points is available under this category.

<u>(EQ-1) Outdoor Air Delivery Monitoring – 1 Point:</u> One point is available to buildings that provide capacity for ventilation system monitoring to help sustain occupant's comfort and well-being. In order to obtain the point, building designers must install permanent monitoring systems that provide feedback on the performance of ventilation systems to ensure minimum operating

requirements. All monitoring equipment must be configured to generate an alarm when the conditions vary by 10% or more from the setpoint.

> **LEED-NC 2.0 and 2.1:** The earlier criteria required only carbon dioxide monitoring.
>
> **EQ-1 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average**
>
> It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings. The LEED-NC Version 2.2 Guide notes that air flow and CO_2 monitoring systems can be applied to any building or HVAC system type, including mechanically and naturally ventilated buildings.

<u>(EQ-2) Increased Ventilation -1 Point:</u> One point is available to projects that provide additional outdoor air ventilation to improve indoor air quality for improved occupant's comfort, well-being and productivity. For mechanically ventilated spaces, breathing zone outdoor air ventilation rates to all occupied spaces must be increased by at least 30% above the minimum rates required by the ASHRAE Standard. Natural ventilation systems for occupied spaces must be designed to meet the recommendations set forth in the Carbon Trust Good Practice Guide.

> **LEED-NC 2.0 and 2.1:** Under the earlier criteria, mechanically ventilated spaces qualified for this point by complying with ASHRAE 129-1997.
>
> **EQ-2 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Strong**
>
> Historic Buildings typically provide operable windows, allowing for occupant controlled increased ventilation.

<u>(EQ-3) Construction IAQ Management Plan – 1-2 Points:</u> These points are awarded to projects that attempt to reduce indoor air quality problems resulting

from the construction/renovation process in order to sustain the comfort and well-being of construction workers and building occupants. One point is available to projects that develop and implement an Indoor Air Quality Management Plan for the construction and pre-occupancy phases of the building. A second point is available to projects that perform a building flush-out after construction ends, and before occupancy.

> **LEED-NC 2.0 and 2.1:** The earlier criteria required adherence to Sheet Metal and Air Conditioning National Contractors Association Guidelines for Buildings Under Construction.
>
> **EQ-3 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average**
>
> It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

<u>(EQ-4) Low Emitting Materials – 1-4 Points:</u> The use of Low Emitting Materials is encouraged to reduce the quantity of indoor air contaminates that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants. One point is awarded when all adhesives and sealants used on the interior of the building comply with the requirements of reference standards established by the USGGC. A second point is available to projects that use materials such as architectural paints, coatings, primers, anti-corrosive and anti-rust paints, clear wood finishes, and floor coatings. that adhere to standards established by the USGBC.

A third point is awarded to projects with carpets that meet the testing and product requirements of the Carpet and Rug Institute's Green Label Plus program. A final point is available to projects that use composite wood and agrifiber products without added urea-formaldehyde resins. Laminating adhesives used to fabricate on-site and shop-applied composites wood and agrifiber assemblies must not contain added urea-formaldehyde resins.

EQ-4 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average
It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

(EQ-5) Indoor Chemical & Pollutant Source Control – 1 Point: Indoor chemical and pollutant source control is intended to minimize exposure of building occupants to potentially hazardous particulates and chemical pollutants. One point is awarded to building designs that minimize and control pollutant entry into buildings and cross-contamination of regularly occupied areas. This can be achieved through the following measures: employ permanent entryway systems at least six feet long in the primary direction of travel to capture dirt and particulates from entering the building at all entryways that are directly connected to the outdoors; where hazardous gasses or chemicals may be present or used, exhaust each space sufficiently to create negative pressure with respect to adjacent spaces with the door to the room closed; and in mechanically ventilated buildings, provide regularly occupied areas of the building with air filtration prior to occupancy that provides a Minimum Efficiency Value of 13 or better.

EQ-5 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Weak
The existing interior configurations of historic buildings may make achieving this point more difficult than for a new construction project.

<u>(EQ-6) Controllability of Systems – 2 Points:</u> Up to two points are awarded for providing a high degree of occupant control over lighting and thermal comfort to promote the productivity, comfort, and well-being of building occupants. For lighting, building designers must provide individual lighting controls for 90% of the building occupants to enable adjustments to suit individual task needs and preferences. Buildings must also feature lighting system controllability for all shared multi-occupant spaces to enable lighting adjustments that meet group needs and preferences.

In order to earn an additional point under this category, a building must provide for individual comfort controls for 50% of occupants to enable adjustments to suit individual task needs and preferences. Operable windows can be used in lieu of comfort controls for occupants of areas that are 20 feet inside of and 10 feet to either side of the operable part of the window. Buildings must also provide comfort system controls for all shared multi-occupant spaces to enable adjustments to suit group needs and preferences.

LEED-NC 2.0 and 2.1: The earlier criteria required that designers provide a minimum of one operable window and one lighting control zone per 200 SF for all occupied areas within 15 fee of the perimeter wall. A second credit could be earned for providing controls for each individual for airflow, temperature, and lighting for 50% of the non-perimeter, regularly occupied areas of building.

EQ-6 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average-Strong

It is not anticipated that historic projects would be likely to incorporate more lighting controls than other projects. However, as noted above, historic buildings typically employ operable windows.

(EQ-7) Thermal Comfort – 2 Points: Up to two points can be awarded for building designs that provide a comfortable thermal environment that supports the productivity and well-being of building occupants. The first point can be earned through design of the HVAC systems and the building envelope to meet the requirements of ASHRAE Standard 55-2004, Thermal Comfort Conditions for Human Occupancy.

To earn the second point, thermal comfort must be verified over time. Building managers must agree to implement a thermal comfort survey of building occupants within a period of 6 to 18 months after occupancy. After assessing building occupant overall satisfaction, building managers must identify thermal comfort related problems and address them.

LEED-NC 2.0 and 2.1: In order to earn the second point, building designers were required to install permanent temperature and humidity monitoring systems configured to provide operators control over thermal comfort performance.

EQ-7 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average
It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

(EQ-8) Daylight and Views – 2 Points: This standard is intended to provide a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of a building. One point can be achieved through one of the following options:

Option 1: Achieve a minimum glazing factor of 2% in a minimum of 75% of all regularly occupied areas.

Option 2: Demonstrate through computer simulation that a minimum daylight illumination level of 25 footcandles has been achieved in a minimum of 75% of all regularly occupied areas.

Option 3: Demonstrate through indoor light measurements that a daylight illumination level of 25 footcandles has been achieved in a minimum of 75% of regularly occupied space.

A second point is available to projects that achieve this level of day-lighting in at least 90% of regularly occupied space.

EQ-8 HISTORIC BUILDINGS PROJECTED PERFORMANCE: Strong
The existing configurations of historic buildings may make achieving this point more difficult than for a new construction project. In other instances, however, traditional buildings may easily meet this requirement.

VI. Innovation Points (ID)

<u>(ID-1.1-1.4) Innovation in Design - 1-4 Points:</u> Innovation Points are intended to provide design teams and projects the opportunity to be awarded points for exceptional performance above the requirements of LEED-NC, or for categories that are not addressed by LEED-NC.

<u>(ID-1.2) LEED Accredited Professional – 1 Point:</u> One point is offered to projects in which at least one principal participant on the project team is LEED Accredited.

ID HISTORIC BUILDINGS PROJECTED PERFORMANCE: Average
It is not anticipated that projects involving historic buildings would score differently than new construction or non-historic existing buildings.

VII. Conclusion

Based on the projected performance of historic buildings above, it is expected that historic buildings would tend to accumulate more points under the Materials and Resources and Indoor Environmental Quality categories. Performance under the Water Efficiency and Sustainable Sites categories is expected to be poorer – though the latter is especially surprising given the perceived strengths of historic buildings in this area. The weakest performance is expected to be demonstrated under the Energy and Atmosphere category.

Chapter Three will compare these expectations against how LEED-NC certified historic projects have scored to date. While each renovation project for a historic building is unique, an analysis of LEED scorecards may help reveal general areas of weaknesses and strengths under the sustainability criteria. In subsequent chapters, in-depth case studies of historic buildings will also inform an understanding of the application of LEED-NC to historic buildings.

Finally, performance of historic buildings under the LEED criteria will be weighed against what is known about the sustainable attributes of historic buildings. Consideration will be given to how the LEED rating criteria might be adapted to more accurately reflect the many environment, economic, and cultural benefits of buildings conservation.

Chapter 3
LEED-NC Scorecard Evaluation:
Assessing Historic Building Performance

While the synergies between green building and historic preservation are increasingly recognized, many still believe that there are considerable "points of friction" between green building and historic preservation. In October 2006, the Pittsburgh Landmark and Trust Foundation and the Green Building Alliance sponsored the Greening of Historic Properties National Summit in Pittsburgh, Pennsylvania, to explore areas of divergence and agreement in green building and historic preservation practices.

A White Paper was produced shortly after the summit, and identified a number of challenges associated with integrating green building and historic building standards. It argues that strains exist between preservation and green building "due to a lack of flexibility between their [green builders and preservationists'] respective standards and guidelines." [42] The White Paper identifies particular conflict in the areas of energy efficiency and in the use of green materials in historic rehabilitation projects.

Though the White Paper's characterization of the relationship between preservation and green building has been soundly refuted by a number of preservationists, most notably by architect Carl Elefante of Quinn Evans Architects in Washington, D.C., this is not the first instance in which conflict between green building and preservation is alleged.[43] Architect Nancy Solomon

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[42] Pittsburgh History & Landmarks Foundation and The Green Building Alliance, The Greening of Historic Properties National Summit White Paper (Pittsburgh, PA, October 2006): 3. http://www.phlf.org/events/preservationconference/greenhistpres.html

[43] See architect Carl Elefante's response to the White Paper at: www.apti.org.

explains the perceived historic tensions between the two camps in a 2003 article in *Architectural Record:*

> For decades, there has been an underlying tension between historic preservation and environmental design: the former seeking to protect our history and culture, typically by applying traditional methods of construction and conservation to familiar buildings from the past; the latter trying to protect human health and natural habitat and promote alternative sources of energy, often through the application of innovative technologies and construction methods to novel forms.[44]

While Ms. Soloman goes on to suggest that preservationists and green builders are finding common ground, she also maintains that areas of conflict still exist.

In their 2005 article "Integrating Environmental and Cultural Sustainability for Heritage Properties," Andrew Powter and Susan Ross also express their concerns about the relationship between preservation and green building. They note that "a review of the results of using several assessment systems on existing heritage building. . . suggests that the objectives of sustainability and heritage conservation may not be as synchronized as one might think."[45] They argue that many heritage projects may not do well under assessment systems because they are not tailored to existing buildings. They further allege that "some heritage projects that have received moderate or good environmental-sustainability ratings appear to have had a significant adverse impact on the heritage character of a building and its built environment."[46]

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[44] Nancy B. Solomon, "Tapping the Synergies of Green Building and Historic Preservation," Architectural Record 191, no. 7 (July 2005): 155.

[45] Andrew Powter and Susan Ross, "Integrating Environmental and Cultural Sustainability for Heritage Properties," APT Bulletin 36, no. 4 (2005), 9.

[46] Ibid., 8.

This thesis examines these perceived difficulties and synergies by examining the application of LEED-NC criteria to historic projects. Specifically, this chapter analyzes U.S. Green Building Council (USGBC) scorecards for LEED-NC certified projects, and compares the distribution of LEED points for historic buildings to non-historic buildings. For the purposes of this research, historic buildings are defined as those that are at least fifty years old (i.e. they do not have to be designated on any official local, state or federal register.). Non-historic projects include both new construction and substantial renovations of existing buildings younger than fifty years old. It should be noted that the designation of "historic" as used herein is not meant to imply that a building is historically significant under National Register criteria, or that of any other agency. LEED-NC certification has been awarded to projects involving a variety of historic buildings – from the more pedestrian to works of considerable architectural or cultural importance.

Scorecard data used in this chapter was supplied by the U.S. Green Building Council, and includes the 445 projects that were certified under the LEED-NC criteria prior to August 2006. While scorecard information is supplied on the USGBC's website on a project-by-project basis, the aggregate data analyzed herein was obtained directly from the USGBC's office for LEED Certification.[47] The USGBC also supplied a list of registered and certified projects that had been designated as "historic" based on unknown criteria. Projects listed as historic by the USGBC were researched online, and in some

[47] See the U.S. Green Building Council's website at: www.usgbc.org.

instances, project owners or architects were contacted directly to determine whether a project indeed involved a building aged fifty years or more. It was subsequently determined that many of the projects included on the USGBC's historic list were newly constructed, or did not meet the fifty year criterion utilized in this thesis. These projects were excluded from the historic projects data set.

Conversely, research on LEED-NC certified projects also revealed that a number of projects that are historic renovations were not included on the USGBC's list of historic projects. Because it was not practical to research each of the 445 projects to determine which were historic, research was performed on each of the projects that earned a point for building reuse under the Materials and Resources category (MR-1). It is believed that the vast majority of historic projects would earn this point, which requires that 75% of the building shell be maintained. Based on this research and the USGBC's list of historic projects, it was determined that a total of 32 historic buildings were renovated under the LEED-NC criteria between the LEED program inception in 2000 and August 2006. While every reasonable effort was made to ensure that this list includes all historic projects, some projects may have been inadvertently omitted if they did not earn the MR-1 credit.

The following analysis of scorecard data raises concerns. Each building is unique, and is designed to respond to the different programmatic and functional requirements of its owner and users. Decisions about which LEED-NC points to seek in any given project hinge on a number of factors, such as building site, climate, and budgetary constraints. Because of the immense variation in projects, small differences between points earned by historic and non-historic buildings cannot necessarily be attributed to differences between existing buildings more than 50 years old, and other rehabilitations or new construction projects. However, larger differences in point accumulation and trends within a category will be examined carefully.

As in Chapter 2, this chapter will analyze scorecard data according to LEED categories, including Sustainable Sites, Water Efficiency, Materials and Resources, Energy and Atmosphere, Indoor Environmental Quality and Innovation Points.

I. Sustainable Sites (SS)

Chapter 2 predicts that historic projects will earn fewer points in the Sustainable Sites category than their non-historic counterparts -- despite the perceived strengths of historic buildings in this area. LEED-NC scorecard data validates concerns about underperformance in this category. As can be seen in Figure 2, historic projects earn an average of approximately one point less than non-historic projects in the Sustainable Sites category. Out of a total possible 14 points, non-historic projects earn an average of 6.9 points, while historic projects earn less at 6.0 points.

A review of credits earned across all fourteen subcategories within the Sustainable Sites criteria reveals a more nuanced picture of the point

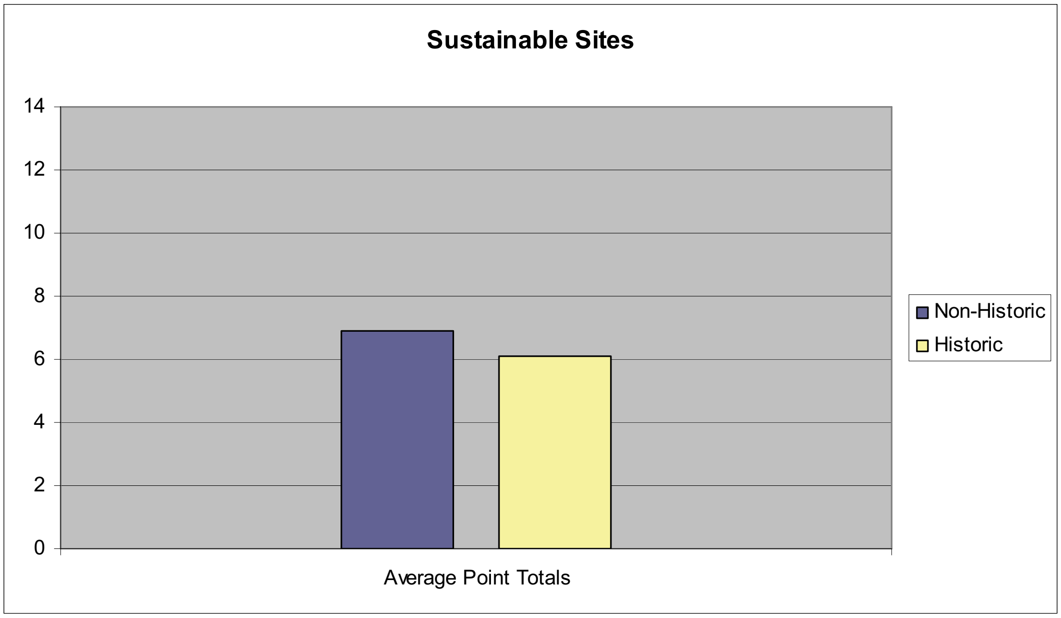

Figure 2: Average Point Totals for Sustainable Sites Category

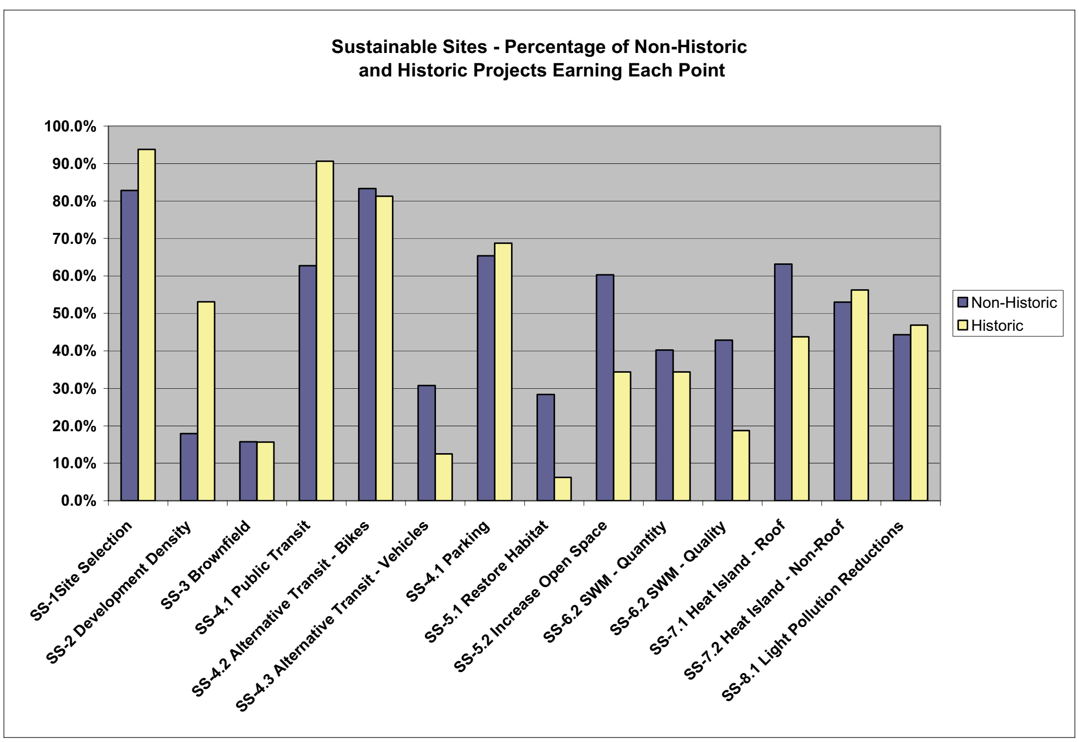

Figure 3: Sustainable Sites Point Distribution

Table 2: Sustainable Sites -- Historic Buildings Performance

Credit		Non-Historic	Historic	Projected HS Performance	Actual HS Performance
SS-1	Site Selection	82.8%	93.8%	Strong	10.9%
SS-2	Development Density	17.9%	53.1%	Strong	35.2%
SS-3	Brownfield	15.7%	15.6%	Strong	-0.1%
SS-4.1	Public Transportation	62.7%	90.6%	Strong	27.9%
SS-4.2	Alternative Transport - Bikes	83.3%	81.3%	Average	-2.0%
SS-4.3	Alternative Transport - Vehicles	30.8%	12.5%	Average	-18.3%
SS-4.4	Parking	65.4%	68.8%	Strong	3.4%
SS-5.1	Restore Habitat	28.3%	6.3%	Weak	-22.1%
SS-5.2	Increase Open Space	60.3%	34.4%	Weak	-25.9%
SS-6.1	SWM - Quantity	40.2%	34.4%	Weak	-5.8%
SS-6.2	SWM - Quality	42.9%	18.8%	Weak	-24.1%
SS-7.1	Heat Island - Non-Roof	63.2%	43.8%	Weak	-19.4%
SS-7.2	Heat Island - Roof	53.0%	56.3%	Weak	3.2%
SS-8	Light Pollution Reductions	44.3%	46.9%	Average	2.6%

distribution. It demonstrates that while the average number of points earned under the Sustainable Sites criteria is relatively similar for historic and non-historic projects, these projects tend to accumulate different points within the category. Figure 3 displays the percentage of historic and non-historic projects that earn each point under the Sustainable Site criteria. As can be seen in Figure 3, more than 90% of historic projects earn a point in site selection (SS-1), while around 80% of non-historic buildings earn the same point. A wider variation can be seen elsewhere, such as in Development Density (SS-2). Slightly more than 50% of historic projects earned this point, which encourages high density development, while only 18% of non-historic projects were awarded the credit. No difference is seen between historic and non-historic projects in the development of brownfields (SS-3).

Twenty percent more historic projects than non-historic projects earn a credit for providing easy access to mass transit (SS-4.1), as well as for not providing additional parking (SS-4.4). Fewer historic projects earn credit SS-4.2-4.3, which requires providing bicycle racks and accommodations for low emitting vehicles, respectively.

Newly or more recently constructed projects outperform in the site development category, however, with nearly 30% of non-historic projects earning a point for the protection or restoration of habitat, while only 8% of historic projects claimed the same credit (SS-5.1). There is a similarly wide gap in points earned for maximizing open space (SS-5.2). Below average performance was predicted for historic projects in this subcategory, since existing buildings will be significantly constrained in their efforts to minimize building footprints. Perhaps more than any other single point in the Sustainable Sites category, the reduction of a building footprint (SS-5.2) is a good example of a point that historic buildings may have a difficultly earning if they are not fortunate to have been originally designed in a way that meets USGBC standards. Given the numerous benefits associated with building re-use, it is reasonable to ask whether it makes sense to hold historic buildings to such a standard. This will be explored further in subsequent chapters.

A relatively substantial difference can also be seen between historic and non-historic projects with regard to non-roof heat island mitigation (SS-7.1).

This is another example in which it appears somewhat more difficult for historic buildings to meet the standard, which awards a point when at least 50% of site hardscape is shaded or paved with materials with a Solar Reflectance Index (SRI) of at least 29 and/or open grid pavement system. Alternatively, a minimum of 50% of parking spaces can be placed under cover. In instances in which increased shading or covered parking is not achievable, it is important to consider whether a functioning site hardscape should be removed and replaced with different and “better” materials. While the problems associated with heat island effects are significant, the pertinent LEED-NC points do not take into consideration that it might be less wasteful and energy-intensive to preserve materials that are already in place.

Interestingly, historic and non-historic projects scored very similarly under the Roof Heat Island Mitigation sub-category (SS-7.2), which requires the use of high SRI roofing materials, or vegetated roofs. This suggests more flexibility in choice of roofing materials than was expected, based on concerns discussed in Chapter 2 regarding the use of historically sensitive roofing materials.

II. Water Efficiency (WE)

As can be seen in Figure 4, historic and non-historic project point accumulations are somewhat more similar under the Water Efficiency category. Historic and non-historic projects earn approximately 2.6 and 3 points out of 5

Figure 4: Average Point Totals for Water Efficiency Category

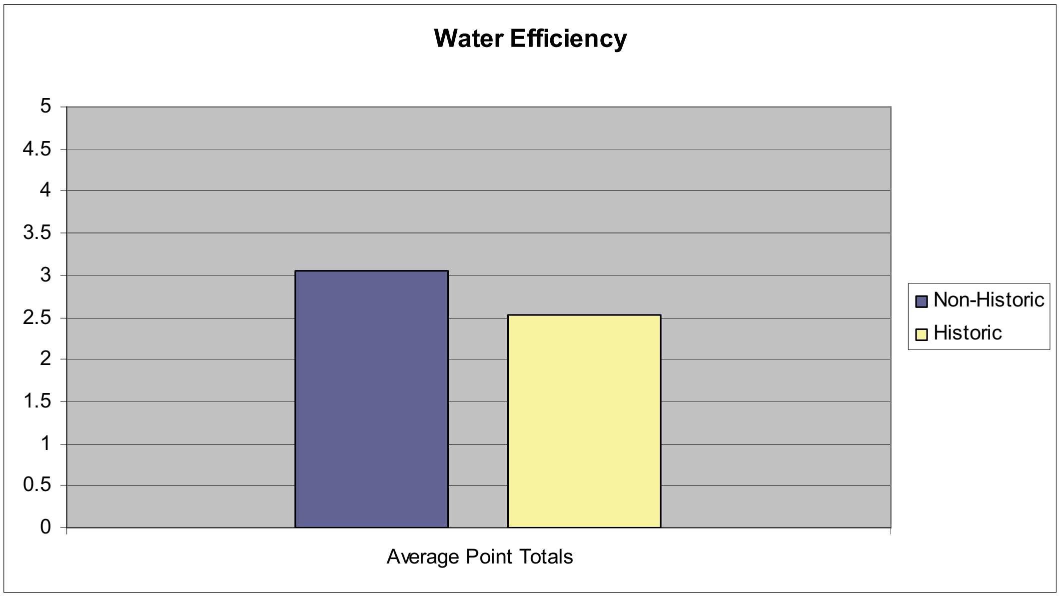

Figure 5: Water Efficiency Point Distribution

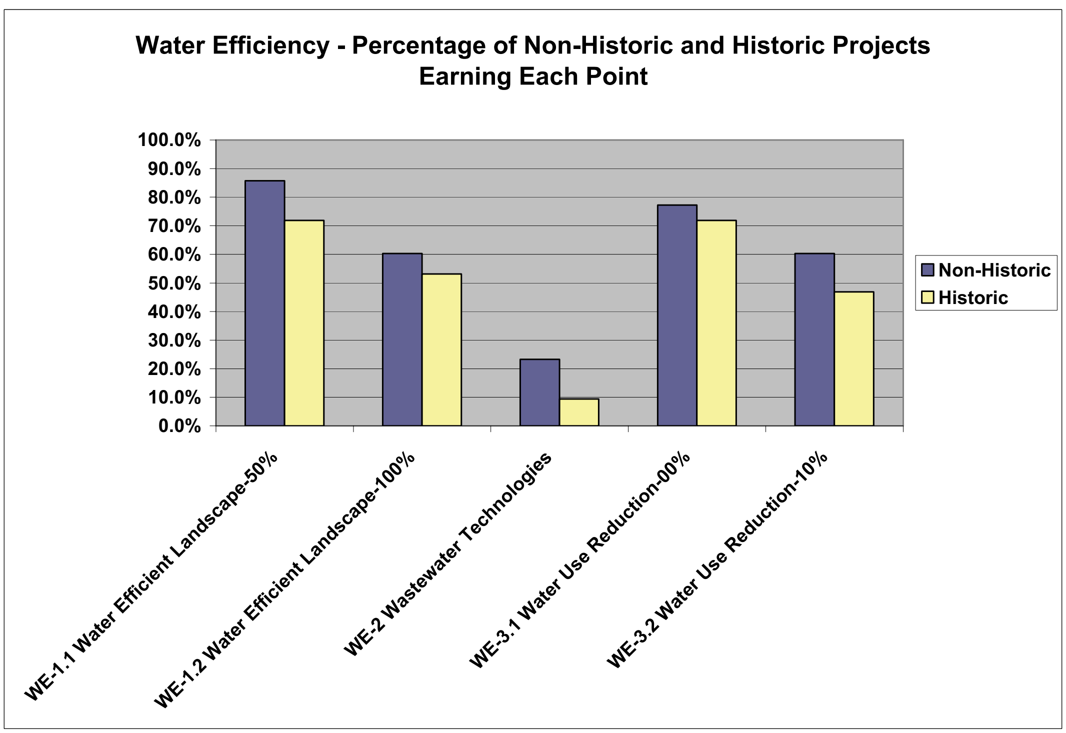

Table 3: Water Efficiency -- Historic Buildings Performance

Credit		Non-Historic	Historic	Projected HS Performance	Actual HS Performance
WE-1.1	Water Efficient Landscape-50%	85.7%	71.9%	Average	-13.8%
WE-1.2	Water Efficient Landscape-100%	60.3%	53.1%	Average	-7.2%
WE-2	Wastewater Technologies	23.2%	9.4%	Average	-13.9%
WE-3.1	Water Use Reduction-20%	77.2%	71.9%	Average	-5.4%
WE-3.2	Water Use Reduction-30%	60.3%	46.9%	Average	-13.4%

points, respectively. Chapter 2 projected that historic buildings would score on par with non-historic buildings in the Water Efficiency category.

Somewhat weak performance for historic projects is observed in the use of water efficient landscaping (WE-1.1 and WE-1.2) and water use reduction (WE 3.1 and 3.2); historic projects achieve these points about 10% less often than non-historic projects for each of these categories. The weakest relative performance is seen in the use of Innovative Wastewater Technologies (WE-2). Only 23% of non-historic projects achieve this point, and less than 10% of historic projects earn the credit. However, architects have noted the difficulty of obtaining this point for any project, as it requires the use of new fixtures such as waterless urinals and composting toilets. These may be more undesirable to buildings owners because they are technologies with which potential residents and tenants may be unfamiliar, and find unappealing.

III. Energy and Atmosphere (EA)

The White Paper identifies energy efficiency as one of the most significant challenge in the application of LEED standards to historic buildings. It notes:

> A primary concern with green building guidelines involves the weight given to compliance with energy efficient benchmarks. While energy efficiency is a paramount concern to both new construction and historic renovations, it is often not possible to incorporate many of the energy-saving construction techniques in historic structures.[48]

The paper cites insulation of foundations as a good example of energy efficient measures that cannot easily be applied to historic buildings, noting that "it is nearly impossible to insulate a foundation without completely excavating the area around the structure." [49]

Based on a careful review of LEED-NC Energy & Atmosphere standards, Chapter 2 predicted that the scores of historic preservation projects would be weaker than those of non-historic projects. Specifically, weaker performance was anticipated for EA-1 through EA-3.2 – a total of 13 points – and more average performance was expected for EA-3 – EA-6.

Despite such concerns, a comparison of average point totals between non-historic and historic buildings reveals that there is very little difference in the average point accumulations in the Energy and Atmosphere category. Out of 17 possible points, non-historic projects earn an average of 6.37 points in this category, while historic projects earn an average of 6.28 points – a seemingly

48 Pittsburgh History & Landmark Foundations and the Green Building Alliance, *White Paper*, 9.
49 Ibid.

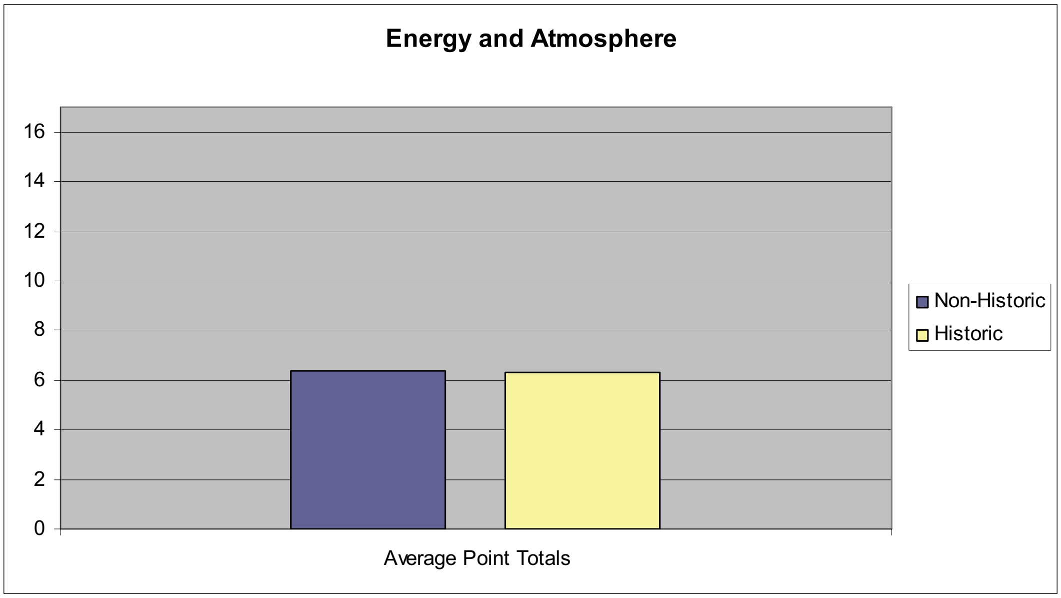

Figure 6: Average Point Totals for Energy and Atmosphere Category

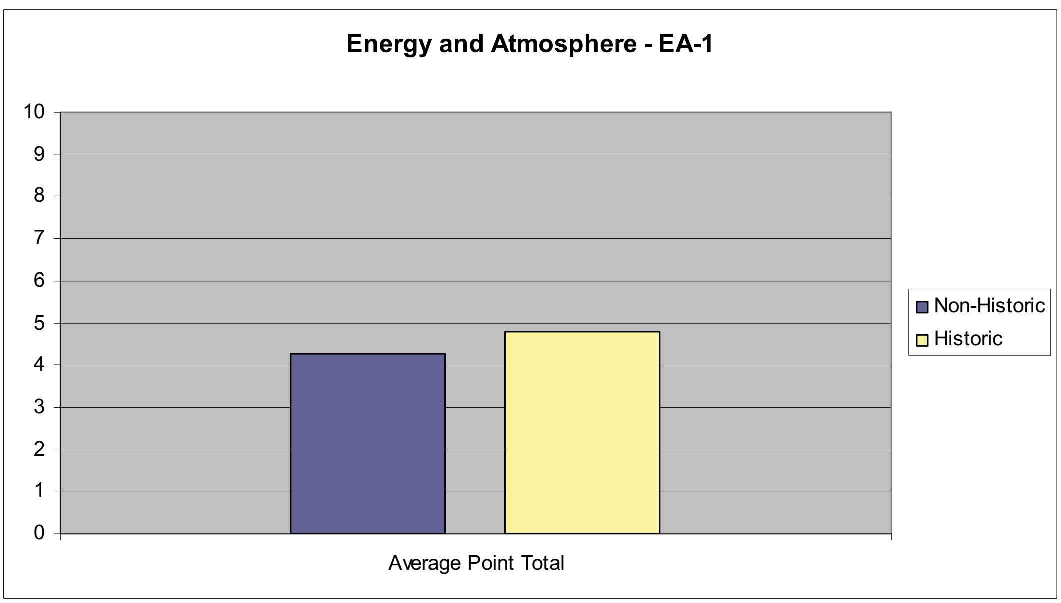

Figure 7: Unlike other subcategories, EA-1 offers up to ten points for Optimizing Energy Performance. This subcategory is displayed separately in the chart above.

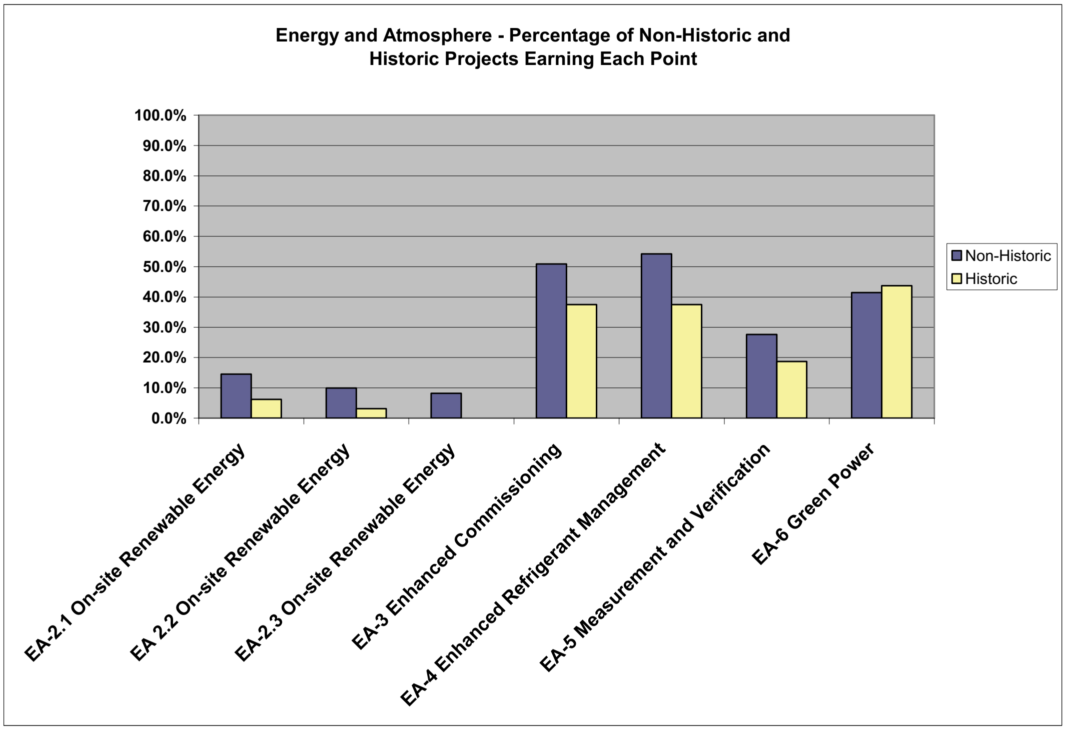

Figure 8: Energy and Atmosphere Point Distribution

Table 4: Energy and Atmosphere - Historic Buildings Performance

Credit		Non-Historic	Historic	Projected HS Performance	Actual HS Performance
EA-1	Energy Performance	N/A	N/A	Weak	N/A
EA-2.1	On-site Renewable Energy	14.5%	6.3%	Weak	-8.3%
EA-2.2	On-site Renewable Energy	9.9%	3.1%	Weak	-6.8%
EA-2.3	On-site Renewable Energy	8.2%	0.0%	Average	-8.2%
EA-3	Enhanced Commissioning	50.8%	37.5%	Average	-13.3%
EA-4	Enhanced Refrigerant Management	54.2%	37.5%	Average	-16.7%
EA-5	Measurement and Verification	27.6%	18.8%	Average	-8.9%
EA-6	Green Power	41.4%	43.8%		2.3%

insignificant difference (Figure 6). However, a closer look at point accumulations in the Energy and Atmosphere category reveals an uneven distribution of points between the two types of projects (Figures 8).

The EA-1 Optimizing Energy Performance subcategory is unique in that it offers up to 10 points for demonstrating improved levels of energy performance above an established baseline standard. Figure 7 looks specifically at the average number of points accumulated under EA-1 for historic and non-historic buildings. Historic buildings accumulate an average of 4.8 points in this category, while non-historic buildings accumulate average of 4.3 points. The relatively strong performance of historic buildings under this standard may be attributed to relatively low levels of baseline energy efficiency, which can be easily improved. It may also be attributable to lower required levels of efficiency in existing buildings.

The average number of points earned across the other subcategories in Energy and Atmosphere category better align with the concerns expressed by attendees of the 2006 Green Building Summit. Figure 8 displays the percentage of non-historic and historic projects earning points EA-2 through EA-6. With only one exception, an analysis of certified projects finds that non-historic projects earn Energy & Atmosphere points with more frequency than their historic project counterparts for points EA-2-EA-6. The largest difference is seen in EA-3, EA-4, and E-5, which offer points for enhanced commissioning, enhanced refrigerant management, and measurement and verification, respectively. Approximately 17% more non-historic projects earn this point than historic projects.

Historic projects' performance under EA-2.1-EA 2.3, On-Site Renewable Energy, is also weak. This series of points is awarded to projects that provide on-site renewable energy, such as solar, and wind power. Points are offered as follows: one point for projects with at least a 2.5% use of renewable energy; two points for projects with 2.6%-7.5% use of renewable energy; and three points for projects that exceed 7.6% renewable energy. However, out of all LEED-NC certified projects, only 34 have earned all three points under this category, suggesting that it is exceptionally difficult for any project to earn these points.

Historic projects were slightly more likely to earn credit for use of green power.   EA-6 awards one point for projects that provide at least 35% of the building's electricity from renewable sources. This can be achieved by purchasing green power from a local power company. Many utility companies now offer the option to purchase power from renewable sources. The Center for Resource Solutions (CRS), a San Francisco based non-profit, provides certification of renewable power products sold by energy service providers.[50] Green power sources must be approved by CRS in order to obtain this LEED credit.

[50] For more information about the Center for Resource Solutions, see www.resource-solutions.org.

IV. Materials and Resources (MR)

The White Paper also expressed concern about conflicts between the Secretary of the Interior's Standards for Rehabilitation, which requires replacements that are sensitive to original materials, and the U.S. Green Building Council's encouragement of alternative materials, such as recycled goods. A total of six of thirteen points available in the Materials and Resources category are awarded for the use of alternative materials, such as certified wood, salvaged materials, and rapidly renewable materials. The analysis in Chapter 2 was more optimistic about the potential performance of historic buildings in this category – particularly in their ability to earn points for use of new "green" materials, such as those that have a recycled content. Requirements for these materials are fairly modest – for example 10% use of recycled content,- and it was thought that historic projects may be able to reasonably accommodate these materials.

As can be seen in Figure 9, historic projects have an average point total in the Materials and Resources category that is an average of almost 1.5 points higher than non-historic projects. Of the six categories in which LEED-NC buildings can earn points, this is the only category in which historic buildings have average point scores that are higher than their non-historic counterparts. A close look at the distribution of historic and non-historic projects earning each point in the Materials and Resources category is revealing. As would be expected, historic buildings earn points for building re-use far more often than

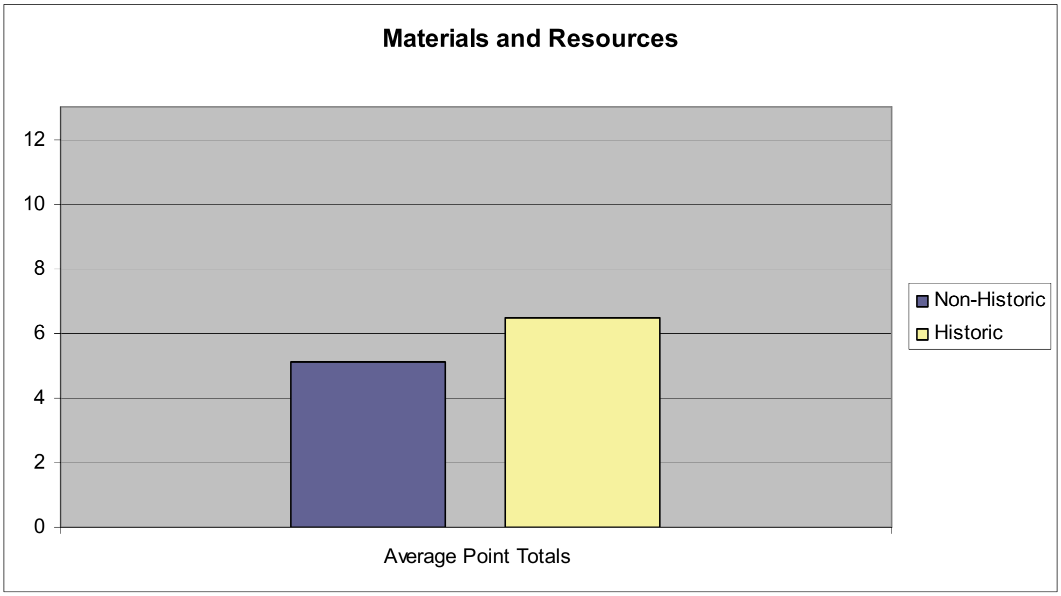

Figure 9: Average Point Total for Materials and Resources Category

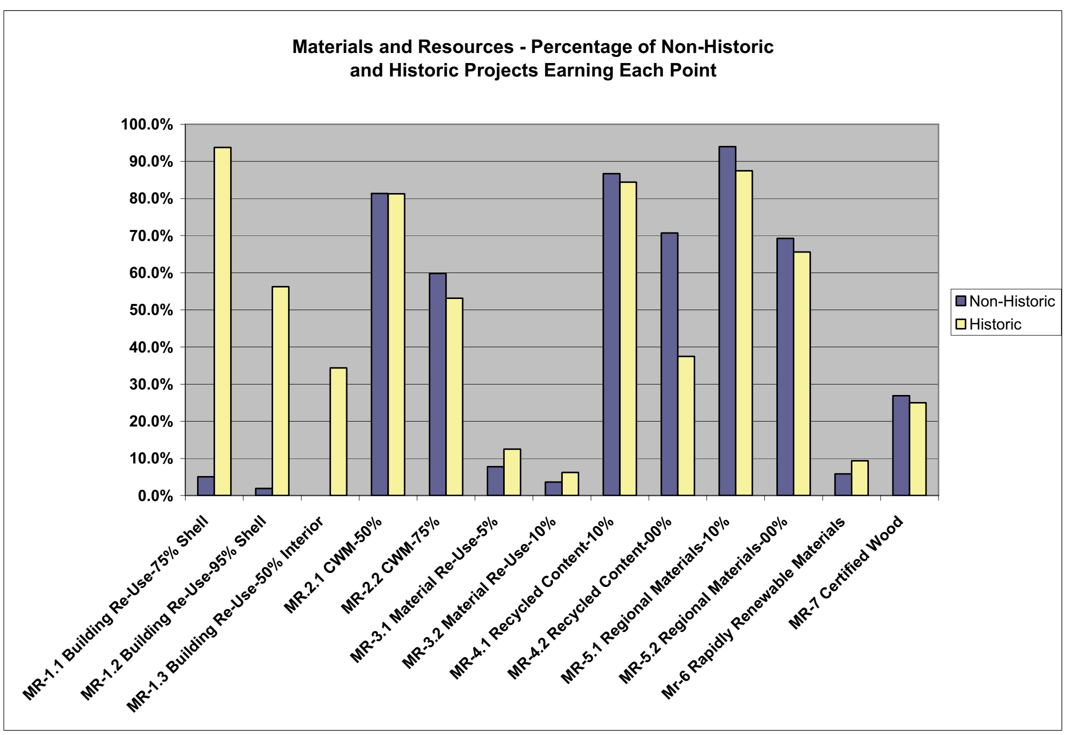

Figure 10: Materials and Resources Point Distribution

Table 5: Materials and Resources – Historic Buildings Performance

Credit		Non-Historic	Historic	Projected HS Performance	Actual HS Performance
MR-1.1	Building Re-Use-75% Shell	5.1%	93.8%	Strong	88.7%
MR-1.2	Building Re-Use-95% Shell	1.9%	56.3%	Strong	54.3%
MR-1.3	Building Re-Use-50% Interior	0.0%	34.4%	Strong	34.4%
MR-2.1	CWM-50%	81.4%	81.3%	Average	-0.1%
MR-2.2	CWM-75%	59.8%	53.1%	Average	-6.7%
MR-3.1	Material Re-Use-5%	7.7%	12.5%	Average	4.8%
MR-3.2	Material Re-Use-10%	3.6%	6.3%	Average	2.6%
MR-4.1	Recycled Content-10%	86.7%	84.4%	Average	-2.3%
MR-4.2	Recycled Content-20%	70.7%	37.5%	Average	-33.2%
MR-5.1	Regional Materials-10%	93.9%	87.5%	Average	-6.4%
MR-5.2	Regional Materials-20%	69.2%	65.6%	Average	-3.6%
MR-6	Rapidly Renewable Materials	5.8%	9.4%	Average	3.6%
MR-7	Certified Wood	26.9%	25.0%	Average	-1.9%

non-historic buildings (MR1.1 - MR 1.3).[51] Performance on construction waste management (MR-2.1) is nearly the same for historic and non-historic buildings. Performance differences for MR-2.2, however, which requires a pre-occupancy flush out of the building, were more significant – about 7% fewer historic projects earn this credit than non-historic projects.

Performance under materials reuse (MR 3.1 - MR 3.2) exceeds that of non-historic buildings, though it must be noted that very few historic or non-historic projects earn this point, and historic projects outperform non-historic by a very slim margin. A similar finding is made with regard to the use of rapidly renewable materials (MR-6). With the exception of credit MR-4.2, which

[51]The high level of attainment of the MR-1.1 credit observed in this study may be attributable to methodology used in determining which LEED certified projects are historic. See page 57-59 of this chapter.

requires the use of 20% recycled content, performance of historic buildings appears to be very similar to non-historic buildings in the other point categories. Figure 10 suggests that while it is no more difficult for historic buildings to incorporate 10% recycled materials, it is far more difficult to achieve the 20% threshold.

On balance, it seems that concerns about difficulties for historic buildings in achieving points in the Materials and Resources category are not substantiated by the average total point accumulation within the category. Yet a close review of trends within the category suggests that it has been more difficult for historic projects to incorporate "green" materials.

V. Indoor Environmental Quality (EQ)

The Greening of Historic Properties National Summit White Paper also notes concern regarding new building control systems. It explains:

> Integrating new HVAC systems and retrofitting old wiring and plumbing often requires the gutting of an interior of a structure to reach or create mechanical spaces. Unfortunately, this creates a direct conflict with historic standards that mandate the retention of existing interior finishes, the replacement of damaged surfaces with like materials, and the invisibility of any new systems or equipment.[52]

Based on these concerns, it would be expected that historic buildings would tend to earn fewer points in the Indoor Environmental Quality category than non-historic projects. A comparison of average point totals for these projects suggests that scores for historic projects are lower than non-historic

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52 Pittsburgh History & Landmarks Foundation and Green Building Alliance, White Paper, 11.

projects. As can be seen in Figure 11, non-historic projects score an average of 8.5 points out of a total of 15, while historic projects earn 7.5 points.

Indeed, non-historic projects do tend to earn many points under the Indoor Environmental Quality category with more frequency (Figure 12). Outdoor Air Delivery Monitoring (EQ-1), Construction Indoor Air Quality Management Plans (EQ-3.1-3.2), Indoor Chemical & Pollutant source control (EQ-5) are good examples of this. Historic projects are also less likely to earn points for achieving thermal comfort levels consistent with ASHRAE standards, as well as verification over time. (EQ-7.1-7.2)

Yet historic projects score on par with or better than non-historic projects in some categories. A larger percentage of historic projects earn credits for the Increased Ventilation subcategory (EQ-2), no doubt in part because of the widespread integration of operable windows in historic buildings. Historic projects also appear slightly more likely to earn credits for Daylighting and Views (EQ-8.1-8.2), which may be attributed to the historical importance of natural lighting in buildings. Performance regarding the Controllability of Systems was similar for both historic and non-historic projects (EQ-6.1-6.2).

Historic projects earn fewer points for three of four credits in the Low Emitting Materials subcategory, but the difference is less than 10%, and there is an overall high level of attainment for these points (EQ-4.1-4.4). In the use of low emitting paints and finishes (EQ-4.2), historic projects slightly outperform non-historic projects.

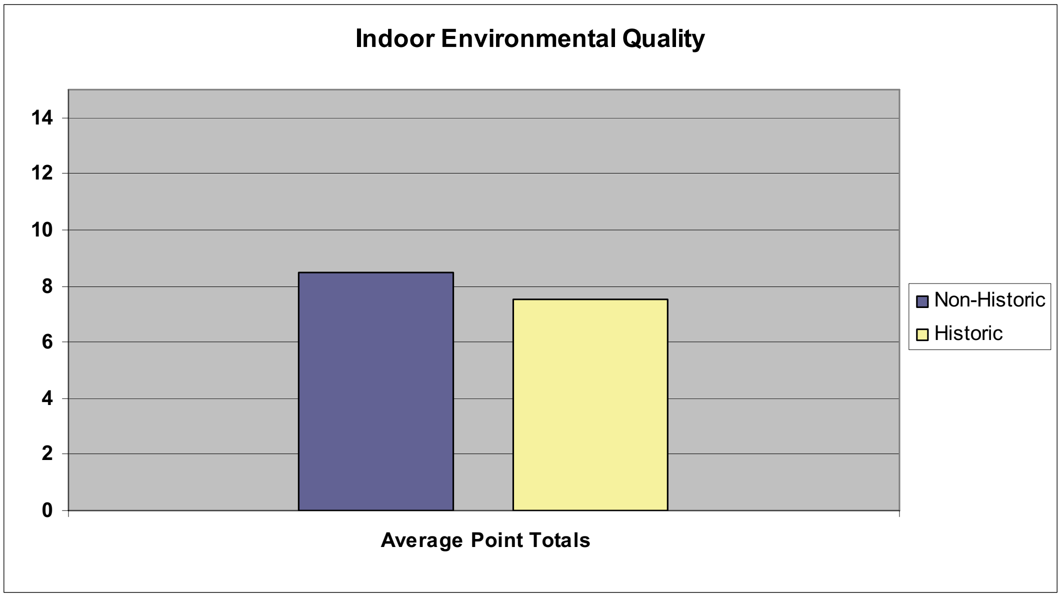

Figure 11: Average Point Totals for Indoor Environmental Quality Category

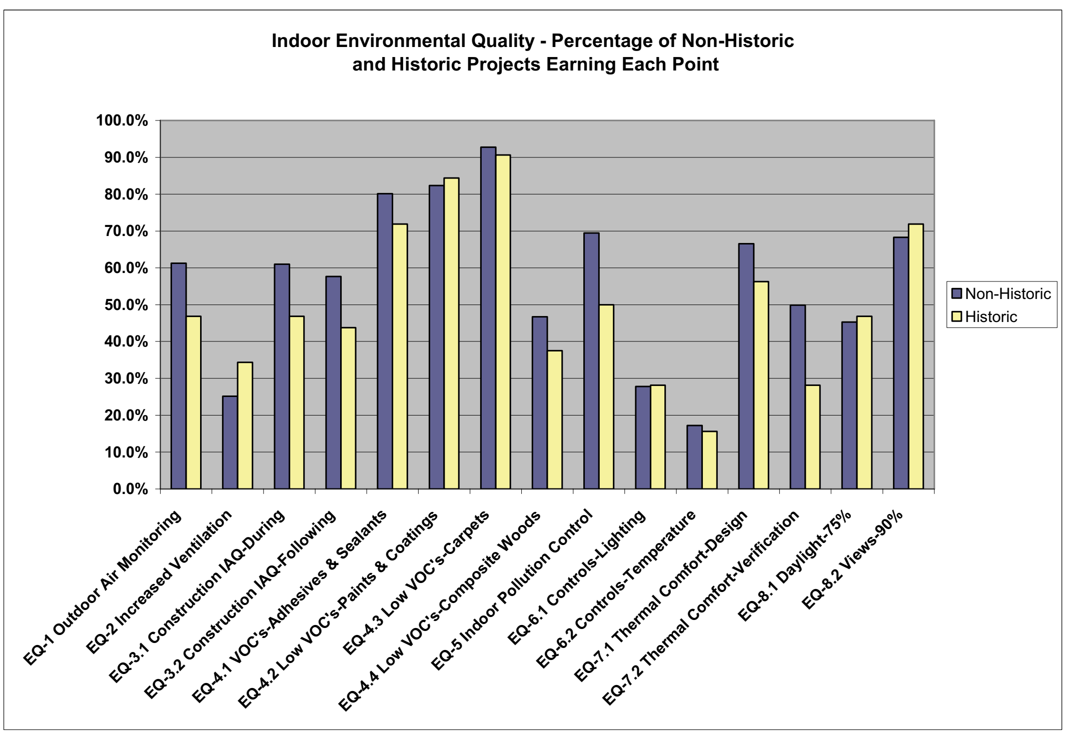

Figure 12: Indoor Environmental Quality Point Distribution

Table 6: Indoor Environmental Quality -- Historic Buildings Performance

Credit		Non-Historic	Historic	Projected HS Performance	Actual HS Performance
EQ-1	Outdoor Air Monitoring	61.3%	46.9%	Average	-14.4%
EQ-2	Increased Ventilation	25.2%	34.4%	Strong	9.2%
EQ-3.1	Construction IAQ-During	61.0%	46.9%	Average	-14.1%
EQ-3.2	Construction IAQ-Following	57.6%	43.8%	Average	-13.9%
EQ-4.1	VOC's-Adhesives & Sealants	80.1%	71.9%	Average	-8.3%
EQ-4.2	VOC's-Paints & Coatings	82.3%	84.4%	Average	2.1%
EQ-4.3	VOC's-Carpets	92.7%	90.6%	Average	-2.1%
EQ-4.4	VOC's-Composite Woods	46.7%	37.5%	Average	-9.2%
EQ-5	Indoor Pollution Control	69.5%	50.0%	Weak	-19.5%
EQ-6.1	Controls-Lighting	27.8%	28.1%	Average	0.3%
EQ-6.2	Controls-Temperature	17.2%	15.6%	Strong	-1.6%
EQ-7.1	Thermal Comfort-Design	66.6%	56.3%	Average	-10.3%
EQ-7.2	Thermal Comfort-Verification	49.9%	28.1%	Average	-21.8%
EQ-8.1	Daylight-75%	45.3%	46.9%	Strong	1.6%
EQ-8.2	Views-90%	68.3%	71.9%	Strong	3.6%

VI. Innovation Points (ID)

Five innovation points are offered under LEED-NC for projects that exceed the performance requirements of LEED-NC in a particular subcategory, or demonstrate innovative performance in categories not addressed under LEED-NC. Four of the five credits are for general innovation (ID-1.1-1.4), while the fifth credit is awarded to projects that have at least one principal participant in the project that is a LEED Accredited Professional (ID-2).

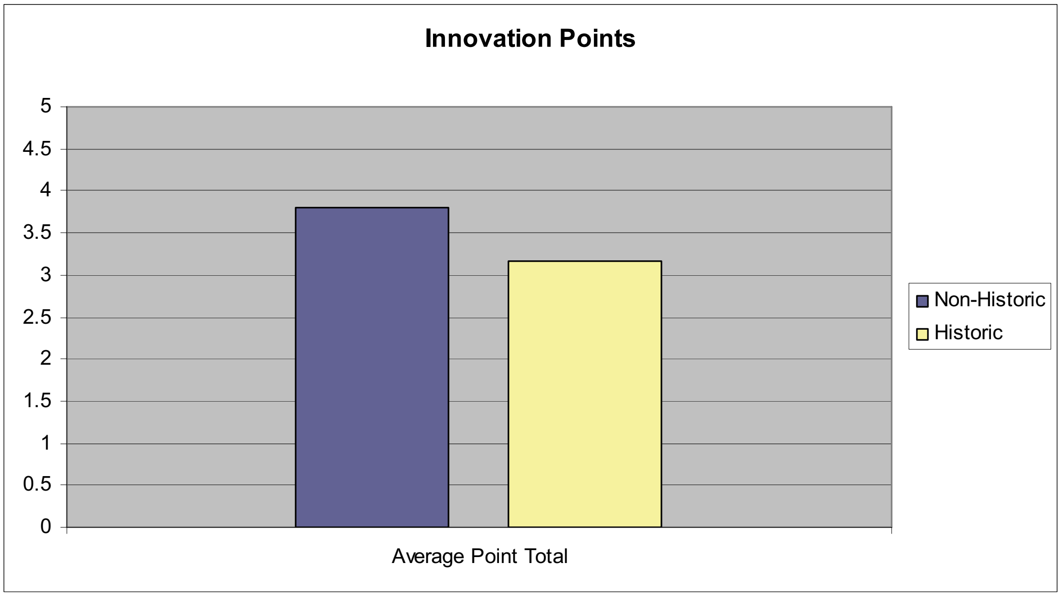

Figure 13: Average Point Totals for Innovation Points Category

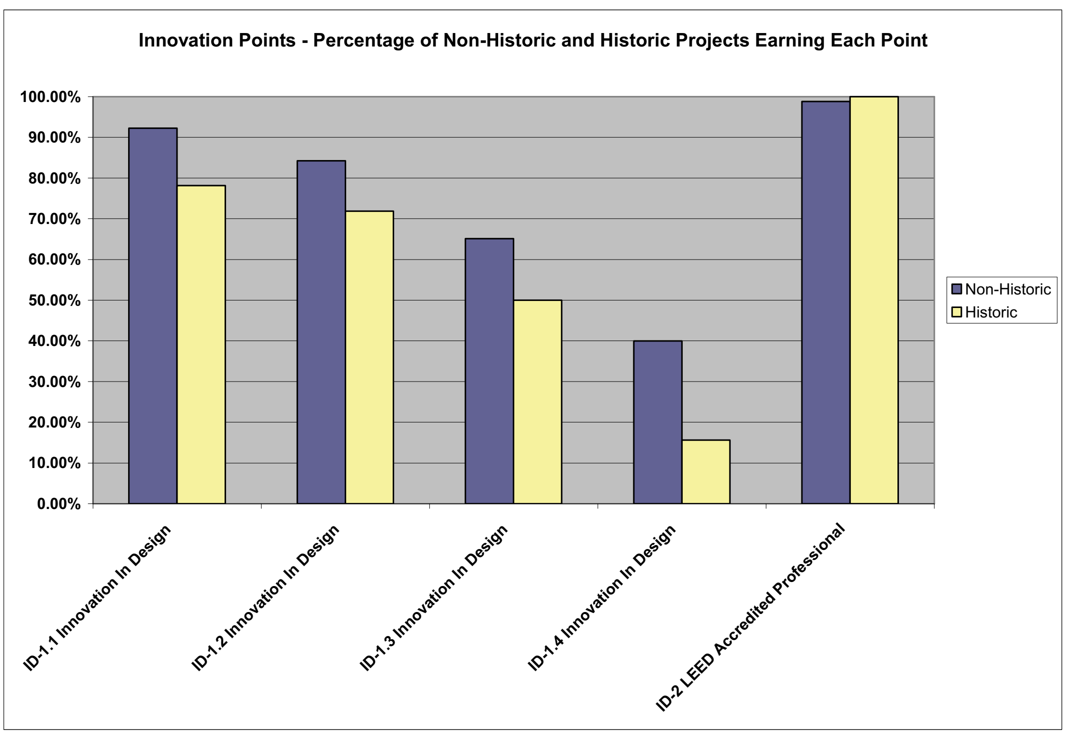

Figure 14: Innovation Points Distribution

Table 7: Innovation Points -- Historic Buildings Performance

Credit		Non-Historic	Historic	Projected HS Performance	Actual HS Performance
ID-1.1	Innovation In Design	92.3%	78.1%	Average	-14.1%
ID-1.2	Innovation In Design	84.3%	71.9%	Average	-12.4%
ID-1.3	Innovation In Design	65.1%	50.0%	Average	-15.1%
ID-1.4	Innovation In Design	40.0%	15.6%	Average	-24.3%
ID-2	LEED Accredited Professional	98.8%	100.0%	Average	1.2%

As can be seen in Figures 13 and 14 historic projects earn innovation points with less frequency than non-historic projects. Non-historic projects earn nearly four of the five available credits on average, while historic projects earn approximately three of five credits on average. As Figure 18 indicates, average performance was predicted for historic projects in each of the Innovation point subcategories.

VII. Summary

While many aspects of point accumulation under the LEED-NC program are nuanced, based on the analysis above some general trends can be identified regarding the performance of historic buildings relative to non-historic buildings.

Sustainable Sites: On average, historic projects earn fewer points in this category than non-historic projects. Given the enormous benefits of reusing an existing building on a previously developed site, it is discouraging that historic projects do not perform as well as non-historic projects.

Water Efficiency: Historic projects tend to score fewer points in the Water Efficiency category than non-historic projects. However, overall point accumulations are similar, with non-historic projects earning an average of three of five points in this category, and historic buildings earning an average of 2.6 of five points.

Energy and Atmosphere: Interestingly, performance for historic and non-historic buildings in the Energy and Atmosphere category is very similar. Historic and non-historic projects earn points differently in this category, however, with historic projects accumulating more points in the Optimizing Energy Performance subcategory (EA-1). Non-historic buildings perform better in every other subcategory under the Energy and Atmosphere criteria, except for the purchase of green power, where historic and non-historic project scores are roughly equivalent.

Materials and Resources: Historic projects outscore non-historic projects by an average of almost 1.5 points in the Materials and Resources category. This difference in point accumulation is largely attributed to the ease with which historic buildings earn credit for building reuse (MR-1.1-1.3). However, it is noteworthy that far fewer historic projects earn credits 1.2 and 1.3 than credit 1.1, as the standards for building re-use are very restrictive. Historic projects do not appear to have an advantage in any other subcategory under Materials and Resources, with the exception of Materials Reuse (MR-3.1-MR-3.2).

Indoor Environmental Quality: Non-historic projects earn an average of one point more in the Indoor Environmental Quality category than historic projects. Historic projects display an advantage in providing increased ventilation (EQ-2), and a slight advantage with providing daylight and views (EQ-8.1-8.2). However, non-historic projects outperform in every other sub-category, including construction Indoor Air Quality management and thermal comfort.

Innovation Points: With one exception, historic projects earn points for innovation with less frequency than non-historic projects. Below average performance in this category was not predicted, and may present a significant opportunity to accumulate additional LEED-NC credits for historic projects. This will be explored further in subsequent chapters.

This analysis of point distribution provides a helpful way to look at the performance of historic buildings under LEED-NC criteria from a broad-based view. The following chapter will look at the application of LEED-NC criteria to historic buildings more narrowly through the examination of two case studies. It is hoped that an analysis of these case studies will reveal additional information about the application of LEED-NC to historic projects.

Chapter 4
Measuring Up:
Historic Rehabilitation LEED-NC Case Studies

The previous chapter evaluated LEED-NC scorecard data to compare whether and how historic projects and non-historic projects accumulate credits, in an effort to understand how LEED-NC criteria and historic preservation practices may conflict. The chapter concluded that when total points earned within a category are tallied, historic projects tend to accumulate fewer points under the Sustainable Site, Water Efficiency, and Indoor Environmental Quality criteria for LEED-NC. Historic projects score very similarly to non-historic projects in the Energy and Atmosphere category, however, and outscore non-historic projects in the Materials and Resources category.

Given perceptions about the difficulty of integrating sustainability standards with historic building rehabilitation, larger differences between historic and non-historic projects might have been expected. While lower point accumulations in some LEED-NC categories may suggest points of tension between green building criteria and historic preservation standards, the data does not suggest fundamental incompatibilities between the green building standards advocated by the USBGC and preservation standards.

This chapter provides an in-depth evaluation of two LEED-NC case study projects. Two buildings were selected for the case studies: the Cobb Building in downtown Seattle, Washington; and the Administration Building at the President Lincoln and Soldiers' Home National Monument, informally known as Lincoln Cottage, in Washington, D.C. Both buildings were completed shortly after the turn of the century, with construction of the Cobb Building completed in 1910, and completion of the Administration Building in 1905. The Administration Building was designed in the Italianate Renaissance Revival style, whereas the Cobb building combines elements of Beaux-Arts classicism and the Chicago commercial style perfected by architect Louis Sullivan.

While these buildings share similarities in terms of date of construction and some iteration of a classical style, they have served very different purposes historically, and their current or proposed uses differ significantly. These buildings were chosen as case studies because of these differences in use, and important differences in ownership. The Cobb is managed by a private for-profit developer, while the Lincoln Cottage Visitor's Education Center is leased and operated by the non-profit National Trust for Historic Preservation. The Cobb will continue to be used as a profit-generating asset, and the Administration Building will continue in its quasi-public use as an education center associated with the Lincoln Cottage. Differences in use and management may elucidate differences between the private sector's approach to building reuse and that of a non-profit organization in the context of LEED-NC certification.

At the time this research was completed, both of these buildings were undergoing the LEED-NC certification process, and had not yet been certified. The Cobb is undergoing certification through the LEED-NC version 2.1 standards, while the Lincoln Cottage Visitors Education Center project is undergoing certification through LEED-NC version 2.2. Where relevant, differences in the versions will be identified.

I. The Cobb Building

Figure 15: “The Cobb Building.” (Photo by Author, March 2007.)

The Cobb Building is an 11-story structure in downtown Seattle, Washington, and was recently converted from commercial space to luxury rental housing. This building is owned by the University of Washington, but is managed by the Unico Corporation of Seattle. Though owned by the University, the building is managed in a manner that is consistent with any income-producing asset in the private sector – that is to say that increased profitability was the primary motivation for rehabilitation, not public benefit. This project is an exemplary for-profit adaptation of a historic building, which has been very financially successful. Unico is seeking a silver LEED-NC rating for the building.

Located on the 1300 block of 4th Avenue in downtown Seattle, the Cobb building is situated on a 10-acre plot that was the first home of the University of

Washington. Around the turn of the century, the University moved north of downtown, but retained the land known as the Metropolitan Tract as an investment. The Cobb Building was constructed on this tract after the University relocated, and was initially conceived as part of a larger downtown development that was to encompass a department store, hotel, offices, and retail and a plaza. Only five of the ten planned buildings were constructed, but each was designed in a style similar to the Cobb, incorporating elements of Beaux-Arts classicism and the style of the Chicago school. The building was designed for the single purpose of housing doctors and dentists, and is alternatively known as the Medical/Dental Building. The Cobb received significant media attention upon its opening in 1910, as it was the first structure built in the west for a single professional purpose.[53]

While the building remained office space for over ninety years, in recent decades the space became less desirable for commercial purposes, given the restrictive floor plans common to early 20th century buildings. In the years prior to its rehabilitation, the building was designated Class "C", signifying that it was one of the least desirable commercial spaces. Since the University of Washington continues to own the ground beneath the building, Unico could not convert the structure into condominiums – which would have been a logical choice given Seattle's real estate market in recent years. Commercial space would also have been difficult, given the constraints of the interior space as described above.

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[53] National Park Service, "Seattle: A National Register of Historic Places Travel Itinerary," http://www.cr.nps.gov/nr/travel/seattle/ (accessed 2007, April 21).

Unico settled on a conversion into high-end rental units, and decided to pursue LEED-NC certification of the building because it was the "right thing to do," and the firm believed that there would be a marketing advantage associated with a LEED certified product.[54] In discussing reasons for pursuing LEED certification, Unico President and CEO Dale Sperling notes he believed that the "sustainability factor" is very important to younger generations, and that increasingly these generations will make decisions about where to live and work based on the green qualities of the environment.[55]

In order to make the project economically feasible, Sperling took advantage of the federal historic preservation tax credit, which provides a 20% credit for eligible rehabilitation expenses for income-producing historic properties. Receipt of the tax credit also suggests a very high quality of rehabilitation, since the National Park Service must approve project designs in order for developers to earn the credit. Projects are evaluated for consistency with the Secretary of the Interior's Guidelines for Historic Rehabilitation, which while somewhat flexible, also ensure historically sensitive design. Examining a tax credit project that is also attempting LEED-NC certification provides the ideal opportunity to explore potential conflicts between green and historic standards.

Based on interviews by the author with the developer, a LEED accredited design expert who worked on the project, the construction manager, and an architect, this case study details the experience of applying LEED-NC to this private for-profit project. It highlights areas where experience in applying LEED-

[54] Dale Sperling (CEO, Uncio Properties) in discussion with the author, March 2007.
[55] Ibid.

NC were complicated by working with a historic structure, as well as areas where there is a symbiotic relationship between LEED-NC and the rehabilitation of a historic building. As in previous chapters, this case study is presented according to LEED-NC categories, including Sustainable Sites, Water Efficiency, Materials and Resources, Energy and Atmosphere, and Indoor Environmental Quality.

The Cobb: Sustainable Sites

Project designers for the Cobb Building anticipate earning nine of the fourteen available points in the Sustainable Sites category (See Appendix 2 for LEED-NC scorecard.) The project demonstrates the ease with which urban projects can earn many of the credits in this category. Points are expected for site selection, and location in an urbanized area (SS-1 and SS-2). The Cobb Building is likely to earn a credit for brownfield redevelopment (SS-3), as the USGBC awards this credit whenever hazardous materials such as asbestos are removed. The project is also likely to earn all available transportation credits (SS4.1-4.4). The Cobb benefits from having easy access to mass transit in its urban location, as well as a parking garage immediately adjacent which allows the project owner to provide ample bicycle storage, as well as a Flexcar for common use.[56]

As only 25% of the site is open space, credit SS-5.1 is not expected to be awarded for protection and restoration of habitat. This point requires that at

[56] Flexcar is one of many car sharing programs throughout the country designed to encourage those who live in urbanized areas to forgo car ownership. Members can rent cars by the hour; cars are located conveniently throughout major cities.

least 50% of the site area (excluding building footprint) be restored with native or adapted vegetation. While a green roof is provided as an amenity for residents to enjoy as an urban garden and includes native vegetation, this was not sufficient to meet the 50% site area requirement.

However, credit S-S5.2, which encourages the maximization of open space, will likely be awarded. This point requires that projects exceed local requirements for open space by at least 25%. Since the site zoning does not require open space on this urban property, the architects of the Cobb Building rehabilitation were required to meet a minimum 25% open space requirement. This was achieved through the green roof.

The project will not receive the two available stormwater management points, which recognize reduction of storm water quantity and an increase in the quality control of storm water. LEED AP accredited designer Nancy Henderson notes that the design team made an effort to obtain the stormwater quantity control points, but simply could not meet the criteria for SS-6.1 or SS-6.2.[57] Ms. Henderson explains that because the site was completely built out, there was little opportunity to add any kind of storm water control. Adding vegetation to the roof did help reduce the runoff, but only by about 10%. A 25% reduction is required to earn point SS-6.1.

The Cobb likely will receive one of the two credits available for reduction of heat island effect. This point was awarded for providing covered parking, which is adjacent to the site. Credit for reduction of the roof heat island effect

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[57] Nancy Henderson (LEED Accredited Professional, ArchEcology), in discussion with the author, March 2007.

(SS-7.2) could not be secured. There is substantial vegetation on the roof, but not enough to meet the minimum requirement of 50% vegetation of the site.

The Cobb: Water Efficiency

Because the project included installation of a highly efficient irrigation system on the Cobb site, project designers hope to secure credit WE-1.1 for water efficient landscaping. Credit WE-1.2, which is awarded to projects that do not use any potable water to irrigate, will not be received. Ms. Henderson explains that there was some rain barrel collection for stormwater, but not enough to eliminate the need for potable water. The project also did not earn a point in the Innovative Wastewater Technology subcategory (WE-2); This credit is difficult for any project to obtain, however, as it requires the use of composting toilets, waterless urinals, or other technologies that building owners or users frequently find cost prohibitive, undesirable or both.[58]

Both of the available points are expected for water use reduction. The Cobb is the first residential project in Seattle to use dual flush toilets, and thereby anticipates earning credit WE-3.1 for a 20% reduction in water use. WE-3.2, which recognizes a 30% reduction in water use, is also expected to be awarded for the Cobb, as is an innovation point for the reduction of water by over 40%. These savings were secured through the installation of other highly efficient fixtures, including washing machines and dishwashers.[59]

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[58] Ibid.
[59] Ibid.

The Cobb: Energy & Atmosphere

The Cobb expects to earn only two out of seventeen available points in the Energy & Atmosphere category, a noteworthy contrast to the stronger average performance of historic buildings examined in Chapter 3. An analysis of this category suggests that most difficulties encountered in applying the Energy & Atmosphere criteria to the Cobb Building are attributed to its use as a residential building and the costs of greening a project, and not to its status as a historic structure. Ten points are available under this category for optimizing energy performance (EA-1). Because of the high cost of modeling for large buildings, the developer was unwilling to undertake the energy modeling necessary to earn the points.[60]

Though the building has not been modeled to demonstrate its energy efficiency, a high performance heating and ventilation system was installed. Ms. Henderson expects that the building would have performed very well in modeling, and earned a number of the available LEED-NC credits. Since the residential units were intended to be marketed to high-end residents, air conditioning was also installed; this is somewhat unusual given Seattle's mild climate.[61]

Renewable energy sources were not incorporated into the project (EA-2). Unico had a five year return on investment requirement, and the return on renewable energy typically exceeds this timeframe by a number of years. Even

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[60] Ibid.
[61] Ibid.

with tax incentives, the use of renewable energy did not meet the developer's return requirements, and was not seriously considered.[62]

Ms. Henderson also explains that commissioning is generally not undertaken in residential buildings (EA-3). She mentions that the "mechanical and electrical systems for residential buildings in Seattle are very rudimentary," and that "commissioning has not been seen as beneficial for residential [developments.]"[63] Views about commissioning, however, are beginning to change with the development of many condominiums in Seattle, which have more sophisticated HVAC systems. Because of the high tech HVAC system incorporated in the Cobb, Unico funded additional commissioning, which likely enables the project to earn a credit in this sub-category. A credit for use of non-ozone depleting products is expected for installation of a HVAC system that does not use harmful refrigerants (EA-4).

The measurement and verification point will not be awarded (EA-5). The project designers did not attempt to earn this point, as measurement and verification for residential units is not as practical as it would be for a commercial or institutional use. As noted above, many mechanical systems used in the northwest are not sophisticated enough to warrant the complicated and costly measurement and verification process. Furthermore, as each unit in the Cobb has its own system, testing would have been a large expense for the project.

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[62] Nancy Henderson, (LEED Accredited Professional, ArchEcology), e-mail message to author, March 23, 2007.
[63] Ibid.

Finally, while Unico does not plan to purchase green power for the building (EA-6), they will do so if they fall short of the credits needed to earn a silver LEED rating.

The Cobb: Materials and Resources

The rehabilitation of the Cobb Building is a classic example of the difficulty associated with obtaining all available points in the building re-use category. While the project will be awarded one point under this subcategory for maintaining at least 75% of the existing walls, floors, and roof, the building failed to earn the second point available to projects that conserve at least 95% of the same building components. Though approximately 90% of the building was conserved, building designers had to install a structural core in the building, which disturbed more than 5% of the existing building shell. Reconfiguration of the interior spaces from office to residential use also meant that the building could not earn a point for maintenance of at least 50% of interior non-structural elements.

Over 80% of construction was diverted from landfills, therefore the Cobb will earn the two available points under the construction waste management subcategory (MR-2.1-2.2). Earning points for resource re-use, however, did not prove as easy. It was not possible to use salvaged materials that would have amounted to 5% of the project budget (MR-3.1-3.2). Ms. Henderson explains that meeting this requirement is especially difficult for residential projects. It can be very difficult to find enough salvaged materials to use in a multi-unit project, and given the importance of standardization in design for such project, it is neither practical nor desirable to re-use materials in some but not all units.

This credit requires the use of salvaged materials from *another* building, or requires that salvaged materials from the project building be used in a different way. Ms. Henderson explains that this is intended in part to discourage projects from re-using windows, as the USGBC believes that this would be encouraging use of less energy efficient materials. This matter is discussed in much greater detail in Chapter 6. [64]

Project designers anticipate using earning credit MR-4.1, which requires that materials with a high recycled content amount to at least 10% of the total value of building materials. The Cobb achieved this through the use of insulation with recycled components, recycled steel, and drywall. However, it was not practical to use enough recycled materials to reach the 20% threshold (MR-4.2). Fortunately, 60% of the materials used in the project were from local sources – thanks in part to a nearby concrete manufacturer south of Seattle – and the easy availability of other building materials in the northwest. This enables the Cobb to earn both of the points available under MR-5.1-5.2 for use of local and regional materials. The project is seeking an additional innovation point since the use of local materials was approximately 60% of the total material used.

As noted above, the Cobb is undergoing certification for LEED-NC v. 2.1. Standards for the use of rapidly renewable materials are more restrictive under

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[64] Nancy Henderson, (LEED Accredited Professional, ArchEcology), e-mail message to author, April 16, 2007.

2.1 than they are currently under 2.2. The older version requires that projects use rapidly renewable materials that amount to 5% of the total project budget, while the new standard requires only a 2.5% contribution to the budget. Project designers for the Cobb do not anticipate earning the rapidly renewable resources credit (MR-6). While the design team considered using bamboo flooring, they instead selected hardwood for aesthetic reasons. Even if bamboo had been used, it would not have been enough to total the required 5% of all building materials.

Finally, the building also did not earn a credit for use of certified wood. This was another decision based mostly on aesthetics – building designers preferred the look of oak floors to that of a certified wood floor.[65]

The Cobb: Indoor Air Quality

According to the project architects, the Indoor Air Quality category also presented difficulties, but more related to the residential nature and schedule of the project than to the historic fabric. The project team did not seek a point for carbon dioxide monitoring, since carbon dioxide monitoring is not typically employed in residential projects (EQ-1). CO_2 monitoring is more prevalent in commercial projects, in areas where significant numbers of people congregate. The point for increased ventilation effectiveness (EQ-2) was not sought; this is not typically undertaken in residential projects because most windows are operable.

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[65] Nancy Henderson (LEED Accredited Professional, ArchEcology), in discussion with the author, March 2007.

A construction Indoor Air Quality management plan was in place for the construction phase of the project (EQ-3.1). However, a building flush-out before occupancy was not performed prior to tenant move-in (EQ-3.2). Because of the phased lease-up of the building, a building flush-out was not practicable. Alternately, LEED-NC would have required air testing in one of seven units, or fourteen total units, in order to achieve EQ-3.2 through an alternate means. This proved undesirable because of the high costs of air testing.

Figure 16: “Fourth Avenue Entrance, the Cobb Building” (Photo by author, March 2007).

Project designers expect to earn all credits for low emitting materials (EQ-4.1-4.4). The credit for indoor pollution and chemical source control is also anticipated for the Cobb. Project designers included "walk-off" mats and grills in the entry way to remove dirt and other debris from shoes; the janitor's closet has a dedicated vent to the exterior so chemicals do not spread throughout the building.

The standards for controllability of systems differ between LEED-NC version 2.1 and version 2.2. Under version 2.1, credit EQ-6.1 is awarded for controllability of lighting for the perimeter of the building; EQ-6.2 is awarded for controllability of lighting in non-perimeter spaces. LEED-NC version 2.2 requires controllability of lighting to earn credit EQ-6.1, and controllability of thermal systems to obtain credit EQ-6.2. Under version 2.1, the Cobb will likely receive a credit for EQ-6.1, as there is a high degree of controllability of lighting along the perimeter of the building. The project team does not anticipate earning a credit for EQ-6.2, however. Because of the Cobb's design, there are no substantial "non-perimeter" spaces, other than the building corridors.[66]

Meeting criteria for EQ-7.1-7.2 also did not prove practical for the project. This subcategory requires that designers include HVAC systems in accordance with ASHRAE design criteria, and that project managers monitor thermal comfort performance over time. Ms. Henderson observes that achieving this level of thermal comfort is not appropriate in residential buildings in the northwest. ASHRAE requires specific performance for temperature ranges and

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[66] Nancy Henderson, (LEED Accredited Professional, ArchEcology), e-mail message to author, April 16, 2007.

humidity, and residential mechanical systems in the northwest typically do not meet these standards. [67]

Finally, day lighting requirements as provided in EQ-8.1-8.2 also proved easy to meet in the Cobb because of the building's numerous windows.

The Cobb: Innovation Points

As noted previously, the project team anticipates earning two Innovation credits for reducing water use by 40%, and for using approximately 60% local materials. Two more Innovation points are expected for green housekeeping (which entails the use of green products for cleaning), and green building education. A final point will be awarded for the involvement of a LEED Accredited Professional.

II. Lincoln Cottage Visitor Education Center

The President Lincoln Cottage and Soldiers' Home National Monument in Washington D.C. is managed by the National Trust for Historic Preservation in cooperation with the Armed Forces Retirement Home. In 2000, the Trust initiated efforts to preserve Lincoln Cottage, where the Lincoln family resided seasonally between 1862 and 1864. The Cottage was constructed in 1842 for George Washington Riggs, one of Washington's earliest and most successful bankers, and is located three miles north of the Capitol on a rise overlooking the City.

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[67] Nancy Henderson, (LEED Accredited Professional, ArchEcology), e-mail message to author, March 23, 2007.

As part of opening the Lincoln Cottage to the public, the Trust also undertook the adaptive reuse of a nearby building. The Administration Building, an Italianate Renaissance Revival style building that was constructed 1905 as part of the Soldiers' Home complex, will be used as a Visitor Education Center (VEC) for Lincoln Cottage, and will incorporate administration space for the Trust. The Trust hopes to open the newly preserved Lincoln Cottage and rehabilitated Administration Building in February 2008.

The National Trust is committed to integrating sustainable planning policies and sustainable conservation treatments in both the Lincoln Cottage and the VEC. This effort is undertaken as part of the National Trust's larger Sustainability Initiative, which is designed to promote the understanding of historic buildings as significant environmental, economic, social and cultural resources. There are four elements to the Initiative, including: advocating for policy that is supportive of the crucial role historic buildings play in sustainable development; research on sustainability issues related to preservation, such as embodied energy values, and the ways in which historic buildings promote economic, social, and cultural sustainability; education and outreach on the relationship between preservation and sustainability; and more energy efficient practices in the Trust's own properties.[68]

[68] Emily Wadhams (Vice President Public Policy, National Trust for Historic Preservation) and David Overholt (Preservation Projects Director, National Trust for Historic Preservation), in discussion with the author March – April, 2007.

Figure 17: “Lincoln Cottage,” (Robert C. Lautman Photography © 2005. Photo reproduced by permission of National Trust for Historic Preservation)

As suggested above, the Trust takes a comprehensive approach to sustainability, considering elements such as economic sustainability, contextual sustainability (such as view shed and relationship to the Soldiers’ Home complex and neighborhood outside the gates), and the “use of sustainable materials, systems, and ecologically sound practice during the preservation process.”[69] David Overholt, Preservation Projects Director at Lincoln Cottage, notes that “risk assessment, emergency planning, disaster mitigation planning, cyclical maintenance planning and conservation treatments that make use of durable, maintainable materials result in a comprehensive preservation strategy

[69] David C. Overholt, "Sustainable Preservation at Lincoln Cottage" (working paper, National Trust for Historic Preservation, Washington, DC, 2006) 4.

designed to protect Lincoln Cottage and the Visitor Education Center in perpetuity." [70]

As part of the Trust's commitment to "green preservation," they are seeking a silver certification from the LEED-NC program for the VEC. The effort is undertaken in part through the support of United Technologies Corporations which is facilitating the LEED-NC certification. This section will look in detail at the sustainable elements incorporated into the project, and ongoing efforts to certify the building under the LEED-NC program.

Visitor Education Center: Sustainable Site

The Visitor Education Center (VEC) demonstrates the relative difficulty historic projects can experience in accumulating credits under the Sustainable Sites category. Only five of fourteen credits are anticipated in this category, including credits for Site Selection (SS-1), which discourages the location of projects on inappropriate sites such as wetlands, farmland, or parkland. A credit is expected for SS-2, Development Density & Community Connectivity, as the VEC is located in a densely populated neighborhood. Two credits are also anticipated for providing access to alternative transportation (SS-4.1-4.2). Project designers for the VEC expects to earn credits for its location in an area with easy access to mass transit, as well as for providing bicycle storage racks and changing facilities for employees. [71]

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[70] Ibid.
[71] David Overholt, (Preservation Projects Director, National Trust for Historic Preservation,) in discussion with the author, March, 2007.

The project will likely earn two credits for stormwater water design (SS6.1-6.2). Mr. Overholt explains that the Trust spent a considerable sum on improving the stormwater management for the site. The previous stormwater dispersion system emptied water into the municipal stormwater channel, which was eventually deposited in the Chesapeake Bay. Project designers disconnected the existing roof drain from the stormwater system, and redirected water to bioswales located on the property. The bioswales serve as a natural means of filtering storm water and depositing it back into the ground.[72]

In addition, permeable paving was included in the site design to help address stormwater issues, and the overall amount of paving on the site was reduced, allowing water to seep back into the ground naturally rather than diverting it to stormwater channels. The project will therefore likely earn credits for SS-6.1-6.2, which requires the reduction of stormwater deposited into storm channels, and promotes water infiltration into the ground.

[72] Ibid.

Other points in the Sustainable Sites category proved infeasible, impractical, or cost-prohibitive for the project. The VEC is not located on a brownfield site, and did not receive credit for brownfield reuse (SS-3). Earning the additional credits for alternative transportation – such as providing fuel-efficient vehicles or reducing parking capacity - were not posisble for the project since it is part of a larger site with separate parking requirements.

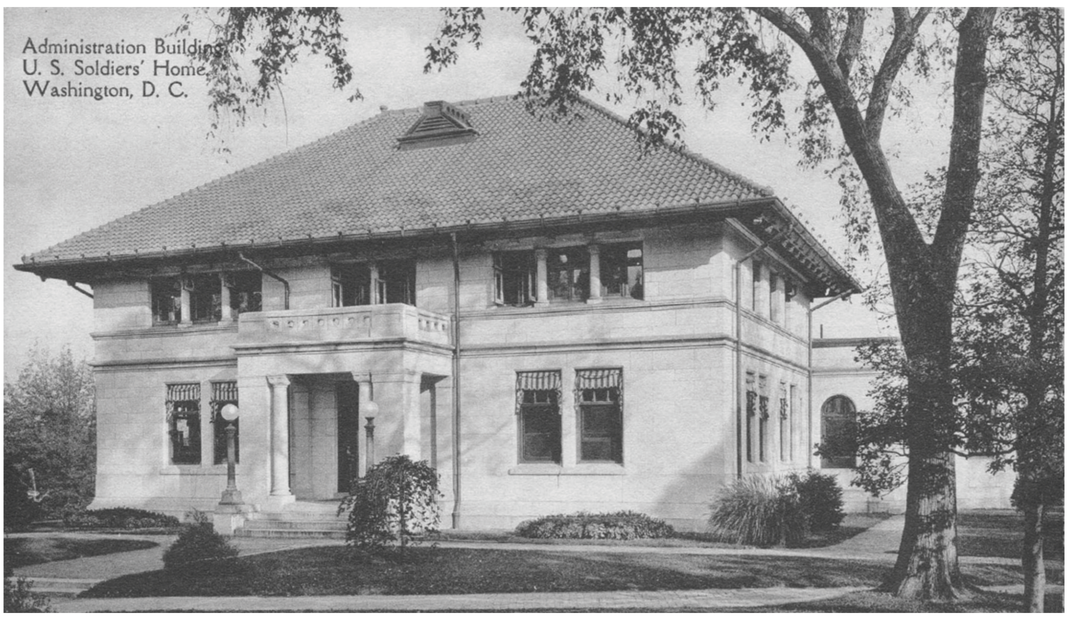

Figure 18: "Administration Building, President Lincoln and Soldiers Home National Monument." (Photo by Hyers, LIN0059 Headquarters from United States Soldiers' Home copy of pamphlet © 1931. Reproduced by permission of the National Trust for Historic Preservation.)

Site Development credits (SS-5.1-5.2) were not sought. These credits are awarded for protection or restoration of habitat and maximizing open space. Projects must restore or protect a minimum of 50% of the site area with native or adapted vegetation to earn credit SS 5.1. Even though there is a large amount of existing open space around the VEC, the design team did not pursue the credit in order to maintain flexibility in the landscape design. Construction Manager and Project LEED Coordinator Gavin Gardi explains that the National Trust wanted to pursue landscaping that would evoke the Lincoln era, and be in harmony with the context of the Soldiers' Home site. The National Trust did not want to be bound by the vegetation restrictions imposed by the LEED-NC standard.[73] Credit SS-5.2 requires a reduction in the development footprint such that the open space on site exceeds zoning requirements by 25%. As the existing footprint of the VEC did not conform to this requirement, it was not possible to claim the credit.

The project also will not obtain credits associated with the reduction of heat island effect (SS7.1-7.2) SS-7.1 is awarded to projects that reduce the heat island effect associated with non-roof sources, by providing extensive shading, paving materials with a high solar reflective index, or open grid pavement systems. In this instance, the National Trust did not seek the credit in part because of the nature of their property lease. The Trust has a 50-year lease for the Lincoln Cottage property, but the agreement does not include some of the perimeter areas associated with the two buildings, including parking lots and many of the nearby pathways. Under this arrangement, it was not practical for the Trust to replace existing infrastructure with more permeable materials. Reflective roofing materials were used, but the change was not substantial enough for the project to earn the reduction in heat island effect credit for roofs (SS-7.2).

[73] Gavin Gardi (Construction Manager and Project LEED Coordinator, The Christman Company) and Elisabeth Dubin (Architect, Hillier Architects), in discussion with author, March 2007.

Credit SS-8.1 for the reduction of light pollution was also not awarded. Construction Manager and Project LEED Coordinator Gavin Gardi and Architect Elisabeth Dubin notes that there were sensitivities regarding the historic property and lighting.[74] The Trust preferred to maintain a historically appropriate lighting scheme, and while this entailed the installation of very little new outdoor lighting, the lighting design did not meet LEED-NC specification. The Trust also remained sensitive to the Soldiers Home's requirements for lighting the property, given concerns about elderly and disabled users of the site.[75]

Visitor Education Center: Water Efficiency

Four of five points in the water efficiency category are anticipated, including WE-1.1. and WE-1.2 for water efficient landscaping. Project designers removed the existing irrigation system, which had not functioned for a number of years. Drought resistant plantings were installed, as were planting beds that are designed to retain rain water. No potable water is used for irrigation. While the Innovative Wastewater Technology point was not awarded (WE-2), two credits for water use reduction were awarded for the use of low-flow fixtures. These new fixtures are expected to reduce water usage by 30% or more.

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[74] Ibid.
[75] Ibid.

Visitor Education Center: Energy & Atmosphere

The Visitor Education Center project designers anticipate earning eleven of seventeen possible credits in the Energy & Atmosphere category, including an impressive nine of ten points in the Optimizing Energy Performance subcategory (EA-1). Considerable effort was put into upgrading the existing HVAC systems to achieve a high level of efficiency. Energy modeling was used to help determine what systems would best suit the exterior envelope and building usage. A new Energy Star HVAC system was installed, and is estimated to provide energy savings of up to 40% over time. Solar reflective surfaces were also used on the roof to help reduce solar gain during summer months.[76] In addition to these energy reducing measures, project designers installed ¼" laminated glass to reduce UV degradation of artifacts that will be displayed in the VEC. The glass has the added benefit of providing additional thermal and acoustical insulation.

A point for Enhanced Commissioning (EA-3) was also awarded. The more extensive commissioning process was a large expense, but helped make certain the HVAC system functions as designed. Though the upfront cost of commissioning is high, it serves as a cost-savings in the future since it ensures that the maximum energy efficiency is achieved. Credit EA-4 was also awarded for Enhanced Refrigerant Management, since the upgraded HVAC system does not use harmful refrigerants.[77]

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[76] David Overholt, (Preservation Projects Director, National Trust for Historic Preservation,) in discussion with the author, March, 2007.
[77] Ibid.

While the design team considered the use of geothermal heating, it was deemed impractical. There is extensive infrastructure underground for utilities as well as trees on the site, which were thought to potentially interfere with the placement of a field of geothermal wells. Other renewable sources of energy

Figure 19: "Administration Building" (Photo by David C. Overholt, National Trust for Historic Preservation, February 2004.)

were not incorporated into the property, thus the project did not earn the three credits available for Onsite Renewable Energy (EA-2.1-2.3).

The National Trust does not intend to undertake additional Measurement & Verification activities for the Visitor Education Center, and will not earn credit for this (EA-5). Also, the Trust does not intend to purchase green power for the project because power is supplied to the entire site as a whole (EA-6).

Visitor Education Center: Materials & Resources

Six of thirteen available Materials & Resources credits are expected for the VEC project. This project is in a distinct minority of historic LEED-NC certified projects in that it earned all three Building Re-use credits (MR-1.1-1.3). Very little of the exterior core and shell were disturbed in the construction process, thus project designers anticipate earning two credits for retaining 95% or more of the building shell. Fifty percent or more of the interior non-structural elements will be saved, and the building will therefore likely qualify for the interior re-use credit.

Credits are also anticipated for the successful diversion of 50% of construction waste from landfills, and the project may even reach a rate of 75% or higher, enabling the project to qualify for the second Construction Waste Management point (MR-2.1-2.2). Project designers are more certain that the VEC will qualify for the recycled content credit (EA-4.1) through the use of recycled carpet, counter tops, and components that will be built into the exhibit features. While these materials will be sufficient to earn the 5% credit, they will not likely be enough to earn the 10% recycled materials credit (EA-4.1-4.2) Finally, a point is expected for the use of Certified Wood.

Other points for Regional Materials will not be earned (EA-5.1-5.2). According to Mr. Overholt, there simply was not a high enough volume of these materials to earn the credit. Finally, the VEC project will not earn the credit for the use of Rapidly Renewable Materials (EA-6).

Visitor Education Center: Indoor Environmental Quality

The VEC project designers anticipate earning ten of fifteen possible points in the Indoor Environmental Quality category. The designers, Mr. Gardi and Ms. Dubin, note that the Trust will seek a point for Outdoor Air Delivery Monitoring (EQ-1). Air is monitored to ensure that carbon dioxide levels do not exceed allowable limits, and the HVAC system is designed to increase the delivery of outdoor air when carbon dioxide exceeds certain levels. One point is expected for Increased Ventilation (EQ-2). Mr. Overholt explains that this point is possible through the incorporation of a highly-efficient HVAC system, but also because of the operability of the windows.

The project designers also implemented a Construction Indoor Air Quality Management Plan during construction, which will secure an additional point in the Indoor Environmental Quality category (EQ-3.1). The Trust anticipates earning the second credit under this category as well, which requires a flush-out of toxins prior to opening the building (EQ-3.2).

Project designers expect that all available points for the use of Low Emitting Materials will be awarded, including for the use of less hazardous adhesives and sealants, paints and coating, carpet, and composite wood and agrifber products (EQ-4.1-4.4). Credit will be sought for controllability of lighting, as there is task lighting in each work space (EQ-6.1). One point is also anticipated for a high degree of Controllability of Systems for thermal comfort (EQ-6.2). Work spaces provide individual controls for heating and cooling.

A credit for thermal comfort design will not be awarded, as the project did not meet ASHRAE standards EQ-7.1. The Trust intends to perform a survey of building occupants to ensure that their thermal comfort needs are met, thereby qualifying for credit EQ-7.2. Finally, credits for a high degree of daylighting and views will be earned, given the ample use of windows and a large skylight in the building (EQ-8.1 and EQ-8.2).

Project designers note it was undesirable to seek a point for Indoor Chemical & Pollution Source Control (EQ-5). This would entail disturbing historic fabric to provide direct ventilation for a small janitor's closet, which the Trust was unwilling to do given the limited benefit of venting this small space. Earning credit EQ-5 would also require the installation of recessed walk-off mats in the entry way. The Trust has gone to great lengths to maintain the historic encaustic tile floor in the space, and does not wish to disturb the tile.

Visitors Education Center: Innovation Points

The project team anticipates earning a total of three Innovation points for the VEC. One point will be awarded for the use of a LEED Accredited Professional. Two other points are expected for green house keeping, and LEED educational posters and signage.

III. Learning from LEED-NC Case Studies

While there are areas where it appears more difficult for historic projects to earn LEED-NC credits than non-historic projects, such as in the Sustainable Sites and Indoor Environmental Quality criteria, historic projects show a remarkable degree of adaptability in responding to LEED-NC standards. With this acknowledged, there are a number of ways in which LEED-NC could be modified to better respond to the realities of historic buildings – or any existing building. LEED-NC shortcomings include:

- Certain LEED-NC sub-categories handicap existing buildings;
- LEED-NC does not sufficiently recognize the value of historic buildings because of their durability, embodied energy, and social and cultural value;
- There are some instances in which LEED-NC may create incentives to make changes that actually undermine efforts to promote sustainability; and
- There are wider concerns about the narrow approach to sustainability taken by the U.S. Green Building Council.

These issues will be looked at closely in Chapter 6, and recommendations will be offered to address these concerns. However, the Cobb Building and Lincoln Cottage Visitor Education Center demonstrate the relative ease with which LEED-NC is applied to historic buildings. Ms. Henderson, who managed the LEED certification of the Cobb, has worked on the certification of a number of LEED-NC buildings. In her experience, working with LEED-NC in a historic rehabilitation is not considerably more difficult than working with LEED-NC in new construction.[78] Lincoln Cottage VEC Construction Manager and LEED Coordinator Gavin Gardi notes that no sustainability criteria would fit every project, and that while LEED-NC "is not a perfect fit" for historic projects, it generally works well.

[78] Nancy Henderson, (LEED Accredited Professional, ArchEcology), in discussion with the author, March 2007.

Both of these projects were undertaken with significant regard for historic fabric. The National Trust, as steward of some of the nation's most significant historic resources, takes special care in ensuring sensitive rehabilitations of its buildings. The developer of the Cobb also gave considerable attention to historically sensitive rehabilitation in order to obtain the 20% federal historic rehabilitation tax credit. The two projects are therefore examples of sensitive rehabilitations in which efforts to green the project were integrated with relatively little conflict between green standards and the Secretary of the Interior's Standards for Historic Rehabilitation.

Designers for the VEC building did encounter some difficulty in integrating a vegetation scheme that would have met the USGBC's standards, and would have been consistent with the Trust's efforts to maintain a landscape that evokes the Lincoln era. There were also concerns about destroying historic fabric through the implementation of Indoor Pollution Source Control measures, such as installing walk-off mats and providing direct ventilation of the janitor's closet. However, such concerns were more the exception than the rule.

The Cobb and VEC projects were far more likely to encounter friction with LEED-NC standards because of concerns about the cost of implementing some green elements, such as air quality monitoring in the Cobb. There were also instances in which it simply did not make sense to pursue a point because LEED-NC standards are not regionally sensitive. For example, designers of the Cobb did not pursue EQ-7.1 and EQ-7.2 because weather conditions in the northwest do not require the climactic controls specified in the LEED-NC standards.

The case study analysis and examination of LEED-NC scorecard data in Chapter 3 do not suggest that there are large points of tension between green building and historic preservation standards. With relatively few exceptions, LEED-NC and historic projects can be mutually reinforcing, and perhaps even help demonstrate the degree to which there is a natural link between historic preservation and sustainability.

Yet it is noteworthy that LEED-NC was not used for the Lincoln Cottage preservation itself, an instance in which project designers were required to take an especially high degree of care in dealing with sensitive historic fabric. A number of "green" features were incorporated into the Lincoln Cottage project. Preservation Projects Director David Overholt notes that the National Trust did consider submitting the VEC and Lincoln Cottage together for LEED-NC certification, but chose not to for a number of reasons. For example, high VOC paints were chosen for the cottage for their durability and reflective qualities, and because the Trust seeks to restore the building to the Lincoln period of occupancy as accurately as possible. [79]

Mr. Overholt also explains that the Lincoln Cottage was not submitted because of consideration of the building's mechanical systems. A large number of LEED-NC points are dedicated to systems efficiency, and the Trust did not initially plan to install air conditioning, preferring instead to maintain the

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[79] David Overholt, (Preservation Projects Director, National Trust for Historic Preservation), in discussion with the author, March, 2007.

building's less sophisticated, passive heating, cooling, and ventilation systems. (The Trust eventually decided to install air conditioning out of climate control concerns.)[80] Mr. Overholt explains further:

> Ultimately we decided that preservation decisions may have conflicted with LEED certification decisions. The Trust sees great potential to LEED certify ancillary buildings, support buildings and new buildings at the historic sites. The sustainable strategy at the Cottage focused more on craftsmanship and durability than Energy Star equipment and bike racks.[81]

Thus LEED-NC may be a feasible – albeit imperfect – sustainability standard for historic projects in which designers do not contend with highly sensitive historic fabric. Use of the standard may be far more challenging in instance in which preservationists seek to preserve monument-quality structures.

One such restoration is examined in the following chapter. In 2004, Goody Clancy architects of Boston initiated the renovation of H.H. Richardson's Trinity Church in Boston, one of the country's most historically significant buildings. An alternate approach to sustainable preservation was undertaken by the project owner and architects. While LEED standards were not applied, the approach was one of "organic sustainability" – a notable contrast to the more restrictive and regimented nature of LEED criteria.

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[80] Ibid.
[81] Ibid.

Chapter 5
H.H. Richardson's Trinity Church: A Lesson in Preservation-Based Sustainability

While the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Standard is one of many approaches to conscientious building, it has become the de facto standard in "green building" design in the United States.[82] Many have expressed concerns about the USGBC's efforts to promote green design and have accused it of being too narrow in its approach. Specifically, the USGBC focuses almost exclusively on the ecological implications of building, and promotes "green building" through the LEED-NC program to mitigate the negative environmental effects of construction and building operations.

There is good reason to question the efficacy of the USGBC's efforts to lessen environmental impacts through LEED-NC, since these standards ignore important considerations such as life-cycle analysis and durability. It is therefore all the more troubling that LEED's approach to "green building" is often accepted as the means of achieving sustainability. Economic development consultant and preservationist Donovan Rypkema explains his concerns about this common misperception. He argues that "'green buildings and sustainable development are not synonyms," and that "sustainable development has more elements than just environmental responsibility."[83]

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[82] K. M. Fowler and E. M. Rauch, Sustainable Buildings Rating Systems Summary (Unknown Place of Publication: U.S. Department of Energy and General Services Administration, 2006).
[83] Donovan Rypkema, "Historic, Green and Profitable" (speech delivered at Traditional Building Conference in Boston, MA; March 8, 2007).

This chapter examines the preservation-based approach to sustainability advocated by Mr. Rypkema and other preservationists. This method takes a much more comprehensive and complex view of sustainability, and reflects preservationists' views that it is not enough to simply promote green building to achieve sustainability goals. Instead, preservation-based sustainability responds to a much broader understanding of this concept that includes environmental protection, economic efficiency and stability, and cultural and social preservation. Henry Hobson Richardson's Trinity Church in Boston, Massachusetts serves as the case study for this multifaceted approach to sustainability.

While the preservation of Henry Hobson Richardson's Trinity Church has been profiled in a number of sources, such as *Architectural Record*, this chapter takes a different path and specifically examines the project team's holistic approach to sustainability issues.[84] While many elements of the restoration and expansion of Trinity Church would fit neatly into the LEED-NC criteria, the project team neither registered the project under LEED, nor sought certification from any other sustainable building assessment systems. The result of their preservation-based restoration and expansion is an environmentally, economically, socially, and culturally sustainable project that offers important lessons in thinking comprehensively about the meaning of sustainability as it relates to the built environment.

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[84] Nancy B. Solomon, "How is LEED Fairing After Five Years in use?" Architectural Record 193, no. 6 (2005 June, 2005): 135-138.

I. Trinity Project Overview

Built in 1877, Trinity Church in Boston is one of architect H.H. Richardson's masterpieces. With its massive stone walls and signature large semicircular arches, Trinity Church embodied the style that would come to be known as Richard-sonian Romanesque because of the strong Roman influence in the architect's work, which departed significantly from the popular Gothic and Second Empire designs of the time.

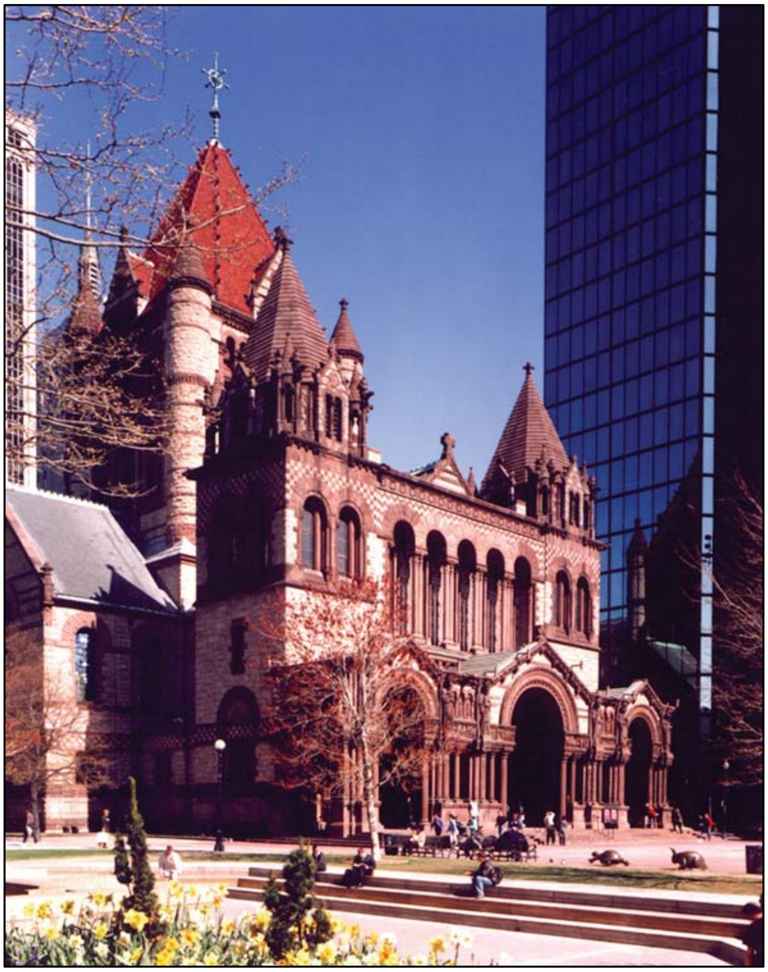

Figure 20: "Richardson's Trinity Church." (Photo by Peter Vanderwarker ©. Photo reproduced by permission of Trinity Church, Boston.)

Richardson's work greatly influenced both his American and European contemporaries, and he is the only American architect to have a style named after him.

In addition to the monumental significance of its architecture, Trinity Church also houses some of the most important works in American religious art, including the murals and stained-glass of artist John La Farge. By the early

21st century, however, the church had begun to show signs of its age, including deterioration of mortar in the tower and moisture infiltration through the roof. In addition, some of the flashings needed repair or replacement, and windows were badly in need of cleaning. There was also some concern about rot of a small number of the wooden pilings supporting the structure, due to trouble with water table levels in the Back Bay throughout the years. Though the vast majority of wood pilings were in good condition, those that were no longer sound were reinforced. Repair work was needed on the interior as well, including restoration of murals, stained-glass windows, and the Aeolian-Skinner pipe organ.[85]

In addition to these needed repairs, the congregation had outgrown the facility, and required additional meeting and activity space. Because of the Church's urban location, it would be difficult to expand into a new outbuilding. Since the option of adding on to the Church was not considered particularly desirable, the project team decided to expand downward into the basement.

In 1999, the Trinity Church congregation developed a Master Plan to identify needed repairs to the church, as well as address the Church's growth needs. The 1999 plan called for repairs and additions to the Church that amounted to approximately twice the amount of funding the Church generated for the project. Thus when the Boston-based architectural firm of Goody Clancy was selected to undertake the restoration and addition of community space, the first order of business was a review of the 1999 Master Plan and a prioritization

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85 Jean Carroon (Principal Architect, Goody Clancy), in discussion with the author, March 2007.

of needs. Based on this analysis of priorities, the project was divided into six distinct phases. Importantly, work could be terminated at the end of any phase to allow the church to generate additional financial resources if funding was not immediately available to proceed with the next phase of work.

Phase one entailed the installation of geothermal wells. These were installed prior to transformation of the basement into a community meeting area, and were needed primarily to cool and heat the new space. Six wells were installed along with a four-pipe system that allow for the system to simultaneously perform heating and cooling, and for some of the wells to be at rest. The geothermal pumps move heat into or out of the earth using water wells; during the winter, heat is extracted from the earth and used to pre-heat the building's heating system, while during summer the system works in reverse, removing heat from the building and pumping it back into the earth.

Goody Clancy's Principal-in-Charge of Preservation, Ms. Jean Carroon, believes that this was the first installation of geothermal wells in the Back Bay, and possibly in Boston.[86] This phase of this project was not without difficulties, as the project team had to drill vertically 1500 feet to reach bedrock that maintains a constant temperature, in this instance between 50 and 55 degrees Fahrenheit. The system provides for adequate cooling of Trinity Church's undercroft, and the Church now requires less steam to heat the building during colder months.

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[86] Ibid.

Phase Two entailed repairs to the exterior envelope, including the tower. The mortar in the tower stone work was deteriorating, and there were problems with a leaking roof. Work undertaken in this phase was identified as the most crucial, as the continued deterioration of the mortar and roof would put the building at significant risk of losing historic fabric. Waterproofing below grade was also required to make the basement space useable. Windows and flashing were also repaired where needed. Stone work was replaced with matching stones found throughout New England.

With the most pressing deterioration concerns resolved and heating and cooling now available to the church's basement, in Phase Three Goody Clancy began work on transforming the undercroft into usable space. Project designs called for lowering the basement by four feet, and in so doing created 22,000 square feet of usable space. Colorful glass designed by artists Alexander Beleschenko and Raffaella Sirtoli Schnell was incorporated into the space, turning the undercroft "into a brightly lit, welcoming space" that is used by the congregation for a variety of purposes, including musical performances, classes, and meetings.[87]

Phase Four included improvements to the Parish House, also designed by H.H. Richardson. These upgrades included restoration of existing meeting space in the Parish House and the restoration and reconfiguration of other existing spaces. The mechanical systems were also updated, and the Parish

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[87] Construction Owners of America, "2005 Co-Winner," http://www.coaa.org/Default.aspx?tabid=162 (accessed April 21, 2007).

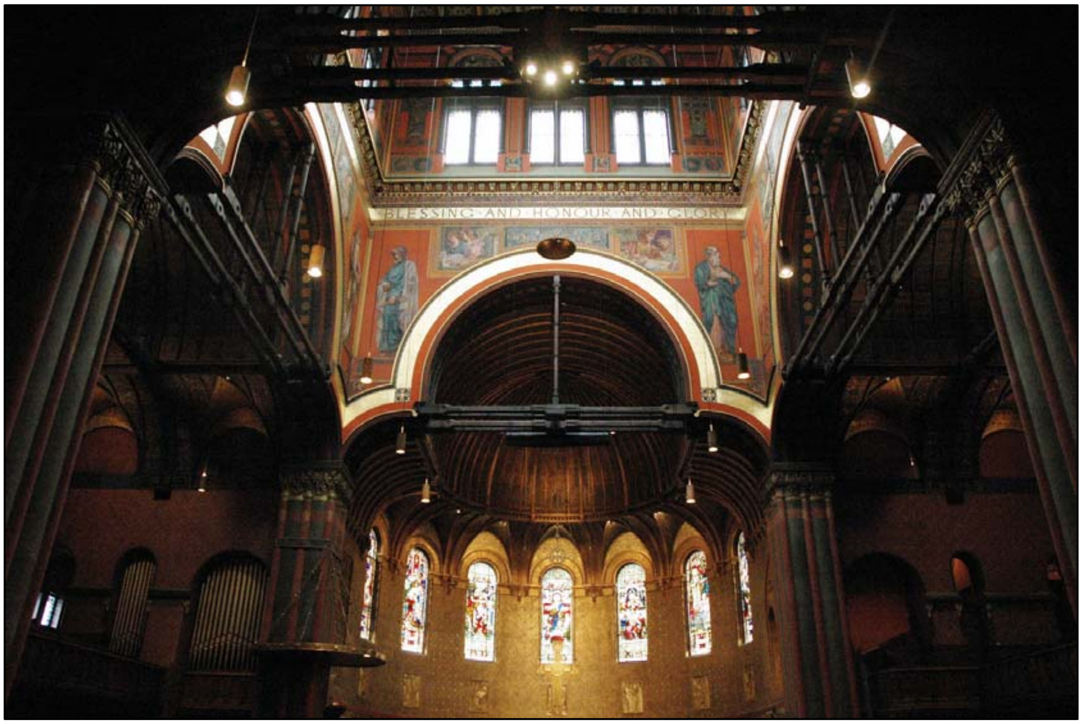

Figure 21 "Interior of Trinity Church," (Photo courtesy of Trinity Church, Boston.)

House is now also cooled and pre-heated in part using the new geothermal wells.

The La Farge Murals were also in need of repair. Phase Five entailed the repair of many La Farge murals, which had been damaged by water leaks in the Tower.[88] The murals had also been badly treated during a restoration 50 years prior when paint colors were altered, as were some of the lines in the murals.[89] Phase Five sought to restore the murals to their original condition as closely as possible. Phase Six, which is currently underway, entails the repair of stained-glass.

88 Temin,Christine. "Making New History at Trinity Church," Boston Globe June 9, 2004.
89 Zezima, Kate. "Religion Journal; House of many Treasures Gets the Gilding It needed." New York Times September 25, 2004.

II. Preservation-Based Approach to Sustainability

The Trinity Church project is representative of the sensitivity taken by preservationists when restoring historically significant buildings. These efforts are primarily aimed at preserving fabric and ensuring the long term survival of the building, while accommodating present user needs. As will be discussed later, this approach promotes the sustainability of historic buildings in a holistic way. The first three phases of the Trinity Church project will be examined closely, and will inform this chapter's discussion of a preservation-based approach to sustainability. These three phases of the project are especially important because they deal with the preservation of the building envelope, the incorporation of energy efficient systems, and the transformation of the basement into usable space.

When asked about the impetus for "greening" the Trinity Church project, Preservation Architect Jean Carroon explained that a conversation between the Church directors and the architects about sustainability per se never took place. In noting Goody Clancy's commitment to quality architecture and sustainability, Ms. Carroon explains that "it was just assumed we would be environmentally responsible."[90] She noted that this entailed thinking about the resources required to restore the building, as well as ensuring the most cost-efficient operating costs. Fundamentally, however, Ms. Carroon notes that the project is about "good design" that best serves the needs of the community.[91]

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[90] Jean Carroon (Principal Architect, Goody Clancy), in discussion with author, March 2007.
[91] Ibid.

The following section will look at the restoration of the Trinity Church and examine Goody Clancy's efforts to incorporate design sensitive to sustainability issues.

Site Environmental Considerations

H.H. Richardson's Trinity Church is a good example of a project that reaps large environmental benefits from its urban location. The building is situated in Boston's Back Bay, surrounded by subway stations and bus stops, which makes the location easily accessible by mass transit. Parking is also available on-street or in nearby garages, but only six spaces are available on site. Given site constraints, it was neither possible nor desirable to add additional parking as part of the building improvements.

There are significant concerns about water table issues in the Back Bay, as buildings in this area of Boston were traditionally built on wood pilings because of the marshy ground. As the water table dropped over the years and exposed existing pilings to rot, the stability of many of the area's buildings was threatened. Since the 1930s, Trinity Church has directed its stormwater back into the ground beneath the building to promote the stability of the pilings.

While the previous system was altered slightly, the project team ensured that storm water would continue to be deposited underground to recharge the water table directly beneath the church. This promotes environmental sustainability through maintenance of the water table as well as reducing the burden on the municipal storm water channels. But just as importantly, the handling of storm water supports cultural sustainability in helping make certain the survival of the church and other nearby buildings for generations to come.

In instances related to heat island effect and vegetation, the project team determined that there would be a larger social benefit in maintaining the church in a historically sensitive manner than would be gained by focusing only on ecological impacts. For example, the project team's handling of vegetation demonstrates an instance in which preserving the historic landscaping trumped purely environmental considerations about the installation of native or drought resistant plants, grasses and trees. Little vegetation was altered throughout the course of the project, as the Building Committee and project architects wished to maintain the historic site setting.

Similarly, the project team did not focus on reducing heat island effects. The project team preferred to maintain the historic landscaping of the site, rather than provide additional shading or alter paving material (though it should be noted that a good portion of the building is already shaded because it is surrounded by some of Boston's tallest skyscrapers). Additionally, Goody Clancy did not consider alterations to the roof that would reduce the heat island effect associated with the roof.

Conservation of Water

In an effort to conserve water, project designers installed new water saving plumbing fixtures, such as low-flow toilets. A new irrigation system is also designed to include a rain sensor, so sprinklers will be de-activated once a certain level of moistures is detected.[92] Storm water management, as discussed above, was also designed for the responsible disposal of water. These water saving measures result in reduced economic costs in the long-term (less use of fresh water), environmental protection (reduced fresh water use), and preservation of the landmark (through protection of the wooden pilings).

Energy Efficiency

The Trinity Church project incorporates significant energy efficiency measures. As one of Goody Clancy's other project architects involved in the project, Stefan Knust note that one of the earliest decisions regarding the program for the project, the transformation of the Church basement into usable space, "was a significant positive first step." [93] This new floor is well insulated by the earth and the floor above, reducing total energy demands during the summer and winter. Compared to an above grade new structure, the energy use within the church undercroft is considerably lower. [94]

The project team faced a quandary, however. A new space in the church undercroft would require heating and cooling, and traditional HVAC systems would take up considerable space, as well as potentially damage historic fabric. A decision was made to install the geothermal pumps, as described above. In addition to facilitating the use of more energy efficient space in the church undercroft, the geothermal wells typically use approximately 40% less energy

[92] Stefan Knust (Architect, Goody Clancy), e-mail message to author, March 15, 2007.
[93] Ibid.
[94] Ibid.

than conventional HVAC systems during peak periods.[95] This will significantly reduce the financial costs of operating the building – no small consideration for a non-profit entity such as a church.

The geothermal wells were incorporated into the project in a seamless way, and are not visible in the landmark building. According to the project architects, geothermal well installation requires only an 8" hole, covered by a 24" manhole cover. These manhole covers are the only visible evidence in the undercroft of the new heating and cooling system. Mr. Knust notes that a new mechanical room for some of the equipment is located under the parking area, and is not visible to the visitor. The new systems are quiet and produce no vibrations, and do not present water leaking hazards or add any new loads to the building. Additional loads and potential leaking would have been a significant concern with a conventional rooftop HVAC system.[96] In addition to being environmentally friendly, the geothermal wells were an important way to promote the preservation of H.H. Richardson's masterpiece.

The geothermal systems were commissioned to ensure that they were functioning properly, and achieving the maximum level of efficiency. The project architects implemented other energy efficiency measures, including energy monitoring over time, which provides data on the system's efficacy in reducing energy consumption. Such commissioning and monitoring promotes both environmental and economic sustainability.

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[95] Ibid.
[96] Ibid.

The decision to locate additional meeting space underground as well as use geothermal wells embodies the project team's commitment to environmental, economic, and cultural sustainability. Use of the undercroft was a significant means of conserving energy that otherwise would have been used to construct and operate a new building. Geothermal wells, one of the most environmentally friendly forms of heating and cooling, also contributed significantly to the effort to minimize the building's environmental footprint. In conserving resources both during construction and in operation, these decisions also helped promote the long-term economic sustainability of the Church. Finally, the project team's commitment to preserving the fabric of the historically significant church was fundamental to each decision made about the project.

On a somewhat smaller scale, Goody Clancy's approach to lighting also embodies preservationists' three-pronged approach to sustainability. The architects gave considerable attention to ensuring that lighting was energy efficient and historically appropriate. To promote energy efficiency, sensors are used so that lighting is turned off when a room is not in use, and energy efficient fluorescent and HID sources of light have been used in the majority of spaces. Incandescent lighting is "limited to unique situations, involving display, forum [and] chapel functions and situations where color rendering is critical."[97] A high degree of lighting controllability is also offered so that the many layers of lighting can be configured to best serve the required function. The architects further note that "every effort has been made to color-match halogen, incandescent,

[97] Ibid.

fluorescent and HID sources to provide a consistent and appropriate luminous environment."[98] The result is a lighting scheme that is environmentally conscientious, economically efficient, and historically sensitive.

Materials & Resources

As noted above, the architectural team located materials that matched Trinity's exterior stonework. Existing stone that was found during building excavation was also used in some spaces. This level of care is especially important in a building of Trinity's historical significance. A number of recycled materials were used, such as concrete and steel, and wood finishing in the undercroft is not from an exotic source. In addition, wood from a number of beams that were removed from the church basement were salvaged for reuse as flooring in the Church's new common's structure. Locally generated materials were used, where possible, though distance traveled for materials was not logged. The result of this thoughtful use of materials is a balance between historic conservation and the conscientious use of "green" materials.

Indoor Environmental Quality

Where possible, Goody Clancy made use of low-emitting materials on the interior, such as paints and carpeting. Yet in some instances, the need to restore building fabric in a historically sensitive manner outweighed the importance of green considerations. For example, in the restoration of original

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[98] Ibid.

painting, conventional paints were used to maintain the historic appearance of the walls.

Other environmentally sensitive elements were incorporated into the project. Walk-off mats were installed to remove debris from shoes, thereby reducing the introduction of contaminants into the building. A copy room space is also vented directly to the exterior. Carbon dioxide monitors are installed, and monitor ventilation systems. The HVAC system is activated to increase fresh air intake when carbon dioxide exceeds certain levels.

III. Evaluating LEED-NC in the Context of Preservation-Based Sustainability

In analyzing the Trinity Church project, it is useful to consider how the restoration might have fared under LEED-NC criteria. Goody Clancy demonstrated great sensitivity to many of the issues incorporated in the LEED-NC standards, and it is likely the project would have claimed points easily in each of the five LEED-NC categories. For example, incorporation of new technologies such as geothermal wells would be viewed especially favorably, as would the handling of stormwater and water conservation measures. Yet LEED-NC does not award points for a number of other important dimensions. These shortcomings are explored below, and discussed further in the next chapter.

Preservation-Based Social/Cultural Sustainability

The USGBC standards do not take into consideration the importance of preserving culturally and historically significant buildings as community institutions and as tangible links to the past. Other than the rather limited incentive to preserve existing buildings offered through the MR.1.1-1.3 Building Reuse credits, the USGBC is silent on the issue of maintenance of historically significant structures. As has been discussed throughout this thesis, preservation of the built environment is central to cultural and social sustainability.

Chapter 4 demonstrates that it is possible to maintain a relatively high degree of sensitivity to historic fabric under LEED, but LEED-NC does not encourage building designers to consider issues of cultural sustainability. Some may argue that it is not the place of LEED or any other green building tool to promote cultural preservation, and that preservationists can work within the existing standards to promote this goal. Yet this approach underestimates the degree to which LEED can persuade project designers and building owners to consider the broader cultural and social consequences of their actions.

Preservation-Based Environmental Sustainability

There are other compelling reasons to believe that the preservation-based approach to environmental sustainability should be better represented in LEED-NC. In seeking to preserve heritage properties, preservationists are encouraged to use construction methods and materials that match as closely as possible the building's original materials and construction techniques. Because these traditional materials and methods of construction have evolved through centuries of trial and error, they may be much more sustainable than cutting-edge or bottom-dollar construction methods in use today.

Furthermore, while LEED-NC offers 17 points for energy efficiency, it substantially ignores issues of embodied energy in buildings. For example, had the Trinity Church congregation decided to construct a new building rather than embed a new space within the existing building, LEED-NC would have awarded no fewer points for a new building, provided it met the same energy efficiency, storm water handling, and materials criteria, etc. Little if anything in the USGBC standards encourages project architects and building owners to take a creative and more energy efficient approach in meeting their space needs.

In a similar vein, LEED-NC does not penalize projects for razing an existing building, and building anew – despite the tremendous embodied energy embedded in existing buildings and the large amounts of energy required to demolish an existing structure, and rebuild another structure in its place. Mr. Rypekma argues that this is the result of the USGBC's narrow approach to "green building," which focuses exclusively on the operational energy use of a building rather than the energy needed to construct it. He notes that the energy used in the construction of a building is fifteen to thirty times its annual energy use, and that "razing historic buildings results in a triple hit on scarce resources." He explains:

> First, we are throwing away thousands of dollars of embodied energy. Second, we are replacing it with materials vastly more consumptive of energy. What are most historic houses built from? Brick, plaster, concrete and timber. What are among the least energy consumptive of materials? Brick, plaster, concrete and timber. What are major components of new buildings? Plastic,

> steel, vinyl and aluminum. What are among the most energy consumptive of materials? Plastic, steel, vinyl and aluminum. Third, recurring embodied energy savings increase dramatically as a building life stretches over fifty years…If you have a building that lasts 100 years, you could use 25% more energy every year and still have less lifetime energy use than a building that lasts 40 years. And a whole lot of buildings being built today won't last even 40 years.[99]

The following chapter will explore possibilities for integrating into LEED-NC a more comprehensive accounting of energy efficiency.

Preservation-Based Economic Sustainability

The economic sustainability of buildings can be thought of in two ways: first, in terms of the microeconomics of building operations -- that is, ensuring that mechanical systems and building envelopes perform as efficiently as possible to reduce long term operating costs; and second, economic sustainability can be thought of with regard to the macroeconomics of the built environment, such as how building construction and the building stock contribute to overall efforts to promote economic development and stability in communities.

LEED-NC is concerned with the former, awarding numerous points for energy efficient measures that promote savings in energy use and costs. Energy conserving measures promoted by LEED -- such as the use of renewable energy and efficient HVAC systems – undoubtedly promote long-term economic sustainability in reducing energy needs. (Although it should be noted

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[99] Rypkema, "Historic, Green and Profitable," 7.

that here again the USGBC can be limited in its approach. While LEED-NC encourages the use of new, innovative and technologically advanced materials, some of these untested materials will require replacement in the near term, and ultimately prove more costly than more traditional material to maintain.)

Of considerable importance, however, are the economic implications for building construction and rehabilitation on a larger scale. The building industry makes up more than 14% of the American Gross Domestic Product, and has tremendous effect on local and national economies. Decisions about whether to repair materials rather than replace them, such as in the case of wood windows, have implications for whether local labor is used (thereby supporting the local economy), or whether materials are brought in from far and wide (supporting labor in far-off places). Decisions about whether to maintain historic buildings also can have an effect on small business incubation. Existing spaces are typically far more affordable to innovative small businesses than new construction. Finally, maintaining historic fabric is also a crucial component of creating environments that provide the high quality of life that is so important to promoting economic competitiveness.[100]

The final chapter of this thesis will offer specific recommendations about how LEED-NC might better recognize the qualities of historic buildings that make rehabilitation and restoration an inherently sustainable activity. But this chapter will also examine how LEED-NC might be reconfigured to reflect principles of sustainable building understood by preservationists to inform new

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[100] Ibid.

construction. For certain, there is much to be gained in promoting the preservation of the existing building stock for environmental, economic, and culture considerations. Yet preservationists may contribute just as much in helping LEED-NC better integrate principles of quality building that must be incorporated in new design in order for these projects to be truly sustainable.

Chapter 6
Beyond LEED-NC 2.2:
Recommendations for Change

While analysis of scorecard data and case studies suggests that there are many areas in which historic buildings and LEED-NC are compatible, there are a number of areas in which historic buildings do not perform as well as non-historic buildings. However, lower point accumulations for historic buildings in certain subcategories do not necessarily indicate that it would be impossible for a typical historic project to earn these credits. As demonstrated in the LEED-NC case studies in Chapter 5, project designers and owners often do not attempt to secure points for a variety of reasons, including cost, climate, and scheduling. Nonetheless, there are clear instances in which LEED-NC disfavors historic buildings. The first section of this chapter is dedicated to these specific areas of concern, and offers suggestions for remedies where appropriate.

Lower point accumulations for historic buildings in some categories also reveal certain fundamental shortcomings in the LEED-NC criteria. The second section of this chapter addresses these more deep-seated flaws. If these shortcomings were to be addressed, historic buildings might be able to accumulate points more easily. But just as importantly, reforming LEED-NC will also produce meaningful changes in the way new construction is evaluated.

I. Shortchanging Historic Buildings: Trouble Spots in LEED-NC

There are a number of “trouble spots” for historic buildings in LEED-NC. These are areas in which historic projects noticeably perform below their non-historic project counterparts, or areas in which stronger performance for historic projects relative to non-historic projects is expected based on what is known about sustainable qualities inherent to most of these buildings. Areas of concern are highlighted below, and where appropriate, a recommendation for change is offered.

Sustainable Sites

SS-5.1-5.2 (Site Development)

Site development points are awarded for restoring a minimum of 50% of the site area with native or adapted vegetation (SS-1). Overall point attainment in this subcategory is relatively low, with only 30% of non-historic projects earning this credit. A nominal 6% of historic projects earn this point, suggesting that it is extremely difficult for historic buildings to obtain this credit.

As an urban project, the Cobb Building in Seattle could not obtain this credit, even with fairly substantial native vegetation on the building's roof top. The Lincoln Cottage Visitors Education Center (VEC), which is located on a more suburban site, opted to not replace vegetation with LEED compliant greenery in order to maintain a historic aesthetic. When historic sites have little vegetation available at grade and do not incorporate green roofs, or in instances where it is undesirable to replace vegetation for reasons of historic sensitivity, this point is not available to historic projects.

The standard for SS-5.2 is also limiting for historic buildings. The objective of this credit is to provide a high ratio of open space to development by exceeding local open space requirements. While 60% of non-historic projects earn this credit, only 34% of historic projects achieve the same point, indicating that historic projects are at disadvantage. As the footprint for an existing building is already determined, and sites may not meet – much less exceed – current zoning requirements for open space, the point is difficult to earn unless the building footprint happens to exceed zoning requirements by the required percentage.

Alternately, providing green roof vegetation and pedestrian-oriented hardscapes in an urban area can be used to obtain the credit. In many instances this too will be out of reach for historic buildings that have limited hardscape available to pedestrians, do not have a roof suitable for greening given limitations of its configuration, or have historically sensitive roofs that are not appropriate to alter with vegetation.

<u>SS-6.1-6.2 (Stormwater Management)</u>

Stormwater credits prove elusive for many historic projects as well. The Cobb case study is illustrative. While efforts were made to reduce the stormwater runoff quantity and improve the quality of runoff through stormwater management, this proved impossible because the site was built out and constrained by existing building design. Architects were limited in their ability to address these concerns.

<u>SS-7.1 (Non-Roof Heat Island Effect)</u>

While 63% of non-historic projects earn a credit for reduction of non-roof related heat island effect, only 43% of historic projects earn this same point. This credit is awarded by placing a minimum of 50% of parking spaces under cover, or by shading, using paving materials with a Solar Reflective Index of 29, or by using an open grid pavement system for 50% of the site. Low credit attainment in this category suggests that historic projects are constrained in their urban environments, and cannot easily implement one of the recommended strategies. This credit also raises fundamental questions about the appropriateness of stripping out existing materials that may still have a long service life remaining.[101] This concern is examined further in Section II of this chapter.

The LEED-NC guidelines note that sustainable design objectives are intended to "encourag[e] development and preservation or restoration practices that limit the environmental impact of buildings on local ecosystems."[102] Because historic buildings are already in place, and rehabilitation does not typically result in disruption of any previously undeveloped land, historic buildings should score well under this category. While scores for historic buildings are not significantly lower than those of non-historic buildings, it remains disappointing that they do not perform better in this category given their many sustainable attributes.

Encouraging environmentally sensitive stormwater management is important for environmental sustainability, as is a reduction in non-roof related heat island effects, (though this raises the question of whether existing materials

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[101] "Service Life" is the concept that each component of a building has a definable period of time within which it performs without major interventions for repair or maintenance. For more information, see http://www.canadianarchitect.com/asf/enclosure_durability/, for general information on enclosure durability.

[102] U.S. Green Building Council, New Construction Reference Guide Version 2.2, 2nd ed. (Washington, D.C: U.S. Green Building Council, 2006). 19.

with long remaining service lives should be preserved, even if they do not reduce the island effects. This is address further in the next section.) No changes to these points are recommended. Nonetheless, historic buildings are often at a disadvantage in these subcategories, since they are by definition constrained by their existing site and design. These are areas in which a LEED-NC "best practices" guide for historic buildings could be particularly useful.

Of all the Sustainable Sites credits, SS-5.2 is of particular concern. As noted above, site development credits are often not available to existing buildings because these structures have not been designed in a way that conforms with USGBC requirements. Additionally, while promoting the preservation of open space is a worthy goal, it is far from clear that this is an appropriate and reasonable objective for building sites in highly urbanized areas.

Acknowledging that it may not be possible for historic buildings to earn all possible points under the Sustainable Sites program, an attempt should be made to "level the playing field" for existing buildings, including those that are older than 50 years. The following recommendations are offered:

Sustainable Sites Recommended Changes

1. The intent of SS-5.2 is to "provide a high ratio of open space to development to promote biodiversity." While perhaps a good goal in concept, this seems to have the effect of promoting low density development of a site and encouraging sprawl. Since only 18% of LEED-NC new construction projects claim credit for SS-2, which requires high density development, but 60% claim credit for a high

proportion of open space to building footprint (SS-5.2), it appears that many new LEED-NC certified projects are built on low density sites, perhaps in suburban or exurban locations.

Point SS-5.2 should be reconfigured to help promote more dense development of sites. New construction projects could claim credit SS-5.2 for promoting development of a site that maximizes its use, rather than maximizes open space. This has the effect of reducing greenfield development, which helps protect green space and biodiversity in a far more powerful way. [103]

Projects that make use of existing buildings can be judged by this same standard. Given the urban locations of many historic buildings, it is expected that historic projects will have an easier time meeting this new standard than earning the credit as it is currently configured. Nonetheless, this credit will remain unattainable for some historic projects.

2. A point should be offered for projects that rehabilitate buildings on National State, and/or Local Historic Registers. The pilot LEED-New Development (LEED-ND) criteria include this standard in its "Green Construction and Technology" category to "encourage use of historic buildings in manner that preserves their historic materials and characters."[104] This point would recognize the contribution of historic buildings to promoting sustainable sites, such as the cultural and economic advantages to preservation (as opposed to material and resource value, which is covered by points MR1.1-1.3).

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[103] SmartCode 6.5 is a form-based planning ordinance developed by advocates of New Urbanism, and may be useful in helping determine appropriate densities for sites depending on whether they are located in more urbanized or rural areas.

[104] U.S. Green Building Council, LEED-ND Guidelines, 107.

Water Efficiency

While historic projects earn Water Efficiency credits about 10% less often than non-historic projects, no alterations to these credits are suggested. As replacement of plumbing and irrigation systems is not unusual in rehabilitation projects, historic projects do not appear to be particularly disadvantaged in this category.

Water Efficiency Recommended Changes

None

Energy & Atmosphere

EA-3 – EA-5 (Enhanced Commissioning, Enhanced Refrigerant Management and Measurement and Verification)

Performance of historic rehabilitation projects under the Energy & Atmosphere category is more puzzling. While performance in EA-1, Optimizing Energy Performance, exceeds new construction or non-historic rehabilitations, historic buildings earn points in the Enhanced Commissioning, Enhanced Refrigerant Management and Measurement and Verification Subcategories (EA-3 , EA-4 and EA-5) with less frequency than non-historic buildings. It is not readily apparent why this would be the case. In most instances, HVAC systems are upgraded as part of the rehabilitation process. Commissioning these systems, providing for Enhanced Refrigerant Management, and Measurement and Verification does not seem to pose unique challenges to historic buildings.

Energy and Atmosphere Recommended Changes

> While no change to these points is recommended, see Section II of this chapter for a more thorough discussion about incorporating additional energy measures into LEED-NC.

Materials & Resources

MR1.1-MR.1-3 (Building Reuse)

While the three Building Reuse points offered under the Materials & Resources category acknowledge the contribution of historic buildings (or any other existing building) to conserving materials and reducing waste, there is wide concern among preservationists that the three points offered do not sufficiently recognize the embodied energy contained in existing buildings. These concerns are exacerbated by the overly stringent requirements for obtaining these credits. Research of scorecard data finds that only 17 of 32 historic LEED certified projects have earned MR 1.2, which requires the re-use of 95% of the building's existing walls, floor and roof. Only four projects have earned credit for preservation of 50% or more of existing interiors.

MR 3-1 (Materials Re-Use)

Historic buildings outperform non-historic buildings in this subcategory, which rewards reuse of building materials that constitute 5% or 10% of the total value of materials used in the project. However, there is an overall low level of credit attainment in this category, with 12.5% of historic projects earning a point for 5% materials reuse, and 6% earning an additional point for a total of 10% reuse of materials. Because this credit is based on the costs of materials, reuse of existing materials in the building, such as doors, windows, lighting fixtures, and moldings, are not recognized as materials reuse.

<u>MR 4-1 (Recycled content)</u>

Scorecard analysis reveals an interesting trend. Approximately 84% of historic building rehabilitations incorporate at least 5% recycled content into the project, while 86% of non-historic projects earn this same point. Yet only 37% of historic projects claim credit for 10% recycled content, as compared to 70% of non-historic projects. This suggests that it may be difficult to for historic projects to reach this 10% threshold given the nature of materials needed to complete rehabilitation projects.

Materials and Resources Recommended Changes

1. MR1.2 rewards projects that reuse 95% or more of a building's existing walls, roof and floors. Since adapting a building to a new use very often entails moderate changes to the building walls, floor and roof, this credit is difficult for many projects to obtain. Given the importance of recognizing the significant embodied energy in existing buildings – even when some alterations are made to the structure of the building – it is recommended that MR 1.2 be awarded to projects that use 85% or more of the existing floors, ceilings and walls. This would continue to encourage maintenance a significant amount of the original material, while allowing more leeway for necessary alterations.

Materials & Resources Recommended Changes - Continued

2. MR-1.3 offers credits for projects that make use of at least 50% of existing interiors. As of August 2006, only 4 historic projects claimed this credit. LEED-NC should continue to promote a high degree of interior fabric re-use because of the embodied energy contained in these materials, the waste generated by demolition, and the possible cultural significance of original interiors However, the USGBC should also recognize that reaching this 50% threshold is extraordinarily difficult because of the need to respond to new uses.

3. Two points should be available under the interior reuse category; one point could be offered for re-use of 25% of materials, while a second point could be offered for re-using 50% of materials. This would continue to encourage project designers to make use of existing interior materials, but would better recognize the difficulty of doing so.

4. As noted above, re-use of materials in existing buildings, such as doors, windows, fixtures, etc., is not recognized under the MR 3.1 Materials Re-Use category. The criteria for this credit should be modified to allow such materials to contribute to the goal of achieving 5-10% materials re-use based on the total value of materials. Replacement costs could be used to calculate value.

Indoor Air Quality

EQ-1 (Outdoor Air Delivery Monitoring)

Approximately 15% fewer historic buildings earn credit for Outdoor Air Delivery monitoring than non-historic projects (46% vs. 61%). This difference is difficult to explain, as the requirements provide recommendations for monitoring of mechanically or naturally ventilated spaces. These requirements do not appear to impose more of a burden on historic buildings than non-historic buildings.

EQ-3 (Indoor Air Quality Management Plans)

Two points are offered for Construction Indoor Air Quality Management Plans – one for the construction phase, and one for building flush-out prior to occupancy. As with EQ-1, 15% fewer historic projects earn this credit than non-historic projects (46% vs 61%). There are not any obvious reasons why historic projects would be more burdened by this requirement than non-historic projects.

EQ-5 (Chemical & Pollutant Source Control)

This credit is awarded for Indoor Chemical & Pollutant Source Control. Seventy percent of non-historic projects earn this point, while only 50% of historic projects claim the credit. As was noted in the Lincoln Cottage Case Study, this is an area in which the desire to preserve historic fabric may conflict with the installation of walk-off mats, the ventilation of janitors' closets, and the like.

EQ-6.1-6.2 (Lighting and Thermal Control)

Approximately 10% fewer historic projects than non-historic projects earn credit for a high degree of lighting controllability. This difference may be attributed to existing wiring in buildings, which may not be easily modified to provide task lighting. However, the relatively high level of attainment for this credit (67%) suggests that this is not often the case.

There is a larger discrepancy between the performance of historic and non-historic buildings in the controllability of thermal comfort. Approximately 20% fewer historic projects earn this credit than non-historic projects (28% vs. 49%.) It may be difficult to configure existing space and systems to meet the stringent ASHRAE requirement for ventilation. This topic requires more research before an appropriate recommendation can be offered.

Indoor Environmental Quality Recommended Changes

None

Innovation Points

Non-historic projects earn an average of four out of five Innovation points, while historic projects earn an average of three out of five credits. Innovation points should represent “low-hanging fruit” that historic projects can easily achieve, especially in light of the difficultly of obtaining other available points.

Innovation Points Recommended Changes

> Develop a "best practices guide" with information about how past historic projects have successfully obtained Innovation points.

In discussing the challenges historic buildings confront under LEED-NC, it must be acknowledged that there are three points under LEED-NC for building reuse that are unavailable to new construction projects (MR-1.1-1.3). It is neither equitable nor necessary to insist that all LEED-NC credits must be preservation friendly. Nonetheless, historic building face far more challenges under LEED-NC than new construction, and there is room for improvement of the standards.

The aforementioned suggestions provide relatively simple solutions that address some but not all of the difficulties that face historic projects undergoing LEED-NC certification. These recommendations would likely reconcile some of the point difference seen between historic and non-historic buildings, and would help to "even the playing field" for existing buildings under LEED-NC. However, these suggestions do not address the more fundamental problems with LEED-NC discussed in the following section.

II. Fundamental Flaws

This analysis of LEED-NC identifies two interrelated flaws of the program. First, and perhaps most significantly, LEED-NC does not assign points in a way that represents the value associated with a particular credit – a criticism raised by many. Secondly, LEED-NC does not adequately account for energy used in construction and demolition, as well as issues such as durability of materials and building assemblies, and the adaptability of buildings.

Recalibrating LEED-NC Credits

LEED-NC's "one point per subcategory approach" fails on at least two counts. First, it does not sufficiently recognize the mathematically measurable energy savings that can be realized by certain actions. Second, it does not measure the intangible benefits associated with these actions, such as those related to social, cultural and economic benefits. In order to better promote sustainable development, LEED-NC credits must be recalibrated to reflect their environmental, economic, social, and cultural contributions to promoting sustainability. The weight assigned to these credits must be based on this comprehensive understanding of a particular action, rather than simply its ecological effect.

For example, providing a bike rack and changing facility are not equivalent to re-using 75% of an existing structure. Yet under LEED-NC these actions are viewed as promoting essentially the same level of social good. Consider again the example of Seattle's Grand Central Arcade in Pioneer Square. It was determined that saving this structure from demolition and rebuilding would result in energy savings of 730,000 gallons of gasoline, or enough to power 250 automobiles for an average of five years.[105] However worthy the goal of facilitating bicycling as a means of transportation, it cannot be reasonably argued that it provides a benefit equivalent to building reuse. To take this example to its logical extreme, ten employees in a LEED-NC certified building would need to bike to work 30 miles roundtrip, five days a week, for well over 200 years to reach energy savings that approach maintaining 75% of an existing building.[106]

There are significant social, cultural and economic benefits to building preservation and bike rack installation that must be considered as well. The strengths of historic buildings in promoting local economic development, social stability, and cultural preservation were examined in Chapter 5 and will not be discussed further here. However, when considering the benefits of building re-use, these must be part of the calculation. Similarly, promoting biking encourages exercise and good health (social sustainability), as well as helping create a demand for infrastructure that supports alternative means of transportation, such as bike paths and bike lanes (social sustainability, economic sustainability.)

It is understandable that the LEED-NC standards were developed to provide one credit for each subcategory (with the exception of EA-1 – Optimizing Energy Performance). Determining the relative importance of one action compared to another is no simple endeavor, and cannot easily be reduced to

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[105] Calvin W. Carter, "Assessing Energy Conservation Benefits: A Study" in New Energy from Old Buildings, ed. National Trust for Historic Preservation (Washington, D.C.: Preservation Press, 1981).103-104.

[106] Assumes one gallon of gas is used for each 30 miles traveled in a car.

numbers. Recalibrating LEED-NC to better reflect public good becomes all the more complicated when actions are evaluated more holistically on the basis of their contribution to environmental, social, cultural and economic sustainability. These concepts are not easily defined, much less measured, and these facets of sustainability overlap with each other considerably. Yet if LEED-NC is to better reflect the multifaceted principles of sustainability, then some effort must be made to establish the meaning of environmental, economic, social and cultural sustainability, and assign credit values based on how well a subcategory contributes to these goals.

Improving Energy Accounting in LEED-NC

The second concern is based on LEED-NC's shortcomings in evaluating energy efficiency through life cycle analysis, and considerations about durability and adaptability. These failings fundamentally affect points awarded under the Energy & Atmosphere and Materials & Resources categories. Under the current systems, projects that make use of long-lasting materials are insufficiently recognized. Conversely, projects that offer little in the way of durable construction may be overly-rewarded for their use of unproven materials.

Incorporating Life Cycle Assessment

A common criticism of LEED-NC is its failure to take into account Life Cycle Assessment in evaluating the use of materials. Life Cycle Assessment (LCA) can be defined as follows:

> Life Cycle Assessment is a process to evaluate the environmental burdens associated with a product, process, or activity by identifying and quantifying energy and materials used and wastes released to the environment; to assess the impact of those energy and materials used and releases to the environment; and to identify and evaluate opportunities to affect environmental improvements. The assessment includes the entire life cycle of the product, process or activity, encompassing, extracting and processing raw materials; manufacturing, transportation and distribution; use, re-use, maintenance; recycling, and final disposal.[107]

LCA is considered to be the most comprehensive approach to understanding the full effects of a building during its entire life, including such factors as material usage, embodied energy, carbon dioxide emissions, air pollution, solid waste generation, and water pollution.

Yet despite the comprehensiveness of LCA analysis, Canadian Architect notes that this process is used relatively rarely. They note instead that "the trend in measures of sustainability is away from the numerical components of life cycle assessments, towards labeling programs for buildings which parallel eco-labeling for product." This is true of LEED-NC, which does not directly incorporate LCA considerations into its standards for green building.

Architects Walter Sedovic and Jill Gotthelf highlight their LCA related concerns regarding the use of replacement windows in historic building rehabilitations. [108] The replacement of windows is often undertaken as an energy saving device, since a belief persists that new windows with high U

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[107] Canadian Architect, "Measures of Sustainability," http://www.canadianarchitect.com/asf/perspectives_sustainibility/measures_of_sustainablity/measures_of_sustainablity_lca.htm (accessed April 21, 2007).

[108] Walter Sedovic and Jill H. Gotthelf, "What Replacement Windows can't Replace: The Real Cost of Removing Historic Windows," APT Bulletin 36, no. 4 (2005): 25-38.

values are fundamentally more energy efficient than older windows.[109] Sedovic and Gotthelf question the validity of such claims, arguing that this represents a very limited approach to understanding the total energy cost of a particular element of a building.

While Sedovic and Gotthelf do not speak to the issue of LCA specifically, they point out that promoting replacement windows over retention of existing fabric ignores the following important energy-related factors:

- Maintaining an existing window preserves the embodied energy in the building element. It further eliminates the need to expend energy on replacement windows, which are typically made of aluminum and vinyl – two materials that have some of the highest embodied energy values of any building material.
- Preserving windows reduces landfill waste.
- Manufacturing new windows that are made of vinyl or aluminum is energy intensive, and toxic for the environment.
- Replacement windows are not easily maintained or conserved. Manufacturing processes for these products makes them difficult to repair, and often necessitate their complete replacement.
- Vinyl, fiberglass, sealants, desiccants, and coating systems all degrade , and are not easily recycled or repaired.
- Manufacture's warranties for replacement windows are typically two to ten years, and have far shorter expected service lives than historic windows.[110]

Evaluating whether windows or other materials ought to be replaced in the name of "energy efficiency", then, is no simple problem. LEED-NC must consider the wider environmental implications of replacement materials rather than use simple measures of building operation energy efficiency. This

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[109] "U value" is defined the measure of the heat transmission through a building component. Lower U values indicate a higher degree of energy efficiency.
[110] Sedovic and Gotthelf, "What Replacement Windows Can't Replace," 27.

comprehensive understanding of energy usage throughout the life of buildings must be reflected in Energy & Atmosphere and Materials & Resources credits.

Promoting Durability

Of all of the qualities of historic buildings, perhaps one of the most celebrated is durability. *Canadian Architect* offers the following explanation for durability:

> From a sustainability perspective, a material, component or system may be considered durable when its useful service life (performance) is fairly comparable to the time required for related impacts on the environment to be absorbed by the ecosystem.[111]

An example is cited in which a wooden shed constructed 100 years ago is still functional today, and the wood used to build the structure has now been replaced by fully mature trees which replace the trees used to construct it. Yet the concept of durability is not limited to traditional building materials. "Given sufficient service life, even materials like aluminum, which is high in embodied energy and environmental impacts, can have their eco-sins absolved."[112]

LEED-NC does not consider the issue of durability, though the USGBC is not alone in failing to integrate this important component of sustainability into its guidelines. As *Canadian Architect* notes, "the durability of buildings lies at the core of sustainable architecture, yet it remains to be fully assessed as a measure of sustainability." The United Nations Environment Programme's recent report *Buildings and Climate Change: Status, Challenges and*

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[111] Canadian Architect, "Measures of Sustainability."
[112] Ibid.

Opportunities echoes the importance of durability in promoting sustainable development. It maintains that the "most important factor in reducing the impact of embodied energy is to design long life, durable and adaptable buildings."[113]

Yet the integration of durability into life cycle analysis and other measures of sustainability complicate an already complex analysis. For example, the sustainability of high embodied energy building components with relatively long service lives may be better than lower embodied energy alternatives with shorter service lives, especially if the former provide superior operating energy performance. Embodied energy and operating energy performance being equal, the relationship between durability and sustainability is linear - the more durable, the more sustainable.[114]

It is not enough, then, to merely select materials with the lowest embodied energy values – such as those of many recycled materials. Embodied energy must be considered in conjunction with the life expectancy of a particular building. In some instances, the use of materials with higher embodied energy levels is clearly justified as it promotes more long-lasting structures that will allow them to fully amortize their environmental costs.

Championing Adaptability

Yet another important quality of historic buildings is their adaptability – or the ease with which they absorb new uses over time. This flexibility has helped

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113 United Nations Environment Programme, Buildings and Climate Change: Status, Challenges and Opportunities, United Nations Environment Programme,2007).
114 Canadian Architect, "Measures of Sustainability."

spur the adaptive re-use of many historic buildings in recent years. Buildings can be built to be durable, with low-embodied energy values, but if these structures are not adaptable, re-use likely will be difficult in the long term, and may tempt owners to revert to demolition. Promoting sustainability means promoting adaptability.

In *How Buildings Learn*, author Stewart Brand examines adaptive architecture, and offers recommendations for creating buildings that mold to users' needs over time. Brand advocates a conservative approach to building design and construction, noting that this cautiousness "protects the option of varying paths of development for the building."[115] He champions "traditional materials, which age well and take advantage of deep experience in the building trades (and avoid the chanciness of trendy new materials.)" Brand cautions against "the aesthetics of the moment."

> If you design a building that you think tourists would admire and envy in ten years, and that preservationists will fight to save in fifty years, you'll probably get the proper mix of bemused conservatism and mythic depth. Freed of fashion, a building can become honestly interesting in its own terms.[116]

LEED-NC has never been, and should never be, a vehicle for evaluating the aesthetics of green design. It is up to architects and owners to incorporate the tenets of quality design that make for "lovable" (to borrow Brand's term) and adaptable architecture. But the USGBC would do well to encourage its users to think critically about adaptability, and provide the tools to do so.

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[115] Stewart Brand, How Buildings Learn: What Happens After They're Built (New York, NY: Viking, 1994).192.
[116] Ibid.,190.

Historic buildings have much to teach on this subject, and the USGBC might offer guidelines for designing adaptable architecture that would be informed by buildings that have "learned well" over time. While these guidelines would remain distinct from the LEED rating criteria, they would provide a powerful tool for promoting sustainable buildings.

Conclusion

Though overall performance of historic buildings under LEED-NC is somewhat stronger than expected, modest changes to LEED-NC can be made to further improve the performance of this class of buildings. In other instances, guidelines may be helpful in helping historic projects achieve points, such as for stormwater management.

These proposed changes will not address the fundamental problems with LEED-NC, however, including the "one point per subcategory" approach which does not adequately consider the degree to which an action supports the goals of environmental, economic, social, and cultural sustainability. Further reform to the LEED-NC criteria is also required to improve the accounting of energy use. LEED-NC effectively promotes reductions in use of energy during the operational phase of a building's life, but does not sufficiently consider the environmental impacts of materials used to construct the building – both in terms of their initial environmental cost, and their demolition costs. Issues of durability and adaptability are central to this calculation.

Integrating these factors into a sustainability rating criteria such as LEED-NC is undoubtedly difficult, and may not be possible at this juncture. There are significant research gaps in areas such as the embodied energy of materials. Michael Jackson, Chief Architect of the Illinois Historic Preservation Agency, noted that the most thorough accounting of embodied energy values is now 30 years old and must be updated to include new construction methods and new materials.[117]

More research is also required on the durability of materials and assemblies. This issue is especially tricky, since there are a plethora of new green building products and design innovations, many of which are untested. In the absence of meaningful data on Life Cycle Analysis and durability, caution should be urged in the use of such unproven materials. This is unlikely to be a popular recommendation for green building advocates and manufactures, who display great faith and enthusiasm in new building products. Yet for green building to be truly green, more must be known about these materials.

Green building and sustainable development (at least in the modern industrialized world) are in their infancy. While LEED-NC must be as friendly as possible to the end-user, the USGBC's challenge is to incorporate a far greater degree of sophistication in its evaluation of Energy & Atmosphere and Materials & Resources issues, and in the way it allocates credits. Only then will the rating system accurately reflect the green qualities of new and existing buildings.

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[117] Mike Jackson, "Embodied Energy and Historic Preservation: A Needed Reassessment," APT Bulletin 36, no. 4 (2005), 47.

Conclusion:
Preservationists' Role in Shaping LEED-NC

As emphasized throughout this thesis, there is a tendency to confuse *green building* with *sustainability*. The two are related goals, but undertaken at different scales. Green building is narrow in focus, and promotes the design, construction and operation of environmentally friendly buildings. While green building is an important component of sustainability, sustainability encompasses much more, including social, cultural, and economic objectives.

With the pilot version of LEED-Neighborhood Development, the USGBC has moved away from its purely green building roots, and has more fully embraced the concept of sustainability, offering points not only for ecologically sound building practices, but also for facilitating social, economic, and cultural sustainability. Points are offered for providing affordable housing, mixed-uses, access to park and recreational facilities, universal accessibility, and community outreach and involvement – to name only some of the many credits available under the LEED-ND program. This could potentially mark a turning point for all LEED programs, which may evolve more toward a holistic approach to the built environment.

As the LEED-NC standards evolve – and they are sure to – historic preservationists have a great deal to contribute to the conversation about sustainability. In their role as stewards for the built environment, preservationists are particularly adept at thinking long term about the way buildings deteriorate over time, are maintained and restored, and adapt to new uses. Preservationists, after all, are in the business of making sure buildings endure for the next generation to use, enjoy and benefit from – and planning for the n*ext generation* is the very essence of sustainability.

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Appendix 1
LEED-NC Certified Historic Projects

LEED CERTIFIED HISTORIC PROJECTS	CITY
Renovation of the Motherhouse	Monroe, MI
Howard M. Metzenbaum US Courthouse	Cleveland, OH
Ecotrust Natural Capital Center	Portland, OR
The Stewart's Building	Baltimore, MD
Center for Neighborhood Technology Renovation	Chicago, IL
Cambridge City Hall Annex	Cambridge, MA
Lincoln Hall Renovation	Brea, KY
Balfour-Guthrie Building	Portland, OR
S. T. Dana Building Renovation	Ann Arbor, MI
Bazzani Associates Headquarters	Grand Rapids, MI
Candler Library Renovation	Atlanta, GA
Conservation Law Foundation Building Extension	Boston, MA
Central Administration Building	Middletown
Office for Hastings Architecture Associates, LLC	Nashville, TN
Children’s Museum of Pittsburgh Expansion Project	Pittsburgh, PA
UW Tacoma - Phase 2B, Cherry Parks	Tacoma, WA
Milton Academy Wiggelsworth Hall	Milton, MA
Ampere Annex	Vancouver, Canada
Scowcroft Building	Ogden, UT
Eastern Village Co-Housing	Silver Spring, MD
Art Center South Campus	Pasadena, CA
Whitaker Street Building	Savannah, GA

Appendix 1 – Continued

LEED CERTIFIED HISTORIC PROJECTS	CITY
Provincetown Art Association and Museum	Provincetown, RI
Skenandoa House	Clinton, NY
Blue Cross Blue Shield of Michigan/Steketee's Building	Grand Rapids, MI
Big-D Corporate Office Headquarters	Salt Lake City, UT
Radcliffe Institute for Advances Study: Schlesinger Library	Cambridge, MA
Kilgo Dormitory Renovation III	Durham, NC
The Water Street Market	Corvallis, OR
Theatrical Outfit Balzer Theater at Herrens	Atlanta, GA
Rosemann Tenant Finish	Kansas City, MO

Appendix 2: Cobb LEED-NC Scorecard

CobbLEEDscorecard-1 | **LEED^{TM} Scorecard of 4/26/2007**

Y	?	N			Possible Points
34	1	34	**Total Project Score**		69

Certified 26 to 32 points **Silver** 33 to 38 points **Gold** 39 to 51 points **Platinum** 52 or more points

Y	?	N		Sustainable Sites	Possible Points 14
9		5			
Y			Prereq 1	**Erosion & Sedimentation Control**	
1			Credit 1	**Site Selection**	1
1			Credit 2	**Urban Redevelopment**	1
1			Credit 3	**Brownfield Redevelopment**	1
1			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
1			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
1			Credit 4.3	**Alternative Transportation**, Alternative Fuel Refueling Stations	1
1			Credit 4.4	**Alternative Transportation**, Parking Capacity	1
		1	Credit 5.1	**Reduced Site Disturbance**, Protect or Restore Open Space	1
1			Credit 5.2	**Reduced Site Disturbance**, Development Footprint	1
		1	Credit 6.1	**Stormwater Management**, Rate and Quantity	1
		1	Credit 6.2	**Stormwater Management**, Treatment	1
1			Credit 7.1	**Landscape & Exterior Design to Reduce Heat Islands**, Non-Roof	1
		1	Credit 7.2	**Landscape & Exterior Design to Reduce Heat Islands**, Roof	1
		1	Credit 8	**Light Pollution Reduction**	1

Y	?	N		Water Efficiency	Possible Points 5
3		2			
1			Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
		1	Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
		1	Credit 2	**Innovative Wastewater Technologies**	1
1			Credit 3.1	**Water Use Reduction**, 20% Reduction	1
1			Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Y	?	N		Energy & Atmosphere	Possible Points 17
2	1	14			
Y			Prereq 1	**Fundamental Building Systems Commissioning**	
Y			Prereq 2	**Minimum Energy Performance**	
Y			Prereq 3	**CFC Reduction in HVAC&R Equipment**	
		2	Credit 1.1	**Optimize Energy Performance**, 20% New / 10% Existing	2
		2	Credit 1.2	**Optimize Energy Performance**, 30% New / 20% Existing	2
		2	Credit 1.3	**Optimize Energy Performance**, 40% New / 30% Existing	2
		2	Credit 1.4	**Optimize Energy Performance**, 50% New / 40% Existing	2
		2	Credit 1.5	**Optimize Energy Performance**, 60% New / 50% Existing	2
		1	Credit 2.1	**Renewable Energy**, 5%	1
		1	Credit 2.2	**Renewable Energy**, 10%	1
		1	Credit 2.3	**Renewable Energy**, 20%	1
1			Credit 3	**Additional Commissioning**	1
1			Credit 4	**Ozone Depletion**	1
		1	Credit 5	**Measurement & Verification**	1
	1		Credit 6	**Green Power**	1

Y	?	N		Materials & Resources	Possible Points 13
6		7			
Y			Prereq 1	**Storage & Collection of Recyclables**	
1			Credit 1.1	**Building Reuse**, Maintain 75% of Existing Shell	1
		1	Credit 1.2	**Building Reuse**, Maintain 100% of Existing Shell	1
		1	Credit 1.3	**Building Reuse**, Maintain 100% Shell & 50% Non-Shell	1
1			Credit 2.1	**Construction Waste Management**, Divert 50%	1
1			Credit 2.2	**Construction Waste Management**, Divert 75%	1
		1	Credit 3.1	**Resource Reuse**, Specify 5%	1
		1	Credit 3.2	**Resource Reuse**, Specify 10%	1
1			Credit 4.1	**Recycled Content**, Specify 5% Post Cons. Or 10% pc, pi	1
		1	Credit 4.2	**Recycled Content**, Specify 10% pc, or 20% pc/pi	1
1			Credit 5.1	**Local/Regional Materials**, 20% Manufactured Locally	1
1			Credit 5.2	**Local/Regional Materials**, of 20% Above, 50% Harvested Locally	1
		1	Credit 6	**Rapidly Renewable Materials**	1
		1	Credit 7	**Certified Wood**	1

Y	?	N		Indoor Environmental Quality	Possible Points 15
9		6			
Y			Prereq 1	**Minimum IAQ Performance**	
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	
		1	Credit 1	**Carbon Dioxide** (CO_2) **Monitoring**	1
		1	Credit 2	**Increase Ventilation Effectiveness**	1
1			Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
1			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
1			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
1			Credit 4.2	**Low-Emitting Materials**, Paints	1
1			Credit 4.3	**Low-Emitting Materials**, Carpet	1
		1	Credit 4.4	**Low-Emitting Materials**, Composite Wood	1
1			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
1			Credit 6.1	**Controllability of Systems**, Perimeter	1
		1	Credit 6.2	**Controllability of Systems**, Non-Perimeter	1
		1	Credit 7.1	**Thermal Comfort**, Comply with ASHRAE 55-1992	1
		1	Credit 7.2	**Thermal Comfort**, Permanent Monitoring System	1
1			Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
1			Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

Y	?	N		Innovation & Design Process	Possible Points 5
5					
1			Credit 1.1	**Innovation in Design**: Green Building Education	1
1			Credit 1.2	**Innovation in Design**: Green Housekeeping	1
1			Credit 1.3	**Innovation in Design**: Local/regional materials to 40%	1
1			Credit 1.4	**Innovation in Design**: water use reduction 40%	1
1			Credit 2	**LEED™ Accredited Professional**	1

U S Green Building Council **Scorecard** LEED^{TM} Calculator 2.0

Project: Lincoln Cottage - Visitor Education Center

Appendix 2
Vistiors Education Center
LEED-NC Scorecard

Sustainable Sites			Yes	Likely	Possible	No
Prereq 1	**Construction Activity Pollution Prevention**					
Credit 1	**Site Selection**	1				1
Credit 2	**Development Density & Community Connectivity**	1	1			
Credit 3	**Brownfield Redevelopment**	1				1
Credit 4.	**Alternative Transportation**, Public Transportation Access	1	1			
Credit 4.	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1	1			
Credit 4.	**Alternative Transportation,** Low-Emitting & Fuel-Effic. Vehicles	1				1
Credit 4.	**Alternative Transportation**, Parking Capacity	1				1
Credit 5.	**Site Development,** Protect or Restore Habitat	1				1
Credit 5.	**Site Development,** Maximize Open Space	1				1
Credit 6.	**Stormwater Design**, Quantity Control	1	1			
Credit 6.	**Stormwater Design**, Quality Control	1				1
Credit 7.	**Heat Island Effect,** Non-Roof	1				1
Credit 7.	**Heat Island Effect,** Roof	1				1
Credit 8	**Light Pollution Reduction**	1				1
	SS Possible Points	14	4			10

Water Efficiency			Yes	Likely	Possible	No
Credit 1.	**Water Efficient Landscaping**, Reduce by 50%	1	1			
Credit 1.	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1	1			
Credit 2	**Innovative Wastewater Technologies**	1				1
Credit 3.	**Water Use Reduction**, 20% Reduction	1	1			
Credit 3.	**Water Use Reduction**, 30% Reduction	1	1			
	WE Possible Points	5	4			1

Energy & Atmosphere			Yes	Likely	Possible	No
Prereq 1	**Fundamental Commissioning of Building Energy Systems**					
Prereq 2	**Minimum Energy Performance**					
Prereq 3	**Fundamental Refrigerant Management**					
Credit 1.	**Optimize Energy Performance**, 10.50% New / 3.50% Exist.	1	1			
Credit 1.	**Optimize Energy Performance**, 14.00% New / 7.00% Exist.	1	1			
Credit 1.	**Optimize Energy Performance**, 17.50% New / 10.50% Exist.	1	1			
Credit 1.	**Optimize Energy Performance**, 21.00% New / 14.00% Exist.	1	1			
Credit 1.	**Optimize Energy Performance**, 24.50% New / 17.50% Exist.	1	1			
Credit 1.	**Optimize Energy Performance**, 28.00% New / 21.00% Exist.	1	1			
Credit 1.	**Optimize Energy Performance**, 31.50% New / 24.50% Exist.	1	1			
Credit 1.	**Optimize Energy Performance**, 35.00% New / 28.00% Exist.	1	1			
Credit 1.	**Optimize Energy Performance**, 38.50% New / 31.50% Exist.	1	1			
Credit 1.	**Optimize Energy Performance**, 42.00% New / 35.00% Exist.	1				1
Credit 2.	**Onsite Renewable Energy**, 2.5%	1				1
Credit 2.	**Onsite Renewable Energy**, 7.5%	1				1
Credit 2.	**Onsite Renewable Energy**, 12.5%	1				1

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Credit 3	**Enhanced Commissioning**	1	1			
Credit 4	**Enhanced Refrigerant Management**	1	1			
Credit 5	**Measurement & Verification**	1				1
Credit 6	**Green Power**	1				1
	EA Possible Points	17	11			6

Materials & Resources			Yes	Likely	Possible	No
Prereq 1	**Storage & Collection of Recyclables**					
Credit 1.1	**Building Reuse**, Maintain 75% of Existing walls, Floors & Roof	1	1			
Credit 1.2	**Building Reuse**, Maintain 100% of Existing walls, Floors & Roof	1	1			
Credit 1.3	**Building Reuse**, Maintain 50% of Intreior Non-Structural Elements	1	1			
Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	1	1			
Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal	1		1		
Credit 3.1	**Material Reuse**, 5%	1		1		
Credit 3.2	**Material Reuse**, 10%	1				1
Credit 4.1	**Recycled Content**, 10% (post-consumer + 1/2 pre-consumer)	1	1			
Credit 4.2	**Recycled Content**, 20% (post-consumer + 1/2 pre-consumer)	1			1	
Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manufactured Regionally	1			1	
Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manufactured Regionally	1				1
Credit 6	**Rapidly Renewable Materials**	1				1
Credit 7	**Certified Wood**	1	1			
	MR Possible Points	13	6	2	2	3

Indoor Environmental Quality			Yes	Likely	Possible	No
Prereq 1	**Minimum IAQ Performance**					
Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**					
Credit 1	**Outdoor Air Delivery Monitoring**	1				1
Credit 2	**Increased Ventilation**	1	1			
Credit 3.	**Construction IAQ Management Plan**, During Construction	1	1			
Credit 3.	**Construction IAQ Management Plan**, Before Occupancy	1			1	
Credit 4.	**Low-Emitting Materials**, Adhesives & Sealants	1	1			
Credit 4.	**Low-Emitting Materials**, Paints & Coatings	1	1			
Credit 4.	**Low-Emitting Materials**, Carpet Systems	1	1			
Credit 4.	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1	1			
Credit 5	**Indoor Chemical & Pollutant Source Control**	1				1
Credit 6.	**Controllability of Systems**, Lighting	1			1	
Credit 6.	**Controllability of Systems**, Thermal Comfort	1	1			
Credit 7.	**Thermal Comfort**, Design	1				1
Credit 7.	**Thermal Comfort**, Verification	1	1			
Credit 8.	**Daylight & Views**, Daylight 75% of Spaces	1	1			
Credit 8.	**Daylight & Views**, Views for 90% of Spaces	1	1			
	EQ Possible Points	15	10		2	3

Innovation & Design Process			Yes	Likely	Possible	No
Credit 1.	**Innovation in Design**: "LEED Educational Signage/Posters"	1	1			
Credit 1.	**Innovation in Design**: Green Housekeeping	1	1			1
Credit 1.	**Innovation in Design**: Specific Title	1				1
Credit 1.	**Innovation in Design**: Specific Title	1				1
Credit 2	**LEED™ Accredited Professional**	1	1			
	ID Possible Points	5	3			3

		Yes	Likely	Possible	No
Total Possible Points	69	38	2	4	26

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