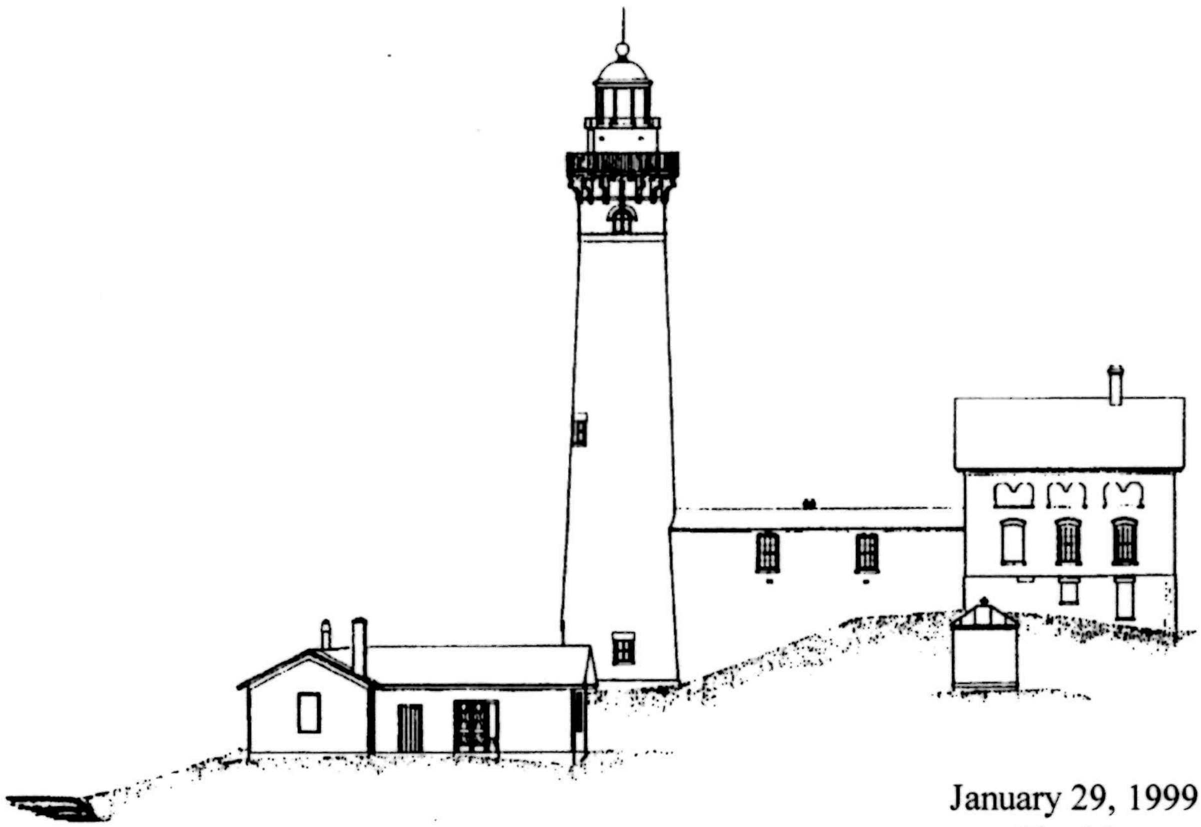
HISTORIC STRUCTURE and CULTURAL LANDSCAPE REPORT

South Manitou Island Light Station
(Historic Structures 51-120 A-I)

Sleeping Bear Dunes National Lakeshore
Empire, Michigan



January 29, 1999
Final Report
Project # 94117.01

QUINN EVANS / ARCHITECTS
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(HS - 51-120A-I)

Prepared by

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Regional Director, Midwest Region

Sleeping Bear Dunes National Lakeshore
Empire, Michigan

National Park Service
United States Department of the Interior

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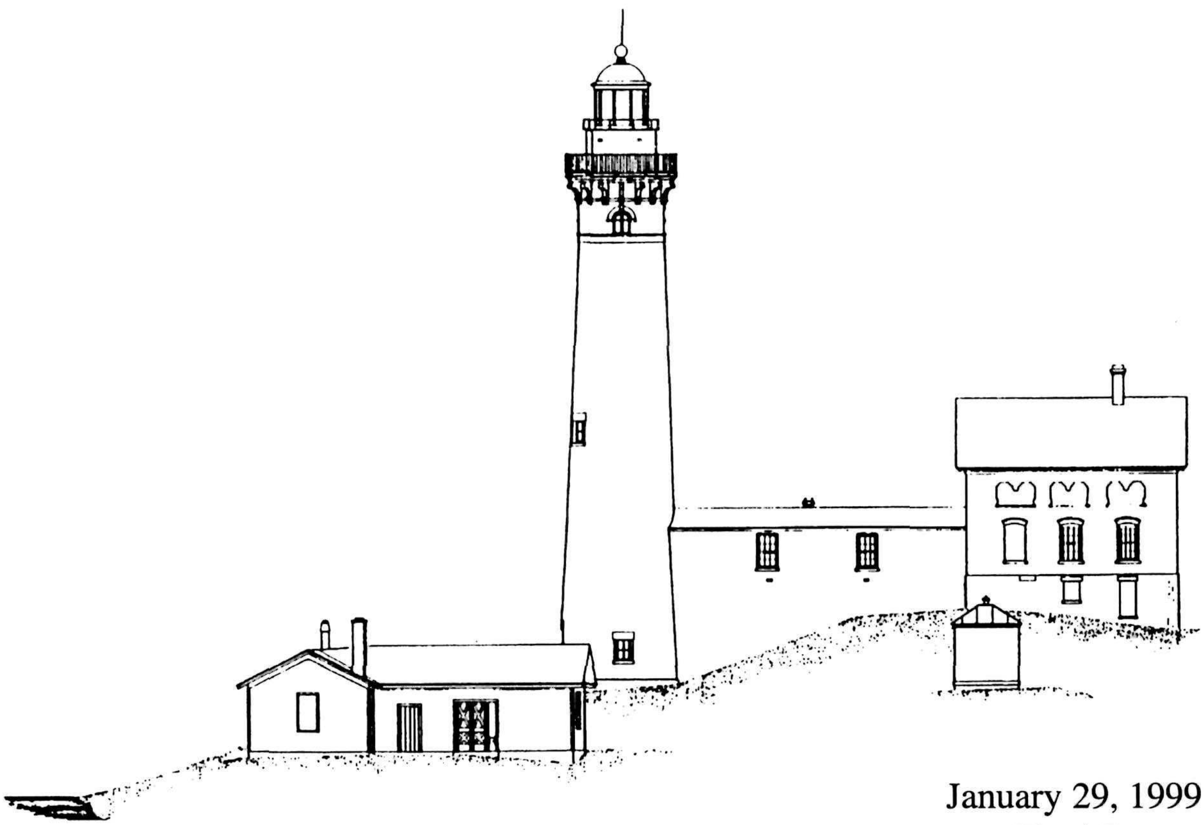

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Statement of Significance

Sleeping Bear Dunes National Lakeshore comprises 71,000 acres along the northeastern shore of Lake Michigan. The park was established to preserve the "outstanding natural features, including forests, beaches, dune formations, and ancient glacial phenomena ... for the benefit, inspiration, education, recreation, and enjoyment of the public."[1] South Manitou Island, which comprises 5,030 acres of Sleeping Bear Dunes National Lakeshore, lies seven miles northwest of Sleeping Bear Point and fifteen miles southwest of Leland, Michigan. The island is approximately three miles long and three miles wide, and has a fairly circular shape with the exception of a crescent-shaped bay that is cut into its eastern shore. It has 12.6 miles of shoreline, and is the southernmost island of the archipelago that occupies the northeastern portion of Lake Michigan.

The South Manitou Island Light Station is the only extant lighthouse in the Sleeping Bear Dunes National Lakeshore and is a significant reminder of a utilitarian yet very important profession which no longer exists in the United States. It is a testament to the historical role of the lighthouse keeper and a distinct way of life.

Because of the island's relatively easy accessibility, as well as the presence of a historically significant light station (and island community), South Manitou Island attracts a large number of visitors. The light station is just one of many cultural resources on the island, yet its prominence and visibility, perhaps more than any other structure on the island, is a tangible reminder of the days of early commercial navigation on Lake Michigan, and the important role that the light played in navigating ships through the Manitou Passage.

The South Manitou Island Lighthouse Complex and Lifesaving Station were placed on the National Register of Historic Places on October 28, 1983.

Project Team Members

Following the objectives of the Lakeshore, the National Park Service, Midwest Regional Office, engaged the professional services of QUINN EVANS / ARCHITECTS, an architectural firm specializing in historic preservation in conjunction with Land and Community Associates, a firm specializing in land and community planning and landscape architecture, to present, analyze, and correlate all research information and documentary materials related to the history and evolution of the South Manitou Island Light Station, both naturally and physically, and to conduct a comprehensive survey of the existing buildings and natural environment. Team members providing support to QUINN EVANS/ARCHITECTS include: Robert Darvas Associates, P.C. for structural engineering; SWS Engineering Inc. for mechanical engineering; Johnson, Johnson & Roy, Inc. for shoreline evaluation; and Seebohm Ltd. for paint analysis. The team has gathered information, in addition to that which had been previously researched and collected, to formulate strategies for repair and to recommend long-range goals for the preservation/rehabilitation of the light station and its surrounding site. The results of this investigative research and documentation are contained in this Historic Structure and Cultural Landscape Report. The report is arranged in the following manner:

Part A: Introduction

Documents the project team members, the scope of the project, and the investigation methodology.

Part B: Historic Documentation Summary

Documents and analyzes historic information as it relates to the chronology of the buildings and site. This section also provides a summarization of and reference to historic documentation previously completed by the National Park Service, as well as original information gathered by QUINN EVANS/ARCHITECTS and Land and Community Associates. In addition, the summary includes a tabulated chain of title for the property to the present, and a detailed architectural and site analysis with historic photographs and maps.

Part C: Archeological Research Summary

Analyzes the archeological investigation of the site as it relates to the Light Station's chronology.

Part D: Cultural Landscape Analysis

Documents and analyzes the chronological development of the site to the present based on physical and documentary evidence. In addition, the analysis includes a base map documenting site conditions at critical periods in the evolution of the site, and provides graphic representation of the relationship between the historic and existing landscape features.

Part E: Historic Architectural Analysis

Presents and analyzes historic building chronology information gleaned from the physical investigation.

Part F: Building Chronology

Presents written and graphic analysis of the buildings' chronology based on known historical, archeological, and physical investigatory information, with an emphasis on: exterior and interior physical elements; interior finishes and hardware; the history of alterations and additions; and an analysis of each building episode.

Part G: Existing Conditions: Landscape

Evaluates and documents the existing conditions of the site, and describes the current condition and use of the natural and man-made elements in the landscape. Also included are observations and analyses of the formal and service areas, public, governmental and private areas of the site, and the utility and circulation systems. In addition, observations and analyses of the site and architectural barriers are documented, as well as the existing condition of vegetation, with those which have a particular historical significance highlighted.

Part H: Existing Conditions: Architectural

Evaluates and documents the existing conditions of the Lighthouse and Fog Signal Building, including their structural and mechanical systems, and interior and exterior materials. This section also includes a brief analysis of the site characteristics specifically related to the buildings' systems, as well as observations of the conditions in the adjoining village that may affect the systems on the site.

Part I: Design Recommendations

Proposes design alternatives and recommendations for the rehabilitation and contemporary use of the buildings, and treatment recommendations for the historic landscape, including plantings, clearings, and other landscape features.

Part J: Research Recommendations

Provides recommendations for further building and site investigations that are outside the scope of this report.

Part K: Preliminary Design

Includes preliminary drawings based upon National Park Service's approved design recommendations, indicating the approved final treatment of the Light Station's structures and surrounding site as selected from the alternatives proposed in Part I in this report.

Part L: Cost Estimates

Provides cost estimates for each major portion of the work to be undertaken as proposed in Part K of this report.

This Historic Structure and Cultural Landscape Report will serve as the planning document for the preservation of the South Manitou Island Light Station and Historic Landscape, and as the basis for development of construction drawings and specifications for their rehabilitation.

Investigation Methodology

Before determining the preservation concept, the rehabilitation/restoration team conducted an in-depth study of previously researched documentary materials related to the main structure, outbuildings, and the overall historic landscape. These materials included: the "Historic Resource Study: Sleeping Bear Dunes National Lakeshore," written by Jim Muhn of the National Park Service; Myron H. Vent's book entitled, *South Manitou Island: From Pioneer Community to National Park*; Charles K. Hyde's book entitled, *The Northern Lights: Lighthouses of the Upper Great Lakes*; Joseph H. Rogers' book entitled, *South Manitou Island: A Field Trip Sourcebook and Guide*; Historic American Buildings Survey (HABS) drawings; National Register of Historic Places Nomination Forms; "General Management Plan: Sleeping Bear Dunes National Lakeshore" produced by the National Park Service; historical backgrounds of the buildings, site, local and Great Lakes region; the historical background of the United States Lighthouse Service, including standard building practices; and, historical photographs and drawings. A thorough survey of the lighthouse, the outbuildings, and the historic landscape was undertaken to document each structure's architectural characteristics and construction techniques, as well as each vegetation species and their historical significance, in order to gain insight into the construction and evolution of the entire light station.

This report is based on documentary evidence collected to date, limited physical probing and destructive testing, and architectural and landscape inspection. Of necessity, the research is not concluded with the completion of this report. Rather, it will be supplemented in the future by further information gathered through additional archeological investigation, and by subsequent documents and information as they are discovered.

[1] U.S. Department of the Interior, National Park Service, Denver Service Center. *Sleeping Bear Dunes National Lakeshore/ Michigan: General Management Plan.* (Denver: 1979), 1.

Part B:
Historic Documentation Summary

Part B: Historic Documentation Summary

Historical Significance

History of the Site

South Manitou Island in Lake Michigan is the southernmost island of an archipelago located off the northeastern shore of Lake Michigan. Little or no information exists about the island prior to the arrival of Europeans, but the island was almost certainly visited by the Native American Indians who lived in the vicinity. The landscape would have supported a mixed deciduous and coniferous temperate woodland.[1] Additionally, the island's dune, forest, plain, meadow, swamp, and aquatic environment would have supported a variety of plant species and animal habitats.

The first Europeans to see or visit South Manitou also remain a mystery. The French explorer, Nicolet, is said to have reached Lake Michigan in 1634, and:

> ...it is quite probable that the French traders, as they skirted the shore of the mainland in their big canoes or attempted to penetrate into the thick forests, were among the first white men to see the islands. The French missionaries, who frequently traveled with the explorers and fur traders, were certainly aware of them. As early as 1673 the islands appeared on Joliet's map which showed them located in the Lac des Illinois ou Michigami. The great French explorer, Robert Cavalier Sieur de la Salle, saw them in November 1680 as he passed down the east coast of the lake on his way to the Gulf of Mexico. [He said that:] 'those [islands] in the lake of the Illinois are a hazard on account of the sand bars which lie off of them.' For over 100 years after the French explorers placed the islands on their map and La Salle made his brief note, there is no written reference to the islands. It likewise appears that there was little or no European use or occupation of the island during the seventeenth century.[2]

With the conclusion of the French and Indian War in 1760, South Manitou Island, along with North Manitou Island and the land west of Lake Michigan to the Mississippi River, were surrendered to the British. No perceptible change took place, however. The fur trade, which had begun in the seventeenth century, continued to be protected through a policy (first French then British) that discouraged colonization. This was achieved by a "royal proclamation [which] forbade anyone to survey land or acquire it by patent or purchase from the Indians."[3] By 1800, the Revolutionary War had been fought and the islands incorporated into the Northwest Territory of the United States. Soon thereafter, they became part of the territory of Indiana, and five years after that, they became part of the territory of Michigan, where they remained.

Despite these geopolitical changes, South Manitou appears to have changed little from the wooded island that had been known to the Chippewas, Ottawas, and early French explorers. It is likely that some hunting and fur trapping occurred on the island, but little is known about this activity prior to the nineteenth century. There is no reason to believe that such uses would have affected the island's physical character in any significant way. There may have been trails and paths and temporary camps, but none have been identified in archeological investigations.

The introduction of steamships to the Great Lakes occurred in 1818, and the Erie Canal opened in 1825, linking the Great Lakes to New York City (and, thus to the Atlantic seaboard) via the Hudson River. In 1829, the Welland Canal was opened linking Lake Erie and the other western Great Lakes to Lake Ontario and the St. Lawrence Seaway. Initially, these events had little effect on the lakes. However, travel on the lakes and colonization of areas surrounding Lake Michigan began to steadily increase, particularly after the introduction of regular steamboat traffic in the 1830s. Soon, innumerable settlers and immigrants were moving west on the lakes' waters via wood-burning steamships. Fur trading continued, reaching its peak in 1830, but by 1840, settlers and lumberjacks were making inroads into the forests of the mainland where the fur-bearing animals lived.

Because the ships usurped vast amounts of wood for fuel on their journeys, frequent stops for refueling were a necessity. Ships plying Lake Michigan began stopping at South Manitou Island for this very purpose. The island was situated on Lake Michigan's heaviest shipping route and had dense forests of hardwood trees. Further, South Manitou had a natural deep harbor which could admit large ships. This, combined with the island's plentiful hardwood forests, made it a logical place for a cordwood dock to be established.

The first visitors to the island appear to have been passengers on the steamships who disembarked and explored the island while the ships refueled. These individuals provided some of the first written accounts of South Manitou Island.[4] Well-known travelers such as Henry Rowe Schoolcraft (an American ethnographer in 1820) and Harriet Martineau (an English author in 1836), described South Manitou as a thickly forested island of white pine, cedar, hemlock, and mixed hardwoods.[5]

The island's first documented settler was William Burton, who cut wood for the steamers. It is not known when he actually arrived on the island. It may have been as early as 1835, but definitely no later than 1837. In the 1840s, Burton was joined by other people who began going to South Manitou to settle on the island as well, either to work for him cutting wood, to play a role in the development of the island as a fueling station, or simply to start a new life. A village soon grew up around South Manitou's harbor. By 1870, however, the "Island's importance as a source of cordwood had begun to wane, and the number of day laborers, who worked primarily for the wood suppliers, had declined to half that of the 1860 census."[6] This was because the Island's timberlands had dwindled, and also because the shipping industry was increasingly using more efficient fuels such as coal and, later, oil. By "the end of the nineteenth century, agriculture and fishing had replaced logging as the economic base of the Island."[7]

In 1873, the island was incorporated into a township and, in 1879, its first post office was established. Even though the number of day laborers had steadily decreased over the years, the number of permanent residents steadily increased. By 1880, the island's population peaked at over 100 residents. After 1880, however, the population began to decline. By 1948, "All but two commercial farming operations and the majority of the farm families had moved on. The seventy residents of the island remaining were mainly associated with the U.S. Coast Guard operations," which had started on the Island in 1902.[8]

In 1836, over 500 ships passed through the Straits of Mackinac into Lake Michigan each year. Because of the large number of ships traveling into and out of Lake Michigan, and the often violent weather in the region, the risk of a shipwreck occurring was significant. Recognizing this danger, the U.S. Lighthouse Service established the first lighthouses and "work was started to clear harbors of sandbars."[9] One of these lighthouses established early on was that on South Manitou Island. The island had the only natural harbor that could admit large ships between the Straits of Mackinac and Chicago - a distance of 300 miles. This, combined with the fact that there was no other light in the region to guide ships through the Manitou Passage, led Congress to appropriate funds on July 7, 1838, for the construction of a lighthouse on the southeast corner of South Manitou Island at the southern edge of the harbor (Figure 1). By the spring of 1840, the lighthouse had been constructed and was guiding ships through the Manitou Passage. Later, in 1858, a new lighthouse was built on South Manitou (Figure 2). The reason for the new construction is unknown, but speculations abound, including that the original lighthouse was completely destroyed by fire after lightning hit it; however, there is no indication of this ever occurring, or any supporting documents to substantiate this claim. In 1871, a new light tower was constructed that was taller, contained a more powerful lens, and was separate from the dwelling, although it was connected to the dwelling by an enclosed passageway (Figure 3).

As steamers converted their fuel source from wood to coal, there was less and less of a need to stop at South Manitou Island. Additionally, railroads began replacing ships for the transport of goods and people. This, coupled with the difficulties of transporting farm products off of the island, the lack of education beyond the eighth grade available on the island, and a greater number and variety of opportunities on the mainland, all led to the eventual desertion of the island, beginning in

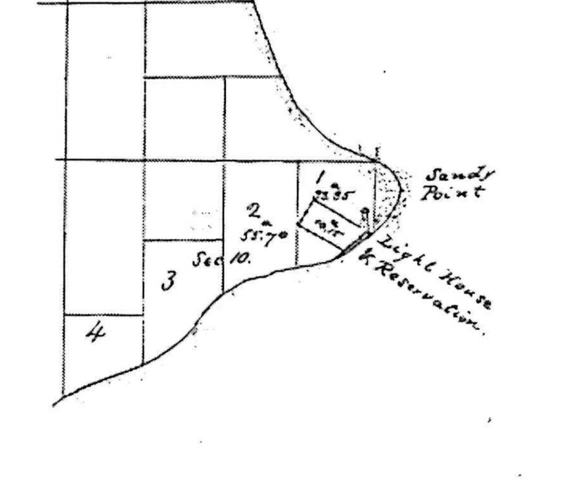

Figure 1 Survey of southeastern portion of South Manitou Island, 1850.

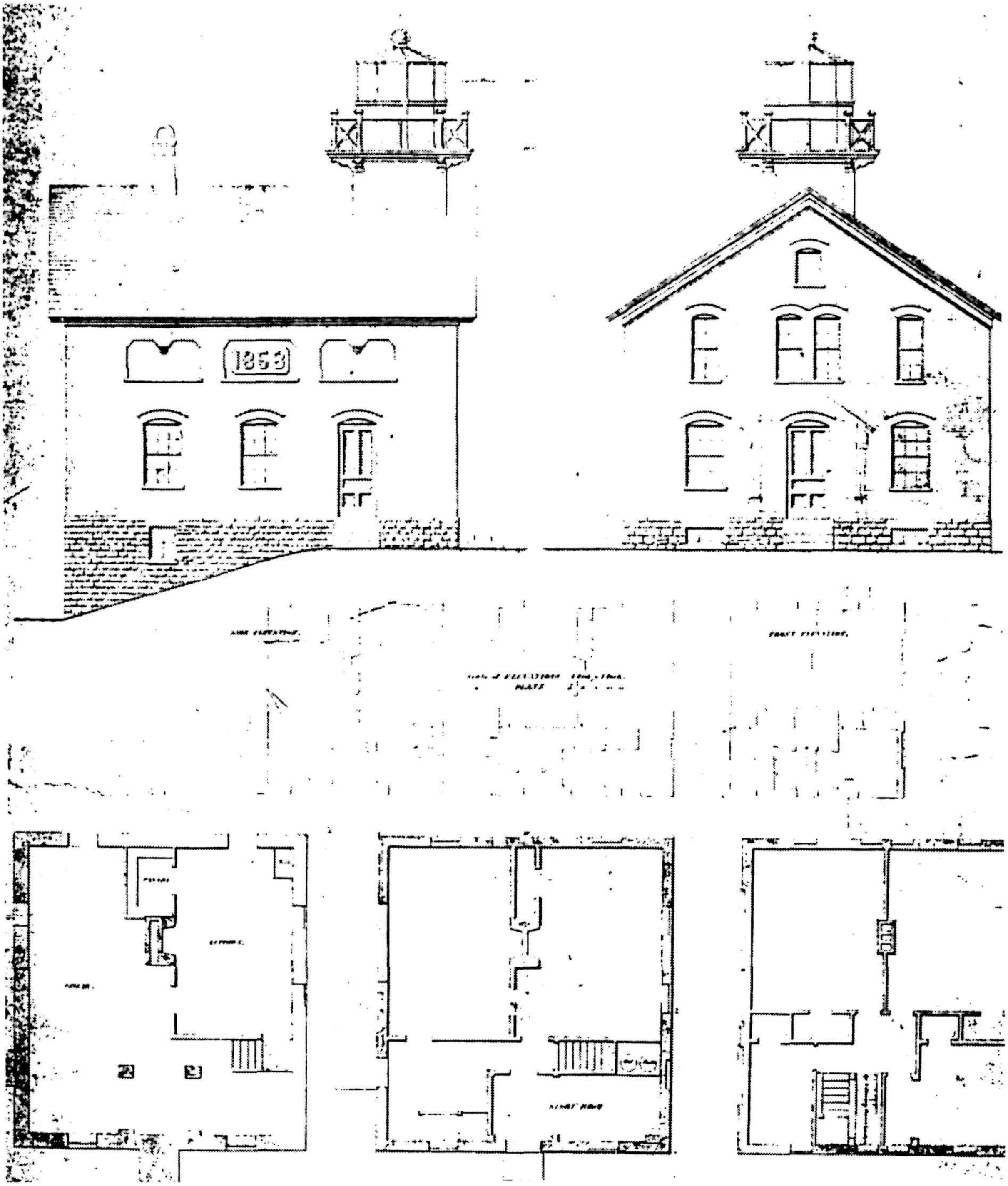

Figure 2 *1858 Construction drawings for the Keeper's Dwelling at South Manitou Island Light Station.*

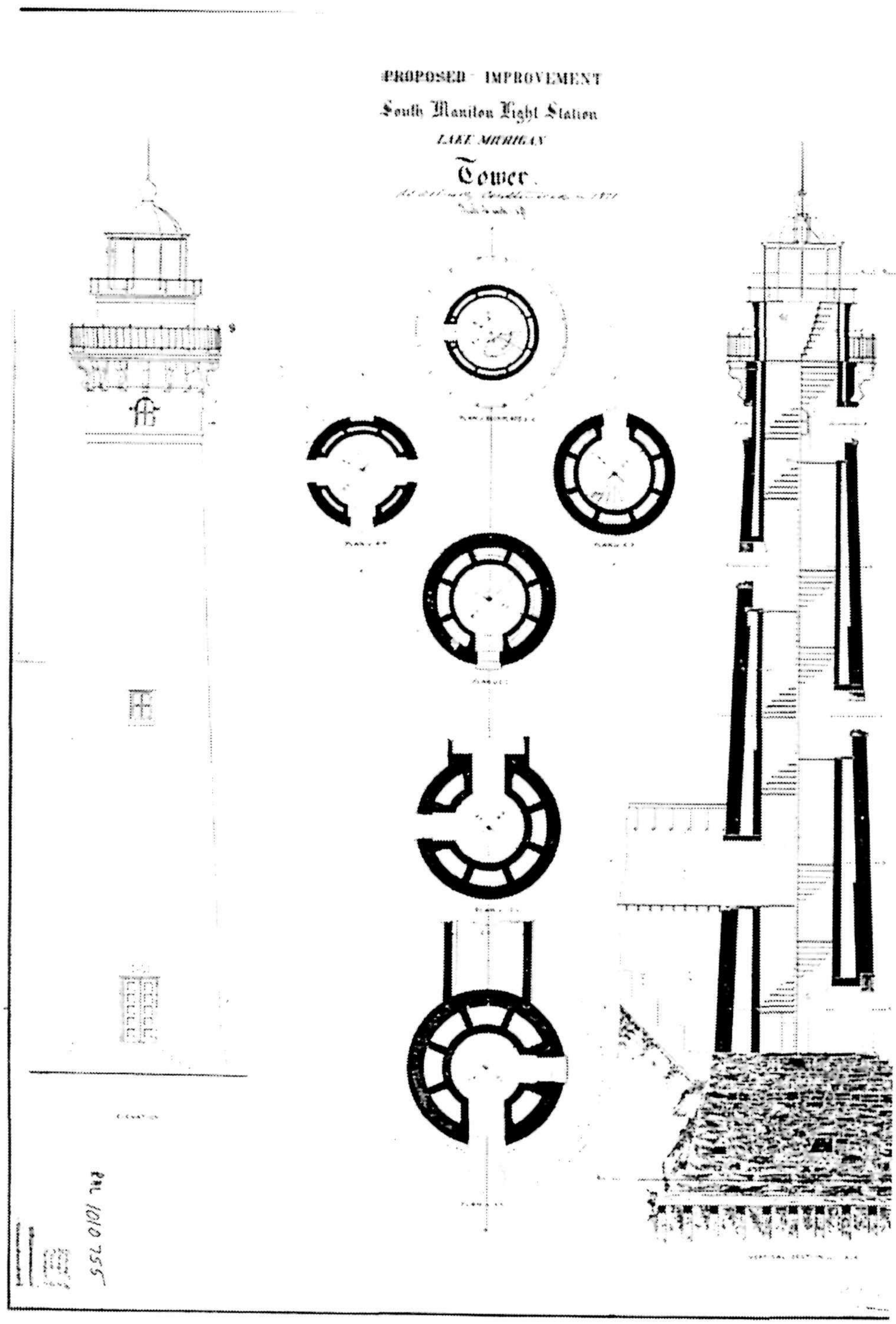

Figure 3 *Construction drawing for freestanding light tower addition at the South Manitou Island Lighthouse, 1871.*

the 1930s. By 1948, there were only a handful of residents living year round on the island, and the general store had closed (the post office had already closed in 1943). The "last year-round resident left [the island] in 1967."[10] The last year round farmers were the Rikers, who rented the George Conrad Hutzler farm. They left the Island in 1974.[11]

With the changes in and the advance of technology of both ships and navigational aids, the U.S. Coast Guard (which had taken over all of the U.S. Life-Saving operations in 1915, and all of the U.S. Lighthouse Service operations in 1939) closed both the lighthouse and the lifesaving station on South Manitou Island on December 12, 1958, and removed all of their personnel. About this time, a movement was started to incorporate South Manitou Island, as well as the entire region around Sleeping Bear Dunes, into a national park. In 1961, legislation was "introduced in Congress which would authorize the eventual purchase of 77,000 acres...It set aside land for a national park, originally called Sleeping Bear Dunes."[12] Almost ten years later, on October 21, 1970, Congress passed Public Law 91-479, establishing Sleeping Bear Dunes National Lakeshore, and setting aside funds for the purchase of land comprising the park, including both South and North Manitou Islands. The first park ranger was stationed on South Manitou Island in the summer of 1972, and lived in the old Coast Guard Station (the former lifesaving station).

In 1979, the National Park Service held several public meetings in an effort to gather information for the development of a General Management Plan for the entire park, including South Manitou Island. Management zones and subzones were established to guide the management of the park. On South Manitou Island specifically, seven historic zones, along with an agricultural management subzone, were designated on the island (Figure 4). The lighthouse, lifesaving station and village all encompass the largest of the historic zones.[13]

History of the Shoreline

The shoreline adjacent to the Light Station prior to 1874 was essentially a natural sand beach, subject to the currents and littoral movement of sediment typical of Lake Michigan. The littoral movement of sand in this area is from north to south, and the southeast point of South Manitou Harbor tends to serve as a groin, collecting material and preventing sand movement directly behind this point. This condition, combined with the current of the lake, causes erosion south of the point, which tends to eventually undermine this point, causing complete failure and mass sand movement within the adjacent shore of the Light Station. Once this occurs, the sand drift again begins to build up along the point, and the cycle repeats.

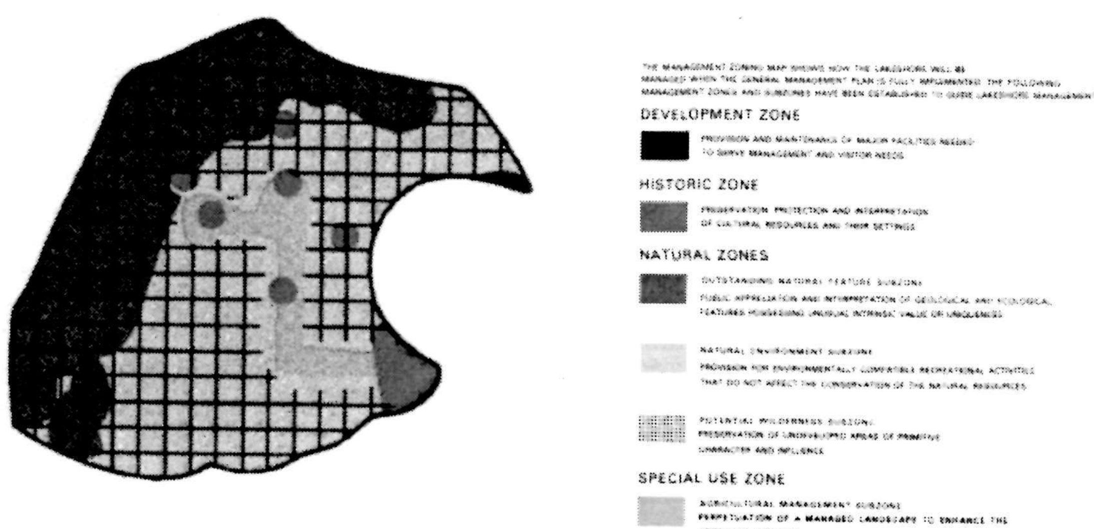

Figure 4 *Drawing from the General Management Plan for South Manitou Island, 1979.*

The annual report submitted 30 June 1874 reported that no work had been done during the year at South Manitou, but expressed concern over the "slowly wearing away" shore. The report described the tower as "but 20 feet from the water" and offered the opinion that "Some protection should be afforded the site at once." The report also indicates the need for a boat house and ways, and states that they will soon be built. It also includes information that an updated steam fog signal was planned for the next year.[14]

By August of the same year, a shoreline protection plan had been proposed for the portion of South Manitou adjacent to the lighthouse. The plan was in response to the loss of "60 to 70 feet during the year." An examination by the foreman, Mr. Crosman, revealed that the low water line was within "42 ft from the tower with a tendency to approach nearer." Lighthouse Engineer Henry M. Robert wrote to Professor Joseph Henry of the Lighthouse Board stating that:

> Last winter a large mass of ice leveled this bar, and since then the shore has been wearing away, and the bar has been forming rapidly. The great storms affecting the point come from the Southwest.
>
> The theory of the case, upon which I have based the protection, is as follows:
>
> The sea beating into the little bay west of the Lighthouse produces an Eastward current along __________. This current served as a protection from the more direct action of the sea, producing, where they met, the deposit forming the bar, and this bar in its turn, serving as a protection from the southerly storms. While this bar lasted there seems to have been no wearing away of the shoreline. If my theory is right the bar should soon form again, and the old state of affairs exist, only that in the meantime the Light would be washed away. To prevent this immediate encroachment, I propose to put three small cribs out from the toe of the high bank, about 40 feet in the water, the direction of the cribs being slightly inclined towards the direction of the current. [The bank] itself would be additionally protected with some brush and gravel wherever its seems to require it. The end cost will not exceed $1,500, and the case is one of such urgency that I at once made arrangements for the delivery of some logs and stone at the point, and as soon as they are delivered, will send a party to do the work.[15]

Robert reported in October of 1874 that the cribs were under construction "as approved by the board." The construction, however, was apparently a difficult process as he also wrote:

> On the 27th the foreman reports_one crib sunk and then filled with stone, which was immediately subjected to the force of a heavy sea caused by a gale which sprang up the same night. Coarse gravel and sand began immediately to pile up on both windward and leeward sides of the crib 18 to 20 inches in depth. There has been much difficulty experienced in getting stone to fill the cribs, and I have been obliged to have a second foreman on the mainland supplying the other with stone...[16]

A month later Robert wrote that the cribs and the shore protection were:

> sunk, and gravel began to lodge on both sides of each pier, and has continued to do so, forming a new shoreline as rapidly as I could have wished. A small pier of cribs, lined with slabs, and filled which was to be south of the lighthouse in the gravel has been placed in front of the site selected for the fog signal house.[17]

The drawing titled, "South Manitou Light Station Shore Protection, Executed according to Report of Superintdt of Construction," and dated 1 July 1876, delineates the four timber cribs and the landing at the fog signal shed (Figure 5). This plan appears to be the completed shore protection project. No letters or reports have been identified to explain the changes from the plan of 1874 (Figure 6), however. As a result, it is also not known whether the implemented shoreline protection plan was completed in 1874, 1875, or 1876.

In August of 1929, a condition survey of the shore protection along the Light Station shore was performed by the Office of The Superintendent of Lighthouses, Twelfth District, Milwaukee, Wisconsin. This survey found the cribs and modifications originally built in 1874 had deteriorated to a point which had caused concern over the safety of the Light Station. It is believed that this survey led to a coastal study of the shoreline, and an eventual emergency action plan to construct crib structures along the shoreline south and north of the fog signal building. These crib structures were originally designed as precast concrete cribs, based on a drawing dated 3 May 1940; however, a revision of the drawing dated 23 May 1940 indicated the cribs were to be built using Armco steel crib structures. A plot plan dated June of 1957 shows the protection plan complete, utilizing the Armco bins. No as-built documentation was found during the inventory of data which reflects the actual cross-section, fill, backfill and foundations of the Armco bin structures.

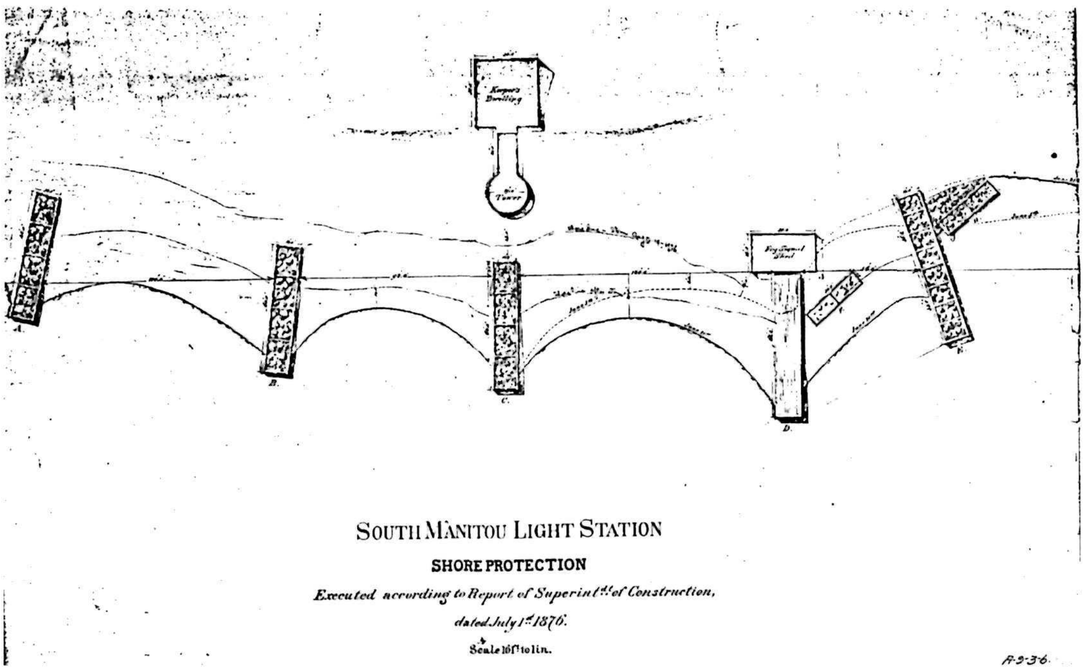

Figure 5 Shore Protection for the South Manitou Island Light Station, 1874.

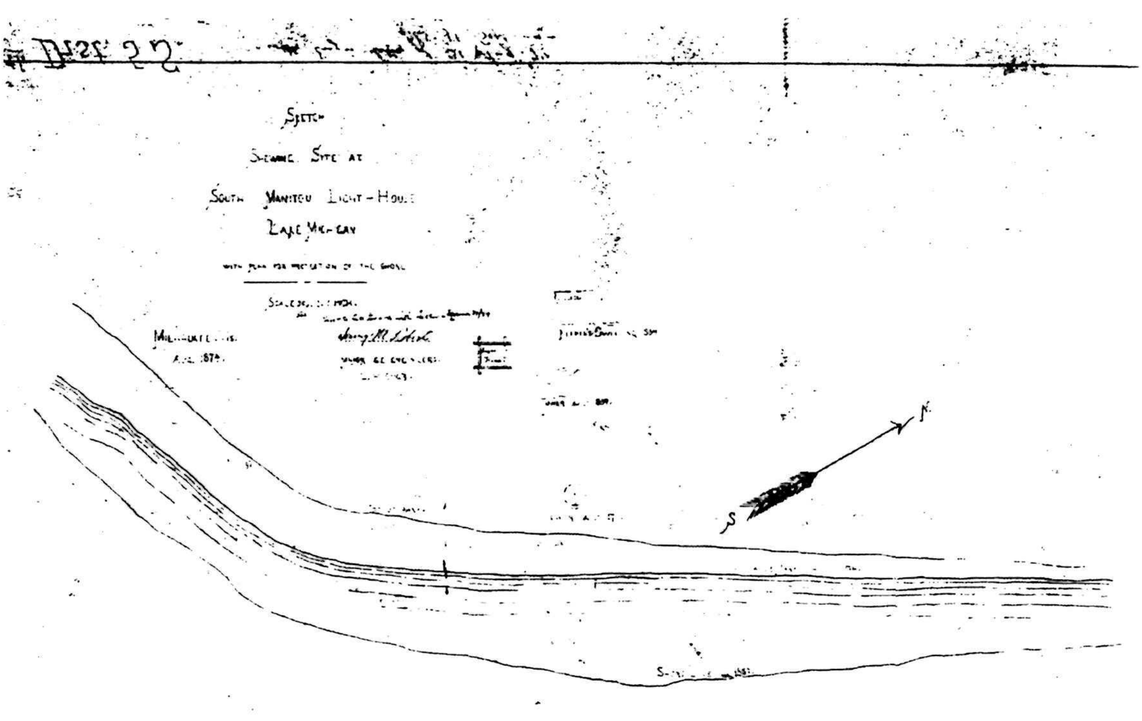

Figure 6 Sketch showing the site at the South Manitou Island Light-House, Lake Michigan; Milwaukee, August 1874.

In 1986, an application to the Department of Army, Detroit District Corps of Engineers was made for the placement of approximately 125 linear feet of riprap between the two existing cribs along the shoreline adjacent to the whistle shed and the Light Station, and approximately 125 linear feet of riprap within the existing crib along the shoreline adjacent to the Light Station. This work was performed in the fall of 1986.

In July of 1988, another permit application was filed with the Department of Army, Midwest Regional Office, which called for the construction of a 408 foot breakwater parallel to the existing shoreline, adjacent to and on top of the cribs and stone previously placed. This work was performed in the fall of 1988, and represents the current condition of the shoreline adjacent to the Light Station.

The shoreline along the island edge adjacent to the Light Station is subject to the forces of the littoral movement of sand, as well as storm and wind created waves across Lake Michigan. These events result in energy that imposes forces both perpendicular and parallel to the shoreline, eventually causing undermining and movement of the stone revetment.

Lighthouse Development

In 1716, the first lighthouse in North America was constructed on Little Brewster Island in Boston Harbor. This lighthouse served as a catalyst for lighthouse construction across the United States, beginning with the Atlantic seaboard. Initially, these first lighthouses were built and maintained by colonial governments or by private organizations until August 7, 1789, when a newly formed Congress of the United States transferred the jurisdiction and administration of all of the lighthouses to the Federal Treasury Department under the auspices of the newly created United States Lighthouse Service.

The opening of the Erie Canal in 1825 linked middle America with the Atlantic seaboard. The "economic benefits to both regions proved significant as grain and lumber moved east and manufactured goods and people went west at a cheaper and faster rate than had been previously possible."[18] As shipping and commerce began to steadily increase, several new communities and major commercial centers sprang up around the shores of Lake Michigan, making shipping an important factor in the lake's economic life. "Each year the number of schooners and steamboats increased to meet the ever increasing business of the Lake Michigan ports."[19]

With large numbers of boats plying Lake Michigan, and the ever-changing and often violent weather that frequently engulfed the region, the likelihood of shipwrecks was great, hence the need for lighthouses was not a question. During the 19th century, ships traveling from Chicago to the Straits of Mackinac used a route which followed the eastern shore of Lake Michigan. Over this distance of 300 miles, there was only one harbor that could admit large vessels - South Manitou Bay.[20] This was significant because harbors and ports helped protect ships from the intense storms, and thus were the ship captains' only hope for refuge. But the Manitou Passage, the waterway between South Manitou Island and the mainland, was not without its dangers in and of itself as it had many treacherous shoals. As a result, in 1837, two naval lieutenants, G.J. Pendergrast and James T. Homans, were sent to find the most appropriate location for a lighthouse. In his report to the Secretary of the Treasury, in conjunction with that of Lt. Pendergrast, Lt. Homans said:

> I made the choice of a site for the lighthouse upon a high knoll on which a stake was placed appropriately marked; bearing of it per compass, from the house near the steamboat landing, South by East. There can be little dispute as to this point being the best for the lighthouse it being open to the course of vessels going up or down the lake, and abundant depth of water within a few yards of the point for the largest craft. The knoll referred to is about thirty feet above the level of the lake, but being formed of sand on the surface, will have to be excavated to make a safe foundation for the lighthouse buildings...As all the steamboats sailing on the upper lakes visit this place for a supply of fuel, or for shelter in storms (for the latter purpose used by all other vessels) thus continually in use by some of the shipping, the need is urgent for the early construction of the lighthouse here. I saw within it, during one twenty-four hours of my stay there, a number of vessels, the aggregate of whose tonnage was 2,000 tons. The value of this harbor is more enhanced by its being the only one admitting the largest vessels in all weather, in the direct route between the Straits of Mackinac and Chicago - a distance of 300 miles.[21]

The site selection for the lighthouse was approved by the federal government, and on July 7, 1838, Congress appropriated $5,000 for its construction. On June 15, 1839, the Treasury Department "gave instructions to the Surveyor General in Cincinnati to reserve public lands for the lighthouse site".[22]

A letter from James Whitcomb, commissioner of the General Land Office, to S. Pleasonton, Esquire, Fifth Auditor of the Treasury Department, reports that "the President ha[d] approved of the reservation of ten acres...on South Manitou Island, in Lake Michigan" on the southwestern point of land forming the harbor upon a high knoll."[23] Whitcomb continued that he had instructed the Surveyor General to designate the reservation "on the plats of the public surveys when they shall be completed and returned to this office and to the proper Registers & Receivers to reserve the lands from sale or entry for the purposes specified."[24] The survey of the light station, conducted in 1839 by E. Hathon, describes the site, which commenced at the east on the border of Lake Michigan.[25] In identifying the site's other borders and stakes, Hathon mentions several trees extant on the site at the time: specifically, pine, hemlock, and sugar maple.[26]

Construction of the lighthouse commenced in 1839, and by the end of spring in 1840 it had been completed, and was guiding ships though the Manitou Passage. Its constant light at night and during storms or fog warned lakefarers, and directed them to safe harbor or safe passage. As intended, the lighthouse immediately became a regional landmark, indicating the island's location in Lake Michigan. It remained the only lighthouse in the vicinity for more than a decade.

Very little is known about the actual structure, although there has been much speculation. Further, no drawings or sketches have been found to date, or are known to exist. Myron Vent, in his book, *South Manitou Island: From Pioneer Community to National Park*, speculates that the lighthouse was precisely that, "a house with a light on top of it," and that "the original lighthouse on South Manitou consisted of a one-and-one-half story house of yellow brick with seven rooms including a sitting room, chamber and kitchen."[27] There is no known information or documentation to substantiate Vent's description, however. Much of what he describes is apparently hearsay, stemming from the folklore of the island. The same can be said of his description of the light, light tower, and fog bell when he says:

> Above the house on a round, white, wooden tower measuring six feet in diameter, stood the light or lantern - a stationary beacon of the fourth order. It was reached by means of a wooden staircase. Because of the rise on which the lighthouse was located, its lantern gleamed in the night some seventy feet above sea level. The lighthouse also had a lifeboat and a fog signal. The signal was a bell weighing 1000 pounds and was struck 'by means of machinery.'[28]

Vent himself admits that "to piece together the story of the lighthouse and its keepers is most difficult," and that "at best the records are fragmentary."[29] And while there may be some truth in his descriptions of the lighthouse and the site, they cannot be relied upon as fact, particularly when he does not cite specific sources in his book. Further, Fresnel lenses (of any order) were not in use yet in the United States at the time of the construction of the lighthouse, so his statement about the tower containing a fourth order light is erroneous.

Another source for the appearance of the first lighthouse on South Manitou Island is a document entitled, "A Brief Sketch of the Life of Charles B. Slyfield," written by Charles Slyfield himself and dated May 9, 1912. In the document, Slyfield states that he was born on June 8, 1854 in "the old stone dwelling at the South Manitou Lighthouse of which my father was at that time keeper."[30] Again, there are no other documents to substantiate this description, which also contradicts Vent's description which stated that the structure was brick. Additionally, Slyfield's father resigned as keeper and they moved off of the island in July 1859, so Slyfield's recollection of the South Manitou Island Lighthouse is from the perspective of a five year old, which may or may not be accurate.

A requirement that the keeper of the light live in the lighthouse and personally ignite the light brought initial human occupation to the site. However, there is no documentation of the effect of this early occupation on the landscape. All that is known is that first settler William Burton became the first keeper.

Maintaining the light's visibility was a primary concern from the outset. Not only did the lens and lantern have to be kept clean, but the vegetation had to be kept from interfering with the function of the light. In his book, Vent quotes from an 1842 letter from the Treasury Department to the District Superintendent that:

> It is alleged that this light is obscured in one direction by trees which may be removed at an expense of about twenty dollars. You will cause the trees to be removed if you shall find the expense will not exceed twenty or thirty dollars.[31]

Apparently the trees were still standing over a year later. When they were finally removed is not known.

Several years later, in 1852, a nine-member Lighthouse Board was appointed in an attempt to alleviate the political and administrative corruption that had plagued the U.S. Lighthouse Service since its creation, and to maximize the efficiency of the agency. The Board eventually divided the country into regional districts with an inspector in charge of each district, and depots established as supply centers for each of the districts' lighthouses. The lighthouses of Lake Superior, Lake Michigan, and Lake Huron all initially comprised the eleventh district, which was headquartered and serviced by a main depot in Detroit, and secondary depots around the district. In 1886, Congress increased the number of districts to sixteen. Under this new organizational scheme, the Great Lakes were divided into three districts, with the ninth district consisting solely of Lake Michigan. Then, sometime between 1910 and 1922, Lake Michigan was changed from the ninth to the twelfth district.

The Lighthouse Board retained the district inspectors that were already in place prior to the creation of the Board, and expanded their numbers in proportion to the increased number of districts. The inspectors "Supervised the keepers within their districts, enforcing the rules and regulations passed by the U.S. Lighthouse Board."[32] The district inspector was generally a naval officer and was responsible for the administration, personnel, and inspection of the light stations. Inspectors "kept a tight rein on lightkeepers to make sure the existent lights stayed in working order and recommended the installation of new facilities where needed."[33]

One radical change that the Board undertook, because of technological advances, and the increasing number of light stations, was the assignment of an engineer to each district who was with the U.S. Army Corps of Engineers. The engineers were responsible for the actual repairs, rehabilitation, and construction of the light stations. They were also responsible for producing, providing, and utilizing standard designs for the lighthouses, and later for the outbuildings at the stations as well. The reason why the engineers were given this responsibility was that the demand and need for new lighthouses was so great that it was virtually impossible to individually design each structure. Despite the use of standard designs, however, minor details were often added to the structures to give them a semblance of individuality, such as date stones, and/or additional windows or doors. This was predicated on the availability of materials and labor, however.

Each district was assigned a U.S. Lighthouse Service Crew that was responsible for the construction of all new lighthouses according to the district engineer's specifications. The crews were also responsible for the major maintenance of all of the structures, both old and new, at the light stations.

Another change, which the Lighthouse Board mandated at the beginning of the second half of the nineteenth century, was the installation of Fresnel lenses in all of the light stations in the country. These lenses, which had long been in use in Europe and were known to provide better illumination than those previously used in the U.S., were gradually acquired for, and installed in, all U.S. lighthouses. District engineers were responsible for determining the lens size each station within their jurisdiction would receive. The size was decided according to the location of the station, and the intensity of light needed. Once this decision was made, the engineer then prepared specification drawings for the installation of the lenses. After the installation of the Fresnel lenses in all of the light stations in the United States had been completed (as well as general station overhauls), the Lighthouse Service became one of the leading navigational aid systems in the world.

It is conjectured that, around the mid-1850s, the original lighthouse at South Manitou Island was completely destroyed by fire, the cause of which is said to have been lightning. It is also conjectured that the current lighthouse, constructed in 1858, was built in the same exact location as the original one, and that it resembled the original structure in both size and function. However, all of this is pure speculation and hearsay, as no documents have been found to date to substantiate these claims. Additionally, Charles Slyfield (whose father was the keeper at South Manitou at the time), in his autobiographical recollections states that "From 1858 I can remember the building of the keepers dwelling at South Manitou and the men boarding with us in the summer of 1858..."[34] This suggests that the original structure did not burn as is generally thought, and that the second lighthouse was not constructed in the same location as the first since Slyfield's family was presumably living in the first lighthouse while the second was being built. Slyfield, however, was only five years old at the time so one could question the reliability of his information. Regardless, a new dwelling was built in 1858.

Elevations and plans for the 1858 lighthouse (Figure 2) provide only limited site information, such as that the lighthouse was built into the lakeside dune at its highest point.

Jim Muhn, a historian at the National Park Service's Denver Service Center, wrote in 1984 in his *Historic Resource Study: Sleeping Bear Dunes National Lakeshore/Michigan* that:

> At present, the construction of the 1839 lighthouse is shrouded in mystery. There is no record of its construction and funding in the National Archives for the South Manitou lighthouse. Yet, it is obvious that a new structure was erected in 1858, for the present lighthouse keeper's dwelling (the 1858 lighthouse) has the date '1858' inscribed in brick on its southwest elevation.[35]

The 1858 keeper's dwelling is essentially a two-and-one-half story, yellow brick structure with a full basement. A wooden light tower originally rose up out of the structure's roof at the east end. According to Vent, a separate structure was built, also in 1858, "to house the fog signal."[36]

Correspondence regarding the appointment of assistant lightkeepers at South Manitou, and at three other lights, gives some indication of the relative remoteness and isolation of the station. In justifying the appointment of assistant keepers, the lighthouse inspector describes the requirement of the keeper to pay constant attention to the fog bell in foggy weather, the need to travel ten or more miles by boat to Glen Arbor for mail and provisions, and the fact that the location of the nearest neighbors on the island is two miles away.[37]

By 1860, there were 1,459 ships plying the Great Lakes, and South Manitou Island's harbor was the most frequently used storm refuge on the lakes. As a result, it was one of the "most important stations in the district."[38] Shipping activities, in fact, had increased to such a degree through the Manitou Passage that it was "frequently impossible to distinguish [the South Manitou Island Light] from those on board of vessels at anchor" in the harbor.[39] As a result, in 1869, recommendations were made for the construction of a separate light tower in front of the dwelling:

> Through the channel between South Manitou Island and the mainland, the principal commerce of the Lake passes, guided by this light which should have a lens of a higher order, with greater elevation and a characteristic distinction not readily mistaken. It is also a guide to a harbor of refuge which is probably more used than any other on the entire chain of lakes...[40]

On August 4, 1870, O.M. Poe, the engineer of the eleventh lighthouse district, submitted construction plans for the tower, with an estimated cost of $30,000. A letter from Poe to Rear Admiral Shubrick, Chairman of the Lighthouse Board, on 18 April 1871 includes a fairly detailed description of the site and the proposed improvements. Poe writes:

> The present dwelling...stands upon a sand hill. The new tower is to be placed at the foot of the hill & and is to be connected with the dwelling by a covered passage way. The main entrance into the tower is to be from the Lake front. The floor of the passage connecting the tower to the dwelling is to be on a level with the dwelling & its connection with the tower. Also the piling & and the grillage upon which the tower is to rest. This piling to be dispensed with should a closer examination of the site warrant it.[41]

By 31 May 1871 Poe was reporting that "works of improvement" were going on. He also reported that a second cargo would contain a pile driver, "it having been found necessary to use piles in the foundation."[42]

The South Manitou Tower was completed in 1871, and had a third order Fresnel lens with a focal plane of 100 ft. It was built with four landings and 100 iron steps leading to the light. With its completion, South Manitou Island had one of the tallest light towers on the Great Lakes.

During November 1874, Henry Robert reported that the boathouse had been built, the walks patched, and stairs built from the top of the bank to the shore. He noted that he expected a schooner to bring material for a new fog signal house and to land at the point where the whistle was to be erected.[43] On 2 December 1874, he reported that he had not heard from the party erecting the fog signal since 14 November but that he "expected the work to be about finished."[44] Three days later he transmitted a "Notice to Mariners" of a fog signal at South Manitou Island.[45] His notice describes the fog signal location as about "34 yards N.E. of the light." Mariners were informed that the whistle would fire a blast of four seconds during each minute when there was thick and foggy weather. This was considered the "first steam powered signal on Lake Michigan."[46] The original fog bell, deemed unnecessary in 1879 due to the presence of duplicate fog signals by that time, was transferred to Duluth on Lake Superior.[47]

The annual report for 1875 includes discussion of several items pertaining to the landscape. For instance, it recommends that the fog signal building be fenced, and that the fences surrounding the dwelling be extended to the lake. The 11th District lighthouse inspector commented that a wire fence would "work well, and be cheap, also."[48]

Correspondence from L. F. Sheridan, who was a keeper at South Manitou, indicates that he was responsible for constructing a building for "wood and stable" in 1878; erecting a fence around a piece of land he cleared for a garden; and, planting fruit trees and shrubbery in the garden.[49] This letter provides the best known documentation to date for the nineteenth-century domestic landscape at the sandy point of South Manitou Island. The letter reveals a commitment to the site's occupation that may not have been present earlier. Whether there was a relationship to the new shoreline protection plan or not is unknown, but perhaps the keeper felt more confident in making site improvements once the cribs were in place.

The annual report of 1879 assesses the condition of the station as "only fair" and makes no mention of any of Sheridan's improvements. The report does note, however, that repairs are needed for the walks around the dwelling, and to one of the shoreline protection cribs.[50]

Correspondence in 1882 includes an authorization for payment of a "fair sum" to the South Manitou keeper for the construction of a barn and fences.[51] The report for that year, contrary to previous years, describes the station as in "very good order," and notes that the crib extending out from the base of the tower was in need of rebuilding.

Life Saving Activities

As the volume of traffic continued to grow on the Great Lakes, an increasing number of ships either ran aground or sank in stormy weather, often with a significant loss of life. Lighthouse keepers did what they could, however, they generally had neither the staff nor the equipment to perform rescue operations. The Federal government was slow to act on this crisis, and did not become actively involved in lifesaving until 1837. Even then it only allocated money sporadically and haphazardly for lifeboat stations and equipment.

In 1854, Congress allocated money for the purchase of lifeboats for twenty-five stations, including the 1854 Frances Surfboat assigned to the lighthouse keeper at South Manitou, but without the provision for hiring full-time crews to operate them. The result was that the system was not as effective as it could be. Finally, in April 1871, after 214 people had lost their lives on the Great Lakes during the winter of 1870-71, Congress appropriated funds to build new lifesaving stations nationwide, and to hire full-time, paid crews. The crews consisted of a keeper who was responsible for the buildings, equipment, and a crew of six or eight "surfmen." During the shipping season on the Great Lakes, the entire crew lived at the lifesaving stations. They spent most of their time "maintaining watches in the lookout towers or patrolling miles of beaches looking for vessels in distress. [They] regularly performed drills with various signal devices, the surfboats, and with the station's 'beach apparatus,' transported on the 'beach cart,' usually pulled by the crew."[52]

On June 18, 1878, Congress created the U.S. Life-Saving Service, which was a separate agency from the U.S. Lighthouse Service even though both were under the direction of the Treasury Department. Responsibilities of the Life-Saving Service involved:

> ... maintaining patrols and lookouts, the manning and operation of surfboats, the boarding of vessels in distress, the transportation of the rescued to shore, and care, shelter and first-aid attention to those in need, also the operation of breeches-buoys and other shore-rescue apparatus and signals. As a corollary of these duties came the work of resuscitation of persons apparently drowned; also the salvaging, pumping out, and bailing of vessels, and assisting crews to manipulate disabled craft.[53]

According to the annual report for 1892 the "circular iron oil house and material for its erection" were delivered in that year, and a small landing crib was built by the keeper using logs that he found on the shore.[54] The annual report for 1893 states that an oil house had been erected 100 feet northeast of the tower.[55] Presumably this oil house is the same structure that was mentioned in the preceding year's report.

By 1893, the Great Lakes were serviced by 47 lifesaving stations, and, by 1900, they were serviced by 60. However, after the turn of the century, only four new stations were opened. One of these was the station at

South Manitou Island, which opened on August 20, 1902. At the time the station was established, over 50 ships were passing the island every day.

The crew at the station consisted of a keeper and six surfmen. The station and three boathouses (one of which belonged to the lighthouse) were built on the southeast point of the island inside the harbor, and about a quarter mile north of the lighthouse. A boardwalk connected the lifesaving station and the light station as well as the lifesaving station and the lookout tower (Figure 7). This connection was essential because the employees at the lifesaving station and at the lighthouse often assisted each other. In some cases, this relationship carried over and influenced the placement of structures. For example, the boathouse for the light station was located at the lifesaving station because the lifesaving station was on the harbor, which provided better protection for the boats during stormy weather. Another example was the steel watchtower for the lifesaving station. Initially it was located southeast of the lifesaving station, on the beach midway between the two complexes (HS 51-122). However, it was relocated to the light station's Fog Signal Building, circa 1939-40 (Figure 8). The remains of the foundation for each the tower are still visible at both locations. The move may have been due to the better view of the open lake or to the reduced danger of beach erosion afforded by the new location.

Beginning in 1910, several bureaucratic and administrative changes began to occur which would eventually bring the U.S. Life-Saving Service and the U.S. Lighthouse Service together under one new agency, the United States Coast Guard. The first change to occur was on February 14, 1903, when Congress created the Department of Commerce and Labor, and transferred the Lighthouse Service from the Treasury Department to the Commerce Department. Then, on June 17, 1910, Congress eliminated the nine-member Light-House Board and placed it under the new Bureau of Lighthouses.[56] In 1915, President William Howard Taft proposed merging the Lighthouse, Life-Saving, and Revenue Cutter services, but Congress would not approve it. Instead, Congress merged the Life-Saving and Revenue Cutter services to form the United States Coast Guard. The Lighthouse Service remained a separate agency until the implementation of President Franklin D. Roosevelt's Reorganization Act of 1939, which eliminated the Bureau of Lighthouses and transferred the Lighthouse Service to the Coast Guard. The 1939 Act was "the last of several efforts to bring all Federal maritime activities under one roof, thus eliminating duplication and improving efficiency."[57]

Lighthouse Equipment

Lantern and Lens Development

Ancient light signals for navigation consisted of open fires on a beach or tower. The flames were at the mercy of the elements until a closed lantern system, constructed with thick glass panes, was developed in England in the late 1600s. This protected the fire (wood, pitch, or candles) but did nothing to amplify the light emitted. Parabolic reflectors were developed throughout the 18th century, eventually employing multiple flame sources and banks of reflectors. This increased light output (and therefore range), but soot from the open flames quickly darkened the reflectors, rendering them useless.

Figure 7 Photograph showing the boardwalk which extended between the light station and the lifesaving station (in the background), circa the early 1900s.

Figure 8 View of the Fog Signal Building and watchtower, circa 1939-40 (SM #3292, Detail).

The Fresnel lens, invented in 1822 by French engineer Augustin Fresnel, marked a major technological leap for lighthouses. Actually a system of projecting light, it utilized a single light source, placed at the focal plane of a set of ridged lenses. The lens design caused all of the rays of light emitted from the source to bend parallel to the horizon, so all available light was captured and sent out to sea. This greatly improved lighting efficiency over previous systems.

The Fresnel system was used in the United States only after 1852. There were six "orders" or sizes, with the First Order being the largest at six feet in diameter and eighteen feet high. The Sixth Order was the smallest, at one foot in diameter and eighteen inches height. Intermediate orders were also developed.

At the South Manitou Island Light Station, the lens system for the new tower was originally specified as a 3-1/2 Order Frenel lens. Revised appropriations were made for a more powerful Third Order lens, in conjunction with a higher tower. The lens, made by H. Lepaute and fitted with a set of Funcks lamps, was installed when the tower was constructed in 1871. Its arc of illumination was 288 degrees.[58] The fuel source for the light was kerosene until 1929, when the official Light List[59] includes the light as an "i.o.e.," or incandescent oil vapor lamp. The light was converted to electricity in 1943.

Both fixed and revolving lights were in use at the time. The fixed type showed a steady light all around the horizon and was useful at isolated locations where there was little interference from other light sources. The revolving lens, mounted on a circular platform with "chariot wheels," created a flashing light pattern by alternating panes of transparent and red or opaque glass around the lantern room's exterior. Each lighthouse in a district would have its own flashing pattern. The revolution of the light was powered by descending weights, much like a clock. The weights had to be wound up by the keeper each night.[60]

Although the light at South Manitou was stationary, standard light house plans used at the time provided for weight shafts throughout the height of the tower. These were included in the construction of the South Manitou Tower built in 1871. This was not merely a way of avoiding changes to the construction drawings, but allowed for the possibility of converting the then-isolated light to a revolving type if shipping traffic and shoreline congestion became so great as to require a distinctive light flashing pattern, as opposed to the simpler steady beam. Increased shipping had already been a factor in the construction of the new tower, as the older light, at a much lower elevation, was becoming hard to distinguish from ships' lights along the shore.

A lighthouse lantern room (the physical housing for the lens and light itself) was typically of cast iron construction. The roof, ventilation ball, and lightning rod were typically of copper, and interior equipment was of brass.[61] A ventilation ball at the top of the tower provided the primary means of venting fumes from early oil-fueled lamps. These vents were baffled, to prevent strong winds from entering and blowing out the flame. Glass in the lantern room was thick (typically 3/8") to withstand high winds, rain, and birds. For revolving lights, alternating panels would be of red or opaque glass, to create a flashing pattern as the light within rotated. Due to birds and windblown debris, replacement of the glass was common.

The existing lantern room at South Manitou Island is constructed on this classic design, and the durable materials have aided in the tower's preservation. At South Manitou, a supply of spare panes was kept in a cabinet (no longer extant) in the passageway, near the tower door. The marks of the cabinet are still visible along the passage, where baseboard has been replaced.

Fog Signal Development

Audio warnings developed in tandem with visual cues as technology advanced and commercial shipping increased. The first fog signal installed at South Manitou Island Light Station was a simple 1000-pound bell struck by clockwork machinery. Although the original no longer exists, the park artifact storage at Sleeping Bear Dunes National Lakeshore includes a similar bell.

The new fog signal building of 1874 housed a 10" steam-powered whistle, and became operational in the 1875 season. The original bell was retained as a backup system, an indication of both the importance of audio signals and the unreliability of the steam boilers in use at the time. A letter from G. Weitzel, Major of Engineers, 11th Lighthouse District stressed the importance of having a properly trained person to tend the boiler that powered the steam whistle.[62] In 1879 a duplicate fog signal building and signal were constructed, and the bell was retired. In 1897, the two buildings were attached and combined into one.

The increased shipping traffic, with larger and deeper ships, meant fewer ships were going through the Manitou Passage between the islands and shore. Instead, they were moving farther out from the coast, where the light signal did not reach. The primacy of the light was being replaced by the fog signal. Although sound was less accurate for determining location, it carried farther and in all weather.

In 1934, the fog signal was changed from a steam whistle to an air diaphone system powered by diesel generators and air compressors. The fog signal itself was now mounted on the tower, providing greater range. It was connected by hoses to a set of four air compression tanks on the ground outside the fog signal building.[63] The steam stacks and whistles were removed.

Automation

The isolated locations of most lighthouses, and the demanding duties required of their keepers, spurred numerous technological innovations with the ultimate goal of complete station automation.

The earliest light automation was invented by Swede Gustaf Galen. His "Sun Valve," formed of two concentric tubes of dissimilar metals, provided automatic fuel shutoff at daylight. Acetylene gas was fed to the lamp through the space between the two tubes. As the sun rose, it heated the tubes, causing the inner tube to expand faster than the outer tube, cutting off the gas flow. At night, the process reversed, and the lamp was relit by a pilot light. This system could also be used to create distinctive flashing patterns, by modulating the flow of gas to the lamp.[64]

Andrew Morse Jr. developed the perpetual bell in 1839. This used a combination of weights and sea-driven winches to operate the bells. Later modifications used a clockwork mechanism powered by a descending weight. The weight was wound by hand; the frequency of winding depended on the ringing pattern. A greater number of strikes per minute meant the bell could be heard farther away. The period between windings was usually no more than 24 hours, to insure the keeper attended faithfully to his duties.[65]

From 1910 until 1939, when the Bureau of Lighthouses went out of existence, the "trend toward the use of automatic equipment at light stations accelerated"[66] In 1916, the Lighthouse Service introduced a device which automatically changed burned-out incandescent bulbs, moving a fresh one into place. By 1925, 74 light stations had been fully automated by the Bureau of Lighthouses.[67] Generally, these were secondary stations, with simplified equipment. More important stations still required full-time attendants.

Electric power had a significant impact on the system of navigational aids. The general use of electricity in lighthouses, however, was not wide spread until the late 1920s when inexpensive portable generators became available. The conversion to electricity occurred fairly rapidly after 1925 and, by the early 1940s, was nearly complete at all light stations on the Great Lakes. Automatic timing mechanisms to turn the lights on and off were also introduced, making automation feasible at many stations. By the 1930s, the Service had also developed fog signals driven by electricity and activated by remote control. Together, these inventions rendered most manned lighthouses obsolete.[68]

The use of electricity also affected lens types, spurring the first significant changes in lenses since the 1850s. While virtually all of the lenses installed in lighthouses in the last half of the nineteenth century were Fresnel lenses, they were rarely installed by the 1920s. A self-contained lens-lantern was developed that had an electric light inside of a glass lens, which also served as the lantern. This new design was weather tight and could be exposed to all types of elements, thereby requiring much less maintenance.

Another technological advance, the radio beacon, also played a role in the demise of manned light stations. Radio beacons were, in essence, a combination of noiseless fog signals and lightless navigational aids, which came into use in the late 1920s. With several beacons operating at the same time, ships could easily determine their position by taking bearings on the various signals. Similarly, radiotelephones came into use. This system allowed the Lighthouse Service to "instantly notify mariners about malfunctioning lights, lost buoys, and other hazards. They also passed on information on weather and ice conditions, water levels, and related news."[69]

Station Closings

The Coast Guard was absorbed into the United States Navy in 1941, only to be returned to the Treasury Department in 1946. With this change, the Great Lakes became the Ninth Coast Guard District, and has remained so to this day, even after the Coast Guard became part of the United States Department of Transportation in 1967. Over the past four decades, the Coast Guard has gradually taken scores of lighthouses entirely out of service, and has automated those remaining. By the fall of 1983, the last two manned lighthouses on the Great Lakes were fully automated.

Little information exists about the closing of the South Manitou Island Lighthouse and Life-Saving Station. Technological advances, combined with the establishment of the North Manitou Island Shoal Lightship initially, and its replacement in 1935 by the North Manitou Island Shoal Light (which was built on a permanent square concrete crib), likely led to the closure of both the lighthouse and lifesaving station on South Manitou Island, and the removal of their personnel.

Not long after the closings, discussion ensued about incorporating all of South Manitou Island and a portion of the nearby mainland into a national park. In 1961, two Michigan senators (Senators Philip A. Hart and Patrick V. McNamara) introduced a bill into Congress to create the Sleeping Bear Dunes National Recreation Area. Then "for nine years this proposal weathered local opposition and debates in Congress that continually changed the park's land boundaries and name."[70] On October 21, 1970, the battle was finally won. Public Law 91-479 was passed by Congress (and signed by President Richard Nixon):

> ...apparently setting aside funds for the purchase of land, including South and North Manitou Islands, to be called Sleeping Bear Dunes National Lakeshore. The act, as passed, included approximately 60,000 acres, some 40,000 on the mainland, approximately 6,000 on South Manitou Island, and 15,000 on North Manitou. The park area included sixty-four miles of shoreline, thirty-one miles of which are on the mainland, twenty miles on North Manitou Island, and thirteen on South Manitou Island. The estimated cost to the Government in 1970 for the purchase of the park area was $20 million.[71]

Between 1973-75, the National Park Service did a study to identify areas of the Lakeshore which might qualify for "wilderness" designation. In a report completed in 1974, three areas were recommended, including most of South Manitou Island. Later, three additional areas were also identified. When many of the people, who had roots on the island, learned of the Park Service's intentions, they became "very concerned that if the island were designated wilderness, with only the exclusion of the Coast Guard area village, that the human history and cultural features would be lost and left to deteriorate," thus, from 1976 "there was an effort on the part of some of the public to attempt to retain the historic integrity of the island, as well as its natural beauty."[72]

As a result the "South Manitou Island Historic District" was placed in the State Register of Historic Places. Then, in the summer of 1977, an inventory was conducted of the historic structures and other man-made artifacts on the island. The result was that a number of properties, including the lighthouse, were deemed eligible for listing in the National Register of Historic Places, and specific buildings were identified for either stabilization or restoration. In 1978, "special appropriations of $55,000 were granted by the National Park Service's regional office for structure stabilization within the Sleeping Bear Dunes National Lakeshore. The lighthouse on South Manitou Island was included as part of this effort."[73] On October 28, 1983, the "South Manitou Island Lighthouse Complex and Life-Saving Station Historical District" were listed in the National Register of Historic Places.

The South Manitou Island Light Station consists of six structures including the Tower, covered Passageway, Keeper's Dwelling, Fog Signal Building, and Brick Oil House. A sixth structure, the round Metal Oil House, still remains, but is located at the lifesaving station. It was relocated there from the light station. There is also evidence of several other features at the light station, including former building foundations, the base of a flagpole, concrete walks, and fragments of a fence.

The significance of the South Manitou Island Light Station is that it was the sight of the first lighthouse built on the Manitou Passage - Lake Michigan's most heavily traveled shipping route during the 19th century. It remained the only lighthouse on the Passage for over a decade, and played an important role in the early days of navigation and commerce on the Great Lakes.

History of Ownership

Prior to South Manitou Island becoming part of the Indiana Territory in 1800, the land on the island was apparently not owned by anyone. French explorers and missionaries did visit the region early on, but there is no known record of ownership, deeds or surveys of the land. In 1805, the island became part of the territory of Michigan, and in 1837 Michigan achieved statehood. On July 7, 1838, Congress appropriated $5,000 for the construction of a lighthouse on South Manitou Island. One year later, the Treasury Department sent instructions to the Surveyor General in Cincinnati "to reserve public lands for the lighthouse site."[74]

Responsibility for the management of the land and structures on the island complex, including the lighthouse, has fallen within the jurisdiction of four different government agencies over the course of the light station's existence. When the land was first acquired by the federal government, it was placed under the jurisdiction of the U.S. Treasury Department, under the auspices of the United States Lighthouse Service, which had been created to administer all of the government-owned lighthouses throughout the country. The Treasury Department retained control until 1903, when jurisdiction over the lighthouses and the U.S. Lighthouse Service was transferred to the Commerce Department. Then, under the Presidential Reorganization Act of 1939, the Lighthouse Service became part of the U.S. Coast Guard.

The light on South Manitou Island was extinguished, and the personnel removed, on December 12, 1958. Over the next ten years, several legislative proposals were placed on the federal dockets to incorporate South Manitou Island, as well as North Manitou Island and the Sleeping Bear Region, into a national park. On "October 21, 1970, Congress established the 71,000-acre Sleeping Bear Dunes National Lakeshore."[75] Management and jurisdiction of the land comprising South Manitou Island, as well as the entire Lakeshore, was placed under the auspices of the National Park Service, which continues its management of the Lakeshore today.

South Manitou Island Light Station Tabulated Chain of Title

1840-1903	U.S. Department of the Treasury, U.S. Lighthouse Service
1903-1939	U.S. Department of Commerce, U.S. Lighthouse Service
1939-1993	U.S. Coast Guard
1993-Present	U.S. Bureau of Land Management

Historical Background Analysis

A light station typically consisted of a complex of interdependent structures, and was clearly and deliberately designed for utilitarian purposes. The light required a keeper who not only would replenish its fuel, but who would also maintain and operate it on a daily basis. Because of these time-consuming responsibilities, and the overall nature of the job, the keeper needed a place to live on site, and, usually, some form of transportation to acquire supplies, etc. Thus, in addition to the light tower, one often finds at least one dwelling and privy, a fog signal building, and multiple storage buildings, including a fireproof oil house for the storage of flammable fuels, and some form of transportation storage, usually a boathouse, stable or garage, depending upon the location of the light station. At the very minimum, a station would have a tower containing both the light and the living quarters for the keeper.

The South Manitou Island Light Station consists of six extant structures which include: a Keeper's Dwelling, a 104 ft. tall light Tower, a covered Passageway (attaching the Tower and the Keeper's Dwelling), a Fog Signal Building, and a Brick Oil House. A Metal Oil House that was originally located at the light station, but which was relocated to the lifesaving station, also still exists. Remnants of other ancillary structures exist at the site as well.

Each of the structures were built in direct relation to the needs of the light station, and had distinct functional roles with respect to the operation of the station, yet they were also often interdependent. For example, when a change was initiated in the type of fuel used for the light, namely from lard oil to kerosene, a need arose for a nonflammable, freestanding structure in which to store the highly flammable kerosene. A brick oil house, thus, became a common structure that was found at many light stations, including South Manitou's.

Light Tower & Dwelling

Very little is known about the first South Manitou Island Lighthouse (although there has been much speculation) except that it was apparently completed in 1840. No drawings or sketches have been found to date, or are known to exist. Myron Vent has speculated that the structure was simply "a house with a light on top of it," and that it "consisted of a one-and-one-half story house of yellow brick with seven rooms including a sitting room, chamber and kitchen."[76] The problem is that there is no known information or documentation to substantiate Vent's description. This includes his description of the light, light tower, and fog bell as well. Further, Charles Slyfield states in his recollections that he was born on June 8, 1854 in "the old stone dwelling at the South Manitou Lighthouse," where his father was the keeper.[77] However, he only lived in the lighthouse for five years, and could have conceivably thought of brick and stone as one and the same, being that he was a young child at the time. Regardless, according to Charles K. Hyde, author of the book, *The Northern Lights*, "the most common design [in the Great Lakes] until around 1870 consisted of a keeper's dwelling of wood, stone, or brick, with the light exhibited in a lantern built into the roof or mounted on an attached square tower."[78]

Just as there is mystery about the design and construction of the first lighthouse so, too, is there mystery about its demise. Rumor has it that the structure was completely destroyed by fire around the mid-1850s, the cause of which is said to have been lightning. It has also been said that the current lighthouse, constructed in 1858, was built in the same exact location as the original one, and that it resembled the original structure in both size and function. However, all of this is pure speculation and hearsay as no documents have been found to date to substantiate these claims. Additionally, Charles Slyfield's recollections contradict all of these claims when he states that "From 1858 I can remember the building of the keepers dwelling at South Manitou and the men boarding with us in the summer of 1858..."[79] This suggests that the Slyfields were living in the original structure while the second one was being built and, therefore, that the original structure was not destroyed by fire, and that the second lighthouse was not constructed in the same location as the original. Again, however, Slyfield was only five years old at the time. Regardless, it is known that the new dwelling was built in 1858, as the date is embedded in brick in the south facade of the structure.

The 1858 Dwelling itself is essentially a two-and-one-half story, yellow brick structure with a full basement that had grade access at the west end. Originally a wooden light tower rose up out of the structure's roof, however, it was removed in 1871 when a new, free-standing, light tower was constructed. The Tower was connected to the Dwelling by a covered Passageway.

In the 1860s, well over 1,000 ships were plying the waters of the Great Lakes, a large number of which passed through the Manitou Passage. Because the light atop the dwelling was often indistinguishable from those of the lights of ships anchored in the harbor, a recommendation was made that a taller and brighter light be constructed. Additionally, taller towers, which could provide a higher focal plane of light, were required at many stations by the 1870s, and often a new brick or stone conical tower was constructed and attached to the existing dwelling by an enclosed passageway. These new towers were generally between eighty and one hundred feet tall. Because of the great need for taller towers, standardized plans became the rule rather than the exception. This saved vast sums of money since the engineers did not have to design new tower plans each time a new tower was approved for construction.

On August 4, 1870, O.M. Poe, the engineer of the Eleventh Lighthouse District, submitted construction plans for a new tower on South Manitou Island. According to a letter written on April 18, 1871 by Poe to Rear Admiral W.B. Shubrick, Chairman of the Lighthouse Board, the tower was "to be a duplicate of the tower erected at Grand Pointe au Sable, Shilligallee, and Presque Isle, Lake Huron."[80] And while it would appear that little, if any thought, was given to the architectural design of such a utilitarian structure, this was apparently not the case in the last half of the nineteenth century. The duplicate towers all exhibited Italianate characteristics, including decorative cast iron brackets supporting the exterior platform, and elaborated crowns above the round top windows at the work room level. Italianate features were popular in residential design in the U.S. from the 1840s through the 1880s. Thus, during the period of time when these towers were being designed, the Italianate style was at its height. It appears that the lighthouse engineers incorporated some of the ornamental features of this style used in residential design into civil design. In a letter dated January 9, 1873, referring to the Lighthouse Board's 1872 Annual Report, the Quartermaster General praises the Board saying:

> I rejoice to see that the Board is paying some attention to architectural design in the newer light houses, and that there is a prospect that hereafter the Bald towers which for so many years, while fulfilling their useful office, have in most conspicuous positions offended all persons of taste on their approach to our coasts, will give place, at very little increase of original cost, to buildings which it will be a pleasure to regard.[81]

By 1871, the tower at South Manitou Island had been completed, and a third order Fresnel lens installed. The 104 ft. tower, as-built, has four landings and 100 iron steps leading to the light. With its completion, South Manitou Island had one of the tallest light towers on the Great Lakes. The tower is connected to the dwelling via a 44 ft. long covered yellow brick passageway. The passageway also has a chimney, indicating that it was heated at one time.

As was common with the submission of standard lighthouse plans, there are inconsistencies between the light tower plan submitted and the as-built structure. Two noticeable differences are in the proposed height of the tower and the length of the passageway connecting the keeper's dwelling to the tower. For example, the length of the passageway in the plan, from the center point of the tower to the edge of the dwelling, was proposed on the construction drawing as 18 feet (Figure 9). That of the as-built structure is 44 feet in length, and incorporates an additional window on each side.

After the tower was built, an assistant was hired to help the keeper. A second assistant was hired after the steam fog signal building was added a few years later. One account states, with respect to the living quarters, that "Originally, the keeper's family and the assistants all lived in the same dwelling, but as the assistants married, they built additional dwellings on the southeast point of the island."[82] Other accounts say that, at times, two families lived in the dwelling.

Fog Signal Building

While the lighthouse itself was of primary importance, the fog signal also played an essential role, particularly when fog or smoke rendered the light useless. Since this was often the case in the Great Lakes region, fog signal buildings were constructed at a rapid rate during the last half of the nineteenth century. As with the towers, dwellings, and oil houses, the district engineer developed standard designs for the fog signal buildings in his territory. The result was that many of the fog signal buildings in the region were virtually identical, albeit with a few minor differences or alterations. However, the 1874 fog signal building at South Manitou Island was an exception. Unlike any of the others in the region, the fog signal building (which is actually the station's second - nothing is known of the first) consisted of two buildings in actuality, one for each boiler (in duplicate), which were located close to each other, but were not connected. Approximately twenty years later, however, one of the structures was moved in order to connect the buildings together so that all of the duplicate equipment would be located within one (combined) structure.

Initially, there were two long metal smokestacks and two 10" steam whistles, each producing an eight second blast between 52 second silent intervals. Prior to the opening of the season in 1934, the fog signal equipment was changed from a steam whistle to an air diaphone system. This system was installed in a unique configuration that was not typical to light stations in the area. While the air compressors were located in the fog signal building, as in a typical installation, from there, air was pumped through above ground air lines to pressurized air receivers (4 large tanks) located at the base of the light tower. An air line attached to the east elevation of the tower carried the air up to the diaphone located at the workroom level of the tower, and the sound was finally emitted from an air horn protruding through the east window of the work room.[83] More common installations provided a dormer at the roof of the fog signal building, through which the signal was broadcast.

Oil Houses

As was the case with many of the light towers and keeper's dwellings around the Great Lakes, standard plans were used for the construction of various outbuildings, with Lighthouse Service Crews responsible for their construction and maintenance. The result was virtually identical outbuildings from station to station. The differences, when they did occur, were usually due more to the substitution of materials that were available than to actual structural changes. For example, the brick oil house at South Manitou can also be found at the Au Sable Lighthouse Complex in Lake Michigan, and at the Raspberry Island Light Station in Lake Superior. The only differences between the structures are their sizes, and the types and colors of bricks used. At South Manitou the brick oil house was constructed out

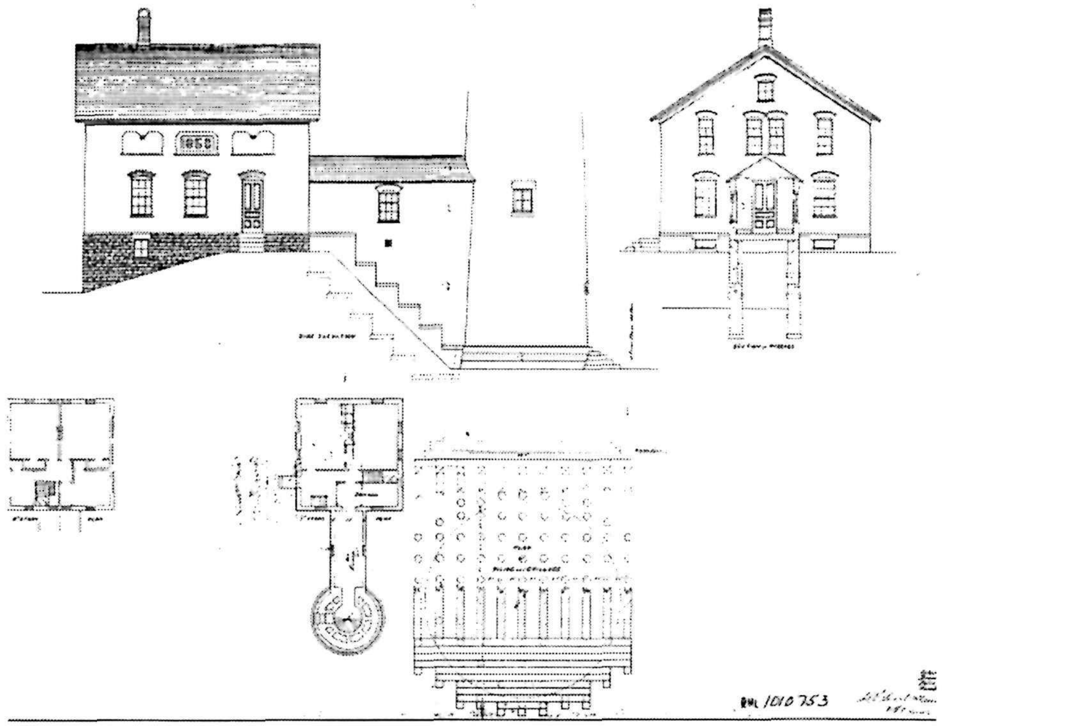

Figure 9 Non-executed construction drawing for the attached Passageway and Tower at the South Manitou Island Light Station, 1870.

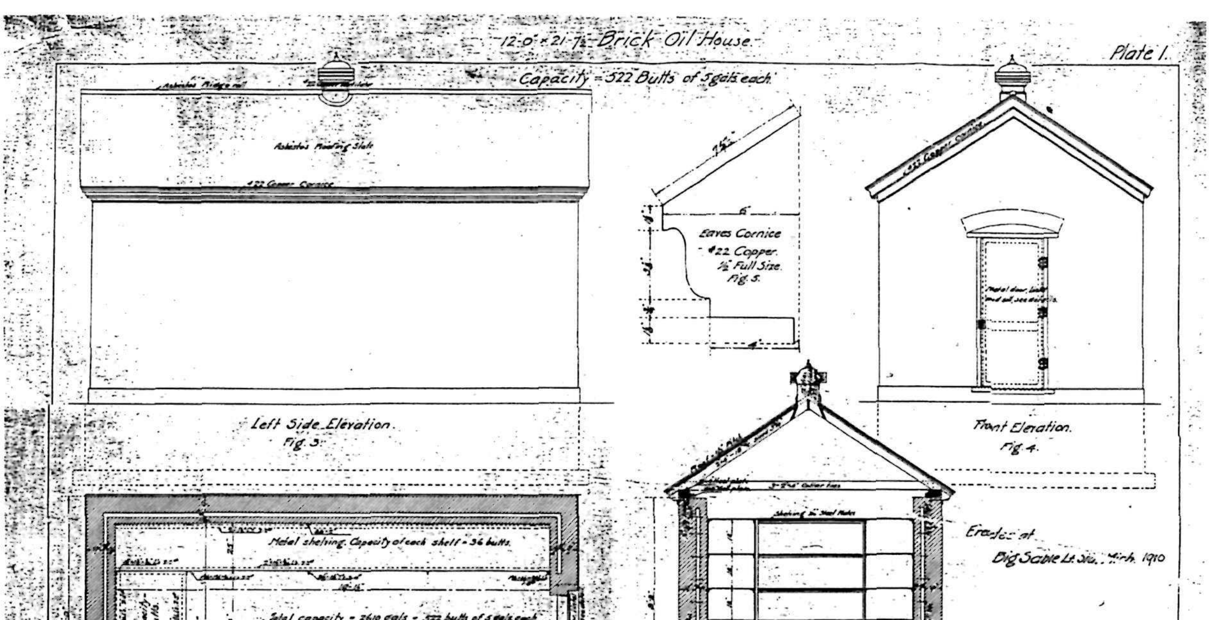

Figure 10 Drawing of a typical brick oil house constructed at several Great Lakes light stations, 1910.

of three different types of bricks likely salvaged and left by a passing lighthouse tender, while at Au Sable the brick oil house is constructed out of red brick, which may have been left over from the construction of the keeper's dwelling there. The determining factor for the size of the various oil houses at each of the stations may have been the level of kerosene consumption, which, in turn, was probably based on the size of the lantern and the isolation of the station. Figure 10 is a drawing of a typical brick oil house, which does not have a site specified on it. Although the size of the structure in the drawing is significantly different from the size of the one at South Manitou, several of the architectural details including the wall construction, metal door, cornice, and ventilator, are identical.

Yet another example of a standard building type at the South Manitou Island Light Station, though relocated from its original location on the site, is the round metal oil house. This metal structure can be seen not only at the South Manitou Island Coast Guard Station (where it is currently located), but at many other light stations around the Great Lakes, such as at the Au Sable Lighthouse Complex on Lake Superior (Figure 11). Furthermore, this structure, which was used to store kerosene, paint, and other flammable materials, can also be found at several other Coast Guard stations.

Other Structures and Changes

Throughout the years of operation of the South Manitou Island Light Station, various other structures contributed to the efficiency and livability of the station. There is photographic evidence of several of these structures, including: a boathouse (located, however,

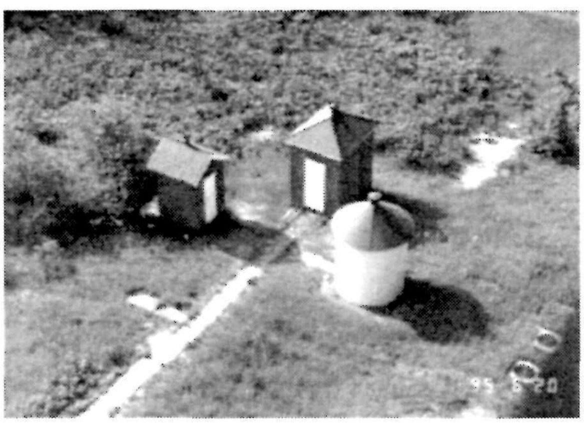

Figure 11 *Aerial view of the Metal Oil House, along with the Brick Oil House and Privy at the Au Sable Lighthouse Complex, Lake Superior, 1995.*

on the site of the lifesaving station); at least one brick privy, which although there is no surface expression of the structure, there is evidence indicating that its location was just west of the Keeper's Dwelling (accessed from the kitchen doors at the basement level of the Dwelling); a woodshed located very close to the southwest corner of the Dwelling; and, a barn/garage that was located in a cleared area west of the Keeper's Dwelling. There is also written documentation and personal recollections of persons who formerly lived at the station, which indicate the presence of several other structures, including: a chicken coop, a horse stable, and a coal house, among possible others, at various times throughout the operation of the light station. Furthermore, ancillary elements were present at different periods of time at the station as well, including: a flagpole, a wood picket fence, an open steel storage tank, and several fuel tanks stored above ground on pairs of concrete saddles.

Brief Photographic Chronology

Unfortunately, no photographs exist of the lighthouse prior to the construction of the freestanding tower, and the removal of the roof lantern at the keeper's dwelling in 1871. Figure 12 is one of the first known photographs of the South Manitou Island Light Station, and shows it as it appeared in 1883. Included in the photograph is the 1871 tower and the enclosed passageway, which connects the tower to the keeper's dwelling. Also discernible in this photograph are the two individual fog signal buildings, with tall metal smokestacks and steam whistles, which were constructed in 1875. Other distinguishable features at the station revealed in this photograph, include: a decorative (likely metal) cap on the chimney of the keeper's dwelling, shutters on the windows of both the keeper's dwelling and the attached passageway, the absence of both oil houses, and the relative lack of vegetation, in relation to the site as it exists today, along the shoreline.

Figure 13, circa the early 1900s, indicates several changes at the station. These changes include: a smokestack protruding out of the west face of the work room level of the tower (added in 1901); the re-configuration of the two individual fog signal buildings into one combined structure, and the side-by-side relocation of the boilers, related smokestacks and whistles to the east portion of the structure; and, the construction of a fence encircling the tower, passageway, and keeper's dwelling.

Figure 12 View looking south toward the South Manitou Island Light Station, 1883.

Figure 13 View from Lake Michigan looking southeast toward the South Manitou Light Station, circa early 1900s.

Figure 14 *View looking south toward the west end of the South Manitou Island Light Station, circa 1902 - 1905.*

Figure 15 *View looking southwest toward the South Manitou Island Light Station, showing several parts of the air diaphone system, circa the 1930s.*

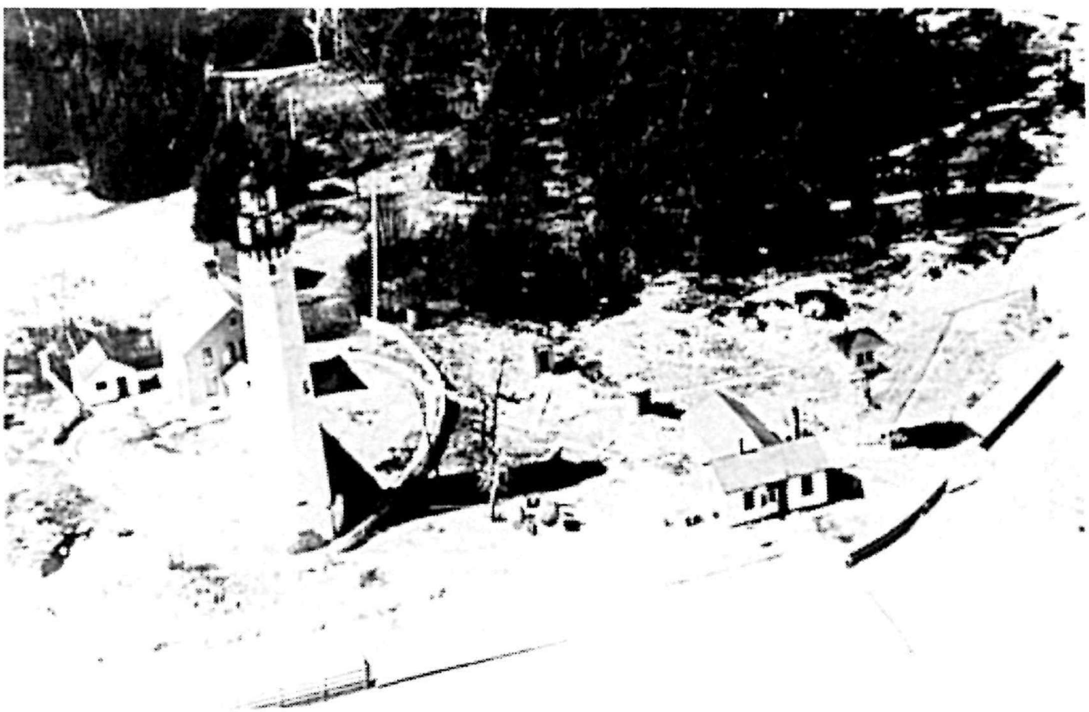

Figure 16 *Aerial view of the South Manitou Island Light Station, circa 1939 - 1940.*

Figure 14, circa 1902, reveals the original location of both the metal and the brick oil houses at the station. Figure 15, circa late 1930s, indicates a significant technological change at the station, which took place in 1934. The steam fog signal equipment was replaced with an air diaphone system. This new system utilized the fog signal building to house the air compressors, and the tower to house the air horn, which emitted the sound (the height allowed the sound to be heard at a greater distance). This photograph also shows some of the fuel tanks, supported on pairs of concrete saddles, located at the isolated site. The picket fence, which first appeared prior to 1875 (based on older photographs) is still present in this photograph as well.

Figure 16 is an aerial view of the station, taken 1939 - 1940, following the transition of control of the light station to the Coast Guard. Discernible features include: a one-story wood frame structure located very near the southwest corner of the keeper's dwelling, presumably used for storage (the remains of which were identified in the archeological report summarized in Part C of this report); the Coast Guard lookout tower in its relocated position just north of the fog signal building; both the metal and brick oil houses; and, an open steel storage tank located northwest of the keeper's dwelling. Furthermore, the air receivers at the base of the tower and the air line between the tower and the fog signal building have been removed, and the entire air diaphone system installed in the fog signal building. This change likely took place during the transition between the U.S. Lighthouse Service and the U.S. Coast Guard. A chimney is also visible on the fog signal building.

1 Myron H. Vent, *South Manitou Island: From Pioneer Community to National Park*, (USA: Eastern National Park and Monument Association, 1973), 8.

2 Vent, 8.

3 Vent, 10.

4 Gilbert/Commonwealth Inc., 14.

5 Mark F. Pfaller Associates, Inc. Prepared for the U.S. Department of the Interior, National Park Service (Milwaukee, WI: 1982), 6.

6 Pfaller, 6.

7 Pfaller, 6.

8 Vent, 11.

9 Susan Dunkelberg-Booker. "South Manitou Island: People, Time, and Changes," (Paper written in March 1981 for Geo. 407: Geography of Michigan, Michigan State University, Lansing, MI), 25.

10 Dunkelberg-Booker, 29.

11 Vent, 76.

12 Vent, 76.

13 U.S. Department of the Interior, National Park Service, Midwest Region, *Sleeping Bear Dunes National Lakeshore/Michigan: General Management Plan: October 1979*, (Denver: Denver Service Center, 1979).

14 Henry M. Robert to Professor Joseph Henry, 7 August 1874. Letter Book 347. 100.

15 Henry M. Robert to Professor Joseph Henry, 21 August, 1874. Letter Book 367, 104.

16 Henry M. Robert to Professor Joseph Henry, 5 October 1874. Letter Book 367, 178.

17 Henry M. Robert to Professor Joseph Henry, 4 November 1874. Letter Book 367, new NA # 323.

18 Jim Muhn. *Historic Resource Study: Sleeping Bear Dunes National Lakeshore*. U.S. Department of the Interior, National Park Service, Denver Service Center (Denver: 1984), 61.

19 Muhn, 62.

20 Lazdins, 2.

21 Vent, 15.

22 Vent, 46.

23 Jas. Whitcomb to S. Pleasonton, Esq. Letter Book 1 (1839). 48.

24 Jas. Whitcomb to S. Pleasonton, Esq. Letter Book 1 (1839). 48.

25 Letter Book 1, page 66 as transcribed by Dave Snyder gives the name as Hathon while the spelling of the last name is given as Hatton in the *1910 Description.*

26 E. Hathon, *Survey of the Lighthouse Reservation on South Manitou Island in Lake Michigan, July 1839.* Letter Book 1, 166.

27 Vent, 46.

28 Vent, 46. It has also been generally assumed, by those other than Vent, that the light was attached to the residence, however, current investigations of both the 1850 plat and the 1874 shore protection plan give rise to some doubts that the tower was attached to the dwelling. Both graphically depict the tower as a separate structure. Since neither plan dates from the original period of construction, they are not conclusive evidence that a separate tower actually existed. It is possible that these drawings may have been done by someone unfamiliar with the site. For the purposes of this submission, however, it will continue to be assumed that the dwelling and light were attached.

29 Vent, 51.

30 Charles B. Slyfield. "A Brief Sketch of the Life of Charles B. Slyfield." (Frankfort, MI: May 9, 1912), 1.

31 Vent, 46-47.

32 Rachel Franklin Weekley, *Historical Data Section: Cultural Landscape Report, Au Sable Light Station, Pictured Rocks National Lakeshore, Michigan*. Prepared for the U.S. Department of the Interior, National Park Service, Midwest Regional Office (Omaha, NE: August 1994), 20.

33 Weekley, 20.

34 Slyfield, 1.

35 Muhn, 71.

36 Vent, 47. (The credibility of Vent as a reliable source of information for the nineteenth-century appearance of the light station has not been established.)

37 T.H. Stevens to Rear Admiral W. B. Shubrick, U.S.N. 9 June 1869. Letter Book 234, 195.

38 T. H. Stevens to Rear Admiral W. B. Shubrick, U.S.N. 28 September 1869. Letter Book 257, 74.

39 T. H. Stevens to Rear Admiral W. B. Shubrick, U.S.N. 28 September 1869. Letter Book 257, 74.

40 Vent, 47.

41 O.M. Poe to Rear Admiral W.B. Shubrick, U.S.N. 18 April 1871. Letter Book 283, 1066.

42 O.M. Poe to Rear Admiral W. B. Shubrick, U.S.N. 31 May 1871. Letter Book 283, 1298.

43 Henry M. Robert to Professor Joseph Henry, 4 November 1874. Letter Book 367, new NA # 323.

44 Henry M. Robert to Chairman Lighthouse Board, 5 December 1874. Letter Book 367, new NA # 357.

45 Henry M. Robert to Professor Joseph Henry, 2 December 1874. Letter Book 367, new NA # 351.

46 Muhn, 64.

47 G. Weitzel to Admiral John Rodgers, U.S. Navy, 16 July, 1879. Letter Book 462, 306.

48 Henry M. Robert to Professor Joseph Henry, 24 August 1875. Letter Book 366, 206.

49 L.F. Sheridan to Lighthouse Board, 22 February, 1884. Letter Book 613, 268.

50 J. N. Miller to Rear Admiral John Rodgers, U.S. Navy, August, 1879. Letter Book 462, 641.

51 J.C. Watson to Chairman, Lighthouse Board, 29 May, 1882. Letter Book 547, 580.

52 Charles K. Hyde, *The Northern Lights* (Lansing, MI: Two Peninsula Press, 1990), 34.

53 Vent, 55.

54 Quinn Evans, "Timeline Updated 10/27/94," entry for 1892.

55 Quinn Evans, "Timeline Updated 10/27/94," entry for 1893.

56 Hyde, 39.

57 Hyde, 46.

58 Henry R. Crump, Lampist. *Descriptive List of Light Stations in the Eleventh District. December 7, 1878.* Letter Book 462, Page 190. Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

59 *Light List: Great Lakes, United States and Canada. Department of Commerce, Lighthouse Service.* U.S. Government Printing Office (Washington, D.C.: 1924-1959).

60 Connie Jo Kendall, "Let There Be Light: The History of Lighthouse Illuminants," *The Keeper's Log: Clockworks*, Spring 1997, 22-29.

61 U. S. Department of the Interior, National Park Service, *Historic Lighthouse Preservation Handbook*, (Washington, D.C.: 1997), Part IV, G, Page 3.

62 G. Weitzel to Professor Joseph Henry, 17 June 1874. Letter Book 347, 91.

63 Sleeping Bear Dunes National Lakeshore Archives, copy of a drawing entitled "South Manitou Michigan, Installation of Diaphone to Replace Steam Boilers."

Photograph (SMI CG4) showing tubes attached to the side of the tower, and large storage tanks on the ground; undated drawing of diaphone installation.

64 "Automatic Lighthouses Save Money," *The Keeper's Log*, Winter 1994, 27.

65 "The History of Fog Signals, Part 1," *The Keeper's Log: Clockworks*, Summer 1990, 22.

66 Hyde, 41.

67 "Automatic Lighthouses Save Money," *The Keeper's Log*, Winter 1994, 27.

68 Hyde, 43.

69 Hyde, 44.

70 Muhn, 151.

71 Vent, 80.

72 Dunkelberg-Booker, 31.

73 Peter A. Lazdins. "South Manitou Island Lighthouse." (Paper written December 3, 1980 for Architecture 673, Historic Preservation, University of Michigan, Ann Arbor, MI), 26.

74 Vent, 46.

75 U.S. Department of the Interior, National Park Service. *Sleeping Bear Dunes National Lakeshore/ Michigan, General Management Plan* (October 1979), 1.

76 Vent, 46.

77 Slyfield, 1.

78 Hyde, 23.

79 Slyfield, 1.

80 O.M. Poe. *Letter to Rear Admiral W.B. Shubrick, U.S.N., Washington, D.C., 18 April 1871.* Letter Book 283, 1066.

81 Quartermaster General. *Letter to Major Geo. H. Elliot, Engineer Secretary, U.S. Lighthouse Service, Washington, D.C., January 9, 1873.* Letter Book 312. National Archives.

82 Dunkelberg-Booker, 15.

63 Sleeping Bear Dunes National Lakeshore Archives, copy of a drawing entitled "South Manitou Michigan, Installation of Diaphone to Replace Steam Boilers."

Photograph (SMI CG4) showing tubes attached to the side of the tower, and large storage tanks on the ground; undated drawing of diaphone installation.

Part C:

Archeological Research Summary

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Archeological Summary

Introduction

This section will summarize the material presented in the technical report entitled, *Cultural Resource Assessment of Proposed Construction Activities, South Manitou Island, Sleeping Bear Dunes National Lakeshore, Michigan,* authored by Gilbert/Commonwealth Inc. of Jackson, Michigan, in June 1985. The report was prepared under the supervision of Donald J. Weir, Principal Investigator/Project Manager; Daniel R. Hayes, Prehistoric Archeologist; and Beverly E. Bastian, Historic Archeologist. The report was submitted to the Midwest Archeological Center in Lincoln, Nebraska.

Abstract

The Gilbert/Commonwealth, Inc. research team completed an archeological and historic inventory of the those lands on South Manitou Island that are proposed for construction activities. The research team identified four artifact concentrations and two of them (G/C No. 3 and 4), were directly associated with the existing lighthouse complex. The report includes detailed management recommendations concerning these sites.

Project Introduction

Gilbert/Commonwealth, Inc. states that:

> The project required the survey of all areas [of South Manitou Island] that could be potentially impacted by the construction of a maintenance complex, well location, and assorted utility lines. In addition, a walkover survey of much of the village area was completed. The investigation was designed to locate, identify, document and evaluate prehistoric and historic sites within each of the identified project areas. All aspects of the research were performed in compliance with the National Historic Preservation Act of 1966, Executive Order 11593, and the Archeological and Historic Preservation Act of 1974.[1]

Prior to the initiation of fieldwork, Gilbert/Commonwealth, Inc. reviewed information from the Bureau of History, Michigan Department of State and the Michigan State University, to identify any known resources on the island. The fieldwork was undertaken on October 4 and 5, 1984.

Environmental Background

Glacial Geology

Gilbert/Commonwealth states that:

> Late Wisconsin glaciation, postglacial lake level fluctuations and aeolian (wind) processes are largely responsible for the topographic characteristics of South Manitou Island. Its basic configuration is that of massive coarse-textured glacial tills resting upon bedrock consisting of Traverse series limestone of the middle/late Devonian period. These till deposits have since undergone subsequent modification by lake level fluctuations, climate change and the biotic community coupled with the deposition of massive sand dunes.[2]

Furthermore, the island originated approximately 11,850 years ago during the last Wisconsin ice advance, known as the Valders stadial. The history of the Great Lakes, including Lake Michigan, is complex following the Valders stadial. The Michigan Basin alone has undergone six major lake stages following the glacial period: the Algonquin, Post Algonquin, Chippewa, Nipissing, Algoma, and modern Lake Michigan. The entire Great lakes area was first free of glacial ice during the Lake Chippewa stage, approximately 9,500 years ago. During the Nipissing stage, the perched dunes along the western shore of South Manitou Island, along with the Sleeping Bear Dunes, both of which consist of sand deposited on top of glacial moraines, were developed. Approximately 3,000 years ago, during the Algoma stage, the lake surface elevation was 595 feet. Subsequent changes throughout the Great lakes and its outlets, approximately 2,000 years ago, resulted in a drop of the lake level to its present elevation of 580 feet. An additional statement by Gilbert/Commonwealth is directly related to the area adjacent to the lighthouse reservation. They state: "The Algoma strandline and several recessional features such as wave-cut terraces are visible today along the bay on the southeastern margin of South Manitou Island."[3]

Soils

The soils of the island consist mainly of podzols, which are derived from coarse-textured glacial tills and fine sand dunes. Previous investigation also found three soil horizons on the island: thin humic horizon at the surface, a bleached horizon of sand sized minerals just below it, and an underlying light brown horizon of redeposited aluminum and iron sesquioxides. Gilbert/

Commonwealth, Inc. states that, "Podzols predominate in the study area except in poorly drained areas where organic peats and mucks have accumulated, and on the unvegetated and unstable dunes."[4]

Climate

The study area has a humid, temperate climate which supports a deciduous and mixed forest temperate woodland. Further, the local climatic conditions of the island are affected by Lake Michigan, which moderates air temperature extremes. Additionally, the microclimates along the island's shores, sustained by air drainage patterns, permit a longer growing season than seen in many comparable inland regions.

Biotic Resources

The study area supports a deciduous and mixed forest temperate woodland as was previously stated. This forest type has been called the Lake Forest formation because it is, "in contrast [with] the largely coniferous forest to the north and deciduous forests to the south."[5] The island also sustains a wide variety of plant associations due to its diverse geological character.

Prehistoric Overview

It is not until the Late Archaic period (3000 B.C. to 600 B.C.) that evidence exists indicating human utilization of the land within the area of the current Sleeping Bears Dunes National Lakeshore. Beachlines from this period (during the Nipissing lake stage) also exist along the Lakeshore. Furthermore, the beginning of the Woodland period is generally recognized by new technical innovations: plant domestication and ceramic manufacture. In analyzing these two periods, Gilbert/Commonwealth states that:

> In the park, and northern Michigan in general, it appears that local climatic conditions limited the use of domesticated plants. It is evident that the Archaic pattern of subsistence continued but with the addition of the use of ceramic vessels and barbed harpoons. This makes the dating of certain sites problematical at best. Sites that are classified as late Archaic may be, in fact, Woodland period sites which lack pottery.[6]

The most information is known, however, from the Late Woodland period, from which about a dozen artifactual sites within the Lakeshore have been dated, (AD 600 - AD 1620). Some of these sites are on South Manitou Island, containing thin pottery tempered with crushed granite and decorated with a variety of motifs. At the same time, Late Woodland sustenance in Michigan was mainly focused on agriculture in the south and seasonal fishing in the north. The documented sites on South Manitou Island, and throughout the Lakeshore, do not substantiate these findings. Further, Gilbert/Commonwealth, Inc. states that,

> ... the sites' size and type of material assemblage suggest that they are short-term temporary occupations probably emphasizing seasonal hunting. Major agricultural sites have been found north, east, and south of the study area, suggesting a possible settlement system association with the Manitou Island sites.[7]

The prehistoric era then ends and the historic contact period begins with the arrival of European goods during the early seventeenth century. This influx saw the replacement of indigenous goods with trade goods, and the involvement of local inhabitants with market economies.

Historic Overview

Gilbert/Commonwealth, Inc. begins by stating that, "South Manitou Island, North Manitou Island, and the Sleeping Bear Dune region of the mainland were always linked in Indian legend, and this connection continued during the Euro-American occupation of the area in the ties resulting from the economic activities of the settlers there."[8] As early as the seventeenth and the eighteenth centuries, explorers and travelers, both French and British, saw the Manitou Islands, which they included on some of their very early maps. The land began to be permanently occupied in the nineteenth century with the introduction of steam boats to the Great Lakes in 1818, and the opening of the Erie Canal in 1825. As discussed in the Historic Documentation Summary of this Historic Structure and Cultural Landscape Report, the harbor at South Manitou Island provided shelter for ships from Lake Michigan storms, and, at the same time, was a frequent stopping point for refueling as South Manitou Island had an abundance of cordwood which was used to power the steam ships. Gilbert/Commonwealth, Inc. says that:

> Exactly when these fueling stops began is not recorded. Probably by late 1837 a house and steamboat landing were on South Manitou, located on the natural, crescent-shaped harbor on the northeast side of the island. These improvements are mentioned in a 1838 U.S. Navy report on the choice of a sandy point, on the southern tip of the South Manitou harbor, as the best location for a lighthouse for this increasingly utilized shipping route.[9]

The harbor had a water depth suitable for large ships and the sandy point had unobstructed visibility of and from the Manitou Passage. The lighthouse was constructed in 1839 - 1840, rebuilt in 1858, altered and updated several times throughout its lifetime, and is now the focus of this report.

South Manitou Island also played an important role in the settlement and development of the nearby mainland. As early as 1846, a trading post was set up on the island and used by settlers from the mainland. By 1847, it was noted that, in addition to trading post and cord wood supply, the harbor at South Manitou also had a wharf, a blacksmith shop, and a grocery store. Furthermore, "In the next decade, a number of settlers found their way to South Manitou, cleared the land in the central and southern parts of the island, and began growing crops and orchards, at first for their own subsistence, but soon for the sale to the ships in the harbor."[10]

Harbor services, lighthouse tending, and farming in the nineteenth century, and the development of a sawmill in the early twentieth century were the occupations of the island.

The late nineteenth century saw the decline of residency on the island, largely the result of ships no longer using cordwood as fuel. The island's lighthouse and Coast Guard station were closed in 1958 and those who remained on the island become more isolated as time went by. By 1970, there was only one family living on the island year round and the entire island was incorporated as part of the Sleeping Bear Dunes National Lakeshore, established that year.

Research and Results

Methodology

The field survey was a combined strategy of both surface reconnaissance and subsurface testing in all of the proposed construction impact zones on the island. Gilbert/Commonwealth, Inc. also completed a walkover survey of much of the village area, with special attention focused on, among others things, the dune upon which the lighthouse stands. In areas of clear ground visibility, close visual inspection techniques were used to indicate any presence of archeological material, while in areas of obscured visibility shovel testing was employed.[11]

Results

Four artifact concentrations were identified by Gilbert/Commonwealth, Inc. (They did note, however, that the village and nearby area was littered with sheet midden materials primarily dating to post-1940, left from the increased recreational use of island, and were, therefore, not recorded.) Two of the sites were not within close proximity to the lighthouse. One was near the Visitor's Center in the village and another near the maintenance facility. The third artifact concentration identified by Gilbert/Commonwealth, Inc., however, was located southwest of the keeper's dwelling (and appears to be within the limits of the lighthouse reservation), on a steep and heavily overgrown dune face. This site consists of a brick and cut limestone block foundation with an associated limestone block retaining wall and wooden picket fence (Figure 17).[12] These identifies are evident in a circa 1928 photograph of the dwelling and surrounding site (Figure 18).

Gilbert/Commonwealth further describes the site by stating,

> The foundation measures 2.1 m long and 1.2 m wide and is open on the downslope side, where it is possible that the walls may have extended. It is constructed primarily of rough cut and odd sized limestone blocks with some brick evident along the north wall. Wall thicknesses range from 28 to 42 cm. [Figure 17 is a drawing depicting this foundation in plan view.] Several shovel tests within the foundation produced only cinder ash and charcoal.[13]

In Figure 18 , it also appears that the foundation is of a simple wood framed building with a pitched roof, probably used for storage, etc. The retaining wall within the study site measured 9.7 m long and was found to be construction similar to that at the identified foundation wall. The photo also reveals a wood picket fence atop this wall with a gate directly behind the dwelling. Additionally, Gilbert/Commonwealth, Inc. identified a set of wooden steps in the photograph, located in the underbrush during their research.

Artifacts found and recorded by Gilbert/Commonwealth, Inc. included: a tobacco tin, one glass artifact, the remains of two porcelain vessels (one of a toy teacup and one of a saucer), and some butchered mammal bone. This site's assemblage can generally be dated to 1900 -1930.[14]

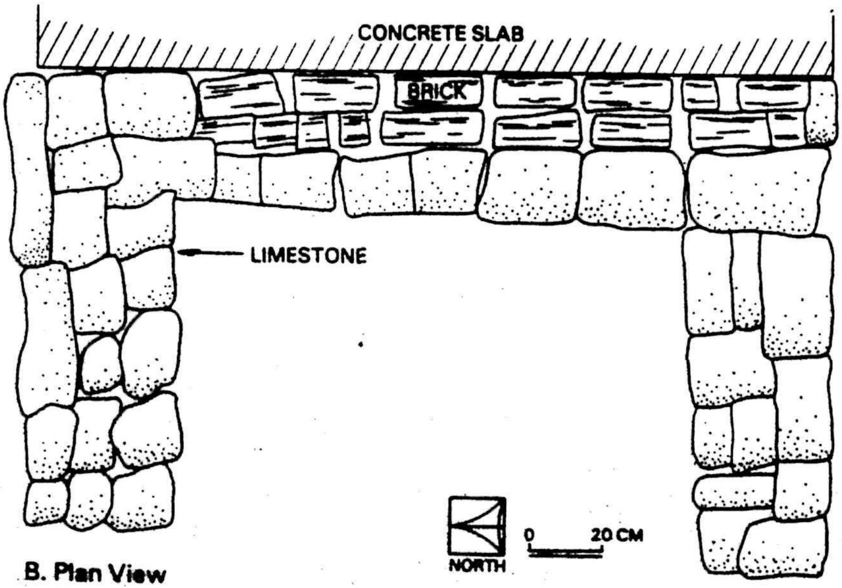

Figure 17 Plan view of the brick and cut limestone foundation unearthed southwest of the Keeper's Dwelling at the South Manitou Island Light Station, 1985.

Figure 18 View looking east toward the South Manitou Island Light Station, circa 1928. Note the wood frame structure southwest of the Keeper's Dwelling and the wood picket fence.

The fourth artifact concentration identified by Gilbert/ Commonwealth, Inc. is located northwest of the keeper's dwelling, in the relative location of the former wood frame barn depicted in Figure 18. The site assignment was based upon the recovery of buried refuse materials here (at the base of the dune on which the third site was located). Regarding this site, Gilbert/ Commonwealth, Inc. states that:

> A series of five shovel tests were dug along the base of the dune slope, all but one of which produced circa 1870 - 1917 artifacts. Soil profiles varied, but at least two revealed buried, artifact-bearing humic horizons overlain by the artifact-bearing recent sands which are probably attributed to [the] downslope erosion of the dune. Conditions depicted in [Figure 18] support this assumption.[15]

Artifacts recovered in association with the level of soil that most likely represents the relic ground surface dating to the lighthouse period (shovel test 3) include: an oxidized iron strap, a solarized machine-made glass bottle sherd from a milk bottle styled vessel, and a single opal glass (milk glass) sherd. The method of manufacture and color suggest a 1903 - 1917 date range for the machine-made bottle fragment.[16]

Furthermore, shovel test 1, extending to a depth of 48 cm below the current ground surface, revealed: wire nails, machine-cut nails, a heavily corroded tin ware vessel rim fragment, a saw-cut mammal vertebrae, fire-cracked rocks, and a pair of whiteware ceramic sherds. Shovel test 2, at a depth of 40 cm, revealed: a saw-cut mammal bone, fragments of a butchered fowl bone, a lump of coal, a furnace cinder, a fragment of stove lining firebrick, a plain undecorated whiteware body sherd, and a stoneware crockery sherd. Shovel test 5 was the last artifact-producing unit. A single artifact was recovered, which was a solarized glass body sherd located in the top 15 cm depth of the unit. Shovel test 4 was similar in soil profile to shovel test 5, but lacked any cultural remains.

Recommendations

Gilbert/Commonwealth, Inc. presents their view of cultural resource management as having a dual purpose: the accumulation and interpretation of new data to enhance the present archeological record, and the preservation of this record regardless of its state of interpretation.[17] While it is difficult to assign a value to each site investigated, it is important to assess relative attributes in order to formulate a management strategy. Regarding the two sites investigated by Gilbert/ Commonwealth, Inc. they state that, "the two sites located behind the lighthouse, alone do not appear to be significant, but taken into association with the lighthouse complex should be considered important aspects of the total site, which exhibits great potential for meeting eligibility requirements for the National Register of Historic Places."[18] This site was, indeed, placed in the Register in 1983. Gilbert/Commonwealth, Inc. goes on to say that:

> Present plans for running an electric line up to the rear of the complex would at a minimum cause destruction of a portion of the G/C 3 [southwest of dwelling] retaining wall and picket fence, and the G/C 4 [northwest of dwelling] midden. The G/C 3 foundation would not be affected. National Park Service personnel suggested an alternative to this alignment which would call for running the electric line northeast along the dune to the existing walkway. This area was surveyed without encountering any additional sites. It is recommended that this design modification be implemented to avoid disturbing G/C 3 and G/C 4.[19]

As the electric line was already installed and stubbed northwest of the Dwelling during the physical investigation undertaken by Quinn Evans/Architects in October of 1994. It is assumed that the above recommendations provided by Gilbert/Commonwealth, Inc., were followed in its installation.

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1 Gilbert/Commonwealth, Inc. of Michigan. "Cultural Resource Assessment of Proposed Construction Activities South Manitou Island, Sleeping Bear Dunes National Lakeshore, Michigan." Prepared for the United States Department of the Interior, National Park Service, Midwest Archeological Center, Lincoln, Nebraska. (Jackson, MI: 1985), 1.

2 Gilbert/Commonwealth, Inc. of Michigan, 3.

3 Gilbert/Commonwealth, Inc. of Michigan, 5.

4 Gilbert/Commonwealth, Inc. of Michigan, 6.

5 Gilbert/Commonwealth, Inc. of Michigan, 7.

6 Gilbert/Commonwealth, Inc. of Michigan, 11.

7 Gilbert/Commonwealth, Inc. of Michigan, 11.

8 Gilbert/Commonwealth, Inc. of Michigan, 13.

9 Gilbert/Commonwealth, Inc. of Michigan, 14.

10 Gilbert/Commonwealth, Inc. of Michigan, 16.

11 Gilbert/Commonwealth, Inc. of Michigan, 18.

12 Gilbert/Commonwealth, Inc. of Michigan, 21.

13 Gilbert/Commonwealth, Inc. of Michigan, 21.

[14] Gilbert/Commonwealth, Inc. of Michigan, 25.

[15] Gilbert/Commonwealth, Inc. of Michigan, 25.

[16] Gilbert/Commonwealth, Inc. of Michigan, 26.

[17] Gilbert/Commonwealth, Inc. of Michigan, 27.

[18] Gilbert/Commonwealth, Inc. of Michigan, 27.

[19] Gilbert/Commonwealth, Inc. of Michigan, 27.

Part D:
Cultural Landscape Analysis

Part D: Cultural Landscape Analysis

South Manitou Island's light station is a significant cultural landscape established and maintained because of its strategic location on the Manitou Passage. Symbolic legends—associated with two Native American groups, the Chippewas and the Ottawas—developed to explain and describe the two island land forms of South Manitou and North Manitou Islands and that are the origin of the National Lakeshore name of "Sleeping Bear." Developed in the nineteenth-century as a part of an evolving regional and national system of light stations, the site developed in response both to natural features and to changing technologies and policies. The island's natural characteristics not only provided an open view of the shipping channel along the lake's eastern shore but, most importantly, a safe harbor for large vessels sailing to and from Chicago. As the first lighthouse built on Lake Michigan's major nineteenth-century transportation route and the Manitou Passage's only lighthouse for a decade, the South Manitou landscape was well-known to nineteenth-century travelers, sailors, and shippers, and played a significant role in nineteenth-century Great Lakes navigation.

Analysis by Historical Episode

Pre-1839 (Exhibit 1)

The pre-1839 landscape was a natural landscape. Its characteristics were those that provided the basis for its development as a major Lake Michigan light station. Apparently there was no human-influenced organization of the site. No evidence of permanent settlements or camps has been identified. It appears that there was no major land use developed by Native Americans and both French and British colonial policies discouraged colonization in the area.

Views of the island from the lake that would have been known to native Americans and, as noted by travelers, would have been of a thickly forested island of mixed coniferous and deciduous vegetation. Vegetation mentioned for this period included cedar, pine, hemlock and sugar maple trees. Other natural characteristics of the site included the sufficient depth of water to accommodate large ships within a few yards of the point; the shoreline; and the high, sandy knoll about thirty feet above the level of the lake on the southwestern portion of land forming the harbor. Anyone venturing onto the island shore from a boat would have views to the Manitou Strait or Passage from any points where natural vegetation did not obscure the view.

The introduction of steamships to the lake in the early nineteenth century provided an incentive for human habitation and use of the island. Since the early steamships were dependent upon refueling with wood to burn in their boilers, stops along Lake Michigan's Manitou Passage were essential.

The island's first settler, William Burton, moved to the island between 1835 and 1837 and made his living cutting wood for the steamers from the island's abundant hardwoods.

The island's natural characteristics also made it an ideal location for a light station to serve the Manitou Passage, known for its many treacherous shoals. In 1837 G.J. Pendergrast and James T. Homans, two naval lieutenants detailed to find the most appropriate place for a lighthouse in the Manitou Passage, identified South Manitou as their choice. In his report to the Secretary of the Treasury, Homans noted an urgent need for the lighthouse since the island was "continually in use" with ships already stopping for fuel or for shelter in storms. Homans continued that there was "little dispute as to this point being the best for the lighthouse it being open to the course of vessels going up or down the lake..." He also noted that "being formed of sand on the surface, [the site] will have to be excavated to make a safe foundation for the lighthouse buildings." The natural characteristics of the site, a sandy point extending into the lake, with its ample water depth in the harbor and the visibility of the point to and from the lake made it an optimal choice for lighthouse development.

First Lighthouse 1839-1857 (Exhibit 2)

The site selected for the lighthouse was close to the lakeshore. Development of a lighthouse established the first landscape organization of the site. Although its exact location, configuration, and footprint have not been identified to date, this first lighthouse was built on the sandy knoll and established the precedent for the siting of the lakefront light station. No information concerning other site features has been identified.

The site developed during this period in response to natural features. The character of the site also developed directly in response to its land use as a light station and the activities associated with its operation. The lighthouse was sited on the higher elevation of the sandy knoll which assured the most prominent location for the light and provided a superior location for observing lake conditions. This location also provided the convenient access to the lake that was essential for the operation of the station.

It is not known if there was any building cluster in this first period or if the lighthouse was a singular structure. Vent, who is not a particularly reliable source for this period since his observations are not firsthand, has described the site as possessing a fog bell and a boat, the 1854 Frances Surfboat assigned to the lighthouse keeper. It is not known whether the bell was housed in a separate structure and there is no mention of a boathouse for this period. It is assumed that the boat was left in the open although there may have been some structure associated with its storage. It is logical to assume, however, that at least a privy was developed as part of the initial construction but there are no known references to one. There are also no indications of other utilitarian and domestic site features for this period. It is not known if there was garden cultivation. It is logical to assume that there would have been clothes drying lines. There may or may not have been woodsheds. If there weren't any, there would have been woodpiles.

Nothing is known about internal site circulation during this period. Since there had been little site development beyond the construction of the lighthouse, it is probable that there were only informal paths on the site during this period. There were probably paths to the water, to any auxiliary structures such as a privy, and to any other parts of the site used on a regular basis for personal or occupational activities. It is logical to assume that there was also a path to the village.

There undoubtedly were small-scale site features associated with domestic life and the function of the station but none have been identified.

The extent of vegetation on the knoll prior to construction is not known, but any trees and shrubs would have been cleared from the site for construction to proceed. The extent of other vegetation is not known. Timber had been cut for several years at this point for firewood so the area may not have still exhibited its natural mixed forest character. Vent, however, quotes 1842 and 1843 correspondence concerning undesirable vegetation that was obscuring the view of the light.

Second Lighthouse and Early Station Development 1858-1870 (Exhibit 3)

The character of the site continued to develop directly in response to the natural characteristics of the site and its use as a light station. Views to and from the point were essential to the successful function of the site. The landscape organization of the site continued to orient to the lake and the station's lakefront functions. The foremost aspect of the site was the light located at the east or lakeshore end of the station's second lighthouse built in 1858.

A simple building cluster definitely began to develop during this period with the construction of the second lighthouse on the sandy knoll. The lighthouse of 1858 was sited for views and convenient lake access. A privy was built northwest of the lighthouse in 1859. There was also a fog bell and some sort of housing for the bell. There are accounts of the dilapidated housing for the bell in the 1860s. There are no known references to other buildings or structures during this period, however; nor are there references to walkways, fences, clotheslines, gardens, woodsheds, or other features that could have been associated with domestic or occupational uses of the site.

Third Lighthouse and Expansion 1871-1896 (Exhibit 4)

The evolution of the site in response to both its natural characteristics and its use as a light station is most evident between 1871 and 1896 when the site experienced considerable development. This period is the major period of expansion and development. Landscape organization continued to be influenced by the need to orient to Lake Michigan and the utilitarian nature and use of the site. Expansion during this period resulted in construction of the interrelated buildings and structures necessary for the successful and efficient operation of a light station.

The considerable historic graphic documentation that has been identified for this period is useful in historic analysis of the site. There are five available period photographs (Figures 1–5), a shoreline protection plan from 1874,[1] the 1876 as-built shore protection plan, and a very detailed plot from 1887. The 1887 plot (Figure 6) provides considerable site information and gives the best indication of landscape features and characteris-

Figure 1 View looking south toward the South Manitou Island Light Station, 1883.

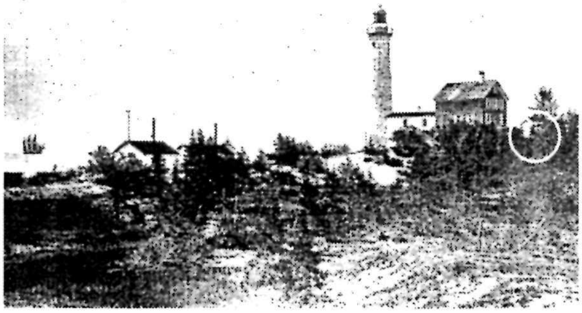


Figure 3 Earliest known depiction of the woodshed/stable/shop, from a photograph circa the late 1800's.

Figure 2 View looking south toward the South Manitou Island Light Station, circa 1884.

Figure 4 View looking south toward the South Manitou Island Light Station, circa the early 1890s.

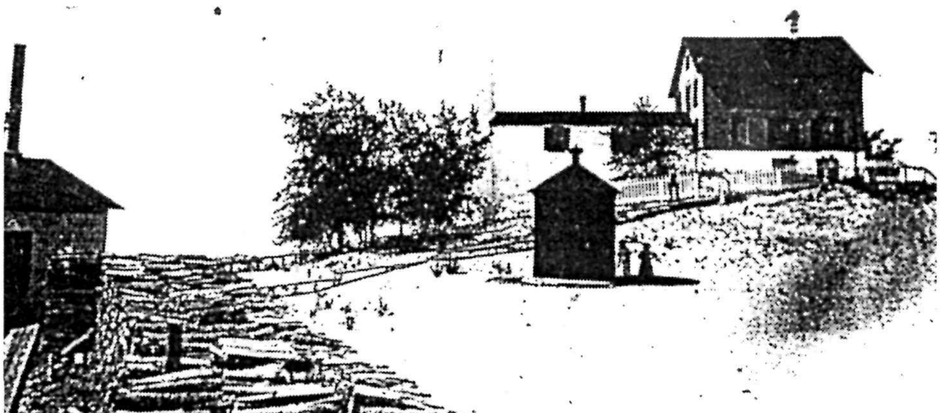


Figure 5 Undated photograph circa 1893-1897, showing a double plank walk leading to the second fog signal building. Note also the clearly depicted picket fence and the boardwalks stepping down the slope.

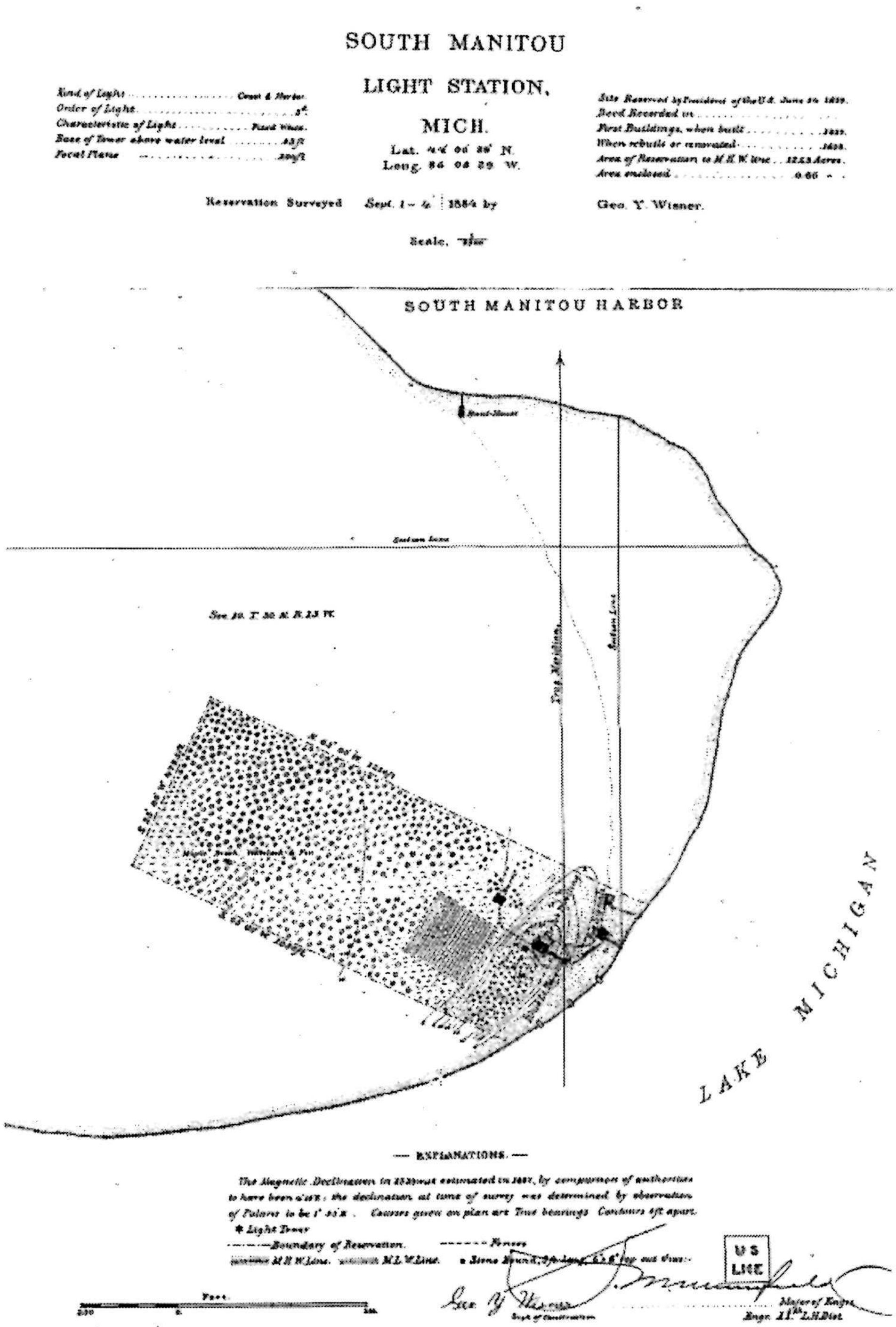


Figure 6 Reservation survey for the South Manitou Island Light Station dated September 1 - 4, 1887.

tics extant during the 1871–1896 period. The 1887 survey, which indicates the site plan of the light station during this period, shows the location of the dwelling, the tower, and a number of other site features. The survey identifies the acreage of the rectangular reservation as 12.63[2] acres with 0.66 acre enclosed. Photographs from this period clearly depict the elevated site of the keeper's dwelling.

During this period land uses became more specific with distinct buildings and structures developed or adapted to meet the increasingly highly specialized functions of a light station. The earliest development during this period was construction of the light tower in 1871; by necessity the light was oriented to the east toward the lake, placing it in a more vulnerable location than the light had occupied previously when incorporated into the dwelling. Construction of the tower in this period improved visibility of the lake from the light tower and made the light an even more visible feature from the lake.

The increased separation of the light tower and the keeper's dwelling provided a greater distinction between the domestic life and the occupational role of the keeper. This arrangement is believed to be typical of light station designs of the period. Although the staff increased after the new tower was built, no additional residences were added to the station. The light station at South Manitou remained relatively isolated with only one dwelling. For the first time the keeper's dwelling had a single use, that of a residence, although the light function was still readily accessible from a connecting passageway also built in 1871. Although the light tower was the dominant visual feature of the site, other structures were added to supplement its function.

The addition of two fog signal buildings (the first in 1874 and the second by 1879) at the eastern edge of the shoreline was a major change that was consistent with changing technologies and policies. The transition from a mechanical bell to steam-operated fog signals to warn mariners of dangerous fog conditions required a substantial investment in equipment and was labor intensive for the station to operate. The necessity of locating fog signals near the water's edge called even more attention to the eroding shoreline and the increasing need for shoreline protection for the growing light station.

Development of a shoreline protection plan in 1874 was in response to an alarming loss of 60–70 feet of shoreline during the 1873-1874 period. The construction of shoreline protection cribs in the 1870s and 1880s was the beginning of the still-ongoing efforts to maintain the island shoreline at this location to protect light station structures. This aspect of site development was directly related to the naturally eroding shoreline and the creation of dangerous sand bars. The already extant lighthouse appears to have been threatened at least by 1873 and the site selected during this period for development of the fog signal was even more vulnerable given its closer location to the shoreline. The 1887 survey depicts three shoreline protection cribs; each of the fog signal sheds has a pier extending to the lakeshore.

Several distinct areas of development were defined during this period of expansion: the residential/light tower cluster and associated auxiliary structures, the barn opposite the garden and north of the dwelling, the fog signal and oil storage cluster, and the boathouse located off the site. The cluster arrangement of buildings and structures developed in response to the need for efficient operations and the natural features of the site. The keeper and assistants needed to live on site and be able to reach the light tower and fog signal buildings within minutes during emergency situations.

As a result, the station developed as a compact and dense arrangement of buildings and structures in close proximity to one another. There was little free choice available to the planners of the site. The dwelling and tower locations responded to the topography of the site to ensure visibility while the fog signal operations were clustered near the water's edge. The woodshed/stable/shop/ added in 1878 was conveniently located near the residence. The earliest known depiction of this building is in an undated photograph from circa the late 1800s (Figure 3) showing a gable-roofed structure just to the west of the keeper's dwelling. In contrast, the circa 1882 barn northeast of the dwelling was somewhat removed from the residential function as it would have been on any farm of the period.

Construction of the metal oil house north of the dwelling in 1893 marked the change to flammable kerosene fuel and the need to store it away from the residence. The oil house was located west of, but safely apart from, the fog signal buildings. The 1887 survey indicates the boat house location at the South Manitou

Harbor apart from the light station site; presumably the boathouse noted but not depicted on the survey is the boathouse built in 1874.

It appears that with the expansion of the station, that the internal circulation system became more formal with a system of curvilinear walkways developed to link the dwelling, the tower, and the fog signal buildings. These walkways are indicated on the 1887 plan (Figure 6) which provides the only nineteenth-century plan identifying walkway locations. This plan depicts an elliptical walkway around the keeper's dwelling and the tower and connecting to two curvilinear walkways leading to the two fog signal buildings near the beach. Boardwalks are known to have been present at the light station during this period from late nineteenth-century photographs. A double plank walk extending from the fog signal building and away from the site is visible in a photograph taken between 1893 and 1897 (Figure 4). Its terminus is not visible, however, so it is not known how far the boardwalk actually extended, although presumably there was at least a developed path to the village at this time. A similar depiction of the site is given in an undated photograph circa 1893–1897 (Figure 5) that shows a double plank walk leading to the second fog signal building. This photograph also clearly shows two elevated walks, presumably boardwalks, descending the knoll to the shore. The walks in some cases are broken at intervals by steps, with one end of a board set at grade and the next board elevated above it, presumably to reduce the steepness of the walk. Since little is known of other walkways on the site for this period, it is possible that there were still informal paths leading to other structures such as the privy, woodshed, and barn, or boardwalks may have been developed in these areas as well.

There is more documentation available for vegetation in this period than for previous periods. This may indicate that a garden was developed for the first time during this period. It is entirely possible, however, that there were earlier gardens but that they were not included in official reports and logs or that references to them have not been found. In 1878 there is mention of clearing a garden, of fencing the garden, and of planting fruit trees and shrubs in the garden. The 1887 plan (Figure 6) also indicates the extent of vegetative cover on the site. It is assumed that this depiction is more or less accurate. The character of the vegetation would have remained mixed hardwood and coniferous trees and shrubs native to the region. The 1887 survey shows the site as almost totally vegetated with trees and shrubs except on the sandy beach. The survey identifies maple, birch, hemlock, and fir specifically by name. Some low vegetation is apparent in the 1883 photograph of the site but the species cannot be identified. Neither the 1887 survey or period photographs depict any vegetation that would have impeded views to and from the lighthouse. A similar circa 1884 photograph with the same orientation (Figure 2), reveals a broader view of the area immediately adjacent to and west of the keeper's house. The vegetation shown on the circa 1884 photograph is still not clearly discernible but the profiles indicate that there is some fairly tall tree cover which appears to be primarily deciduous but with some coniferous forms also apparent. Photographs for this period also indicate the presence of low shrubs and groundcover scattered throughout the site. The site's sandy soil is apparent in all photographs from the period with many sandy areas left unvegetated. The wide beach apparent in photographs from this period appears to be covered with a combination of typical scattered beach debris and low native vegetation.

As in the preceding periods there undoubtedly were small-scale site features associated with domestic life and the function of the station but there is little written or graphic documentation. The 1893–1897 photographs (Figures 4 and 5) show large stacks of wood in the fog signal shed vicinity; the wood would have been used to fire the steam boilers.

The 1887 plan indicates the fencing northwest of the dwelling and fencing of the garden that was mentioned in reports for 1878. A dotted line extending from the shop to the privy and back to the dwelling indicates a fence in the location west of the dwelling. There are additional written references to fencing in the 1870s but these fences are not indicated on the plan. The plan does not include fencing of the fog signal house as recommended in 1875 or a fence surrounding the dwelling and proposed to be extended to the lakeshore. These references imply that the dwelling was fenced sometime prior to 1875 since an extension was recommended in that year. The exact location of that fence is not known but it is logical to assume that it corresponds roughly with the fence location shown in later photographs.

The first photographic documentation of fencing at the light station is a pair of circa 1893–1897 photographs (Figures 4 and 5). In the first photograph the fence appears to have narrow wood pickets that extend above the top wooden rail. The fence, which may or may not date from the 1875 period, also appears to have been whitewashed or painted white. The second photograph shows the fence much more clearly. The pickets are narrow in width with pointed tops that project above the upper rail. The fence climbs the knoll on the north side of the lighthouse and turns to enclose an area to the west of the keeper's dwelling. It is assumed that the fence completely enclosed the tower, passageway, and dwelling.

A number of coniferous trees are visible on the knoll; a few deciduous trees are also apparent. Mixed deciduous and coniferous trees are also visible on the higher elevation to the rear of the combined fog signal shed.

Modernization Period 1897-1933 (exhibit 5)

The period 1897–1939 was one of modernization and site consolidation with land use and activities associated with those uses appearing to change little during this period. The landscape organizational pattern established and developed during earlier periods continued through this period, and indeed, throughout the remainder of the station's operational period. The site was essentially completed during this period and achieved much of the visual character still evident today. The major change during this period was the consolidation of the two fog signal buildings into one. Other changes associated with more efficient and modern operations technologies and policies included construction of the brick oil house west of the original metal oil house and installation of the steel tank west of the brick oil house.

Photographs are the best researched sources of site history information that have been investigated for the years 1897 to the present. The available photographs from the late nineteenth and early twentieth centuries reveal considerable information about the site but reflect only a few changes from the earlier period. They supplement the earlier letter book citations by providing visual documentation for landscape features. Few photographs identified to date, however, provide detailed views of individual landscape features. Archeological studies suggest that there was an automobile garage and a chicken house but no photographs or documentary evidence has been identified concerning such features. Physical investigations of the site have identified surviving ornamental plantings such as lilac and primrose but historical research to date has revealed nothing about the origins of these and other vestiges of the domestic landscape.

The 1910 *Description of Buildings, Premises, Equipment, Etc. at South Manitou Light Station* provides one of the best sources of documentation for South Manitou in the early twentieth century. The description gives the area of the reservation as 10.15 acres by original survey of A. E. Hatton in July 1839, and of 12.63 acres according to George Y. Wisner September 1-4, 1884. There is no indication of an attempt to resolve the discrepancy. This description, as did the 1887 survey, lists 0.66 acres as enclosed. It describes the reservation as not "fenced in." The description of "Enclosures to premises" continues, "Tower, dwelling, shed, and privy are fenced in with picket fences. There is a wire fence around the garden, size 135' x 171'-6." The description gives the distance from the tower to the high water mark as 74 feet. The boat landings are described as "directly in front of fog signal house, also one constructed by the U.S.L.S.S. in front of the boat house." There is a description of a 134-foot, three-plank walk leading from the tower to the boat landing in front of the fog signal house. The condition of the station is listed only as "fair." The lighthouse background "upon which it is projected, as seen from the sea or lake" is described as "trees and foliage of surrounding countryside." The land area in timber or shrubbery is estimated at "about 8 acres, more or less."

The soil in the "immediate vicinity" of the dwelling was not evaluated as "susceptible of being protected by grass, shrubbery, or trees," although other portions of the reservation were evaluated as such. None of the reservation was evaluated as suitable for profitable cultivation. The description identifies four cribs for beach protection. Four outbuildings are listed: a boat house, barn, woodshed, and privy. The description continues that there are walkways to all outbuildings. It lists 315'-6" of concrete walkways surrounding the dwelling; the balance are plank walks. The description also reports that the garden has been "given up" on account of shifting sand." The former garden space, however, was still enclosed. The only cistern identified is the one "under dwelling." The boat landing was described as "8'x8" [*sic*] ... made of 2"x6" stock spiked together ..." The description notes that the 1901 boat house was located on the U.S. Life Saving Station reservation and linked to the lighthouse reservation by a plank walk extending from the landing.

A circa 1902 photograph (Figure 7) provides the earliest known view of the addition of the brick oil house to the light station cluster arrangement northeast of the dwelling. A circa late 1930s photograph (Figure 8) provides the earliest reliable visual documentation for the concrete oil drum stands still present on the site, although there is an indication of an oil drum stand in the 1902 photograph midway between the two oil houses. A photograph believed to date from about the same time as the 1910 description (Figure 9) shows a picket fence, relatively steep stairs descending the knoll from the rear door of the keeper's dwelling, and two chickens pecking in the sparsely vegetated yard. Since no chicken house is mentioned in the description, the chickens may have been either at free range or sheltered in the barn.

A similar view circa 1928 (Figure 10) shows the first known instance of a flag pole with the American flag at full mast, the same fence, and what appears to be a laundry yard enclosed with an unpainted post and wire fence. Much of the area directly behind the fence is bare. The laundry yard appears to occupy what would have been the garden prior to 1910. The gable-roofed structure located generally west of the keeper's house on the left in the photograph may be the barn mentioned in the letter books for the period.

Another gable-roofed building on the knoll adjacent to the dwelling is probably the woodshed/shop, also visible in the circa 1910 photograph. It appears that the vegetation within the picket-fenced area on the knoll may have been thinned or removed between during the interval between the dates of these two photographs.

Later photographs from circa 1930 (Figure 11) and from 1933 (Figure 12) reveal no substantial change in the landscape. Both the brick and metal oil houses are still present. Sparse ground cover, clumps of deciduous trees, and the same cluster arrangement with its picket fence are still evident. The photograph shows an oil drum in its stand northeast of the lighthouse tower. An aerial photograph of the light station in the 1930s (Figure 13) provides the best view of cluster arrangements

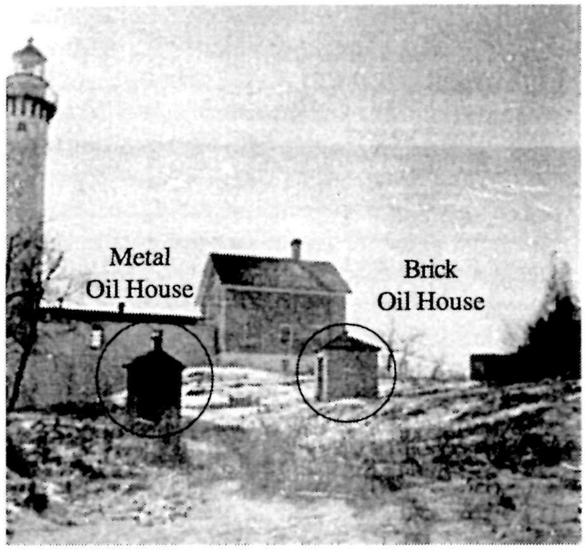


Figure 7 *View looking south toward the South Manitou Island Lighthouse, circa 1902.*

Figure 8 *View looking southwest toward the South Manitou Island Light Station, circa the early 1930s.*

and of the spatial relationship of the light station to the island.

The utilitarian organization of the site is evident. The dominant light tower and the fog signal building are sited as close to the shoreline as feasible and practical in keeping with their role in navigational safety and communication. All other features are subordinate to and supportive of those two functions and have less prominent locations. At the lake's edge the piers and shoreline cribs are visible; portions of the curving and elliptical walkways are also apparent in this aerial view. A photograph of the fog signal building taken after 1897 when the two individual structures were combined

Figure 9 *View looking east toward the South Manitou Island Light Station, circa 1910.*

Figure 10 *View looking east toward the South Manitou Island Light Station, circa 1910.*

Figure 11 *View looking north toward the Light Tower, Passageway, and Keeper's Dwelling at the South Manitou Island Light Station, circa 1930.*

Figure 12 *View looking south toward the South Manitou Island Light Station, circa 1930.*

(Figure 14) provides visual documentation of the pier extending from its central door. The pier is a horizontally laid board pier but the terminus with the water is not visible in the photograph. The aerial view contributes to an understanding of the relatively unimportant role of vegetation to the station. Vegetation is located primarily at the edges of the cluster and sets the station apart from other island areas. This view makes it clear that the site in the 1930s has retained much of the essential character of the late nineteenth century.

The major response to the natural character of the site during this period appears to have been abandonment of the garden established west of the residential/light tower during the preceding period. The garden was abandoned by at least 1910 as a result of the overwhelming effects of windblown sand on gardening efforts. The relative lack of ornamental and fruit-bearing vegetation is probably related to the damaging effects of wind and sand on introduced vegetation.

On-site vegetation appears to have remained essentially the same as during the preceding period with two exceptions. The area north and east of the residential/light tower cluster appears to have become more densely vegetated. There is also a clump of nine tall deciduous trees (believed to be cottonwoods) clearly visible between the Tower and the Fog Signal Building in an undated photograph from the early twentieth century, circa 1902-1910 (Figure 15).

Photographic analysis appears to indicate that fence design but probably not fence locations changed several times during this period. This degree of change may reflect the vulnerability of fences to wind, sand, and water; or, perhaps, the change is attributable to experimentation with various designs to find a more effective way of using fencing to control the effects of windblown sand on the residential/light tower cluster. What may be the second fence on the site (or possibly a reworking of the first fence depicted during the preceding period) appears in the undated photo from the early twentieth century (Figure 15). This fence also has narrow pickets but they do not extend above the top rail. A third fence design with broad pickets appears to have been more enduring than its predecessors. It appears both in the circa 1910 (Figure 9) and circa 1928 (Figure 10) photographs of the station from the west, and in an undated photograph of the front of the Light Tower (Figure 16). The fence, which is white, appears to be about chest high on a human figure standing near

Figure 13 *Aerial view of the South Manitou Island Light Station, circa the 1930s.*

Figure 14 *View looking west toward the Fog Signal Building at South Manitou Island, circa 1900.*

Figure 15 *View from Lake Michigan looking southwest toward the South Manitou Island Light Station, circa the early 1900s.*

the Tower's door. Since the figure is presumed to be an adult male, the height of the fence is likely to have been approximately four feet.

Final Period of Operation 1934-1958 (Exhibit 6)

The station landscape appears to have experienced only minor development during its final period of operation. Major operational changes, however, affected land use and the daily activities associated with the site. As a result of the 1939 reorganization with the U.S. Coast Guard, the light station was vacated except to operate the light. It was at this time that the residential

Figure 16 *View of the South Manitou Island Light Tower and surrounding picket fence, circa the early 1900s.*

function, which had been a site characteristic since its establishment, was abandoned. Coast Guard families lived in the village and everyday domestic chores at the station such as keeping chickens and hanging out laundry were no longer associated with the light station.

Aerial photographs of the light station during this period provide an overview of the site's organization, most of which was established during earlier periods. A circa 1930s photograph (Figure 13) shows the fenced, residential/light tower cluster and fog signal building in relation to the U.S. Coast Guard lookout tower and village near the island's sandy point. What is presumably a boardwalk path between the light station and the lifesaving station is evident behind the fog signal building. Three jetties and the pier at the fog signal building mark the shoreline. A later aerial photograph from 1939–1940 (Figure 19) provides a more detailed view of the site, showing not only building clusters but smaller-scale landscape features, fences and walks. Steel seawalls reinforce the lakeshore in three places.

Figure 17 View from Lake Michigan looking southwest toward the South Manitou Island Light Station, circa the 1930s.

Fencing at the light station continued to exhibit change during this period. An undated photograph that post-dates the 1934 installation of the air diaphone system (Figure 8) shows a fourth fence design that returns to the use of a narrow, white-painted picket but with the top rail painted a dark color. Another undated photograph from about this period (Figure 17) shows a similar fence with a white top rail. A fifth fence design with broad pickets and a sloping cap is shown clearly in a 1938 photograph at the front of the Tower (Figure 18). The aerial photographs from the late 1930s (Figure 13) and early 1940s (Figure 19) continue to show the fence enclosing the residential/light tower cluster. By 1946, however, the fence is not visible in site photographs (Figures 20 and 21). The disappearance of the fence during this period may be related to the fact that there were no longer residents living in the cluster or may have been a World War II-era decision not to commit limited construction materials and labor to fence maintenance and repair. Alternately the fence may not have been considered necessary under Coast Guard management practices. For whatever reason, the loss of the fence in the 1940s represented a lessened commitment to managing the natural processes of the site, and the beginning of the site's reclamation by the forces of sand, wind, and water.

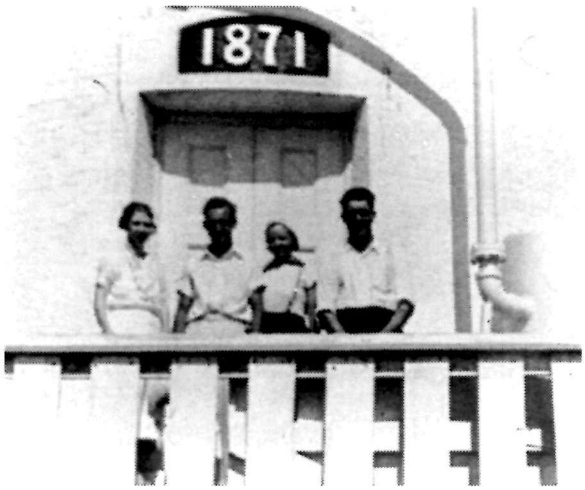


Figure 18 August 1938 view of the fence at the front of the Tower.

Figure 19 Aerial view of the South Manitou Island Light Station, 1939 - 1940.

The final addition to the station was built circa 1939–1940 when a wood frame Coast Guard lookout tower was constructed on the beach near the fog signal building (Figure 20). The 1944 *South Manitou Is. L.S. Plot Plan* (Figure 22), prepared by the U.S. Coast Guard in 1944, indicates the location of the lookout tower. This

Figure 22 *View looking southeast toward the South Manitou Island Light Station, circa 1946.*

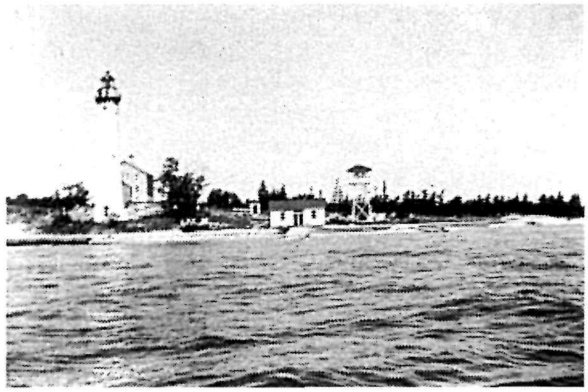


Figure 21 *View from Lake Michigan looking west toward the South Manitou Island Light Station, 1946.*

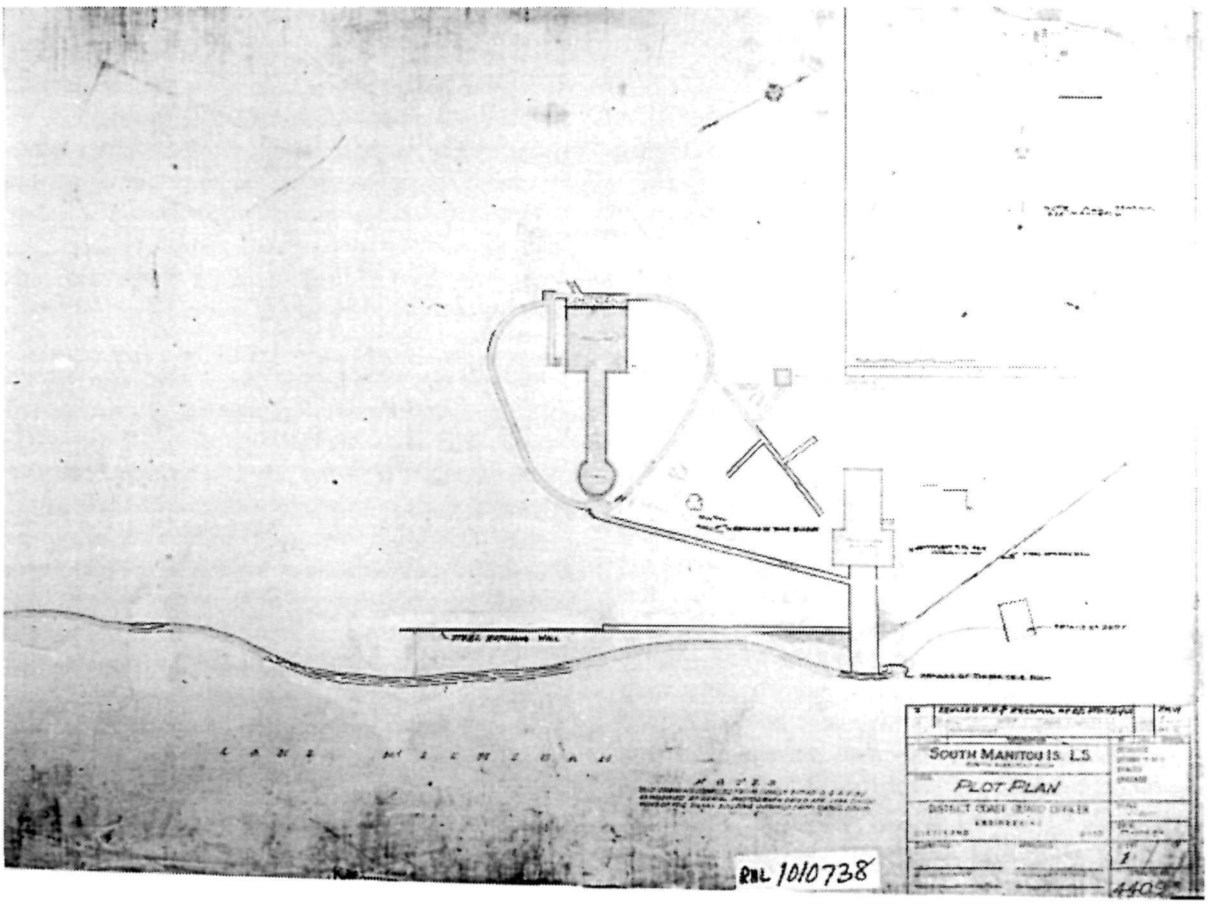


Figure 22 *The 1944* South Manitou Is. L.S. Plot Plan , *prepared by the U.S. Coast Guard in 1944,*

plan provides the best known documentation of the complete light station prior to its closure in 1958. In addition to depicting the site's buildings, the plan also includes the stone-filled timber cribs and three timber jetties developed for shoreline protection. The timber jetty nearest the lookout tower is identified as in "poor condition."

The light station landscape ceased to be a functional landscape in the 1950s. The South Manitou Island light was discontinued when it was replaced by a lighted gong buoy on the South Manitou Shoal.[3] The actual U.S. Coast Guard closing of the lighthouse on 12 December 1958, however, brought an official end to more than a century of light-related functions on the island.

Post-operational Period 1959-1969 (Exhibit 7)

Following the lighthouse closure, the site was left to deteriorate and was vandalized occasionally. Lakeshore erosion continued to affect the shoreline. The light station's dominant site features, however, had been designed and built to withstand extreme weather and, although they suffered damage, most endured—even without care. Since it was no longer necessary to keep the site functional and accessible, shifting sand, which had always been a problem, began to cover much of the site, obscuring walkways and other landscape features. On-site probing in the summers of 1995 and 1997 indicates that many of these features survive and are buried beneath the sand. Changes that postdate the closure are not well-documented. Many changes are attributable to neglect, vandalism, and the island's extreme weather conditions. It appears that the outbuildings associated with the residential/light tower cluster—the privy, the shop, and the barn—disappeared during this period.[4] How and why they were removed is not clear; they may have been destroyed by weather or vandalism, or simply dismantled by trespassers searching for salvage materials. With the loss of the light station's utilitarian function, vegetation at the site began to take on a denser character.

National Park Service Management 1970–1995 (Exhibit 8)

In 1970 the U.S. Congress passed the law establishing Sleeping Bear Dunes National Lakeshore and set aside funds for the purchase of land including South Manitou Island. A subsequent 1974 National Park Service study identified most of the island as an area to be designated as wilderness. This concept was not favored by many who appreciated the island's cultural resources, including the light station. As a result of this concern, the core of the light station was reconsidered and evaluated as eligible for the National Register; it was listed in 1983 but its landscape values were not identified as character-defining features. As part of the GMP process, the light station and its environs have been included in a historic zone and not designated as wilderness.

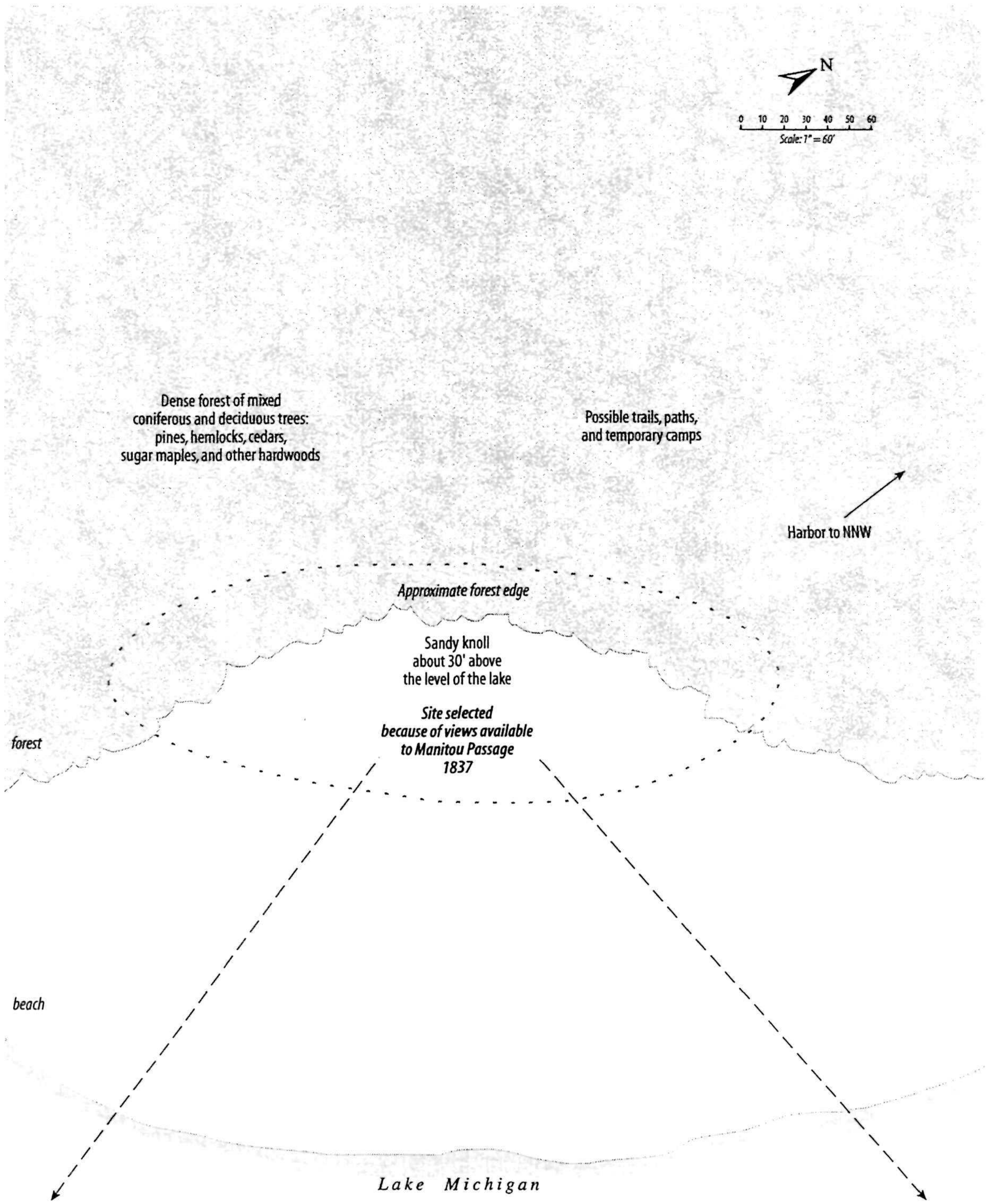
The light station today, as operated by the National Park Service, consists of the Keeper's Dwelling, covered Passageway, Light Tower, Fog Signal Building, the Brick Oil House, and foundations of other ancillary structures. Repairs and maintenance are performed consistent with the needs of building protection and visitor access and safety. New concrete sidewalks were installed around the residential/light tower cluster in 1981. The boardwalk leading from the light station to the harbor was replaced in 1993 to facilitate visitor access and maintenance functions. The replacement was with in kind materials and matches the historic walk; however, due to shrinkage of the boards, plywood plugs were later added to fill in the gaps where the planks formerly met end-to-end.

Additional efforts have been made by the National Park Service to control and limit the extent of shoreline erosion. In 1983 a steel seawall was installed in the vicinity of the fog signal building. By 1987, a more extensive protection strategy was implemented with the construction of a boulder revetment extending along the shoreline from northeast of the fog signal building to several hundred feet south of the Light Tower.

A comparison of the vegetative character of the site in 1995, with that apparent in historic photographs from the period of operation, indicates significant vegetative regrowth during this period. There are several tall balsam fir and junipers on the north side of the Passageway, cottonwood trees both east and north of the Tower, and numerous Lombardy poplars northwest of the Fog Signal Building. Cottonwoods grew in that general location historically. The surrounding wooded areas have encroached closer to the site than they were during the historic periods for which there is photographic documentation. Considerably more understory vegetation and shrubs are apparent in the 1990s than during the period of operation.

Exhibit 1

(Not to scale, see Appendix F)



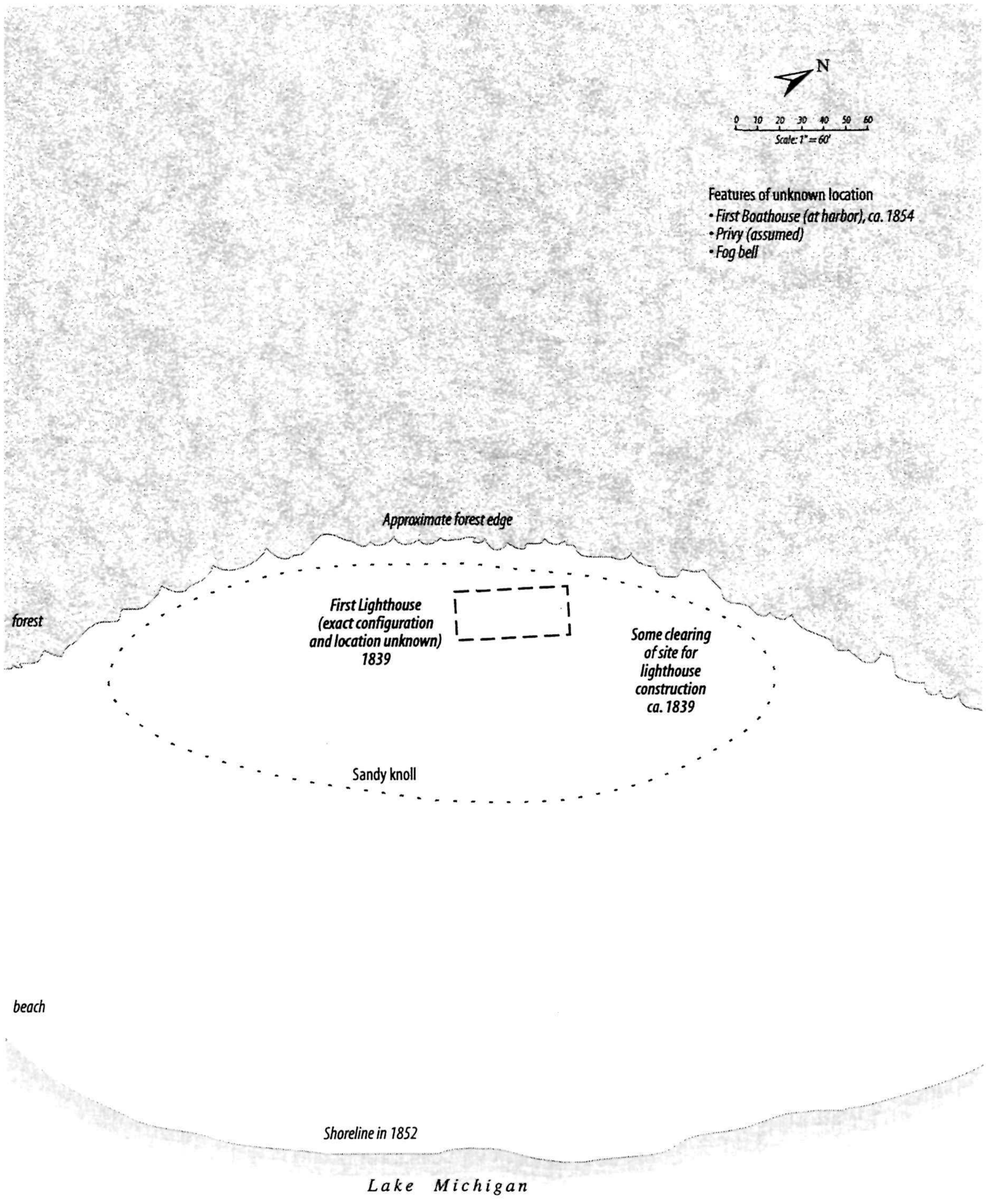
Map Sources:
Sketch Shewing [*sic*] Site at South Manitou Light-House, Lake Michigan, August 1874.

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 1
SOUTH MANITOU ISLAND LIGHT STATION
Landscape Chronology: Pre-1839

Exhibit 2

(Not to scale, see Appendix F)



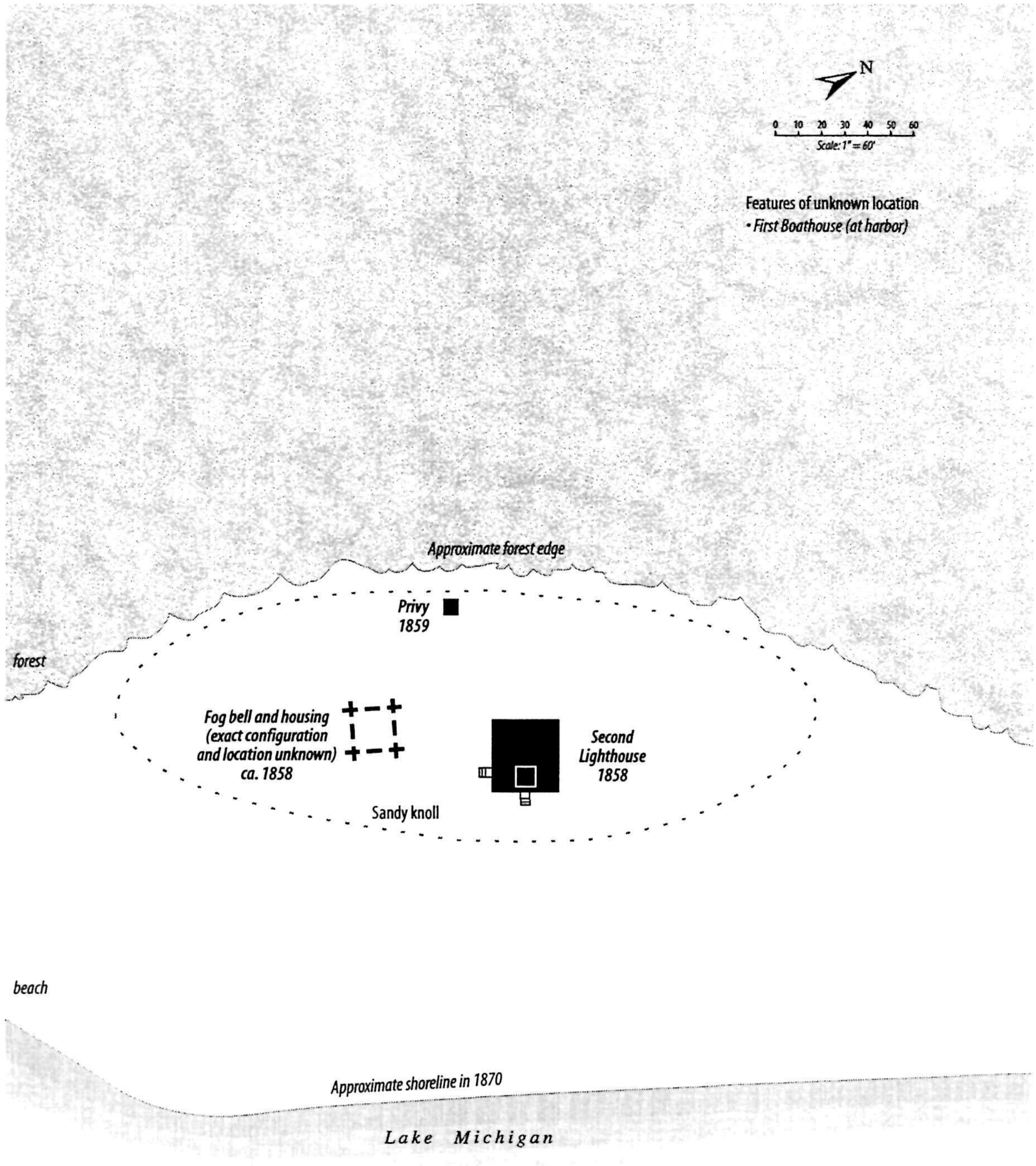
Map Sources:
Sketch Shewing [*sic*] Site at South Manitou Light-House, Lake Michigan, August 1874.

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 2
SOUTH MANITOU ISLAND LIGHT STATION
Landscape Chronology: 1839-1857

Exhibit 3

(Not to scale, see Appendix F)



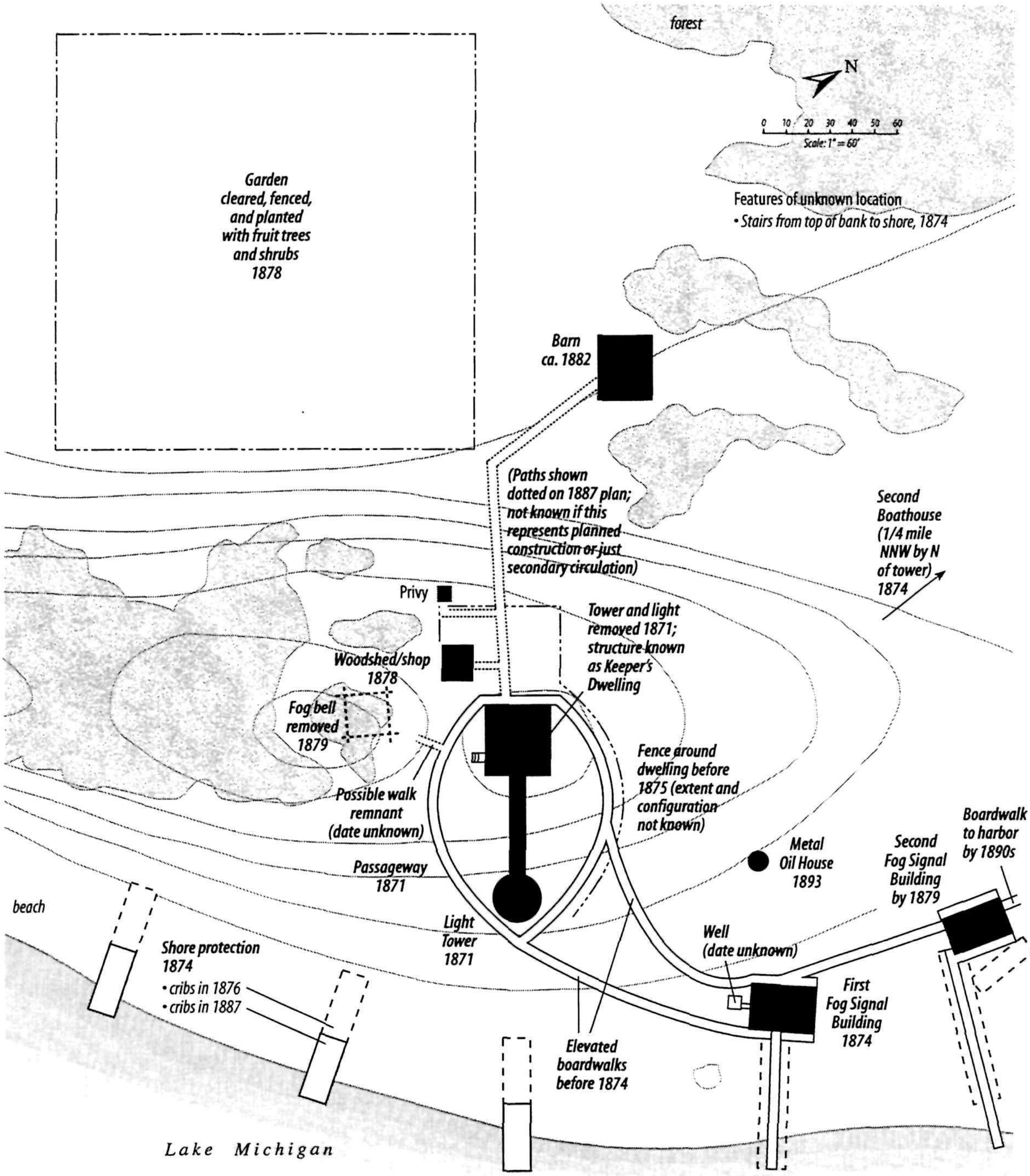
Map Sources:
Sketch Shewing [*sic*] Site at South Manitou Light-House, Lake Michigan, August 1874.
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 3
SOUTH MANITOU ISLAND LIGHT STATION
Landscape Chronology: 1858-1870

Exhibit 4

(Not to scale, see Appendix F)



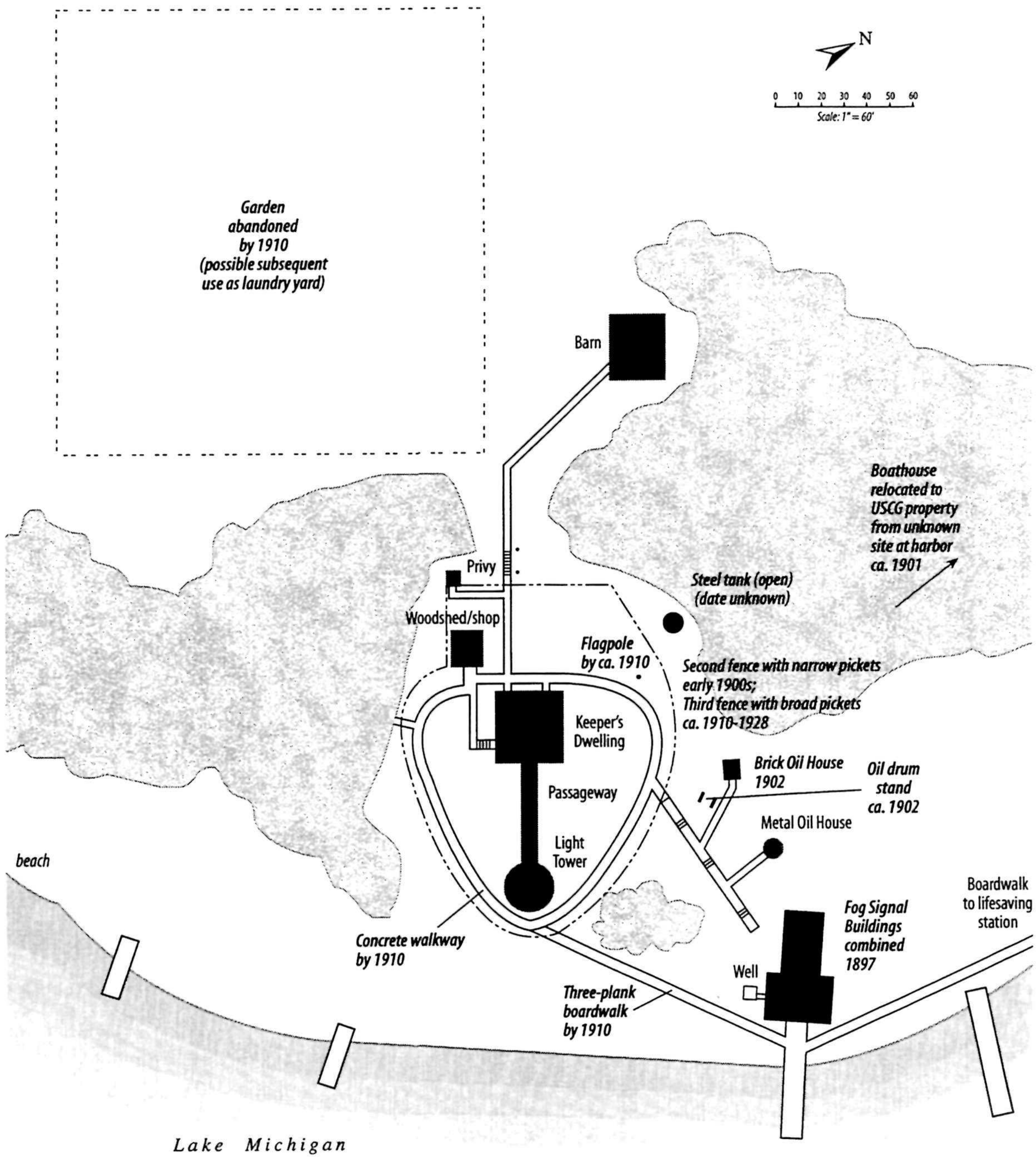
Map Sources:
South Manitou Light Station, Shore Protection, July 1, 1876.
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
SLBE Negative #s 1106, 1222, 1212 [Figures 1, 2, 4]
Undated photographs, collection of Glen Furst [Figures 3, 5]

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 4
SOUTH MANITOU ISLAND LIGHT STATION
Landscape Chronology: 1871-1896

Exhibit 5

(Not to scale, see Appendix F)



Map Sources:
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
SLBE Negative #s 3324, 2068, 1235, 1333, 2051 [Figures 7, 9, 10, 15, 16]
South Manitou Is. L.S., South Manitou, Mich., Plot Plan, June 27, 1944.

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

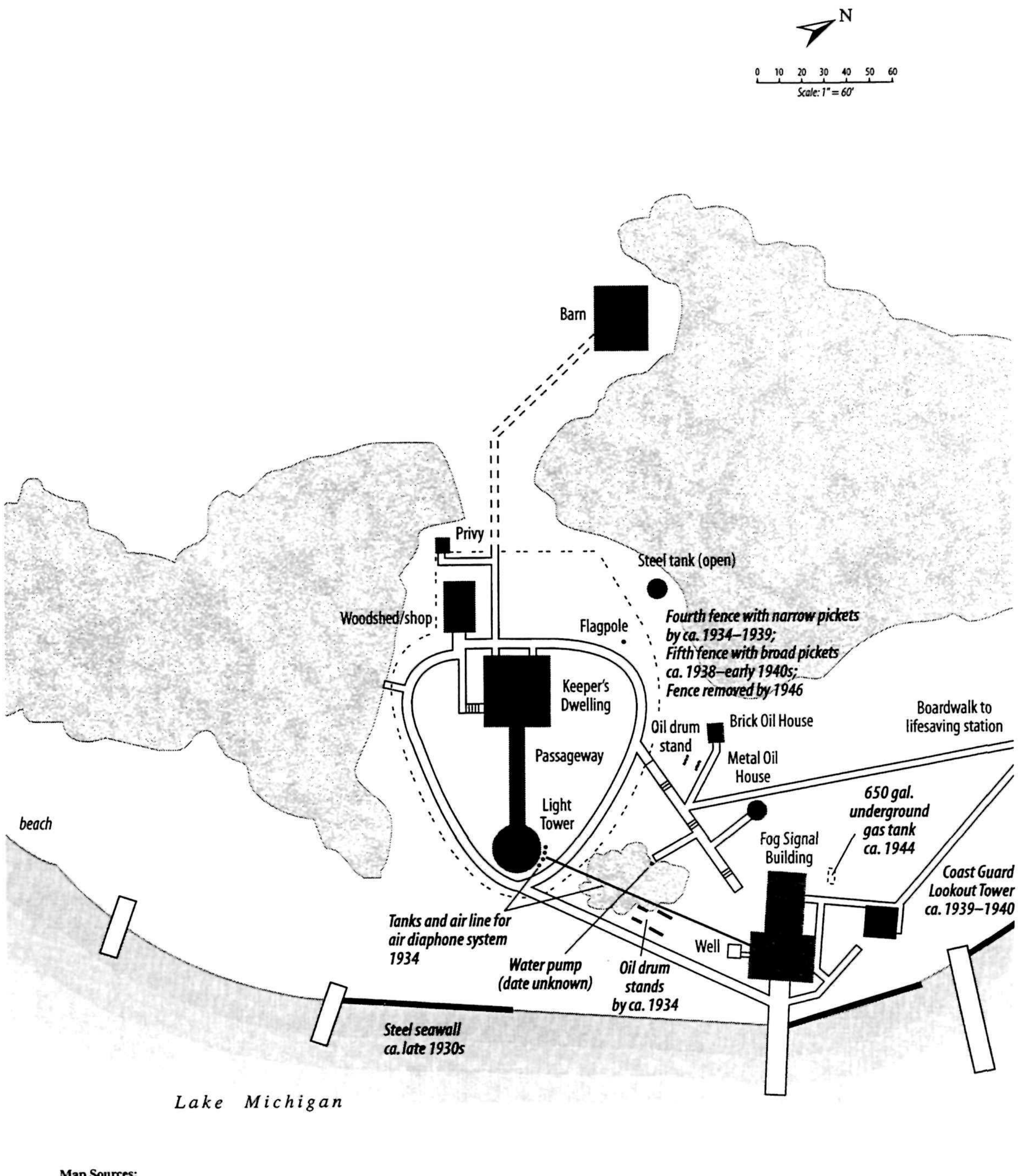
Exhibit 5

SOUTH MANITOU ISLAND LIGHT STATION

Landscape Chronology: 1897-1933

Exhibit 6

(Not to scale, see Appendix F)



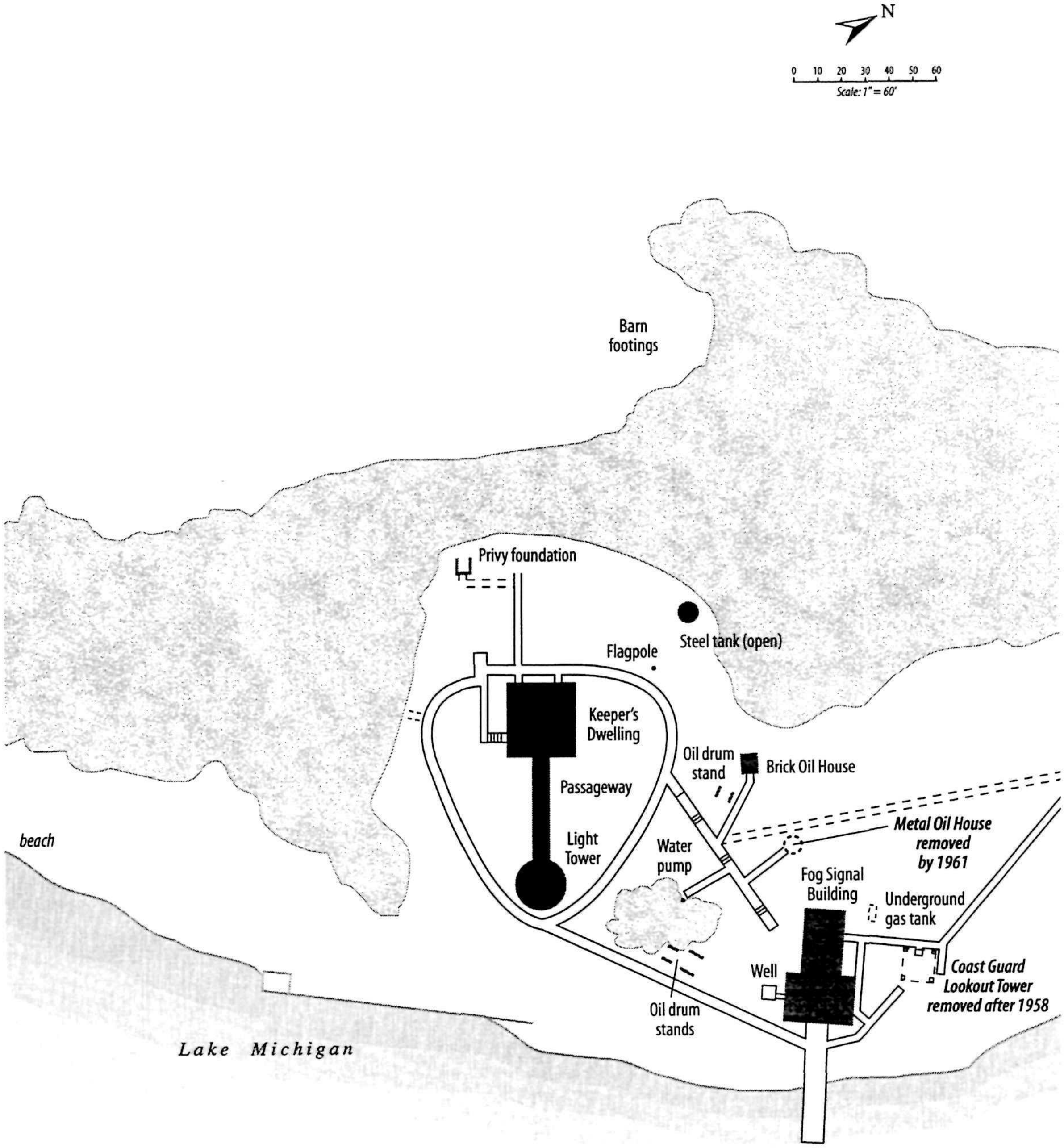
Map Sources:
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
South Manitou Is. L.S., South Manitou, Mich., Plot Plan, June 27, 1944.
SLBE Negative #s 2055, 1238, 1242, 1223, 3292, 2027, 2124 [Figures 8, 12, 13, 17–19, 21, 22]

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 6
SOUTH MANITOU ISLAND LIGHT STATION
Landscape Chronology: 1934-1958

Exhibit 7

(Not to scale, see Appendix F)



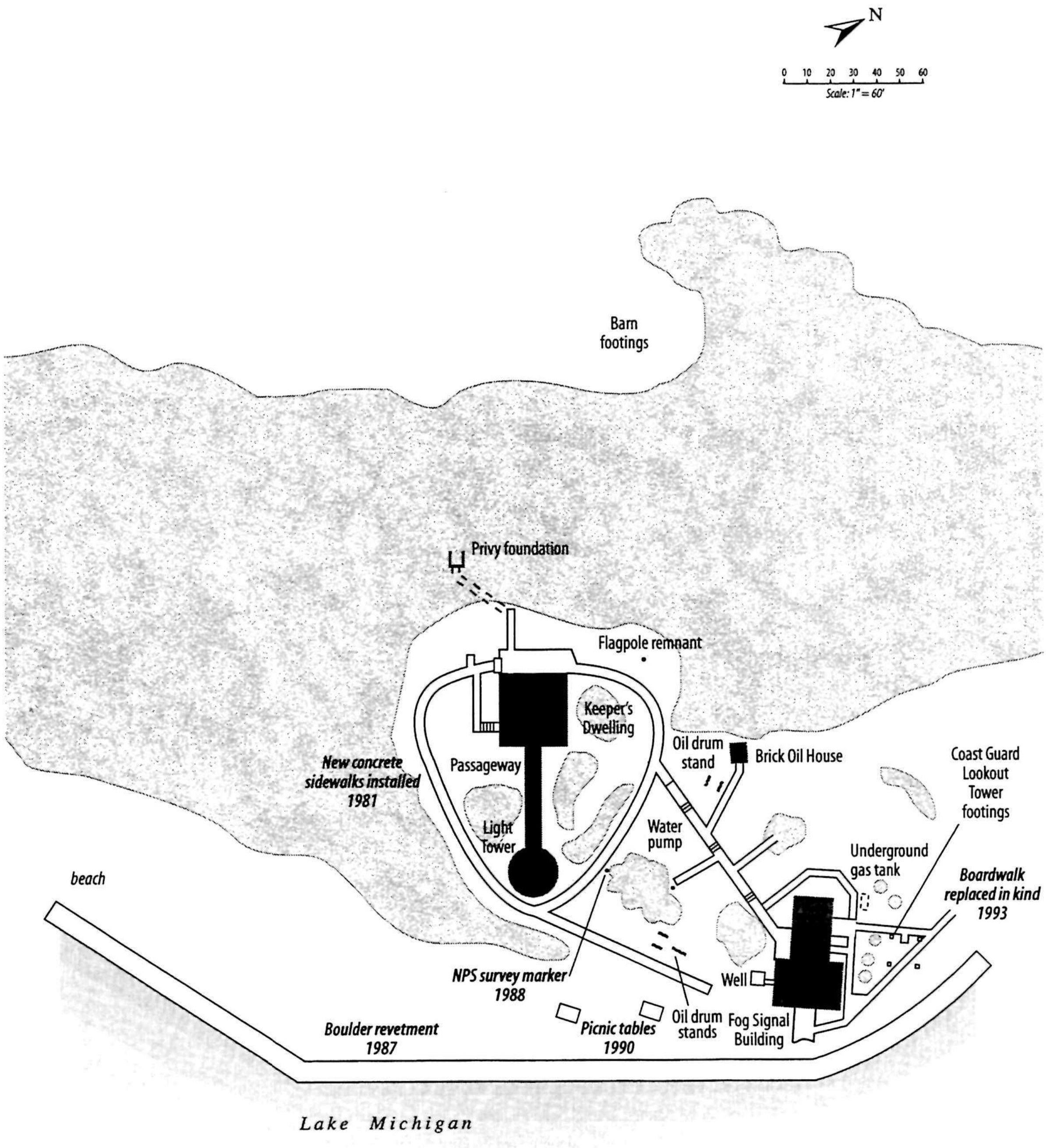
Map Sources:
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
South Manitou Is. L.S., South Manitou, Mich., Plot Plan, June 27, 1944.

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 7
SOUTH MANITOU ISLAND LIGHT STATION
Landscape Chronology: 1959-1969

Exhibit 8

(Not to scale, see Appendix F)



Map Sources:
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
South Manitou Is. L. S., South Manitou, Mich., Plot Plan, June 27, 1944.
South Manitou Is. L. S., South Manitou, Mich., Revised Plot Plan, May 10, 1965.
Photographs, Betty Kramer collection, 1980s.
U. S. Lighthouse Reservation, Historic American Buildings Survey, 1988.
Fieldwork conducted by Land and Community Associates, June 1995, June 1997.

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 8
SOUTH MANITOU ISLAND LIGHT STATION
Landscape Chronology: 1970-1995

[1] The 1874 sketch showing the shore line protection for the South Manitou site *(Drawing 6a)* is believed to be a proposal because it varies substantially from the 1876 *South Manitou Light Station Shore Protection, Executed according to Report of Superintdt of Construction (Drawing 6)* which is believed to reflect as-built conditions. The 1874 sketch is interesting but puzzling for what it may reveal about the original 1839 construction on the site. The sketch shows a siting, size, and orientation for the keeper's dwelling that is not similar to the 1858 keeper's dwelling. The dwelling depicted on the 1874 sketch is a more elongated rectangle; it also depicts a separate freestanding tower and a fog bell frame, all of which are located west of the 1871 tower.

[2] This figure is in conflict with the A.E. Hatton figure of 10.15 acres.

[3] This date had previously been believed to be 1958. The 1989 interview with Ronald Rosie, however, gives the date as 1952.

[4] The metal oil house appears in the 1946 view of the light station (Figure 22), but is missing in a 1961 magazine photograph of the site. Shortly after NPS assumed responsibility for the island in 1970, the remains of the metal oil house -- including its interior shelving -- were discovered in a trash mound and relocated to the Coast Guard lifesaving station.

Part E:
Historic Architectural Analysis

Part E: Historic Architectural Analysis

The extant structures at the South Manitou Island Light Station appear relatively the same as they did in 1958, when the station was abandoned by the Coast Guard. However, some physical change has taken place, much of which is the result of extensive vandalism and deterioration throughout the 12 years following the Coast Guard's departure. During this period, no administrative agency claimed jurisdiction or provided maintenance to the station until 1970. Since its initial jurisdiction over the station in 1970, the National Park Service has been implementing procedures to mitigate the continuous problems of deterioration and vandalism at the station, while, at the same time, providing maintenance and stabilization of the individual structures.

Keeper's Dwelling (with attached roof lantern)

General Observations

The 1858 construction at the South Manitou Island Light Station included a brick keeper's dwelling with a wood frame lantern attached to the roof at the east (lake) end of the building. This dwelling is extant today, however, the roof lantern was removed and the roof opening covered over in 1871.

The 1858 dwelling is a two-and-one-half story structure. It was originally constructed as a single family residence. However, after minimal physical changes were undertaken, the structure eventually began to house two keepers and their families. The building is approximately 30' - 6" x 32' - 0" with 2' - 0" thick stone foundation walls, which extend up to 8' - 6" above grade (essentially making the basement at grade level) at the west end of the structure. The first and second floor walls are 15" thick brick, comprised of three brick wythes and an air space.

A significant amount of the materials found in the dwelling are considered to be original to 1858. The extent of original material and its structural condition can be attributed to the importance that the United States Lighthouse Service placed on building its structures with solid, durable materials, and the strict maintenance guidelines that keeper's were required to follow. An example of this attention to the quality of materials can be seen in the extant construction specifications for the Split Rock Lighthouse on Lake Superior, which state, "All framing lumber will be good merchantable [sic] white pine or Norway, free from the usual defects."[1] Although the construction specifications for the structures at South Manitou have not been located, it can be assumed that the same standard of quality was sought for these structures as well, and for all of the light stations under the auspices of the Lighthouse Service.

Interior

There are several existing elements in the attic of the dwelling that were constructed in conjunction with the original roof lantern. The attic contains only one finished room, which is approximately 6'-7' x 13'-6'. (The remaining attic space is unfinished and uninhabitable.) The room is finished with materials similar to those found throughout the floor levels of the dwelling below. Access to the attic from the second floor below is via a wood ship's ladder (Figure 1) in the central hall, (Room 202). This stair, along with the simple handrail along the south wall and the newel post at the opening at the top of the stair, is the only remaining element intact from the original balustrade that surrounded the opening. A second newel post lies on the

Figure 1 *View of the wood ship's ladder at the second floor central hall of the Dwelling, which leads up to the attic, 1994. Note the "scoop" at the corners of the wood treads and the painted runner.*

floor of the hall below, and several wood pieces, which appear to be part of this balustrade, were found stored in the pantry in the basement. Furthermore, an additional portion of the balustrade is currently being stored in the National Park Service's museum collection on the mainland for future reinstallation or replication.

An identical stair, handrail, and newel post can be found at the nearby Grand Traverse Lighthouse in Northport, Michigan. The roof lantern at the Grand Traverse Lighthouse is also identical to the original one at South Manitou Island. This is not surprising as the Grand Traverse Lighthouse, in its original design (it was added onto in 1902), is identical to that of the South Manitou Island Lighthouse. This duplication, with respect to both the design and finishes, shows the standardization of details which took place within the Lighthouse Service.

A raised 25" x 26" wood platform, which is 8" above the floor level, remains partially intact at the northeast corner of the finished portion of the attic, as seen in Figure 2. This wood platform served as a base for a second ship's ladder which led up to the roof lantern. This ship's ladder is no longer extant, but is presumed

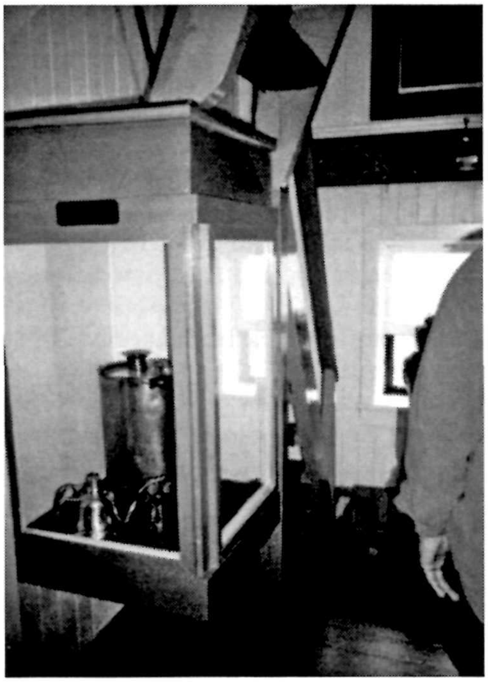


Figure 3 *View of the restored attic space at the Grand Traverse Lighthouse, 1994.*

Figure 2 *View looking east in the finished portion of the Dwelling's attic, 1994. The raised wood platform at the northeast corner once supported a ship's ladder, which led up to the roof lantern.*

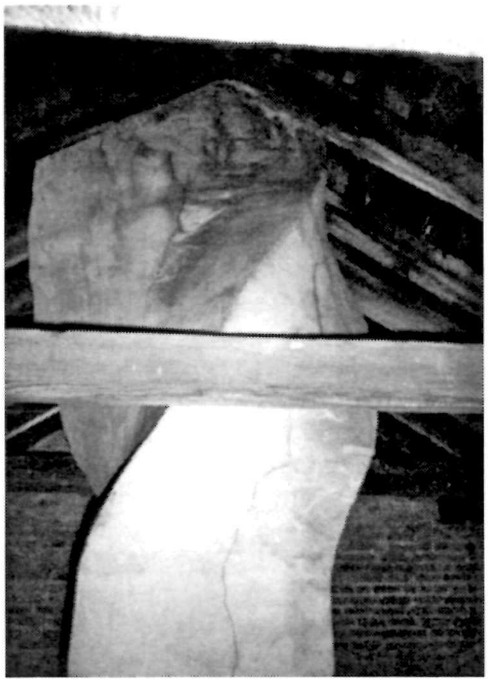


Figure 4 *View looking north into the unfinished attic space at the spiraling, plaster covered chimney in the Dwelling, 1994.*

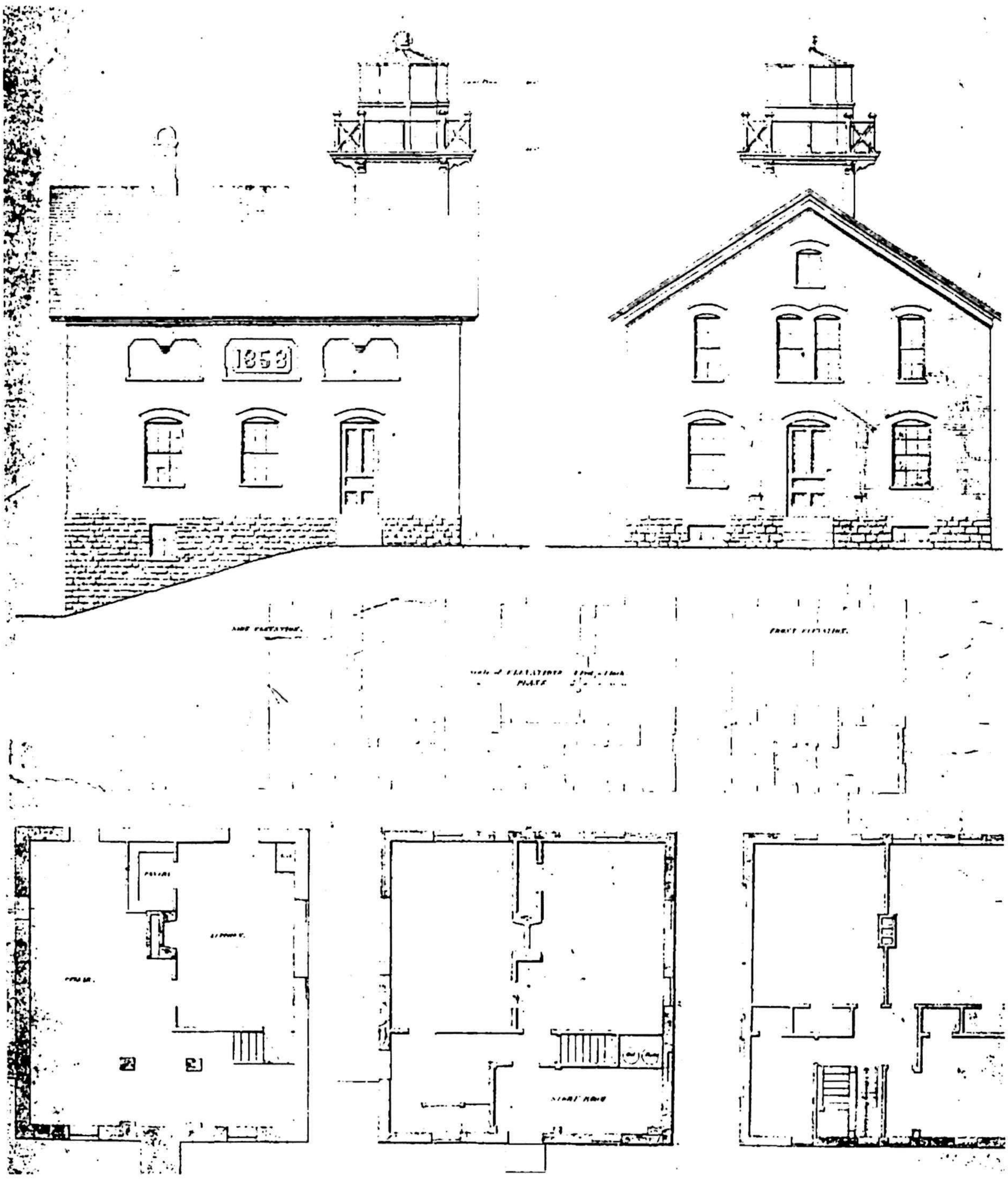


Figure 5 1858 Construction drawing for the South Manitou Island Lighthouse (Keeper's Dwelling with attached roof lantern).

to be identical to the one at the Grand Traverse Lighthouse. Figure 3 is a view of the restored interior of the attic at the Grand Traverse Lighthouse, showing the ship's ladder leading up to the roof lantern, and what the same space would have looked like at South Manitou prior to the removal of its roof lantern in 1871.

The chimney configuration of the dwelling, which spirals through the attic rafters before meeting the roof ridge, most likely also dates to the 1858 construction. The exterior brick surface of this chimney, as seen in Figure 4, is finished with plaster. The plaster was most likely applied for fire protection, and not for aesthetic purposes, as the surrounding space is uninhabitable. The twist in the chimney is for aesthetic purposes: it insures that the long side of the chimney is perpendicular to the ridge of the roof, the typical orientation.

An original feature of the 1858 dwelling is Door [I-2]. Although there is no known photographic evidence, a historic drawing of the east elevation, (Figure 5), indicates that this door, which currently connects Room 102 of the dwelling with the passageway, was an exterior door before the construction of the passageway in 1871. The threshold appears to have been a few feet above grade with exterior stone steps that led to grade.

Figure 6 *View of the Passageway looking east through Door I-2 from Room 102, 1994. Prior to the construction of the Passageway, this was an exterior entrance door into the Dwelling.*

Figure 6 is a photograph of the opening in its existing condition; the wood panel door is no longer extant.

As indicated on the 1858 construction drawings, (Figure 5), there were originally only two interior walls in the basement, which enclosed the kitchen (Room B-05) at the northwest corner of the basement. The rest of the basement space was open, and labeled only as "cellar" on the construction drawings. The large brick piers, which formerly supported wood posts which, in turn, supported the roof lantern above, were freestanding elements within the open space.

Figure 5 also shows the kitchen sink located (as it is currently) at the northwest corner of the kitchen. Historic documentation suggests, however, that the cistern, located below it, was not constructed until several years later. The 1868 annual report from the District Engineer to the Chairman of the Lighthouse Board includes a request that "Copper eavetroughs and conductor should be provided and a proper cistern [installed]."[2] This statement suggests that even if a cistern was included in the original construction, it was inadequate.

Exterior

As seen in Figure 5, the exterior appearance of the dwelling has not been altered much since its initial construction. The drawing of the south elevation, however, indicates one original feature which is no longer extant. This feature is a decorative, presumably metal, chimney cap. Although some early historic photographs (Figure 7) indicate its presence, it appears to have been removed by the turn of the century. Its removal was probably due to deterioration, followed by the lack of necessity for replacing it. Later historic photographs, such as Figure 8, indicate that the corbelled bricks at the top of the chimney were painted a color different than the rest of the chimney, presumably to resemble a cap.

Figure 7 *View of the South Manitou Island Light Station, circa the early 1890s.*

Figure 8 *View of the South Manitou Island Light Station, circa the early 1900s.*

1871 Tower

General Conditions

The 1871 light tower, which is connected to the keeper's dwelling by a 44' - 0" long enclosed passageway, is 18' - 4" in diameter at its base, and tapers to 12' - 8" at the parapet. The center space of the tower has a constant 8' - 0" diameter. The structure is comprised of two concentric walls, which extend the full height of the tower. At the ground level, the concentric walls are 2' - 0" thick (exterior) and 1' - 0" thick (interior) with a 3' - 3" air space between them. At the lantern room level they taper to 1' - 0" thick and 8" thick with a 4" air space in between. The top the tower is composed of a cast iron exterior galley surrounding the lantern.

A design feature of the tower is the false window opening located at the watchroom level. At the exterior, there appears to be four evenly spaced decorative round top windows. However, closer inspection reveals that one of the openings is actually only a recess in the outer brick wall. As a true opening, this window would not have provided much light, and would have been unsafe due to the proximity of the interior cast iron stair which runs alongside of it. Furthermore, this opening faces the island, and would not have been useful in watching for ships or fog on the lake. The construction drawings for the tower, (Figures 9 shows the design and Figure 10 shows it as built), indicate that the false opening was intended, and physical investigation confirmed, that this was an original feature. This feature was not unique to the South Manitou Island tower, however. The same false window (on the same tower design) can be observed at several other towers at Great Lakes light stations, including the tower at the Au Sable Lighthouse on Lake Superior and the tower at Petite Pointe Au Sable Lighthouse on Lake Michigan.

As might be expected, because of its height, the tower was susceptible to natural elements such as lightning. The copper ventilation ball at the top of the tower carried a platinum-tipped spindle to conduct lightning. There were also two 1/2" copper cables for grounding.

The lantern, essentially a small room with ten sides, was constructed of a cast iron framework with a sheet copper roof. Nine sides of the lantern were glazed with two layers of 1/4" clear glass. The remaining, landward, side, was opaque. The outer panes were 31 1/4" x 69 5/8" plate glass; the inner storm plates were 29 1/4" x 68". This two-layer system served as both insulation and protection against the birds. Often, unsuspecting birds would fly right through the glass. A letter from Keeper Burdick to the Lighthouse Inspector in 1917 describes one such incident, saying that,

> A duck flew through the storm pane and plate glass in the tower last night. Both the outside and inside glass were cracked all to pieces, and one duck lay dead near the lens. I think more than one struck, but only one got inside. When the inside plate broke it struck the lens and chipped it in a few places. We have put in a new storm pane.[3]

Interior

The light installed in the 1871 tower was a third order Fresnel lens with a fixed white beam visible for over 18 miles. The lens was constructed by Henry Lepaute of Paris. There were four panels of 28 lenses each and one reflector panel, set in a polygonal configuration. The height of the len's focal plane above mean high water was 104'.

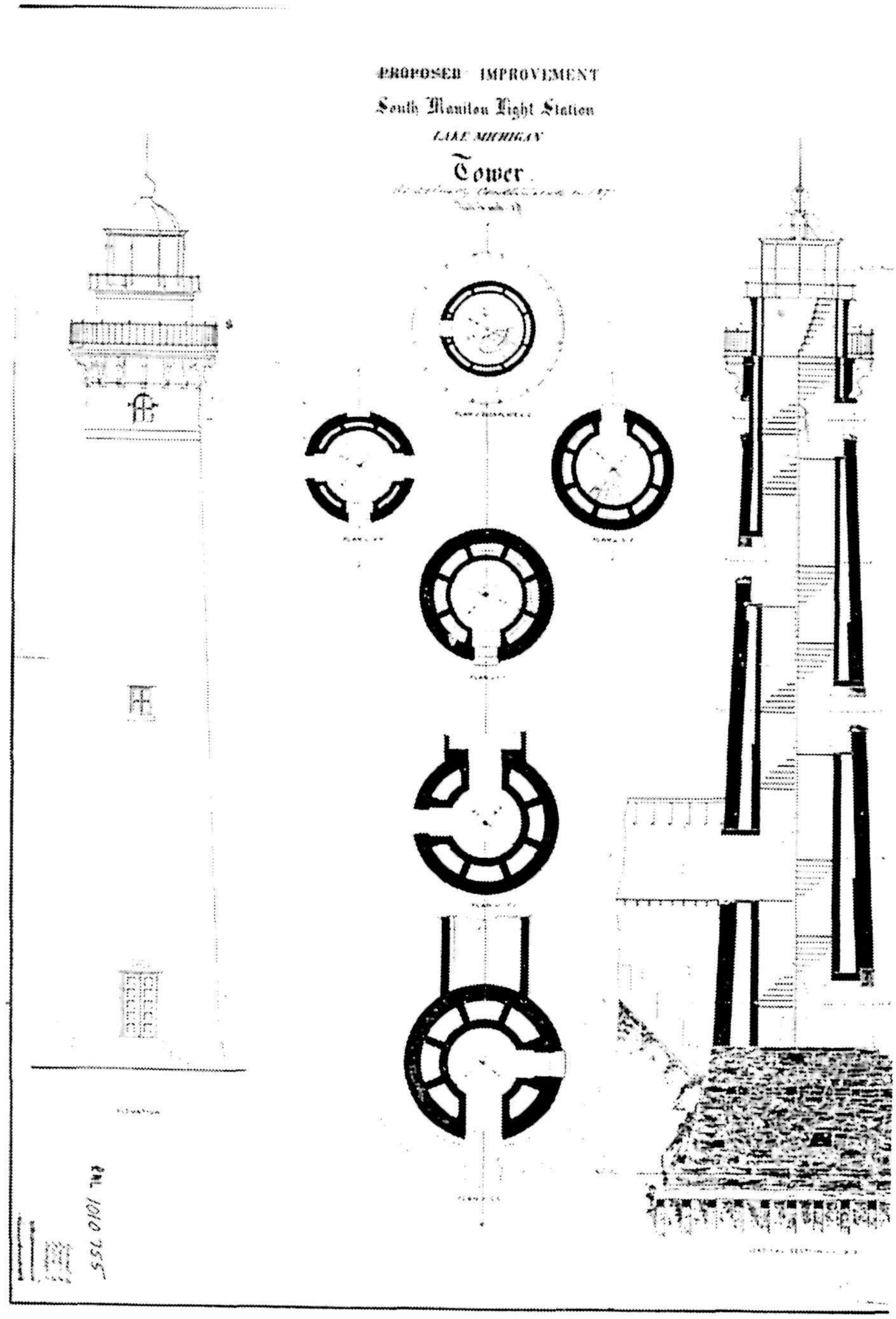


Figure 9 *Construction drawings for the "Proposed Improvement South Manitou Island Light Station Lake Michigan, 1871" showing the new tower design. Changes have been made to this drawing showing the as-built structure.*

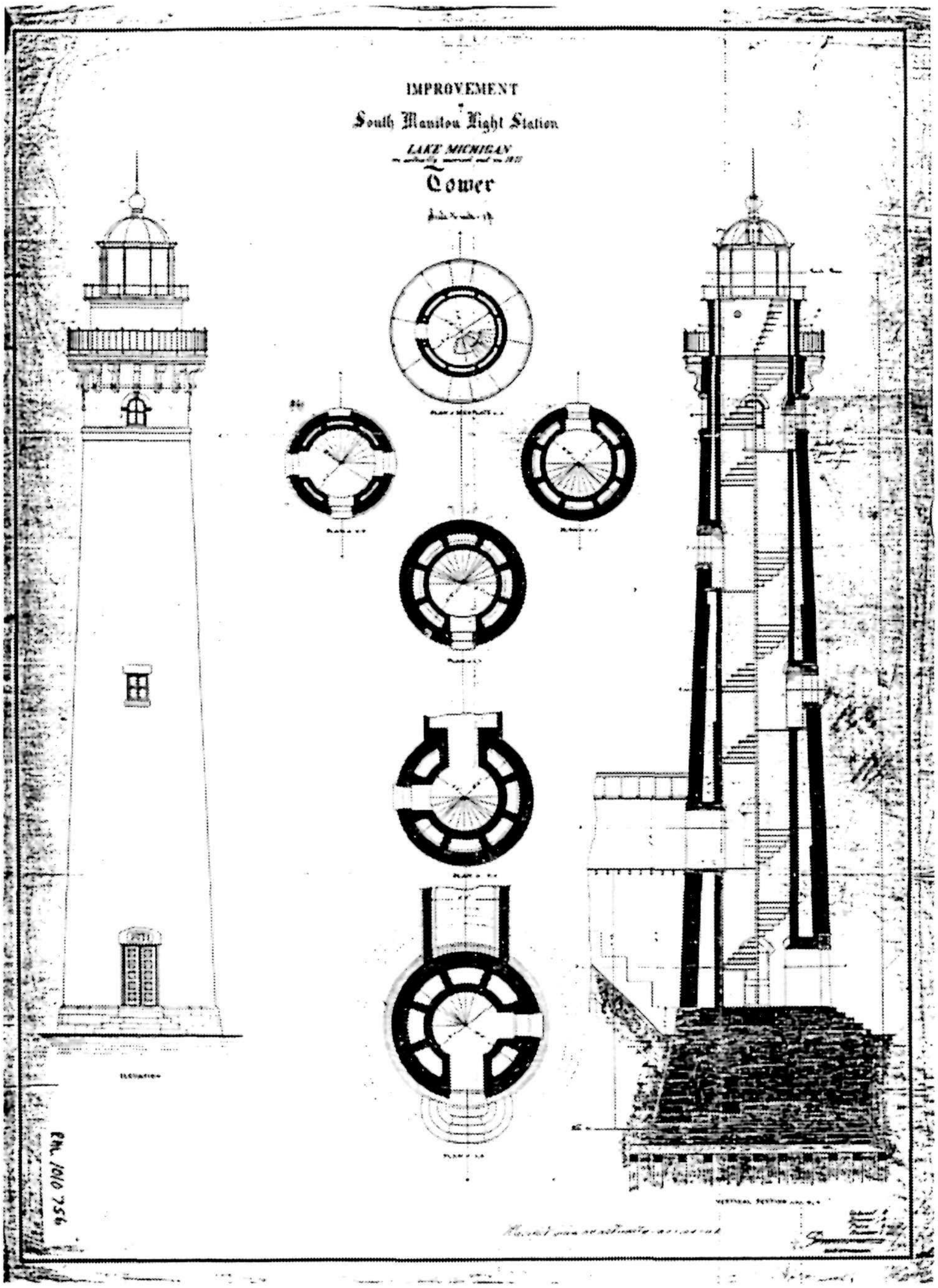


Figure 10 *As-built drawings for the new tower completed in 1871. Notice the greater detail in the doors, "Improvement at South Manitou Island Light Station, Lake Michigan, as actually carried out in, 1871."*

An interesting detail of the South Manitou tower is the presence of the counterweight cabinets within the brick wall, one at the ground level and one at the workroom level, which are typical features of towers that had revolving lights. The shaft within the wall structure was utilized to hang the weights, and were wound at the bottom by the keeper. Although the South Manitou tower exhibited a fixed light, the shaft's presence was a part of the standard details for this particular tower design. If the need arose to alter the light's characteristics in the future, due to increase shipping traffic, the shaft would already be in place.

Alterations to the Keeper's Dwelling

General Observations

As at several other isolated light stations around the Great Lakes, most repairs, maintenance, and upgrading were performed by crews sent to the station by the U.S. Lighthouse Service. A letter from the District Engineer to the Lighthouse Board justifies the reason for using these crews instead of local crews (as may have been the case at a more accessible station). The engineer states in his letter that:

> The methods indicated are the most economical and advantageous to the Government, for the reason that the station is isolated and at a great distance from the source of supply, and the materials can be purchased in this market [Milwaukee] and transported to the station by the Hyacinth. The manner of performing the labor is the best for the reason that the men employed by the Government are skilled in this line of work [plastering in this particular situation] and have had long experience.[4]

It was quite typical for materials to be bid and purchased from the lowest bidder in the city where the district depot was located. With South Manitou Island being part of the Ninth District during the turn-of-the-century, the depot was located in Milwaukee. (The stationed had previously been serviced by the depot in Detroit when Lake Michigan was part of the Eleventh District.) Typically, a circular was posted requesting bids. Due to the relatively small jobs that were constantly being undertaken, and the same bidders consistently applying, formal contracts were often not entered into, for reasons of time. In a letter from the Ninth District's Engineer to the Lighthouse Board of 1902, the engineer concurs with this approach, stating that, "In view of the small amounts involved, the known responsibility of the bidders, and the fact that payments are not to made until delivery and acceptance of the articles, I respectfully recommend that formal contracts be waived."[5]

There is a significant amount of historic documentation detailing materials and costs for repairs and alterations to the South Manitou Island Light Station throughout its history. However, it is difficult to determine exactly what repairs were made. For example, a letter from the District Engineer to the Lighthouse Board in August of 1904, lists acceptable bids for materials including: lumber, factory work from a sash and door company, hardware, paints, and stone.[6] Therefore, it can be assumed that the lighthouse was continuously being upgraded and that most routine maintenance was not significant enough to document in specific detail.

The 1871 construction alterations at the lighthouse structure itself included the construction of the 104' - 0" tall brick light tower, and the construction of a 44' long brick, enclosed passageway that connected the keeper's dwelling with the new tower. As a result of this new construction, the only significant change at the keeper's dwelling entailed the removal of the original roof lantern atop the dwelling. However, several lesser alterations were undertaken, as stated below, in the years that followed.

Interior

A letter of 1874 from the District Engineer addressed to the Chairman of the Lighthouse Board listing repairs at the station states that "A drive pump [is] put in... [and the] Kitchen ceiled..."[7] It is assumed that this statement refers to the newer kitchen, (Room B-06), which was originally part of the cellar's open space. It is likely that, shortly after the construction of the new tower in 1871 and the appointment of additional keepers, the second, south kitchen (Room B-06) was created. Physical investigation revealed that the joists and the underside of the floor structure in this space were whitewashed (obviously prior to the installation of the plaster ceiling). It is likely that the whitewash was the finish applied when the space was just an open storage area, and sufficed for a while as a kitchen, until the ceiling was finished with plaster in 1874. The other half of the engineer's statement, that "A drive pump is put in", suggests that it was not until this time that the kitchen was actually fully functional. Prior to this point, water would have had to have been brought in from the other kitchen, or from an exterior well.

Figure 11 View looking northwest in the storage room (Room B-03) in the Dwelling, 1994. Note the door opening at the left leading from the stair, which has one step leading into this room that is precariously hanging over the subcellar.

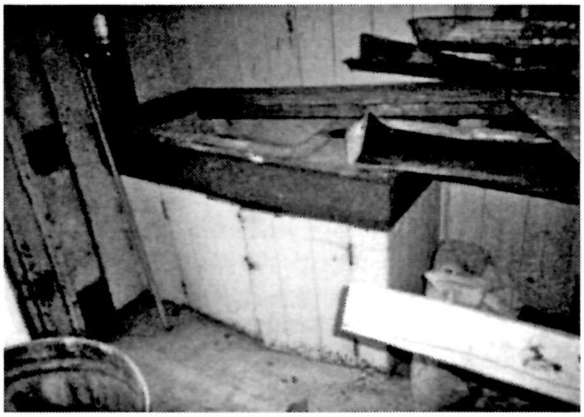


Figure 12 View looking at the northwest corner of the kitchen (Room B-05) in the Dwelling, 1994. Note the area of missing wood wainscot at the left edge of the photo, revealing an earlier wall treatment.

Recollections of the children of former keepers include the presence of two, distinct kitchens. Furthermore, they remember that the door between the two kitchens (Door B-4), was always kept closed, providing privacy for the two families. Presumably, the family that used the south kitchen would reach it from the stair from the first floor by way of the east door opening at the stair (Door B-1), and then cross the storage area at the east portion of the basement. Following the installation of the subcellar adjacent to Door [B-1], in the northeast storage room (Room B-03), it appears that the door opening may have been rendered unusable, because the step leading to it hung over the subcellar (Figure 11). However, one assumption may be that the subcellar originally had a removable cover (most likely wood) placed over it that served as a floor for the family to walk across to reach their kitchen.

Figure 12 shows an area of the west wall of the kitchen (Room B-05) where the wood wainscot has been removed along the exterior door opening, revealing another finish beneath the wainscot. This underlying finish consists of plaster, which extends down to a wood baseboard, and is identical to that found throughout the upper floors of the dwelling. Wood furring strips were nailed directly onto the plaster surface of the walls to provide a nailing surface for the wood wainscot. It is unknown at this time when the present wood wainscot was installed.

Physical investigation revealed a different wood wainscot along the south wall. This wainscot differs from that found at the other three walls (which, as previously described, was installed over the original plaster finish) in that it is flush with the plaster surface above, suggesting that it may be an original feature of the kitchen. Furthermore, it only extends 2' - 3/4" above the floor whereas the later dated wainscot at the other walls extends 3' - 0" above the floor. The wood boards are also a different size at the two different wainscots.

Physical investigation and historic drawings (Figures 5 and 13) indicate that all three of the fireplaces in the dwelling, two at the first floor and one at the basement, originally had open fireboxes. Some time after the original construction of the building, possibly with the introduction of wood or gas burning stoves, each of the fireplaces was infilled with brick and finished with plaster and wood baseboard trim. Furthermore, there is a circular opening at each chimney face which indicates the connection of a stovepipe. A historic wedding photo of Keeper Burdick and his wife taken in 1907, in front of the Parlor's (Room 105) fireplace, reveals that by this time the firebox was already infilled. Physical investigation in 1994 revealed that the infill had been removed, with the exception of the wood baseboard. The other two fireplaces in the dwelling, although damaged by vandalism, were still infilled during physical investigation, as seen in Figures 14 and 15.

The water situation, in terms of both domestic water service and condensation buildup, within the keeper's dwelling, seems to have been insufficient and the cause of several problems at the station. A letter from the District Engineer to the Lighthouse Board dated April

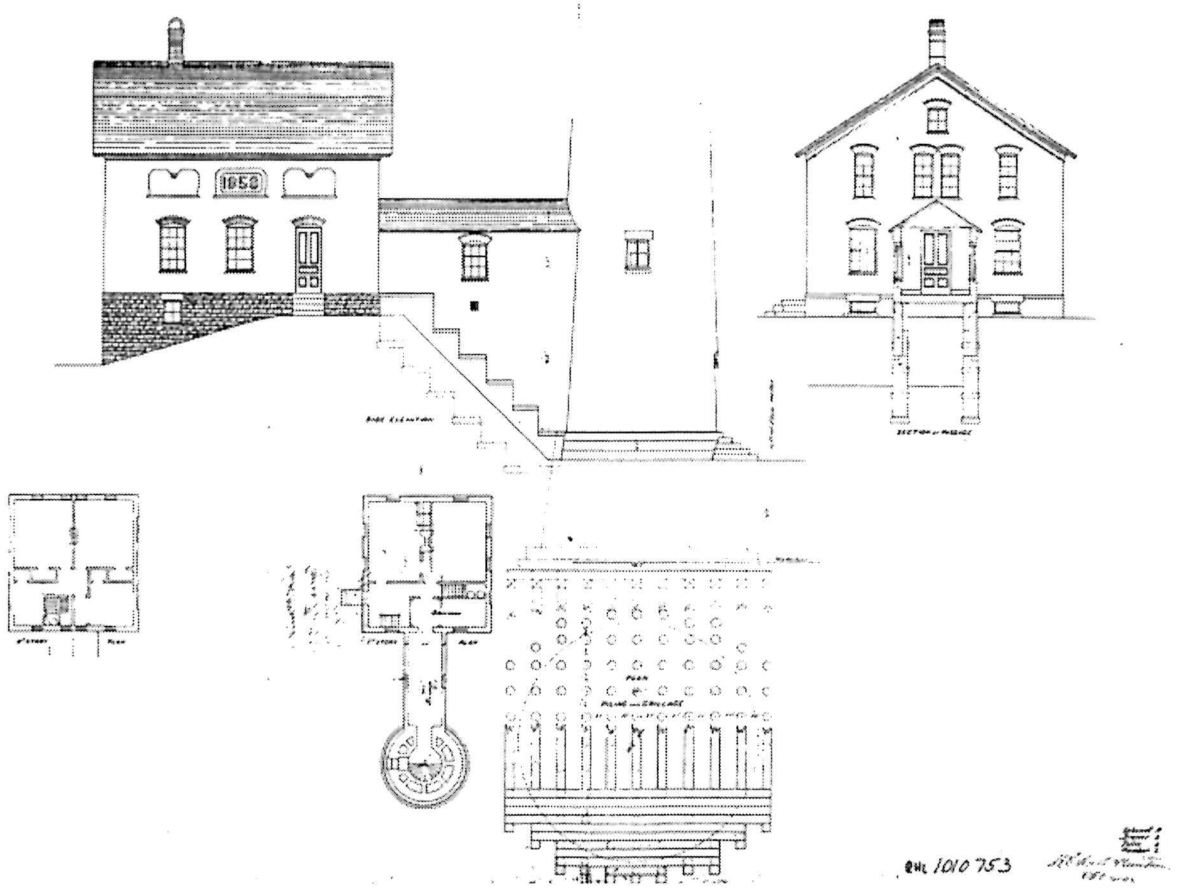


Figure 13 *1870 drawing of the South Manitou Island Light Station, including the original Keeper's Dwelling, and the proposed Passageway and freestanding Light Tower.*

Figure 14 *View of the fireplace at the south wall of the parlor (Room 108) in the Dwelling, 1994.*

Figure 15 *View looking toward the southwest corner of the kitchen (Room B-05) in the Dwelling. Note the overall deteriorated condition of the surfaces and finishes, and that the fireplace remains infilled with brick and plaster.*

15, 1901 specifically addresses the sanitary conditions at the South Manitou Light Station stating that,

> I have the honor to report that the dwelling at South Manitou Light Station, Mich. is in an unsanitary condition... the keeper stated that both himself and his wife had typhoid fever, that this was the third case of typhoid fever that had originated at the station during the last nine years. The doctor who attended them stated: 'That they had been exposed to the germs of typhoid fever either from the water or from the dampness of the house. The watercloset [sic] was altogether too close to a pump in the garden where the drinking water was obtained; that the cistern being under the kitchen floor might be the cause; that at all times the rooms, halls and stairways sweat to a great extent.[8]

The engineer goes on to further describe the unhealthy condition of the cistern in his letter saying that,

> The cistern, which is really a cess pool [sic] under the kitchen floor and under the sink, collecting animal life and vegetable matter, should be filled. There is little necessity for cisterns on the lakes. They are rarely cleaned out for fear of losing the water; and, no doubt, this water has been used to a greater extent than either the well or lake water.[9]

This recommendation made by the engineer was never carried out, however. Nine years later, the 1910 *Description Of Buildings, Premises, Equipment, Etc.* indicates the continued presence and use of the cistern. It says that the "..cistern under [the] dwelling [is] 7'4" x 7'6" x 2 1/2" [with a capacity of] 1017 gals... [the] cistern is of brick, cement coated, [and] cleaned out annually."[10] However, this description does indicate that, in contradiction (or maybe because of) the engineer's 1901 letter, the cistern was properly maintained and "cleaned out annually". The cistern remained, whether used or not, throughout the lifetime of the station. Physical investigation of the cistern in 1994 (Figure 16) revealed that it was only 6'-6" deep. The lesser depth than that stated in 1901 may be due to the buildup of debris from the lack of use and neglect since the abandonment of the station.

In addition, the engineer continues his analysis and recommendation for the well that presumably provided contaminated drinking water. He states that, "The well in the garden has never been fit for use, except to water the garden. The well should be moved and driven at a point in front of the tower."[11] No evidence of a connection to a well that would have been located in front (east) of the tower was discovered during the 1994 physical investigation.

It is unclear whether the cistern was actually ever used for potable water. One recollection of a former keeper's son is that this was never the case. George Hutzler, whose father was the assistant keeper in 1912, remembers that when he lived in the dwelling, drinking water was brought into the dwelling daily with a water pail. The water pail was filled from the reservoir located at the Fog Signal Building.

The statement within the engineer's letter regarding the condensation that was always present on the interior walls of the dwelling is another indication of the unhealthy living conditions at the time. His letter states that:

> ...there is no way of heating the front part of the house, which is partly underground, and the only heat it receives is from the adjoining rooms and this is, no doubt, intermittent. This causes the moisture on the walls. The case is, no doubt, aggravated by not properly airing the building. To remedy this, it is suggested that a hot air furnace be placed and the pipes can be readily led up through each story, with short extensions, thus heating all rooms.[12]

It appears that this recommendation by the engineer was also never implemented by the Lighthouse Service. There is no extant physical evidence of a hot-air heating system. At the south wall of Room 204 at the second floor, however, there is an area approximately 16" x 16" where the plaster appears to be patched and is sinking behind (no longer flush with) the surrounding plaster. Physical investigation revealed that the perimeter of this square piece is rusted from ductwork located within the wood framing, as seen in Figure 17. Furthermore, the rusted duct is fully visible in the wall directly below at the first floor, where the plaster is missing. This duct, which appears to run the full height of the first and second floors and is adjacent to the chimney, was the only one observed during physical investigation. A viable assumption is that it provided outside air to the chimney for combustion and that it was not part of a more extensive heating system.

The combination of the chimney and combustion duct would have been sufficient for the dwelling during the early and late parts of the season, but may not have been adequate during the winter months.

Furthermore, in a taped interview with the National Park Service, Ronald Rosie, who was a member of the last family to live in the dwelling (his father was keeper until they left in 1941), does not recall any central heat-

Figure 16 View looking down into the cistern located at the northwest corner of the basement of the Keeper's Dwelling, 1994.

Figure 17 View of the south wall in the northwest bedroom (Room 204) in the Keeper's Dwelling, 1994. Note the rust at the plaster surface from the metal duct within the wall framing (at the bottom left corner of the photograph).

ing system. In fact what he does recall are, "Three stoves; one at each floor" and that his mother would "sprinkle salt down the chimney to "eat up the carbon" that was generated.[13]

The 1910 *Description of Buildings, Premises, Equipment, Etc.* states that "The attic of the dwelling is used as the main store room for supplies, such as chimneys, wicks, wipers,..."[14] This statement indicates that the attic continued to be utilized following the removal of the roof lantern in 1871.

Exterior

Windows

The original drawings for the 1858 dwelling indicate that there was only one basement window at the south elevation, (Figure 5). Currently, there are three basement windows along this elevation. One assumption is that the two additional windows, (D-1 and D-2), were added in the 1870s, in conjunction with the other alterations that separated the open space of the cellar into individual rooms.

Roof

By 1914, several of the elements of the dwelling were in need of replacement. In May of 1914, the District superintendent submitted a "Recommendations for Repairing Aids to Navigation" form to the Commissioner of Lighthouses, outlining several aspects of proposed work. This work included: "Covering [the] roof of [the] dwelling with asbestos shingles," in addition to several other areas that required attention throughout the station. The Superintendent also detailed the reason for the proposed work in his recommendations, stating that,

> The present shingles of [the] roof of [the] dwelling are in a bad state of decay, it is proposed renewing roof with asbestos shingles. Some plastering in [the] dwelling needs renewing. Some of the old window sub-sills are badly decayed, [and] will be renewed with reinforced concrete sills.[15]

Physical investigation revealed that asbestos shingles were, indeed, installed. However, the other alterations were not verifiable.

Alterations to the Tower

Interior

Historic documentation and drawings indicate that the cast iron floor of the watch room in the tower was not installed until 1901. The proposal for this alteration was submitted to the Lighthouse Board in October of 1899. In his proposal, the District Engineer states that:

> The tower at South Manitou Light-Station, Mich. has no arrangement for a watchroom which can be heated by a stove, which is a necessity during the cold weather, without heating the entire lantern. A tight floor placed at the level of the landing below the gallery [lantern room] would convert the upper portion of the tower into a suitable watchroom, having a trap door from the staircase below and a trap door entering the lower portion, or the watchroom so called.[16]

It is likely that the recessed wood lined storage closet was constructed in the tower wall in this newly created "room" shortly thereafter. As described in the 1910

Description of Buildings, Premises, Equipment, Etc., there was a "Small closet in [the] wall in [the] room below [the] lantern,... used for storage of extra burners, chimneys, etc... [and] Fitted up with two shelves."[17] The unfinished joint at the opening of the closet further suggests that the closet was not an original element of the tower, but was "cut" out of the wall some time later. Most of the paint finish had worn off of the wood surfaces of the cabinet and both of the wood doors were missing during physical investigation. However, a similar built-in shelf is fully intact at the duplicate tower of the Au Sable Light Station along the shore of Lake Superior, (Figure 18).

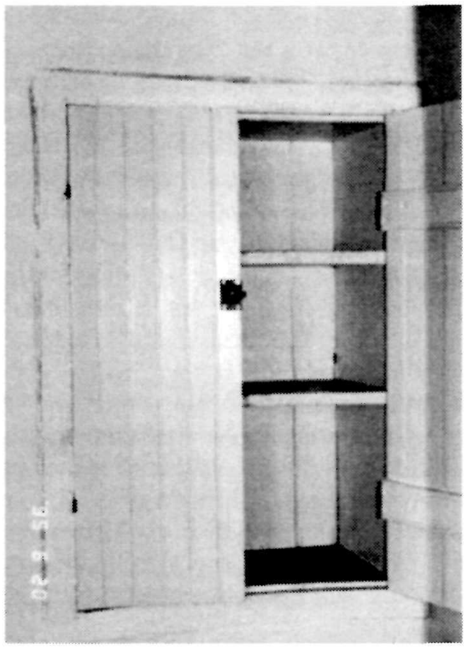


***Figure 18** Detail view of the wood lined storage closet in the work room of the Tower at the Au Sable Lighthouse on Lake Superior, 1995.*

Physical investigation revealed a concrete "plug" in the former stovepipe opening in the wall of the tower at the watchroom level, (Figure 19). It is assumed that a stove was installed, in conjunction with the watchroom floor (as indicated in the engineer's request in 1899), to provide heat for the keeper during his nightly shifts. However, there is some evidence that a stove, although not adequate, was installed on the landing some years prior. One historic photograph taken prior to 1901 indicates the possible presence of a stovepipe with a slightly different configuration than the one installed in 1901, and physical investigation revealed two separate openings, suggesting a relocation (Figure 19). One of the openings was patched with a piece of the wood wainscot and the other was filled in with concrete in 1991 by the National Park Service as a safety precaution for visitors in the tower.

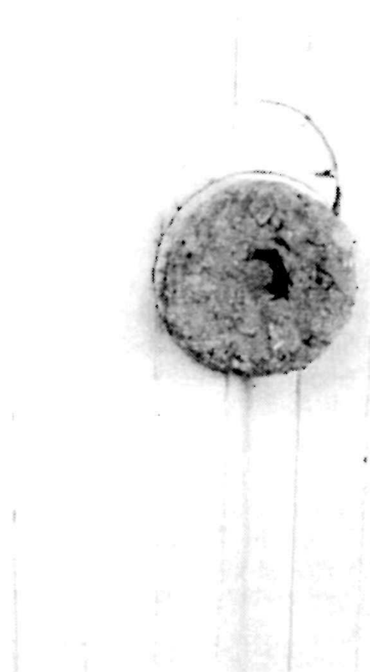


***Figure 19** Detail view of the concrete "plug" in the former stovepipe opening at the workroom of the Tower, 1994. There is also another circular marking in the wood wainscot, suggesting that the opening was relocated.*

By 1902, the year following the installation of the watchroom floor, several repairs were already needed for both the watchroom and the lantern room above it. A letter from the district engineer to the Lighthouse Board includes a request for appropriations for several alterations/repairs, such as:

> "...for relining [the] lantern, furnishing [a] new lens protector, lengthening [the] smokestack of [the] watchroom and furnishing [a] new door for [the] watchroom [he actually means the lantern room] leading to the parapet..."[18]

Exterior

As part of the air diaphone fog signal system installed in 1934, four air tanks were placed alongside the northeast exterior face of the base of the tower (Figure 20). An air line ran from the fog signal building to these tanks, and a second air line ran up the east face of the tower to the diaphone horn itself located in the watch-room near the top of the tower. This elaborate system was removed in the early 1940s. However, during physical investigation, a rusted metal tank was observed in Room B-01 of the basement of the dwelling. The proportions of this tank suggested that it is most likely one of these original air tanks. Currently, the diaphone horn, with the pipe, is stuck in the ground outside of the island visitor center.

Figure 20 *View looking southwest toward the South Manitou Island Light Station, circa the late 1930s. Note the air tanks and air lines which were part of the air diaphone system.*

Figure 21 *Detail view of the wood panel doors leading into the base of the Tower, 1995.*

Doors

Physical investigation also revealed that the current three-panel doors at the Tower are in good condition, and have little deterioration or paint buildup, as seen in Figure 21. A document of the National Park Service says that, "[the] historic wood door[s] of [the] tower [were] rebuilt for [the] 1980 season," thereby substantiating the notion that the current doors are replacement doors.[19] One important feature of these replacement doors is that they have a three-panel configuration while historic drawings (Figures 9 and 10) reveal that the original set of doors had a five-panel configuration.

Passageway

Exterior

There is an area of rough, unpainted stone that is exposed just above grade at the center of the south elevation of the Passageway (Figure 22). This stone may be evidence of the initially proposed location of the light tower, suggesting that construction of the foundation commenced prior to the change in the location of the existing tower. However, historic documentation suggests that these design changes were made, and money appropriated for, the altered location of the tower prior to any actual construction taking place. If this was the case, then the exposed unfinished stone may only be due to a change in grade elevation which has exposed a portion of the foundation wall that was originally below grade. This would explain why the stones are not as regular in coursing and are not painted.

Interior

Physical investigation revealed the ghosted profile of a cabinet at the northeast corner of the passageway, (Figure 23). Figure 23 also reveals a joint in the wood baseboard at the ends of the ghosted image, indicating where the baseboard had been replaced. Due to the close proximity of the demarcation of the tower, it is most likely the result of either a desk used by the keeper during the evenings and/or storage shelves for equipment that was used in the tower. One likely assumption is derived from the recollections of Fred Burdick whose father was the keeper from 1908 through 1928. In a taped interview with the National Park Service, Fred recalls that there was a floor cabinet in this location, which was used to store replacement glass panels for the tower's lantern. They would be safely stored here

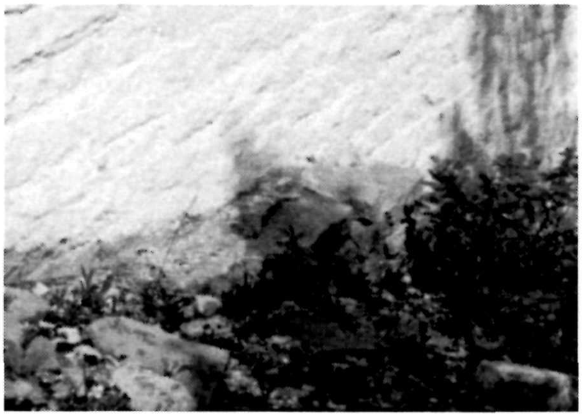


Figure 22 *Detail view of the exposed, unfinished stone along the south elevation of the Passageway, 1994.*

Figure 23 *View of the northeast corner of the Passageway, 1994. Note the ghosted outline on the plaster, and the coinciding joint where the wood baseboard has been replaced.*

and carried up the cast iron stairs to replace broken panes when necessary.[20] Ronald Rosie, whose father was also a keeper in the late 1930s through 1941, also recalls that the cabinet was used to store replacement glass panes.

Furthermore, Fred Burdick, along with two other sons of former keepers, Glen Furst and George Hutzler, all recall another specific interior feature of the passageway. All three men remember that there was a long, black mat [presumably linoleum or a similar material] that extended the entire length of the passageway and was approximately two - three feet in width.[21]

Related Outbuildings

Fog Signal Building

Historic documentation indicates that there was some form of a fog signal constructed or installed in 1858 in conjunction with the construction of the keeper's dwelling. Presumably this original signal consisted of a bell, as indicated in a letter from the District Engineer to the Lighthouse Board several years later. The Engineer stated that money was needed to, "repair the Fog Signal (a bell) at this station, the wood work of which is in a very dilapidated condition."[22]

In 1874, a new Fog Signal Building, containing a steam-powered fog signal, was constructed. Upon its completion in late 1874, a "Notice to Mariners" was distributed which stated that the fog signal would be in operation, "on and after the opening of navigation in [the] Spring [of] 1875; [and] in case of accident the fog-bell will be struck by machinery."[23] One resource states that the new fog signal was the first steam-powered signal on Lake Michigan.[24]

Additional historic documentation suggests that by 1879, a duplicate fog signal building, which housed a duplicate steam-powered fog signal, had been constructed. A letter from the District Engineer to the Chairman of the Lighthouse Board states that, "there being now, duplicate fog signals at South Manitou, the bell is no longer required..."[25] Figure 24 shows these identical structures which were located near, but not attached to, each other. Another letter, written later in 1879, states that, "The smoke stack of the old fog signal is worn out..." further suggesting by the use of the word "old" that one of the duplicate structures was built prior to the other and now, four years later, was already worn out.[26]

As the characteristic of each station's light was unique, so too, was its fog signal. South Manitou's fog signal consisted of a blast of 8 seconds duration with an interval of 52 seconds of silence between each blast. As originally constructed, each of the two duplicate fog signal buildings had a 10" steam whistle and smokestack, as shown in Figure 24. In addition, at the interior of the each building there was a duplicate boiler which produced the required steam. All necessary equipment was installed in duplicate as a precaution against any period of down time needed to repair equipment.

In 1897, the two identical structures were relocated and attached to each other, to form a single "T-shaped" building, (Figure 25). In conjunction with this relocation, new boilers were installed. These boilers, in addition to the duplicate smokestacks and steam whistles, were all relocated to the eastern of the two attached buildings. This eastern portion of the com-

Figure 24 View looking south toward the South Manitou Island Light Station, circa 1884.

Figure 25 View looking south toward the South Manitou Island Light Station, from the late 1890s or early 1900s.

bined structure was then referred to as the "Machinery Room" since all of the equipment was now located within it. A drawing depicting the floor plan of the combined structure, (Figure 26), indicates that there was a workbench located at the northeast corner of this room. Although no longer extant, physical investigation revealed demarcations left by this workbench in the wood boards of the north wall of the room. The workbench was presumably removed in conjunction with the installation of electricity, as this was the proposed location of the electrical distribution panel, (Figure 27). Physical investigation also revealed that an opening (presumably a door), at the south end of the west wall of this room, had been infilled. One assumption is that this was a door opening when this was a separate, detached structure, and was no longer required when the two buildings were combined.

The west portion of the combined building was referred to as the "Work Room" and remained free of equipment. A coal room was constructed within the northeast corner of the work room. Physical investigation revealed a large area of infill in the west wall of the coal room (Figure 28). It appears that there had once been an opening between the coal room and the work room, which extended from the floor to the ceiling.

The engineer's proposal for the relocation of the fog signal buildings included several other updates as well, and stated:

> I have the honor to transmit herewith a plan with estimate of cost for renovating and fireproofing the fog signal house at [the] South Manitou Light Station, and installing new boilers there. The houses as now arranged are detached, and somewhat out of repair. They are not lined, and the roofs are of shingles.
>
> It is proposed to move one of the houses and attach it to the other as shown on [the] plans [no longer extant], and to line the inside with sheet iron and renew the roof with corrugated iron, thus making the building positively fireproof.[27]

Physical investigation revealed that the entire interior of the fog signal building had, indeed, been lined with sheet metal, and a corrugated metal roof had been installed.

David Clary states in his publication entitled, *The Life of the Keepers as Reflected in Their Official Journals*, that:

> The [presence of a steam fog signal] multiplied the maintenance responsibilities of the keepers to a remarkable degree. The [keepers'] journals indicate that throughout the 20th century the fog signal accounted for more of the men's time as it grew in navigational importance. Ships became larger and avoided the coasts. The light was often of less service to them than the signal that could alert them to the proximity of the fog-shrouded shores.[28]

The fog signal thus became an important element of the light station and one of the most important responsibilities of the keepers.

Five years after the major overhaul of the fog signal building in 1897, repairs and upgrades were required once again. The District Engineer explains this in a letter to the Lighthouse Board in March of 1902. He states that, "At the time new boilers were installed some five years ago, these engines [referred to earlier in the letter as 'old fashioned type horizontal engines] were not replaced by new ones but were continued and placed upon brick bases."[29] The engineer continues in his let-

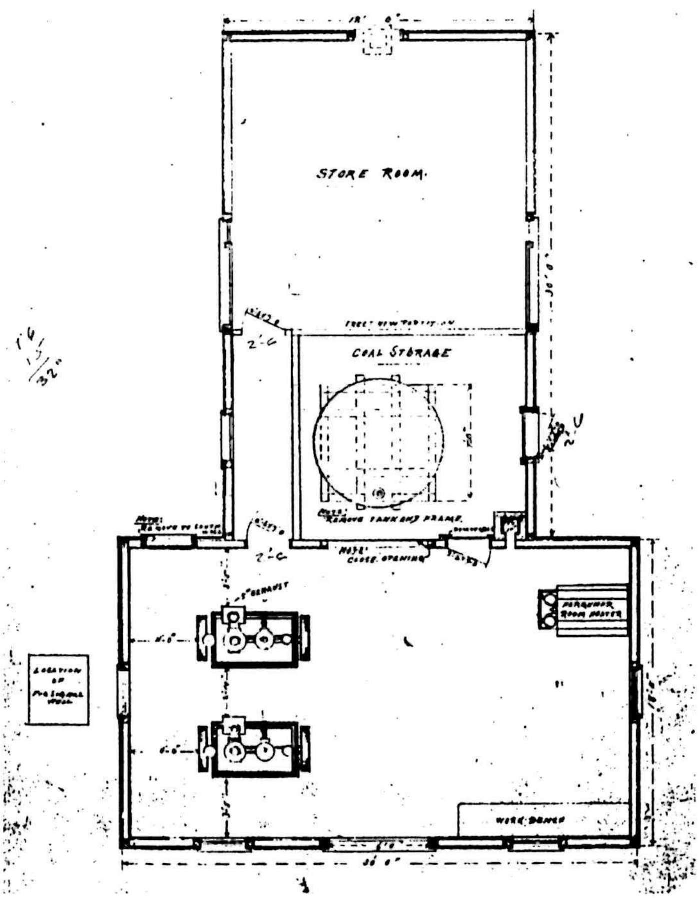


Figure 26 Drawing of the combined Fog Signal Building, 1941.

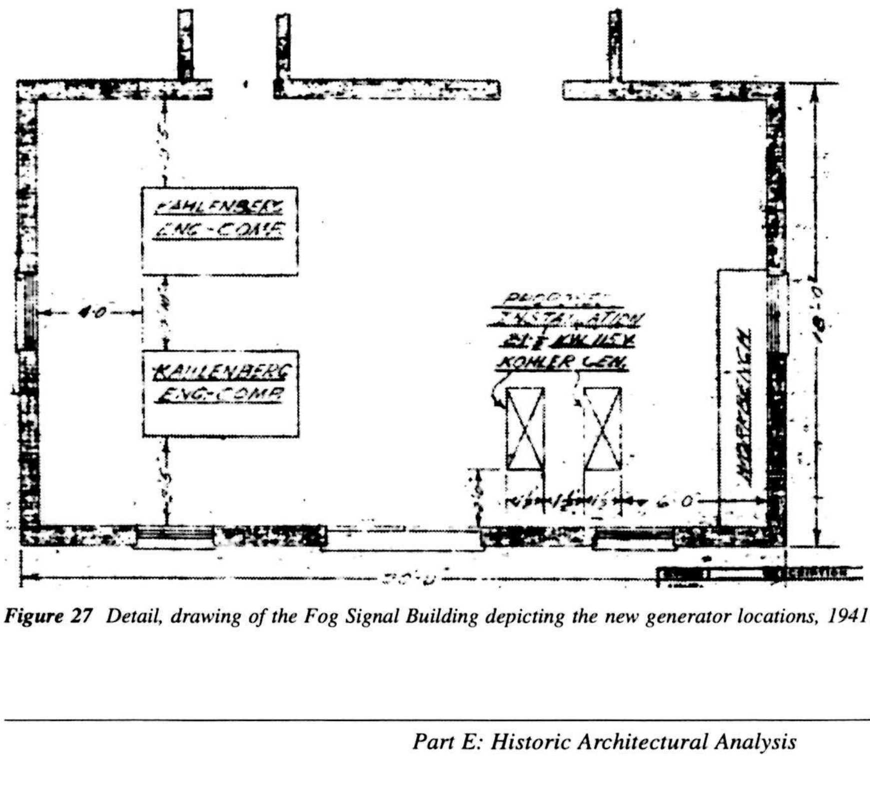


Figure 27 Detail, drawing of the Fog Signal Building depicting the new generator locations, 1941.

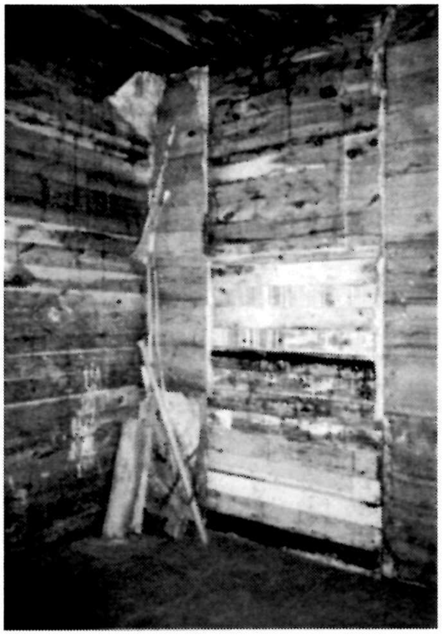


Figure 28 View looking toward the southwest corner of the coal room in the Fog Signal Building, depicting wood infill, possibly from a former opening, 1994.

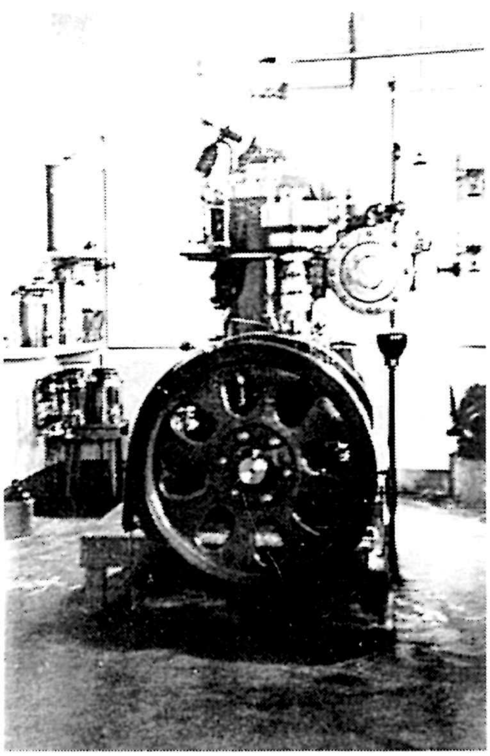


Figure 29 One of the two replacement engines installed at South Manitou circa 1902. Photo, taken from a family album, circa 1911-1949.

ter to recommend installing the engines that were recently removed from the Pierhead Light Station (Figure 29). To install these new engines, his cost estimate also included appropriations for, "two new cast iron engine beds, two fly wheels, and fitting up [a] new steam pump."[30] Although there is no documentation that the engine pictured in Figure 29 is one of the engines from Grand Haven, it is a vertical, not horizontal engine, and is consistent with the engine described in the 1910 "Description of Building Premises, Equipment" of the South Manitou light station.

Maintenance of the fog signal building was a continuous aspect of the station's routine, and by 1914, as at several other areas throughout the station, it was in need of general repairs. In the "Recommendations for Repairing Aids to Navigation" form the District Superintendent submitted to the Commissioner of Lighthouses in 1914, the proposed work for South Manitou Island Light Station was outlined, and included: "[a] new plank walk to [the] boat house and new reinforced concrete steps and walk, and repairs to [the] fog signal building."[31] The Superintendent also explained the reason this work was necessary. He states that:

> Some of the old wood sills of the fog signal building are badly decayed, [and] will be renewed by reinforced concrete sills. The coal bin will be built for fog signal coal and sundry repairs made to [the] building. Brick floor under fire box of boilers, new reinforced concrete steps and walks will be laid to the fog signal building in place of old wooden walk and a new plank walk will be laid leading to the boathouse.[32]

In 1934, the fog signal was changed from a steam-powered whistle system to an air diaphone system, which was run by diesel generators and an air compressor. The particular air diaphone system at South Manitou Island was unique in its configuration. No longer was it contained only within the fog signal building; the light tower was utilized for its height to help direct sound farther. Figure 30 is a drawing of the air diaphone system installation. As depicted in Figure 27, the two (duplicate, as was always the case) diesel generators were located within the machinery room of the fog signal building. A gas tank was buried just north of the building that supplied these generators. Air was pressurized and transported, via above ground lines, to air tanks at the base of the tower. From these air tanks, another air line was attached to the east face of the

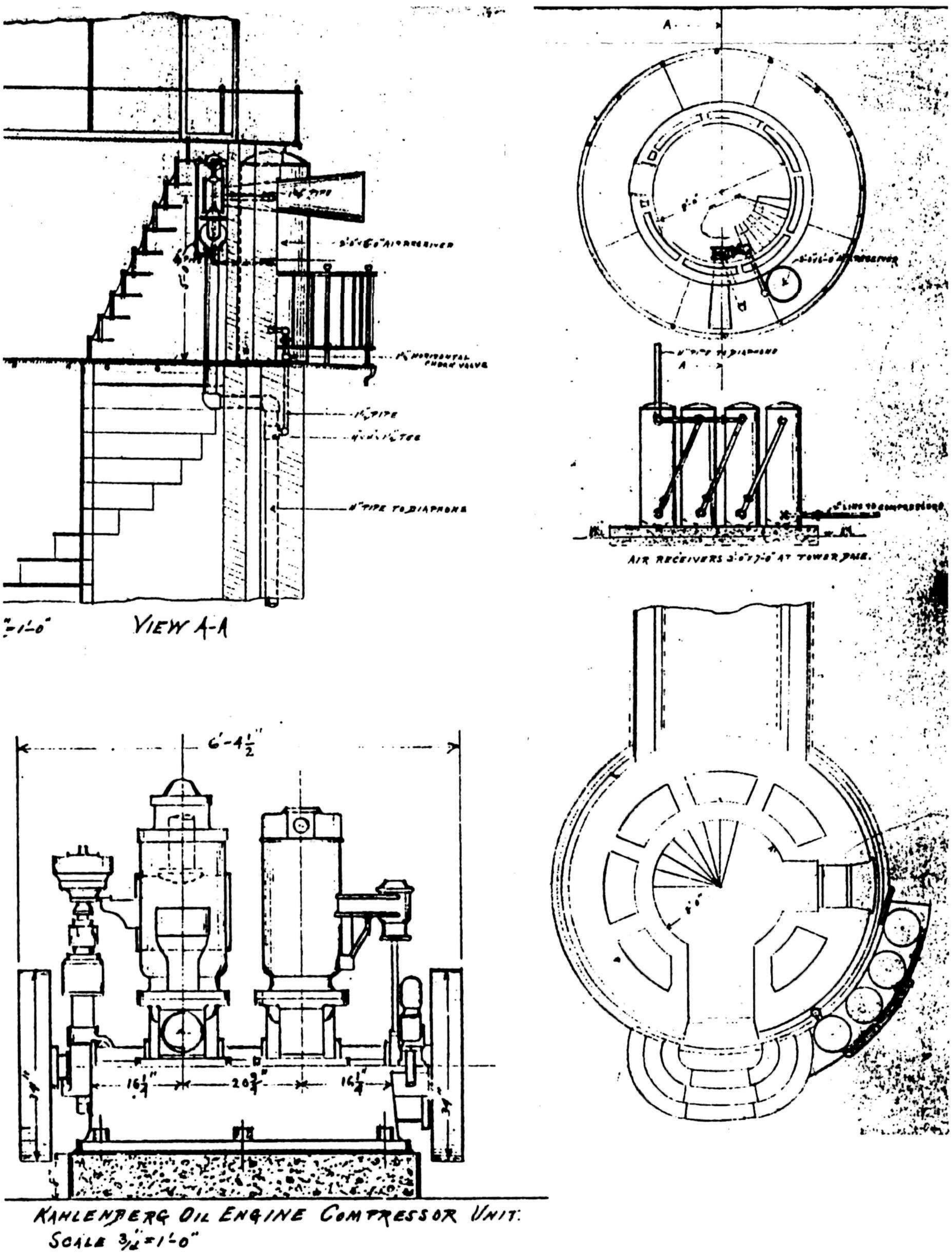


Figure 30 *Details of drawing entitled "South Manitou Island Installation of Air Diaphone to Replace Steam Boilers," 1934.*

tower which extended to the diaphone itself and to the horn, which were located in the watchroom.

Ronald Rosie remembers the system at the top of tower; there was a diaphragm which vibrated and made the actual sound, the air motor was nearby on a table, and a kerosene lamp was kept under the table so that the motor wouldn't freeze. He also remembers that the horn sounded for 7 seconds every minute.[33]

In conjunction with the installation of the air diaphone system, the steam stacks and whistles were removed from the Fog Signal Building. A brick chimney and metal vent stack were then installed with the new equipment. A large furnace was also installed in the northwest corner of the Machinery Room.

Physical investigation revealed a butt joint in the clapboard along the south elevation of the west portion of the fog signal building. This joint starts at the same height as the adjacent door opening and extends downward through fourteen pieces of the clapboard siding. There is also a subtle joint directly below this in the concrete foundation. The reason for this joint is currently unknown, but one speculation is that it may represent a former opening, of which there is currently no documentation.

Physical investigation revealed that the extant pair of doors at the east elevation of the fog signal building are not original. The doors are two-panel, with the top panel comprised of divided lights. Historic photographs, (Figure 25), indicate that the original doors had a five-panel configuration. Furthermore, during physical investigation, the exterior surface of the walls and all of the exterior trim, were painted white. Historic photographs indicate that this paint scheme was in place for a long period of time. Prior to that point, however, the paint scheme comprised of a darker color trim, including the corner boards, aprons, window sashes, and window frames.

As part of the abandonment of the station, the fog signal operation was discontinued and most of the related equipment removed by 1958. Figure 31 shows the interior of the building in 1994, with only fragments of elements left, including: concrete pads from the Kohler generators, from air compressors, connections through south wall to exterior well, cabinet along west wall of machinery room. As was the case throughout the South Manitou Island Light Station, following the departure of the Coast Guard in 1958 maintenance of the site and structures was discontinued, vandalism prevailed, and the Fog Signal Building gradually deteriorated. Intervention by the National Park Service, beginning in 1970, mitigated further deterioration and vandalism of the building. This was accomplished by stabilizing and repairing the structure.

Figure 31 *Interior view looking northeast inside of the Fog Signal Building, 1994.*

Metal Oil House

By 1877, the U.S. Lighthouse Service had begun to convert the primary fuel at light stations across the country to kerosene because it provided better illumination than the previous fuel, which was lard oil. By 1885, kerosene was the principal fuel used to illuminate lights nationwide.

The transition from lard oil to the much more flammable kerosene led to the need for safer storage areas. After the conversion from lard oil to kerosene, the concern for fire-safety led to the construction of storage areas which were completely separate from other structures at the station. These storage areas, otherwise known as oil houses (constructed of both metal and brick), began to be constructed at several Great Lakes light stations during the end of the nineteenth century. The metal oil house at South Manitou Island was constructed in 1893, nine years prior to the construction of the brick oil house. This order of construction was somewhat unique to South Manitou Island, as at most other light stations around the Great Lakes the brick oil house was the first one built.

Island folklore has it that sometime after the departure of the Coast Guard, the metal structure was turned on its side and rolled to the village. There a man who had declared himself mayor of the island used the structure as a jail (although the story says that no one was actually ever jailed).

It has been reported that in 1970, shortly following the National Park Service's presence on the island, the metal oil house (and its interior metal shelving) was located in a trash mound and moved onto the U.S. Coast Guard station site. During the late 1970s and the early 1980s, the structure was used to store propane gas cylinders. However, physical investigation in 1994 revealed that the structure was empty.

Brick Oil House

The brick oil house at South Manitou Island Light Station was constructed in 1902. With the tremendous and rapidly growing need for brick oil houses around the Great Lakes, a standard design was developed for their construction. As a result, many of the oil houses in the region share similar architectural characteristics. However, as was common, the basic standard design was often modified, allowing for slight variations at each station, which was usually based on the availability of materials.

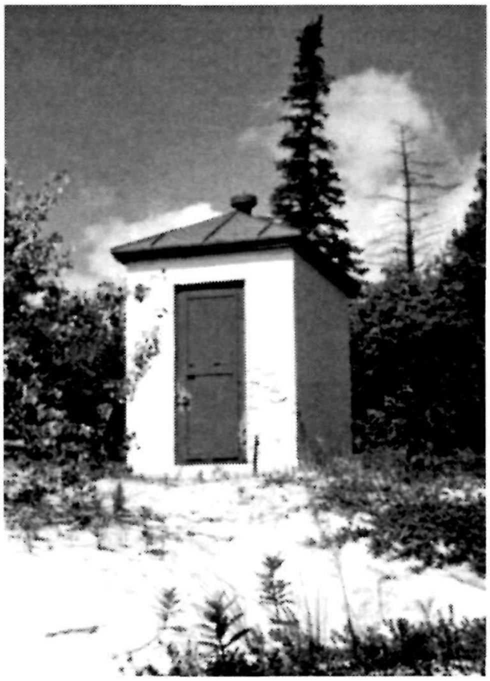


Figure 32 *View of the Brick Oil House at the South Manitou Island Light Station, 1994.*

Brick oil houses also typically had metal doors with concrete or stone sills and floors, and a metal roof and central vent, as seen in Figures 32, 33, and 34. Lighthouse construction crews typically traveled to the various stations constructing the standard design brick oil houses within a few days' time.

Although all of the brick oil houses were similar, the type of brick varied. Physical investigation revealed that the exterior brick surface at South Manitou Island was covered with several layers of paint. This is not typical, and was not observed at several other light stations around the Great Lakes which have similar brick oil houses. Generally, these other brick oil houses had exterior walls of unfinished brick. One assumption about the applied finish on the South Manitou Island brick oil house is the presence of several different types and colors of bricks beneath the paint surface. Paint was therefore applied to camouflage the incompatible masonry throughout walls. Some of the brick types found in the walls are unique to the station, suggesting that it is likely that the structure was constructed with excess bricks brought to the station from other stations by a lighthouse tender.

Figure 33 *View of the Brick Oil House at the Raspberry Island Light Station, Lake Superior, 1995.*

Figure 34 View of the Brick Oil House at the Au Sable Lighthouse Complex, Lake Superior, 1995.

A National Register Form completed for the South Manitou Light Station, however, states that the exterior of the brick oil house was unfinished. It is not known whether this is an incorrect statement, or if the deteriorated areas of the brick surface were covered with parging and painted after the National Register Form was completed. Based on its condition, it appears that this is an incorrect statement, due to the apparent age of the parging and paint.

Boathouse

Historic documentation suggests that a boathouse was built shortly after the construction of the light station. The documentation also suggests that the boathouse was always located on the natural harbor, approximately three-quarters of a mile from the light station itself, due the protective nature of the harbor (there was no protection at the station). Mark Pfaller Associates, Inc. in their *Historic Structure Report of the South Manitou Island Life-Saving Station*, state that, "...this boathouse was probably constructed about 1854, when the South Manitou Island Light Station was assigned one of twenty-five metal surfboats [a 1854 Frances Surfboat] allocated to the Great Lakes by the Federal Government."[34] They also state that the presumed location of this original boathouse was "Just west of (USLSS) station grounds, near west property line of original plot.[35]

A letter from the district engineer to the Lighthouse Board in 1901 indicates that by this time, the original boathouse was no longer acceptable and that:

> I beg to state that the boat house at the station is old and insufficient capacity for the boats furnished to the service. It is located on property which does not belong to the United States and has been so located for many years. The United States Life Saving Service have [has] acquired a certain tract of land and are [is] about to build a new Life Saving Station at a point to the northern of the Lighthouse Reservation... The suggestion is made that the boat house be rebuilt and enlarged and moved on to the reservation of the U. S. Life Saving Service, if the necessary permission can be obtained from that service, which is believed to be possible....The boat house being rebuilt should conform to the structures that the Life Saving Service are about to erect.[36]

Both the construction drawings (Figure35) and several historic photographs of this boathouse exist. Figures 36 and 37 reveal the location of the boathouse as it appeared on the site of the U. S. Life Saving Station.

It is unclear who owned the land on which the original boathouse was located. However, the engineer must have felt that its relocation was essential, as he again states the urgency of its relocation a month after his first letter. He states:

> Referring to the Board's letter of May 1, 1901, No. 1,812, in reference to [the] boathouse at South Manitou Light Station, Michigan, I beg to state that the boathouse is outside of the lighthouse reservation and believed to be on private property, and had been so located for possibly ten years or more. The present location is somewhat preferable to a location on the front of the lighthouse reservation, for the reason that it is now in the bay and sheltered from all points except the east, and an east would have a very short sweep across and the main land is near by. If located on the reservation, it would be very much exposed from all directions except the west and northwest and would require considerable outlay for not only the construction of landing cribs but their constant renewal afterwards. The Life Saving Service would, undoubtedly, allow the Light-House Service to occupy a small portion of their reservation if the request was made of them...[37]

Another letter from the same engineer to the Lighthouse Board later that month suggests that the boathouse was not going to be reconstructed but that it was going to

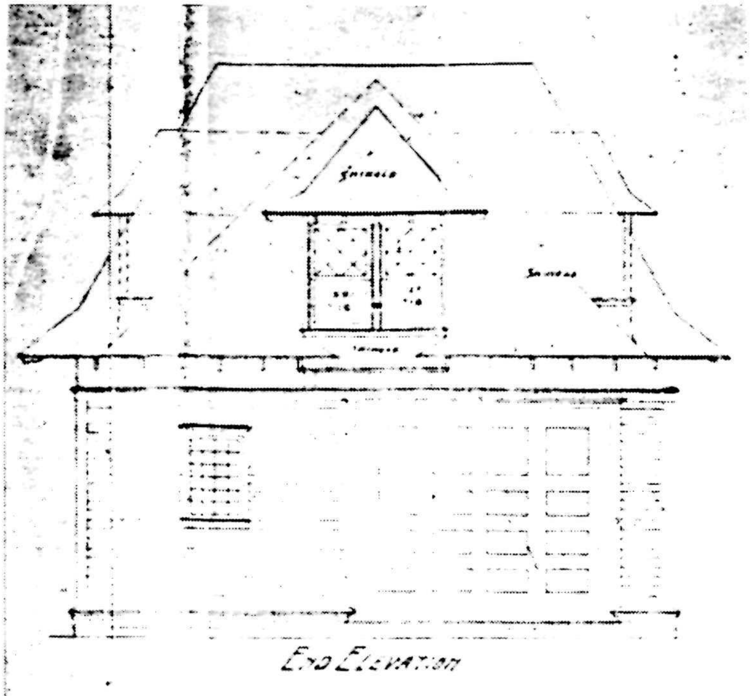


Figure 35 *Construction drawing of the Boathouse at the South Manitou Island Light Station, 1901.*

Figure 36 *View looking northeast toward the U.S. Coast Guard Station and the Light Station's Boathouse (in the center), circa early 1900s.*

Figure 37 *View looking west toward the U.S. Coast Guard Station and the Light Station's Boathouse, circa early 1900s.*

just be relocated and repaired. The letter states that the, "Estimate [includes] the cost for moving, enlarging, and repairing [the] boathouse at South Manitou, Mich."[38] Whether it was to be moved and repaired, or entirely reconstructed, a photocopy of a presumed log from the South Manitou Island Light Station, dated, June 14, 1901, states that the, "Board was informed by letter from [the] Life Saving Service that they consented to the placing of [the] boathouse on [the property of the] life saving station, with understanding that it will be removed upon [the] request of [the] Life Saving Service."[39]

The Historic Structure Report by Mark P. Pfaller Associates, Inc. states that alterations were made to Boathouse No. 1 (belonging to the Coast Guard) in 1931-32 and during that time, they moved their belongings into the Lighthouse Boathouse.[40] This statement indicates that the Light Station's Boathouse was still intact in 1932. However, it is assumed to have been removed, destroyed, or relocated from the Coast Guard station by 1958.

An interview with one of the South Manitou Island former residents brought some interesting information about the boathouse. Fred Burdick, whose father was the keeper from 1908 through 1928, remembers that in the later years of the village the Light Station's boathouse was often used to hold parties for the island's residents, such as at the Fourth of July, boxing matches, etc.[41]

From the early photographs the boathouse appears to have been a uniform, medium tone. However, due to its location on the property of the Coast Guard Station, the District Superintendent submitted a recommendation to the Commissioner of Lighthouse and hence, the Bureau of Lighthouse in Washington, D.C. to change to the paint color of the structure per a request from the Coast Guard. In his recommendation, he states that,

> The keeper of the Coast Guard Station at South Manitou Island has received instructions from headquarters, to change the color for all their buildings to white. The boathouse owned and used by the Lighthouse Service at South Manitou Island is on the Coast Guard property and they have requested the Lighthouse Service to change the color of the boat house from lead color to white, so as to conform with the future color of their buildings.[42]

Additional Structures

Although no longer extant, there were several important elements and structures at the station that were essential to its operation and efficiency. For example, there was a brick privy near the southwest corner of the keeper's dwelling, and a wood frame barn in the cleared area west of the keeper's dwelling which was used for livestock, etc. Ronald Rosie, whose father whose father was keeper until 1941, recalls that the barn was two-stories and that his family stored their car in it.[43] There was another wood frame structure, referred to in historic documentation as either a shop or a wood shed, which was located near the southwest corner of the keeper's dwelling.

Telephone Service to the Island

There is a significant amount of historic documentation containing correspondence between D.H. Day, an entrepreneur from the mainland region near South Manitou Island, and the U.S. Lighthouse Service. Several letters of 1902 refer to his impatience in being ready to provide and install the underwater telephone cable from the mainland to South Manitou Island, and the government's slow response.

The main purpose of Congress passing Public Act 130 (on April 31, 1902) and securing funds for the system, was to establish storm-warning stations at South Manitou Island and Glen Haven and to have a telephone cable installed connecting the two. The Act specifically states:

> Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the sum of fifteen thousand dollars, or so much thereof as may be necessary, be, and the same is hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for the purpose of constructing, maintaining, repairing, and operating, under the direction of the Secretary of Agriculture, telegraph, cable, of telephone lines between Glenhaven, Michigan, and South Manitou Island, Lake Michigan, and for the establishment, equipment, and maintenance of storm-warning stations at those points.[44]

Once installed, the phone system allowed for the provision of an efficient weather station on the island. A weather service employee lived at the lifesaving station and collected information from the nearby weatherstation. The underwater cable connected weather stations at Glen Haven, South Manitou Island,

and North Manitou Island, to provide weather alerts and to direct which storm warning flags were to fly.

While the main reason for passing Public Act 130 and securing funds was for the establishment of weather stations, it was also a great benefit and advantage to the keepers. The importance of the telephone cable installation to the keepers, and to the other residents of South Manitou Island, in particular, was not overlooked. In a letter to the Lighthouse Board in August 1902, R.P. Bishop of Ludington, Michigan, states the urgency of its installation to the Board, when he states that:

> It would please me if this matter could be taken up at an early date as possible. It would furnish means of information to the vessel interests during the fall and winter storms. It would also furnish means of communication with the Light House and people living on South Manitou island during that portion of the year when they are practically cut off from the outside world.[45]

Physical investigation revealed a somewhat large, rectangular demarcation in the paint surface of the north wall of the north kitchen (Room 105) in the Keeper's Dwelling. This demarcation revealed a darker green paint than that surrounding it. In a taped interview with three former children of light keepers, all three of them said that this was the location of the telephone.

The date of telephone installation at the Light Station is not known, but it is speculated that telephone service was extended after the U.S. Life-Saving Service and the U.S. Lighthouse Service were combined.

1 Mark F. Pfaller Associates, Inc., Historic Furnishings Study, Au Sable Lighthouse, Pictured Rocks National Lakeshore (Milwaukee, WI: 1981),89.

2 Annual Report, 1868, National Archives.

3 October 19, 1917 Superintendent copy of : James P. Burdick, Keeper, South Manitou Light Station, Letter to Lighthouse Inspector, Milwaukee, Wisconsin, October 13, 1917. Record Group 26, Box 803 (1911-1939), File 979, National Archives.

4 Major [name illegible], Corps of Engineers, U.S.A., Engineer, Ninth Lighthouse District, Letter to the Lighthouse Board, Washington, D.C., June 27, 1906, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

5 Major [name illegible], Corps of Engineers, U.S.A., Engineer, Ninth Lighthouse District, Letter to the Lighthouse Board, Washington, D.C., March 28, 1902, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

6 Major [name illegible], Corps of Engineers, U.S.A., Engineer, Ninth Lighthouse District, Letter to the Lighthouse Board, Washington, D.C., August 3, 1904, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

7 Henry M. Robert, Major of Engineers, U.S.A., Lighthouse Engineer, 11th District, Lake Michigan. Letter to Professor Joseph Henry, Chairman of the Lighthouse Board, Washington, D.C., November 4, 1874. Record Group 26, Letter Book 367, Page 323, National Archives.

8 Captain [name illegible], Corps of Engineers, Engineer, Ninth Lighthouse District, Letter to the Lighthouse Board, Washington, D.C., April 15, 1901, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

9 Captain [name illegible], Corps of Engineers, Engineer, Ninth Lighthouse District, Letter to the Lighthouse Board, Washington, D.C., April 15, 1901, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

10 *Description of Buildings, Premises, Equipment, Etc. at South Manitou Light Station, South Manitou Island, Michigan*, March 1, 1910, Record Group 26, United States Coast Guard, Bureau of Lighthouses, 1911-1939, National Archives, p.?

11 Captain [name illegible], Corps of Engineers, Engineer, Ninth Lighthouse District, Letter to the Lighthouse Board, Washington, D.C., April 15, 1901, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

12 Captain [name illegible], Corps of Engineers, Engineer, Ninth Lighthouse District, Letter to the Lighthouse Board, Washington, D.C., April 15, 1901, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

13 Tape #4; Ronald Rosie

[14] *Description of Buildings, Premises, Equipment, Etc. at South Manitou Light Station, South Manitou Island, Michigan,* March 1, 1910, Record Group 26, United States Coast Guard, Bureau of Lighthouses, 1911-1939, National Archives, p.?

[15] Superintendent [of Lighthouses], for the Office of Lighthouse Inspector, Twelfth District, Milwaukee, Wisconsin, Recommendations for Repairing Aids to Navigation, submitted to The Commissioner of Lighthouses, May 4, 1914, Record Group 26, Box 803 (1911-1939), File 979, National Archives.

[16] Letter to Lighthouse Board, 1899, National Archives.

[17] *Description of Buildings, Premises, Equipment, Etc. at South Manitou Light Station, South Manitou Island, Michigan,* March 1, 1910, Record Group 26, United States Coast Guard, Bureau of Lighthouses, 1911-1939, National Archives, p.?

[18] Major [name illegible], Corps of Engineers, U.S.A., Engineer, Ninth Lighthouse District, Letter to the Lighthouse Board, Washington, D.C., May 16, 1902, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

[19] National Park Service Maintenance Files, Job Order Request, June-July 1979.

[20] Videotape #3

[21] Videotape #3

[22] O. M. Poe, Lighthouse Engineer, 11th District. Letter to rear Admiral W. B. Shubrick, Chairman of the Lighthouse Board, Washington, D. C., October 7, 1870. Letter Book 283, Page 480. Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

[23] Henry M. Robert, Major of Engineers, Lighthouse Engineer. *Notice to Mariners transmittal to the Chairman of the Lighthouse Board, Washington, D.C., December 5, 1874.* Letter Book 367, Page 357, Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

[24] Muhn, 64.

[25] G. Weitzel, Lighthouse Engineer, *Letter to Admiral John Rodgers, U.S. Navy, Chairman of the Lighthouse Board, Washington, D.C., April 14, 1879.* Letter Book 462, Page 240, Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

[26] J.N. Miller, Commander, U.S.N., Inspector, 11th District. Letter to Admiral John Rodgers, U.S. Navy, Chairman of the Lighthouse Board, Washington, D.C., August 1879. Letter Book 462, Page 641, Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

[27] Letter to the Lighthouse Board, 8-189_, National Archives.

[28] David A. Clary. *Au Sable Light Station, Pictured Rocks National Lakeshore: The Life of Keeper as Reflected in Their Official Journals.* Prepared for the U.S. Department of the Interior, National Park Service, Midwest Regional Office (Omaha, NE: 1975),6.

[29] Major [name illegible], Corps of Engineers, U.S.A., Engineer, Ninth Lighthouse District, Letter to the Lighthouse Board, Washington, D.C., March 3, 1902, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

[30] Major [name illegible], Corps of Engineers, U.S.A., Engineer, Ninth Lighthouse District, Letter to the Lighthouse Board, Washington, D.C., March 3, 1902, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

[31] Superintendent [of Lighthouses], for the Office of Lighthouse Inspector, Twelfth District, Milwaukee, Wisconsin, Recommendations for Repairing Aids to Navigation, submitted to The Commissioner of Lighthouses, May 4, 1914, Record Group 26, Box 803 (1911-1939), File 979, National Archives.

[32] Superintendent [of Lighthouses], for the Office of Lighthouse Inspector, Twelfth District, Milwaukee, Wisconsin, Recommendations for Repairing Aids to Navigation, submitted to The Commissioner of Lighthouses, May 4, 1914, Record Group 26, Box 803 (1911-1939), File 979, National Archives.

[33] Videotape #4.

[34] Mark F. Pfaller Associates, Inc., Historic and Architectural Data Sections, Historic Structure Report, South Manitou Island Life-Saving Station, Sleeping Bear Dunes National Lakeshore. Prepared for the U.S. Department of the Interior, National Park Service (Milwaukee, WI: 1982),63.

[36] Captain [name illegible], Corps of Engineers, Engineer, Ninth Lighthouse District, Letter to the Lighthouse Board, Washington, D.C., April 15, 1901, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

[37] Captain [name illegible], Corps of Engineers, Engineer, Ninth Lighthouse District, Letter to the Lighthouse Board, Washington, D.C., May 4, 1901, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

[35] Pfaller, 63.

[38] Captain [name illegible], Corps of Engineers, Engineer, Ninth Lighthouse District, Letter to the Lighthouse Board, Washington, D.C., May 22, 1901, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

[39] Photocopy from 1812, Subject Index, South Manitou L.S., Mich., June 14, 1901, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

[40] Pfaller, 34.

[41] Videotape #2, (Fred Burdick).

[42] Superintendent [of Lighthouses], for the Office of Lighthouse Inspector, Twelfth District, Milwaukee, Wisconsin, Recommendations as to Aids to Navigation, submitted to The Commissioner of Lighthouses, March 13, 1919, Record Group 26, Box 803 (1911-1939), File 979, National Archives.

[43] Videotape #4.

[44] United State Congress. Public Act - No. 130 (photocopy), May 31, 1902. Record Group 26, Box 254 (1901 - 1910), File 1812, National Archives.

[45] Roswell P. Roswell, Chairman of the Committee on Ventilation and Acoustics, House of Representatives, U.S., Washington, D.C., Letter to the Lighthouse Board, Washington, D.C., August 16, 1902, Record Group 26, Box 254 (1901-1910), File 1812, National Archives.

Part F:
Building Chronology

Part F: Building Chronology

History of Alterations and Additions

Physical investigation has revealed that a significant portion of the extant materials at the keeper's dwelling dates to the structure's original construction of 1858, while the material at the enclosed passageway and tower, date to those structures' original construction date of 1871. At the same time, however, several elements and finishes at all of the stations's structures were constructed or applied during later episodes in the station's history.

The year 1871 is pivotal in the history of the South Manitou Light Station, because it marked the most significant amount of physical change at the station during its entire history. This physical alteration included the construction of the independent light tower and the enclosed passageway connecting it with the keeper's dwelling. Additionally, the original 1858 lantern, along with its fourth order Fresnel lens, was removed from the roof of the keeper's dwelling following the construction of the new tower, which held a third order Fresnel lens.

Physical change at the station was usually directly correlated with necessity, that is change was usually undertaken to improve the efficiency of the station. As a result, alterations were usually kept to a minimum. When they did occur, they were generally the result of the development of new technology. What follows is the history of the South Manitou Island Light Station, which is divided into seven distinct episodes of time. These episodes are based on both known physical changes at the station and influential changes in ownership.

Analysis of Episodes

Episode I: 1839 - 1857

Significant features and/or events: Original survey of land for the lighthouse reservation; construction of the original light and keeper's dwelling.

Unfortunately, there is no extant written or graphic documentation of the South Manitou Island Light Station which dates to within this period of time. There have been, however, many speculations with respect to the station's appearance during this period. Many of these descriptions are based upon recollections of former keepers' children who were very young while living at the station. One speculation is provided by Myron Vent, a descendent of a former keeper, in his book, *South Manitou Island: From Pioneer Community to National Park.* Vent states that:

> Although no drawing or sketch of the original lighthouse exists... [it] consisted of a one-and-one-half story house of yellow brick with seven rooms including a 'sitting room, chamber, and kitchen'... Above the house on a round, white, tower measuring six feet in diameter, stood the ... lantern."[1]

However, as was previously stated, there is no extant evidence to justify this detailed description.

Another one of Vent's speculations is that there was only one keeper assigned to the station through the duration of this episode. He states that, "From 1840 to 1872 apparently only one keeper was authorized without an assistant."[2] Although no documentation exists to verify this statement, it was probably true, at least for the first several years of operation. It was typical during the early years of the Lighthouse Service to assign only one keeper to each light station. Consequently, most of the early keepers' dwellings were constructed as single family residences. It was not until several years later, after the advent of the steam-powered fog signal, that additional keepers were assigned to provide assistance at light stations. However, at South Manitou, an assistant was added after the construction of the new tower in 1872, and a second assistant added after the construction of the fog signal building in 1874.

There is also no known extant written or graphic documentation regarding when the station first constructed a fog signal building, what it looked like, or when the station's fog signal device was acquired. Vent speculates on this issue as well, saying that, "The signal was a bell weighing 1000 pounds and was struck 'by means of machinery'."[3] There are several remarks in official correspondence from the following years (Episode 2) of a fog signal bell. The National Park Service has a 1,000 lb. fog signal bell in the Sleeping Bear Dunes National Lakeshore park's artifact storage building. However, it is not from South Manitou, but would be similar to the one that was originally on South Manitou.

One graphic document dating to 1874 appears to indicate the general size and location of the station's 1839 structures (Figure 1). However, while this document states that the structures it depicts date to 1839, his-

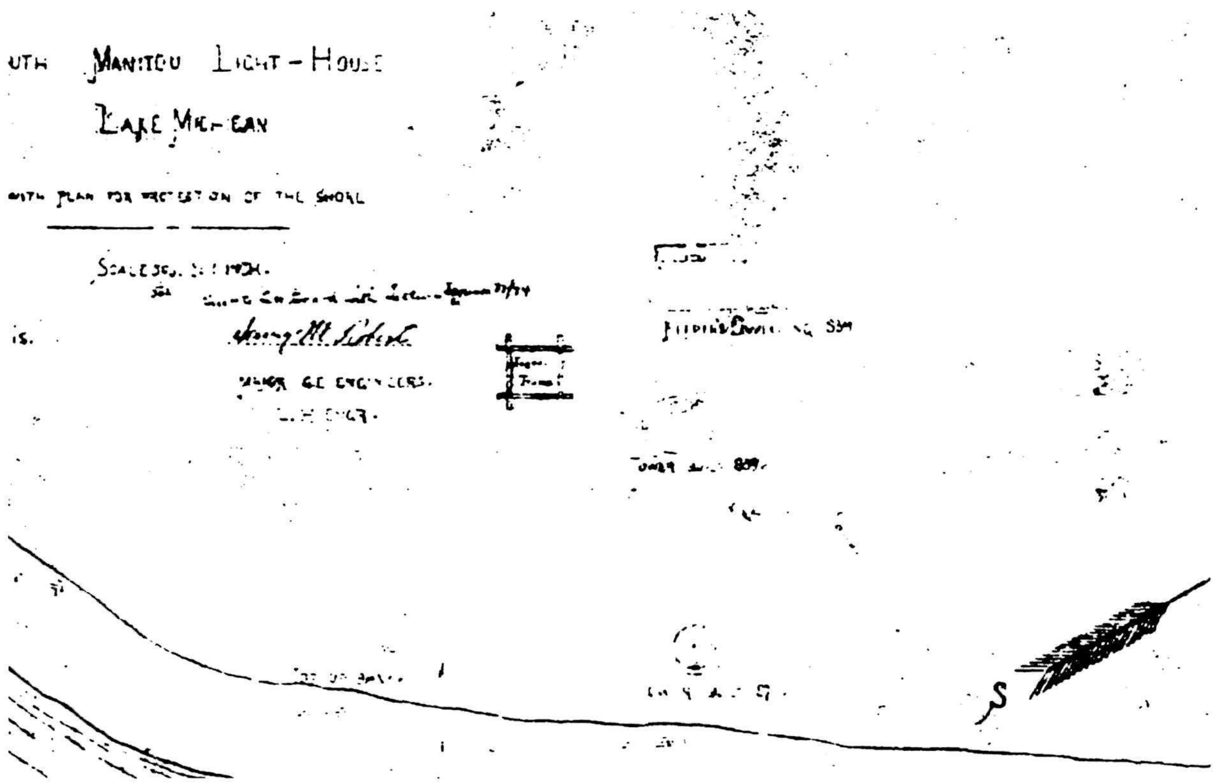


Figure 1 *Detail of a 1874 sketch of the South Manitou Island Light Station. The structures it depicts are highly disputable.*

toric documentation and photographs indicate that this was not the way the station appeared in 1874, the year the drawing was sketched. The drawing depicts a frame structure that houses a fog bell, a keeper's dwelling, and two freestanding towers, which may represent the station prior to 1858, however, there is no other information to substantiate this. One possibility may be that the person who executed the sketch, which was drawn in Milwaukee, never actually visited the station, or the sketch may be of another station, but was inaccurately titled.

Episode II: 1858 - 1870

Significant features and/or events: Construction of a new keeper's dwelling with an attached roof lantern.

There is a linen drawing on file at the State of Michigan archives which dates to May 18, 1858, and is presumed to have been the construction drawings originally proposed for the 1858 dwelling and roof lantern. However, these drawings indicate a one-story addition attached to the west end of the dwelling and, instead of the brick infill window at the east end of the north elevation, the drawings indicate an entrance with steps leading to grade. It is assumed that these drawings were not fully accepted, but instead, were altered. Another original linen drawing shows the same structure with some alterations and has written on it in red ink, "As built in 1858," (Figure 2). This drawing appears to be the one actually used to construct the structure.

An 1868 letter from the District Engineer to the Chairman of the Lighthouse Board reveals some of the conditions of the lighthouse during that year, and that (at ten years old), it required several repairs. The letter in fact states that, "This station required extensive repairs. See Inspector's report. [not extant] New plastering is required through[out] and painting. Copper eavetroughs and conductor should be provided and a proper cistern."[4] This letter indicates that during the early years there was either no cistern present or if one

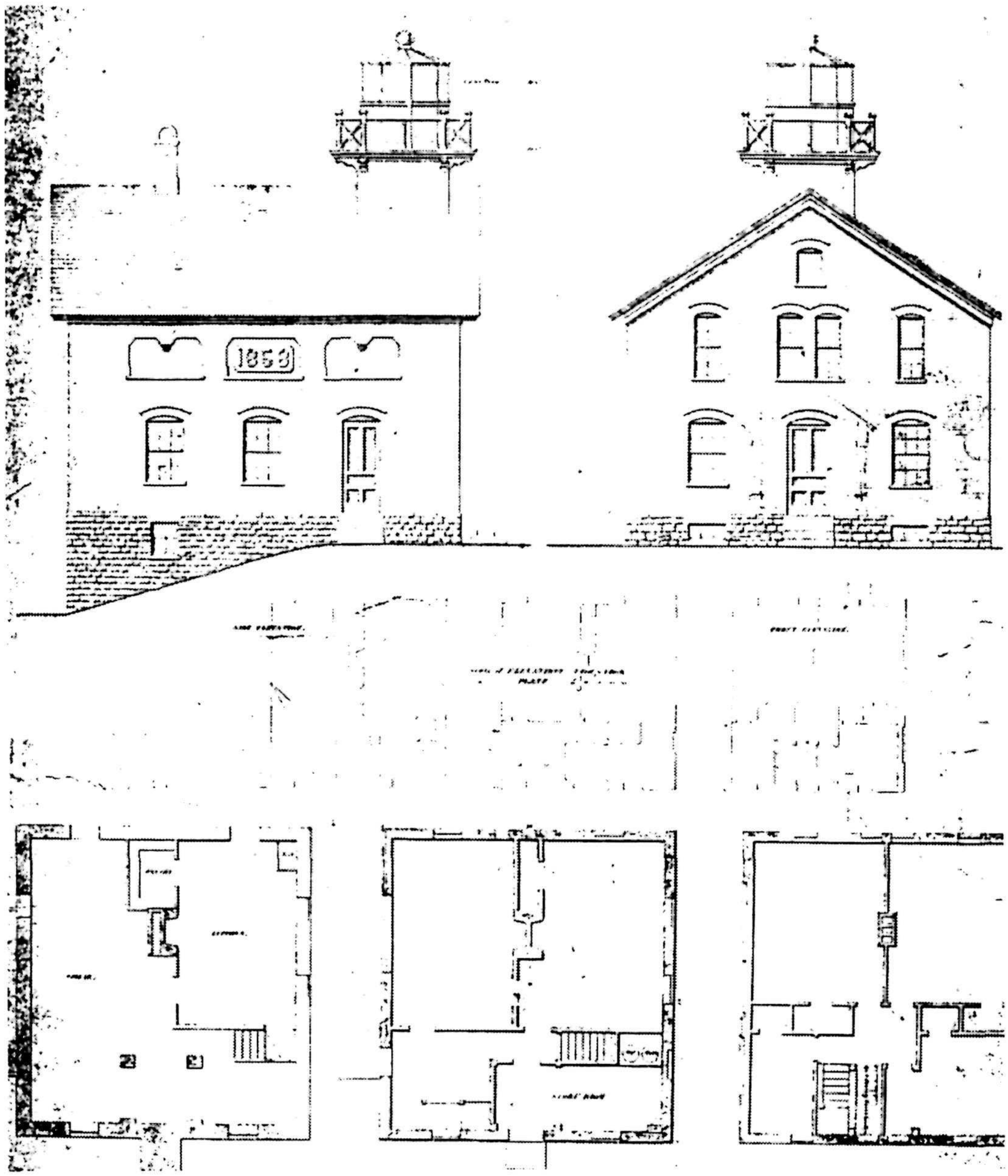


Figure 2 1858 drawing of the South Manitou Island Keeper's Dwelling; the original has "As built in 1858" marked on it.

was in place, it was considered inadequate. Furthermore, it appears that there was no form of a roof drainage system prior to this request for gutters and downspouts.

As early as 1869, recommendations for a taller tower and a light of greater intensity were made for the South Manitou Island Light Station. Correspondence between District Engineers and Inspectors and the Lighthouse Board indicate the reason for the recommendations. In August of 1870, Congress appropriated $10,000 for the erection of a new, 65'-0" (from base to focal point) freestanding tower, which would be connected to the dwelling by a covered passageway. In addition, a 3 1/2 order Fresnel lens was to be installed in the lantern of this new tower.[5] This would provide a light of greater intensity than the fourth order Fresnel contained in the roof lantern at that time. However, these appropriations were not utilized for construction and, as a result, reverted back to the Treasury Department the following July. Subsequently, the project was temporarily abandoned. Shortly thereafter, new recommendations were proposed by the District Engineer for a larger sum of appropriations, $30,000, to be exact. These appropriations would provide for a new tower of greater height than was originally proposed, and the installation of a third order Fresnel Lens (rather the less powerful 3 1/2 order, which had been previously requested). The height of the newly proposed tower would be 64' - 6" from base to focal plane, and would sit on a base 29' above the mean lake level, providing an overall focal plane that was 93' - 6" above the lake.

This episode marks the first documentation of the presence of a fog signal at the station. There is currently no extant information, written or graphic, indicating the location or appearance of this Fog Signal Building (besides the fact that it was wood and housed a bell). Myron Vent speculates in his book, *South Manitou Island: From Pioneer Community to National Park*, that a separate structure was built to house the fog signal in 1858. Again, however, as with most of the information regarding the earliest years of the light station, this date cannot be verified.

Written documentation suggests that an assistant keeper was assigned to the station during the end of this episode, prior to the extensive alterations that were to take place in 1871. A letter from the District Inspector to the Chairman of the Lighthouse Board in 1869 indicates that an assistant keeper had already been appointed for South Manitou Island. The letter states that:

> ... in relation to the appt. of asst. Light Keepers at South Manitou... I would respectfully state that I have already made the recommendation, for the following reasons. 1st - South Manitou Light House is situated on an Island, that the Keeper is compelled to go a distance of ten miles or upwards to procure his mail and provisions. Glen Arbor is the nearest post office situated on the mainland, and inconsequence of which the keeper is compelled to go in a small boat and is frequently detained by adverse winds, there are no neighbors nearer than two miles. There is also a fog bell at this station and in foggy weather (which is peculiar to this part of Lake Michigan) requires constant attention.[6]

Based upon this statement, the need for an assistant during this early period can be easily understood.

Episode III: 1871 - 1896

Significant features and/or events: Construction of the new light tower, the attached passageway, the new fog signal buildings, and the metal oil house.

Figure 3 (the 1870 drawing for the construction of the new tower and attached passageway), indicates the basement of the dwelling in its original configuration. This configuration consisted of only one partitioned room (which was the northwest kitchen), with the rest of the basement being open space and labeled only as "cellar". Therefore, it is assumed that it was not until sometime after 1870 that the basement was further subdivided into more rooms, and the additional window installed at the east end of the south elevation.

The 1871 construction was carried out as proposed, including the installation of a new third order, Fresnel lens. The lampist for the district describes the lens following its installation, saying that:

> The new Fresnel lens, installed in 1871, was made by H. Lepaute, fitted with a set of Funcks Lamps, and had an arc of illumination that was 288 degrees.[7]

The date in which an assistant keeper was officially assigned to the station is unclear. A letter of the previous episode suggests that there were already two keepers at South Manitou prior to the construction of the new tower, made necessary because of the station's isolation and the operational demands of the fog signal bell. However, written documentation dated August 1872 implies that it was not until this year that an assistant keeper was assigned to South Manitou. A letter from the Lighthouse Inspector to the Chairman of the Lighthouse Board, states that, "The appointment of an assistant keeper is recommended on account of the increased labor incident to the change of lights..."[8] The assistant keeper was then officially authorized by the Treasury Department the following month.[9] Furthermore, a letter from the District Inspector to the Chairman of the Lighthouse Board in 1873 states that an assistant keeper had only been appointed since October 1st of 1872.[10]

The vagueness of the number of keepers officially assigned to the station continues for several years of its history. An enclosure from a letter from the District Inspector to the Chairman of the Light-House Board in 1878 indicates that compensation had been paid that year to a keeper, a first assistant, and a second assistant.[11]

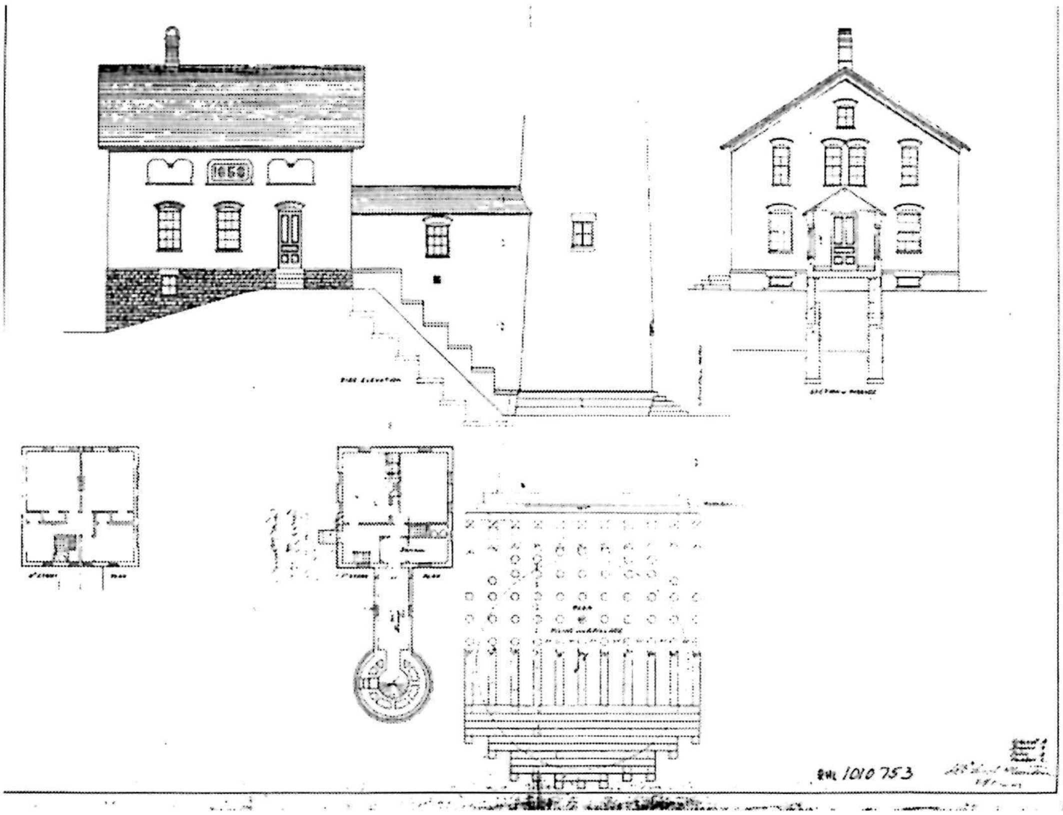


Figure 3 *1870 construction drawing for the new Passageway and independent Tower at the South Manitou Island Light Station.*

There was minimal change at the station during the later part of this episode. Correspondence between the District Engineer and the Chairman of the Lighthouse Board indicates that storm shutters were sent to the station and installed in 1874.[12] There are not many extant photographs taken prior to this early period, therefore, it not exactly known whether these were the first shutters to be installed at the dwelling or were replacement shutters. Original drawings don't indicate their presence, however, construction drawings often didn't include such "furnishings" as shutters, downspouts, and the like. Historic photographs indicate that the shutters, which presumably were a high maintenance item at the station, were removed by the turn of the century.

A new fog signal building was constructed at the station in 1874. However, it appears that the original fog bell continued to be maintained for a few years following the construction of the 1874 steam-powered signal. Historic documentation indicates that by 1879 an identical structure to the 1874 one was constructed near the 1874 structure (but not adjoining it) and, at that time, the fog bell was discontinued.

Near the end of the episode, storage areas for flammable materials were required, especially for the kerosene which was the light's fuel. The 1893 Annual Report of the Light-House Board states this was the year that the, "circular oil house [was] erected 100' northeast of [the] tower."[13]

Episode IV: 1897 - 1933

Significant features and/or events: relocation of the fog signal buildings to create one combined structure; installation of a floor and watchroom in tower.

1897 was a pivotal year in the history of the fog signal at the South Manitou Island Light Station. The duplicate wood frame fog signal structures, which had been constructed twenty years earlier, were relocated and connected together, thereby creating one combined structure.

Although there had been a stair landing just below the lantern room (and possibly a small stove sitting on it), there was not an enclosed watchroom incorporated into the tower's original construction. The only occupiable space at the top of the tower was the lantern room itself. A letter from the District Engineer to the Lighthouse Establishment in 1899 indicates the need for additional room for the keeper. He states that:

> The tower at South Manitou Light-Station, Mich. has no arrangement for a watchroom which can be heated by a stove, which is a necessity during the cold weather, without heating the entire lantern. A tight floor at the level of the landing below the gallery [lantern room] would convert the upper portion of the tower into a suitable watchroom, having a trap door from the staircase below and a trap door entering the lower portion, or the watchroom [of the lantern room].[14]

An earlier photo circa 1890s, Figure 4, indicates some sort of stack at this level. This stack was likely from a small stove which was considered inefficient, and, as stated in the above letter, heated the entire lantern, creating a fire hazard. Subsequently, the watchroom was constructed as requested. Although the information from this period is limited, it appears that this watchroom was not utilized for long following its construction. In 1910, *The Description of Equipment, Buildings, and Premises, Etc.* was completed and regarding a watchroom at the station, stated that, "None in use in the tower. The dwelling is used as the watchroom."[15]

By 1902, the need for the "fireproof" storage of flammable materials, especially kerosene, appears to have increased. The Annual Report of 1902 indicates that by that year the brick oil house was constructed.

Historic photographs dated as early as 1910 (Figure 5 is a better image from 1928) reveal that by this year, wood entry vestibules had been constructed at each of the west entrances to the Keeper's Dwelling. In a taped interview with three children of former keepers, all three of them remember that in each of the vestibules, there was a wood box for the storage of wood which was used to burn in the dwellings' stoves.

Also first seen in a 1910 photograph (Figure 6 shows the vestibule circa 1930), was a wood storm shed that was constructed on the concrete porch at the south entrance into the dwelling. Physical investigation, however, did not reveal any evidence of this structure.

Figure 4 *View looking south of the South Manitou Island Light Station, circa early 1890s (Detail). Note the smokestack above the parapet at the west side of the Tower.*

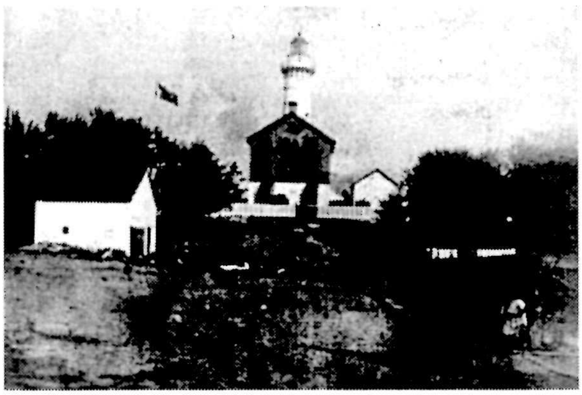


Figure 5 *View of the west elevation of the Keeper's Dwelling, circa 1928. Note the wood vestibules around each of the entrances.*

Photographs through the 1950s indicate the presence of this shed, suggesting that it may have still been place at the time the station was abandoned and deteriorated in the years following, likely to due to a combination of neglect and vandalism.

The 1910 *Description of Equipment, Buildings, Premises, Etc.* states that the, "Keeper and two (2) assistants occupy the single dwelling."[16] Through at least 1922, as stated in the Annual Report of that year, one keeper and two assistants continued to be stationed at South Manitou.

The official *Light List,* which was published annually by the U.S. Lighthouse Service, indicates that the light itself was changed from kerosene in 1929. This is the first year that the illuminant was indicated as an "ioe," which is an incandescent oil vapor lamp.[17]

Figure 6 Detail: Aerial view of the South Manitou Island Light Station, circa 1930. Note the wood vestibule around the south entrance to the Keeper's Dwelling.

Episode V: 1934 - 1958

Significant features and/or events: Installation of the air diaphone fog signal system; ownership transfers from the U.S. Lighthouse Service to the U.S. Coast Guard, and electricity is brought to the station.

One of the most significant changes that took place in 1934 at the South Manitou Light Station was the removal of the steam-powered fog signal system and the installation of an air diaphone system. The new air-powered diaphone system utilized both the Fog Signal Building and the Light Tower. The air diaphone system was operated by two diesel powered generators located in the Fog Signal Building. These generators pressurized the air that was transported to the tanks located at the base of the Light Tower. An air line which ran up the east face of the Tower transported the air to the actual diaphone and horn located at the watchroom level of the Tower. A common situation at many Great Lakes lighthouses used the fog signal generators to provide electricity to the light and the entire station. However, there was no electricity at South Manitou Island until almost ten years after the installation of the air diaphone system. The official Light List indicates that 1943 was the first season that the light was electrically powered.[18]

After enduring several years of inadequate quarters, the need to accommodate two keepers and their families within the single dwelling more efficiently was, apparently, of utmost concern to the keepers and the entire lighthouse district. The South Manitou Island Light Station dwelling had been constructed almost 80 years earlier as a single-family residence, with no provisions for privacy between two, sometimes three, individual families. Several proposals were drafted for the alteration of the keeper's dwelling to efficiently and comfortably house two families. A copy of one set of these proposals, dated January 19, 1935, is currently on file at the Sleeping Bear Dunes National Lakeshore archives. In addition to other alterations, this proposal included a one-story addition along the entire west elevation. There appears to be a "stamp-of-approval" on the drawings, which reads, "remodeling of Dwelling S.M.L.S. Approved January 19, 1935, C.H. Hubbard, Superintendent."

The Superintendent of Lighthouses, stationed in Milwaukee, submitted these proposals to the Commissioner of Lighthouses. Based on the physical investigation, and the lack of further documentation, it is assumed that none of these proposals were accepted by the higher authorities and, therefore, were never carried out. Another proposal was submitted the following year in January (1936), which included: the installation of two bathrooms; the division of the first and second floors to one per keeper; and, the division of the basement into two separated, unconnected kitchens, one for each keeper. As stated in a reply from a Chief Engineer writing on behalf of the Commission, dated April 1936, this proposal was viewed favorably. The engineer stated that, "The Bureau has noted the plans which you have submitted with interest."[19] However, there were no available funds for such construction alterations at that time. The Engineer also states in his letter that:

> You are advised that in the Public Works Program as submitted the only provision for additional keepers' quarters in your district is at Chambers Island Light Station. The Bureau has no information at this time as to whether or not funds for any of this work will be provided..."[20]

Although the light continued to operate through the late 1950s, it appears that the dwelling was no longer occupied by the early 1940s. Most of the information about when this took place is either speculation or recollection. While no written historic documentation has been found pinpointing the exact time the last family left, Ronald Rosie states, during an interview with members of the National Park Service, that his family was the last to live in the dwelling, and that they left the island in 1941.

On file at the National Archives there is a drawing dated 1942, which depicts the installation of a gas refrigerator in the south kitchen of the dwelling. The drawing has marked on it in pencil the words, "Check if done," indicating that the installation may never have been carried out. However, it is still curious why, when the dwelling was supposedly unoccupied, that they even considered installing a refrigerator.

There is another set of proposed drawings (Figure 7) which indicates some architectural alterations, in addition to the installation of plumbing and electricity, in the dwelling. The architectural alterations include relocating the stairs to the basement from their location near the north side of the structure to directly beneath the stair leading to the second floor. Another proposed change, following the stair relocation, is the conversion of the office (Room 102) and the stair (Room B-04) into one room for use as a kitchen. There is no evidence indicating that any of these alterations were undertaken, with the exception of the installation of electrical service throughout. The reason behind this is probably that the dwelling was utilized by the keepers as the Coast Guard office or storage space when they were there.

The official *Light List* records the station, both in 1957 and 1958, as having, "Resident Personnel."[22] This may just mean that they resided nearby (at the South Manitou Island village), or that at least one of them still occupied the dwelling.

The Coast Guard left the island at the end of the 1958 season, although it appears that the operation of the fog signal may have been discontinued as early as the end of the 1954 season. The official *Light List*, published by the Coast Guard, did not state the presence of a fog signal at the South Manitou Island Light Station during the season of 1955 and thereafter.. This departure resulted in the closing of both the South Manitou Island Light Station and the nearby South Manitou Island Life-Saving (Coast Guard) Station.

Episode VI: 1959 - 1969

Significant features and/or events: Abandonment of the station by the Coast Guard, regrowth of the natural site, and deterioration and vandalism of the architectural fabric.

Unlike other light stations around the Great Lakes, which were abandoned by personnel, but remained as automated aids to navigation, the South Manitou Island Light Station was completely abandoned. The light and

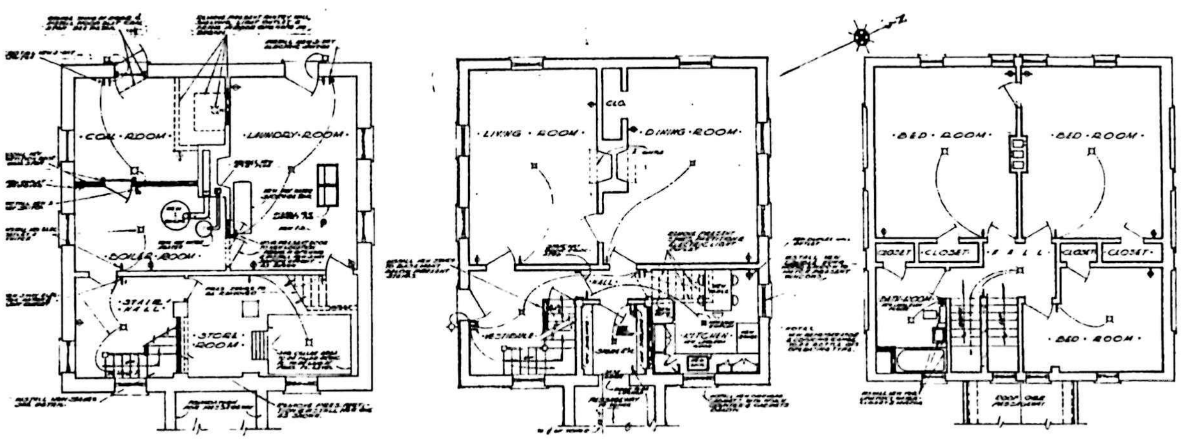


Figure 7 Detail, construction drawings for the proposed repairs and improvements to the South Manitou Island Light Station Keeper's Dwelling, 1945.

the fog signal were both permanently discontinued. This abandonment, along with the site's isolation, left no incentive for maintenance of the station by the Coast Guard.

During the period of abandonment, an island resident "watched over" the station and had a key. He made minor attempts at mitigating the vandalism that kept occurring, such as bricking in the bottom window of the tower to prevent people from breaking it and entering the tower.

Episode VII: 1970 - Present (1996)

Significant features and/or events: Maintenance and stabilization of the Station by National Park Service.

Outlined here are several of the specific treatments that were completed or proposed at the South Manitou Island Light Station by the National Park Service. All of this information comes from the maintenance files that are kept on file at the Sleeping Bear Dunes National Lakeshore headquarters located in Empire, Michigan.

By 1978, the National Park Service had spent approximately $50,000 for the stabilization of historic structures within the Sleeping Bear Dunes National Lakeshore, which included the South Manitou Island Light Station.

Keeper's Dwelling (51-120A)

1976: Replacement of approximately 50% of the cement asbestos shingles was begun at the Keeper's Dwelling; rotten and deteriorated sheathing and rafters were replaced.

1978: The replacement of the Keeper's Dwelling roof was completed with the exception of the cap and flashing around the chimney.

1978: The chimney at the Keeper's Dwelling was tuckpointed, primed, and two finish coats of paint were applied.

1978: The brick surfaces of the Dwelling were prepared for painting.

1978 - 1979: All of the windows at the Keeper's Dwelling, Passageway, Tower, and Fog Signal Building were removed, reconditioned in Traverse City, and reinstalled.

1978 - 1979: Records indicate that tuckpointing was undertaken, however, where it was performed was not stated.

1991: A search was made for appropriate hardware to replace that which was missing at the Dwelling and the Passageway.

1991: The shutters for the Dwelling and Passageway were rebuilt and/or reconditioned from existing fabric.

Passage (51-120B)

1980: Deteriorated roof shingles were removed and replaced with in-kind materials at the Passageway.

1980: The non-historic plywood sheathing was removed from the roof of the Passageway and new sheathing (that resembled the historic) was installed; felt was also installed.

Tower (51-120C)

1979: The windows of the lantern were re-glazed with 1/8" thick Lexan; the casings were replaced as needed; and the historic wood door at the base of the Tower was rebuilt for the 1980 season.

1980: The interior stair of the Tower was painted. This included a primer, plus a red "Rustoleum" finish paint.

1980: Where needed, the interior face of the walls were patched.

1980: The steps and base of the tower were painted.

1980: The masonry was removed from the window openings of the tower and windows were installed.

Fog Signal Building (51-120E)

1978: Missing parts of the chimney were rebuilt using bricks that were found on the island.

1978: A new corrugated roof was installed and partially primed; all required caulking and spackling at the structure was undertaken; and 2 coats of exterior paint were applied.

1980: The doors at the Fog Signal Building were reconstructed to replace the deteriorated ones in place. These were painted according to National Park Service historic standards.

1982-83: The windows were repaired. Those beyond repair were replaced in kind.

1984: The roof of the Fog Signal Building was stripped and repainted.

1991: Asbestos testing was undertaken; the only areas that were reported as containing asbestos particles were at the roof shingles of the dwelling and passageway.

Brick Oil House (51-120D)

1979: A request was made to replace the steel door at the brick oil house. (Completion undetermined)

1984: A request was made to remove the existing paint and repaint the metal roof of the brick oil house. (Completion undetermined)

1 Myron Vent, *South Manitou Island: From Pioneer Community to National Park* (USA: Eastern National Park and Monument association, 1973), 46.

2 Vent, 50.

3 Vent, 46.

4 W. F. Reynolds, Brev. Brig. Gen. and Lighthouse Engineer. *Letter to Rear Admiral W. B. Shubrick, Chairman of the Lighthouse Board, Washington, D.C., September 28, 1869.* Letter Book 257, Page 74. Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

5 O. M. Poe, Lighthouse Engineer, 11th District. Letter to Rear Admiral W. B. Shubrick, Chairman of the Lighthouse Board, Washington, D.C., August 1, 1870. Letter Book 283, Page 122. Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

6 T. H. Stevens, Lighthouse Inspector, 11th District. *Letter to Rear Admiral W. B. Shubrick, U.S.N., Chairman of the Lighthouse Board, Washington, D.C., June 9, 1869.* Letter Book 234, Page 195. Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

7 Henry R. Crump, Lampist. *Descriptive List of Light Stations in the Eleventh District. December 7, 1878.* Letter Book 462, Page 190. Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

8 A. Murray, Comm., Lighthouse Inspector. *Letter to Professor Joseph Henry, Chairman of the Lighthouse Board, Washington, D.C., August 1, 1872.* Letter Book 309, Page 1210, Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

9 Wm. A. Richardson, Acting Secretary. *Letter to the Treasury Department, Washington, D.C., September 3, 1872.* Letter Book 312, Page 75, Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

10 A. Murray, Commodore, U.S.N., Lighthouse Inspector. *Letter to Professor Joseph Henry, Chairman of the Lighthouse Board, Washington, D.C., March 6, 1873.* Letter Book 334, Page 75, Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

11 J.N. Miller, Commander, U.S.N., Inspector, 11th District. Letter to Admiral John Rodgers, U.S.N., Chairman of the Lighthouse Board, Washington, D.C., November 4, 1878." Letter Book 462, Page 427, Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

12 Henry M. Robert, Major of Engineers, Lighthouse Engineer. *Letter(s) to Professor Joseph Henry, Chairman of the Lighthouse Board, Washington, D.C., October 5, and November 4, 1874.* Letter Book 367, Page 178 and 323. Bureau of

Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

13 Excerpt referring to the Ninth District from the "Annual Report of the Light-House Board to the Secretary of the Treasury for the Fiscal Year ended June 30, 1893," (Washington, D.C.: U.S. Government Printing Office, 1893). Sleeping Bear Dunes National Lakeshore Archives.

14 J.G. Warren, Captain, Corps of Engineers, Engineer, Ninth Light-House District. *Letter to the Lighthouse establishment, October 2, 1899.* Letter Book 1332, Page 390.5, Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives.

15 *Description of Buildings, Premises, Equipment, Etc., at South Light-Station, South Island, Mich., March 1st, 1910.* Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives, p. 6.

16 *Description of Buildings, Premises, Equipment, Etc., at South Light-Station, South Island, Mich., March 1st, 1910.* Bureau of Lighthouses, Records of the U.S. Coast Guard, Record Group 26, National Archives, p. 13.

17 *Light List: Great Lakes, United States and Canada. Department of Commerce, Lighthouse Service.* U.S. Government Printing Office (Washington, D.C.: 1924-1959).

18 *Light List: Great Lakes, United States and Canada. Department of Commerce, Lighthouse Service.* U.S. Government Printing Office (Washington, D.C.: 1924-1959).

19 C.A. Park, Chief Engineer (For the Commissioner [of Lighthouses*]), Letter to the Superintendent of Lighthouses, Milwaukee, Wisconsin, April 22, 1935,* Box 803 (1911 - 1939), File 979, Bureau of Lighthouses, records of the U.S. Coast Guard, Record Group 26, National Archives.

20 C.A. Park, Chief Engineer (For the Commissioner [of Lighthouses]), *Letter to the Superintendent of Lighthouses, Milwaukee, Wisconsin, April 22, 1935,* Box 803 (1911 - 1939), File 979, Bureau of Lighthouses, records of the U.S. Coast Guard, Record Group 26, National Archives.

21 *Light List: Great Lakes, United States and Canada. Department of Commerce, Lighthouse Service.* U.S. Government Printing Office (Washington, D.C.: 1924-1959).

Part G:
Landscape Existing Conditions

Part G: Landscape Existing Conditions

Environmental Context and Setting

The South Manitou Island Light Station is located in the southeast portion of South Manitou Island, the southernmost island of the archipelago located in the northeastern portion of Lake Michigan. The island, one unit of Sleeping Bear Dunes National Lakeshore, is 11.3 km (7 mi.) northwest of Sleeping Bear Point on the Michigan mainland. The island is publicly accessible by commercial boat transit from Leland, Michigan; access for National Park Service staff is by launch from Glen Arbor, Michigan. Private boats can also dock in the South Manitou Harbor. Along with the nearby National Park Service ranger and dock station and visitor center, the light station occupies a sandy point off the southeastern tip of the island, forming the southern edge of South Manitou Harbor (Figure1). Together, the light station and the ranger complex comprise the South Manitou Island Lighthouse Complex and Life-Saving Station Historical District, which was entered into the National Register of Historic Places on 28 October 1983 (Figure 2).

Figure 1 *Aerial view looking north of the South Manitou Island Light Station, with South Manitou harbor beyond, 1995.*

Figure 2 *Aerial view looking south of the South Manitou Island Light Station and Life-Saving Station Historical District, 1995.*

South Manitou Island is a product of glacial deposition atop a tilted layer of Devonian limestone bedrock.[1] Following glaciation, an episodic lowering of the water level in the Great Lakes basin occurred as meltwater found new outlets and the earth's crust rebounded. Each period was of sufficient duration to produce distinct terraces and plateaus, such as those that characterize the eastern portion of the island.[2] The light station is situated on a coastal dune just southwest of a sandy point, between a coastal wooded area consisting of mixed pine and hardwood species and a sand and pebble beach. The lakeshore immediately adjacent to the light station is defined and stabilized by a revetment of large boulders, testimony to a continuing battle against coastal erosion that has occurred since the establishment of the light station.

Summary Analysis of Existing Conditions

A comparative analysis of information from the site history with the existing conditions data reveals the presence of character-defining landscape features and qualities related to the significance of the South Manitou light station. Significant cultural landscape characteristics are inextricably associated with the development and operation of the site. The site's overall landscape organization and patterns of spatial organization, response to natural features, views and viewsheds, historic land uses and activities, and the actual buildings and structures and their cluster arrangement inform the current understanding of the site and its historic function as a major Great Lakes light station. Future archeological investigations may be helpful in providing information about vegetation, boundary demarcations, and small-scale features. Without that information it is difficult to analyze fully their role in the station's cultural landscape.

Vegetation, however, does not appear to be particularly important in understanding the site. In fact, absence of vegetation historically in the most used areas of the station and within important sight lines was desirable. Vegetation may have played a role in site stabilization and wind protection. The 1910 *Description* indicates that vegetation was largely a background of trees and foliage for the lighthouse and, as such, contributed historically to the setting of the station.

The domestic landscape does not appear to have had extensive embellishments. The garden, for example, was abandoned by at least 1910 because of the problem of windblown sand. Today a few isolated remnants of the domestic landscape, primarily ornamental and fruit-bearing plant species, survive and help evoke the station's residential period. Since the overall site design and organization were primarily the product of military engineers and the site was subject to inspection at any time, ornamental plantings were one of the few individual marks that lighthouse occupants could make on the landscape. These landscape features reflect late nineteenth- and early twentieth-century life at the station. The limited remnant plant material survivors may be useful interpretive devices that add human interest to the site for visitors.

Like vegetation, site fencing may have played a role in protecting the residential/light tower cluster from the effects of windblown sand. The vulnerability of this site to harsh weather conditions, windblown sand, the shortened season of operation, and the changing tenure of keepers probably influenced the development of the landscape in this regard. Similarly, only a few small-scale features, such as oil drum stands, survive on the site; they also add interest to the site and help to complete the larger picture of the station's institutional landscape.

Circulation systems, primarily pedestrian walkways, reinforce an understanding of the internal organization of the site. Boundary demarcations were never particularly important except to delineate small areas of the site such as the keeper's dwelling, light tower, and the garden plot.

Site Description *(Exhibit 9)*

Located approximately 300 yards southwest of the present National Park Service ranger and dock station and visitor center, the light station occupies the eastern end of the original U.S. Lighthouse Reservation, a rectangular parcel of 10.15 acres extending west-northwest from the shoreline of Section 10, Township 30N, Range 15W, Lot 1.[3] The present-day boundaries of the light station, however, are perceived as topographic in character. The site is bounded on the east by the lakeshore, on the north by the lower-lying beach and adjacent sandy terrace, on the west by the west face of the sandy knoll on which it is situated, and on the south by an adjacent sandy knoll of somewhat higher elevation. The site slopes to the east-southeast and orients to Manitou Passage, the portion of Lake Michigan lying between the mainland and North and South Manitou Islands.

The light station consists of five buildings. Three of these—the keeper's dwelling, the attached passageway, and the light tower—are connected and occupy a central, dominant position on the site (Figure 3).

The Fog Signal Building is located near the northeast corner of the site adjacent to the lakeshore revetment. The brick oil house, the smallest building on the site, is located approximately midway between the keeper's dwelling and the Fog Signal Building, on the northeastern slope of the knoll. Foundation remnants and archeological remains of several structures are also present, both within the present site boundaries and beyond the knoll to the west. The complex also includes a concrete walkway system and several small-scale features related primarily to its original light station functions or to more recent visitor interpretative uses. The lighthouse complex is linked to the National Park Service ranger complex by a narrow boardwalk.

Overall Landscape Organization and Patterns of Spatial Organization

The general organization of the light station site as a reflection of its elevated and sloping topography is evident in the linear arrangement of buildings consisting of the keeper's dwelling, the attached passageway, and the light tower. The oldest of these buildings, the keeper's dwelling, which originally supported a rooftop light, occupies the northernmost high point along the knoll. The passageway and light tower are sited on the axis of the keeper's dwelling to the east-southeast, parallel with the predominant slope of the site. The axial symmetry of this arrangement is reinforced by an elliptical, concrete walkway that surrounds the three buildings. The Fog Signal Building, located roughly 100 feet to the northeast of the light tower, has an axis nearly parallel with that of the residential/light tower cluster. Historic plans and proposals for shoreline stabilization dating as early as 1874 show, in several instances, timber cribbing extending from the shore along this axis, further indicating their importance as an organizing principle of the site. The cribbing associated with the Fog Signal Building was at one time a rail system boat launch for the "surfboats" associated with the nearby lifesaving station. This area, now underwater, is a maritime archeological site.

Historic photos from the 1910s and 1920s showing the residential/light tower cluster from the west also indi-

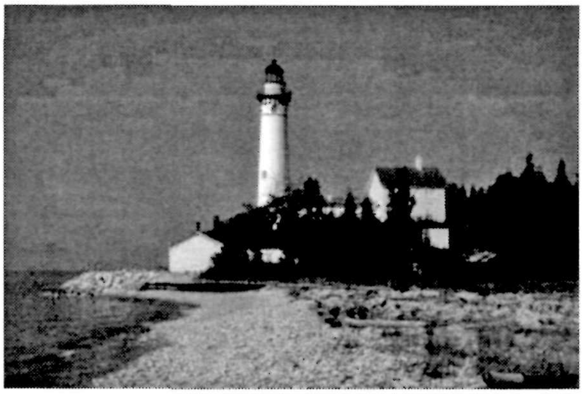


Figure 3 View looking south at the South Manitou Island Light Station from sandy point, 1995.

cate that its axis may have helped organize features such as outbuildings and gardens in this portion of the site (Figures 4 and 5).

A secondary feature of the site's organization is the system of concrete walkways that link various areas of the site. This system consists of the walkway that encircles the keeper's dwelling and light tower, two diagonal walks that link this building cluster with the Fog Signal Building, and a number of lateral walks that give access to outbuildings and other extant or former site features. The walkway system accommodates the site's topography with both steeply sloping walks and walks that incorporate steps at regular intervals.

The surrounding forested areas and shrub- and grass-covered dunes provide the vegetative setting for the light station complex. Within the complex, the walkway system defines landscape areas that include a variety of native and introduced plant materials. The area within and adjacent to the encircling walk, in particular, exhibits a more domestic landscape character that includes apricot trees, lilac, wild rose, and evening primrose.

Response to Natural Features

The siting of the keeper's dwelling, which originally supported a rooftop light—the second documented lighthouse on the site—was a direct response to local topography. The 1858 dwelling occupies the northernmost high point of a sandy knoll, providing its light with maximum elevation, and hence, visibility. This siting also reduced potential visual interference from adjacent vegetation, although later nineteenth-century photographs indicate that most vegetation on the dune

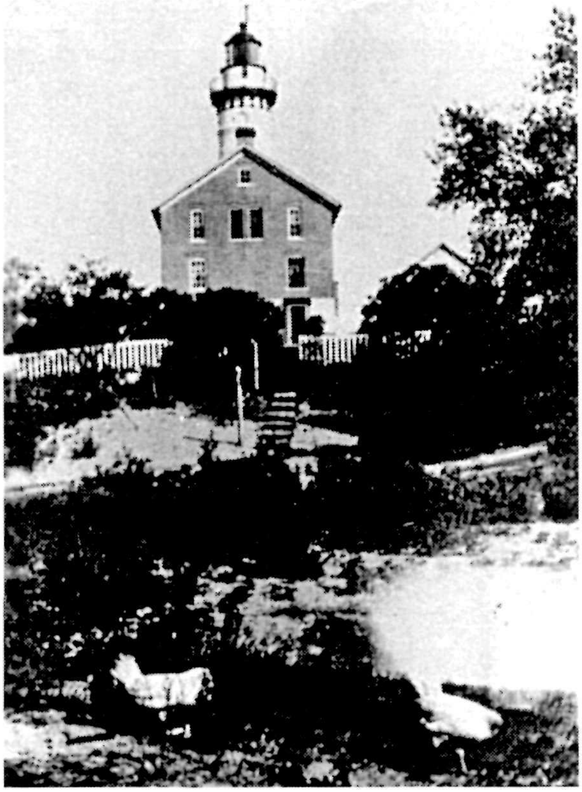


Figure 4 View looking east toward the Keeper's Dwelling and related outbuildings, circa 1910.

Figure 5 View looking east toward the Keeper's Dwelling and related outbuildings, circa 1928.

Figure 6 View looking south toward the South Manitou Island Light Station, 1883.

Figure 7 View looking south toward the South Manitou Island Light Station, circa 1884.

Figure 8 View looking south toward the South Manitou Island Light Station, circa the late 1800s.

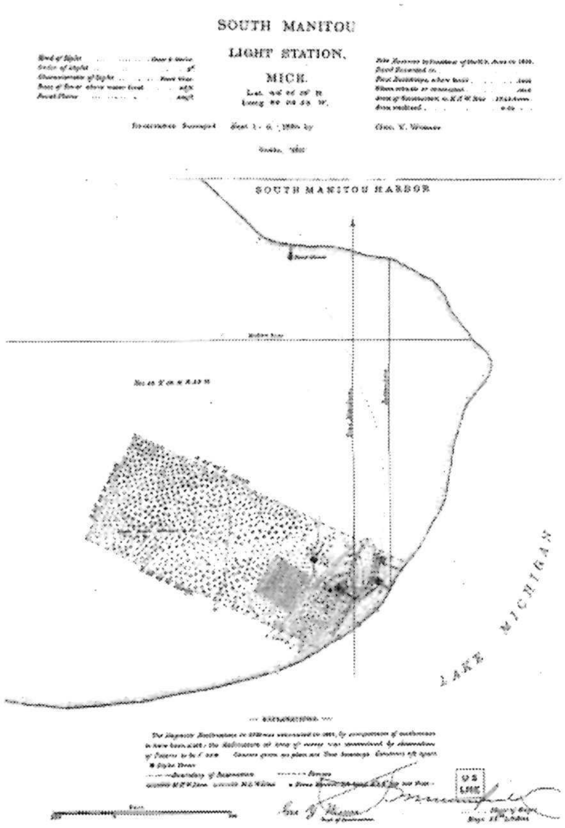


Figure 9 Drawing of the South Manitou Island Light Station surveyed September 1-4, 1884 by Geo. Y. Wisner, 1887.

was low in character (Figures 6, 7, and 8). With the construction of the 1871 light tower, the lower grade at the tower's base necessitated a taller structure to gain advantage over the 1858 light. The sloping topography, however, enabled the construction of the enclosed passageway to the tower without significantly obscuring light and views to the dwelling.

Although the lighthouse's navigational function required it to occupy a fairly exposed site, the location of some of the station's other structures was dictated by a need for climatic protection or to enhance their operation. The original Fog Signal Buildings' location on the leeward side of the knoll may have afforded them some degree of protection from west winds. This siting was retained when the buildings were joined in 1897. Certainly being near the water's edge helped ensure that no intervening vegetation might attenuate or muffle warning signals. The building's proximity to the surface of the lake also may have helped reflect and conduct the sound waves for longer distances.

Other features of the light station site less directly associated with its navigational functions were sited in even more protected locations. The 1887 plan of the reservation (Figure 9) shows a shop and privy west of the keeper's dwelling, just below the ridge of the knoll, and a garden area and barn farther west below the foot of the knoll. Although this location undoubtedly provided some degree of protection from lakeside winds, the 1910 description of the South Manitou Light Station notes that the garden area by that time already had been given up "on account of shifting sand."

Shoreline Protection

Shore protection represents a different response to natural features and processes. Because of its exposed site, erosion of the shoreline has been a concern since the light station's establishment. The present landscape contains three approaches to providing shoreline protection. The earliest is the remains of timber cribbing that extends outward from the front of the Fog Signal Building (Figure 10). This feature originally was a rail system that served as a boat launch for the "surfboats" associated with the lifesaving station to the north (Figures 11 and 12). Steel cribbing consisting of a horizontal member supported by upright posts represents a later effort to protect against erosion; this treatment is evident north of the Fog Signal Building (Figure 13). The balance of the shoreline adjacent to the light station reflects the most recent stabilization effort, a revetment of boulders ranging in size from one to four feet, placed over a base of geotextile matting (Figure 14). The overall height of the revetment from the water line is ten to twelve feet.

There are several reasons why the shoreline along the Light Station has continued to experience damage, including:

Stone Size - The size of the stone was not adequate to resist the storm events that occur at this location. The stone has experienced a significant amount of movement, which has created excessive voids within the stone layer, causing loss of bedding and settlement of the stone.

Toe Protection - The toe of the structure was not adequately keyed into the lake bed. This condition, coupled with undersized stone, has caused undermining of the structure due to the scouring currents, again creating settlement and loss of bedding material.

Figure 10 *View of the timber cribbing in front of the Fog Signal Building, 1995.*

Figure 11 *Fog Signal Building near the Lighthouse, circa the early 1900s.*

Figure 12 *The South Manitou Island Light Station, from the late 1800s or early 1900s.*

Figure 13 Iron and rock shoreline protection at the South Manitou Island Light Station, 1995.

Figure 14 Sandy terrace and boulder revetment at the South Manitou Island Light Station, 1995.

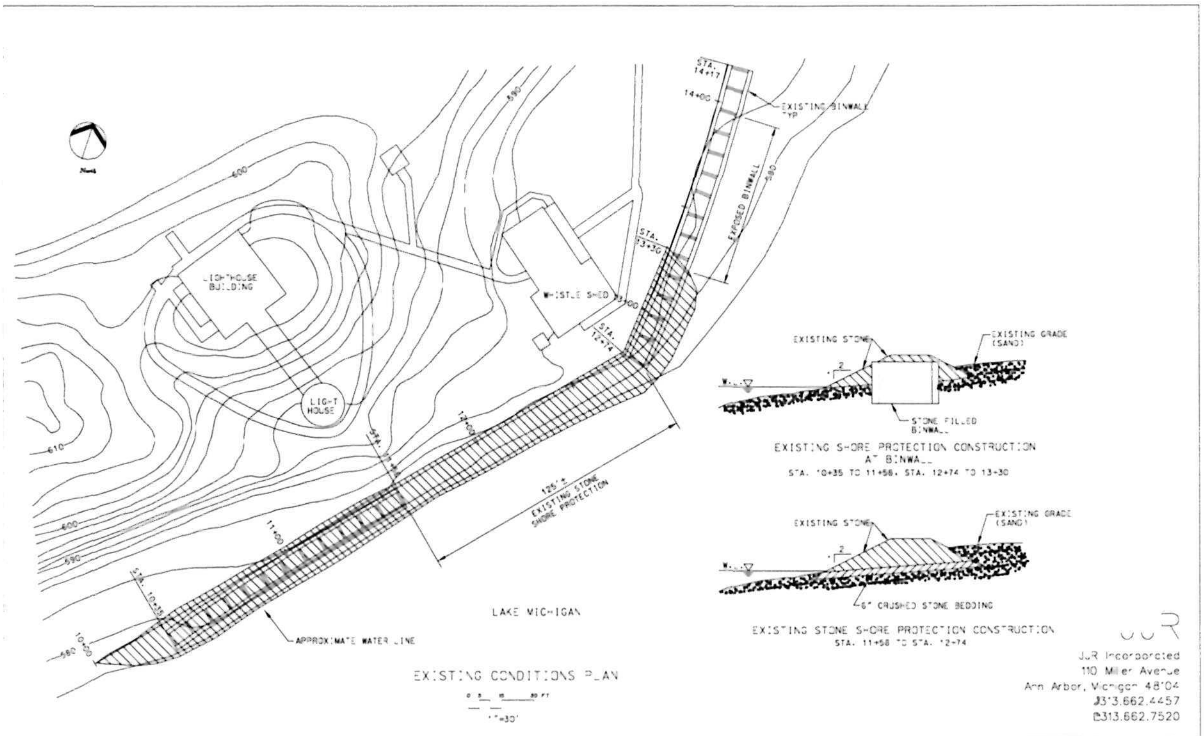


Figure 15 Existing shoreline conditions.

Filtering Layer System - A typical revetment for shoreline protection is designed in layers, with finer material used as a bedding, and layers of stone with successively coarser gradations being placed on top of each other to create a "filter" preventing the loss of material. Each layer's gradation is based on its overlayer material size, all of which are based on the stone size required to minimize damage. The revetment along the South Manitou shoreline was not constructed in a layered fashion, but was designed as a rubble-mound graded riprap structure. This detail did not provide for the storm forces and littoral movement of sand which caused structure damage and undermining due to scouring.

Proper Crest - An engineered revetment, designed to protect property from storm damage, requires a minimum crest width and height. The height of the crest is based on the acceptable amount of overtopping that will be tolerated at the design storm. The width of the crest is based on the amount of rough surface area required to dissipate the waves that overtop the revetment. The revetment along the South Manitou shoreline was not provided with a crest width, nor was its crest set at an elevation which would properly protect the shoreline from overtopping and erosion. The stone material placement provided a temporary erosion control, specifically during the low water elevations of the early and mid 1990s. As water levels rise to near record highs in the late 1990s, the revetment is providing much less protection against storms, and continues to experience damage due to wave energy and scouring.

The original crib structures built in the 1870s appeared to have failed, based on the historical accounts, due to settlement and/or undermining. The details of the crib structures show no embedment of the structures to sound material. It appeared the structures were detailed as gravity structures, intended to remain in place solely through the weight of the structure resisting the forces of the lake. The fine sand materials along the shoreline were not capable of properly supporting the structure, and without adequate embedment, the structures settled and eventually broke apart. The stone stabilization placed in the mid-1980s served to temporarily stabilize the shoreline, but has experienced significant damage. The existing shoreline of today, shown in Figure 15, will continue to deteriorate due to scouring, undermining, and storm damage.

Land Uses and Activities

The light station no longer serves a navigational function. The light tower complex, however, remains a highly visible landmark from Lake Michigan during daylight hours. Although it has no official role in navigation, the tower undoubtedly still provides informal orienteering function as a well-known visual point of identity. The site's present land use is one of visitor interpretation, with independent and ranger-conducted tours of the site. Access to the light tower is with ranger escort; public access is not currently provided to the passageway, keeper's dwelling, or other structures on the site. A wayside north of the Fog Signal Building adjacent to the boardwalk provides the only visitor interpretation for self-guided visitors to the light station site. Recreational use of the site is also reflected in the provision of two picnic tables along the sandy terrace above the revetment, and the nearby Giant Cedars Trail and marker adjacent to the site on the north.

Cluster Arrangements of Buildings and Structures

Three of the extant structures at the station are connected, forming the residential/light tower cluster, the site's principal cluster arrangement and most dominant built features: the two-and-a-half story, stone and brick masonry keeper's dwelling, built in 1858; the attached, brick passageway linking the keeper's dwelling and the light tower, built in 1871-72; and the 104-foot-tall, brick light tower itself, also built in 1871-72. The three buildings occupy the central portion of the site and form a linear arrangement that extends from a local high point down the slope of the knoll toward the lakeshore (Figures 15 and 16).

The one-story, clapboard Fog Signal Building (along with its well enclosure to the south), the brick oil house, and the footings of the U.S. Coast Guard lookout tower to the north, form a second, if less well-defined, cluster in the northeast corner of the site. Historic photos from the 1930s and 1940s indicate the earlier appearance of this fog signal/oil storage cluster in its more complete condition (Figures 17 and 18). Historically this was a larger cluster that also included the metal oil house and an open, cylindrical storage tank, located east and west of the brick oil house, respectively. The metal oil house was moved from the light station by 1961, and was relocated to its present location behind the lifesaving station in the National Park Service ranger complex sometime after 1970.

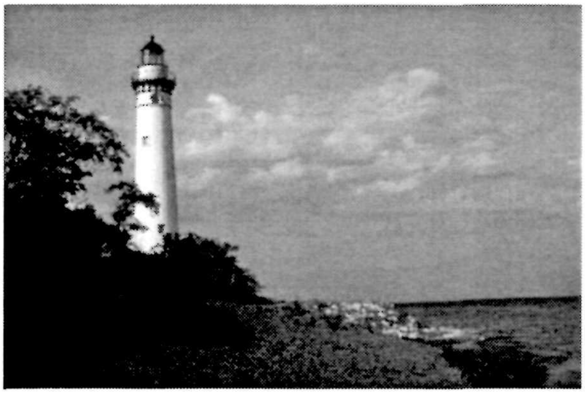


Figure 16 *View of the Tower at the South Manitou Island Light Station from the southwest, 1995.*

Figure 17 *View of the South Manitou Island Light Station and Coast Guard Lookout Tower, 1939-40.*

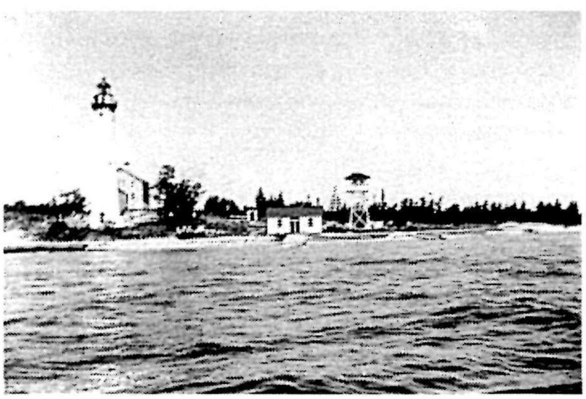


Figure 18 View of the South Manitou Island Light Station and Coast Guard Lookout Tower, 1946.

Circulation Systems

Extant circulation systems at the light station site are exclusively for pedestrian use; no vehicular systems are present, although the remains of "surfboat" rail launch in front of the Fog Signal Building have been preserved as an underwater maritime archeological site. Pedestrian circulation is primarily of two types—concrete walkways that occur within the site and link various buildings and outdoor areas, and wood boardwalks that link the site to the National Park Service ranger complex as well as provide secondary circulation within the site.

The major element of the concrete walkway system is the walk that surrounds the residential/light tower cluster. It follows continuously the grade of the site without steps except for a single change of grade near the southwest corner of the keeper's dwelling; in places the grade of this walk is somewhat steep. Generally two feet wide and of cast-in-place construction, the walk is occasionally edged in tan or red brick, the former possibly remnant material from the first lighthouse and keeper's dwelling on the site (Figure 19). A wider area of paving occurs at the rear of the keeper's dwelling. Drifted sand covers the walk in two places on the south side of the residential/light tower cluster (Figure 20). At the entrance to the light tower, the walk is paved with a large bluestone slab (Figure 21). A series of rocks form casual stepping stones down the adjacent bank to the sandy terrace above the revetment.

A diagonal walk with a moderate grade leads from the light tower entrance toward the Fog Signal Building; it appears to be a remnant of the walk that at one time extended to the front of the Fog Signal Building. This

Figure 19 *Tan brick edges at the elliptical walk north of the "Lighthouse cluster", 1995.*

Figure 20 View of the sand drifts over the sidewalk south of the Keeper's Dwelling, 1995.

Figure 21 View of the bluestone slab and steps at the Tower, 1995.

Figure 22 View of the diagonal walk linking the Fog Signal Building with the Lighthouse cluster, 1995.

walk presently serves as the major approach route to the lighthouse from the Fog Signal Building, and provides the site with a certain "Front Street" character with respect to the sandy terrace and revetment immediately to the east. A second diagonal walk linking the residential/light tower cluster and its encircling walk with the Fog Signal Building traverses the northeastern slope of the knoll (Figure 22). As a result, the walk is interrupted at regular intervals by three short series of steps. The eastern portion of this walk is obscured by a considerable depth of windblown sand. This diagonal walk provides access to the brick oil house via a lateral walk that is nearly level in grade. A second, sand-covered walk branches off the diagonal walk leading to the water pump, while a possible third walk may lie beneath the sand leading to the former site of the metal oil house. A two-plank boardwalk at the eastern end of the diagonal walk extends around the northwest end of the Fog Signal Building. The diagonal walk terminates in a concrete patio on the south side of the Fog Signal Building.

Several other lateral walks of similar character branch off the encircling walk. The longest extends parallel with the south wall of the keeper's dwelling to the foot of the stairs at the side entrance to the building. Nearby, a remnant walk once provided access to the shop that is no longer extant. Another lateral walk extends from the rear of the keeper's dwelling toward the wooded area on the west side of the dune. Branching from this is a diagonal walk, now covered with sand and vegetation, that provided access to the privy. Another remnant walk, also covered by sand, appears to branch from the encircling walk just south of the storage building approach walk; it may have provided access to the first fog bell housing.

At the northeast corner of the site, a series of concrete walks and boardwalks provide access to the Fog Signal Building and former Coast Guard lookout tower location from the north. Many portions of the concrete walk are cracked, broken, missing, or covered with sand. The concrete apron at the front of the structure is in particularly poor condition. North of the lookout tower footings a boardwalk approximately 400 yards in length leads to the National Park Service ranger complex (Figure 23). It consists of two, two-by-twelve boards of staggered lengths supported by four-by-six sleepers at approximately forty-two inch intervals. Adjacent to the boardwalk immediately north of the lookout tower site is a wayside area structured of narrower boards (Figure 24).

Figure 23 View of the boardwalk leading to the National Park Service Ranger Complex (the former U.S. Life-Saving Station), 1995.

Figure 24 View of the Lighthouse wayside and boardwalk, 1995.

Figure 25 A more domesticated landscape adjoins the Keeper's Dwelling, 1995.

Vegetation (See also Master Plant List)

Vegetation at the light station consists of native and nonnative species of trees, shrubs, and herbaceous plants. Both deciduous and evergreen plant materials are represented. The overall vegetative character of the site is of clusters of shrubs and small trees, punctuated by several groupings of larger trees, set against a wooded backdrop of the coastal forest. The precinct around the keeper's dwelling is characterized by a more domesticated landscape which includes apricot trees, lilac, wild rose, and evening primrose (Figure 25). Lilac shrubs have naturalized to other portions of the site, and extend into the dunes to the south, west and north. Notable groupings of trees include several stately balsam firs on the north side of the residential/light tower cluster (Figure 26), a stand of cottonwood adjacent to the lighthouse entrance (Figure 27), several large cottonwoods northeast of the light tower, a cluster of junipers on the former site of the metal oil house, and a grouping of Lombardy poplars north of the Fog Signal Building (Figure 28). Poison ivy is prevalent throughout the site.

Master Plant List

Plants identified at the light station site include:

Trees

Apple	*Prunus malus*
Apricot	*Prunus armeniaca*
Balsam fir	*Abies balsamea*
Choke cherry	*Potentilla virginiana*
Cottonwood	*Populus deltoides*
Lombardy poplar	*Populus nigra*

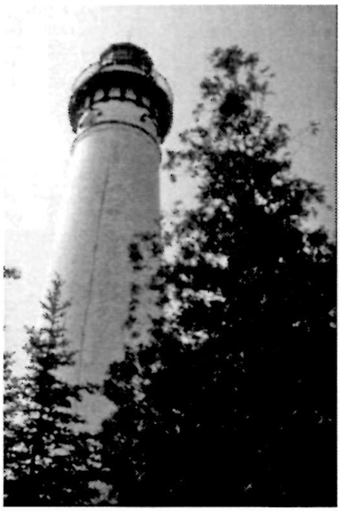


Figure 26 Stately Balsam Firs adjoin the Light Tower, 1995.

Figure 27 Cottonwood Trees at the Lighthouse [entrance], 1995.

Figure 28 Lombardy Poplars adjacent to the Fog Signal Building, 1995.

Sugar maple	*Acer saccharum*
White cedar	*Thuja occidentalis*

Shrubs

Buffaloberry	*Arctostaphylus uva-ursi*
Common juniper	*Juniperus communis*
Creeping juniper	*Juniperus horizontalis*
Lilac	*Stringa vulgaris*
Red-osier dogwood	*Cornus stolonifera*
Wild rose	*Rosa acicularis*

Herbaceous Plants

Absinthe wormwood	*Artemisia absinthium*
Aster	*Aster praealtus*
Beach grass	*Ammophila breviligulata*
Beach pea	*Lathyrus japonicus*
Bladder campion	*Silene vulgaris*
Bluebell	*Campanula rotundifolia*
Common milkweed	*Asclepias syriaca*
Evening primrose	*Oenothera oakasiana*
Gray goldenrod	*Solidago nemoralis*
Pitcher's thistle	*Cirsium pitcheri*
Poison ivy	*Toxicodendron radicans*
Rough cinquefoil	*Potentilla norvegica*
Sea-rocket	*Cakile edentula*
Starry false solomon's seal	*Smilacina racemosa*
Timothy	*Phleum pratense*
White sweet clover	*Melilotus alba*
Yellow sweet clover	*Melilotus officionalis*

Small-scale Features

A variety of small-scale features is present at the light station site, including those associated with the function or servicing of the station, those related to visitor interpretation or recreation, and those that provide site protection and stabilization.

Service-related features:

- fog signal well enclosure
- oil drum stands (2-1/2 sets)
- water pump
- cistern outlet at north side of keeper's dwelling
- miscellaneous pipes (3)
- foundation with 4 pins at southwest corner of keeper's dwelling

Visitor-related features:

- light station wayside, adjacent to boardwalk
- picnic tables (2), on sandy terrace
- trail marker, north of wayside

Site protection features:

- log retaining steps, west of Fog Signal Building

Miscellaneous institutional features:

- flagpole remnant, north of keeper's dwelling
- National Park Service survey marker, northeast of light tower

Figure 29 *View of the South Manitou Island Light Station from the Manitou Passage, 1995.*

Views and Viewsheds

Its height makes the light tower, which is visible for a considerable distance from Manitou Passage, a prominent feature of South Manitou Island (Figure 29). The light station complex as a whole is not visible from the National Park Service ranger complex because of the presence of the intervening dune and associated vegetation, but isolated glimpses of the tower are available from several points. A particularly characteristic view of the complex is available, however, from the sandy point which forms the south edge of the harbor (Figure 30). Another notable, closer-range view of the tower is available from the beach southwest of the complex. (Figure 31).

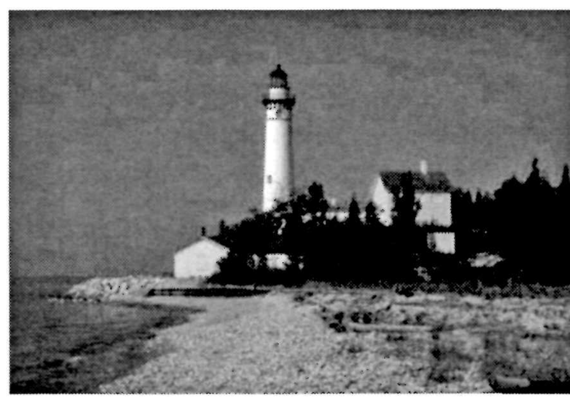


Figure 30 *View of the South Manitou Island Light Station from the sandy point which forms the south edge of the harbor, 1995.*

Views from the site are primarily toward the southeast, across Manitou Passage to the mainland. The panorama available from the lantern or exterior walkway of the tower, however, is the defining view from the site. From here one can survey the majority of the island, with particularly good views of South Manitou harbor (Figure 32).

Archeological Resources

A number of known archeological resources provide additional information about the historic character and use of the light station site. Immediately west of the keeper's dwelling are two foundation remnants that may indicate the location of the station's former shop or storage building. Beyond it to the west, just below the brow of the knoll, is a three-sided brick foundation remnant of the station's privy. Nearby are remnants of what

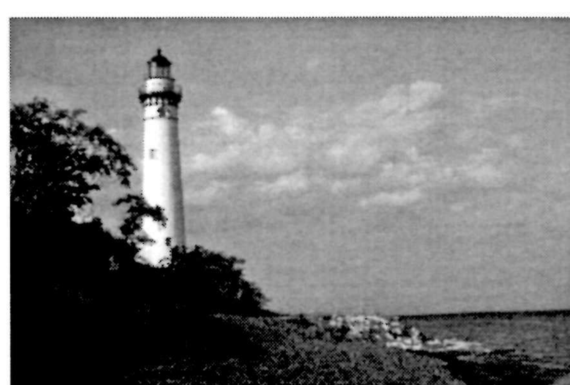


Figure 31 *View of the South Manitou Island Lighthouse from the southwest, 1995.*

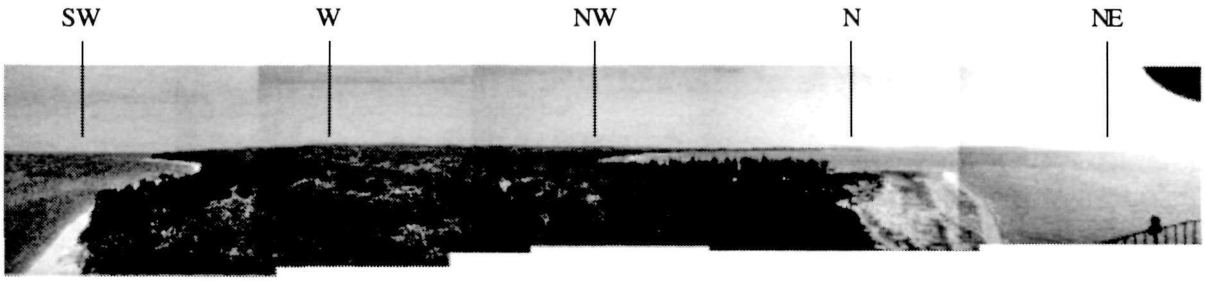


Figure 32 Panoramic View of South Manitou Island from the Light Tower, 1995.

may have been the wood fence surrounding a large portion of the complex. The larger six-by-six member may have been a fence post, while the one-by-four member is suggestive of a picket. At the foot of the dune to the west is a series of pier foundations that mark what was most likely the station's barn; the foundations are typically 18" square, and are arranged in a grid with a module of approximately nine feet. A nearby open area of grass and drifted sand to the south of the barn site may have been the station's garden.

Footings also are evident for three of the four legs of the lookout tower located north of the Fog Signal Building, as well as for the tower's stair landing. The fourth footing is discernible by probing at the base of an adjacent red-osier dogwood.

Archeological evidence of other historic site features indicated on various historic drawings also may be present on the site but were not confirmed during fieldwork. These include foundations of the two cylindrical storage buildings flanking the brick oil house, the underground gas tank north of the Fog Signal Building, and the first fog bell frame. In addition, archeological evidence also may be present for features only known through narrative documentation, such as the 1839 lighthouse and keeper's dwelling, the boat house, the chicken coop, and the automobile garage.

As discussed previously, the underwater remnants of the rail system in front of the Fog Signal Building, used to launch the lifesaving station "surfboats", have been preserved as a maritime archeological site.

Boundary Demarcations

The present-day landscape of the light station is remarkably similar to that depicted in early twentieth-century photographs of the site, with the notable exception of fencing. The wood picket fence that at one time flanked the walk encircling the residential/light tower cluster is now gone. It is not known whether recommendations for additional fencing around the Fog Signal Building were ever implemented, but clearly fences played an important role in defining various areas within the light station compound.

Today, the boundary demarcations that help define the site are less apparent, but nonetheless discernible. Perhaps most obvious is the boulder revetment that defines the eastern boundary of the site and separates the station from the eroding shoreline. Similarly, the wooded backdrop of the coastal dune forest on the west provides a strong visual, if not physical, boundary to the site. Determining the site boundary to the north and south is less definitive, where beach and sand dune represent continuity more than barrier. Again, however, physical features provide important clues. To the south, an adjacent sandy knoll of somewhat higher elevation prevents a view to the beach from the encircling walk, forcing views to turn back into the site. On the north, where the site is more open to the adjacent landscape, the entrance to the site seems to occur where a grouping of Lombardy poplars intervene between the wayside exhibit and the Fog Signal Building.

Deficiencies of Site Structures

There are several types of deficiencies associated with site structures (Exhibit 10). In general, these are related to the cumulative effects of age, lack of use as a light station, and weather. Identified site deficiencies include the following:

- eroding shoreline,
- sand-covered walkways,
- cracked and broken walkways,
- missing segments of walkways,
- overgrown plant materials encroaching on historic site features and views,
- broken flagpole,
- missing oil drum saddle, and
- broken water pump.

Observations and Analysis of Site and Architectural Barriers

The natural and cultural resources of the light station present a number of site barriers that are impediments to universal accessibility. Complete universal accessibility is, perhaps, an un-achievable goal for a site which is accessible primarily by commercial tour boat, almost entirely covered with sand, and whose most visible cultural resource is a light tower accessible only by steep, curving stairs. Identification of the station's site and architectural barriers, however, is the first step in increasing and/or improving access to the site.

Observed site and architectural barriers include the following (Exhibit 10):

- sandy coastal site,
- steep grades in portions of the site,
- steps along some concrete walkways,
- cracked and broken walkways,
- missing segments of walkways,
- narrow boardwalks, and
- stairs leading to and within the light tower and keeper's dwelling.

Evaluation of Integrity

The South Manitou lighthouse site appears to possess integrity as a historic cultural landscape that represents the navigational functions of a significant Great Lakes lighthouse complex in the nineteenth and early twentieth centuries. The site was developed as a utilitarian and largely standardized landscape with certain prescribed features and policies that established the character of its development and management. The site as it exists today reflects that legacy and retains essential aspects of integrity of location, design, setting, materials, workmanship, and feeling.

Landscape changes at the station usually occurred in response to operational needs or changes in governmental policies and relate to the overall history of the site and to light stations generally. The site's character began to change most dramatically, perhaps, in 1939 when the residential function was discontinued. The sights, sounds, and even smells of the lighthouse era are gone with the loss of the functioning light, steam boilers, and fog signals. The most significant loss of integrity is associated with the absence of the traditional lighthouse functions. Since 1939, the site has probably taken on even more of a utilitarian feeling with the loss of the small-scale features and the absence of the custodial care usually associated with a domestic landscape.

The absence of fences and some auxiliary structures and walkways diminishes but does not destroy the integrity of the cultural landscape. The overgrowth of vegetation also intrudes on integrity of feeling to some extent. The primarily sand-covered landscape that exists today, however, may actually resemble the site historically when it was in need of repair and maintenance with walks covered and fences down following a destructive storm.

However, the landscape organization of the period of operation is still apparent although incomplete with the loss of auxiliary structures. The site retains its essential character-defining features, however: the keeper's dwelling, attached by an enclosed passageway to the light tower, and the Fog Signal Building. The survival of the brick oil shed and other cultural landscape remnants such as ornamental vegetation, covered but still-extant walkways, oil drum stands, and archeological sites add to the integrity of the site. Although there has been a loss of auxiliary structures in the residential/light tower cluster, small scale-features, fencing, and some walkways, the site retains integrity through its ability to portray much of its character during the historic period of operation.

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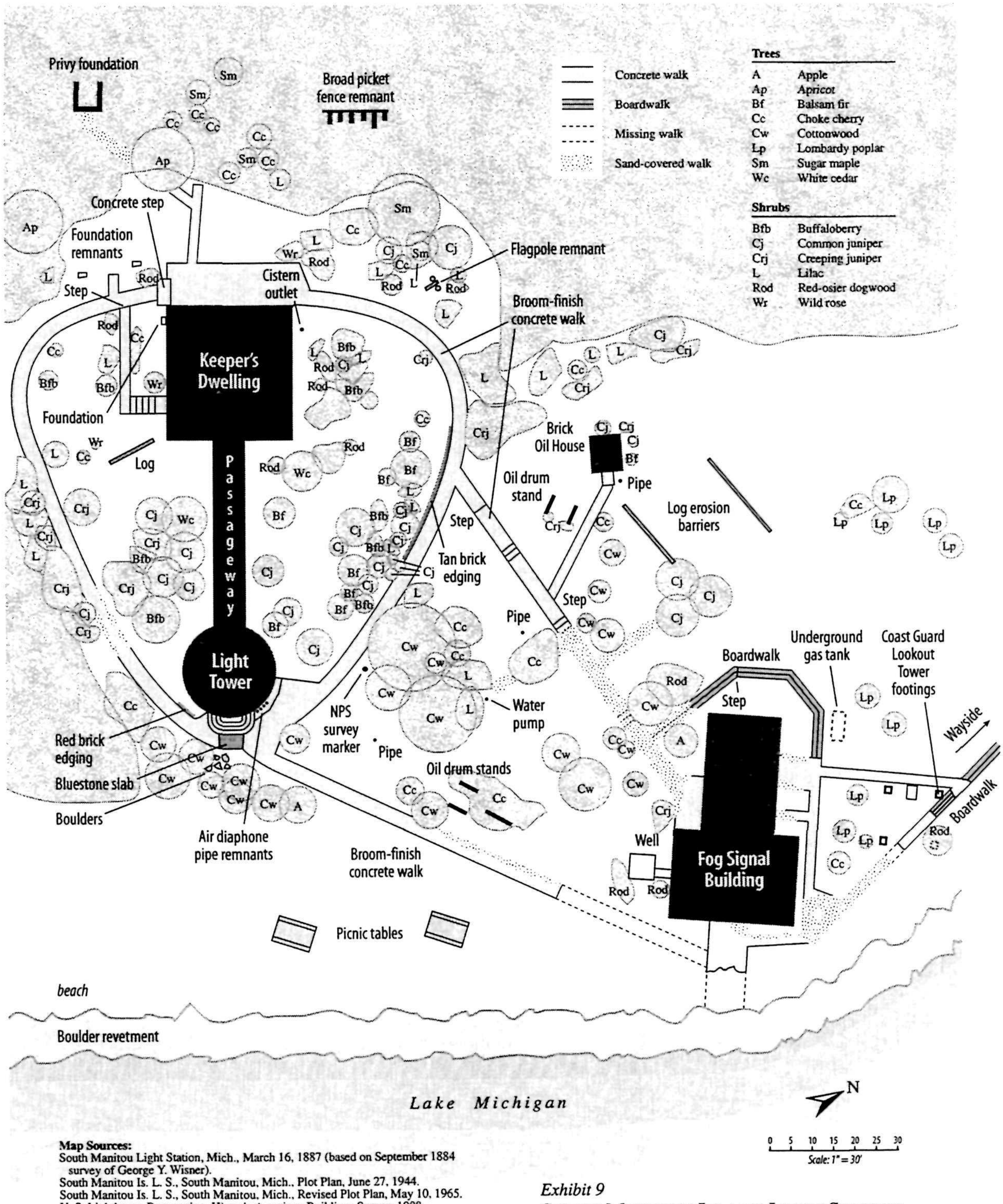
1. Joseph Rogers, cited in Susan Dunkelberg-Booker, "South Manitou Island: People, Time, and Changes," 1981, 2.
2. Dunkelberg-Booker, Figure 20.
3. Survey of A.E. Hatton, July 1839. A later survey, conducted by George Y. Wisner, July 1-4, 1884, determined the area of the reservation to be 12.65 acres

Exhibit 9

(Not to scale, see Appendix F)



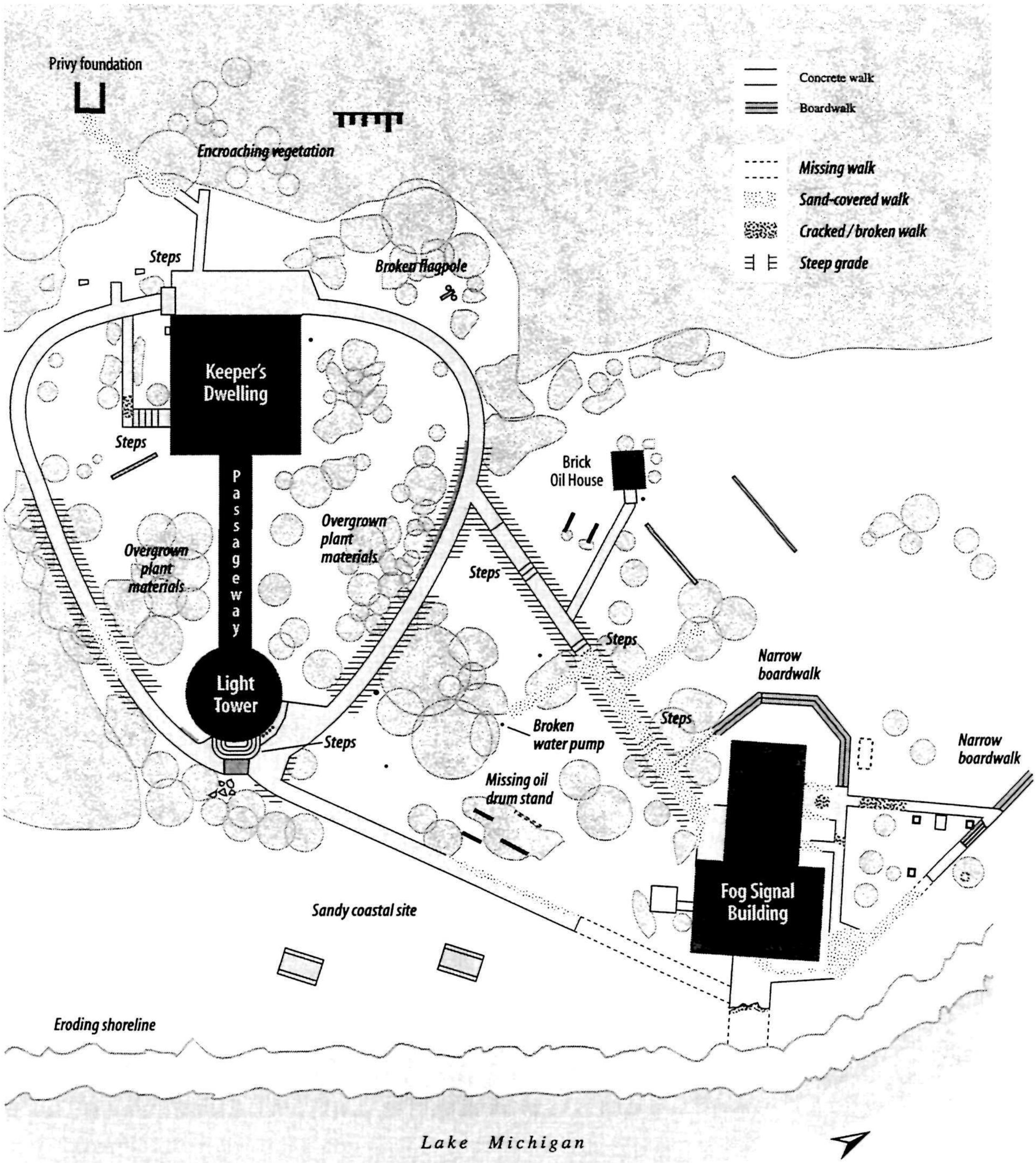
Map Sources:
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
South Manitou Is. L. S., South Manitou, Mich., Plot Plan, June 27, 1944.
South Manitou Is. L. S., South Manitou, Mich., Revised Plot Plan, May 10, 1965.
U. S. Lighthouse Reservation, Historic American Buildings Survey, 1988.
Fieldwork conducted by Land and Community Associates, June 1995, June 1997.

Drawing prepared by Land and Community Associates, 1996. Revised March 1998.

Exhibit 9
SOUTH MANITOU ISLAND LIGHT STATION
Landscape Existing Conditions 1997

Exhibit 10

(Not to scale, see Appendix F)



Map Sources:
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
South Manitou Is. L. S., South Manitou, Mich., Plot Plan, June 27, 1944.
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U. S. Lighthouse Reservation, Historic American Buildings Survey, 1988.
Fieldwork conducted by Land and Community Associates, June 1995, June 1997.

Drawing prepared by Land and Community Associates, 1996. Revised March 1998.

Exhibit 10
SOUTH MANITOU ISLAND LIGHT STATION
Site Deficiencies and Barriers

Part H:
Architectural Existing Conditions

Part H: Architectural Existing Conditions

Structural and Loading Analysis

Observations of Existing Structural Conditions

The following structural comments by Robert Darvas Associates, P.C., the structural engineers engaged as part of the project team, are based on two visits to South Manitou Island to record the existing conditions of the light station's structures. Observations of items of structural concern were noted and photographs taken during those visits. The field notes are included on the ten 50% reduction drawings, S.01 through S.10, in Appendix A of this report. The structural drawings are as follows:

- S.01 Basement Plan
- S.02 First Floor Framing Plan and Details
- S.03 Second Floor Framing Plan and Sections
- S.04 Attic Floor Framing Plan
- S.05 Roof Framing Plan
- S.06 First Floor Plan - Existing Conditions - Load Areas
- S.07 Second Floor Plan - Existing Conditions - Load Areas
- S.08 Keeper's Dwelling Sections
- S.09 Keeper's Dwelling Roof Sections and Details
- S.10 Light Tower Section & Plans
- S.11 Fog Signal Building

The photographic log sheets are also appended to this report. Drawings furnished by the National Park Service were used to generate the plan dimensions, sizes, and elevations. Generally, the National Park Service information corresponded to the few field dimensions taken. Additionally, the National Park Service Sleeping Bear Dunes National Lakeshore staff supplied information regarding the monitoring of some of the items (e.g. tower stair movement), which were reviewed and taken into consideration for this report. The report is limited to those items that were directly visible and accessible and to that acquired information which can be reasonably inferred

An interdependent load analysis was performed to determine the general existing capacities of the floor areas of the buildings. Some additional analysis was performed to determine if the existing capacities could be improved. All of the timber appeared to be a close-grained, dense wood, free of knots, checks, or splits. The buildings were constructed in the last half of the nineteenth century, which indicates that the timber was stronger (old growth wood) than current farmed lumber. All floors felt very stiff under foot. All of the floor joists had full section depth at their bearings without notches. All of the sizes shown on the drawings are the full actual size of each member. The wood for the structural members exhibited no wood rot at the observed locations, despite some indications of high moisture (e.g. buckling floor decking, roof deck staining, etc.). The above indicates that reasonably high historical stress values can be used in the load analysis. Values of allowable bending stress of 1300 to 1400 psi were utilized in the analysis. Where applicable, a basic allowable compressive stress of 1200 psi was used. A value of 150 psi was used for the basic allowable horizontal shear stress. The Modulus of Elasticity was assumed to be in the 1,600,000 to 1,800,000 psi range. Applicable stress modifications and analytical methods were utilized from the *1991 National Design Specification for Wood Construction* (NDS), published by the American Forest and Paper Association. In addition, *The BOCA National Building Code/1993* (BOCA), published by the Building Officials and Code Administrations International, Inc., was adopted as the structural design standard for this project.

While viewed as one complete entity, the lighthouse structure can, in fact, be treated as three distinct elements; the original 1858 Keeper's Dwelling; the 1871 Light Tower and the Passageway, which connects the Light Tower to the Keeper's Dwelling and was also constructed in 1871. The following discussion will treat each element separately. An additional structure, the Fog Signal Building located to the north of the lighthouse, was also inspected, and a discussion of this building follows the lighthouse observations.

Light Tower General Description

The Light Tower is generally an elegant, tapering, cylindrical masonry structure with an interior spiral stair. Review of historical drawings indicate that the stone masonry base rests on a substructure consisting of layers of crossing heavy timber cribbing (grillage) below grade. The cribbing is, in turn, supported by many round wood piles (resembling telephone poles). Concerns were expressed about the adequacy of the wood substructure considering the age of the cribbing and piling at the outset of this survey. The exterior structure above the stone base is constructed of thick, double wythe, brick masonry walls which are whitewashed on the exterior. The interior finish is a cementitious plaster. The tower has an exterior observation platform (parapet) and lantern at the top.

The interior spiral stair extends a total of 6 levels from the ground level to level 5 which is level with the observation deck (parapet). Level 1 occurs at the floor level of the attached passageway, which provides access from the first floor level of the Keeper's Dwelling. Concern was expressed about the apparent settlement and movement of this stair assembly prior to our survey. The stair is supported by a central column having a measured 2.55 inch outside diameter. This column extends from the ground level base to the underside of level 5 where it is tied into a flared cast iron connector, as shown in Figure 1.

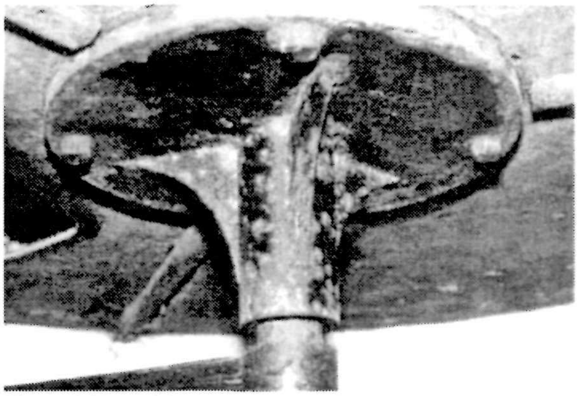

Figure 1 View of the top connection of the Spiral Stair, 1995.

Pie-shaped, cast-iron, open-grate tread and riser units are sleeved over the central column. The riser unit sleeve has a 3.75 inch outside diameter. The riser height was measured at 8 inches. The vertical riser plate is 0.685 inch thick and the tread plate is 0.583 inch thick. The tread/riser units are tied together with a bolt detail at the perimeter wall line as shown in Figure 2. The riser tread assembly is intended to cantilever from the center post with some lateral stability provided at the landings.

Figure 2 View of the exterior edge of the Spiral Stair, 1995.

The landing levels are pie-shaped, open-grate, iron castings that are bolted together to form a semicircular platform. The landings are sleeved over the central pipe column and rest on the riser/tread assemblies below at that location. Additional landing support is provided by cast iron brackets embedded in the masonry tower wall at the perimeter of the landing, as shown in Figure 3.

Figure 3 Detailed view of the Landing Support, 1995.

Tower Observations

The piling and cribbing foundation system of the type used to support the Light Tower has historically performed exceptionally well. The timber in this case is below grade, and has, most likely, been more or less continuously submerged below the water line. This condition prevents exposure to the quantities of oxygen that are needed to promote fungus-caused wood rot. Reliable physical testing methods to determine the pile conditions are difficult to implement, and tend to be very costly. They would involve excavation and dewatering to physically observe the pile conditions. Additionally, the tower would require bracing to insure stability during testing. Therefore, no investigations of this type would appear warranted unless there were strong indications of foundation-related distress or differential movement in the tower's superstructure. The relatively brittle masonry construction of the superstructure is not very forgiving of this type of foundation failure and will show distinct distress. The tower appears, to the eye, to be reasonably plumb throughout its height. There is no major cracking at the juncture of the tower and the connecting passageway. Further, there is no cracking pattern on the tower that would appear to relate to foundation failure or movement. Additional costly investigation does not appear to be justified at this time.

Figure 4 *View of the soft joints at the base of the light tower, 1995.*

However, the tower is in need of some attention. The stone base of the tower has open masonry joints, which have lost mortar as shown in Figures 4 and 5. Note that a pocket knife blade can easily be inserted into the soft joints with little resistance (less resistance than a soft wood and comparable to wood rot) up to the hilt of the knife to a depth of two to three inches. The mortar may have become soft due to a leaching of the lime component, but more resistance to the blade penetration would be expected. It is suspected that the joint has lost mortar from weathering and has become packed with soil and other organics. This condition allows moisture to enter the joint with a long-term deleterious effect. Water penetration causes a freeze/thaw deterioration of the stone masonry, and results in cracking of the brick masonry above the stone work. The deterioration is progressive, and particularly acute for the Light Tower due to the severe seasonal weather exposure and high moisture shoreline location. Some minor hairline cracking was observed in the brick work, and appears to be a migrating extension of an open stone joint just below.

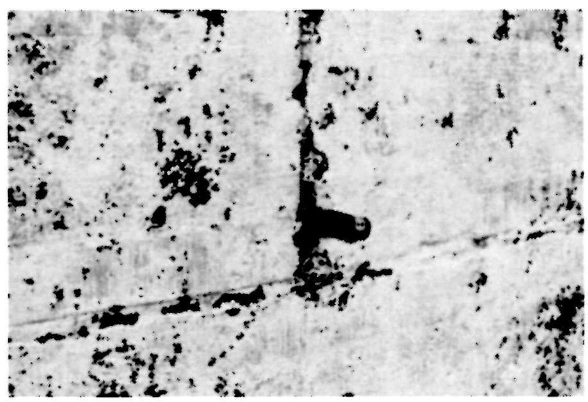

Figure 5 *View of the soft joints at the base of the Light Tower, 1995.*

Additional cracking was observed in the stone masonry steps that adjoin the exterior entrance of the tower. Some of the stone appears to have a surface crazing pattern, which usually results in surface spalling and deterioration of the stone. The joint between the Tower and the exterior steps at the northeast side of the Tower appears to have settled and is cracked, which will eventually allow water penetration at that location. Repointing of all open and loose stone masonry in both the steps and the Tower's base should be performed. All loose and deleterious material should be removed from the stonework joints. The joints should be filled and tooled with a soft (possibly latex modified) mortar that is compatible with the stonework. Strong portland type mortars are generally too stiff for the adjoining stone, and will cause the destruction of the stone adjacent to the joint due to normal structural movements. The mortar should match the color and texture of the historic mortar. The Tower's base should be inspected by park personnel on a yearly basis (early in the spring) to determine the extent of mortar loss in the stone jointing. Repointing of the Tower's base will likely have to be done on an ongoing basis also. This type of attention to external moisture penetration will prevent further base deterioration and will prolong the life of the tower.

There are many locations of cracking in the cement plaster material at the interior of the Tower. This cracking tends to be more predominant at or near the window recesses in the structure. The surface was sounded by light tapping in several locations near this cracking. The material did not sound out hollow, and seemed to be reasonably bonded to the masonry substrate. These cracks appear to be due to the age of the surface material, and the moist, poorly ventilated, thermal environment that the interior experiences. There were no indications that this cracking signified any major structural concerns at the time of the survey. The cracking appears to be cosmetic in nature and should be repaired as desired. However, the cracking will allow moisture vapor penetration to the substrate. Also, the seasonal temperature fluctuation permits internal condensation at the plaster masonry interface at these crack locations, which will cause accelerated progressive deterioration of the plaster surfaces.

Generally, the overall condition of the Tower superstructure is very good, and shows no signs of severe structural concern. However, seasonal cosmetic repairs should be done to improve the tower's weathering resistance.

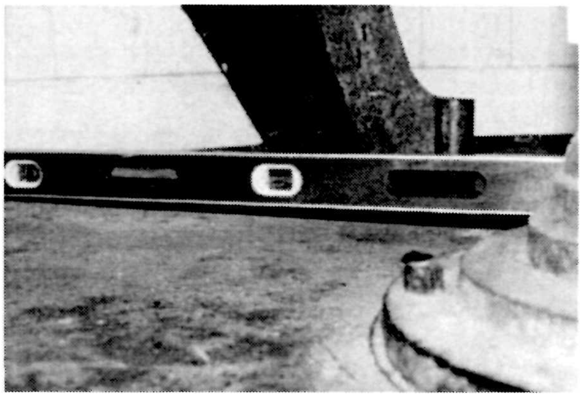

***Figure 6** View of the promenade landing (Lantern Room) which slopes to the middle of the Tower, 1995.*

Interior Stair Conditions

The interior stairs show indications of significant settlement. Level 5 (level with the parapet) slopes downward toward the center column support 1 inch in 4 feet as measured with a mason's level, (Figure 6). The hatch floor in this area consists of 0.675 steel plate over the stair landing. A one inch gap was measured between the topmost stair tread sleeve and the bottom of the cast landing connector as shown in Figure 7.

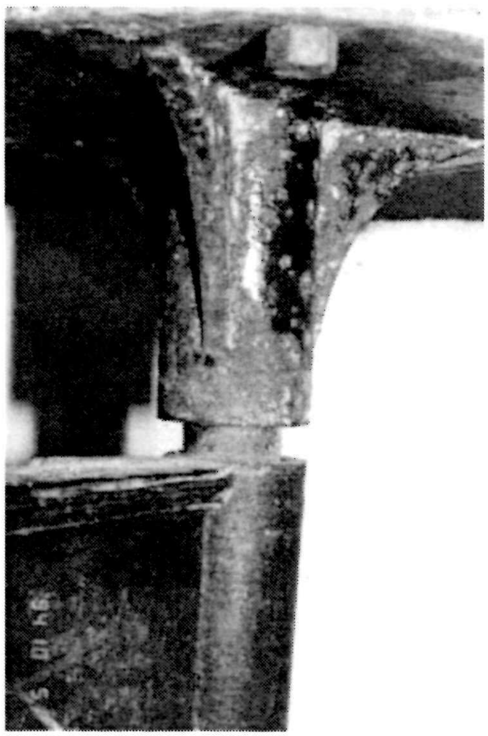

***Figure 7** View of the 1" gap at the top of the spiral stair, 1995.*

The stair assembly has moved downward a total of 2 inches or more in the past. This was further verified by the fact that the first tread below this landing slopes 2-1/8 inches. The vertical distance from the level 5 landing to the level 4 landing measured 138 inches. There are 17 risers at 8 inches each between these landings, which equals 136 inches. That leaves 2 inches of movement to make up the rest of the vertical dimension. This also means that most of the previous movement has been accommodated in the distance between the level 5 and level 4 landings in previous repairs. The National Park Service staff have been monitoring the stair's movements for some time. These records were reviewed, and it appears that any significant movement has been arrested by previous repairs. Any recorded historical movements are either insignificant, or could be attributed to normal measurement variation. Documentation for these repairs has been reviewed, but the nature and method of repair are unclear at this time. The presumed cause of the movement is also not clearly defined in historical information.

Figure 8 shows the underside of landing 4. Note that the cast iron bracket support for the landing grate appears to be broken or missing. This condition compromises the capacity of the landing. All other landing support brackets should be closely inspected. Missing, damaged, or loose support brackets should be repaired or replaced with proper support.

Generally the stair can be used for limited group tours as the National Park Service has been conducting, providing that the landing support concerns are addressed and that the regular, ongoing monitoring of vertical movement is continued. Tours should be suspended and

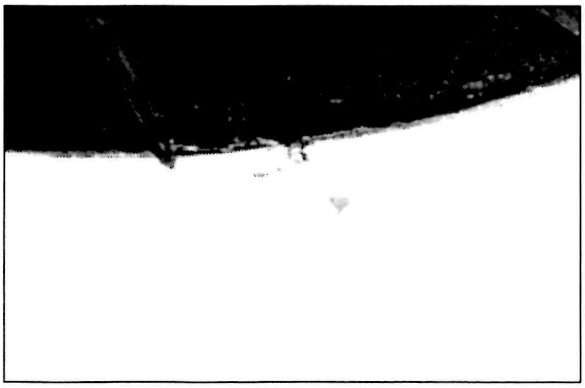

Figure 8 View of the missing or broken support bracket at a landing in the Tower, 1995.

a qualified engineer contacted if any significant movement (3/8" or more) is discovered during normal monitoring. The apparent lateral sway movement of the stair runs is consistent with this type of stair, and while it may be uncomfortable, it does not indicate a structural problem. The lateral sway could be easily restrained, but would detract from the human experience of the historical tower.

Passageway General Description

The Passageway provides access between the Light Tower and the Keeper's Dwelling. This element is constructed with a stone masonry foundation below the first floor level. Multi-wythe brick masonry extends above the first floor level to the roof. The roof is a simple gable shape, framed with cut lumber. The rafters are full 2" x 4" members having a variable spacing of 16" to 21". The rafters slope approximately 7" vertical to 12" horizontal. Double ceiling joists frame each side of the rafters, and typically are 1-1/8" x 3-1/4" in size. A 4" x 4" member is used in lieu of the double ceiling joists in some instances. The floor framing consists of 2-3/4" x 3-1/2" wood joists spanning from north to south across the passageway. Only one spacing measurement of 13 inches was taken due to accessibility limitations. There are two layers of flooring, a one-inch pine subflooring and a one-inch tongue-and-grove pine flooring (see drawings S.01 through S.03 in Appendix A for the general layout and sections of this element). The walls and ceiling are surfaced with plaster on wood lath.

Passageway Observations

The general conditions of the Passageway appear to be reasonably good despite the apparent lack of ventilation or thermal tempering of the interior space. The roof ridge lines appear straight and true. The wood rafters, ceiling joists, and sill plates do not show signs of wood rot in the areas accessed during our survey. However, ventilation of this space should be improved during any rehabilitation efforts. This is particularly important since it is anticipated that the space will remain unheated in the future and the structure will be frequently exposed to a very severe humid environment. Similar consideration is advised for all of the structures on this site since the moisture content of wood needs only to reach 20% for the onset of wood rot.

The brick masonry walls of this structure show some localized moderate signs of deterioration. The north wall appears to bow outward to some extent, but there are few signs of cracking distress to indicate that this is a problem. The wall may have been constructed with the bow. No action is needed for this item at this time other than continued observation to determine if this is a progressive problem.

The brick has been painted in the past in an effort to protect the surface. There are some signs of exterior surface spalling, particularly on the north wall. An exterior layer of the brick surface has deteriorated and popped off. This is a fairly common condition for brick that has been painted with a relatively impervious substance. One cause of this condition relates to moisture migration through the wall. Moisture vapor tends to migrate through a brick wall under certain environmental conditions (vapor pressure). The paint does not allow the wall to breath, leaving the moisture to collect at the interface of the brick and paint. This causes the paint to peel under some conditions, or it can contribute to surface saturation of the brick. Further freeze/thaw expansion and contraction cycles cause the brick to pop the surface outward creating a brick spall. Future painting of the masonry walls should be done with a high quality substance that will permit the brick to breath and release the vapor pressure.

The stone window sill of the westerly window of the north wall (P-4) shows a moderate crack as though the stone is split throughout its width, (Figure 9). This does not pose any serious structural concern at this time, and can be protected by sealing or injecting the crack. The stone foundation wall on the south side of the passageway shows a ragged outcropping of laid up stone at the base of the wall. This condition appears to be the

Figure 9 *View of the north wall of the Passageway, showing the window sill crack, 1995.*

way that this foundation was constructed. There are many open joints that can permit water penetration between the rough foundation stones and between the foundation stones and the more finished stone masonry above. The presence of moisture at these locations could lead to future distress in the stone and brick masonry above due to frost heave during cold weather. The joints in this stone should be sealed with mortar to minimize the effects of frost heave.

The floor felt firm underfoot and showed no signs of serious concern. There are two wall vent grilles in the stone masonry below this floor on both the north and south walls. These vents are generally located below the Passageway windows and should provide some degree of ventilation for this enclosed space. The lumber quality was assumed to be consistent with the other framing for this structure (see the preceding General Description section), free from wood rot or other deterioration. A load analysis was performed for this floor assuming a 10 psf dead load and that all of the necessary connections are capable of carrying the required forces. Due to deflection limitations, a maximum allowable live load of 113 psf was determined (as shown on drawing S.06 in Appendix A). This live load meets the 100 psf live load minimum BOCA places for public use. The two layers of flooring were determined to be adequate for 10 psf dead load and 100 psf live load.

A roof analysis was performed on both the rafters and ceiling joists. The roof structure varies in spacing from 16 inches to 21 inches center to center; an average spacing of 18.5 inches was used in the analysis. The doubled 1-1/8" x 3-3/4" ceiling joists were used in the analysis. A 50 psf ground snow load was used, as per BOCA, to determine the balanced snow load of 30 psf and unbalanced snow load of 37.5 psf. With drift loads considered, the maximum snow load applied was 83 psf. Combined with 10 psf dead load on the rafters and 8 psf dead load on the ceiling joists, a computer analysis was performed. A hand analysis was also done on a typical rafter member to check for combined bending and compression. Appropriate modification factors were applied in both analyses. See the table below for the actual stresses determined in the members. The allowable stresses in the table are the respective base stresses with appropriate modification factors applied. Deflection of both the rafters and joists is negligible.

<u>Stress Comparisons</u>
<u>of Passageway Roof Members</u>

	Actual Stress		Allowable
	Rafter	Joist	Stress
Bending Stress	450 psi	51 psi	1852 psi
Shear Stress	38 psi	4 psi	173 psi
Compressive	44 psi	NA	1252 psi

For an allowable base stress of 1400 psi for bending and an allowable base stress of 150 psi for shear, the maximum allowable total load is 273 psf. This amount is more than twice the expected load. The roof members of the Passageway are all adequate, assuming all of the necessary connections are capable of carrying the required forces.

Keeper's Dwelling General Description

The Keeper's Dwelling was constructed with timber wood floor and roof framing. Interior load bearing walls are wood stud type components. This part of the lighthouse has a basement, first floor, second floor, and attic level. The first floor level extends into the Passageway for protected access to the Light Tower. The exterior foundation walls between the basement and the first floor are stone masonry. The exterior walls from the first floor to the roof are constructed with multi-wythe brick masonry. The interior vertical load bearing system of the building does not carry loads directly in line to the foundation level (see sections on drawing S.08). The second floor ceiling joist load is supported on a central wall at the west end of the building. There is no wall at the same location below the second floor, and the second floor joists must carry the load to the offset walls. Similar conditions exist below the first floor joists. This type of complex structure seems to be typical of lighthouse dwellings in the Great Lakes area. The fact that the floor system must carry part of the weight of the floors above in addition to its own weight severely limits the load capacity of the floors, although the safe allowable loads all fall within residential load levels. The roof structure over this element also is complex in nature. The apparent simple gable roof form is supported with a complex interdependent wood timber framing system.

Keeper's Dwelling Observations

Exterior Masonry Walls

The east foundation wall shows signs of distress on the north side of the Keeper's Dwelling, as shown in Figure 10. The corner appears to be cracking and there is significant loss of stone and mortar. There is some indication of previous extensive repairs in this area, and the brick masonry above this area also shows signs of previous repairs and some present surface spalling. The cracking and deterioration patterns are not consistent with differential settlement. They may be caused by a combination of thermal expansion and contraction, and moisture penetration. The structure undergoes the extremes of seasonal temperature variation, with no tempering from internal heating which produces the maximum of volume change and associated distress. Moisture penetration (driven or condensate) into the cracked distressed areas further aggravates the problem by leaching mortars, and through freeze/thaw expansion and contraction. There is little that can be done about the cause of this problem in the absence of thermal tempering of the building. The present condition should be repointed and repaired. This area will probably need ongoing periodic maintenance.

Figure 10 *View of the foundation wall distress of the east wall of the Keeper's Dwelling, 1995.*

The east wall at the south side of the Dwelling also shows signs of age/environment-related deterioration. The head stone of the basement window on this side shows an apparent vertical through crack near the north jamb. This crack is shown in Figure 11. The brick work above this location shows hairline stepped cracking. The head stone should be either replaced or epoxy-injected to restore its integrity as a load carrying element. The wall cracking above should be repointed to prevent moisture penetration and related progressive damage. Paint flakes and some spalled surface areas were recorded near the south corner of this wall, as shown in Figure 12. The causes for this spalling were discussed previously.

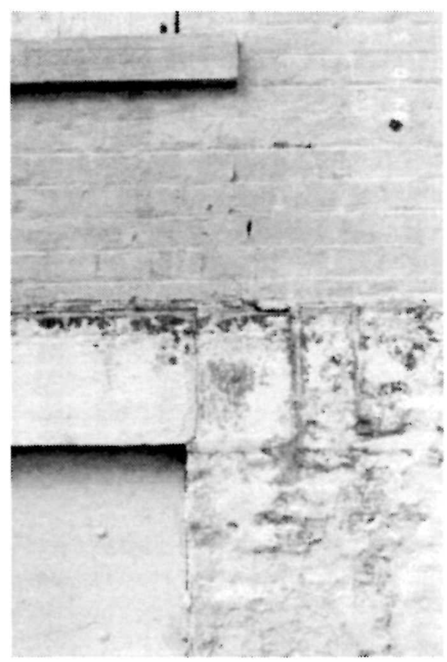

Figure 11 *View of the east wall of the Keeper's Dwelling, south side, showing the window head stone cracking, 1995.*

Figure 12 View of the east wall of the Keeper's Dwelling, south side, showing surface spalls near corner, 1995.

Similar deterioration was recorded for the north wall of the Keeper's Dwelling. There are numerous localized areas of brick surface spalls on this wall, as well as peeling paint. The stone basement wall shows hairline joint cracking in some locations. The first floor window sill, located toward the east end of this wall, shows signs of severe deterioration, as shown in Figure 13. The sill is badly fractured and delaminated. Organic material has filled in some of the cracks, and a small plant is growing out of this material. This sill is beyond repair and should be replaced. The condition at this window sill appears to be an isolated moisture/thermal occurrence, and bears no relation to any major structural movement or failure.

The west stone foundation wall shows signs of previous repairs. The surface of the wall presently has some spalled areas and some hairline cracking. These areas were primarily observed near the head and sill of the door openings. There are apparent cracking areas just above the distress around the doors where the brickwork has previously been repaired. This indicates that the problem is recurring and will require ongoing maintenance to prevent progressive additional loss of the fabric. Again, the problem is thermal/moisture related, as was previously discussed.

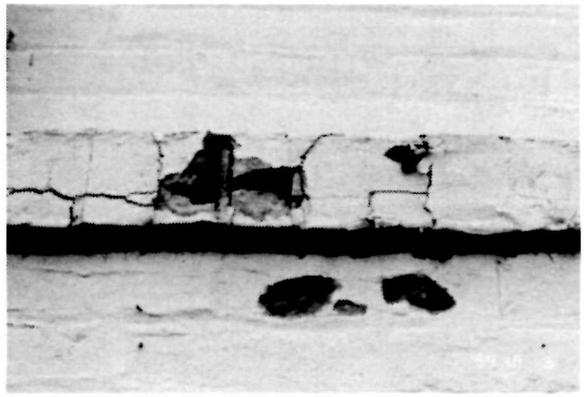

Figure 13 View of the deterioration at the north wall window sill, 1995.

The localized spalling and cracking problem continues on the south wall of the Keeper's Dwelling. The stone foundation wall to the west of the stairs has been extensively repaired in the past. These repairs appeared to be reasonably sound at the time of the survey. The basement window located to the east of the stairs is in poor condition with sill cracking and shifting. The stone masonry surrounding this window is also in poor condition, as shown in Figure 14. The wood sill and jambs at the inside of this window have severely rotted away, indicating large volumes of moisture penetration at this location.

The brick arch above the door located in the south wall has a vertical crack near the keystone of the arch, as shown in Figure 15. Note also that the paint has begun to peel and that there are beginning signs of brick surface spall above this arch to the sill of the brick recess. The arch is a true arch and the distress cracking of the keystone is a concern, although there is no apparent shifting in the arch at this time. The integrity of the arch must be restored by either reconstruction/repair or epoxy injection.

The exterior concrete stair leading from the door in the south wall down to grade is severely distressed with major cracking, as shown in Figure 16. There have been previous unsuccessful attempts to repair this stair. It is suspected that the cause of the movement distress is related to age, settlement related to an inadequate foundation, and moisture freeze/thaw conditions. This stair could be repaired, but the distress is likely to recur and become more severe. This stair should be reconstructed on appropriate foundations. Consideration could be given to a wood stair if that would fit the historic character of the structure's rehabilitation.

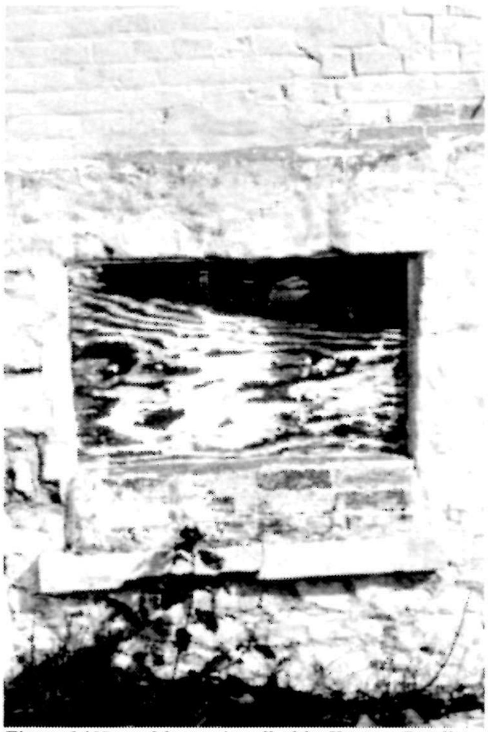

Figure 14 *View of the south wall of the Keepers Dwelling, showing the east basement window, 1995.*

Figure 15 *View of the south wall of the Keeper's Dwelling, showing the cracked keystone, 1995.*

Figure 16 *View of the stair distress at the south exterior stair of the Keeper's Dwelling, 1995.*

Roof Framing

The roof framing, at first glance, appears to be simple and straightforward. The north-south spanning rafters are supported at the exterior walls, and are notched to rest on east-west beams located about 8 feet inside the exterior bearing walls. Collar ties located near the beam height are positioned on each side of the spiraling chimney, and near the end of the attic level platform for the original light tower, which was part of the Keeper's Dwelling (see drawings S.05 and S.09 of Appendix A). 4" x 4" wood struts extend diagonally upward from the attic floor level to the beam on each side, and are birds' mouth joined into the beam bottom, providing support for the beam as shown in Figure 17.

However the beam is butt-jointed slightly west of its mid-length at the collar ties at that location (see Figures 18 and 19). The beam joint is a straight through-cut which clearly interrupts the beam's continuity. This means that the collar ties must pick up the forces that the beam carries from the rafters, and, in turn, return those forces to the rafters near the cut. Additionally, the rafters do not impose a full load to the beam, but partially span half the width of the structure while sharing load with the beam. The entire roof system becomes a complex, interdependent, load-carrying system due to this unusual jointing. The butt joint may have been

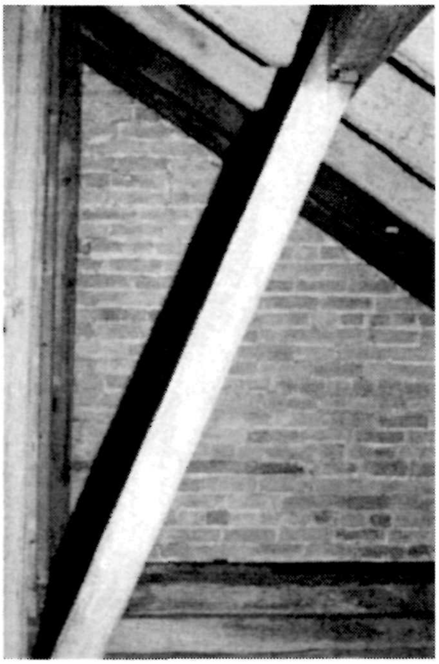

Figure 17 *View of the diagonal strut and birds mouth jointing in the attic of the Keeper's Dwelling, 1995.*

created when the original tower was replaced with the 1871 tower. The area at the east end of the Keeper's Dwelling would have been at least partially restructured.

The roof ridges appear to be true and straight, and no apparent unusual sag was observed in the roof planes. Therefore, the system appears to have performed historically well. There was no observed wood rot in the framing, although there is some evidence of water staining due to past roof leaks. No evidence was found that roof leaks continue at this time. However, the rafters to the west side of the chimney appear to have been cut, and their upper ends may have experienced some moisture penetration causing some minor rot (not unusual around chimney flashing), as shown in Figure 20. It was also observed that the rafters are not appropriately headered at the chimney. This isolated condition should be corrected during any rehabilitation undertaking.

No load analysis was performed for the roof since it appears to have performed very well over its history. An appropriate verifying analysis should be performed as a part of any rehabilitation effort. This would include determining and verifying local snow and wind loads. All existing codes refer to local officials to dictate these loads. Structural analysis can then be performed during the next phase of the restoration effort.

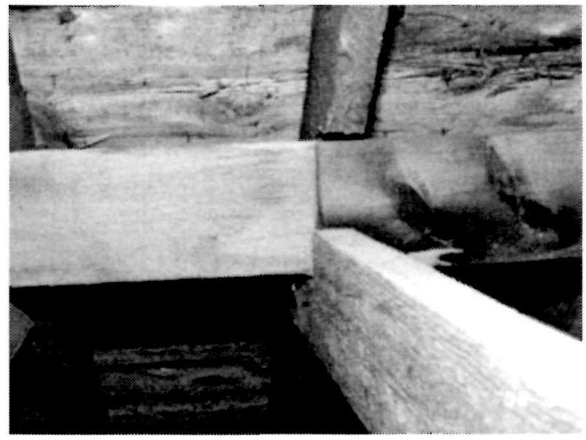

Figure 18 *View of the beam butt joint at the north side of the roof, 1995.*

Figure 19 *View of the beam butt joint at the south side of the roof, 1995.*

Attic Level Framing

The majority of the attic level consists of ceiling joist framing, and has no floor decking. It has been assumed that no superimposed live load will be added over the ceiling joist areas. There is an area of floor decking platform at the east side of the attic at the original light tower location (see plan drawing S.04 of Appendix A) which felt reasonably sound under foot. Presumably, this platform, between the original 8" x 8" tower columns and extending an additional 7 to 8 feet to the west, served as a landing level to access the original roof lantern, which was located directly above. The exposed framing in the tower area of this level reveals a differing framing type compared to the rest of the Keeper's Dwelling. Typically, the Keeper's Dwelling is framed with simple joists bearing over walls or beams

Figure 20 View of a rafter cut at the spiraling chimney of the Keeper's Dwelling, 1995.

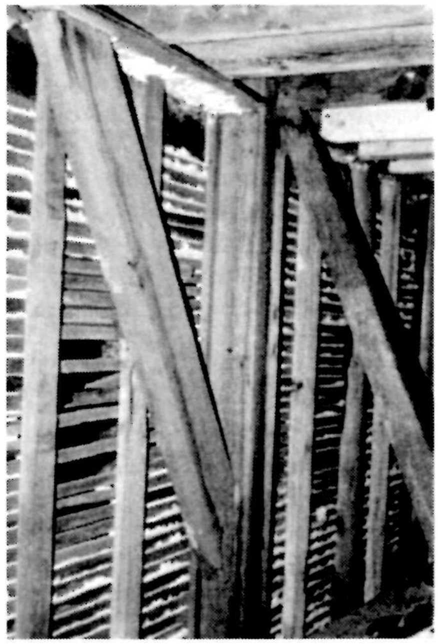

Figure 21 View of the columns and diagonal bracing in the attic at the original Tower (roof lantern) location, 1995.

with no mortise or other type of complex connection. The tower area is framed with a system more consistent with heavy timber framing of this historical era. The columns are relatively massive (nominal 8" x 8") wood members which are braced in an east-west direction with heavy 4" x 8" diagonal struts (see drawing S.04 and S.09 of Appendix A and Figure 21). The tower perimeter beams appear to be heavier members, and are joined to the columns with a sophisticated reverse scarf type tenon and pinned with wood trunnels, as shown in Figure 22. This type of framing, joining, and bracing is consistent with a tower that would extend above the roof of the a dwelling and provide needed resistance to the lateral wind loads imposed on this relatively narrow extension.

Figure 22 View of the heavy timber joinery at the original Tower, 1995.

Second Floor Level Framing

All exposed joists appeared to be in good condition at this floor level. Access was obtained through the failing ceiling to determine the location of the joist laps which indicated interior bearing locations, (these are shown on drawing S.08 in Appendix A). The size and spacing of the joists was determined at those access points. The ceiling was removed in the southeast corner of Room 104 in order to determine the nature of the joist bearing at the exterior wall. This condition is shown on Detail 2 of drawing S.03 (Appendix A). The joists are pocketed or embedded in the brick masonry at the exterior bearings. There was no wood rot observed at the access locations.

A computer model analysis was performed for the interdependent offset-bearing conditions at each side of the chimney for all levels acting together. Hand analysis was performed for the east-west spanning joists, located in the floor of Rooms 201 and 203. The results of this analysis are shown graphically on drawing S.07 (Appendix A). The loads for Rooms 204 and 205 are interdependent, with the loads imposed on level one below, to some extent. There is, theoretically, an infinite number of load combinations taking both levels into account (e.g., level one load capacity is reduced if higher loads are imposed on level two). However, the analysis attempted to obtain a maximum load capacity for level one since that level, presumably, will experience the largest traffic in any future use of the structure. The analysis also assumes that door headers and fireplace headers are appropriately framed and of adequate size to provide load capacity equal to the typical framing. This can be verified later, and can be rectified if deficiencies are uncovered. The east and west third of the floor area can safely support a superimposed load of 100 pounds per square foot (psf), in addition to the existing self weight dead load. The central third of the floor area is capable of supporting a safe superimposed load of between 30 and 50 psf. The latter load is fairly low for unrestricted public access, although it is suitable for a residence (the original use of the structure). The lowest load of 30 psf is only partly due to the offset bearing path discussed earlier. The large number of relatively heavy plaster wall partitions in this area reduces the magnitude of the safe allowable superimposed load. The floor joists in this area could be reinforced with additional floor joists made of CCA treated paralams, and with the addition of some basement shoring, this area could support a reasonable superimposed load for public access and the display of limited interpretive material.

First Floor Framing

Access to the first floor was similar to that obtained at the second floor to determine the support conditions, joist sizes, and spacings. These conditions are recorded on drawing S.02 (Appendix A). All major accessed structural components appeared to be in good condition, and no wood rot was observed. The results of the floor load analysis are recorded on drawing S.06 (Appendix A). The analysis includes all of the assumptions stated above for the second floor level. The floor structure in Rooms 101 and 102 can safely support a superimposed load of 100 psf. The floor area west of the east edge of the fireplace in Rooms 103 and 104 should also be able to support a safe superimposed load of 100 psf, providing none of the partitions in the basement below are removed. The area east of the fireplace in Rooms 103 and 104 are limited to a 50 psf superimposed load capacity. The lower load in this area is primarily due to the offset load path discussed earlier, since the joists in this area must also carry part of the floor load above, in addition to their own loading. The addition of a shoring beam in the basement directly below the partition between Rooms 103 and 104 would significantly increase the load capacity of this floor area. The beam, however, would require shoring columns in the basement at each end. It may be possible to conceal the columns.

Fog Signal Building General Description

This structure is presently a T-shaped building in plan as shown on drawing S.11 (Appendix A). Access to this structure was severely limited as all the interior surfaces are covered with horizontal wood planking. It is understood that the structure was originally two rectangular buildings, and that one of the buildings was moved, rotated, and connected to the other to form the present shape. The roof ridge lines and planes all appear to be reasonably straight and true, which indicates that the roof structure has performed well in this severe environment. However, the interior of the east/west part of the tee shows many signs of water staining on the wall and sloped ceiling surfaces. It is suspected that a significant part of the staining is attributable to internal condensation of water vapor since the space is poorly ventilated. The roof sandwich (decking and roofing on top, joists between, and decking on the bottom) has very little or no effective ventilation. It is assumed that the enclosed wood rafter members may have at least some wood rot due to this condition.

The exterior foundation shows many cracks, particularly at the east side of the east half of the tee. There are also indications of foundation cracking and attempted repairs on the west half. The foundation was probed at the west end of the west half with a long metal rod. Concrete foundations exist at the corners of this wall, but no foundations were located between the corners of this wall. This seems to indicate that the corner foundations support a wood sill beam that spans between the corners of this half. This is apparently also true of the north and south walls of this half. Remains of the sill beam were observed at the west corner of the south wall. The beam at this location is almost entirely rotted away, and the remaining exposed portions can easily be probed with a pocket knife. The foundation system for this structure is suspect, and should be replaced with a suitably designed and constructed foundation. Because of the conditions discussed above, a new floor system will most likely be needed as well. A concrete slab placed over compacted slab would be best, but other systems can be designed. These other systems would depend upon the expected use of the structure.

The roof structure is comprised of 1-7/8" x 4-1/8" rafters at 31 inches to 32 inches center to center and a collar tie assumed to be of the same size and spacing. The roof has a slope of 30°± and spans 18 feet across. A structural analysis was performed on the roof structure using an average spacing of 30 inches; 10 psf dead load on the rafters; and 8 psf dead load on the collar tie. Both snow and wind loads were considered as well. A 50 psf ground snow load was used, as per BOCA, to determine the balanced snow load of 30 psf and unbalanced snow load of 37.5 psf. As per BOCA, exposure "D" category was used in the wind analysis. A basic wind speed of 78 mph was used, creating a 9 psf suction force on the windward side, and a 20 psf suction force on the leeward side. A computer model was set up for the east half of the building that allowed for a 15 percent increase in the allowable stresses of the members, as per NDS (see the table below for the actual stresses of the members determined from the computer analysis. The allowable stresses in the table are the respective base stresses with appropriate modification factors applied.

Stress Comparisons of
Fog Signal Building Roof Members

	Actual Stress		Allowable
	Rafter	Joist	Stress
Bending Stress	1462 psi	397 psi	1852 psi
Shear Stress	39 psi	11 psi	173 psi
Deflection	.06 in	.05 in	L/360

For an allowable base stress of 1400 psi for bending and an allowable base stress of 150 psi for shear, the maximum allowable total load is 45 psf, greater than the expected load. Assuming all of the necessary connections are capable of carrying the required forces, the roof members are all adequate. Assuming similar geometry and adequate connections, the roof members of the west half of the building are also all adequate.

The walls of the Fog Signal Building consisted of 2"x 4" members at 17.5 inches (average spacing) center to center. Several load cases were considered and analyzed for axial, bending, combined bending and compression, and shear cases as per NDS. See the table below for the actual stresses of the members determined from the hand analysis. The allowable stresses in the table are the respective base stresses with appropriate modification factors applied.

Stress Comparisons of Roof Members of
Fog Signal Building

	Actual Stresses		
	Windward Wall	Leeward Wall	Allowable Stress
Compressive	125 psi	125 psi	526 psi
Bending	1396 psi	977 psi	2576 psi
Shear	49 psi	34 psi	173 psi
Deflection	0.345 in	0.242 in	L/240

Because plaster is not expected to be placed on the walls, a deflection criteria of L/240 was used. This L/240 criteria is not as stiff as L/360. Assuming all of the connections are capable of transmitting the necessary forces and the geometry of the west half of the building is similar, all of the walls of the Fog Signal building are adequate.

Exterior Fabric Analysis

Keeper's Dwelling

Roof

The roof of the Keeper's Dwelling was at one time covered with asbestos cement shingles, which were installed on the structure in 1914. The current shingles are replacements that were installed by the National Park Service in the late 1970s. National Park Service documentation from 1978 states that, "The new slate roof [referring to the extant asbestos cement shingles] was completed with the exception of the cap and flashing around the chimney."[1] During physical investigation, the roof surface displayed relatively no signs of damage or deterioration, with the exception of a few missing shingles.

Chimney

The chimney of the Keeper's Dwelling is yellow brick covered with several layers of beige paint identical to that which coats the wall surfaces below. The entire chimney above the roof line generously bows toward the west. The chimney was tuckpointed by the National Park Service in 1978. Physical investigation revealed no areas of severe brick damage, except for minor spalling and discoloration at the west edge of the top portion of the corbelled brick. Furthermore, excessive paint buildup was observed at the metal flashing at the intersection of the chimney and the roof.

Gutters

The Keeper's Dwelling currently has no gutters or downspouts, however, there are metal brackets at the both the north and south elevations. These brackets indicate the former locations of rectangular downspouts. Physical investigation revealed that several replacement gutters and downspouts were stored in the basement of the dwelling, however, none have been installed.

Windows

All of the window openings of the dwelling (18 in all) are supported by arched brick heads which have a decorative, raised brick, "eyebrow" detail above them, (Figure 23). During physical investigation, most window openings were boarded up with plywood covers. At those windows that were opened for investigation, the exterior wood jambs were severely weathered.

At the east end of the north elevation, first floor, there is a false window opening. This recess has the same proportions as the other first floor window openings. Visible in historic photographs and drawings, this appears to be an original condition (Figures 24 and 25). Based upon investigation of the first floor window openings, it consists of brick that is recessed approximately 4" from the overall wall surface. There are also false window openings (Figure 23) at the second floor level of both the north and south elevations. The middle recess on the south elevation has the construction date, "1858," in raised brick.

Figure 24 *View looking south toward the Keeper's Dwelling, 1883. Note that the east window is a false opening at this early date.*

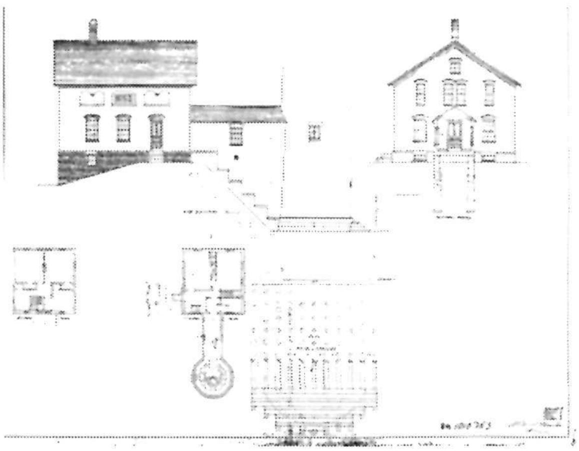

Figure 25 *1870 Drawing of the Keeper's Dwelling with proposed alterations.*

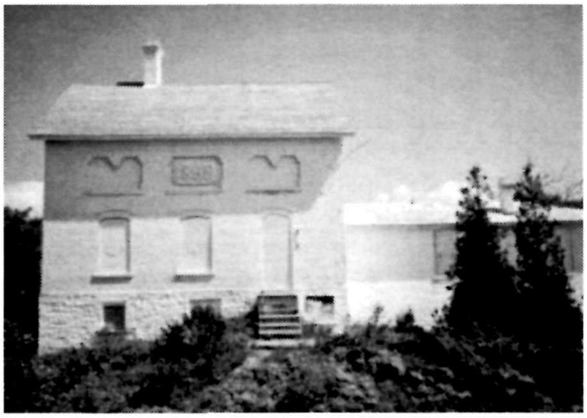

Figure 23 *View of the south elevation of the Keeper's Dwelling, 1994. Note the decorative brick recesses at the second floor, and the raised brick "eyebrows" above the door and window openings.*

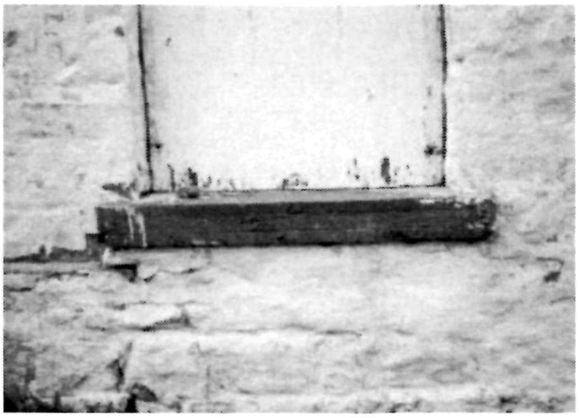

Figure 26 *Detail view of a typical tooled face limestone sill at the Keeper's Dwelling, 1994.*

All of the window sills are smooth cut limestone with elaborately tooled faces. They are either painted or whitewashed to match their adjacent wall surfaces, with the exception of two of the basement windows. Both the basement window at the west end of the south elevation and one of the basement windows at the north elevation have unfinished sills (Figure 26).

At the interior of the dwelling, all of the windows consist of four-over-four, double-hung, wood sash, which are painted white. The interior wood jambs and stools at all of the openings were in poor condition, having experienced severe weathering and vandalism. However, no damage or paint buildup was observed at the sashes, all of which were reconditioned by the National Park Service in the late 1970s. It appears that these new sashes have been protected since their installation, for the most part, by custom fit plywood covers.

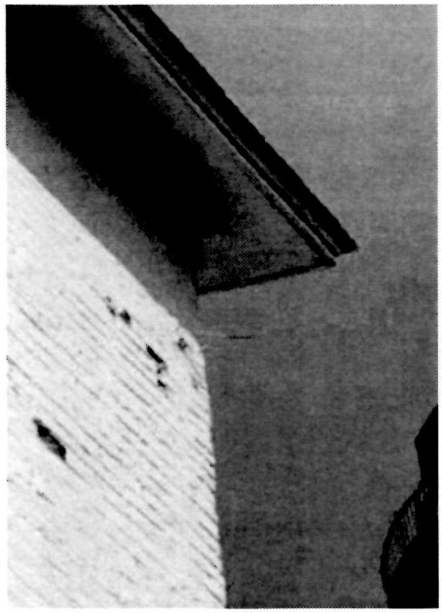

Figure 27 *View of the southeast corner of the Keeper's Dwelling, 1994. Note the deteriorated and spalling brick and the metal bracket which previously supported a downspout.*

Masonry

All of the foundation walls are rough ashlar stone. The Keeper's Dwelling's walls at the first and second floors (of all four elevations) are yellow brick laid in common bond with three courses of stretchers for every course of headers. There are several areas of failing paint and spalling brick, especially at the east corner of the south elevation, several of which have been covered over with a tooled parging to represent brick. However, much of this parging has also failed and pulled loose from the brick surface (Figure 27). There is another area of tooled parging at the brick above the western-most window (D-10) of the first floor. Furthermore, physical investigation revealed the accelerated deterioration of interior materials and finishes caused by water infiltration at these deteriorated areas of brick.

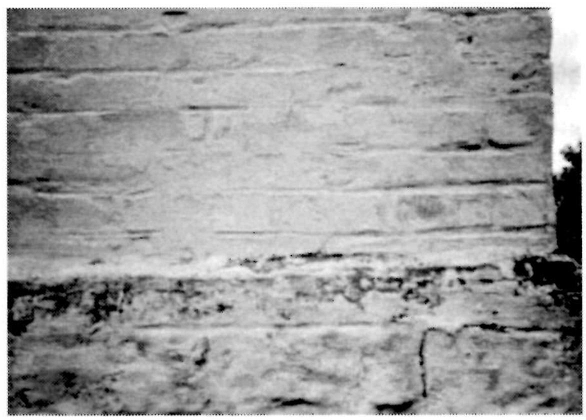

Figure 28 *View of the west end of the north elevation of the Keeper's Dwelling, 1994. Note that the parging is crudely tooled to resemble mortar joints, a typical condition of the exterior brick wall surfaces.*

There is a cement mortar wash, which creates a water table, at the top of the foundation wall (Figure 28). This sloped mortar wash is either broken, chipped, or wearing thin in several areas around the Dwelling's perimeter.

Figure 29 View of the basement window (D-1) at the east end of the south elevation of the Keeper's Dwelling, 1994. Note the deteriorated foundation wall between the window and the concrete steps.

Figure 30 Detail view of the exterior concrete steps leading to the main entrance into the Keeper's Dwelling along the south elevation, 1994. The face of both the top riser and the door sill have an elaborate tooled pattern, while the face of the risers below are less ornate.

South Elevation

A crack in the parging at the west end of the south elevation follows the profile of the underlying cut stone quoining at the corner of the building. At the east end of the foundation wall, the parging has failed and broken off of the stone surface, and a large amount of the mortar has also deteriorated between the concrete steps and the east basement window, (D-1), (Figure 29). Also, the limestone sill of this window (D-1) is cracked in half and the bottom portion of the sill has deteriorated. Physical investigation also revealed that this window is infilled at the bottom with three courses of rough brick which protrude from the face of the wall.

The exterior stone and concrete stairway leading to the main entrance of the Keeper's Dwelling consists of six steps near the east end of the Dwelling's south elevation. The face of the stone sill (Door E-4) at the top of the stair has the same decoratively tooled pattern as at the limestone window sills. The top step, which is actually an individual slab, also has a decorated tooled face. Unlike the window sills, however, the stone surfaces at both the stair and the door sill are unpainted. The bottom three risers of the stair are rough concrete with no decoration, and the two above them have an interesting scoring pattern, which is coarser and not as elaborate as the top riser (slab) or the door and window sills. The contrast between the two tooled patterns can be seen in Figure 30. Both exposed sides of the stair have a cement facing that was applied over the stone surface. National Park Service maintenance records indicate that deteriorated cement was removed and the existing cement applied in 1983.

The arched brick head of the door opening at the main entrance (Door E-4) has a mortar crack, however, it appears to have been repaired, and is now not very noticeable. Just east of the door, there is a rusted conduit and base from a former light fixture. The rust has stained the area of brick surface around the fixture.

North Elevation

A crack in the parging applied over the foundation at the west end of the wall follows the profile of the cut stone quoining at the corner of the building, (Figure 31). At the top of the foundation wall, near the east end of the dwelling, there is a flush lintel stone, which has no opening to support (Figure 32). The reason for this

Figure 31 *View of the northeast corner of the stone foundation wall at the Keeper's Dwelling, 1994. Note the cracking of the cementitious parge coat along the profile of the cut stone quoining.*

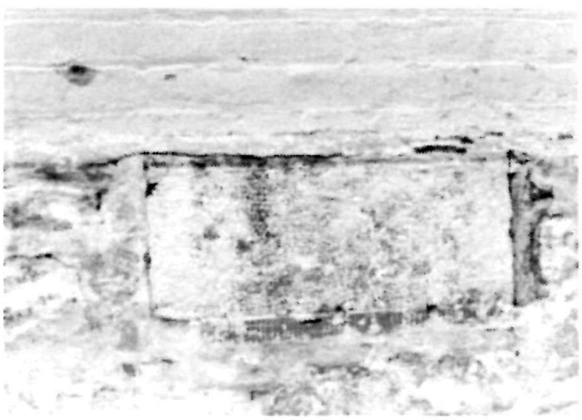

Figure 32 *Detail view of the flush stone lintel (its purpose unknown) located near the east end of the north elevation of the Keeper's Dwelling, 1994.*

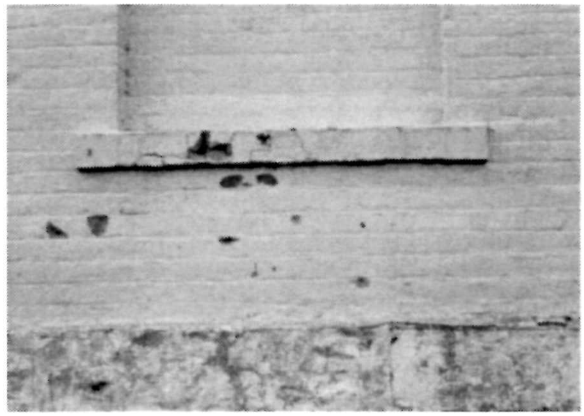

Figure 33 *Detail view of the deteriorated brick sill, and the wall surface below, at the false window opening at the east end of the north elevation, 1994.*

unique condition is currently unknown, and there is no evidence of a historic opening in this location. This stone is smaller in size and placed higher on the wall than the other stone lintels that actually support the window openings.

There are several areas of spalling brick along the north elevation, especially below the west brick recess at the second floor, and at the brick sill of the false window (Figure 33). An area of the brick surface at the east end of the wall, just above the foundation, appears to be coated with an excessive amount of parging that is crudely tooled to resemble mortar joints (Figure 28). With the exception of the aforementioned areas, the overall brick surface of the north elevation has experienced only minor blemishes and cracks.

East Elevation

The area of the foundation wall north of the Passageway has a deep vertical crack with a large gouge along it, which follows the profile of the quoining at the northeast corner of the structure. The adjacent basement window, (D-6), has been infilled with brick, has a mortar wash at the sill, and is coated with whitewash as at the foundation wall surfaces. A unique feature of this opening is that the stone lintel extends almost 8'-0" in width, much wider than the window opening itself. Furthermore, there is a rusted piece of conduit exposed at the top south corner of this infilled opening. Directly above, at the first floor, the brick arch above window (D-15) has a crack along one of the mortar joints at the center of the opening.

There is a vertical crack below the first floor window (D-7) south of the passageway and the cement wash at the top of the foundation wall is severely deteriorated from excessive wind and water damage. Furthermore, the window is infilled with one course of rough brick, approximately 5" in height, with the remainder of the opening covered with plywood. There is also an excessive amount of parging beneath this window. The brick surface at the south corner of the wall appears to have been repaired its entire height and coated with parging that is crudely tooled to resemble brick. However, this repair work has failed in several areas, and the brick has continued to spall and deteriorate (Figure 34).

Figure 34 *View looking west at the southeast corner of the Keeper's Dwelling, 1994. Note the deteriorated condition of both the cementitious parging and the underlying brick.*

West Elevation

Due to the contour of the site surrounding the Keeper's Dwelling, the basement floor becomes level with grade at the west elevation, exposing approximately 8'-0" of the foundation wall (Figure 35). The entire wall is covered with a parging, as at the other elevations of the foundation. There are two exterior door openings in the 1' - 0" thick foundation wall along this elevation (one leading into each of the two kitchens).

Passageway

Roof

National Park Service records indicate that the roof of the entire Passageway was re-shingled in 1980. Photographs of this work reveal that the roof was stripped down to the wood rafters, and was entirely rebuilt. The new wood sheathing boards appear to be either 1 x 8s or 1 x 10s spaced horizontally, close together. The maintenance records also indicate that, "a 65# felt was installed, the eaves were enclosed to match [the] existing style, and that the replacement shingles were those that had been removed from the keeper's dwelling."[2] However, Kim Mann, Sleeping Bear Dunes National Lakeshore Superintendent, states that no shingles were reused from the Keeper's Dwelling. Rather, the roof shingles in place were cut from asbestos board and sent to the island from the mainland. There is no apparent surface damage, with the exception of the southeast corner at the intersection of the Tower where several shingles are missing. The metal flashing at the intersection of the Passageway's roof and the east wall of the Keeper's Dwelling is pulling loose (Figure 36), and

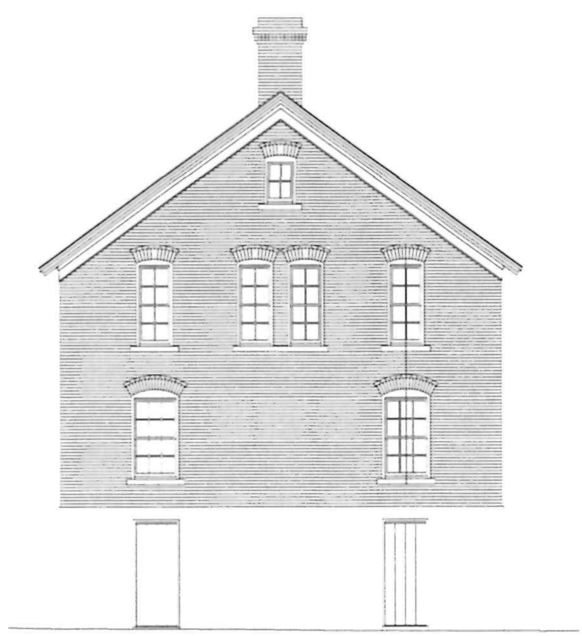

Figure 35 *Drawing of the west elevation of the Keeper's Dwelling showing the exposure of the foundation, 1994.*

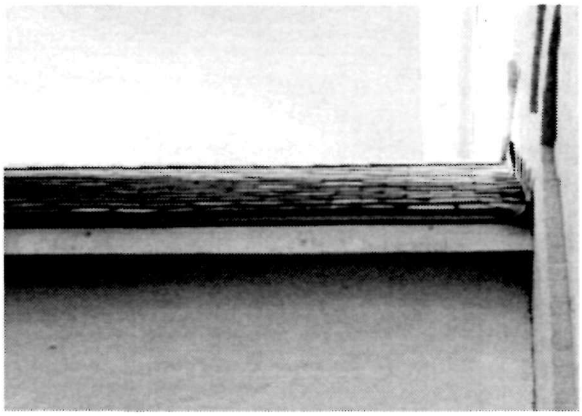

Figure 36 Detail view looking south at the intersection of the Passageway's roof and the east wall of the Keeper's Dwelling, 1994.

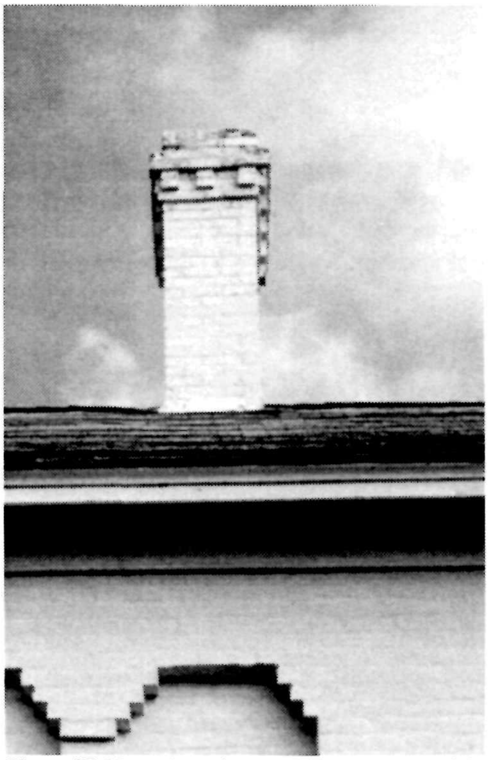

Figure 37 View of the deteriorated top portion of the chimney, 1994.

is most likely allowing water to penetrate into the brick wall.

Chimney

The Passageway's chimney has several layers of the same beige color paint as that found at the Keeper's Dwelling. There are areas where the paint has failed and is peeling, revealing the red brick beneath. A tooled parging was applied to these damaged areas, however, it appears that deterioration has continued, resulting in some entire bricks missing at the top of the northeast corner (Figure 37).

Gutters

There is no evidence of gutters or downspouts having been historically located at the Passageway.

Windows

The four windows at the Passageway are similar to those found at the Keeper's Dwelling, supported by brick arched heads with double-hung wood sashes. The limestone sills at these windows are smooth-faced, however, unlike the decoratively tooled faces found at the Keeper's Dwelling. The sills are covered with whitewash and, during physical investigation, all of the window openings were boarded up with plywood. There are four 2" x 8" metal grilles, which presumably ventilate the inaccessible space beneath the floor of the Passageway. Each of these grilles is located beneath a window. The black paint on the grilles has peeled, resulting in oxidation of the metal.

South Elevation

The majority of the foundation wall (at both the north and south elevations) is a rough ashlar stone, coated with parging and several layers of whitewash, similar to the foundation walls of the Keeper's Dwelling. However, between this portion of the foundation and the brick wall above, there are five courses of regularly-sized cut stone blocks, each approximately 5" x 19", (Figure 38). The red brick walls above are covered with several layers of whitewash, and several areas of the brick are patched with parging, presumably indicating former areas of spalling and deterioration. At one large area, between the east window (P-2) and the Tower, both the whitewash and parging have failed and are breaking loose from the brick surface. This failure appears to have occurred some time ago, as the flaked and broken areas have since been covered over with whitewash.

North Elevation

As at the south elevation, failure and peeling is evident due to the excessive buildup of the whitewash and parging, both of which have broken loose from the

Figure 38 View of the south elevation of the Passageway, 1994.

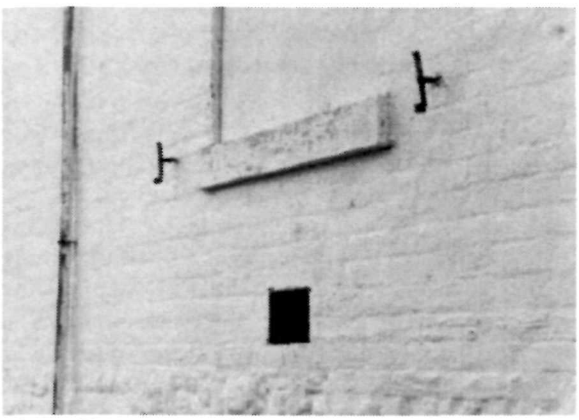

Figure 39 View of Window P-3 at the north elevation of the Passageway, 1994.

Figure 40 Detail view of the stone steps at the base of the Tower, 1994.

underlying brick, and have deteriorated in several areas. The west window (P-4) has a cracked sill, and there are several cracks in the masonry between the sill and the metal ventilation grille directly below it. There are a few remaining rusted metal hooks placed horizontally from each other along the elevation which, based on historic photographs, formerly supported a piece of surface mounted piping or metal conduit. There is also a 2 inch diameter, galvanized conduit running vertically the full height of the Passageway approximately 7'-10" west of the Tower. Two painted metal shutter holds were observed at the east window, (P-3), each one 12" from the window opening (Figure 39). These are the only remaining shutter holds left on the building of those that were likely located at all of the windows. A small number of tagged historic shutter hardware exists and is now located in archival storage, in the Sleeping Bear Dunes headquarters building.

There is a large area between the Tower and the east window [P-3], which displays diagonal cracks suggesting an extensive amount of historic settlement in this area. This is most likely due to the changes in soil conditions and weather, which led to this portion of the wall settling at a different rate than the adjacent Tower's walls.

Tower

Base

The base of the Tower, which extends approximately 12" - 14" above grade, consists of large cut-stone blocks, which are approximately 12" in height. The stone blocks also curve to form the circumference of the Tower while tapering slightly upward. Furthermore, the base protrudes approximately two inches out from the brick face of the Tower, with the top of the stone cut at an angle to act as a water table. The base appears to have once been coated with several layers of a black paint or an asphalt-type coating, but during physical investigation most of this finish had worn off (Figure 40). National Park Service records indicate that the last application of the black finish was in 1980.

Several of the mortar joints at the stone base of the Tower have deteriorated. Some have been repointed, but the replacement mortar appears to have also failed. There is a large joint between the concrete walk and the base of the Tower which appears to have been previously repaired with an infill material, however, this

Figure 41 *Detail view of the pair of doors at the base entrance into the Tower, 1994.*

Figure 42 *Detail view of the exterior of the Tower, including a remaining metal bracket, which formerly supported the chimney stack from the stove in the work room, 1994.*

material has failed and cracked, allowing the width of the joint to continually widen.

The stone steps also have the remnants of several layers of a black paint or asphalt-coating on them, similar to that observed at the base. There are several gouges and areas where the concrete has cracked and broken loose at the steps, appearing to be almost "gnawed" from snow, water, and ice buildup. The faces of the steps have the same bush-hammered tooling as that found at the stone sills of the Dwelling. The pair of wood doors at the entrance to the Tower are in good condition, with no evidence of paint buildup or failure observed (Figure 41). According to National Park Service records, these doors were fabricated and installed in 1980.

Walls

Physical investigation revealed that the red brick wall of the Tower is covered with several layers of whitewash. National Park Service records indicate that the Tower walls were tuckpointed and whitewashed in 1978. A detail view of the Tower exterior is shown in Figure 42.

Lightning Protection

A 1/2" diameter braided copper cable serves as the Tower's lighting protection, and extends the full height of the Tower along its north face, from the metal parapet deck down into the ground. There is also a copper ventilator ball with a copper point and platinum tip, located on the roof of the lantern. An additional 3/4" braided copper cable leads from the base of the cast iron stairway, through the Tower wall, and along the outer face of the base of the Tower into the ground (Figure 43).

Windows

The windows of the Tower all have sloped stone sills, which have a scooped profile at the outer corners and a stone lintel, which is curved and flush with the adjacent brick surface (Figure 44). The four window openings at the watchroom (near the top of the tower) are more elaborate, with decorative crowns that are painted black.

Parapet

Figure 43 Detail view of the copper grounding cable (part of the lightning protection system) extending out from interior base of the Tower, 1994.

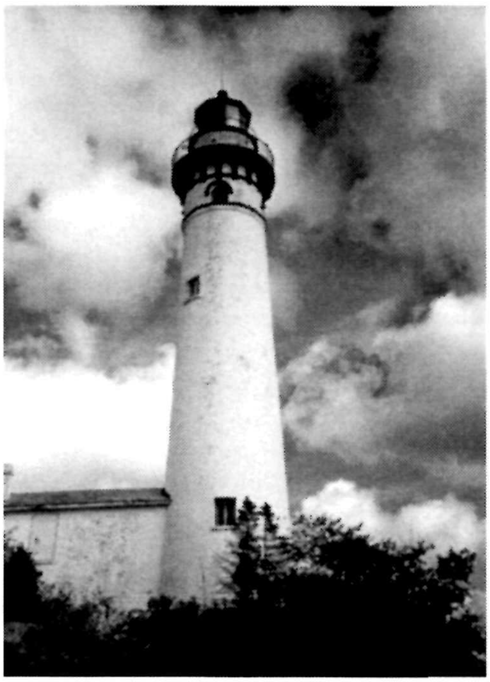

Figure 44 View looking north at the Light Tower, 1994.

The exterior platform (parapet), which is accessed from a door at the lantern room, is constructed of cast iron. It also has a simple cast iron guardrail, which consists of large sections, each approximately 40" in height, that are bolted together. The entire platform is supported from below by large, Italianate cast iron brackets. The black paint has worn off of most of the cast iron surfaces at this area, exposing the bare metal and resulting in extensive oxidation.

Interior Fabric Analysis

Tower

Walls

The interior wall surface of the Tower is coated with a semi-rough cement plaster which is approximately 1/2" thick. The stair treads and landings butt up against the red brick wall, which is plastered around each tread. Cracks in the plaster of the interior wall of the Tower have been filled with a patching compound, which appears medium to dark gray in color, and is very conspicuous against the whitewash of the adjacent plaster walls.

Windows

All of the openings at the Tower have replacement wood casement windows, which, according to National Park Service records, were installed in 1980. The four windows along the height of the stairs (at different heights) all have round arch interior openings, creating a floor-to-ceiling recessed niche, while the head at the exterior face of the opening is flat. The Watchroom windows at the top of the Tower have round tops at the inside and exterior (Figures 44 and 45). The first, second, and fourth windows up (in order of climbing the stairs) have casement sashes at the exterior edge of the opening, while the third window up has two pairs of casement windows, one at its exterior edge and one at the interior edge of each opening. All of the windows are thought to have originally had two sets of casements. The bottom rails of the wood sash at the fourth window up have deteriorated. Each of the windows needs to be rebuilt along with the storm windows, louvers, and associated hardware.

Ground Level

The floor at the ground level of the Tower consists of large, interlocking stone blocks. Physical investigation

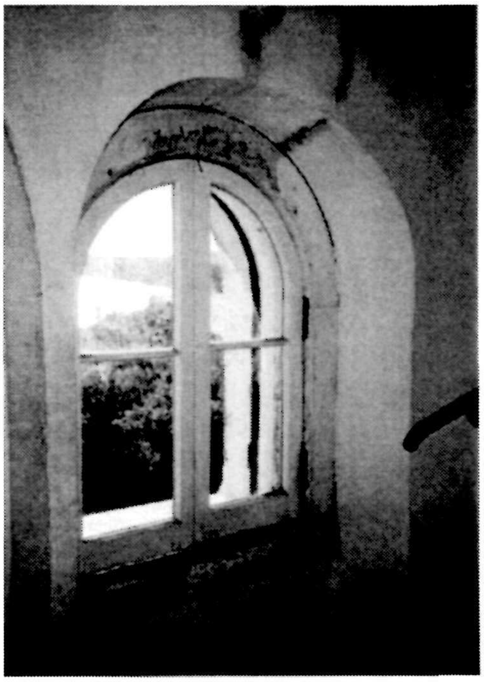

Figure 45 Interior view of one of the round top windows at the Watchroom level of the Tower, 1994.

revealed that most of a previous paint finish has worn off of the stone surface.

Cast Iron Stair

The stair is comprised of 48" inch wide cast iron treads and landings which have a decorative open pattern. The stair is supported on an integral central interlocking post, which has experienced extensive oxidation and rusting. The top surfaces of the approximately 48" inch wide treads still retain their black paint, however, there is no remaining paint on the undersides of the treads, which flake to the touch due to rust. The curved metal handrail, which is attached to the exterior wall of the Tower, is also rusting.

Watchroom

The floor consists of a solid cast iron deck, which has experienced some oxidation. There is a hatch opening and door to provide access to the winding stair below. There are three round top windows at this level of the Tower. Each window is recessed in a round top niche, which extends from a 4" thick stone slab that slightly protrudes from the floor level of the watchroom and up around the window (Figure 45). In each of the three niches, the plaster has cracked around the entire perimeter of the window openings. This appears to be the result of both uneven settlement and water infiltration. There is also an excessive amount of nail holes in both the aprons and casing at each of the windows.

Each of the three windows have both an inner and outer pair of wood casements. The outer pair of casements are missing, however, at the window facing south. The inner windows have wood frames while the outer frames are cast iron.

There is a cabinet built into the northwest portion of the wall, which is lined with painted, beaded edge, tongue-and-groove, wood boards. The ghosted outlines of the metal hinges that once held the double doors (which are no longer extant) were also observed.

Lantern Room

A hatch door opening in the cast iron deck floor, provides access into the lantern room from the watchroom below. This hatch door, as well as the hatch door in the watchroom, was removed by the National Park Service to allow for ease of passage during tours, and are stored in the Fog Signal Building.

A bright yellow strip was painted, and a pipe wrap cushion installed, around the perimeter of the Lantern Room's hatch door opening by the National Park Service in 1991 for visitor safety. The floor deck slopes toward the center of the 7'-7" diameter space, approximately 1" off level to provide drainage away from the plaster and wood wall surfaces. A curved cast iron ladder provides access up to the small, upper deck which encircles the lens pedestal (this provided access to the large, third order Fresnel lens). This deck consists of eight segmented pieces of cast iron. Physical investigation revealed that two of these segments are missing near the ladder.

The walls of the lantern room are lined with a wainscot, comprised of 2 3/8" wide tongue-and-groove, beaded, wood boards. The metal pedestal, which once held the Fresnel lens, has experienced excessive oxidation (Figure 46). Furthermore, all of the brass ventilator caps are missing. The door opening leading onto the exterior platform has a cast iron frame and sill, which have also rusted.

The interior ceiling of the lantern is lined with 10 segmented pieces of zinc, which are painted white. However, much of the paint has worn off, and the ex-

Figure 46 View looking into the Lantern Room of the Tower toward the cast iron pedestal, which formerly supported the third order Fresnel lens, 1994.

Figure 47 Detail view of the separating joint in the wood baseboard beneath a window in the Passageway, a typical condition beneath all four of the Passageway windows, 1994.

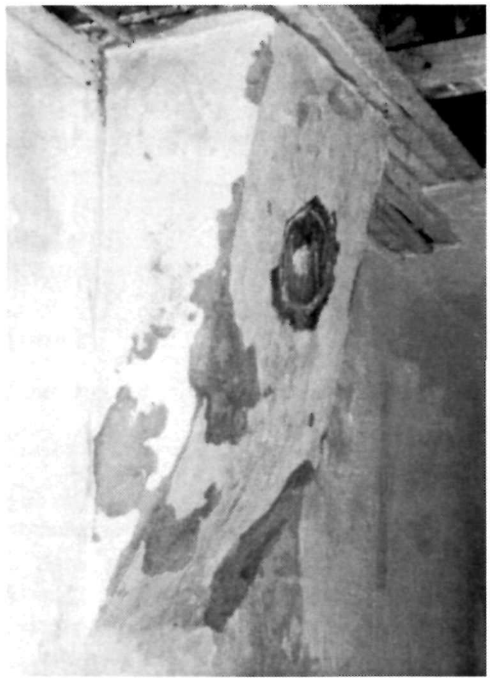

Figure 48 Interior view of the chimney in the Passageway, which is corbelled in from the wall approximately 5'-0" above the floor, 1994.

posed zinc has oxidized. Above the pedestal, there are five cast iron rods which extended outward in a circle and attach to the ceiling.

Passageway

Floor

There is a 17-1/2" wide area of floor boards along the south wall between windows P-2 and P-3 that has been patched. Physical investigation revealed a small piece of brightly colored linoleum at the west end of the Passageway, which is firmly adhered to the wood floor.

Walls

There is a joint in the baseboard beneath each of the windows in the Passageway (Figure 47). These joints have separated, most likely due to wood shrinkage and settlement in this unheated space. The baseboard throughout the space has excessive paint buildup and, consequently, has experienced paint failure as evidenced by the alligatored pattern of cracking.

The chimney is corbelled out from the south wall, beginning approximately 5'-0" above the floor. The stepped profile of the brick is not visible because the

Figure 49 Detail view of the head of the door opening between the Passageway and the Tower, 1994. Note the small circular opening through which the electrical conduit to the Tower was formerly fed.

Figure 50 View of the east wall in the southeast basement storage room (Room B-01) of the Keeper's Dwelling, 1994. Note the remnants of the parging that was tooled to resemble masonry.

surface is finished with plaster, giving it smooth, rounded edges (Figure 48). The stovepipe hole had once been plastered over, however, most of the plaster was worn off during the 1994 physical investigation.

Openings

At the east door leading into the Tower, (Door I-1), there is a huge gouge in the stone jamb on the south face. There is also a circular hole cut through the wall of the Tower above the door. According to the historic electrical drawing, this was where the electrical conduit ran to provide light to the Tower, (Figure 49).

Dwelling

Basement

Room B-01, Storage room / Asst. Keeper's Pantry

Floor: The flooring consists of rough wood planks ranging in width from 8" - 14", which run in an east-west direction. These planks appear to have originally spanned the entire room, but now only remain at the west end. Physical investigation also revealed the same linoleum flooring as that found in the adjacent Kitchen (Room B-06). The area where the wood flooring is missing exposes the wood sleepers resting on the brick subfloor.

Walls: The west wall has the same finish as its opposite face, which is in the Kitchen (Room B-06). The south and east walls are rough stone, which are covered with a parging that is scored to resemble large masonry blocks (Figure 50). It appears that several layers of whitewash were applied over the tooled surface, but most of both the whitewash and the parging have worn off. The window at the east wall (D-7) has been removed from its opening and infilled with blocking and plywood (Figure 50). The window at the south wall (Window D-1) is also missing from its opening. The painted wood window framing is severely deteriorated and the sill is missing, thus, exposing the rough stone opening. The north wall is divided by two piers, which were constructed to support the original roof lantern that was located directly above them. The east pier is rough stone which extends as a pilaster from the east basement wall, while the west pier is constructed of yellow brick, which is painted. The wall surfaces between the piers are lined with wood planks and shelving brackets all of which are covered with whitewash. The shelves these brackets once supported are no longer extant.

Ceiling: The plaster ceiling is extensively deteriorated due to water infiltration.

Room B-02, Storage Room

Floor: The floor is comprised of two layers of brick. The first layer rests directly on grade face up, while the top layer is laid on its side. It appears that the top surface of the top layer of brick was previously painted.

Walls: The south half of the west wall, which is common with the kitchen (Room B-06), has the same finish treatment as its Room B-06 face, (see the description for the existing conditions of room B-06). The north half of this wall is covered with plaster, which is intact, but has several layers of peeling paint. The north and east walls of the room are rough stone which have excessive paint buildup in some areas, while other ar-

***Figure 51** View of the south wall of the northeast basement storage room (Room B-02) in the Keeper's Dwelling, 1995.*

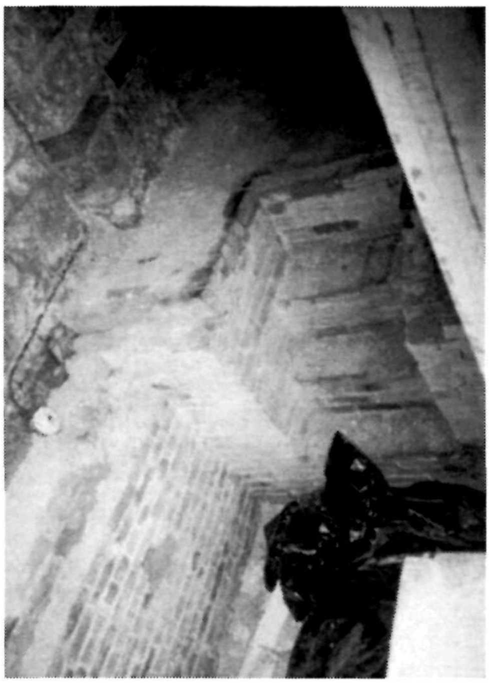

***Figure 52** View looking down into the subcellar (Room B-03) of the Keeper's Dwelling, from the stair, 1994. Note the steep brick-lined steps leading down into the subcellar, and the exposed conduit of a former light fixture.*

***Figure 53** View of the east wall in the northeast basement storage room (Room B-03) of the Keeper's Dwelling, 1994. Note that most of the parging has worn or broken off of the stone wall surface.*

eas are "worn" bare. A large area of the north wall at the northwest corner of the room has been covered with parging. The south wall is a mirror image of its other face, (which is in Room B-01), consisting of wood planks which line the space between the two piers. The painted wood shelves remain intact between these piers (Figure 51).

Ceiling: The plaster ceiling is showing signs of severe deterioration, which appears to be the result of water infiltration. Broken keys have resulted in missing plaster at over half of the ceiling's surface. Furthermore, the exposed heavy conduit is severely rusted.

Room B-03, Sub-Cellar

Floor: There are three steps leading down into the subcellar from the floor of the storage room above. The steps and the floor of the subcellar are lined with red brick, (Figure 52).

Walls: The walls of the subcellar are also lined with unpainted red brick. It appears that this subcellar space was added sometime after the original construction of the dwelling, as evidenced by the brick lined floor of the basement, which is unevenly broken at the perimeter of the subcellar.

The window opening at the east elevation above the subcellar, (Window D-6), is infilled with unpainted brick. The wood frame is partially intact and covered over with green paint, (Figure 53).

Figure 54 View of the stair that hangs precariously over the subcellar (Room B-03) in the Keeper's Dwelling , 1994

Figure 55 Detail view of the basement stair (Room B-04) of the Keeper's Dwelling, 1994. Note the paint failure and buildup, and the change in color indicating the previous location of the stair runner.

B-04, Stairway to first floor

Although the door has been removed (as at most interior openings of the dwelling), there is an opening (Door B-1) leading into the area of the subcellar, Room B-03, which remains. During physical investigation, this opening was temporarily blocked with wood members, as it is dangerous because it leads to a step that is precariously hanging over the subcellar, the floor of which is some 5'-0" below, (Figure 54).

There is a ghosted outline in the paint surface of the treads and risers, evidence of the presence of either a vinyl runner or a paint scheme intended to resemble a runner. There is extensive paint buildup, which has caused failure and can be seen by the alligatored pattern of cracking (Figure 55).

Room B-05, Dining Room / Keeper's Kitchen

Floor: The floor is covered with 2 1/4" wide tongue-and-groove pine boards running in an east-west direction. The entire floor surface has been painted with several layers of gray paint. The paint is thicker in a band approximately 1'-6" wide along the walls, suggesting that these excessive layers were applied around a historic floor covering.

Walls: All of the walls in the room have a wood wainscot, which is covered with an excessive buildup of white paint. The wainscot at the north, east, and west walls is comprised of beaded boards, extends 36" above the floor, and has a cap that is two inches deep to the plaster. Physical investigation revealed that several of the tongue-and-groove boards are pulling apart from one another. The wood wainscot at the south wall differs from that of the other three walls of the room. This wainscot consists of 4 3/4" flat boards which are 2'-3/4" tall, and capped with a 6" flat board.

The plaster surface above the wainscot at all of the walls of the room is cracking and chipped in several areas. Furthermore, a significant portion of the plaster has failed and broken loose, leaving only exposed lath on the surfaces. In addition, there are some areas where the plaster has been replaced with wall board, including a patch on the east wall at the south end of the room. The joint between the two materials has pulled apart, presumably due to water infiltration, and is very conspicuous.

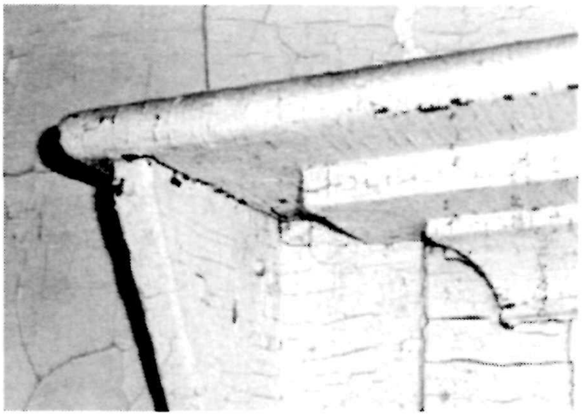

***Figure 56** Detail view of the wood fireplace mantle in the Keeper's Kitchen (Room B-05), 1994. Note the paint buildup and excessive cracking.*

The fireplace is trimmed with a wood mantle and casing, both of which have extensive paint buildup (Figure 56). Several of the nails connecting the pieces of wood comprising the mantle have rusted and stained the paint surface. A few pieces of wood are missing and the east vertical member has a deep, vertical split spanning its entire height.

Ceiling: There are a few small areas where the plaster has completely failed and broken loose, exposing the underlying wood lath. Additionally, there are areas where the plaster has been replaced with wall board, including a large section of the ceiling directly above/ in front of the fireplace. Both the remaining plaster and wallboard have deteriorated in areas due to water infiltration.

Other: There is a wood beaded-board cabinet with two doors around the cast-iron sink in the northeast corner of the room. The sink is connected to a brick cistern, which is located directly below it. The wood cabinet is covered with several layers of gray paint. Although the wainscot continues around the cabinets at both the north and west walls, it is 48" tall (rather than the 36" height as it is at the rest of the wall surfaces).

Both exterior door openings in the basement (at Rooms B-05 and B-06) have wood framing and wood "batten" or "ledged" doors. These doors consist of two layers of four vertical planks each, with z-shaped (diagonal and horizontal) bracing at the interior. National Park Service records indicate that these doors were reconditioned in 1980.

Room B-05 A, Pantry

Floor: The flooring is comprised of 2" wide tongue-and-groove pine boards laid in an east-west direction. Brown paint remains on these boards, with little evidence of paint buildup.

Walls: There are wood base and wall cabinets along the west wall of the pantry, all of which are in poor condition. The left door of the wall cabinets, and the right door of the base cabinets, are missing. The exposed wall surface between the cabinets is finished with 3 1/2" vertical beaded board. There is a 1" x 4" board with a beaded bottom edge attached horizontally to the wall directly below the wall cabinet, with several nails protruding from it. Presumably, these nails were once used to hang pots and other kitchen utensils.

The south wall is covered plaster, which is still intact, but has several severe cracks and punctures. There are demarcations in the paint of this wall indicating the locations of former shelves. There is a 15 1/4" wide x 19 1/2" tall pass-through window at the center of the wall, with only fragments of the glass pane intact.

The east wall is also covered with plaster, but has extensively deteriorated. The chimney steps into the room along the east wall and is also finished with plaster, which is in poor condition. Furthermore, over one quarter of the plaster is missing from the north wall, exposing the underlying lath.

Ceiling: Over 95% of the ceiling plaster is missing in the pantry, thereby exposing the wood lath. In some areas, the wood lath is also either broken or missing. Furthermore, exposed metal conduit was attached to the ceiling for the central light fixture. The location of this conduit prohibits the wall cabinet door at the west wall from being fully opened (it can only be opened a few inches and it hits the conduit).

Room B-06, (Assistant Keeper's) Kitchen

Floor: The floor consists of 2 1/4" tongue-and-groove boards running in an east-west direction, laid directly on the brick subfloor. The entire floor surface is covered with a brightly colored linoleum, which is deteriorating and pulling loose from the wood surface.

Walls: All of the walls have a 37" high vertical tongue-and-groove beaded board wood wainscot. There is

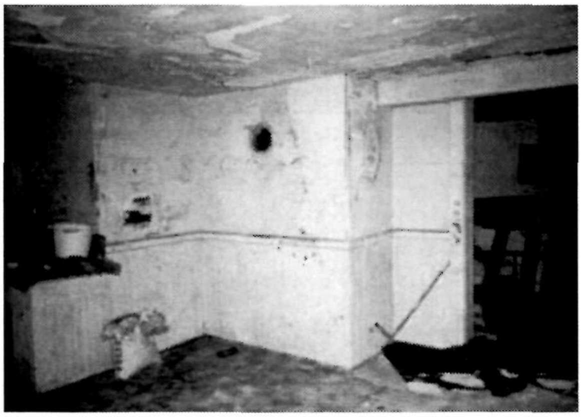

Figure 57 View looking northwest in the Assistant Keeper's Kitchen (Room B-06). Note the deterioration of the plaster at both the ceiling and walls.

Figure 58 Detail view of the wood beaded board cabinet and the remaining piece of the metal hand pump at the sink in the northwest corner of the Assistant Keeper's Kitchen (Room B-06), 1995.

extensive paint buildup at the wainscot, which is accelerating peeling and revealing an extensive amount of the wood beneath, which is splitting along the grain. The plaster surface above the wainscot, which has either deteriorated or is missing at several locations throughout the room (Figure 57), is most likely the result of water infiltration. There is also a wood coat hook rail on the west wall near the exterior door.

Ceiling: The plaster ceiling has experienced extensive deterioration due to water infiltration, and the underside of the first floor structure is visible in several areas.

Other: There is a wood cabinet and a piece of the hand pump from the cast iron kitchen sink at the northwest corner of the room. The wood is weathered and several parts of the cabinet are missing. The sink has been removed and unfinished boards have been placed across the counter surface (Figure 58).

First Floor

General Conditions

Windows: All of the interior wood window stools throughout the dwelling are severely weathered, exposing bare wood, and several are deteriorated and splitting. Most of the paint finish has also worn off of the interior wood casing at the windows throughout the structure.

Room 101, Entrance Hall

Floor: The floor consists of 5 1/2" wide tongue-and-groove boards, which run in a north-south direction. Remnants of heavy paint buildup remain, but most of the wood surface is bare and weathered. A few pieces of board have a rough surface and are beginning to deteriorate.

Walls: There is plaster damage, apparently caused by water infiltration, below window (D-8) and above Door (E-4). The wood trim around this door is also broken and damaged from vandalism, as seen in the detail photograph of the jamb (Figure 59). There is a small area of missing plaster along the east wall beneath the stair.

There are two layers of 1/2" plaster at the north and west walls of the room. A large section of the plaster is missing from the west wall, revealing the unusual placement of the wood studs and the lath pattern. This may

Figure 59 *Detail view of the deteriorated and damaged wood doorjamb at Door E-4 in Room 101 of the Keeper's Dwelling, 1994.*

Figure 60 *Detail view of the face of the stair risers that are painted a darker gray to give the appearance of a continuous stair runner, 1994.*

Figure 61 *Detail view of the intermediate newel post, the only remaining element of the balustrade at the stair in the northwest corner of Room 101 of the Keeper's Dwelling, 1994.*

Figure 62 *View looking northeast in the Entrance Hall (Room 101) toward the stair, 1994. Note that the balustrade and some of the tread nosing are missing at the stair, and the deteriorated condition of the adjacent plaster surfaces*

indicate that a change in location of the door leading into the parlor (Room 104) took place. There is also a distinct vertical crack in the plaster, and a butt joint in the wood baseboard directly below on the parlor side of the wall. However, no historic documentation has been located to verify this assumption.

Ceiling: Over one quarter of the plaster is missing from the ceiling of this room, and where it remains, most of the keys are broken and the plaster is pulling away from the lath.

Stairs: The wood stairs leading to the second floor at the northeast corner of the room have excessive paint buildup along the stringers, while most of the paint has worn off of the exposed surface of the treads. A 17" wide strip of vinyl was formerly attached to each tread with metal nosing. Several pieces of this vinyl remain, although they have deteriorated and are falling apart. The face of each riser (the portion that is the same width as the vinyl pieces on the treads) is painted a darker gray to give the appearance of a continuous stair runner (Figure 60). There is evidence that the balustrade consisted of spindle balusters that were let into the treads, but none of the balusters are extant. The only remaining element of the balustrade is the intermediate newel post, which extends alongside the stair to the floor for support, however, its newel cap is missing (Figures 61 and 62). This newel post appears to be mahogany, with a dark stain and a clear finish applied to it.

Room 102, Office

Floor: The floor consists of 5 1/4" wide tongue-and-groove boards laid in a north-south direction. Although mostly worn off, there are remnant areas of paint buildup (up to 1/8" thick) remaining. There is a raised platform at the northwest corner of the room (13 1/2" above the floor level) to allow headroom at the stair below. During physical investigation, the exterior shutters for the building (constructed by the National Park Service) were stored on this platform. There is an area approximately 12" x 16" near the east wall where the floor boards have been cut and patched with non-historic, 3 1/4" boards.

Walls: All of the walls in this room are finished with plaster. There is extensive damage, including damaged and missing plaster and lath at both the south and west walls. There are also random areas of damage elsewhere throughout the room, the result of both vandalism and water infiltration.

Figure 63 *View of the west wall in the Keeper's Office (Room 102), 1994. Note the ghosted outline in the paint at the chamfered wood post, indicating that something was previously hung (and painted around) in this location.*

Ceiling: Over half of the ceiling plaster is missing at the north end of the room, and there is extensive cracking throughout the remaining plaster surface area.

Other: There are four chamfered wood posts (two each along the east and west walls of the room), which extend continuously from their basement pier supports through to the attic where they once supported the former roof lantern. A demarcation in the paint surface of the west post indicates the ghosted profile outline of a plaque or other object previously hung here (Figure 63).

Room 103, North Parlor

Floor: The floor consists of 2 1/2" wide maple tongue-and-groove boards running north-south. Most of the boards have "cupped" from the presence of excessive moisture. Water stains are also visible on the surface of the boards throughout the room. In addition, there is a demarcation in the floor boards near the fireplace indicating the former location of a stove pad.

Walls: All of the walls in the room have three coats of plaster, resulting in a total thickness of 3/4". At the south wall, each side of the fireplace has a large area where both the plaster and lath are missing. At the north and west walls, there is water damage at the plaster beneath each of the windows. In addition, there is evidence of water infiltration at the baseboard trim at both of these walls, as it is pulling away from the wall (and pulling apart from itself at its joints). The plaster and lath is missing from a portion of the south wall east of the chimney, exposing two 3" x 12" rusted metal ducts, which appear to run the full height of the wall.

The fireplace on the south wall of the room is finished with wood trim. The wood mantel shelf is missing, but its wood support is still nailed to the wall. The fireplace opening has been infilled with brick and plaster, and has a wood baseboard to match that found throughout the room.

Ceiling: Although no plaster is missing from the ceiling, there is an extensive amount of surface cracking, and the plaster appears to be sagging and loose, suggesting broken keys. Furthermore, even though these conditions exist, the plaster in this room appears newer and in better condition than that found elsewhere in the dwelling.

Room 103A, Closet

Floor: The floor consists of 2 3/8" wide tongue-and-groove boards laid in a north-south direction. The floor area west of the Door I-7 has an additional layer of 1" x 2 1/4" floor boards laid over the main floor boards.

Walls: The plaster walls have several full height vertical settlement cracks along the east and north walls, possibly an indication that the wood framing has settled at a different rate than the adjacent brick chimney, over which the plaster runs continuously.

Ceiling: Over 95% of the ceiling plaster is missing, however, most of the wood lath remains intact.

Room 104, Parlor

Floor: The floor consists of 2 1/2" wide tongue-and-groove boards, which run north-south and have only a few coats of gray paint on them. A large buckle, over 2" in height, in this flooring spans the full width of the room, and has pulled members apart revealing another layer of wood flooring underneath. This lower layer appears to be the original floor, and is not buckled. However, it does have a heavy buildup of gray paint similar to that found in Rooms 101 and 102.

Figure 64 *View of the fireplace along the north wall of the South Parlor (Room 104), 1994. Note that although the brick and plaster infill has been removed at this fireplace, the baseboard remains across the opening.*

Walls: The walls in this room have three layers of plaster, comprising a total thickness of approximately 3/4". The animal hair binder is visible in the two base coats, while the finish coat is smooth and bright white in color (as opposed to the darker gray of the base layers). The plaster at both the west and south walls shows signs of water damage beneath each of the windows, and there are several areas of isolated damage due to vandalism. Also, as mentioned in the description of Room 101, there is a butt joint in the baseboard which may indicate the location of a former opening.

Ceiling: Over one-quarter of the ceiling plaster (mostly near the west wall) is either missing or pulling away from the lath due to broken keys. The surface area of the remaining plaster has extensive cracking and peeling paint.

Other: The brick and plaster which previously infilled the firebox was removed prior to the physical investigation. However, the bottom few inches of the infill

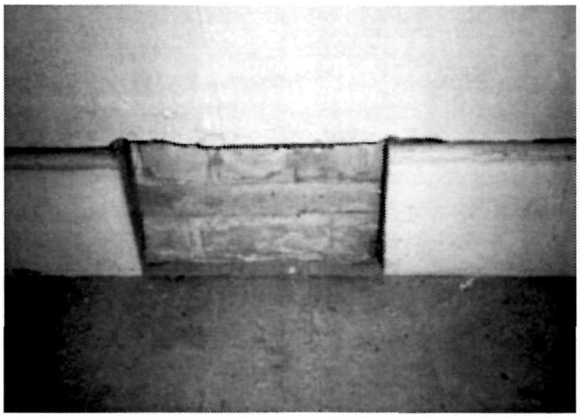

Figure 65 Detail view of the south wall of the southeast bedroom (Room 201), 1995. The wood baseboard has been cut and removed, exposing the wood nailer within the brick coursing to which the baseboard is attached.

Figure 66 View looking southwest at the floor of the Stair Hall (Room 202), 1995. The heavy paint buildup has caused the paint to fail and loosen in large chunks.

(behind and including the wood baseboard) remains (Figure 64). The metal chimney bar, which supports the brick opening, is exposed and has rusted. The metal cover is missing from the stovepipe hole, revealing the sheet metal lining of the shaft. The outline of the former cover is ghosted on the paint surface, and the area that would have been beneath the edges of the cover reveals a different color of paint than the exposed, top layer. There are five nail holes across the front of the wood mantle, with one large one at each side of the firebox opening.

Second Floor

General Conditions

Floors: The finish floor is the same throughout the second floor of the Keeper's Dwelling. It consists of 5 1/2" wide tongue-and-groove boards laid in a north-south direction.

Room 201, Bedroom

Floor: There is excessive paint buildup (some areas as thick as 1/8") throughout the floor surface of the room, which has previously caused large chunks of paint to break loose from the wood boards. There are two areas along the west wall where the original flooring has been removed and new floor boards patched in.

Walls: A 14" wide piece of the wood baseboard is missing along the south wall approximately 3'-7" from the west wall, revealing that the plaster did not continue behind the baseboard. A wood member, the same height as the brick (to keep coursing), is visible within the brick coursing, and was presumably used as a nailing surface for the baseboard attachment (Figure 65). This condition is likely typical at all of the exterior walls of the Dwelling. The physical investigation revealed a piece of wood attached to the baseboard of the south wall, about 2'-0' from west wall, which is presumed to have served as a door stop.

Ceiling: Over three-quarters of the ceiling plaster has pulled loose and is missing in this room. However, most of the wood lath remains intact. Physical investigation revealed that the door trim at both of the door openings in this room is flush with the plaster face - there is no overlapping wood trim piece. This is a condition found throughout the dwelling.

Room 202, Central Stair Hall

Floor: Excessive paint buildup has created cracking, and the paint has failed leaving either large "clumps" of paint or areas of bare wood across the entire floor surface (Figure 66). A rough board has been nailed over the floor, approximately 15" - 18" in length, at the threshold of Door I-15 (leading into Room 203). All four doors leading into this hall have wood threshold saddles.

Walls: All of the walls are plaster, with several areas of damage on each wall due to vandalism and water infiltration. Furthermore, the paint has peeled at each of the outside corners in the hall, revealing wood corner beads within the plaster which are painted red. Areas of missing baseboard trim throughout the hall reveal that the plaster continues down behind the baseboard to the floor, a condition that is likely to be typical at all of the interior walls of the Dwelling. The wood casing at window [D-22] on the east wall has been cut and removed.

Ceiling: The ceiling plaster has experienced several areas of damage both from water infiltration and vandalism. Extensive cracking and broken keys exist at the east end of the space, at the opening to the attic, and below the stair.

Other: There is a wood ship's ladder leading to the attic at the east side of the room. The treads protrude from the stringers approximately 1", and their corners have an inverted "scoop" detail. The treads are also painted white, with an 11" wide gray stripe down the center of each tread, painted to resemble a runner. A simple profile wood handrail is attached to the west wall of the attic space with a simple wood bracket.

Room 203, Northeast Bedroom

Floor: There is excessive paint buildup (some areas as thick as 1/8") throughout the floor surface of the room, which has previously caused large chunks of paint to break loose from the wood boards. In addition, the floor is damaged around the closet, and, at the center of the room, a 5'-0" board has been nailed over the floor, possibly to cover a hole or other damage.

Walls: There are areas of plaster damage due to vandalism at all of the walls, and there is evidence of water damage beneath window D-20. Most of the paint has worn off of the interior window casing. The two north, chamfered posts (which continue from the first floor through to the attic) are exposed in this room, as they are in the room below. There is a 1 1/2" wood painted picture molding, approximately 6'-6" above the floor, at all of the walls, except the portion of the south wall which is adjacent to the Central Hall (Room 202). The existing paint scheme indicates that there was never a picture mold on this wall. The baseboards at the west wall, north wall, and the portion of the east wall that is north of the chamfered post, have an attached wood shoe molding.

Ceiling: Approximately one quarter of the ceiling plaster is missing, and the remaining plaster has several cracks and broken keys. The exposed lath is broken and pulling loose from the ceiling joists in most areas (the result of vandalism).

Room 203A, Closet

Floor: The floor boards run continuously through the threshold of Door I-16 from Room 203. However, the physical investigation revealed that there was no extensive paint buildup in this closet, as seen in Room 203.

Walls: There are several areas of damage at all of the walls in this closet, due to vandalism. There is a clothes hook rail at both the west and north walls, with demarcations in the paint and nail holes, indicating the previous location of metal hooks which are no longer extant.

Ceiling: Most of the ceiling plaster is missing, and the lath that remains is either broken or has deteriorated.

Room 204, Northwest Bedroom

Floor: The flooring beneath and around the windows has experienced considerable weathering. There are also several areas of extensive paint buildup and cracking. There is an area, approximately one square foot, at the center of the room where the floor boards have been cut and patched. There is also a definitive outline at the northeast corner of the room adjacent to the chimney, where the color and number of layers of floor paint change. These demarcations suggest that this was the former location of a stove pad.

Walls: Over half of the plaster and lath (a horizontal section extending the full width of the room) is missing from the north wall, which appears to have been

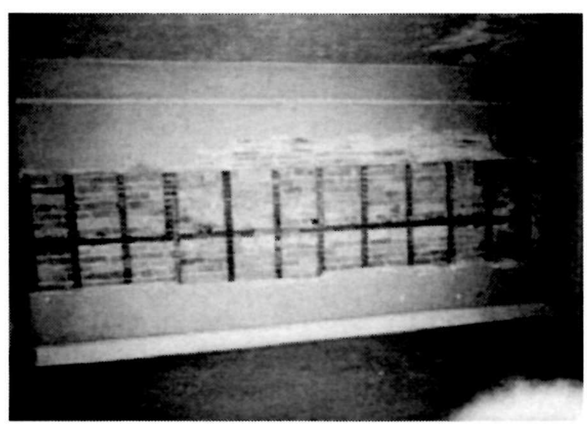

***Figure 67** View of the north wall in the northwest bedroom (Room 204), 1994. The large area of missing plaster has revealed a wood plate within the brick coursing, presumably incorporated as a nailing surface for the wood lath.*

deliberately removed either for exploration or as a result of vandalism. This area exposes the interior surface of the exterior brick wall, including a wood member which is incorporated into the brick coursing approximately 4'-0" above the floor (Figure 67). This detail was likely constructed to provide a nailing surface onto which the wood lath could be nailed. Presumably, there is another wood member beneath the plaster near the ceiling which provides a nailing surface for the picture molding. This condition is likely typical at all of the exterior walls of the Dwelling. Signs of water infiltration at the chimney are evidenced by the spalling and deteriorating plaster, and rust stains from the former metal stovepipe hole cover. There are several areas of damage due to vandalism at both the south and east walls. There are also signs of water damage below window D-19. The wood picture molding, which extends around the entire room except at the chimney face, has the same profile as that of the picture molding seen in Room 203. There is also a painted shoe mold attached to the baseboard at all of the walls.

Ceiling: Approximately one third of the ceiling lath and plaster is missing. Also, there is a hole in the remaining plaster at the center of the room, indicating the former location of a light fixture.

Room 204A, Closet

Floor: The floor boards are continuous through the threshold of Door I-9 from Room 204. However, the paint buildup evidenced during physical investigation was minimal, unlike Room 204.

Walls: The plaster walls throughout the room have experienced surface cracking, a typical condition caused by seasonal changes in temperature and humidity, especially in an unheated space. There is a wood hook rail nailed to the east wall of the closet, approximately 5'-0" above the floor, which has demarcations in the paint surface of seven former metal hooks. At the south wall, there is an area approximately 16" x 16" where the plaster appears to be patched and is sinking behind (no longer flush with) the surrounding plaster. This plaster sagging appears to be caused by the rusting ductwork in the wall framing behind it.

Ceiling: The plaster ceiling also has excessive hairline surface cracking, which appears to be caused by typical weather changes.

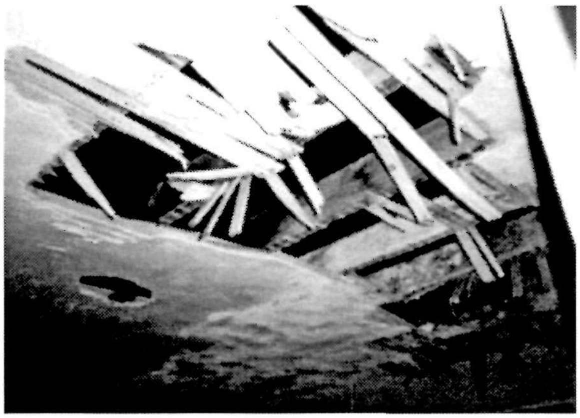

Figure 68 *View of the ceiling in the southwest bedroom (Room 205), 1994. Note the large amount of missing plaster and broken lath, both the result of vandalism.*

Room 205, Southwest Bedroom

Floor: The floor throughout this room has experienced excessive paint buildup.

Walls: There are areas of damage due to vandalism at the south and east walls. The west and north walls have experienced relatively little plaster damage, with only hairline cracks. The metal cover is missing from the stove pipe hole at the chimney face. The wood baseboard is the same throughout the room, with the exception of the length of the north wall between the chimney and the east wall, which has a profile unique to the dwelling.

Ceiling: Over three-quarters of the ceiling plaster and lath is completely missing, with only the nails that used to hold the lath in place remaining (Figure 68).

Attic

Walls: The walls of the finished portion of the attic have a plaster surface, approximately 3/8" thick. There are several areas where the paint is peeling and the plaster has spalled as a result of water infiltration.

Ceiling: Both the flat and sloped surfaces of the ceiling are also finished with a 3/8" thick plaster. There are several areas where the paint is peeling and the plaster has spalled, due to water infiltration.

The wood posts, which supported the original roof lantern, are not chamfered in the attic as they are at the floors below. The wood baseboard (present at all of the walls) does not continue around the posts. However, the post paint color changes at the same height to give the illusion of a baseboard.

Related Outbuildings

Fog Signal Building

Exterior Fabric Analysis

Roof

The corrugated metal roof, which was replaced by the National Park Service in 1978, is painted red. Only minor paint buildup was observed during the physical investigation. Further, maintenance of the Fog Signal Building is revealed in a National Park Service document of June 1984 which states, "Remove/repaint metal roof at whistle shed and magazine."[3] However, it is unlikely that the entire roof was replaced again in 1984. There are no gutters or downspouts on the structure, and no known historic evidence of their former presence. The metal vent stack is painted the same color red as the adjacent metal roof.

Doors: There is a pair of doors, both on the south and on the north elevations, which have an applied wood pattern (X-style). Neither set of doors revealed any overt signs of damage or deterioration. This relatively good condition suggests that they are not the original doors. Furthermore, a National Park Service *Job Order Request* of 1980, which is listed as "completed," states to: "Duplicate and replace doors on [the] Whistle Shed [fog signal building] which are deteriorated and [have] suffered significant vandalism. Install and paint..."[4]

Windows: According to Pete La Valley, the park's building utilities foreman, the windows in the Fog Signal Building were repaired in 1982-83. Those beyond repair were replaced in kind.

East Elevation: The surface of the concrete foundation above grade has been painted gray, and shows no visible signs of damage with the exception of a concentrated area of several large cracks directly below the south window.

The wood clapboard siding has approximately 4 1/2" of exposure. Excessive paint buildup has caused failure in several areas, which has accelerated peeling and cracking, and has led to the exposure of bare wood in some of the areas. During physical investigation, the areas of bare wood displayed only minor signs of weathering and no inherent wood damage, with the exception of a few split boards. Both of the windows, as well as the double leaf door and transom, are covered with plywood. The wood window sills appear weathered and show some signs of wood deterioration.

There is an additional piece of wood trim just below the frieze board, which has been cut at the locations of vertical conduit. A horizontal piece of metal conduit enters the building at the north end, runs along most of the length of the frieze board, and then continues vertically into grade at the south end of the wall. There are also two pieces of sheet metal attached to the wood surface at the top of either side of the door.

North Elevation: Paint buildup, and consequent paint failure and bare wood exposure, is more excessive at the clapboard siding along this elevation than at any of the others. There is a hole, approximately 2" in diameter, cut through first row of siding above grade at east end of elevation.

West Elevation: The wood clapboard siding is in better condition than at the other elevations of this structure due to its protective location from the wind, yet there are still small areas of accelerated paint failure caused by paint buildup. There is a large separation joint in the exposed foundation which appears to be an original condition. One possibility is that two adjacent slabs were poured instead of one larger slab.

South Elevation: The wood clapboard siding is severely weathered along this entire elevation, as it has experienced the most exposure to sun and wind. The concrete cistern adjacent to the south elevation is open beneath the wood siding, with metal pipes extending into the building. There is a large horizontal crack at the east edge of the concrete foundation, likely due to settlement.

Interior Fabric Analysis

Machinery Room

The ceiling of the east section of the building, referred to as the Machinery Room after the two individual buildings were connected, is covered with painted sheet metal that has rusted extensively (Figure 69). The walls in this section of the building were originally all covered with sheet metal also, but most of it has either been removed

Figure 69 *Detail view of an opening in the ceiling of the Fog Signal Building, 1995. A metal chimney stack once extended through this opening.*

Figure 70 *View of the south wall of the Machinery Room in the Fog Signal Building, 1995. Note the circular opening just above the window.*

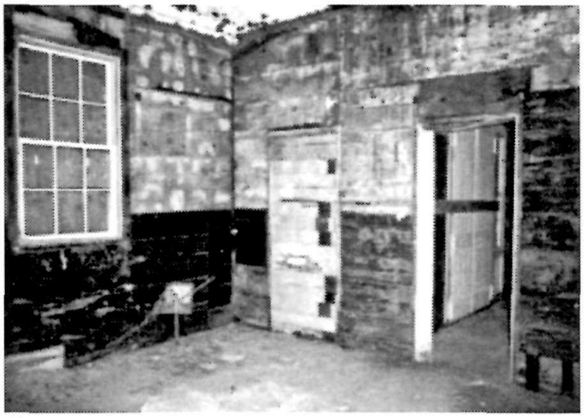

Figure 71 *View looking toward the southwest corner of the east wing of the Fog Signal Building, 1995.*

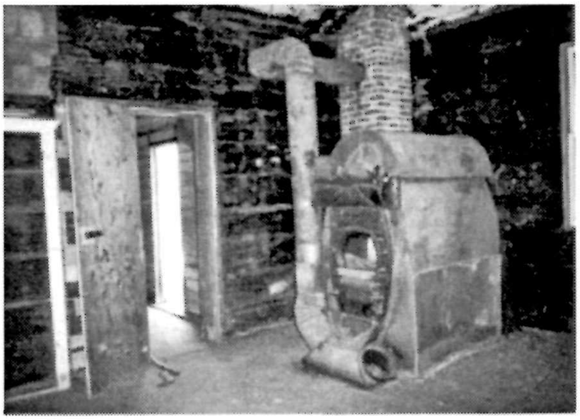

Figure 72 *View looking toward the northwest corner of the Machinery Room in the Fog Signal Building, 1994. The furnace was installed by the Coast Guard.*

Figure 73 *View looking toward the northeast corner of the Machinery Room in the Fog Signal Building, 1995. The concrete pads formerly supported two diesel generators.*

or has fallen off. The exposed walls are comprised of 12" wide boards from the floor up to approximately 5'-0" above the floor, and of 6" wide boards from this level to the ceiling (Figures 70 and 71). The large furnace, which once heated the space, remains near the northwest corner of the space (Figure 72). The concrete slabs that formerly supported the diesel generators also remain in the northeast area of the room (Figure 73).

There are four windows in this room, all of which have double-hung wood sashes, and appear to be in good condition. These sashes are in-kind replacements installed by the National Park Service. The four-light, wood transom above the double leaf door at the east wall also appears to be a replacement. The wood doors at the east elevation are deteriorated, and several of the wood muntins at the divided lights either are broken or are missing.

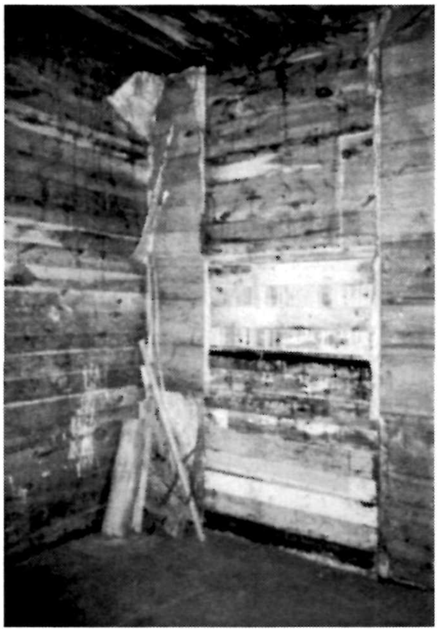

Figure 74 View looking at the southwest corner of the Coal Bin in the Fog Signal Building, 1995.

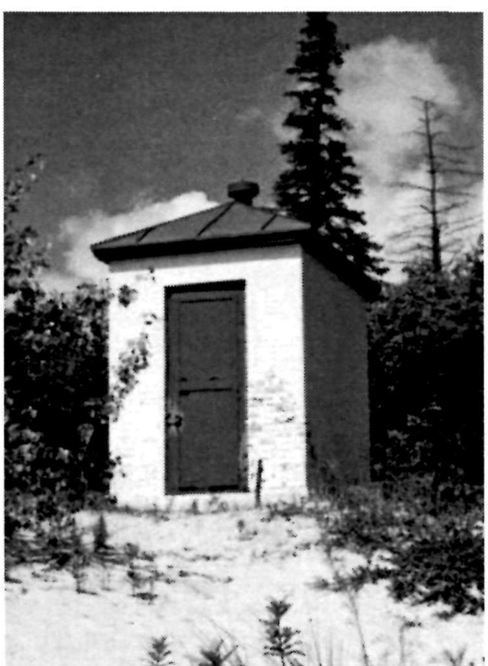

Figure 75 View of the Brick Oil House at South Manitou Island Light Station, 1994.

Work Room

The walls of the west portion of the building, referred to as the Work Room after the connection of the two structures, are covered with 6" wide beaded wood boards. Along the south wall of this room there is a butt joint in the wood finish boards, at the same location as the butt joint at the exterior, which may suggest the former location of a door opening.

Coal Bin

There appears to have been an opening, which extended from the floor to the ceiling, at the west wall of this room and into the machinery room. Physical investigation revealed part of the wall infilled with miscellaneous sized wood boards (Figure 74).

Brick Oil House

Exterior Fabric Analysis

Walls

The exterior brick walls are coated with several layers of the same beige color paint as the exterior brick walls of the Keeper's Dwelling, (Figure 75). In several areas, the paint has either deteriorated and is peeling, or is completely gone, exposing a mixture of underlying paint colors and different brick types. There are at least three types of brick exposed: red, yellow, and yellow iron spot. There are several large areas on each of the four elevations which are covered with parging ranging from 1/4" to 1/2" in thickness, which is crudely scored to resemble brick mortar joints (Figure 76). Physical investigation revealed that most of the parging is deteriorated and falling off of the underlying brick surface. Furthermore, at the east elevation, north of the door, there are signs of deeper deterioration, including spalling brick and missing mortar (Figure 77).

Roof

The metal standing-seam, hipped roof is coated with several layers of red paint. The hipped roof has a standing seam ridge and central vent stack. There is evidence of surface rust at several areas of the roof. In addition, the southeast, northeast, and northwest corners of the cornice are completely rusted through. Small holes in the metal surface were patched by the National Park Service in 1978.

Figure 76 *Detail view of the south corner of the east elevation of the Brick Oil House, 1994. Note the parging, which was tooled to resemble brickwork and is falling off.*

Figure 77 *Detail view of the north end of the east elevation of the Brick Oil House, 1994. Note the spalling brick and deteriorated mortar joints.*

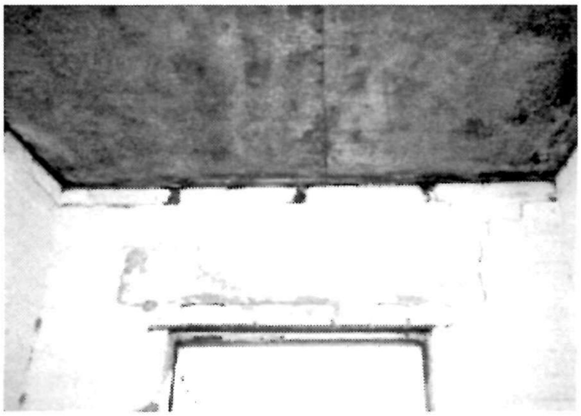

Figure 78 *Detail interior view of the door head and ceiling of the Brick Oil House, 1994.*

Door

The door and door frame are both painted the same red color as the roof, which is contrasts with the adjacent beige brick. The door is 1/8" thick, with 1/4" thick steel battens that have rivet head bolts. The opening has a limestone sill, which protrudes approximately 4" from the wall, and a limestone lintel, which is flush with the wall face. The bottom three courses of brick protrude 1", creating a plinth around the entire perimeter of the building.

Interior Fabric Analysis

The painted concrete floor of the brick oil house is approximately 1" higher than the stone sill at the door, and there is a steel threshold at the door. The interior surface of the brick walls is painted white (Figure 78). The paint has worn off in several areas, exposing the inner brick wythe, which appears to be entirely comprised of yellow iron spot brick. The ceiling is galvanized sheet metal. It is assumed that there is wood framing at the roof above the galvanized ceiling, as is typical for this building type, but it could not be seen without destructive investigation. There are 10 1/4" holes, which form a circle in the ceiling, to provide ventilation in this once highly flammable space.

Metal Oil Storage

Exterior Fabric Analysis

This structure has been moved from its original location at the South Manitou Island Light Station. When it was erected in 1893, it was located 100 feet northeast of the Tower.[5] Apparently it has been moved a

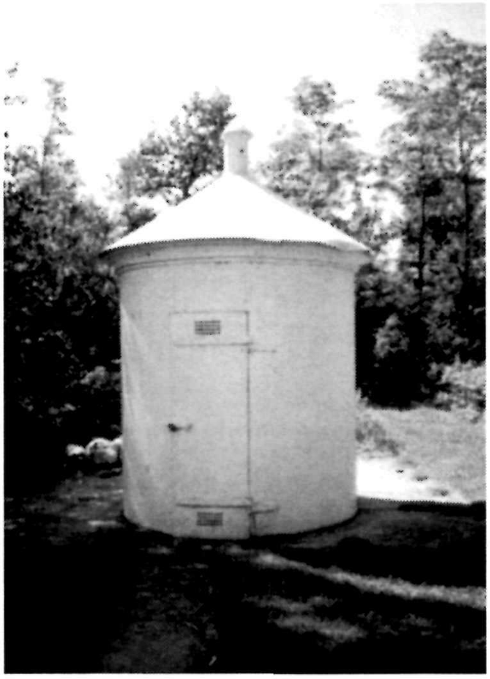

Figure 79 View of the Metal Oil House in its present location at the South Manitou Island Life-Saving Station, 1994.

Figure 80 View of the rusted metal shelving previously located inside the Metal Oil House, 1994.

few times since then. At one point it was "rolled to somewhere in the village and used as a jail."[6] Later it was relocated (date unknown) to behind the historic South Manitou Island U.S. Life Saving Station where currently stands (Figure 79).[7]

The exterior diameter of the metal oil house is 7' - 11". The walls consists of 1/4" steel plates riveted together. The inside diameter of the building is 7' - 10 1/2", indicating that there is a 1/4" air space between the interior and exterior walls. The roof also consists of steel plates riveted together. The roof plates were installed to provide a 7" overhang. However, the structure was relocated by rolling it on its side, which in turn, bent the metal overhang flat against the walls in spots. The ventilation stack at the center of the roof is painted white.

The door is also metal, and has thick steel hinges bolted to its outer face with rivet head bolts. The entire structure has been painted white, and shows only minor signs of rust, such as along the bottom of the door and along the entire threshold.

Interior Fabric Analysis

Although there is currently no physical evidence, historic documentation suggests that the interior walls of the structure were originally lined with brick. Most likely, the brick was removed prior to the relocation of the structure. The curved, steel shelves that once occupied the interior of the building have been removed and sit a few yards from the building itself (Figure 80). The unit has five shelves and is approximately 6' - 10" in total height. The shelves have extensively rusted from continuous, unprotected exposure to the elements. The outside diameter of the shelves is 7' - 10", which is 10 1/2" smaller than the interior diameter of the structure, further suggesting that the interior was once lined with brick.

Both the interior walls and the ceiling of the Metal Oil House have been painted orange. The metal ceiling is supported by seven evenly spaced C-joists radiating from its center. The floor is comprised of unfinished wood planks, which range from 6" to 8" in width, and rest directly on grade. These planks are either severely deteriorated, rotted, or missing from most of the perimeter of the building due to excessive water damage.

Mechanical and Electrical Systems Analysis

Site investigation of the mechanical and electrical systems, and the following preliminary analysis, were undertaken by SWS Engineering, Inc.

Electrical Survey and Comments:

1. It appears that the most recent electrical service was brought to the Light Station from the Fog Signal Building via an underground conduit. This service extended, exposed, to the covered Passageway (First Floor Level). The service terminated at a main switch located in the southeast corner of the Passageway. A panel board was located adjacent to the main switch.

2. There is no doubt that at some time, probably in the forties, the first and second floor and portions of the basement were wired for electricity. Light fixtures, wall switches, and duplex receptacles are located throughout the first floor. None, of course, are active. With one exception (see #3 below), no evidence remains of any other electrical work in the residence.

3. In the basement subcellar there is strong evidence that some form of heavy electrically powered equipment was located in the area at some point in time, as portions of a heavy electrical service still remain.

4. Evidence exists that an electrical branch circuit was installed from the panel board up through the lighthouse itself. Although no evidence remains, this may have been used to power the beacon.

5. None of the present electrical equipment is reusable. Electrical power is stubbed outside just northwest of the Keeper's Dwelling on the lighthouse site. This service may be used to power the anticipated electrical and fire alarm systems for the lighthouse.

6. The underground telephone line to the mainland is the historic cable and is still active to South Manitou Island. The run to North Manitou Island was disconnected when a tanker hoisted its anchor and split the cable between the two islands.

7. There is no security system on the island other than a law enforcement ranger. Due to the remoteness of the site, a security system would be impractical.

8. The electrical power distribution system is served by two diesel generators (1-60 kW and 1-100 kW) located at the maintenance complex. The maximum observed demand load is 40 kW.

Mechanical Survey and Comments

1. There is no evidence that the lighthouse facility ever had any water or sanitary systems.

2. Apparently, the building was originally heated by the fireplaces. There are capped flue outlets in the fireplace walls, which seem to indicate that stoves were installed at a later date to provide heat.

3. In some areas ductwork was installed at the fireplace walls. A viable assumption is that these ducts provided outside air for combustion.

4. Fireplace chimneys and combustion air duct openings could be possibly utilized as a route for a primitive heating system to provide heat during cooler weather. As the island is not occupied during the winter months, there is no need for a total heating system.

5. There is not at present, nor ever was, any form of fire suppression system for the lighthouse.

6. Sanitary systems on the island consist of septic tanks and tile fields. If required, a similar system could be provided for the lighthouse facility.

7. Water mains are installed throughout the southern end of the island. A water main is located in the area of the light station, and could be employed as a source for domestic water. This system does not have the capacity to act as a source for a fire suppression system, however.

8. The Park Service currently has a fire engine on the island, designated for wildfire control rather than the protection of structures. However, the fire protection equipment for both North and South Manitou Islands is presently being reevaluated. The fire equipment plan proposal, still not finalized or approved, will probably call for eliminating the fire truck from the island, replacing it with two ATVs with portable fire suppression pumps.

Historic Paint Analysis

Two series of paint samples were obtained from the light station complex by Steve Seebohm of Seebohm, Ltd. The first series was taken in June of 1995. The second series was taken in Spring 1996. The paint samples were analyzed using a 60X binocular microscope with a 6,500K artificial light source. The colors of each finish layer were matched to the Munsell Color Notation System. Appendix D includes a complete listing of the paint layers discovered, by room and by surface within each room.

The exterior finishes of the complex changed little over the history of the site. The majority of the wall paint campaigns were executed with white or off-white coatings. The entire structure has a contemporary application of whitewash. Detail colors of trim and lantern elements were more difficult to determine, due to the lack of representative samples. However, exterior window and door casing samples were adequate to provide a guide for appropriate trim colors.

The most recent interior finishes all date prior to 1958, and were likely applied during the last occupation of the structure in 1940-41.

Random testing of approximately 20 paint samples identified the presence of lead in both exterior and interior surfaces. As the majority of finishes were applied prior to 1958, it is safe to conclude that the majority of coatings contain lead.

Mortar Analysis

Mortar analysis was performed on 14 samples submitted to Soils and Materials Engineers, Inc. A complete report is included in Appendix E.

Aggregates used in the construction of the Tower, Passageway, and Dwelling were likely from the same source, and are classified as glacial natural crystalline silica, with equal parts of quartz and dolomitic sand. The aggregate size gradation was compared to ASTM C-144. The ASTM C-144 aggregate materials contain course particles which exceed the tested samples. The color varied from a light brown to a dark brown.

The cementitious analysis was performed using both the ASTM C85 Maleic Acid Method and microscopic examination. The mortar mixes common to the 1870s used lime paste and natural cements. Portland cement was imported from Europe prior to U. S. production beginning in 1871, and so approximately 12 states produced natural cement, sometimes referred to as Roman cement. Appendix E contains a table of cementitious material to aggregate ratios found in the analyzed samples.

The mortar samples were observed to be carbonized; that is, the majority of the lime and cement has absorbed carbon dioxide and converted into a dolomitic limestone. The samples had a darker brown color which is more characteristic of a natural cement than Portland cement.

Asbestos Testing

Alderlink and Associates, Inc. tested a bulk sample of shingle from the Fog Signal Building on South Manitou Island in June 1991. The test showed a 40% Chrysotile asbestos content, with the remaining 60% mortar/cement composite.

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1. SLBE maintenance files.
2. Job Order Request; 1980; SLBE maintenance files.
3. SLBE maintenance files.
4. (National Park Service, M/51-120E/JOR May-Sept 1980); SLBE maintenance files.
5. "South Manitou, Mich." (This is the only information on the page. There is no date or reference as to who wrote it or when. It is from SLBE's files. The document lists several dates and lists repairs, etc. that were made to the SMI Light Station.)
6. A quote taken from tape 3 of the oral history videotapes of the SLBE (June 17, 1990). No title.
7. Jill York "South Manitou Island Lighthouse Complex and Life-Saving Station Historical District" (National Register of Historic Places Nomination Form) Item Number 7, Page 2, June 9, 1983.
8. Seebohm Ltd., Letter dated September 19,1995.

Part I:
Design Recommendations

Part I: Design Recommendations

The following recommendations are based on historic research, site investigations, and the stated goals of the National Park Service and Sleeping Bear Dunes National Lakeshore. These recommendations may or may not be implemented, in part or in full, at the discretion of the National Park Service. Changing park functions and goals will affect how these recommendations apply to the South Manitou Island Light Station.

The Secretary of the Interior is responsible for establishing professional standards and providing advice on the preservation and protection of all cultural resources listed on or eligible for the National Register of Historic Places. Accordingly, the Secretary of the Interior lists four distinct, but interrelated, approaches to the treatment of historic properties, as well as standards for each which serve as program guidelines. The four approaches include: Preservation, Rehabilitation, Restoration, and Reconstruction. Choosing the appropriate treatment approach for an individual historic property is critical. As stated by the Secretary of the Interior, "This choice always depends on a variety of factors, including the property's historical significance, physical condition, proposed use, and intended purpose."[1] With respect to the South Manitou Island Light Station, all of these factors, as well as many others, have been examined in order to properly choose the appropriate treatment for the station.

One of the prime objectives of this combined Historic Structure and Cultural Landscape Report is to integrate and mesh these two typically independent analyses into a comprehensive whole. By realizing this particular objective, the most appropriate treatment approach for the entire station can be determined. The entire station comprises the combination and interrelationship of the architectural, cultural, and natural resources of the site.

Treatment Alternatives

Preservation, in a general sense, "focuses on the maintenance and repair of existing historic materials and retention of a property's form as it has evolved over time."[2] More specifically, "preservation," as defined by the *Secretary of the Interior's Standards for the Treatment of Historic Properties*, is the "act or process of applying measures necessary to sustain the **existing** form, integrity, and materials of a 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."[3] Both the landscape and the natural site-related features of the South Manitou Island Light Station have undergone continuous changes throughout their history and, as a matter of the course of nature, will continue to evolve. Because they will continue to change over time, they cannot and should not be "preserved" as they currently exist -- with one exception. Preservation is both appropriate and necessary with respect to the shoreline, which should be stabilized to limit the erosion that poses a threat to the structural integrity of the Fog Signal Building and the Light Tower.

While pure "preservation" of the entire South Manitou Island Light Station is impractical, the National Park Service has stated that one of its goals and intentions with respect to the station is to use it in a new way, yet retain to the extent possible the distinctive materials, features, spaces, and spatial relationships that comprise it. In a November 1995 memo from the Superintendent of Sleeping Bear Dunes National Lakeshore to the Field Director of the Midwest Field Area, the Superintendent states that "The lighthouse will be used only for interpretation which will include the following elements: guided tours to the top of the tower, exhibits of fog signal equipment in the fog signal building, exhibits of lighthouse equipment somewhere on the site and visitor access to the keeper's dwelling."[4] These intentions fall under the first of the Secretary of the Interior's eight "standards for preservation," which states that "a property shall be used as it was historically, or be given a new use that maximizes the retention of distinctive materials, features, spaces, and spatial relationships."[5]

Restoration is generally understood as the depiction of a property at a particular period of time in its history, and includes the removal of evidence of other periods.[6] More specifically, it is defined in the *Secretary of the Interior's Standards for the Treatment of Historic Properties* 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."[7] At the South Manitou Island Light Station, there is insufficient evidence and few artifacts from any one particular period in the history of the station for "restoration" to be a viable option. Further, because of this lack of evidence and artifacts, the station's period of significance is currently understood by the National Park Service as the entire continuum of the station's history. New features, elements, and technological advances all contributed to, and continually affected, the character and appearance of the station over time.

Reconstruction generally involves the recreation of "vanished or non-surviving portions of a property for interpretive purposes."[8] More specifically, it is defined in the *Secretary of the Interior's Standards for the Treatment of Historic Properties* 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."[9] Again the problem is insufficient documentation, and few artifacts, to be able to replicate the appearance of the South Manitou Island Light Station at a specific period of time. Number four of the Secretary of the Interior's "standards for reconstruction" states that "Reconstruction shall be based on the accurate duplication of historic features and elements substantiated by documentary or physical evidence rather than on conjectural designs or the availability of different features from other historic properties."[10] Further, a significant portion of the architecture and several historic features are still intact and, even though some elements are in need of repair, they do not need to be reconstructed. While pure "reconstruction" is not an option for the entire station, limited reconstruction is. Limited reconstruction of specific elements would enhance those elements which already exist, and aide in the successful interpretation of the site.

The historic privy, of which there is evidence as to location, might be reconstructed with the intention of creating a functional artifact for staff and visitors. However, this can only be accomplished if further documentation of the materials and visual appearance of the privy is discovered. Current documentation is insufficient. If the privy is rebuilt, it should be handicapped accessible, assuming the back of the lighthouse structure is also made accessible.

Rehabilitation, generally speaking, "acknowledges the need to alter or add to a historic property to meet continuing or changing uses while retaining the property's historic character."[11] More specifically, it is defined in the Secretary of the Interior's *Standards for the Treatment of Historic Properties*, 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."[12] Further, the Secretary of the Interior states that it is appropriate to use rehabilitation as a treatment approach "when repair and replacement of deteriorated features are necessary; when alterations or additions to the property are planned for a new or continued use; and when its depiction at a particular period of time is not appropriate, rehabilitation may be considered as a treatment."[13] Given these definitions and guidelines, "rehabilitation" as a treatment approach best fits the National Park Service's objectives for the future treatment of the South Manitou Island Light Station. Further, a memo to the Field Director of the Midwest Field Area in November 1995 from the Superintendent of Sleeping Bear Dunes states, with respect to the South Manitou Island Light Station, says that "limited replacement of lost or deteriorated parts is permissible as is adding new elements required for safety and accessibility."[14] It is the intention of the National Park Service to incorporate life-safety and barrier-free elements into the treatment approach for the site. With this understanding, rehabilitation is the only approach that may be taken at the site. This does not mean, however, that the other three approaches would not be used at the site - on the contrary.

The Secretary of the Interior's definition of "rehabilitation" encompasses many aspects of the terms preservation, restoration, and reconstruction. For example, number two of the Secretary's "standards for rehabilitation" states that "The historic character of a property shall be retained and preserved. The removal of distinctive materials or alteration of features, spaces, and spatial relationships that characterize a property shall be avoided," while number six of the "standards for rehabilitation" states that "Deteriorated historic features shall be repaired rather than replaced...," and number one states that "A property shall be used as it was historically or be given a new use that requires minimal change to its distinctive materials, features, spaces, and spatial relationships."[15] Clearly, many of the standards for rehabilitation are virtually identical to the standards for preservation, thereby making preservation an important aspect to any rehabilitation approach taken. So, too, are the restoration and reconstruction approaches. For example, number six of the Secretary of the Interior's "standards for rehabilitation" goes on to say that "Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and, where possible, materials," and number nine states that "New additions, exterior alterations, or related new construction shall not destroy historic materials, features, and spatial relationships that characterize the property."[16]

It is important to understand yet another term that is often used with respect to the treatment of historic properties, but which is not listed as a treatment approach in *The Secretary of the Interior's Standards for the Treatment of Historic Properties.* This term is "adaptive reuse." Adaptive reuse, like preservation, restoration, and reconstruction, also fits under the rehabilitation umbrella, but will not be considered in the design recommendations and treatment of the South Manitou Island Light Station. This is because adaptive reuse is essentially the "process of converting a building to a use other than that for which it was designed. This is accomplished with varying alterations to the building."[17] At South Manitou, very few alterations and additions will be undertaken, with the exception of barrier-free accessibility and life-safety elements. Otherwise, the structures will be repaired, restored and preserved, but not converted to another use altogether. The Keeper's Dwelling, for instance, will not be used as a residence for National Park Service personnel or any others, but will be interpreted and viewed as such for visitors.

Because "rehabilitation" encompasses preservation, restoration, and reconstruction, and meets the National Park Service's objectives for the future treatment of the South Manitou Island Light Station, it is the recommendation of this report that "rehabilitation" serve as the treatment approach and basis for the recommendations that follow.

The Cultural Landscape

Treatment Strategy

Landscape rehabilitation will allow the site as a whole to represent its entire period of operation, while individual features continue to portray the various periods and aspects of the station's life that they represent. Landscape rehabilitation is defined in the *Guidelines for the Treatment of Historic Landscapes, 1996* as a process that "retains the landscape as it has evolved historically by maintaining and repairing historic features, while allowing additions and alterations for contemporary and future uses."[18] *Cultural Resource Management Guideline, NPS-28* states, "Rehabilitation improves the quality or function of a cultural landscape, through repair or alteration, to make possible an efficient contemporary use while preserving those portions or features that are important in defining its significance."[19] All proposed recommendations should be implemented in accordance with the most recent *Cultural Resource Management Guideline, NPS-28,* and the most recent *Guidelines for the Treatment of Historic Landscapes.*

Design Recommendations and Alternatives

The preliminary landscape design recommendations and alternatives are based on the following rehabilitation treatment concepts:

- interpretive use of an interrelated complex of utilitarian light station buildings and structures from throughout the period of operation,
- recovery and repair of the historic concrete walkway system,
- modification of portions of both the existing contemporary and historic concrete walkway system to meet contemporary visitor needs for universal accessibility,
- consideration of the use of fencing to aid in controlling the effects of windblown sand, and to interpret the historic character of site,
- development of a vegetative management policy that includes removal of vegetation that is potentially damaging to architectural site features, or that is inconsistent with the visual character of the site during its period of operation,
- on-site preservation of remnant equipment and,
- shoreline stabilization to protect cultural resources associated with the light station.

Treatment Recommendations

Treatment recommendations have been developed by taking into account the condition and degree of integrity present within the station as a whole and for individual features and characteristics. Recommendations have been developed for the following categories of resources and concerns:

Relative to Structures

- Preserve and stabilize the privy foundation. If sufficient documentation can be produced, consider reconstructing the privy to its historic exterior appearance. Design the interior of the reconstructed privy to provide accessible, functional, toilet facilities for light station visitors. If historic documentation is insufficient and an operational privy is desired on site, construct a new facility adjacent to the extant foundation. (See also Recommended Architectural Treatments)
- Retain all existing buildings and structures to preserve the historic feeling of a complex of interrelated light station resources.
- Relocate the Metal Oil House from its present location at the former Coast Guard station to its historic location west of the Fog Signal Building. Its relocation will require the removal of three junipers which now occupy the historic building site.
- Avoid new construction within the area of historic light station development, and within the areas visible from Lake Michigan. Also avoid new construction, other than shoreline stabilization, that would be visible from the Tower.
- Consider using vacant interior space in existing buildings and structures, where appropriate, for necessary utilities and mechanical systems.
- Acknowledge when developing fire protection strategies for the light station that structure fire suppression is currently beyond the training and capabilities of park staff that are posted on South Manitou Island. However, the fire protection equipment for the islands is presently being reevaluated. In implementing any revised, approved fire equipment plan for the light station precinct, continue to emphasize vegetative fire suppression and exposure control to protect historic structures in the event of fires originating in the landscape. Seek opportunities, as funding permits, to improve fire protection of buildings through the use of new equipment and technologies and additional staff training.

Walkways and Other Circulation

- Retain the existing and historic pedestrian character of the station.
- Avoid developing vehicular access to the site. When developing fire protection strategies for the light station, consider the limited use of all-terrain vehicles that can provide off-the-road mobility without severe landscape damage.
- Rely as much as possible on small-scale or portable fire protection equipment rather than vehicle-mounted equipment to serve the light station. Adequate vegetative fire suppression appears capable of being provided by the 300'–400' range of the current backpack-style Mark II pumps which rely directly on Lake Michigan for their source of water. The fire protection equipment for the island is currently being reevaluated. Any new plan will probably eliminate the fire truck, replacing it with two ATVs with portable fire pumps.
- Continue to provide a boardwalk connection between the light station and the former Coast Guard station.
- Adapt the current boardwalk connection between the light station and the former Coast Guard station as a handicapped accessible route by adding 3' to the width of the current boardwalk. The boardwalk, dating from 1993, consists of 2 x 12s laid end-to-end. The additional 3' should be constructed of similar materials oriented the same way as the existing walk. To distinguish the boardwalk addition from the portion that represents the historic walkway width, locate the joints between the new boards at the halfway point between the joints of the existing walk.
- Consider providing as an alternative route to the light station an accessible path from the former Coast Guard station to the rear (west) elevation of the Keeper's Dwelling, recreating the historic weather station trail.
- Repair and/or reconstruct the concrete walkway in kind to a width of 5' from the terminus of the boardwalk extending from the former Coast Guard station to the Fog Signal Building, and from the Fog Signal Building to the Light Tower.
- Install additional riprap similar to the existing stones adjacent to the walkway at the front of the Light Tower to retard erosion, particularly in light of the recommended removal of the adjacent cottonwood trees. (See Vegetation recommendations, below.)
- Continue the use of the existing concrete walkway system within the light station site. Retain the existing walkway proportions except as noted above.

- Repair or replace in-kind damaged or missing portions of the concrete walkway system.
- Retain and repair, where necessary, the extant brick edging along portions of the concrete walkway system.
- Rehabilitate the walkway from the Keeper's Dwelling to the Privy, making sure to comply with appropriate accessibility requirements.
- Reconstruct the concrete apron in front of the Fog Signal Building to serve as an efficient junction between the concrete walkway and boardwalk systems. Extend the apron to the limit of the present seawall to increase pedestrian access to the waterfront and provide universal accessibility. In so doing, however, protect and preserve the surfboat launch ramp, a maritime archeological site, which extends into the lake from the seawall in front of the Fog Signal Building.
- Rebuild the existing boardwalks west of the Fog Signal Building.
- Continue to use volunteer labor on a periodic basis to uncover and keep clear portions of the extant concrete walkway system obscured by windblown sand. Work with the natural resources staff to ensure that sensitive plants are not damaged or buried as sand is removed from walkways and redeposited back into the dune habitat. Coordinate walkway reclamation efforts with the introduction of additional, native ground cover adjacent to portions of the walkway system susceptible to the accumulation of windblown sand. Such plantings should minimize over time the need for extensive sand removal efforts.
- Coordinate all work on boardwalks and concrete walkways with site drainage requirements.
- Consider reconstruction of historic wood fences in conjunction with the preservation and restoration of the historic circulation system as a means of controlling windblown sand on the walks (see Fencing recommendations, below).
- Explore the feasibility of providing access to the former garden and barn sites via the Giant Cedars Trail.

Vegetation

- Remove any vegetation that endangers or potentially endangers the site's architectural and archeological resources or walkway systems, or that pose a threat to human safety.
- In developing and implementing vegetative management plans, acknowledge the sparse approach to vegetation that characterized this utilitarian site during its period of operation.
- Avoid additional planting unless necessary for site stabilization.
- Explore the use of native ground cover and low shrubs adjacent to walkways, where there is no existing vegetation, to help reduce the effects of windblown sand.
- Retain existing vestiges of ornamental and fruit-bearing species as evidence of the domestic landscape. Consider replacing them in-kind as existing species become damaged or diseased, but do not consider replacement essential. No preservation of genetic plant material is necessary; the existing vegetation does not have significant historical associations.
- Remove major coniferous vegetation within the light station's core.
- Remove all deciduous trees within the light station's core, with the exception of the cottonwood trees between the Tower and the Fog Signal Building. This vegetation is consistent in character with that documented during the period of operation.
- Remove all trees from the former garden, privy, and barn locations. Keep these areas free of trees in the future so that they have interpretive potential, and are clearly identifiable as part of the historic light station. Continue to allow native ground cover and low shrubs to grow in these areas.
- Continue to permit a natural forestal succession outside the historic light station core and the former garden, privy, and barn locations. Strive to achieve a gradual transition between these areas and the cleared area of the core. Avoid a "hard-line" vegetative edge.
- Continue to allow native ground cover and low shrubs to grow within the light station's core.
- Control the growth and spread of poison ivy within the light station core as it is inconsistent with the intensive use of the site during its period of operation, and because it interferes with the contemporary visitors' use of the site.

- Keep vegetation from encroaching on walks but avoid an over-maintained appearance inconsistent with that of the historic period.

Fencing

- Continue historical investigations concerning the history of fencing in the historic core of the light station. Fence types appear to have changed slightly in design throughout the late nineteenth and early twentieth centuries. Before considering the potential for fence reconstruction, it is important to identify prototypes for which there is sufficient documentation to avoid conjecture.
- Consider reconstruction of historic wood fences in conjunction with the preservation and restoration of the historic circulation system as a means of controlling windblown sand on the walks. During at least two periods of its operation (circa 1910–1928, circa 1938–early 1940s), the light station had broad picket fences, which would appear to be more successful than a narrow picket design in controlling windblown sand. The most recent and best documented of these fences is shown in a August 1938 photograph (Part D, Figure 18), which may be used as a source in developing a reconstructed fence prototype. Reference should also be made to a 1973, rough sketch of fencing at the light station by Glen Furst (Appendix F).
- As an alternative to fence reconstruction, develop appropriate materials that interpret the appearance, function and character of fencing at the light station throughout its history.
- Avoid fence reconstruction in other areas of the site for which there is no known historical documentation.

Site furnishings and small-scale features

- Replace, in-kind, the flagpole in its historic location. Fly a current U.S. flag during daylight hours and appropriate weather conditions. If the flag is to be flown around the clock, it must be properly lighted.
- Retain and stabilize, as needed, all remnant foundations from non-extant structures and the few remaining examples of remnant equipment: the several drum stands, the hand water pump, cistern inlets, and the fog signal well. Consider reinstalling in the existing stands oil drums that predate 1958 or that approximate their appearance to make the stands' functions more apparent to visitors. Interpret these remnant cultural landscape features.
- Keep site furnishings to a minimum. Continue to provide a limited number of rustic picnic tables as needed seasonally as temporary site furnishings for visitor use.
- Locate a bench and trash receptacle at each end of the boardwalk between the former Coast Guard station and the light station.

Interpretation

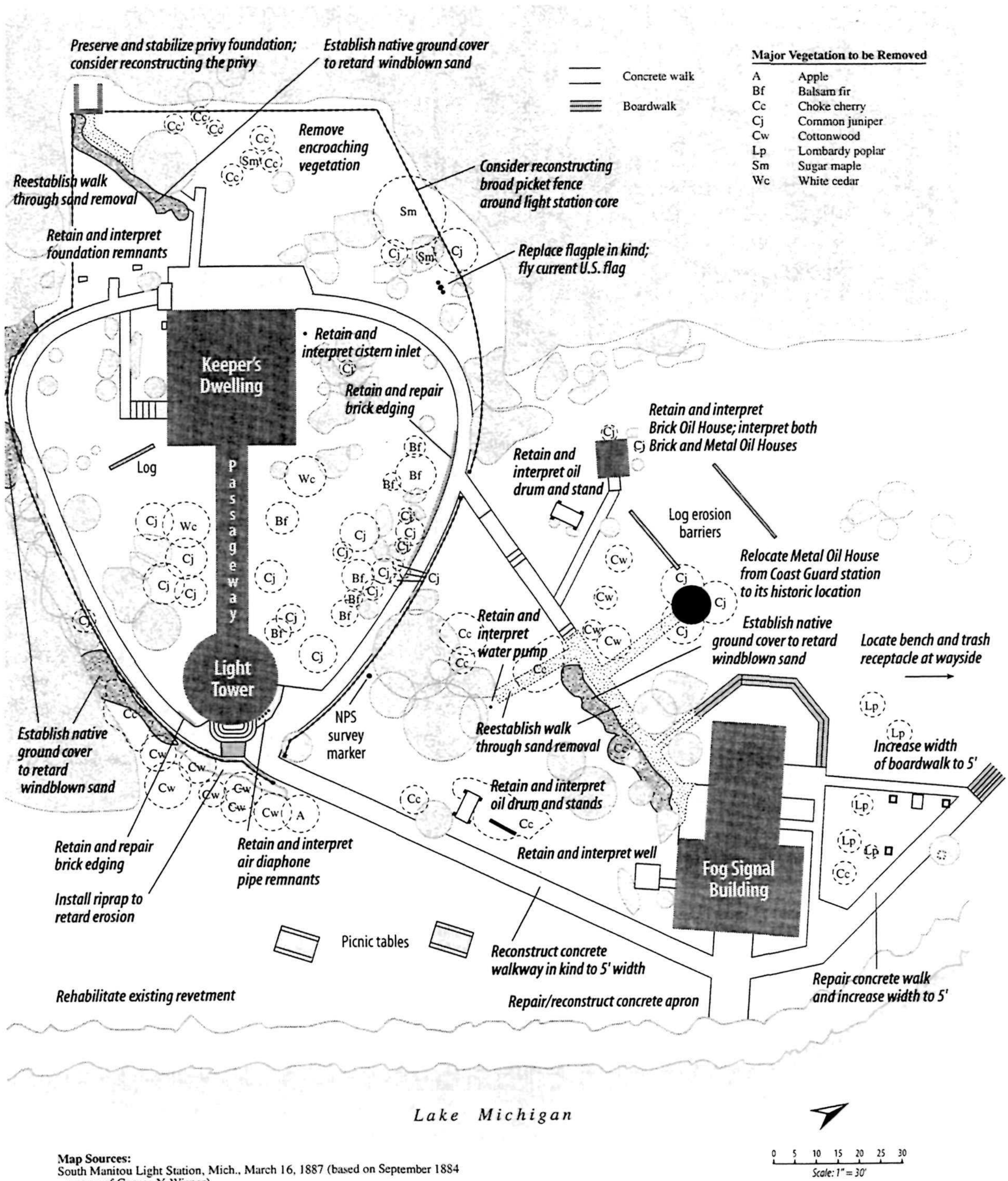
- Avoid a preservation treatment policy intended to evoke any one particular period within the overall period of operation. Retain and interpret a landscape that reflects the station as it has evolved over time.
- Use cultural landscape information in site interpretation; include the site's recent history, preservation efforts, and sustainable practices.
- Use historic photographs, site plans, maps, and oral histories to enhance landscape interpretation.
- Avoid reconstruction or restoration intended solely to interpret specific events or historic periods. Reconstruct landscape features only if based on documentary and archeological evidence.
- Coordinate the implementation of all treatment recommendations of this Historic Structure Report and Cultural Landscape Report with the final approved Interpretive Plan for the light station.

Signs and Waysides

- Continue a minimal approach to signage to maintain the current uncluttered appearance of the station, using signs only where essential.
- In conjunction with the boardwalk system, develop two interpretive waysides that interpret the station's cultural landscape.
- Locate the first wayside midway between the former Coast Guard station and the light station where the existing boardwalk turns to the south. This wayside will provide an introduction to the light station site for all visitors, whether they visit the light station site or not. Incorporate an appropriate historic photograph of the station into the wayside interpretation. The 1883 (SLBE #1106), circa 1884 (SLBE #1222), or the circa late 1800s photograph from the Glen Furst collection would

Exhibit 11

(Not to scale, see Appendix F)



Map Sources:
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
South Manitou Is. L. S., South Manitou, Mich., Plot Plan, June 27, 1944.
South Manitou Is. L. S., South Manitou, Mich., Revised Plot Plan, May 10, 1965.
U. S. Lighthouse Reservation, Historic American Buildings Survey, 1988.
Fieldwork conducted by Land and Community Associates, June 1995, June 1997.

Drawing prepared by Land and Community Associates, 1998. Revised January 1999.

Exhibit 11
SOUTH MANITOU ISLAND LIGHT STATION
Landscape Design Recommendations

be appropriate. Interpret the sandy knoll as the light station's site; also interpret the site's relationship to Manitou Passage, the historical connection and the interrelationship between the Coast Guard and light stations, and the closure of both stations.

- Continue to use the current wayside location north of the fog signal building. 1) Develop a new interpretive focus related to both the historic light station complex and historic and current efforts related to shoreline stabilization. 2) Develop a new wayside that concentrates on the development of the light station core as an interrelated complex of buildings and structures related to the efficient operation of a light station during the late nineteenth and early twentieth centuries. Incorporate the 1933 photograph (SLBE #1238) into the wayside.

Shoreline Stabilization

To preserve and protect the cultural landscape, as well as the historical structures, an engineered stabilization and protection system is required along the reach of the shoreline adjacent to the Light Station site. The following four alternatives could be considered solutions for accomplishing stabilization and protection requirements:

Alternative 1: Jetty Construction - Jetties, or groins built perpendicular to the shoreline, coupled with rehabilitation of the existing revetment, would redirect the littoral movement, and stabilize the shoreline. This alternative requires structures to be built such that settlement and undermining would not occur. This typically requires driving sheeting to a clay or rock material, usually with a crib cross section which is filled with granular material. This is a very costly solution, and usually is used only when the structure can be used for other needs such as boat docking and/or access requirements. (See Figure 1)

Alternative 2: Offshore Breakwater - An offshore rubblemound breakwater structure, built to the north and east of the shoreline would create a harbor adjacent to the lighthouse site, allowing the sand moving along the shore to fill in adjacent to the structure, and eventually bypass the site a safe distance away from the shoreline. This structure would also protect the existing shoreline by dissipating wave energy before reaching the existing revetment. The amount of storm protection would depend on the placement and extent of the rubblemound structure. This alternative would also require additional work along the existing revetment, to ensure stabilization of the shoreline. (See Figure 2)

Alternative 3: Reconstruction of Revetment - The existing revetment could be removed, and a new properly engineered revetment built in its place taking into account the toe, crest and stone criteria discussed in Part C. The material existing at the shoreline could be reused; however, the need to double handle and temporarily stockpile the stone typically drives the costs upward significantly. (See Figure 3)

Alternative 4: Rehabilitation of Existing Revetment - Using the existing revetment as a core, the voids within the existing stone structure could be filled with smaller material, and a core established which would allow the addition of a filter layer and a primary armor layer of stone. The criteria discussed in Part C could be accommodated by modifying the existing revetment more economically than a complete removal and replacement of the structure. Proper crest elevations and widths could be provided without the expense of building a core, and stone sizes could be utilized that would accommodate proper filtration of the revetment. (See Figure 4)

Alternative 4 is the recommended approach to shoreline stabilization as it utilizes the existing revetment along the shoreline thus requiring a minimum amount of material removal and dredging. It also results in the least disturbance to the shoreline and site.

This recommendation for stabilization will require dredging along the existing toe of the revetment to allow placement of a geotextile fabric for filtering and support. An approximately one-foot-thick layer of aggregate bedding material will have to be placed on the fabric filter placement. A secondary armor (filter) stone will then be placed on top of the bedding to approximately two to three feet in thickness. A select, large armor stone will have to be placed at the outward edge of the revetment, to anchor the toe and set the boundary of the new structure. The bedding material will also have to be placed into the openings of the existing stone structure, to fill the voids and create a core for the placement of the remaining stone layers. The secondary armor, or filter stone will have to be placed in a layer along the core to the crest of the existing revetment. A single layer of armor stone will then have to be placed on the filter stone, from the toe stone to the outer edge of the crest.

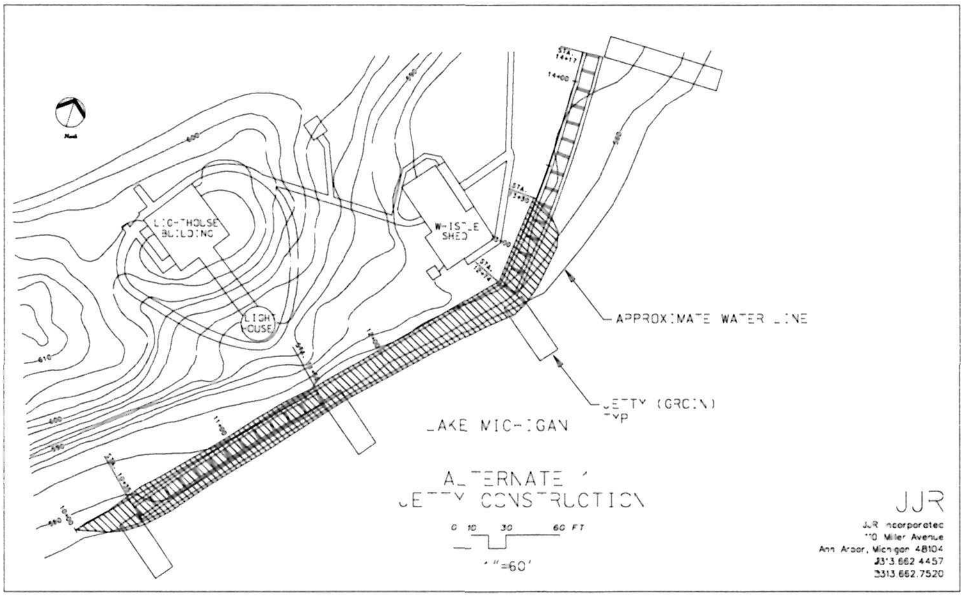


Figure 1

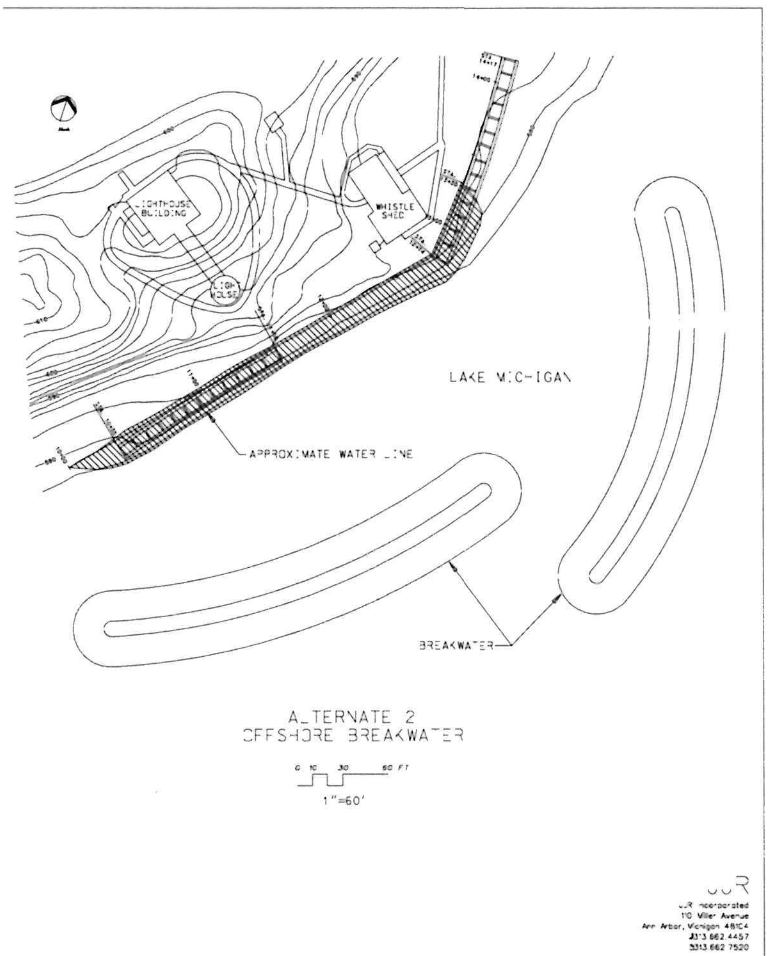


Figure 2

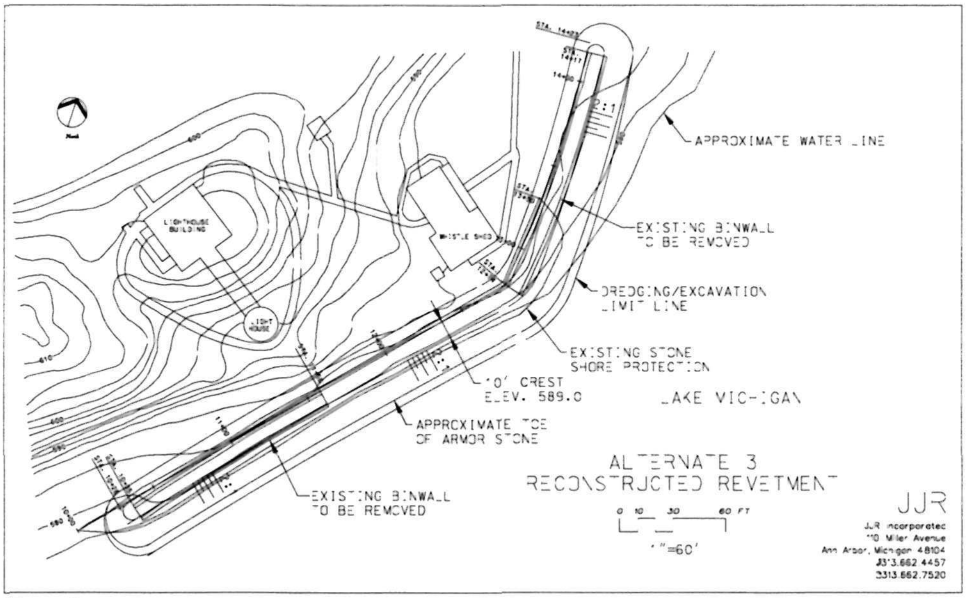


Figure 3

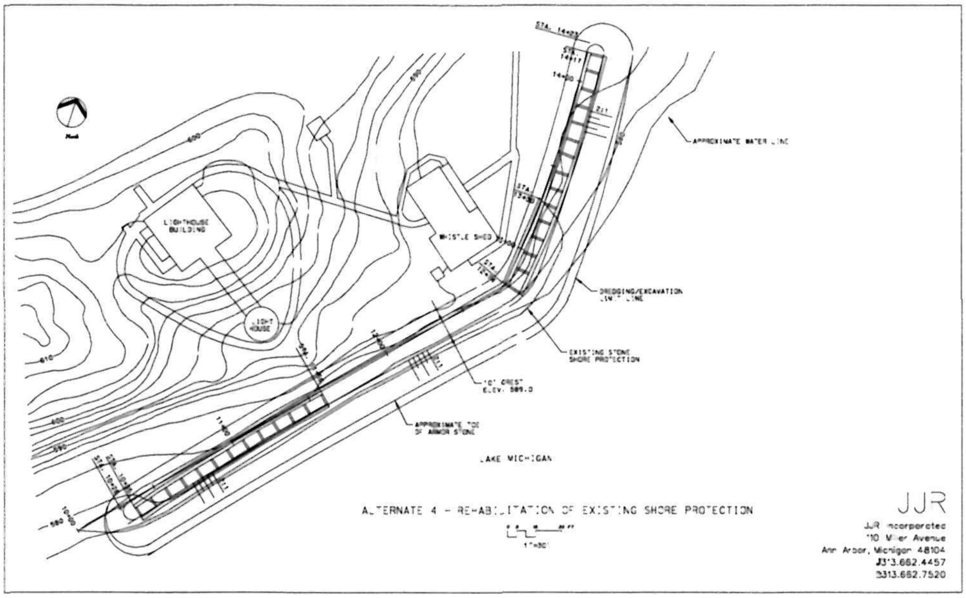


Figure 4

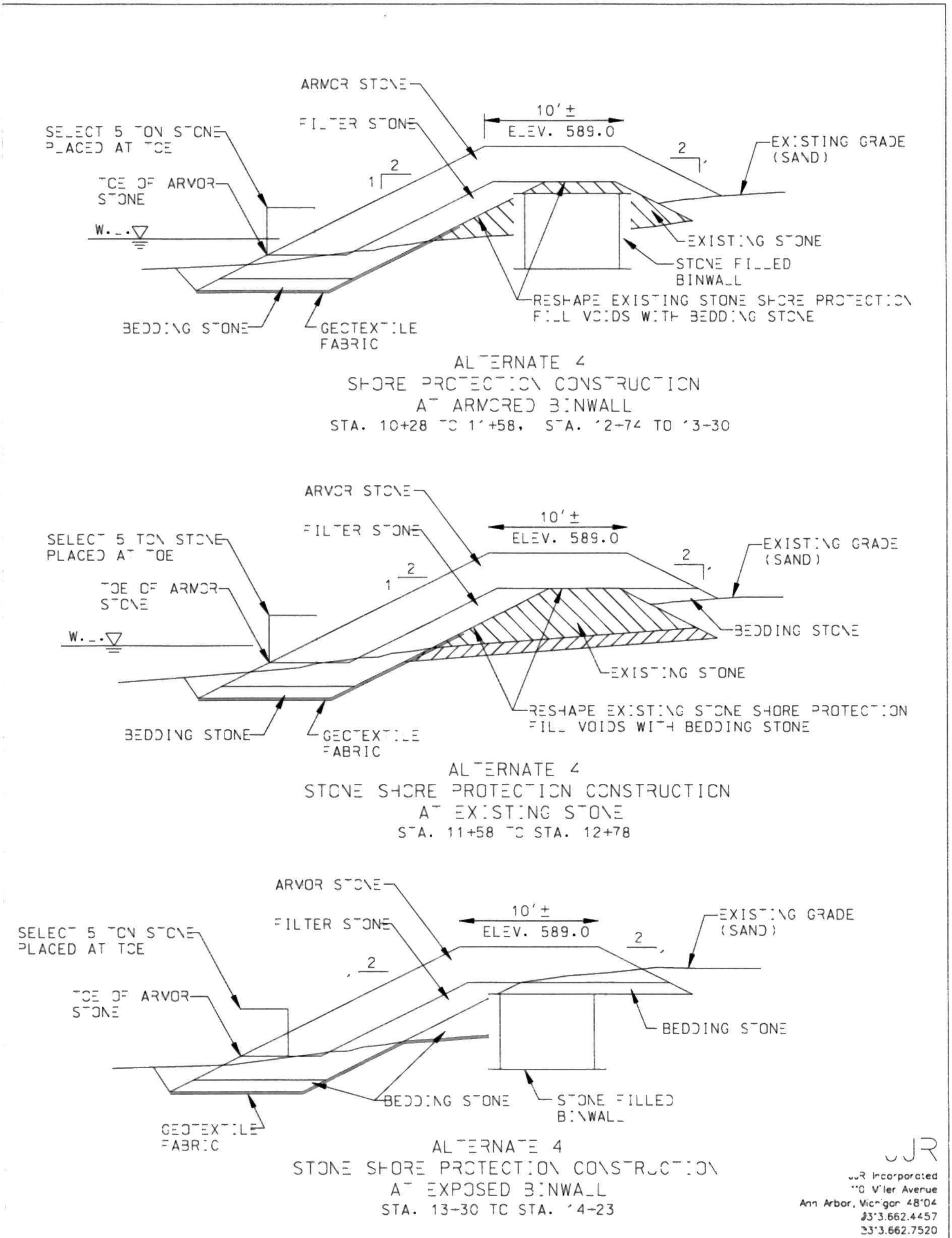


Figure 5: Preliminary cross-section recommendations for shoreline stabilization.

Technical criteria will need to be developed through engineering studies and testing to determine the engineering details of the revetment rehabilitation. Crest height and widths, stone sizes, layer thickness and layering details will all have to be developed through a coastal and hydraulic analysis of this reach of the shoreline along the Island. The following preliminary details are based on the limited assessment performed to date, and are based on other existing stabilization structures along the Lake Michigan Coast.

Crest Height	589 USGS
Crest Width	10 to 15 feet
Bedding Stone Size	2 inch to 8 inch stone
Filter Stone Size	800 pound to 1200 pound stone
Armor Stone Size	2 ton to 5 ton stone

These criteria must be verified through detailed engineering analysis, and should be considered preliminary. Refer to Figure 5 for preliminary cross-section recommendations.

Architectural Features: General Approach

It is recommended that all of the structures be rehabilitated to serve in an interpretive capacity as interrelated elements of the historic light station. New construction should be kept to a minimum, limited to only that which is required to provide barrier-free accessibility and to ensure the health and welfare of the station's future visitors. Where alterations and/or additions are required, they should be undertaken according to the Secretary of the Interior's Standards for Rehabilitation, which states that, "Contemporary design for alterations and additions to existing properties shall not be discouraged when such alterations do not destroy significant historical, architectural or cultural material, and such design is compatible with the size, scale, color, material, and character of the property.."[20]

Furthermore, steps should be taken to maintain all historic elements of the station. Rehabilitation of the structures at the South Manitou Island Light Station will not focus on a particular time period within the station's history, but rather on the importance of the overall evolution of the property. Again, in accordance with the Secretary of the Interior's Standards for Rehabilitation,, "Changes to a property that have acquired historic significance in their own right shall be retained and preserved."[21]

Some on-site determination as to the feasibility of either maintaining and restoring the existing fabric, or replacing it with new in-kind, will likely be required at the time treatment takes place, particularly at severe areas of damage and deterioration. It is suggested that, in cases where it is not feasible to remove the historic fabric without destroying it altogether, and it does not present a safety or structural hazard and/or physically disturb those individuals occupying the structure, the integrity of the material should be maintained.

As much as possible, deteriorated historic features should be repaired rather than replaced. However, as stated by the Secretary of the Interior's Standards for the Preservation of Historic Properties, "Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and, where possible, materials. Replacement of missing features shall be substantiated by documentary and physical evidence."[22]

Based on this standard, all the extant material will be repaired, restored, and refinished, both at the interior and exterior of the structures. Where restoration of particular elements is not practical, reconstruction of those elements may be warranted.

Paint Recommendations

The paint analysis by Seebohm Ltd. provides an opportunity to distinguish between the last period of occupation and the last period of active use at the site. Analysis of interiors finishes shows that the last paint campaign, circa 1940-41, represents the last inhabitants of the Keeper's Dwelling. This and earlier interior paint campaigns may be incorporated on a room-by-room basis in accordance with the interpretive goals of the park. The paint suggests the potential to restore individual rooms of the quarters to various significant periods for didactic purposes.

The current exterior colors date to the last period of use, circa 1958. As the exterior paint colors changed little over time, it is recommended that all new exterior finish colors should match the documented samples from this last campaign.

A memorandum from Merline D. Schlange to the Building and Utilities Foreman of Sleeping Bear Dunes National Lakeshore, dated June 23, 1978, discusses paint colors approved by Randy Biallas, Historic Architect, MWR for use at the South Manitou Light Station. These color recommendations are consistent with the later campaigns analyzed by Seebohm. Biallas also recommends a formula for whitewash, to be used on the Passageway and Light Tower exterior:

> Dissolve 15 pounds of common salt in 7-1/2 gallons of water. To this solution add 50 pounds (1 bag) of hydrated lime. Mix thoroughly until a thick paste is formed. Thin to desired consistency with fresh water.[23]

This formula, however, was found to be unsatisfactory in practice, as it required frequent renewal. The most recent "whitewash" formula used by the park included modern paint admixtures such as "Liquitex" brand binders and lime. This mixture has performed well and its use should be continued.

As the presence of lead paint has been confirmed, an appropriate lead abatement program must be developed prior to any restoration work. Such a program is beyond the scope of this report. All paint preparation or removal work must be conducted within these guidelines.

Mortar Recommendations

For restoration work, the use of natural cement is impractical due to its unavailability. A repair mortar which uses a mix consisting of 1 part Portland cement, 1-1/2 parts hydrated lime, and 6 parts sand aggregate is recommended. In reproducing the original aggregate, Soils and Materials Engineering recommends using a natural masonry sand produced from local sources near Lake Michigan, which has been sieved to remove substantially all particles greater than a No. 16 sieve.

Previous mortar repairs have apparently used a formula recommended by Randy Biallas, in the same memo discussed above:

> "1 part white cement, ASTM C-91; 1 part hydrated lime, ASTM C-207, type S; and 6 parts sand (clean beach sand OK)"[24]

As with the historic whitewash formula described above, the performance of this mortar formula in existing repairs should be evaluated before it is used further.

Structural Summary and Recommendations

The general condition of the light station (Keeper's Dwelling, Passageway, and Tower) is fair, however, there are many cosmetic items that will require attention in order to prevent progressive distress and deterioration. The structure is not used, and is not thermally stabilized, year around. This will lead to continuing problems (mostly cosmetic) that will need to be tended to on a regular basis. Many of the cosmetic items will lead to more serious structural concerns if left unrepaired.

For example, because the buildings are not heated or ventilated, moisture will buildup inside the buildings. This moisture will lead to wood rot, deterioration of the plaster, and surface spalling of masonry. Interior moisture will migrate to the exterior during the dry winter season. Moisture within the brick will then be subject to freeze expansion, which can result in surface spalling of the brick. Any non-breathable paint coating further aggravates this problem. In addition, if the foundation repairs described below are not completed, water can penetrate further into the foundations, causing further deterioration of the mortar and stone due to freeze-thaw action.

When these repairs may need to be repeated depends upon the weather. The greater number of freeze-thaw cycles in a year, the more likely maintenance will be needed on the buildings. Annual inspections of the buildings should be done to monitor any changes, and repairs done as the need arises. Below is a summary of these cosmetic items, the primary structural concerns, and preliminary treatment recommendations for each building.

Tower

- There is no indication of piling problems at this time. Expensive reliable testing should be delayed until there are indications of differential settlement.
- Foundation repointing is needed.
- Interior plaster work should be repaired.

Tower Stairs

- Previous movements are not progressing, but this item should be regularly monitored.

- Some landing brackets at the masonry walls appear to be broken or missing. Close inspection of each bracket location is needed. Repair or replacement of any missing or broken brackets should be done as soon as possible.

Passageway

- The structure is generally in fair shape. Masonry spalls and cracks need to be repaired.
- Floor live load capacity exceeds the minimum 100 psf.
- Roof capacity is adequate.

Keeper's Dwelling

Walls & Exterior Stairs

- Repair of foundation distress, surface spalls, and cracks is needed.
- Some window sills may need to be replaced.
- The south keystone crack above the door needs to be repaired.
- The south side stairs should be replaced.
- There was some wood rot observed in the window sills and jambs in the basement which will need to be replaced.

Roof & Attic

- The structural elements appear to be in reasonable condition.
- The rafters at the chimney should be headered.
- Additional superimposed loads should not be placed on the attic level.

1st and 2nd Floors

- The second floor live load capacity ranges between 30 and 100 psf, depending on the location. The lower load levels can be increased to acceptable levels for public access in an unobtrusive manner since the plaster ceilings will need to be replaced. This will also provide access to the floor joists.
- The first floor live load capacity ranges from 50 to 100 psf. The lower floor load can be increased by the addition of a short shoring beam and posts in the basement.

Fog Signal Building

- The roof structure is in reasonable condition, however, much of the superstructure was not accessible to direct survey. There may be some hidden wood rot, although the roof lines and planes appear straight and true.
- Wood sill plates or beams show extensive rot where they are exposed.
- Foundations are cracked, and require repair or replacement in the east half of the structure.
- The foundations are not continuous in the west half of the structure.
- Proper foundations and floors should be designed and constructed for the west half of this structure.
- Access to hidden structural areas should be provided to determine the extent of any deterioration.

Recommended Architectural Treatments

Keeper's Dwelling

Based on the information obtained from historic documents and photographic research, as well as from physical investigation, the following treatments are proposed for the rehabilitation of the Keeper's Dwelling, including the restoration of extant elements and the reconstruction of missing elements (where appropriate). The Keeper's Dwelling, in addition to the other extant structures at the station, will serve as an interpretative element in telling the history of the interrelated structures that comprise the South Manitou Island Light Station, and the related history of the United States Lighthouse Service as a whole.

Exterior Finish Treatment Recommendations

Roof:

- Repair and/or replace damaged areas of the roof; mainly at the intersections (walls, chimneys).
- Replace deteriorated areas of flashing at the chimney.
- Install a new drainage system, including the installation of downspouts and gutters in their historic locations. The gutters should be replaced in kind. The galvanized gutters currently being stored in the basement match the originals in metal content, and should be installed.

Exterior Brick Surfaces:

- All deteriorated parging should be removed from the exterior brick surfaces. Spalled and deteriorated brick should then be repaired and joints tuckpointed as required. Further analysis will be undertaken to determine if new scored parging should be applied to provide a historic appearance. Finish should then be applied according to the paint analysis.

Exterior Stone Surfaces:

- All deteriorated parging should be removed from the exterior stone surfaces. Following removal, tuckpointing and other repairs should be undertaken. New parging to match the historic appearance, and consistency should then be applied. All of the exterior stone surfaces should be whitewashed in accordance with the paint analysis.

Windows:

- Physical investigation revealed that the sashes of the Keeper's Dwelling were in relatively good condition (based on their recent reconditioning by the National Park Service). Minor repairs and finishing should be undertaken as required.
- All deteriorated wood jambs and sills should be consolidated and refinished where practical. Where consolidation is not practical, jambs and sills should be reconstructed to match the historic ones.
- Storm windows should be constructed as required.

Shutters:

- The historic shutters first installed in 1874 have been removed and repaired by park service employees. The remnants of the original hardware are being stored in the historic architect's office. This hardware should be repaired or duplicated, and the shutters reinstalled in the original locations.

Interior Finish Treatment Recommendations

General Finish Treatments

It is recommended that all of the interior materials and their finishes throughout the Keeper's Dwelling be restored (or replicated where missing or damaged beyond repair) to a sound condition.

Painted Surfaces: With any paint preparation or removal treatments, the paint must be assumed to contain lead. The age of the structures on South Manitou Island virtually guarantees the presence of lead-based paint. In addition, random testing of sampled by Seebohm Ltd. confirmed the presence of lead in painted finishes. Proper abatement procedures must be implemented prior to any paint preparation removal. Final paint colors are to be selected from the documented paint episodes as listed in Appendix D: Paint Study in accordance with the park's interpretive goals for each interior space.

Interior Wood surfaces: Interior wood surfaces include: window and door jambs and casings, windows and doors, baseboard and shoe moldings, and all wood components of the stairs. The majority of these interior wood surfaces throughout the Dwelling are painted, with evidence of significant paint buildup and failure. The buildup and lack of environmental control within the building has created cracking, splitting, and complete upheaval of the paint from the wood surfaces throughout the structure. Some have even just entirely worn off. It is recommended that all wood in this condition be chemically stripped in accordance with lead paint abatement procedures, and then refinished according to the findings and recommendations of the paint analysis. Treatments that are room specific will be addressed in each room's recommendations.

Wood Flooring: Prior to the physical treatment of any of the floor surfaces, the demarcations or ghosted images of all former floor coverings should be accurately documented for archival purposes. All flooring, especially in the areas of extensive finish buildup and failure, which historically had a natural (stain) finish, should be mechanically sanded to remove the finish. This should then be followed by the application of a water-based polyurethane.

Areas of flooring that historically have had a paint finish should undergo paint preparation, including the mechanical sanding of uneven areas to remove paint buildup and the feathering of these areas into the smooth surfaces adjacent to them. The floors should then have new paint applied. Floor coverings, such as varnished canvas or linoleum, frequently used at dwellings in the Lighthouse Service, may be installed if documentation suggests their placement.

Exterior Wall Surfaces: Due to the level of deterioration at most of the exterior walls, in most rooms all of the plaster should be removed from the wall surfaces.

Following plaster removal, all of the openings should be further investigated and, if necessary, be properly sealed and associated deteriorated mortar joints tuckpointed. Furthermore, if there are rotten nailers within the inner brick wythe, the rotten wood should be removed and new wood installed. New metal lath and plaster should then be installed.

Interior (partition) wall Surfaces: At all of the interior walls, where plaster repair is required, the minimal amount of plaster should be removed. If in sound condition, the wood lath should be retained. The open areas should then be fitted with wire lath, and new plaster installed and feathered into the adjacent, sound plaster surfaces. Finally, a skim coat should be applied to the entire wall surface.

Insulation: The installation of insulation and a vapor barrier at the exterior walls and second floor ceiling of the Keeper's Dwelling is not recommended. Since the building would be in use between May and October, the presence of insulation would be of little or no value in an unheated and non-air-conditioned building. The presence of insulation could actually have a detrimental affect, especially during the spring and fall.

In order to minimize condensation at the interior faces of the exterior walls, it is important to maintain an equilibrium of the temperature between the inside and outside. If insulation were present and the building was sealed, the interior would warm up during the day at a slower rate than the outside. Since it is impossible to install a vapor barrier in an older building that will be 100% effective, conditions will occur where the temperature at the interior surfaces will be lower than the dew point of the air and condensation will form on the surfaces promoting mold and growth. The approach to maintaining an equilibrium between the inside and outside is to provide ventilation, thus rendering the insulation useless.

Specific Room Recommendations

Basement

Room B-01, Storage Room/Asst. Keeper's Pantry

- In addition to the floor refinishing discussed above, there is an area in Room B-01 where the floor is partially missing and must be replaced for visitor safety.
- Clean and prepare the rough stone surfaces of the south and east walls. Install a new coat of tooled parging with a whitewash finish.
- Remove the infill at the east window (D-7).
- Replace the sill at window D-1 in the east wall.
- Reinstall the original windows or compatible replacements in the south and east window openings (D-1 and D-7, respectively).

Room B-02, Storage Room

- If the paint study warrants, repaint the top layer of floor brick.
- Remove peeling paint from the north portion of the west wall, prepare the surface, and repaint the plaster.
- Remove excessive paint buildup from the north and east stone walls. Apply new parging where needed.
- Remove the heavy, rusting, conduit from the ceiling. New electrical wiring can be hidden behind the new plaster ceiling.

Room B-03, Subcellar

- For safety reasons, this area should remain off-limits to visitors.

Stair, B-04

- The doorway leading into the subcellar should be permanently blocked.
- Remove extensive paint buildup and alligatoring from treads and risers. Sand, seal, and repaint with a historically accurate scheme recommended by the paint report.

Room B-05, Dining Room/Keeper's Kitchen

- Remove paint buildup on the floor, and determine if there is an underlaying floor covering.
- Chemically remove built-up paint on the wainscoting. Reattach boards that are separating.
- Remove the visually intrusive wallboard patches, replacing with wood lath and plaster. Although the wallboard is not in its self an anachronism, given the lengthy period of significance, the repairs were poorly integrated into the original wall fabric.

- Chemically remove paint buildup from the fireplace trim. Sand, seal, and repaint after making any necessary repairs.

Room B-05 A, Pantry

- Repair the wood base and wall cabinets. Reconstruct the two missing cabinet doors to match the originals.
- Remove the miscellaneous nails at the bead board if they present a hazard to visitors.
- Replace the glass at the pass-through window in the center of the south wall.
- Replace the deteriorated and missing plaster on the north and east walls.
- Remove the exposed metal conduit at the ceiling.

Room B-06, Assistant Keeper's Kitchen

- Remove the deteriorating linoleum from the floor.
- Chemically remove the extensive paint buildup on the wood wainscoting. Repair splits in the wood, seal, sand, and paint.
- Repair the wood cabinet in the northwest corner of the room, restoring the cast iron sink, hand pump, counter surface.

<u>First Floor</u>

Room 101, Entrance Hall

- Replace deteriorating floor boards and the wood trim around Door E-4.
- Install new wooden lath and plaster at the large bare section on the west wall.
- Remove paint buildup on stairs, along with any remaining vinyl material.
- Recreate the stair's spindle balusters and handrail based on historic documentation, existing fragments, and styles used at other Great Lakes lighthouses. Finish to match the extant newel post.

Room 102, Office

- Replace missing lath and plaster at the south and west walls.

Room 103, North Parlor

- Repair water damage to floor boards.
- Repair lath and plaster on either side of the fireplace.
- Restore the fireplace mantel and remove the brick infill in the firebox.
- Repair baseboard trim where it is separating from itself and the wall.

Room 103A, Closet

- Remove the extra layer of floor boards at the area west of Door I-7.
- Repair settlement cracks along the east and north walls.

Room 104, Parlor

- Remove the buckled upper layer of wood flooring and restore the original floor.
- Seal butt-joint in the baseboard.
- Remove the remaining brick and plaster infill within the fireplace.
- Remove rust from the exposed metal chimney bar and paint with a rust-inhibiting finish.

<u>Second Floor</u>

Room 201, Bedroom

- Remove the excessive paint buildup on the floor.
- Replace the missing baseboard along the south wall.

Room 202, Central Stair Hall

- Remove the excessive paint buildup on the floor.
- Remove the board nailed at the threshold of Door I-15 and install a proper threshold.
- Restore the wood corner beads.
- Replace the missing baseboard.
- Repair the wood casing at Window D-22 on the east wall.

Room 203, Northeast Bedroom

- Remove the paint buildup on the floor and repair the damaged flooring around the closet and in the center of the room.

Room 203A, Closet

- Repair or replace damaged and missing plaster throughout the room.

Room 204, Northwest Bedroom

- Repair weathered and cracked flooring near the windows. Remove excess paint buildup on the floors.
- Replace the missing lath plaster on the north wall.

Room 204A, Closet

- Repair the rusting ductwork behind the south wall, then repair the damaged plaster it created.

Room 205, Southwest Bedroom

- Extensive damage due to vandalism requires reconstruction of the plaster at the ceiling, south, and east walls.

Attic

- Repair peeling paint caused by water infiltration at the finished areas of the attic.

Passageway

Exterior

Roof

- The same treatments are recommended for the roof of the Passageway as those recommended at the roof of the Keeper's Dwelling.

Exterior Brick and Stone Surfaces

- Treatment of these surfaces should be the same, and follow the same guidelines, as at the Keeper's Dwelling.
- Repair or replace windows and storms as required.

Interior

Wood Flooring

- Treatment of the wood floor in the Passageway should follow the recommendations presented for the wood floors in the Keeper's Dwelling.

Ceiling

- Due to the damage caused by vandalism, the ceiling should be entirely replaced. This will include the removal of all existing damaged plaster and lath, and be followed by new metal lath and plaster installation. All surfaces throughout the Passageway should then be finished according to the paint analysis.

Tower

Exterior

- Any areas of failing paint should be scraped to a sound surface. All of the exterior masonry surfaces should then be prepared for painting. Whitewash should be applied according to the results of the paint analysis.
- All exterior metal surfaces (the parapet deck, handrail, etc.) should be scraped to either bare metal or a sound paint surface and sanded, and new black (or other, according to the results of the paint analysis) paint applied.
- The historic Tower windows should be reconstructed as two pairs of casements at each opening.
- The Lexan glazing in the lantern room should be replaced with a double sash of tempered glass.

Interior

- The third order Fresnel lens installed in the lantern room at the time the tower was constructed is no longer extant. The lens, its evolution, and retirement should be interpreted for visitors.
- Remove the incompatible patching compound that was previously used to patch cracks in the plaster throughout the Tower. Apply new patching compound that is compatible, both in color and consistency, with the adjacent plaster surfaces. All plaster surfaces should then be refinished according to the paint analysis.
- Reconstruct the missing wood doors at the built-in cabinet in the watchroom, installing appropriate new hardware.
- At the lantern room, the areas of rust at the metal surfaces (including the hatch door in the floor, the floor itself, the lens pedestal, and other metal surfaces) should be scraped, have a rust-inhibitive

primer applied, and be painted according to the results of the paint analysis.

- Any areas of damaged or deteriorated wood at the wainscot should be replaced or repaired. Following all repairs, all of the wood, metal, and plaster surfaces in the lantern room should be finished according to the paint analysis.

Fog Signal Building

Exterior

- Install gutters and downspouts to drain rainwater away from the building foundation.
- Repair the area of cracking concrete on the east elevation, below the southern window. Repair the large crack in the foundation on the south facade, at the east edge.
- Remove excessive paint buildup on the clapboard siding. Repair any deteriorated, split, or rotting boards before sanding, sealing, and finishing with paint in an appropriate color.
- Clean and repair the wood window and door trim.

Interior

- The various fog signal equipment used at the station is no longer extant. The fog signal, its evolution, and retirement should be interpreted for visitors.
- Remove rust from the sheet metal ceiling and walls, followed by a rust-inhibiting finish.
- Where the original sheet metal is missing, install replicated material.
- Repair the wooden doors at the east elevation and replace missing or broken muntins at the divided lights.
- Remove wood infill in the wall between the coal bin and the machinery room.

Brick Oil House

Exterior

- Remove the parge coat and excess paint buildup on the exterior walls. Repair the spalling brick and tuckpoint the mortar joints, before repainting.
- Remove the surface rust on the metal roof; repaint.
- Repair the areas in the cornice that are rusted through.

Interior

- Repaint the interior brick walls.

Metal Oil House

The Metal Oil House should be relocated from the Coast Guard Station to its historic location at the South Manitou Island Light Station.

Exterior

- Straighten the roof overhang damaged by the previous rolling of the structure.
- Remove any rust and repaint.
- Create a foundation for the structure that will prevent water infiltration to the interior and protect new flooring.

Interior

- Restore the curved metal shelves found on site to their original location within the Metal Oil House.
- Install new wooden flooring.

Building Systems

Mechanical

The buildings currently do not have HVAC systems and new systems are not contemplated as part of this project.

Plumbing

Reinstallation of domestic water service in the complex is not recommended.

Electrical

Domestic Service

Evidence exists of the original locations of lighting fixtures and receptacles when the building was initially provided with electricity. These fixtures have long since disappeared and there is no way of knowing what they looked like. Historic drawings and physical investigation indicates the probable location of these devices.

To provide light for life safety and maintenance, simple ceiling mounted light fixtures wired to a light switch by the door should be provided at the original locations in every room. Also, duplex convenience outlets should be provided in all rooms.

Lightning Protection

It is not known, nor is it documented, whether or not the current lightning protection system at the Tower was installed to meet the requirements of Underwriters Laboratories, Inc. Further investigation by the current team is beyond the scope of this study. A licensed installer/designer in this trade should further evaluate the existing condition of the system according to UL standards.

Site Security

Due to the remote location and seasonal usage of the light station, a security system would be ineffective and is not recommended.

Fire Suppression Systems

It is recommended that serious consideration be given to installing some form of fire suppression system in the Dwelling, Passageway, Tower, and Fog Signal Building. Both of these buildings are highly combustible and fire could quickly spread as the result of a careless smoker or other cause. Fire-fighting capabilities on the island are limited to wildfires. A well-designed fire suppression system could decrease the likelihood of serious fire damage during the tourist season by 90%.

It should be pointed out that protection during the winter months is not possible as the fire suppression system must be deactivated when the island is not occupied. Damage from uncontrolled water flow and ice would destroy the buildings we are attempting to protect.

Water for fire suppression can be obtained from the island water system. There is a 3" main approximately 500' removed from the lighthouse complex which could be extended to the buildings. However, for any fire suppression system to operate properly, the current main must be upgraded to provide adequate capacity.

The following discussion outlines the advantages and disadvantages of the various types of fire suppression systems that could be employed for this project.

For maximum protection, the fire suppression systems should provide protection for all occupied areas, including basements. Per NFPA requirements, the systems should be hydraulically designed for light hazard protection. The following four system types offer possible solutions to the problem:

Pre-Action System

Of the four systems, this system offers one of the better solutions to the problem. Unfortunately, it is also one of the most expensive.

A pre-action system consists of standard fused sprinkler heads and piping along with a pre-action valve which is actuated by rate-of-rise heat detectors. The piping system is initially empty. An alarm signal from a heat detector opens the pre-action valve, resulting in water becoming available to the system. At the same time, an alarm signal can be broadcast to a monitoring station notifying that there is a risk of fire in the building. Water is only discharged to the space when the fusible link on a sprinkler head melts from the heat of a fire.

In the event of an electrical system failure, the system will be filled with water so when a sprinkler fusible link melts the system will continue to provide protection for the building.

The advantages of this system include:

- Early warning of a possible fire.
- The excellent protection from water damage due to tampering with or accidental damage to a sprinkler head, as there will be no water in the system unless a heat detector has been activated.
- The portions of the system beyond the pre-action valve are not subject to freezing, as there is normally no water in the piping.

Disadvantages include:

- The installed cost of this system is considerably above the cost of a normal, water-filled system.
- Subsequent to an electrical system failure the system must be totally drained of water.

Firecycle System

The firecycle system is very similar to the Pre-action system as it requires both a signal from an area heat detector and the opening of a fusible link on a sprinkler head before water discharge can occur.

This system possesses two additional features as, after activation, the water discharge is automatically turned off when the temperature at the heat detector is reduced below the detector activation temperature, indicating that the fire has been extinquished. The water is turned back on if the temperature again rises above the detector activation temperature.

As with the pre-action system, an alarm signal can be broadcast to a monitoring station notifying that there is a risk of fire in the building when a heat detector alarms.

The advantages of this system include:

- Early warning of a possible fire.
- As there will be no water in the system unless a heat detector has been activated, this system provides the best possible protection from water damage due, not only to tampering with or accidental damage to a sprinkler head, but also to the fact the discharge will be deactivated once an actual fire has been extinguished.
- The portions of the system beyond the pre-action valve are not subject to freezing, as there is normally no water in the piping.

Disadvantages include:

- The installed cost of this system is considerable above the cost of a normal, water-filled system and is the most expensive of the systems considered in this report.
- Subsequent to an electrical system failure, the system must be totally drained of water.

Dry-pipe System

Under normal conditions, the piping in this system is empty. The system is pressurized with air from an air compressor. Sprinkler heads are fused type. If a sprinkler head is activated, the drop in pressure opens a dry pipe system valve and allows water to flow into the system.

The advantages of this system include:

- This system provides good protection from freezing, as there is initially no water in the system.

Disadvantages include:

- The installed cost of this system is approximately 20% above the cost of a normal, water-filled system.
- Damage to or tampering with a sprinkler head will result in immediate discharge of water.
- In the event of an electrical system failure, the system is inoperable and the dry-pipe valve will not open in the event of a fire.
- At present, quick response heads (see below) are not available for dry-pipe systems.

Wet Pipe System

This system represents 90% of the sprinkler systems in this country. It consists of fused sprinkler heads served by a piping system that is always filled with liquid.

This system is the least expensive of the systems discussed in this report. Systems installed in areas exposed to freezing temperatures must be filled with a glycol solution to prevent freezing of the liquid.

Advantages include:

- Lowest first cost.

Disadvantages include:

- Damage to or tampering with a sprinkler head will result in immediate discharge of water into the protected space.
- No early warning feature.

Sprinkler Heads

Normal, "standard," sprinkler heads are equipped with fusible links which melts at 165 degrees F. Recently, sprinkler heads have been developed which will open at a considerably lower temperature (135 degrees F.) Due to their heightened sensitivity, these "quick response" heads cannot be employed in all applications. They are commonly restricted to residential use. However, the added protection they provide warrant serious consideration for this project.

Piping System

The Keeper's Dwelling and Fog Signal Building offer few opportunities to conceal the sprinkler system piping. The high cost of architectural renovations in an attempt to conceal sprinkler piping cannot be justified. Fortunately, through the use of small diameter copper piping and the judicous location of sprinkler heads, the visual impact of the sprinkler system can be minimized. Furthermore, installation of the system during the replacement of extant wall and ceiling plaster will provide opportunities for hiding components within the wall fabric.

Recommendations

Due to the irreplaceable value of the buildings, the selection of a fire suppression system must be given careful consideration. There is no question that the fire-cycle system affords the maximum protection, as this system minimizes the extent of damage, if any, from the flow of water. The pre-action system offers slightly less protection at a slight reduction in cost. Unfortunately the initial cost of both these systems is quite high, and it is questionable that either one can be considered cost effective.

The most cost effective and reliable system is the basic hydraulically designed standard sprinkler system. This is recommended to serve the project. The sprinkler heads should be of the "quick response" type to assure that the head will discharge early in the fire and allow the best chance for rapid quenching of the fire. Recently, "quick response" heads have become available in a sidewall type. These heads can be mounted directly on the piping at the corners of ceilings and walls, thus minimizing the intrusion of the sprinkler system into the appearance of the rooms.

Handicapped Accessibility

Universal access to the light station from the former Coast Guard station should be provided via the existing boardwalk, modified to a width of 5' throughout its length. Additional boards should run parallel with the existing boardwalk to provide a uniform and visually consistent walking surface (see the Walkways and Other Circulation section of the Cultural Landscape recommendations). Existing concrete walkways from the terminus of the boardwalk to the Light Tower should be repaired and/or reconstructed to a uniform width of 5'. The concrete apron in front of the Fog Signal Building should be repaired and/or reconstructed to the limit of the present seawall to serve as a transition area and to provide universal access to the waterfront. As an alternative to this route, consider an accessible path from the former Coast Guard station to the rear (west) elevation of the Keeper's Dwelling, recreating the historic weather station trail.

The historic concrete walkway on the south side of the complex should become the designated route for access to the lowest (basement) level of the Keeper's Dwelling, through the extant doors on the west elevation. Due to the topography of the site, the existing walkway may exceed a 5% slope. Rather than alter the historic path, it could be rated in accordance with the "challenge level" identification system being developed as part of the National Park Service's Outdoor Accessibility Guidelines. To provide access to the first floor of the Keeper's Dwelling, a new wood ramp that meets Uniform Federal Accessibility Standards for length and width should be constructed.

Doors at the basement and first floor levels of the Keeper's Dwelling should be modified as needed to meet UFAS. Interior doors at the Passageway should also be modified and changed to fire-rated construction. This will provide two means of egress in case of fire at the complex. A means of communicating with the Park Rangers at the former Coast Guard on South Manitou Island should be installed at the junction of the Passageway and the Light Tower, in the event a handicapped person is unable to exit via the Keeper's Dwelling ramp and requires assistance navigating the Tower stairs.

[1] U.S. Department of the Interior, National Park Service, Cultural Resources, Preservation Assistance. *The Secretary of the Interior's Standards for the Treatment of Historic Properties*, 1992 (Washington, D.C.: U.S. Government Printing Office, 1992), 1.

[2] Ibid., 1.

[3] Ibid., 2.

[4] Memorandum from Superintendent, Sleeping Bear Dunes National Lakeshore to Field Director, Midwest Field Area, National Park Service, Attention: Bill Harlow, GLSO re: South Manitou Lighthouse HSR Review Comments. 22 November 1995, p.3

[5] U.S. Department of the Interior, National Park Service, Cultural Resources, Preservation Assistance. *The Secretary of the Interior's Standards for the Treatment of Historic Properties*, 1992 (Washington, D.C.: U.S. Government Printing Office, 1992), 2.

[6] Ibid., 1.

[7] Ibid., 4.

[8] Ibid.,1.

[9] Ibid., 6.

[10] Ibid., 6.

[11] Ibid., 1.

[12] Ibid., 3.

[13] Ibid., 3.

[14] Memorandum from Superintendent, Sleeping Bear Dunes National Lakeshore to Field Director, Midwest Field Area, National Park Service, Attention: Bill Harlow, GLSO re: South Manitou Lighthouse HSR Review Comments. 22 November 1995, p.2.

[15] U.S. Department of the Interior, National Park Service, Cultural Resources, Preservation Assistance. *The Secretary of the Interior's Standards for the Treatment of Historic Properties*, 1992 (Washington, D.C.: U.S. Government Printing Office, 1992), 3.

[16] Ibid., 3.

[17] Diane Maddox, ed.*All About Old Buildings* (Washington, D.C..: The Preservation Press, 1985), 311.

[18] United States Department of the Interior, National Park Service, Preservation Assistance Division, Technical Preservation Services Branch, Washington, D.C. *Draft Guidelines for the Treatment of Historic Landscapes.* May 1992, 7.

[19] *Management of Cultural Landscapes*, Cultural Resource Management Guideline, NPS-28, 104.

[20] U.S. Department of the Interior, National Park Service, Cultural Resources, Preservation Assistance. *The Secretary of the Interior's Standards for the Treatment of Historic Properties*, 1992 (Washington, D.C.: U.S. Government Printing Office, 1992), 3.

[21] U.S. Department of the Interior, National Park Service, Cultural Resources, Preservation Assistance. *The Secretary of the Interior's Standards for the Treatment of Historic Properties*, 1992 (Washington, D.C.: U.S. Government Printing Office, 1992), 3.

[22] U.S. Department of the Interior, National Park Service, Cultural Resources, Preservation Assistance. The Secretary of the Interior's Standards for the Treatment of Historic Properties, 1992. (Washington, D.C.: U.S. Government Printing Office, 1992),3.

[23] U.S. Department of the Interior, National Park Service. Management Policies (Washington, D.C.: U.S. Government Printing Office, Dec. 1988), Chapter 5, p.14.

[24] U.S. Department of the Interior, National Park Service. Management Policies (Washington, D.C.,: U.S. Government Printing Office, Dec. 1988), Chapter 5, p.14.

Part J:
Research Recommendations

Part J: Research Recommendations

The opportunity to understand more about the chronology of the development and evolution of the South Manitou Island Light Station exists. This can be further investigated through continued archeological research. In particular, investigations into the history of fencing on the site should be continued.

A lead paint abatement program should be developed for the light station complex. Random testing of approximately 20 paint samples taken by Seebohm, Ltd. identified the presence of lead in both interior and exterior surfaces. As the majority of finishes were applied prior to 1958, it is safe to conclude that the majority of the coatings contain lead.

An analysis should be conducted of the lightning protection equipment. A determination should be made as to whether the lightning protection equipment was installed properly and recommendations provided as to the future design, use and maintenance of lightning protection devices.

There is currently little information on the historic privy other than the extant foundation. At this time, the information is insufficient for a reconstruction of the building. More information, such as plans and historic photographs, may be discovered in the future.

References

Bibliography

Anderson, Charles M. *Isle of View: A History of South Manitou Island.* 1979.

Department of Commerce, Lighthouse Service. *The United States Lighthouse Service 1915.* Washington, D.C.: U.S. Government Printing Office, 1916.

Department of Commerce, Lighthouse Service. *Annual Report of the Commissioner of Lighthouses to the Secretary of Commerce.* Washington, D.C.: U.S. Government Printing Office, 1922, 1931, 1932.

Department of Commerce, Lighthouse Service. *Light List: Great Lakes, Unites States and Canada.* Washington, D.C.: U.S. Government Printing Office, 1924-1959.

Department of Transportation, United States Coast Guard. *Chronology of Aids to Navigation and the Old Lighthouse Service 1716-1939.* Washington, D.C.: Public Affairs Division, 1974.

Department of Treasury, Lighthouse Service. *Annual Report of the Light-House Board to the Secretary of the Treasury.* Washington, D.C.: U.S. Government Printing Office, 1892-1894.

Dunkelberg-Booker, Susan. "South Manitou Island: People, Time, and Changes." Paper written in March 1981 for Geo. 407: Geography of Michigan, Michigan State University, Lansing, MI. Photocopy.

Gilbert/Commonwealth Inc. of Michigan. *Cultural Resource Assessment of proposed Construction Activities, South Manitou Island, Sleeping Bear Dunes National Lakeshore, Michigan.* Submitted to the U.S. Department of the Interior, National Park Service, Midwest Archeological Center, Lincoln, Nebraska. Jackson, MI: Gilbert / Commonwealth Inc. of Michigan, June 1985.

Grosvenor, Mike and John Stout. *Ronald Rosie, 1989.* South Manitou Island, Michigan, 1989. Videotape.

Hyde, Charles K. *The Northern Lights: Lighthouses of the Upper Great Lakes.* Lansing, MI: Two Peninsula Press, 1986.

Kruch, Chuck and Bob Ruckhopt. *Fred Burdick on South Manitou Island, Summer 1990.* South Manitou Island, Michigan, 1990. Videotape.

Kruch, Chuck and Bob Ruckhopt. *Glen Furst, George Hutzler, and Fred Burdick, South Manitou Island, 1990.* South Manitou Island, Michigan, 1990. Videotape.

Knudsen, Arthur and Evelyn. *A Gleam Across the Waves: The Biography of Martin Knudsen.* 1948.

Lazdins, Peter A. "South Manitou Island Lighthouse." Paper written December 3, 1980 for Architecture 673: Historic Preservation, University of Michigan, Ann Arbor. Photocopy.

Maddex, Diane, ed. *All About Old Buildings: The Whole Preservation Catalog.* Washington, D.C.:Preservation Press, 1985.

Mark F. Pfaller Associates. *Historical and Architec tural Data Sections, Historic Structure Report, South Manitou Island Life-Saving Station, Sleeping Bear Dunes National Lakeshore.* Prepared for the U.S. Department of the Interior, National Park Service. Milwaukee: Mark F. Pfaller Associates,1982.

Muhn, Jim. *Historic Resource Study: Sleeping Bear Dunes National Lakeshore, Michigan.* Edited by Jill York O'Bright. Prepared for the U.S. Department of the Interior, National Park Service, Midwest Region, Denver Service Center, Denver, CO, 1984.

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 162, Page 119. "Letter from W.H. Gardner, Lighthouse Inspector, 11th District to Rear Admiral W.B. Shubrick, Chairman of the Lighthouse Board, Washington, D.C. January 30, 1864."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 234, Page 66. "Annual Report to Rear Admiral W.B. Shubrick, Chairman of the Lighthouse Board, Washington, D.C., October 9, 1868."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26.

Letter Book 234, Page 195. "Letter from T.H. Stevens, Lighthouse Inspector, 11th District to Rear Admiral W.B. Shubrick, U.S.N., Chairman of the Lighthouse Board, Washington, D.C., June 9, 1869."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 257, Page 74. "Letter from W.F. Reynolds, Brev. Brig. Gen. and Lighthouse Engineer to Rear Admiral W.B. Shubrick, Chairman of the Lighthouse Board, Washington, D.C., September 28, 1869."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 283, Page 112. "Letter from O.M. Poe, Lighthouse Engineer, 11th District to Rear Admiral W.B. Shubrick, Chairman of the Lighthouse Board, Washington, D.C., August 1, 1870."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 283, Page 182. "Letter from O.M. Poe, Engineer, 11th Lighthouse District to Rear Admiral W.B. Shubrick, Chairman of the Lighthouse Board, Washington, D.C., August 4, 1870."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 283, Page 480. "Letter from O.M. Poe, Lighthouse Engineer, 11th District to Rear Admiral W.B. Shubrick, Chairman of the Lighthouse Board, Washington, D.C., October 7, 1870."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 283, Page 1066. "Letter from O.M. Poe to Rear Admiral W.B. Shubrick, Chairman of the Lighthouse Board, Washington, D.C., April 18, 1871."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 309, Page 1210. "Letter from A. Murray, Comm., Lighthouse Inspector to Professor Joseph Henry, Chairman of the Lighthouse Board, Washington, D.C., August 1, 1872."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 312, Page 75. "Letter from Wm. A. Richardson, Acting Secretary to the Treasury Department, Washington, D.C., September 3, 1872."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 312. "Letter from the Quartermaster General to Major Geo. H. Elliott, Engineer Secretary, U.S. Lighthouse Service, Washington, D.C., January 9, 1873."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 367, Pages 178 and 323. "Letters from Henry M. Robert, Major of Engineers, Lighthouse Engineer to Professor Joseph Henry, Chairman of the Lighthouse Board, Washington, D.C., October 5 and November 4, 1874."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 367, Page 357. "Notice to Mariners transmittal to the Chairman of the Lighthouse Board, Washington, D.C., from Henry M. Robert, Major of Engineers, Lighthouse Engineer, December 5, 1874."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 234, Page 195. "Descriptive List of Light Stations in the Eleventh District by Henry R. Crump, Lampist, December 7, 1878."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 462, Page 240. "Letter from G. Weitzel, Lighthouse Engineer to Admiral John Rodgers, U.S. Navy, Chairman of the Lighthouse Board, Washington, D.C., April 14, 1879."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 1145, Page 570. "Letter from M.B. Adams, Major of Engineers, U.S.A., Light-House Engineer, Ninth District to the Light-House Board, Washington, D.C., March 22, 1897."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Letter Book 1332, Page 390.5. "Letter from J.G. Warren, Captain, Corps of Engineers, Engineer, Ninth Light-House District to the Light-House Board, Washington, D.C., October 2, 1899."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 254, File 1812. "Letter from the Captain [name illegible], Corps of Engineers, Engineer, Ninth Light-House District to the Light-House Board, Washington, D.C., April 15, 1901."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 254, File 1812. "Letter from the Captain [name illegible], Corps of Engineers, Engineer, Ninth Light-House District to the Light-House Board, Washington, D.C., May 4, 1901."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 254, File 1812. "Letter from the Captain [name illegible], Corps of Engineers, Engineer, Ninth Light-House District to the Light-House Board, Washington, D.C., May 21, 1901."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 254, File 1812. Photocopy of "1812: Subject Index, South Manitou L.S., Mich., June 14, 1901."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. "Instructions to Light - Keepers, 1902." Washington, D.C.: U.S. Government Printing Office, 1902.

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 254, File 1812. "Letter from the Major [name illegible], Corps of Engineers, U.S.A., Engineer, Ninth Light-House District to the Light-House Board, Washington, D.C., March 3, 1902."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 254, File 1812. "Letter from the Major [name illegible], Corps of Engineers, U.S.A., Engineer, Ninth Light-House District to the Light-House Board, Washington, D.C., May 16, 1902."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 254, File 1812. "Letter from R. P. Bishop, Michigan, Chairman of the Committee on Ventilation and Acoustics, House of Representatives, U.S. to the Light-House Board, Washington, D.C., August 16, 1902."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 254, File 1812. "Letter from Major [name illegible], Corps. of Engineers, U.S.A., Engineer, Ninth Light-House District to the Light-House Board, Washington, D.C., August 3, 1904."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 254, File 1812. "Letter from Lieut. Col. [name illegible], Corps of Engineers, U.S.A., Engineer Secretary to the Engineer, Ninth Light-House District, Milwaukee, Wisconsin, 30 June 1906."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. "Description of Buildings, Premises, Equipment, Etc. at South Manitou Light-Station, South Manitou Island, Michigan, March 1, 1910."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 803, File 979. "Estimate of Cost of Proposed Works, South Manitou Lt. Sta., Mich., prepared by F. J. Otter, Assistant Superintendent, Office of Lighthouse Inspector, 12th District, May 4, 1914."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 803, File 979. "Recommendations for Repairing Aids to Navigation from the Superintendent, Office of District Inspector, Twelfth District, to The Commissioner of Lighthouses, May 4, 1914."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 803, File 979. Superintendent copy, dated October 19, 1917, of "Letter from James P. Burdick, Keeper, South Manitou Light Station, to the Lighthouse Inspector, Milwaukee, Wisconsin, October 13, 1917."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 803, File 979. "Recommendation as to Aids to Navigation from the Superintendent, Office of the Inspector, Twelfth District, Milwaukee, Wisconsin, to The Commissioner of Lighthouses, March 13, 1919."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 803, File 979. "Letter from C. A. Park, Chief Engineer, (For the Commissioner [of Lighthouses]), to the Superintendent of Lighthouses, Milwaukee, Wisconsin, April 22, 1935."

National Archives. Records of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. "South Manitou Island Clipping File."

National Archives. Record of the United States Coast Guard, Bureau of Lighthouses. Record Group 26. Box 254, File 1812. Photocopy of "Congressional Public Act No. 130."

Sleeping Bear Dunes National Lakeshore (SLBE) Archives. Photocopy of excerpt referring to the Ninth District from, "Annual Report of the Light-House Board to the Secretary of the Treasury for the Fiscal Year ended June 30, 1892." Washington, D.C.: U.S. Government Printing Office, 1892.

Sleeping Bear Dunes National Lakeshore (SLBE) Archives. Photocopy of excerpt referring to the Ninth District from, "Annual Report of the Light-House Board to the Secretary of the Treasury for the Fiscal Year ended June 30, 1893." Washington, D.C.: U.S. Government Printing Office, 1893.

Sleeping Bear Dunes National Lakeshore (SLBE) Archives. Photocopy of excerpt referring to the Twelve District from, "Annual Report of the Commissioner of Lighthouses to the Secretary of Commerce for Fiscal year ended June 30, 1922." Washington, D.C.: U.S. Government Printing Office, 1922.

Sleeping Bear Dunes National Lakeshore (SLBE) Archives. Maintenance Files. File 51-120A. "Lighthouse Keeper's Residence, South Manitou Island Lighthouse."

Sleeping Bear Dunes National Lakeshore (SLBE) Archives. Maintenance Files. File 51-120B. "Lighthouse Walkway, South Manitou Lighthouse."

Sleeping Bear Dunes National Lakeshore (SLBE) Archives. Maintenance Files. File 51-120C. "Lighthouse, South Manitou Island Lighthouse."

Sleeping Bear Dunes National Lakeshore (SLBE) Archives. Maintenance Files. File 51-120D. "Lighthouse Magazine, South Manitou Island Lighthouse."

Sleeping Bear Dunes National Lakeshore (SLBE) Archives. Maintenance Files. File 51-120E. "Lighthouse Whistle Shed, South Manitou Island."

Slyfield, Charles B. Photocopy of "A Brief Sketch of the Life of Charles B. Slyfield." Frankfort, MI: May 9, 1912.

Snyder, David L., comp. *A Compendium of Written Communication of the Light House Board for the Twelve Light Stations of the Midwest Region, National Park Service, 1839 - 1881.* Prepared for the U.S. Department of the Interior, National Park Service, Midwest Regional Office, Omaha, NE, 1994.

U.S. Department of the Interior, National Park Service, Harpers Ferry Center. *Historic Furnishings Survey: Great Lakes Lighthouses.* Harpers Ferry, WV: 1980.

U.S. Department of the Interior, National Park Service, National Maritime Initiative. *1994 Inventory of Historic Lighthouses.* Washington, D.C.: U.S. Government Printing Office, 1994.

U.S. Department of the Interior, National Park Service, Midwest Region. *Sleeping Bear Dunes National Lakeshore / Michigan: General Management Plan: October 1979.* Denver: Denver Service Center, 1979.

U.S. Department of the Interior, National Park Service, Sleeping Bear Dunes National Lakeshore. *South Manitou Island Village Developed Area Plan: Sleeping Bear Dunes National Lakeshore*. Frankfort, MI: April 8, 1983 (rev. April 5, 1984).

U.S. Department of the Interior, National Park Service, Preservation Assistance Division. *The Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings.* Washington, D.C.: U.S. Government Printing Office, 1983.

Van Stappen, Julie F., (Planning and Environmental Quality, Midwest Regional Office) *Environmental Assessment: Shoreline Stabilization at South Manitou Island Lighthouse, Sleeping Bear Dunes National Lakeshore*. Prepared for the U.S. Department of the Interior, National Park Service. August 1987.

Vent, Myron H. *South Manitou Island: From Pioneer Community to National Park.* (USA): Eastern National Park and Monument Association, 1973.

Vent, William E. and Myron H. *Pioneer Tales and Other Stories of South Manitou Island.* Aurora, IL: J.W. Reproductions, Inc., 1990.

York, Jill. U.S. Department of the Interior, National Park Service. *National Register of Historic Places Registration Form for the "Historic Resources of South Manitou Island."* Omaha, NE, June 9, 1983.

Figure Index and Credits

Part B

Figure 1
Photocopy from an original ink tracing on linen by Charles Noble, Surveyor General, "T.30 V.R. 15W. Part of South Manitou Island. Surveyor General's Office. Detroit, April 8, 1850." Original located at the National Archives, Washington, D.C. Record Group 26/Entry 66 - Lighthouse Site Files/Box 114 - South Manitou Island.

Figure 2
Copy of a construction drawing for the Keeper's Dwelling at South Manitou Island Light Station entitled "Light-House at South Manitou, Mich." 1858. The original is located at the Michigan State Archives and is entitled, "As built in 1858" marked on it. A copy of the drawing is at the Sleeping Bear Dunes National Lakeshore archives.

Figure 3
Copy of a drawing entitled, "Proposed Improvement, South Manitou Island Light Station, Lake Michigan, Tower As Actually Constructed in 1871 (RHL 1010 755)." Sleeping Bear Dunes National Lakeshore Archives, 1871.

Figure 4
Copy of a portion of the *Sleeping Bear Dunes National Lakeshore / Michigan. General Management Plan October 1979.*

Figure 5
Copy of adrawing entitled, "South Manitou Light Station, Shore Protection, Executed According to Report of Superintdt. of Construction, Dated July 1st, 1876." (original watercolor at the Michigan State Archives; copy is at the Sleeping Bear Dunes National Lakeshore's archives).

Figure 6
Photocopy of a "Sketch Showing Site At South Manitou Light-House, Lake Michigan with Plan For Protection of The Shore." National Archives, Cartographic Branch (discrepancy whether this is a correct drawing), 1874.

Figure 7
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the early 1900's.

Figure 8
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, 1941.

Figure 9
Copy of a non-executed construction drawing for the attached Passageway and Tower at the South Manitou Island light Station. On the drawing are the numbers "RHL 1010 753." 1870. Sleeping Bear Dunes National Archives.

Figure 10
Drawing from Pictured Rocks National Lakeshore Archives "12' - 0" x 21' - 7 1/2 Brick Oil House, Prepared under the direction of Lieut. Commander D.W. Blamer U.S.N., Light-House Inspector, Plate 1" 1910. Where is the drawing located?

Figure 11
Photograph by Quinn Evans / Architects, 1995.

Figure 12
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, 1883.

Figure 13
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the early 1900's.

Figure 14
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1902-1905.

Figure 15
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the 1930's.

Figure 16
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1939-1940.

Part C

Figure 1
Drawing reprinted from a report entitled, "Cultural Resource Assessment of Proposed Construction Activities South Manitou Island, Sleeping Bear Dunes Na-

tional Lakeshore, Michigan" by Gilbert / Commonwealth, Inc. (Jackson, Michigan) 1985, p.1.

Figure 2
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1928.

Part D

Figure 1
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, 1883.

Figure 2
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1884.

Figure 3

Figure 4
Photograph from Sleeping Bear Dunes National Lakeshore Archives, ca. the early 1890's.

Figure 5

Figure 6
Copy of a drawing entitled, "South Manitou Light Station, Mich. Reservation Surveyed Sept. 1-4, 1887 by Geo. Y. Wisner" Sleeping Bear Dunes National Lakeshore Archives.

Figure 7
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1902.

Figure 8
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the early 1930's.

Figure 9
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1910.

Figure 10
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1910.

Figure 11
Photograph from the United States Coast Guard, Office of Historian (improper title of archives division), ca. 1930.

Figure 12
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1930.

Figure 13
Photograph from the United States Coast Guard, Office of the Historian, ca. the 1930's.

Figure 14
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1900.

Figure 15
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the early 1900's.

Figure 15
Photograph form the Sleeping Bear Dunes National Lakeshore Archives, ca. the early 1900's.

Figure 17
Photograph from the United States Coast Guard, Office of the Historian, ca. the 1930's.

Figure 18

Figure 19
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1939-1940.

Figure 20
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, 1946

Figre 21
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1946.

Figure 22

Exhibit 1
Sketch Showing [sic] Site at South Manitou Light-House, Lake Michigan, August 1874. Added marks by Land and Community Associates, Charlottesville, Virginia, 1996.

Exhibit 2
Sktech Showing [sic] Site at South Manitou Light-House, Lake Michigan, August 1874. Added marks by Land and Community Associates, Charlottesville, Virginia, 1996.

Exhibit 3
Sketch Showing [sic] Site at South Manitou Light-House, Lake Michigan, August 1874. South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey by George Y. Wisner). Added marks by Land and Community Associates, Charlottesville, Virginia, 1996, 1996

Exhibit 4
Sketch Showing [sic] Site at South Manitou Light-House, Lake Michigan, August 1874. South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey by George Y. Wisner). Added marks by Land and Community Associates, Charlottesville, Virginia, 1996, 1996

Exhibit 5
Sketch of the South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey by George Y. Wisner). South Manitou Is. L.S., South Manitou, Mich., Plot Plan, June 27, 1944. Added marks by Land and Community Associates, Charlottesville, Virginia, 1996, 1996

Exhibit 6
Sketch of the South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey by George Y. Wisner). South Manitou Is. L.S., South Manitou, Mich., Plot Plan, June 27, 1944. Added marks by Land and Community Associates, Charlottesville, Virginia, 1996

Exhibit 7
Sketch of the South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey by George Y. Wisner). South Manitou Is. L.S., South Manitou, Mich., Plot Plan, June 27, 1944. Added marks by Land and Community Associates, Charlottesville, Virginia, 1996

Exhibit 8

Sketch of the South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey by George Y. Wisner). South Manitou Is. L.S., South Manitou, Mich., Plot Plan, June 27, 1944. South Manitou Is. L.S., South Manitou, Mich., Revised Plot Plan, May 10, 1965. U.S. Lighthouse Reservation, Historic American Buildings Survey, 1988. Fieldwork conducted by Land and Community Associates, Charlottesville, Virginia, June 1995.

Part E

Figure 1
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 2
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 3
Photograph by David Evans, Quinn Evans / Architects, 1994.

Figure 4

Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 5
Copy of a construction drawing for the Keeper's Dwelling at South Manitou Island Light Station entitled "Light-House at South Manitou, Mich." 1858. The original is located at the Michigan State Archives and is entitled, "As built in 1858" marked on it. A copy of the drawing is at the Sleeping Bear Dunes National Lakeshore archives.

Figure 6
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 7
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the early 1890's.

Figure 8
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the early 1900's.

Figure 9
Copy of a drawing entitled, "Proposed Improvement, South Manitou Island Light Station, Lake Michigan,

Tower As Actually Constructed in 1871 (RHL 1010 755)." Sleeping Bear Dunes National Lakeshore Archives, 1871.

Figure 10
Copy of a drawing entitled, "Improvement at South Manitou Light Station, Lake Michigan, Tower As Actually Carried Out In 1871 (RHL 1010 756)" Sleeping Bear Dunes National Lakeshore Archives.

Figure 11
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 12
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 13
Copy of a non-executed construction drawing for the attached Passageway and Tower at the South Manitou Island light Station. On the drawing are the numbers "RHL 1010 753." 1870. Sleeping Bear Dunes National Lakeshore Archives.

Figure 14
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 15
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 16
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 17
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Figure 18
Photograph by Michelle Smay, Quinn Evans / Architects, 1995.

Figure 19
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 20
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the late 1930's.

Figure 21
Photograph by Michelle Smay, Quinn Evans / Architects, 1995.

Figure 22
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 23
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 24
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1884.

Figure 25
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the early 1890's.

Figure 26
Copy of a drawing entitled, "Fog Signal Building Proposed Mach. Layout. United States Coast Guard Engineering. Chicago District, Chicago, Ill. 13 March 1941." From the Sleeping Bear Dunes National Lakeshore Archives.

Figure 27
Copy of a drawing entitled, "Floor Plan, Fog Signal Building Electrical Wiring Plans. United States Coast Guard Engineering Chicago District, Chicago, Ill. May 20, 1941." From the Sleeping Bear Dunes National Lakeshore Archives.

Figure 28
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 29
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1911-1949.

Figure 30
Copy of drawing entitled,"South Manitou Island Installation of Air Diaphone to Replace Steam Boilers." From the Sleeping Bear Dunes National Lakeshore Archives.

Figure 31
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 32
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 33
Photograph by David Evans, Quinn Evans / Architects, 1994.

Figure 34
Photograph by Michelle Smay, Quinn Evans / Architects, 1995.

Figure 35
Copy of a drawing of the "End Elevation" of the Boathouse at the South Manitou Island Light Station. From the Sleeping Bear Dunes National Lakeshore Archives, July 24, 1901-Oct. 1, 1901.

Figure 36
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the early 1900's.

Figure 37
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the early 1900's.

Part F

Figure 1
Photocopy of a "Sketch Showing Site At South Manitou Light-House, Lake Michigan with Plan For Protection of The Shore." From the National Archives, Cartographic Branch (discrepancy whether this is a correct drawing), 1874.

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Copy of a construction drawing for the Keeper's Dwelling at South Manitou Island Light Station entitled "Light-House at South Manitou, Mich." 1858. The original is located at the Michigan State Archives and is entitled, "As built in 1858" marked on it. A copy of the drawing is at the Sleeping Bear Dunes National Lakeshore Archives.

Figure 3
Copy of a non-executed construction drawing for the attached Passageway and Tower at the South Manitou Island light Station. On the drawing are the numbers "RHL 1010 753." 1870. Sleeping Bear Dunes National Lakeshore Archives.

Figure 4
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the early 1890's.

Figure 5
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1928.

Figure 6
Photograph from the United States Coast Guard History Division, ca. 1930.

Figure 7
Copy of a construction drawing entitled, "South Manitou Isl. Light Sta., South Manitou Isl. Mich. (Proposed) Repairs and Improvements to Lt. Station Dwelling, Installation Of Sanitary and Heating Systems. District Coast Guard Officer Engineering, Cleveland, Ohio. 23 Mar [19]45 Drawing No. 45029." (RHL 1010 750) From the Sleeping Bear Dunes National Lakeshore Archives.

Part G

Figure 1
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 2
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 3
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 4
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1910.

Figure 5
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1928.

Figure 6
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, 1883.

Figure 7
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1884.

Figure 8
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the late 1800's.

Figure 9
Copy of a drawing entitled, "South Manitou Light Station, Mich. Reservation Surveyed Sept. 1-4, 1884 by Geo. Y. Wisner" Sleeping Bear Dunes National Lakeshore Archives.

Figure 10
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 11
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the early 1900's.

Figure 12
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. the late 1800's/early 1900's.

Figure 13
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 14
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 15
Drawing by JJR, 1997.

Figure 16
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 17
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, ca. 1939-40.

Figure 18
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, 1946.

Figure 19
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 20
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 21
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 22
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 23
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 24
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 25
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 26
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 27
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 28
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 29
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 30
Photograph by Fred Schneider, Land and Community Associates, 1995

Figure 30
Photograph by Fred Schneider, Land and Community Associates, 1995.

Figure 31
Photograph by Fred Schneider, Land and Community Associates, 1995.

Exhibit 9
Drawing by Land and Community Associates, 1995.??

Exhibit 10
Drawing by Land and Community Associates, 1995.

Part H

Figure 1
Photograph by Tom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 2
Photograph by Tom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 3
Photograpgh by Tom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 4
Photograph by Tom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 5
Photograph by Tom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 6
Photograph by Tom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 7
Photograph by Tom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 8
Photograph by Tom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 9
Photograph by Tom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 10
Photograph by Tom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 11
Photograph byTom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 12
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Figure 15
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Figure 16
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Figure 18
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Figure 19
Photograph by Tom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 20
Photograph by Tom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 21
Photograph by Tom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 22
Photograph by Tom Fitzpatrick, Robert Darvas and Associates, 1995.

Figure 23
Photograph by Michelle Smay, Quinn Evans / Architects, 1995.

Figure 24
Photograph from the Sleeping Bear Dunes National Lakeshore Archives, 1883.

Figure 25
Copy of an 1870 drawing of the Keeper's Dwelling with proposed alterations. From the Sleeping Bear Dunes National Lakeshore Archives.

Figure 26
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 27
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 28
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 29
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 30
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 31
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 32
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 33
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 34
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 35
Photograph by Michelle Smay, Quinn Evans / Architects, 1995.

Figure 36
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 37
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 38
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 39
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 40
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 41
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 42
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 43
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 44
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 45
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 46
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 47
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 47
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 49
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 50
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 51
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 52
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 53
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 54
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 55
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 56
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 57
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 58
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 59
Photograph by Michelle Smay, Quinn Evans / Architects, 1995.

Figure 60
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 61
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 62
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 63
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 64
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 65
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 66
Photograph by Michelle Smay, Quinn Evans / Architects, 1995.

Figure 67
Photograph by Michelle Smay, Quinn Evans / Architects, 1995.

Figure 68
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 69
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 70
Photograph by Michelle Smay, Quinn Evans / Architects, 1995.

Figure 71
Photograph by Michelle Smay, Quinn Evans / Architects, 1995.

Figure 72
Photograph by Michelle Smay, Quinn Evans / Architects, 1995.

Figure 73
Photograph by Michelle Smay, Quinn Evans / Architects, 1994.

Figure 74
Photograph by Michelle Smay, Quinn Evans / Architects, 1995.

Figure 75
Photograph by David Evans, Quinn Evans / Architects, 1995.

Figure 76
Photograph by David Evans, Quinn Evans / Architects, 1994.

Figure 77
Photograph by David Evans, Quinn Evans / Architects, 1994.

Figure 78
Photograph by David Evans, Quinn Evans / Architects, 1994.

Figure 79
Photograph by David Evans, Quinn Evans / Architects, 1994.

Figure 80
Photograph by David Evans, Quinn Evans / Architects, 1994.

Part I

Figure 1
Alternate 1. Drawing by JJR, 1997.

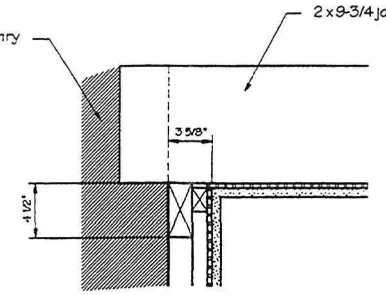
Figure 2
Alternate 2. Drawing by JJR, 1997.

Figure 3
Alternate 3. Drawing by JJR, 1997.

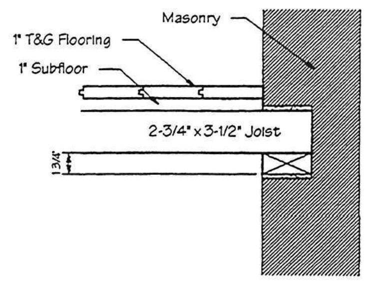
Figure 4
Alternate 4. Drawing by JJR, 1997.

Figure 5
Alternate 4: Cross-section recommendations. Drawing by JJR, 1997.

Appendix A:
Structural Drawings



1 / S.02 **Floor Bearing Detail**
1-1/2" = 1'-0"
0 4" 8" 12" 24"



2 / S.02 **Floor Bearing Detail**
1-1/2" = 1'-0"
0 4" 8" 12" 24"

Notes:
1- 2-3/4 x 3-1/2 at 13.5" centers. 1" pine subfloor and 1" T&G pine flooring.

2- 8 x 7-3/4 beams at perimeter of original tower (3 thus).

3- 2 x 9-1/2 at 15" centers.

4- 2 x 9-3/4 at 14" centers.

5- 2 x 7-7/8 at 14" centers (interior of original historic tower).

6- 4 x 8 beam; floor joists are continuous from exterior wall to exterior wall at the east side of the fireplace.

7- Floor joists are lapped over wall below at the west side of the fireplace.

8- Brick masonry surface spalls observed.

9- Sill stone cracked at window.

10- Previous parge repairs and newer surface spalls in brick masonry.

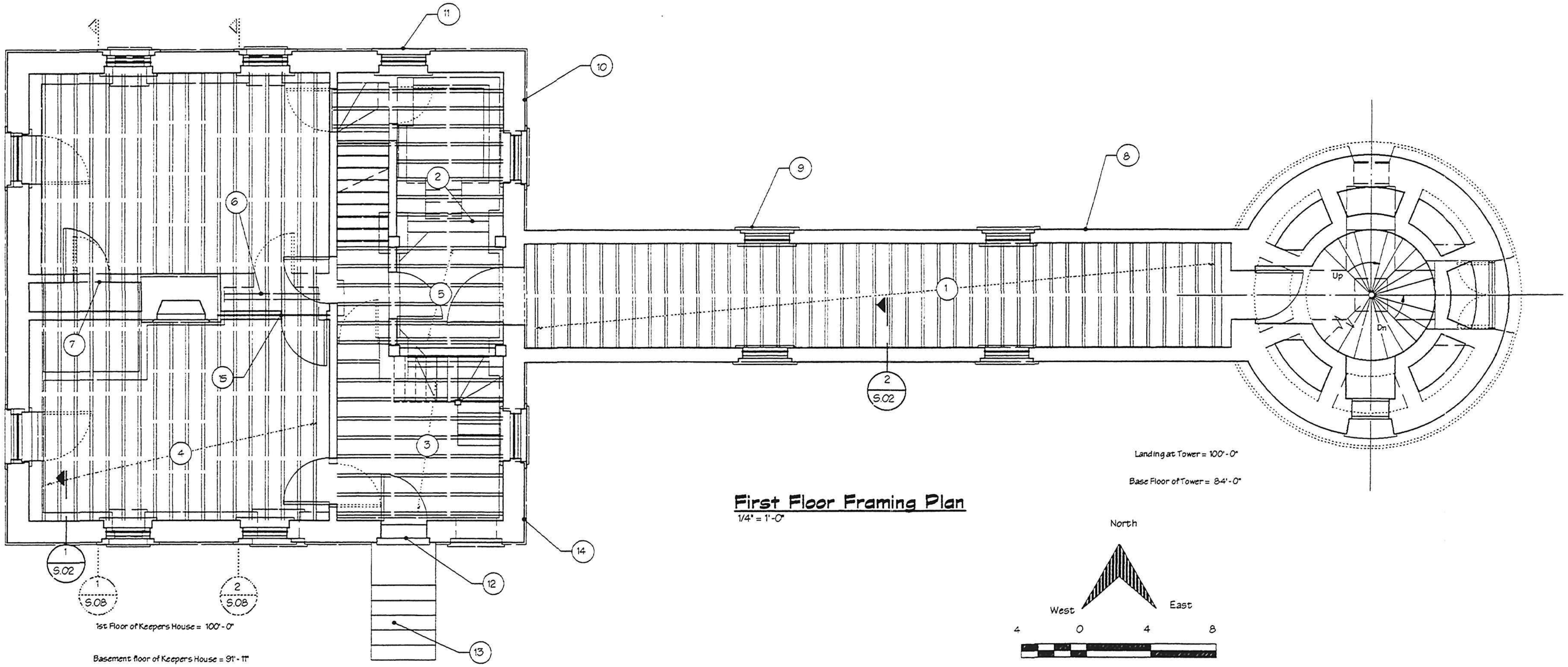
11- Window sill stone is severely cracked and spalled. Open cracks have become impacted with organic's and vegetation was observed growing out of crack.

12- Brick masonry shows signs of weathering and arch keystone above door shows crack.

13- Severe cracking and tilt observed in stair. Condition due to settling, weathering, and frost heave.

14- Brick masonry surface spalls near corner.

15- Add beam and column support below this partition to increase floor load capacity.



1st Floor of Keepers House = 100'-0"

Basement floor of Keepers House = 91'-11"

Landing at Tower = 100'-0"

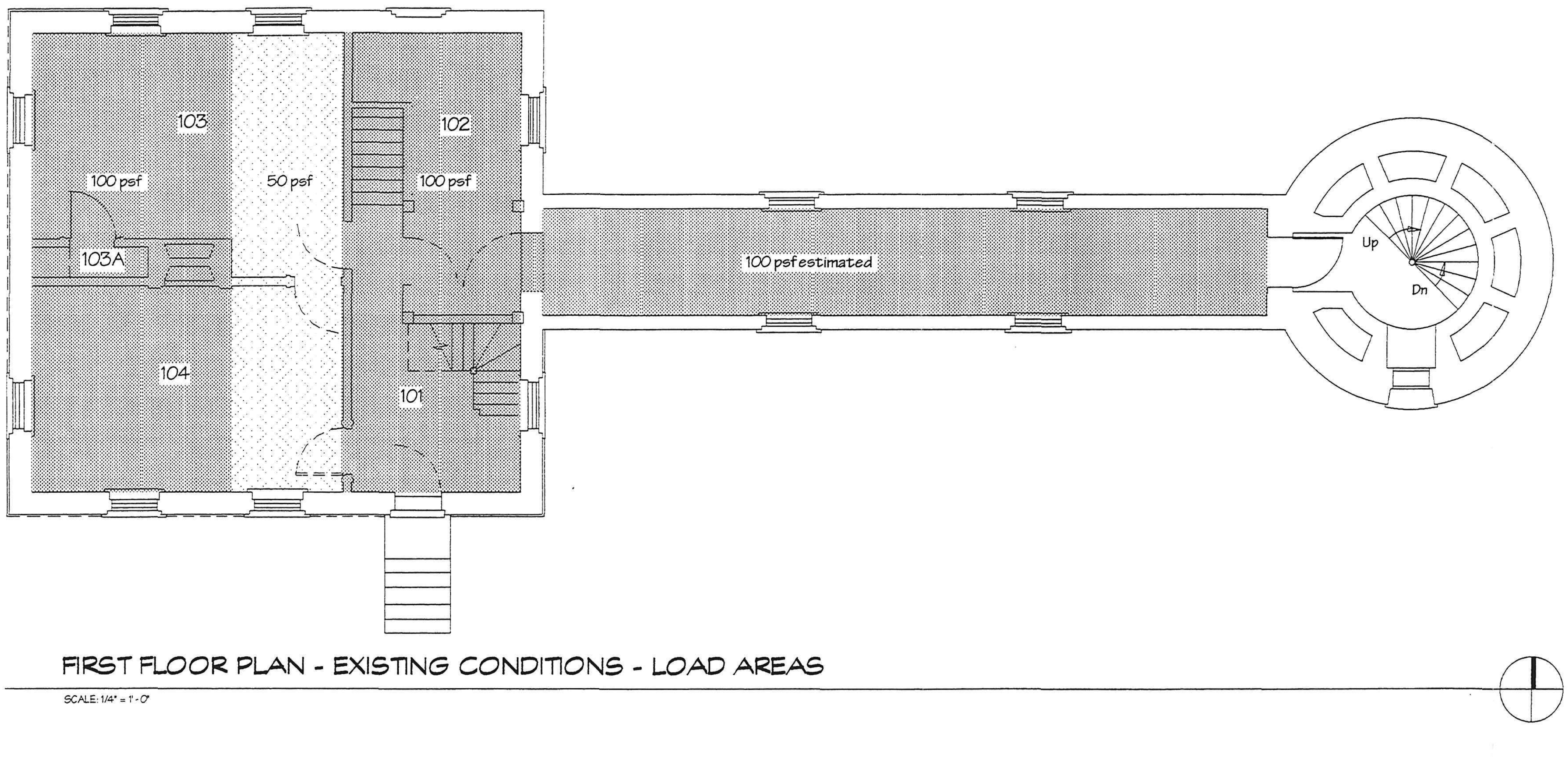
Base Floor of Tower = 84'-0"

First Floor Framing Plan
1/4" = 1'-0"

North
West
East
4 0 4 8

Powercad file: S02fp1

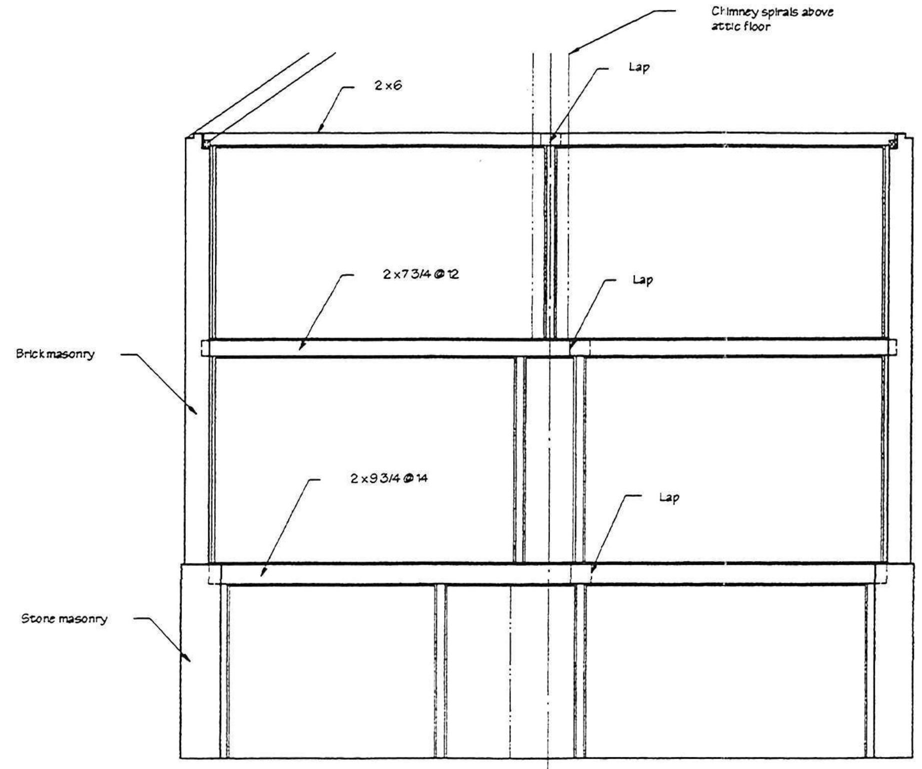
DESIGNED:	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO.
DRAWN:	S.02	KEEPER'S DWELLING AND TOWER EXISTING CONDITIONS	XXX / XXXXX
TECH REVIEW:		SOUTH MANITOU ISLAND LIGHT STATION SLEEPING BEAR DUNES NATIONAL LAKESHORE	PKG. NO. / SHEET X OF XX
DATE:			



FIRST FLOOR PLAN - EXISTING CONDITIONS - LOAD AREAS

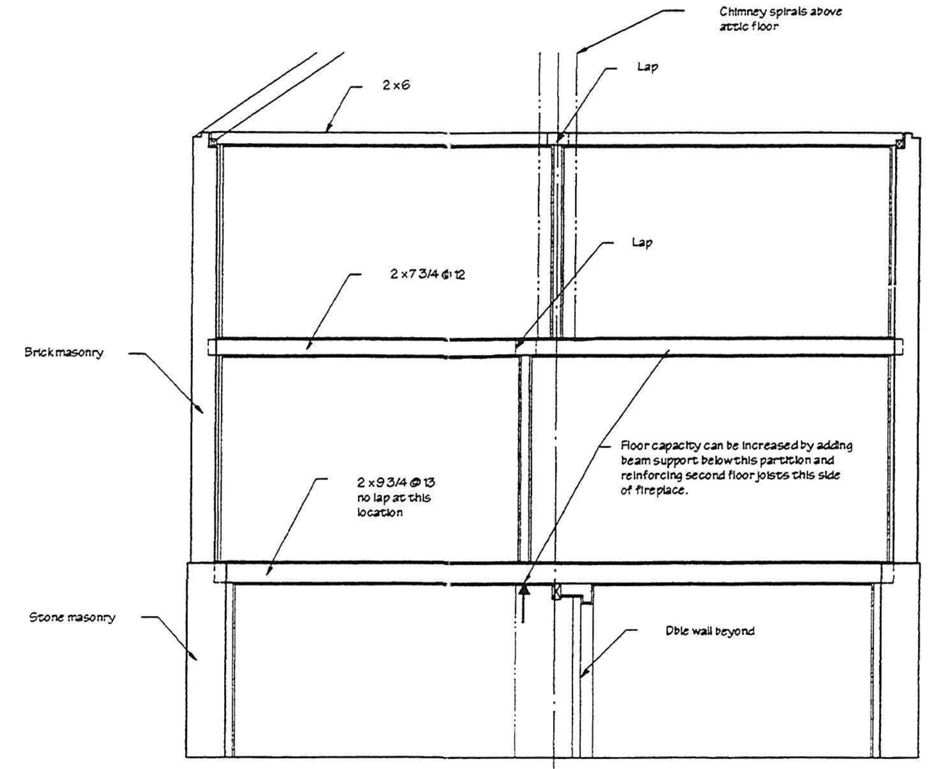
SCALE: 1/4" = 1'-0"

DESIGNED:	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO.
DRAWN:	S.06	KEEPER'S DWELLING AND TOWER EXISTING CONDITIONS	xxx / xxxxx
TECH REVIEW:		SOUTH MANITOU ISLAND LIGHT STATION SLEEPING BEAR DUNES NATIONAL LAKESHORE	PKG. NO. — SHEET X OF XX
DATE:			



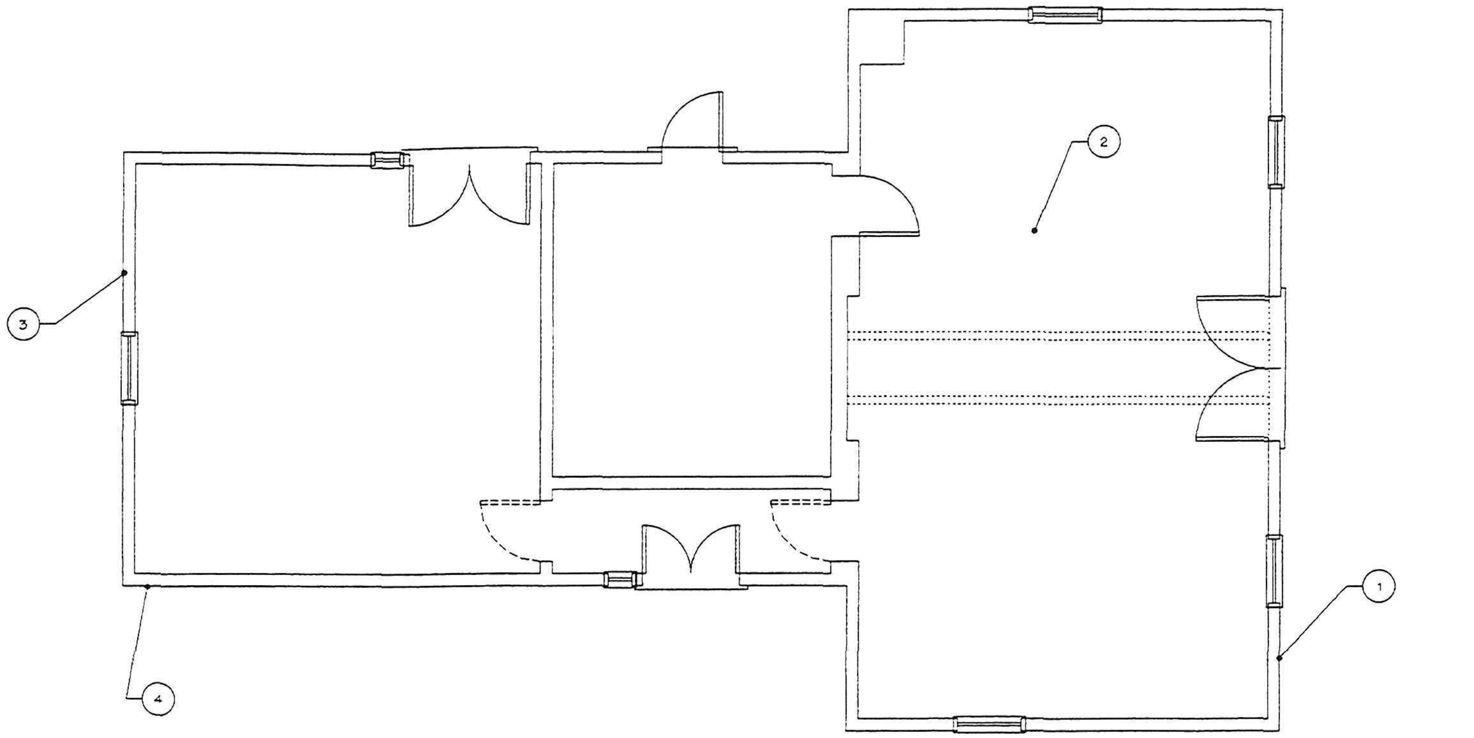
1
S.08
North-south framing at west side of fireplace/chimney
1/4" = 1'-0"

4 0 4 8



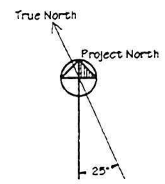
2
S.08
North-south framing at east side of fireplace/chimney
1/4" = 1'-0"

DESIGNED:	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO. xxx / xxxxx
DRAWN:		KEEPER'S DWELLING AND TOWER EXISTING CONDITIONS	
TECH REVIEW:	S.08		PKG. NO. — / SHEET X
DATE:		SOUTH MANITOU ISLAND LIGHT STATION SLEEPING BEAR DUNES NATIONAL LAKESHORE	OF XX



FOG SIGNAL BUILDING PLAN

1/4" = 1'-0"



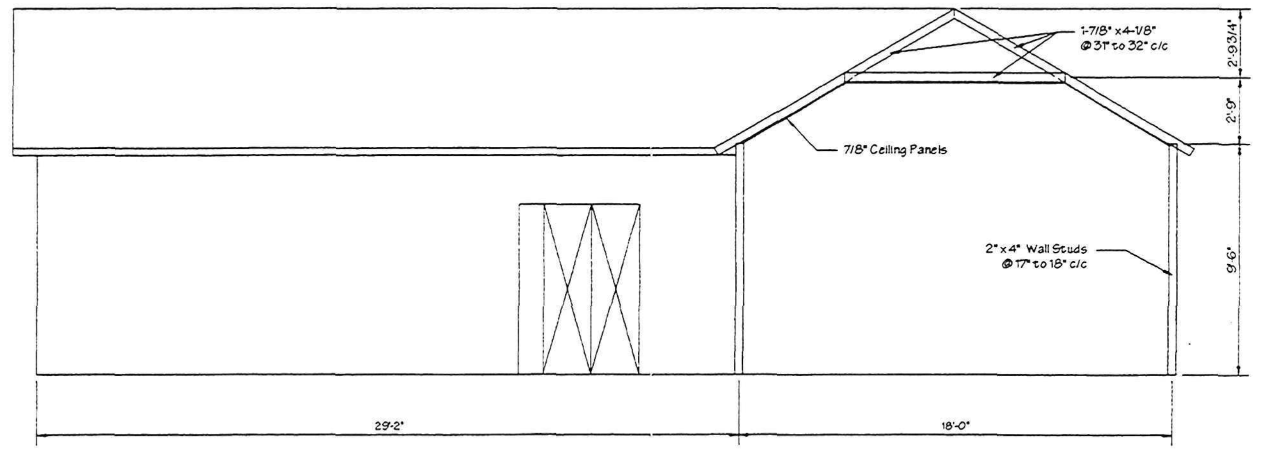
Notes

1- Concrete foundation cracking observed along the east wall.

2- Extensive water staining on the interior wood surfaces of this part of the building.

3- Concrete foundation only at the corners of this building. Probed several locations to a considerable depth and found no foundation. Suspect that a wood sill beam is relied on to carry floor loads to corners.

4- Wood sill beam remnants exposed at this location. Beam shows severe wood rot and has completely rotted away near the corner.

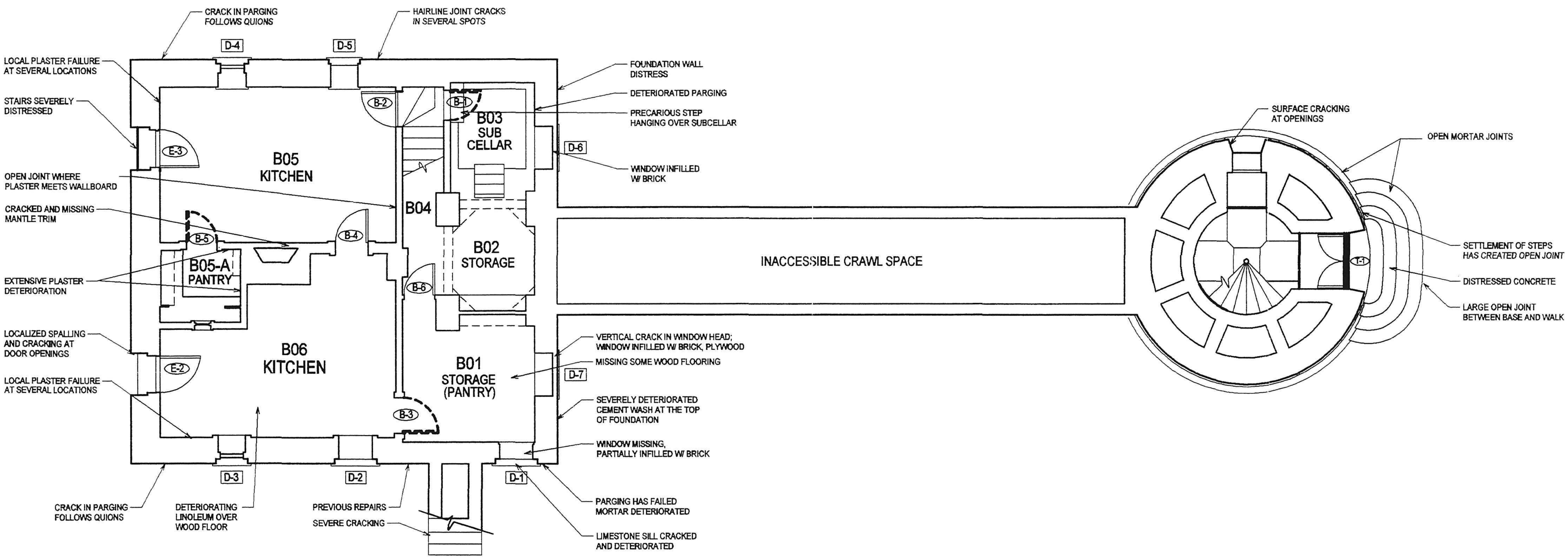


FOG SIGNAL CROSS SECTION

1/4" = 1'-0"

DESIGNED: DRAWN: TECH REVIEW: DATE:	SUB SHEET NO. S.11	TITLE OF SHEET FOG SIGNAL BUILDING EXISTING CONDITIONS SOUTH MANITOU ISLAND LIGHT STATION SLEEPING BEAR DUNES NATIONAL LAKESHORE	DRAWING NO. XXX / XXXXX PKG. NO. — SHEET X OF XX

Appendix B:
Existing Condition Drawings



BASEMENT PLAN - EXISTING CONDITIONS

SCALE: 1/8" = 1' - 0"

4 0 4 8

QUINN EVANS ARCHITECTS
219 1/2 N. Main Street
Ann Arbor, Michigan 48104
734.663.5888

Fitzpatrick Structural Engineering, P.C.
219-1/2 N. Main 1/2 Ann Arbor MI 48104
734-769-0320 Fax 734-769-3015

ISSUED	
DATE	INITIAL
01/15/99	BLR

PREPARED
DESIGNED S.J.; B.R.
DRAWN B.R.
CHECKED S.J.
FIRM QUINN EVANS ARCHITECTS

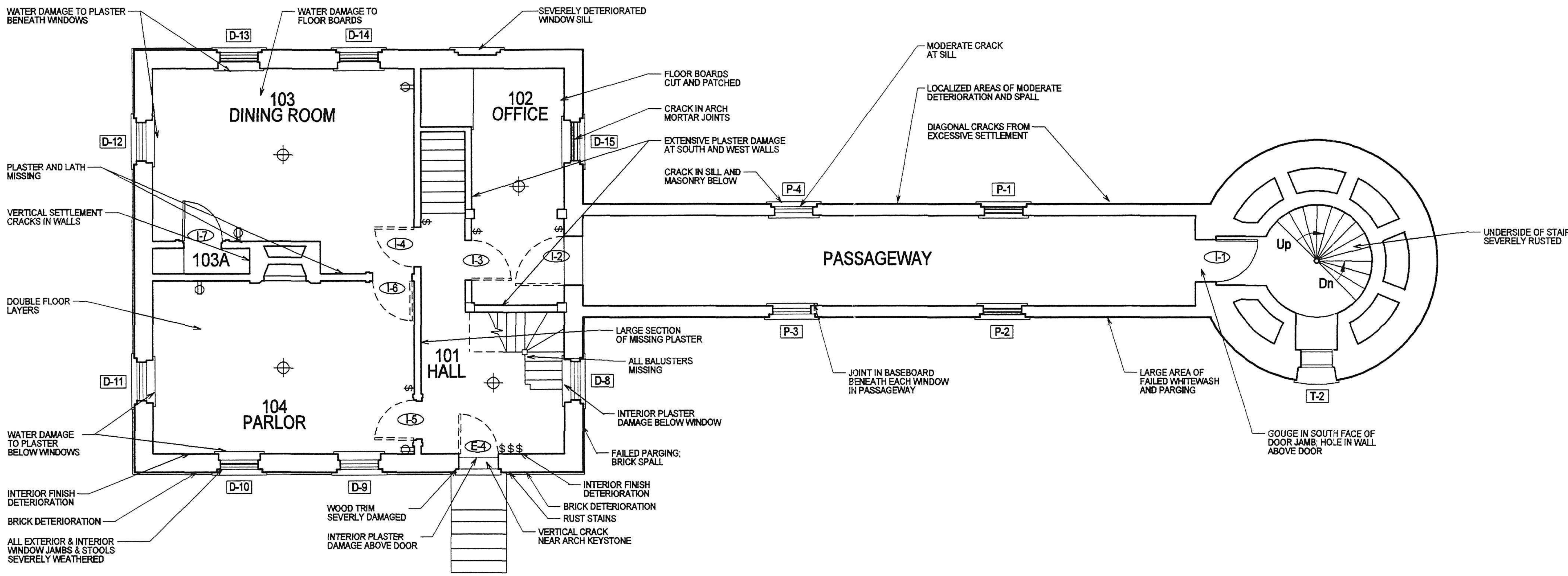
SHEET TITLE
BASEMENT PLAN

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
PLANNING RESOURCE PRESERVATION
MIDWEST REGIONAL OFFICE

EXISTING CONDITIONS
KEEPER'S DWELLING, PASSAGEWAY, AND TOWER
SOUTH MANITOU ISLAND LIGHT STATION
SLEEPING BEAR DUNES NATIONAL LAKESHORE

FILE NAME BSMT.DGN
SUB SHEET NO. A.1

DRAWING NO.
SHEET 01 OF 08

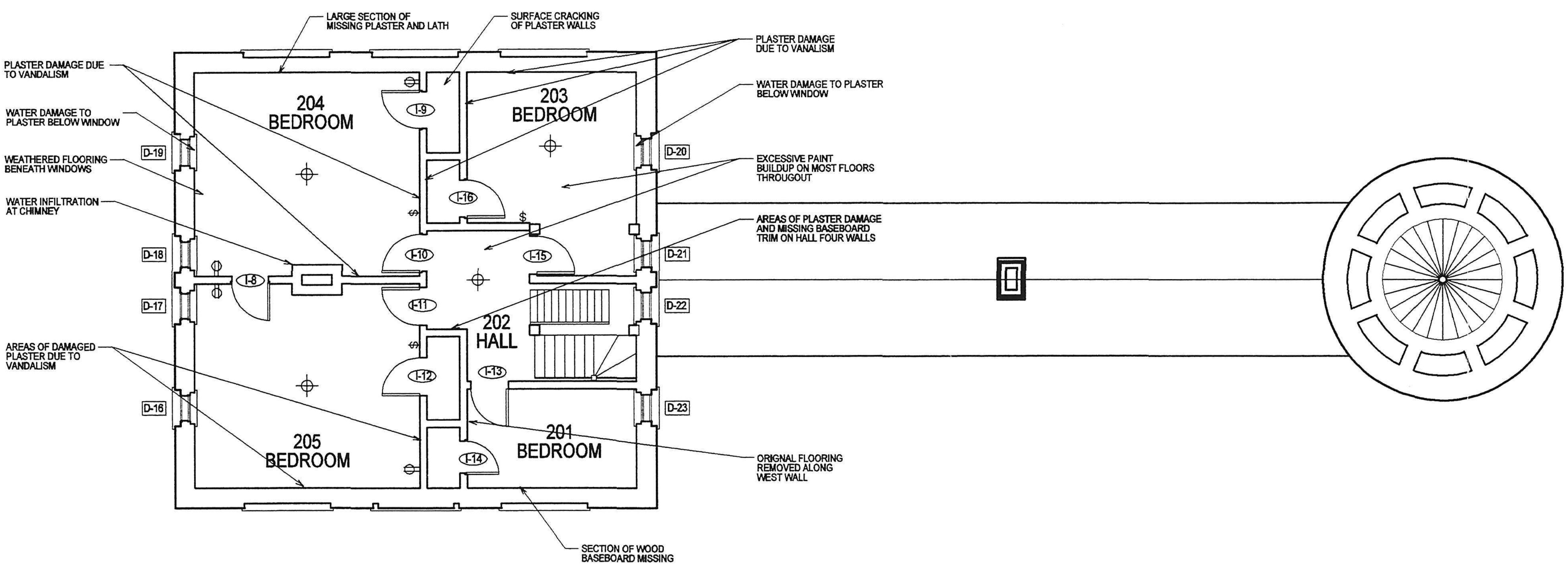


FIRST FLOOR PLAN - EXISTING CONDITIONS

SCALE: 1/8" = 1' - 0"

4 0 4 8

NATIONAL PARK SERVICE	QUINN EVANS ARCHITECTS 219 1/2 N. Main Street Ann Arbor, Michigan 48104 734.663.5888	Fitzpatrick Structural Engineering, P.C. 219-1/2 N. Main 1/2 Ann Arbor MI 48104 734 - 769 - 0320 Fax 734 - 769 - 3015	ISSUED DATE: 01/15/99 INITIAL: BLR	PREPARED DESIGNED S.J.; B.R. DRAWN B.R. CHECKED S.J. FIRM QUINN EVANS ARCHITECTS	SHEET TITLE FIRST FLOOR PLAN	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE PLANNING RESOURCE PRESERVATION MIDWEST REGIONAL OFFICE EXISTING CONDITIONS KEEPER'S DWELLING, PASSAGEWAY, AND TOWER SOUTH MANITOU ISLAND LIGHT STATION SLEEPING BEAR DUNES NATIONAL LAKESHORE	FILE NAME FIRST.DGN SUB SHEET NO. A.2	DRAWING NO. SHEET 02 OF 08

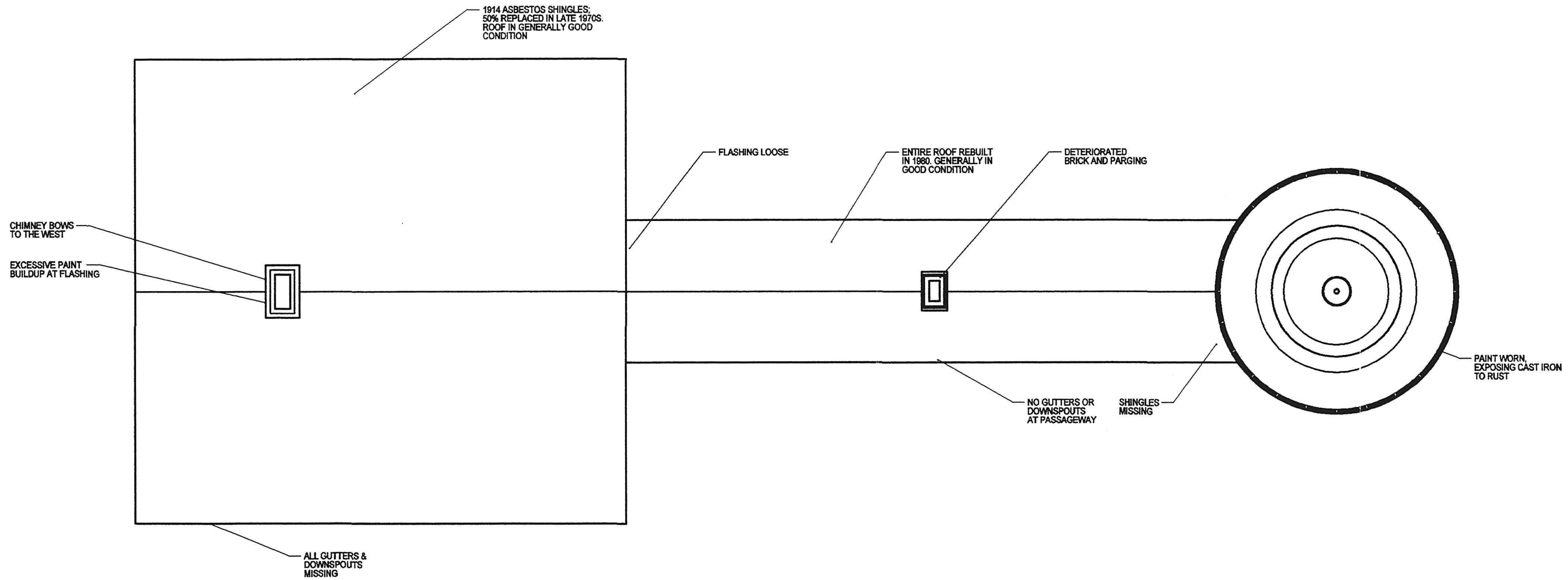


SECOND FLOOR PLAN - EXISTING CONDITIONS

SCALE: 1/8" = 1' - 0"

4 0 4 8

NATIONAL PARK SERVICE	QUINN EVANS ARCHITECTS 219 1/2 N. Main Street Ann Arbor, Michigan 48104 734.663.5888	Fitzpatrick Structural Engineering, P.C. 211-1/2 N. Main 1/2 Ann Arbor MI 48104 734-769-0320 Fax 734-769-3015	ISSUED DATE 01/15/99 INITIAL BLR	PREPARED DESIGNED S.J.; B.R. DRAWN B.R. CHECKED S.J. FIRM QUINN EVANS ARCHITECTS	SHEET TITLE SECOND FLOOR PLAN	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE PLANNING RESOURCE PRESERVATION MIDWEST REGIONAL OFFICE EXISTING CONDITIONS KEEPER'S DWELLING, PASSAGEWAY, AND TOWER SOUTH MANITOU ISLAND LIGHT STATION SLEEPING BEAR DUNES NATIONAL LAKESHORE	FILE NAME SECOND.DGN SUB SHEET NO. A.3	DRAWING NO. SHEET 03 OF 08



ROOF PLAN - EXISTING CONDITIONS

SCALE: 1/8" = 1' - 0"

4 0 4 8

QUINN EVANS ARCHITECTS
219 1/2 N. Main Street
Ann Arbor, Michigan 48104
734.663.5888

Fitzpatrick Structural Engineering, P.C.
219-1/2 N. Main 1/2 Ann Arbor # MI # 48104
734 - 769 - 0320 Fax 734 - 769 - 3015

ISSUED	
DATE	INITIAL
01/15/99	BLR

PREPARED
DESIGNED S.J.; B.R.
DRAWN B.R.
CHECKED S.J.
FIRM QUINN EVANS ARCHITECTS

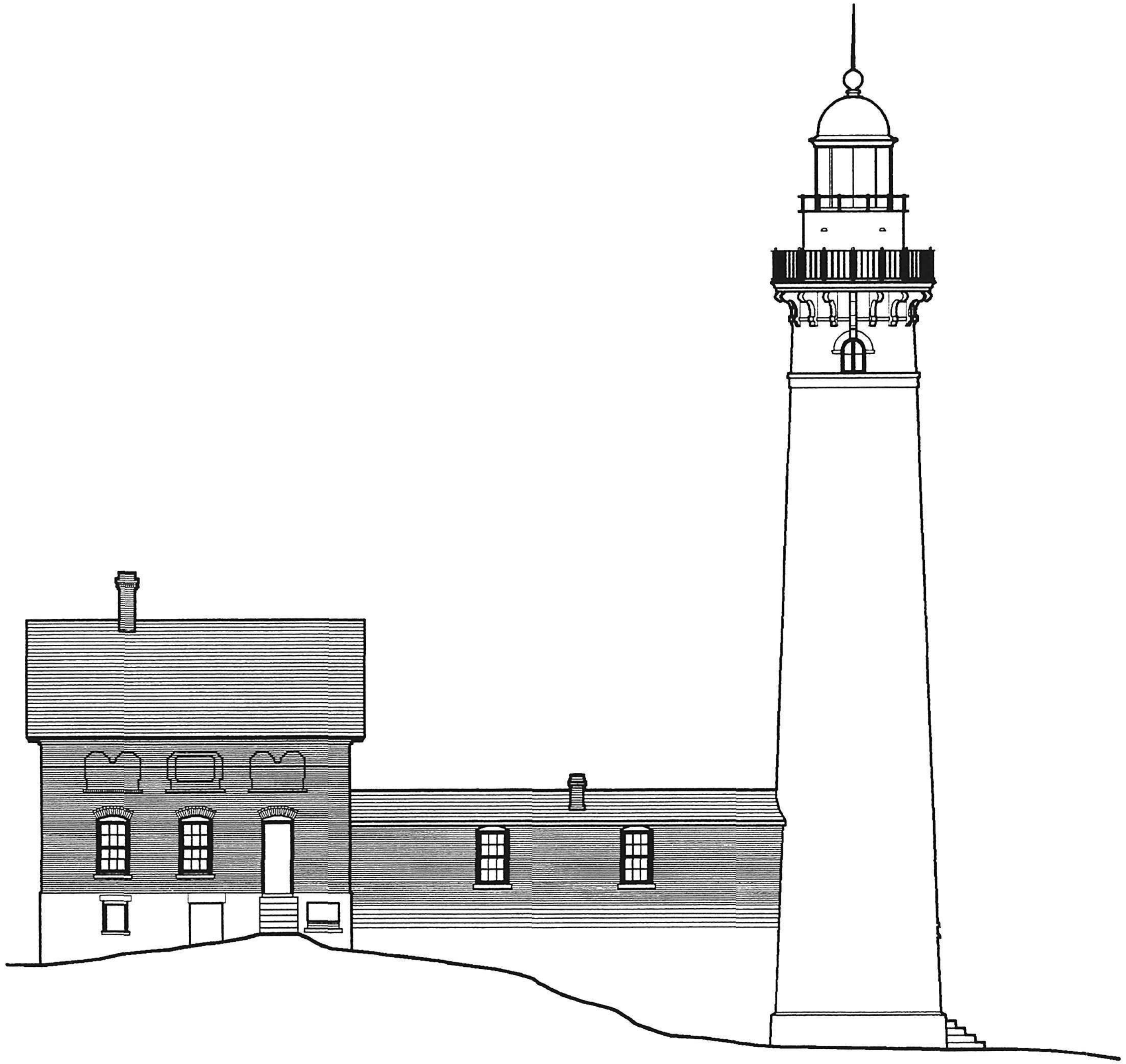
SHEET TITLE
ROOF PLAN

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
PLANNING RESOURCE PRESERVATION
MIDWEST REGIONAL OFFICE

EXISTING CONDITIONS
KEEPER'S DWELLING, PASSAGEWAY, AND TOWER
SOUTH MANITOU ISLAND LIGHT STATION
SLEEPING BEAR DUNES NATIONAL LAKESHORE

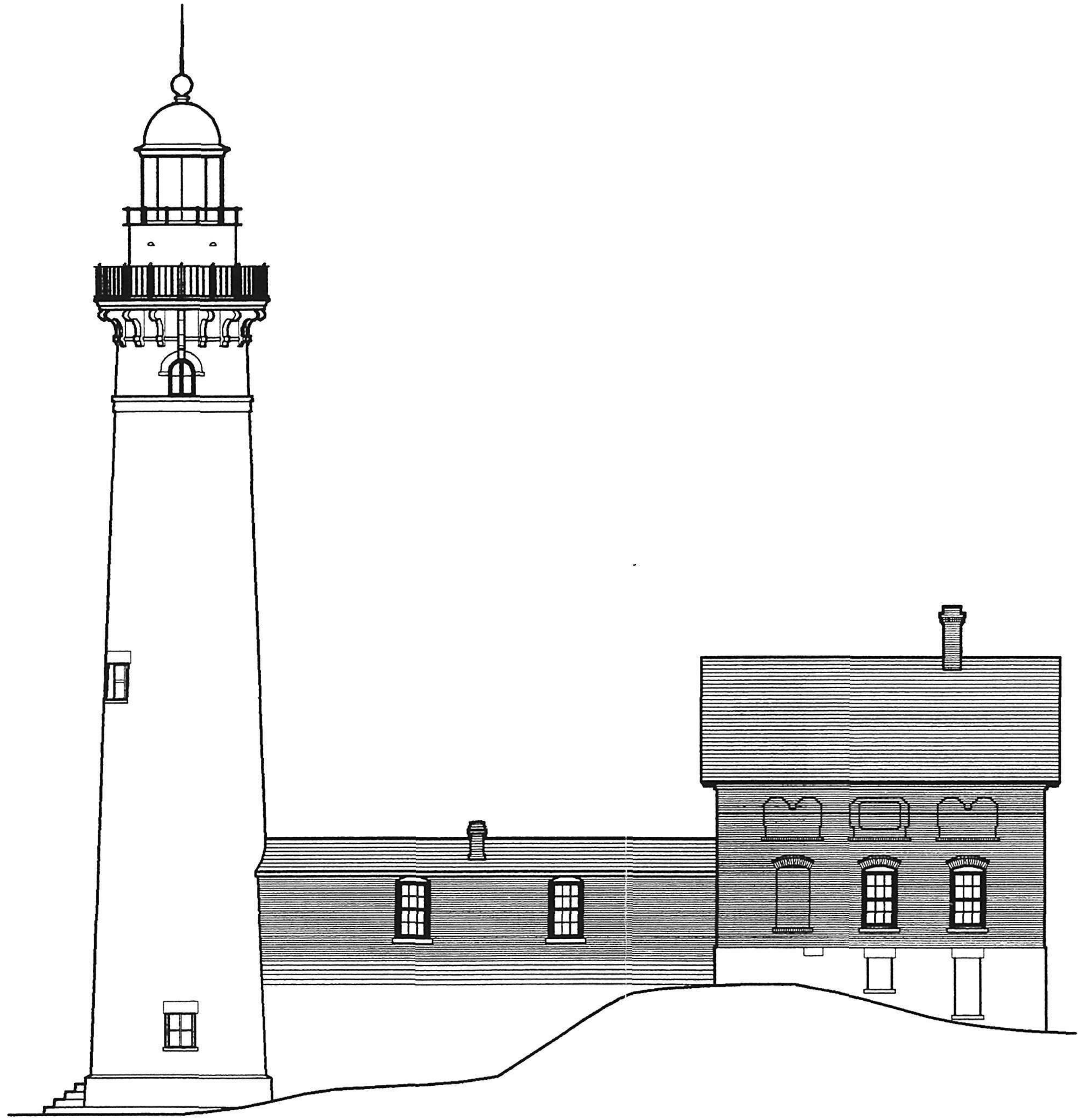
FILE NAME ROOF.DGN
SUB SHEET NO. A.4

DRAWING NO.
SHEET 04 OF 08



SOUTH ELEVATION - EXISTING CONDITIONS

SCALE: 1/16" = 1' - 0"



NORTH ELEVATION - EXISTING CONDITIONS

SCALE: 1/16" = 1' - 0"

8 0 8 16

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Ann Arbor, Michigan 48104
734.663.5888

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734 - 769 - 0320 Fax 734 - 769 - 3015

ISSUED	
DATE	INITIAL
01/15/99	BLR

PREPARED
DESIGNED S.J.; B.R.
DRAWN B.R.
CHECKED S.J.
FIRM QUINN EVANS ARCHITECTS

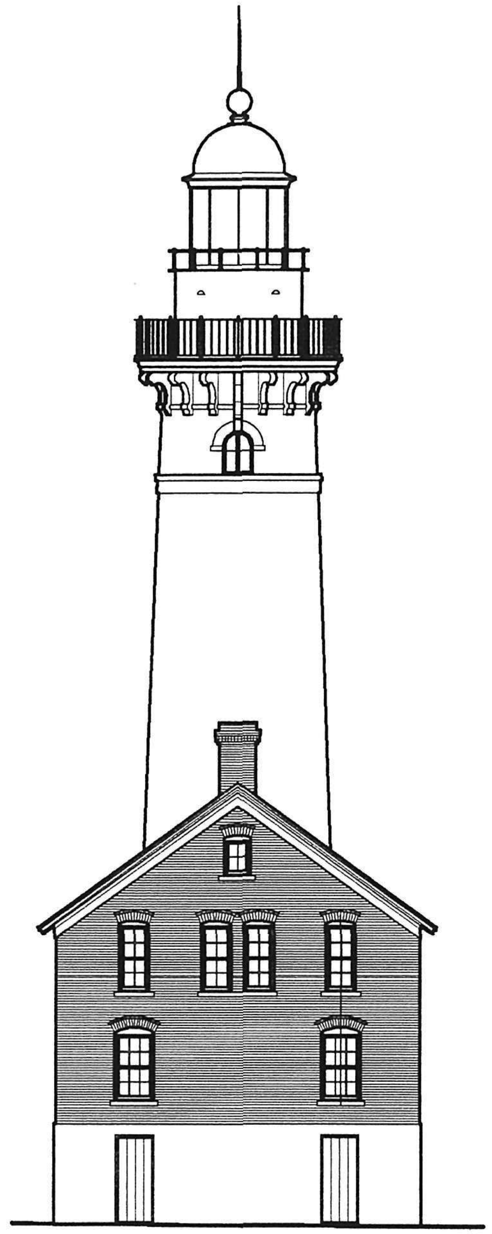
SHEET TITLE
NORTH AND SOUTH ELEVATIONS

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
PLANNING RESOURCE PRESERVATION
MIDWEST REGIONAL OFFICE

EXISTING CONDITIONS
KEEPER'S DWELLING, PASSAGEWAY, AND TOWER
SOUTH MANITOU ISLAND LIGHT STATION
SLEEPING BEAR DUNES NATIONAL LAKESHORE

FILE NAME N-ELEV.DGN
SUB SHEET NO. A.5

DRAWING NO.
SHEET 05 OF 08

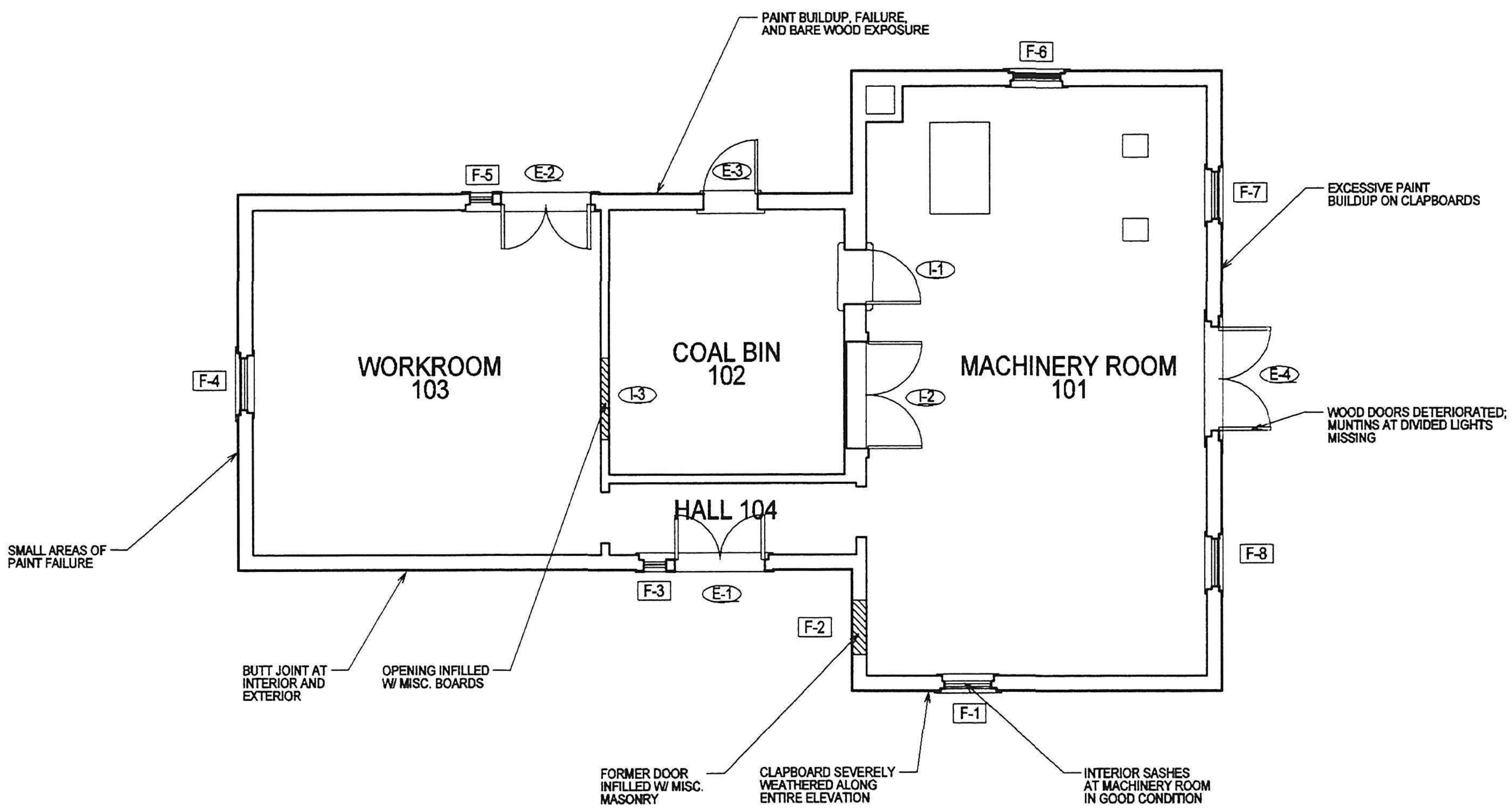


WEST ELEVATION - EXISTING CONDITIONS
SCALE: 1/16" = 1' - 0"

EAST ELEVATION - EXISTING CONDITIONS
SCALE: 1/16" = 1' - 0"

8 0 8 16

NATIONAL PARK SERVICE	QUINN EVANS ARCHITECTS 219 1/2 N. Main Street Ann Arbor, Michigan 48104 734.663.5888	Fitzpatrick Structural Engineering, P.C. 219-1/2 N. Main 1/2 Ann Arbor * MI * 48104 734 - 769 - 0320 Fax 734 - 769 - 3015	ISSUED DATE: 01/15/99 INITIAL: BLR	PREPARED DESIGNED S.J.; B.R. DRAWN B.R. CHECKED S.J. FIRM QUINN EVANS ARCHITECTS	SHEET TITLE EAST AND WEST ELEVATIONS	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE PLANNING RESOURCE PRESERVATION MIDWEST REGIONAL OFFICE EXISTING CONDITIONS KEEPER'S DWELLING, PASSAGEWAY, AND TOWER SOUTH MANITOU ISLAND LIGHT STATION SLEEPING BEAR DUNES NATIONAL LAKESHORE	FILE NAME W-ELEV.DGN SUB SHEET NO. A.6	DRAWING NO. SHEET 06 OF 08



FIRST FLOOR PLAN - EXISTING CONDITIONS

SCALE: 1/8" = 1' - 0"

4 0 4 8

QUINN EVANS ARCHITECTS
219 1/2 N. Main Street
Ann Arbor, Michigan 48104
734.663.5888

Fitzpatrick Structural Engineering, P.C.
219-1/2 N. Main ½ ½ Ann Arbor MI 48104
734 - 769 - 0320 Fax 734 - 769 - 3015

ISSUED	
DATE	INITIAL
01/15/99	BLR

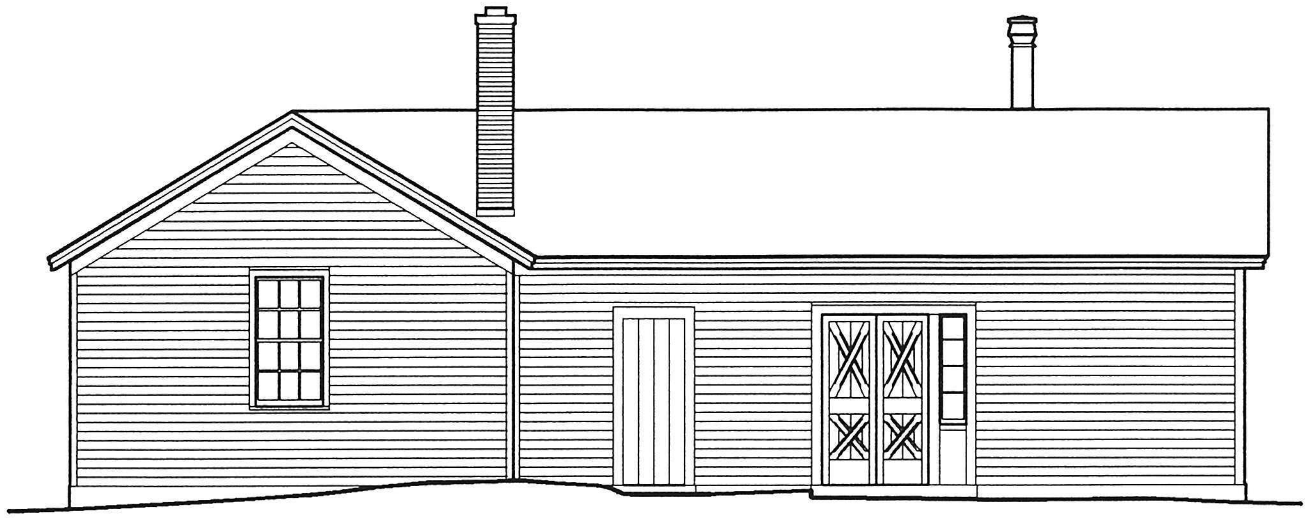
PREPARED
DESIGNED S.J.; B.R.
DRAWN B.R.
CHECKED S.J.
FIRM QUINN EVANS ARCHITECTS

SHEET TITLE
FLOOR PLAN

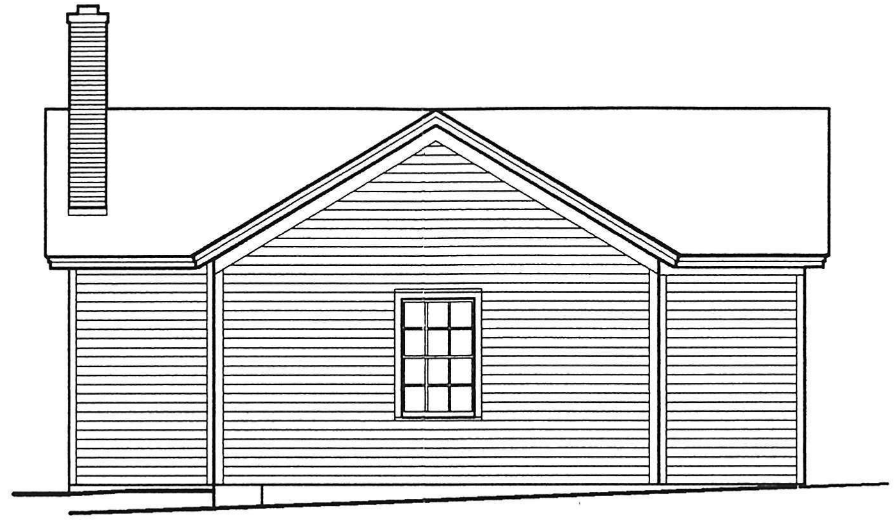
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
PLANNING RESOURCE PRESERVATION
MIDWEST REGIONAL OFFICE

EXISTING CONDITIONS
FOG SIGNAL BUILDING
SOUTH MANITOU ISLAND LIGHT STATION
SLEEPING BEAR DUNES NATIONAL LAKESHORE

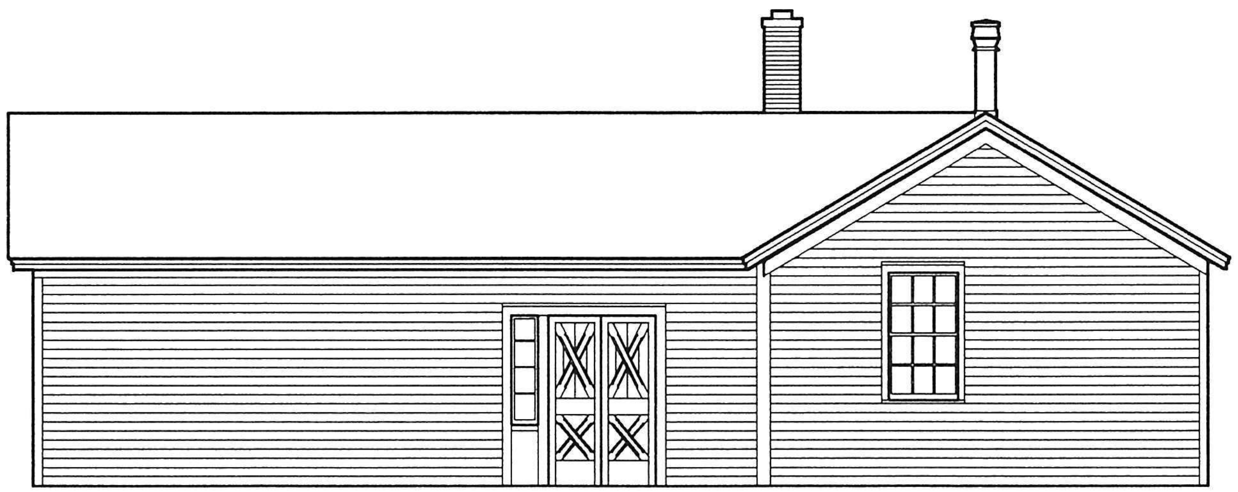
FILE NAME FOGSIG.DGN
SUB SHEET NO. A.7
DRAWING NO.
SHEET 07 OF 08



north



west



south

east

ELEVATIONS - EXISTING CONDITIONS

SCALE: 1/8" = 1' - 0"

4 0 4 8

QUINN EVANS ARCHITECTS
219 1/2 N. Main Street
Ann Arbor, Michigan 48104
734.663.5888

Fitzpatrick Structural Engineering, P.C.
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734 - 769 - 0320 Fax 734 - 769 - 3015

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PREPARED
DESIGNED S.J.; B.R.
DRAWN B.R.
CHECKED S.J.
FIRM QUINN EVANS ARCHITECTS

SHEET TITLE
ELEVATIONS

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
PLANNING RESOURCE PRESERVATION
MIDWEST REGIONAL OFFICE

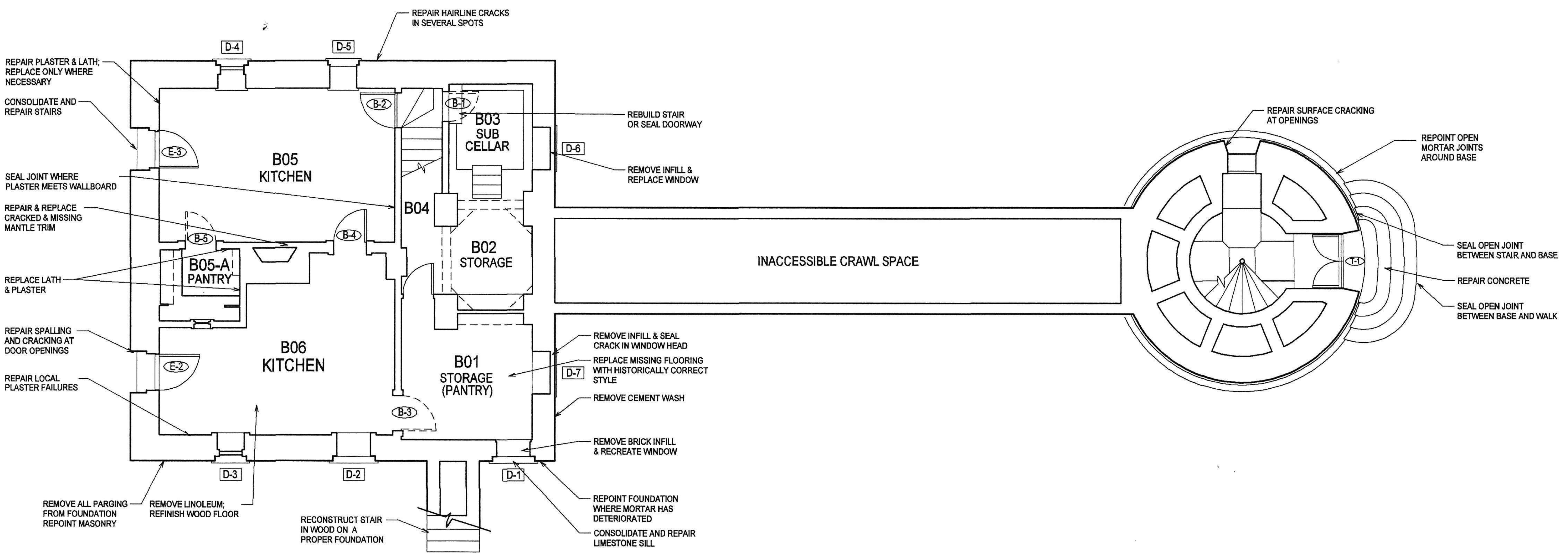
EXISTING CONDITIONS
FOG SIGNAL BUILDING
SOUTH MANITOU ISLAND LIGHT STATION
SLEEPING BEAR DUNES NATIONAL LAKESHORE

FILE NAME FOGSIGEL.DGN
SUB SHEET NO. A.8

DRAWING NO.
SHEET 08 OF 08

Appendix C:

Recommended Treatment Drawings



BASEMENT PLAN - RECOMMENDED TREATMENTS

SCALE: 1/8" = 1' - 0"

4 0 4 8

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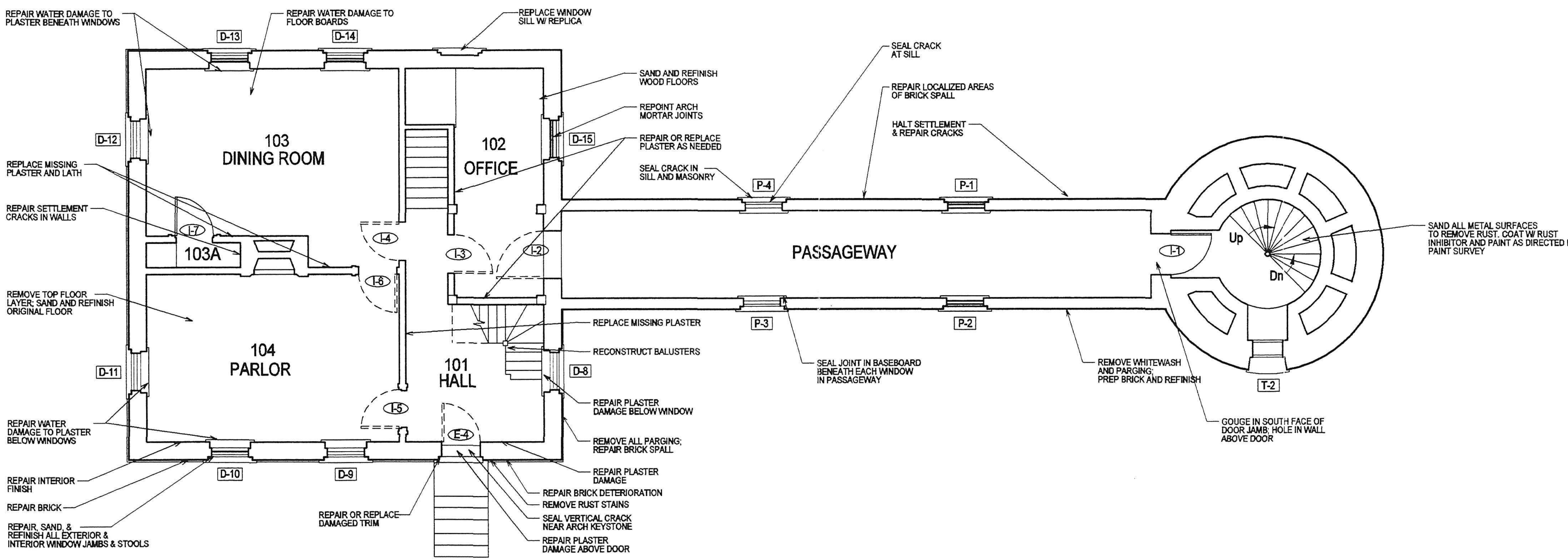
PREPARED
DESIGNED S.J.; B.R.
DRAWN B.R.
CHECKED S.J.
FIRM QUINN EVANS ARCHITECTS

SHEET TITLE
BASEMENT PLAN

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
PLANNING RESOURCE PRESERVATION
MIDWEST REGIONAL OFFICE

RECOMMENDED TREATMENTS
KEEPER'S DWELLING, PASSAGEWAY, AND TOWER
SOUTH MANITOU ISLAND LIGHT STATION
SLEEPING BEAR DUNES NATIONAL LAKESHORE

FILE NAME BSMT.DGN
SUB SHEET NO. A.1
DRAWING NO.
SHEET 01 OF 08



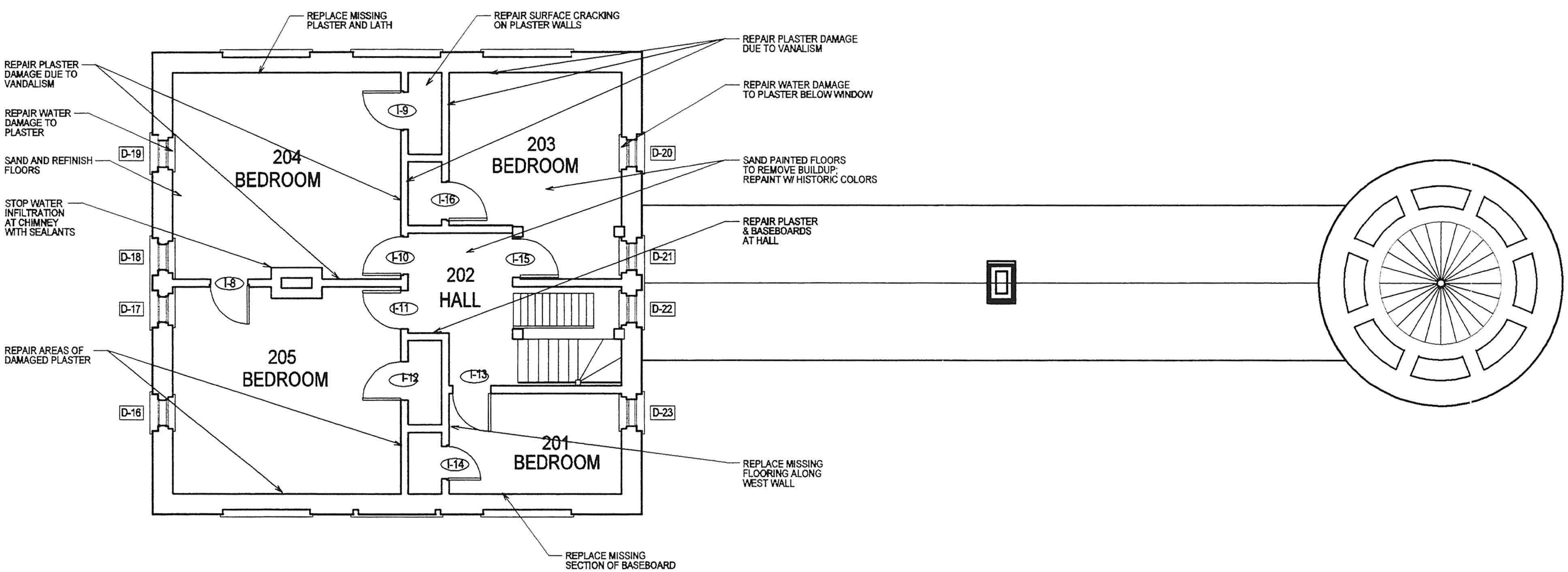
FIRST FLOOR PLAN - RECOMMENDED TREATMENTS

SCALE: 1/8" = 1' - 0"

4 0 4 8

QUINN EVANS ARCHITECTS 219 1/2 N. Main Street Ann Arbor, Michigan 48104 734.663.5888	Fitzpatrick Structural Engineering, P.C. 219-1/2 N. Main ½ ½ Ann Arbor ≡ MI ≡ 48104 734 - 769 - 0320 Fax 734 - 769 - 3015	ISSUED DATE: 01/15/99 INITIAL: BLR	PREPARED DESIGNED S.J.; B.R. DRAWN B.R. CHECKED S.J. FIRM QUINN EVANS ARCHITECTS	SHEET TITLE FIRST FLOOR PLAN

UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE PLANNING RESOURCE PRESERVATION MIDWEST REGIONAL OFFICE RECOMMENDED TREATMENTS KEEPER'S DWELLING, PASSAGEWAY, AND TOWER SOUTH MANITOU ISLAND LIGHT STATION SLEEPING BEAR DUNES NATIONAL LAKESHORE	FILE NAME FIRST.DGN SUB SHEET NO. A.2	DRAWING NO. SHEET 02 OF 08



SECOND FLOOR PLAN - RECOMMENDED TREATMENTS

SCALE: 1/8" = 1' - 0"

4 0 4 8

QUINN EVANS ARCHITECTS
219 1/2 N. Main Street
Ann Arbor, Michigan 48104
734.663.5888

Fitzpatrick Structural Engineering, P.C.
219-1/2 N. Main 1/2 Ann Arbor MI 48104
734 - 769 - 0320 Fax 734 - 769 - 3015

ISSUED	
DATE	INITIAL
01/15/99	BLR

PREPARED
DESIGNED S.J.; B.R.
DRAWN B.R.
CHECKED S.J.
FIRM QUINN EVANS ARCHITECTS

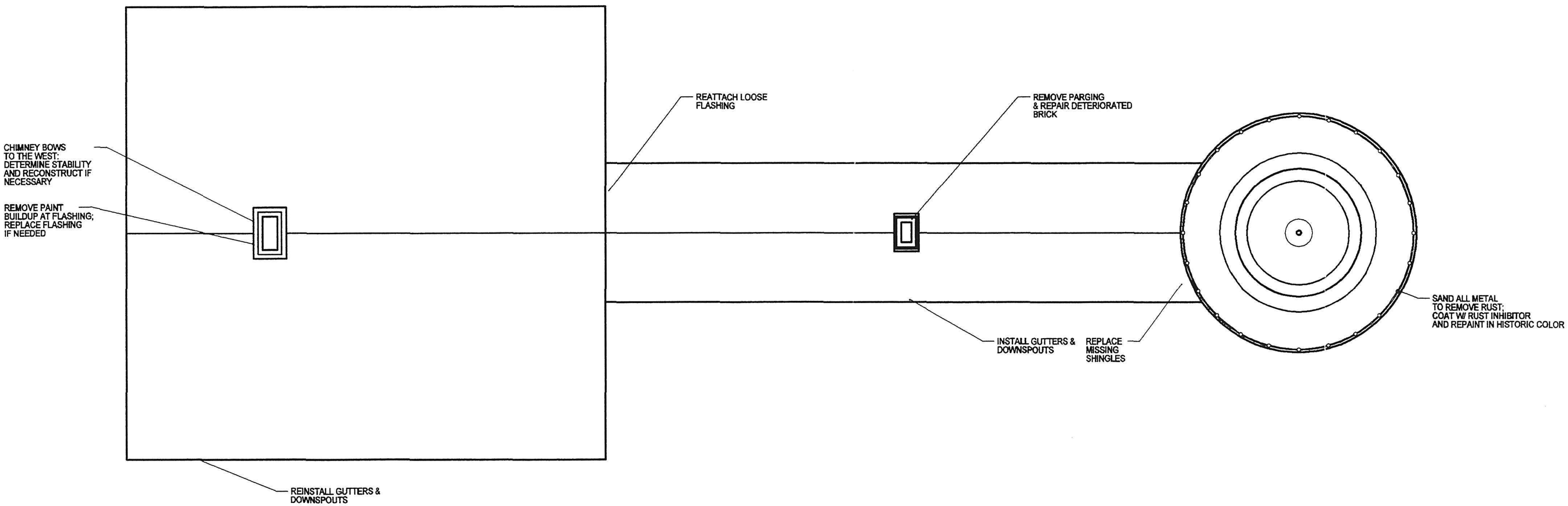
SHEET TITLE
SECOND FLOOR PLAN

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
PLANNING RESOURCE PRESERVATION
MIDWEST REGIONAL OFFICE

RECOMMENDED TREATMENTS
KEEPER'S DWELLING, PASSAGEWAY, AND TOWER
SOUTH MANITOU ISLAND LIGHT STATION
SLEEPING BEAR DUNES NATIONAL LAKESHORE

FILE NAME SECOND.DGN
SUB SHEET NO. A.3

DRAWING NO.
SHEET 03 OF 08



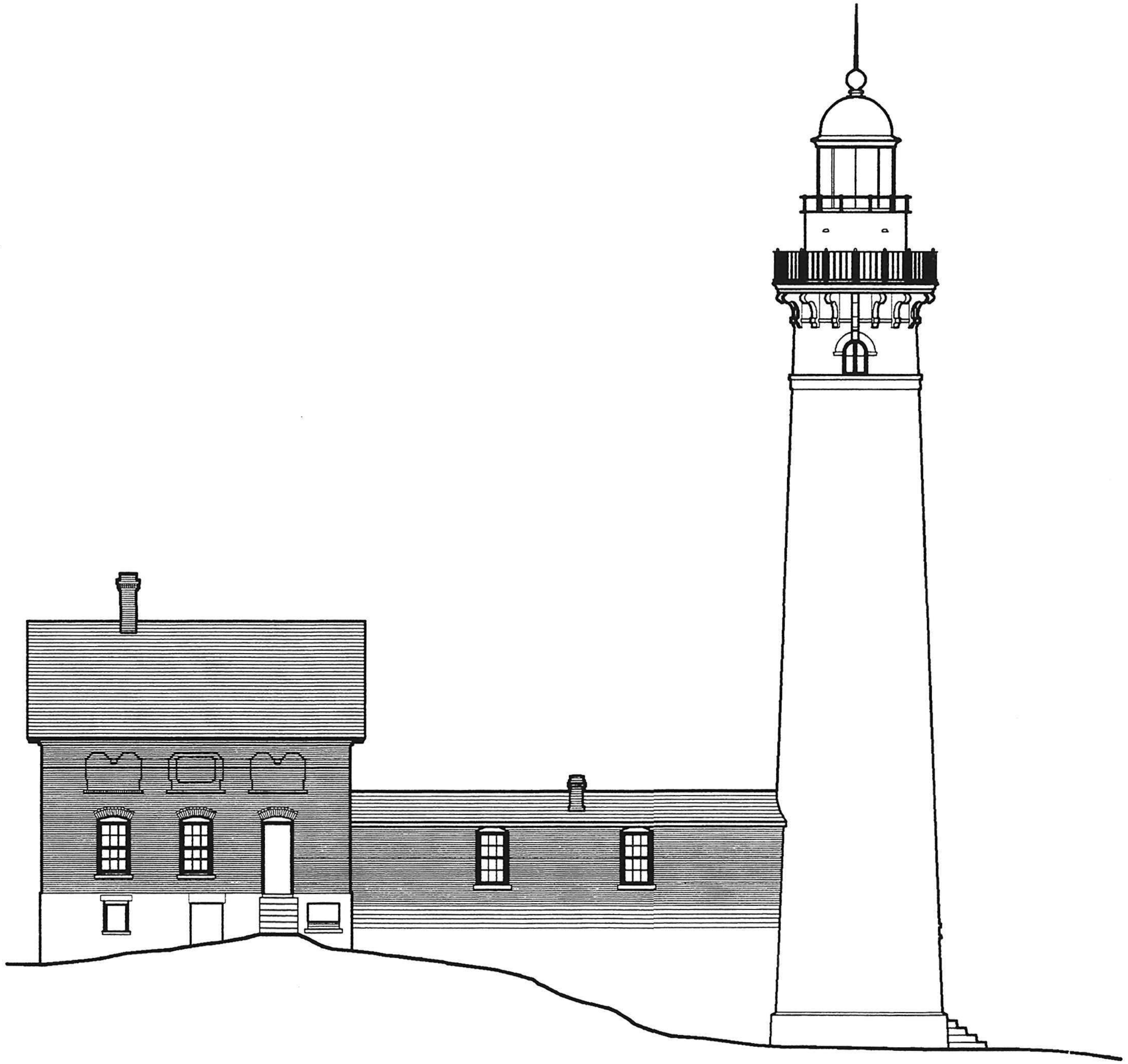
ROOF PLAN - RECOMMENDED TREATMENTS

SCALE: 1/8" = 1' - 0"

4 0 4 8

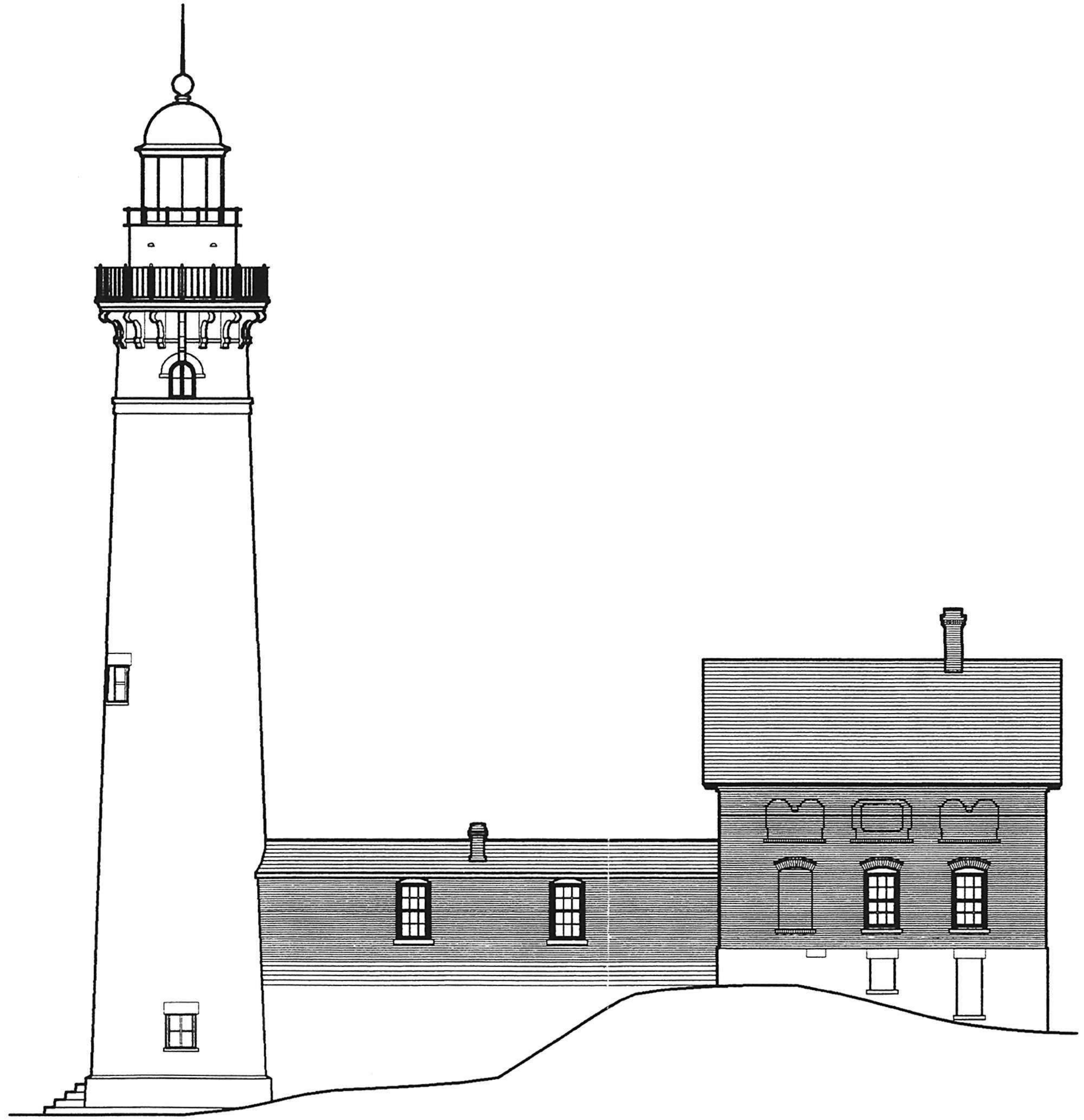
QUINN EVANS ARCHITECTS 219 1/2 N. Main Street Ann Arbor, Michigan 48104 734.663.5888	Fitzpatrick Structural Engineering, P.C. 219-1/2 N. Main 1/2 Ann Arbor * MI * 48104 734 - 769 - 0320 Fax 734 - 769 - 3015	ISSUED DATE: 01/15/99 INITIAL: BLR	PREPARED DESIGNED S.J.; B.R. DRAWN B.R. CHECKED S.J. FIRM QUINN EVANS ARCHITECTS	SHEET TITLE ROOF PLAN

UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE PLANNING RESOURCE PRESERVATION MIDWEST REGIONAL OFFICE RECOMMENDED TREATMENTS KEEPER'S DWELLING, PASSAGEWAY, AND TOWER SOUTH MANITOU ISLAND LIGHT STATION SLEEPING BEAR DUNES NATIONAL LAKESHORE	FILE NAME ROOF.DGN SUB SHEET NO. A.4	DRAWING NO. SHEET 04 OF 08



SOUTH ELEVATION - RECOMMENDED TREATMENTS

SCALE: 1/16" = 1' - 0"

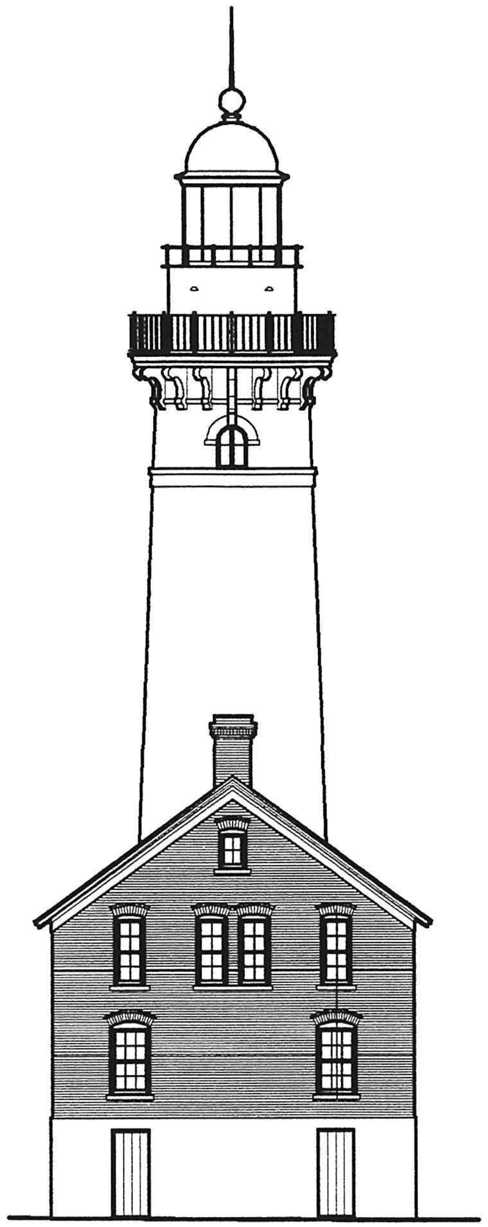


NORTH ELEVATION - RECOMMENDED TREATMENTS

SCALE: 1/16" = 1' - 0"

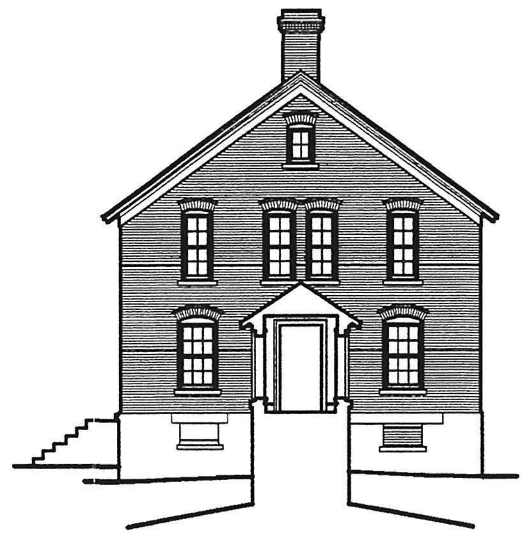
8 0 8 16

NATIONAL PARK SERVICE	QUINN EVANS ARCHITECTS 219 1/2 N. Main Street Ann Arbor, Michigan 48104 734.663.5888	Fitzpatrick Structural Engineering, P.C. 219-1/2 N. Main 1/2 Ann Arbor * MI * 48104 734 - 769 - 0320 Fax 734 - 769 - 3015	ISSUED DATE: 01/15/99 INITIAL: BLR	PREPARED DESIGNED S.J.; B.R. DRAWN B.R. CHECKED S.J. FIRM QUINN EVANS ARCHITECTS	SHEET TITLE NORTH AND SOUTH ELEVATIONS	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE PLANNING RESOURCE PRESERVATION MIDWEST REGIONAL OFFICE RECOMMENDED TREATMENTS KEEPER'S DWELLING, PASSAGEWAY, AND TOWER SOUTH MANITOU ISLAND LIGHT STATION SLEEPING BEAR DUNES NATIONAL LAKESHORE	FILE NAME N-ELEV.DGN SUB SHEET NO. A.5	DRAWING NO. SHEET 05 OF 08



WEST ELEVATION - RECOMMENDED TREATMENTS

SCALE: 1/16" = 1' - 0"



EAST ELEVATION - RECOMMENDED TREATMENTS

SCALE: 1/16" = 1' - 0"

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DESIGNED S.J.; B.R.
DRAWN B.R.
CHECKED S.J.
FIRM QUINN EVANS ARCHITECTS

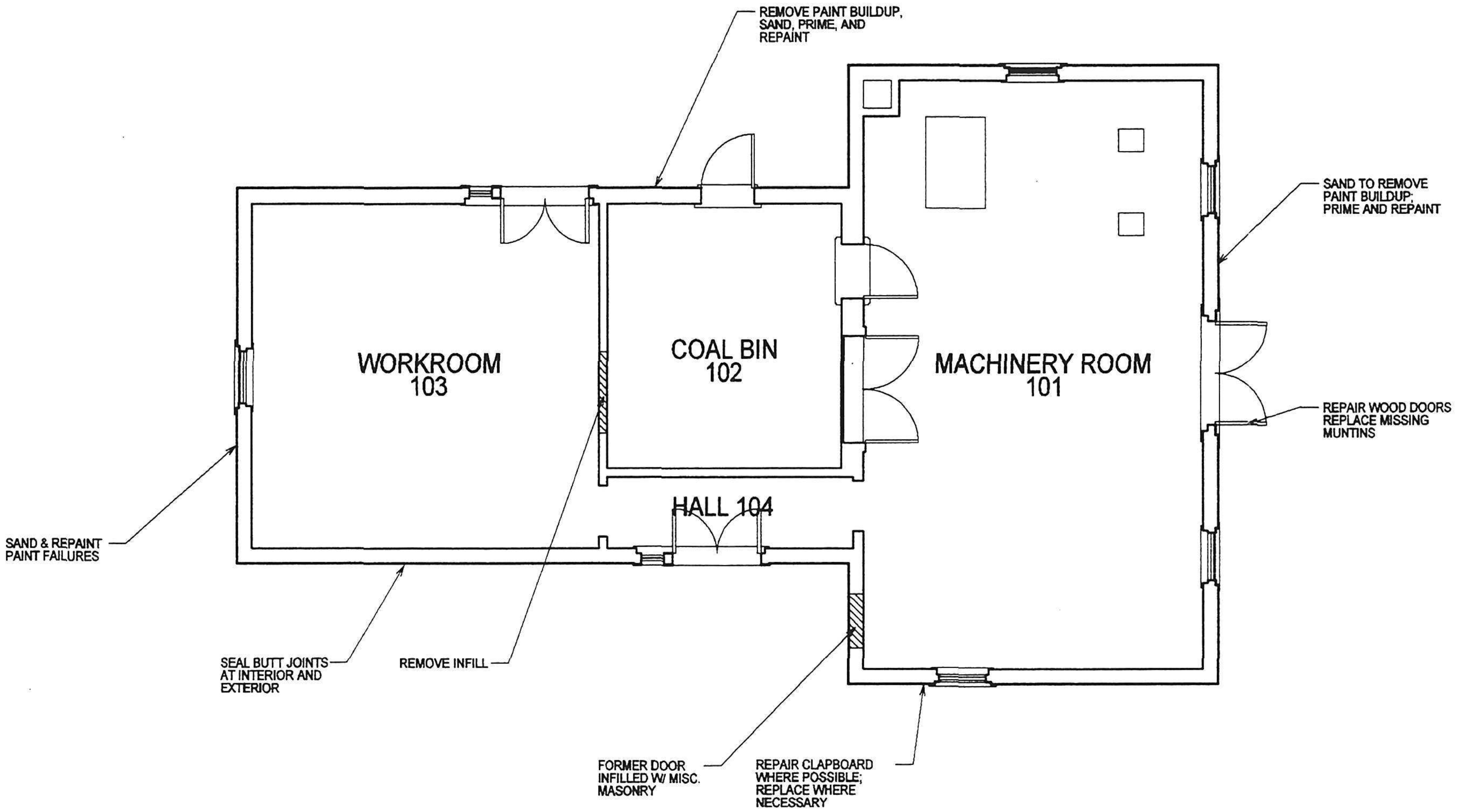
SHEET TITLE
EAST AND WEST ELEVATIONS

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
PLANNING RESOURCE PRESERVATION
MIDWEST REGIONAL OFFICE

RECOMMENDED TREATMENTS
KEEPER'S DWELLING, PASSAGEWAY, AND TOWER
SOUTH MANITOU ISLAND LIGHT STATION
SLEEPING BEAR DUNES NATIONAL LAKESHORE

FILE NAME W-ELEV.DGN
SUB SHEET NO. A.6

DRAWING NO.
SHEET 06 OF 08



FIRST FLOOR PLAN - RECOMMENDED TREATMENTS

SCALE: 1/8" = 1' - 0"

NATIONAL PARK SERVICE

QUINN EVANS ARCHITECTS
219 1/2 N. Main Street
Ann Arbor, Michigan 48104
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Fitzpatrick Structural Engineering, P.C.
219-1/2 N. Main 1/2 Ann Arbor * MI * 48104
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DATE	INITIAL
01/15/99	BLR

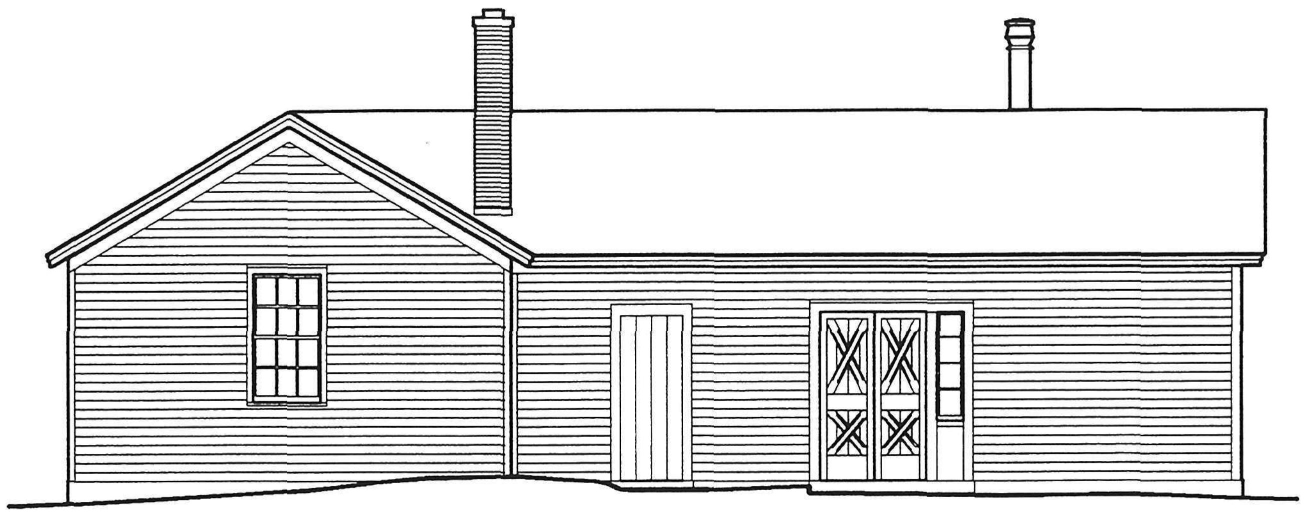
PREPARED
DESIGNED S.J.; B.R.
DRAWN B.R.
CHECKED S.J.
FIRM QUINN EVANS ARCHITECTS

SHEET TITLE
FLOOR PLAN

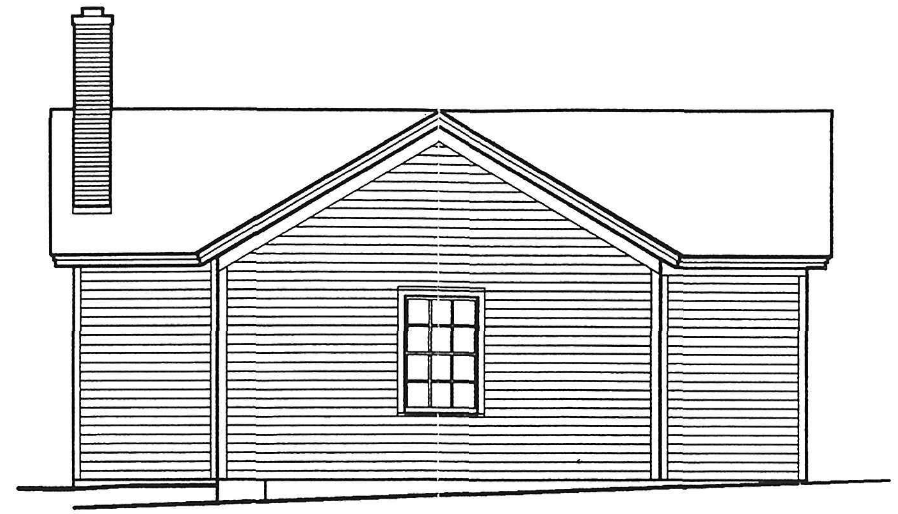
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
PLANNING RESOURCE PRESERVATION
MIDWEST REGIONAL OFFICE

RECOMMENDED TREATMENTS
FOG SIGNAL BUILDING
SOUTH MANITOU ISLAND LIGHT STATION
SLEEPING BEAR DUNES NATIONAL LAKESHORE

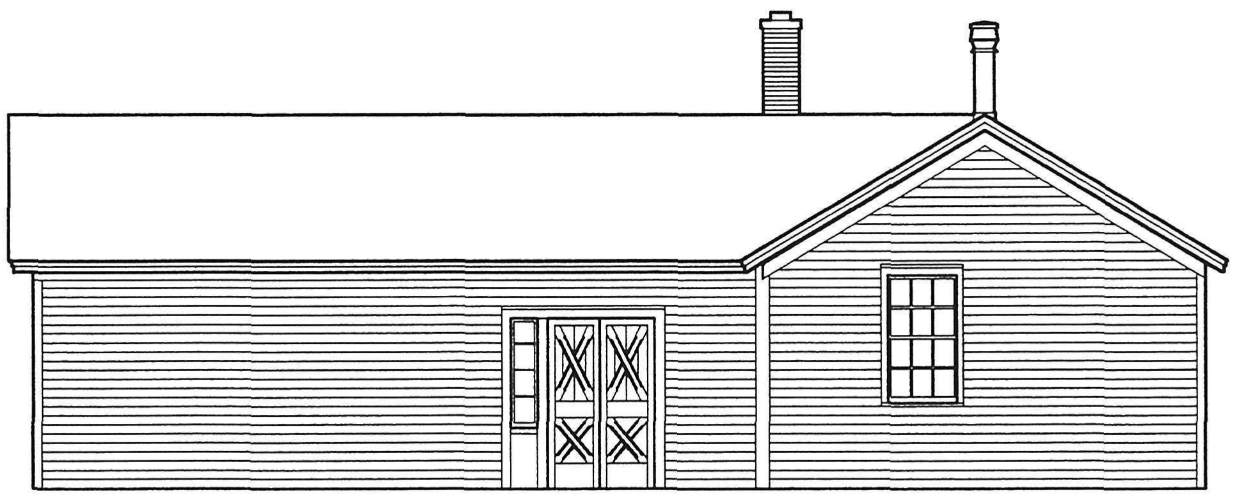
FILE NAME FOGSIG.DGN
SUB SHEET NO. A.7
DRAWING NO.
SHEET 07 OF 08



north



west



south

east

ELEVATIONS - RECOMMENDED TREATMENTS

SCALE: 1/8" = 1' - 0"

4 0 4 8

QUINN EVANS ARCHITECTS
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DESIGNED S.J.; B.R.
DRAWN B.R.
CHECKED S.J.
FIRM QUINN EVANS ARCHITECTS

SHEET TITLE
ELEVATIONS

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
PLANNING RESOURCE PRESERVATION
MIDWEST REGIONAL OFFICE

RECOMMENDED TREATMENTS
FOG SIGNAL BUILDING
SOUTH MANITOU ISLAND LIGHT STATION
SLEEPING BEAR DUNES NATIONAL LAKESHORE

FILE NAME FOGSIGEL.DGN
SUB SHEET NO. A.8

DRAWING NO.
SHEET 08 OF 08

Appendix D:

Paint Study

Historic Paint Color Study

of the

South Manitou Island Lighthouse and Fog Signal Building

July 15, 1997

Excuted by

SEEBOHM, Ltd.
514 Grove Street
Petoskey, Michigan 49770

Executed for

QUINN EVANS/ARCHITECTS
219 1/2 North Main Street
Ann Arbor, Michigan 48104

TABLE OF CONTENTS

INTRODUCTION

The following report documents the chromachronology of interior and exterior surfaces of The South Manitou Island Lighthouse and Fog Signal Building. Samples were taken from existing period surfaces of all interior rooms and on all existing exterior surfaces during the Spring of 1996.

The interior finishes of The Lighthouse all date prior to 1958, and were likely applied during the last occupation of the structure in 1940-41. The finishes applied over the plaster ceilings and walls are extremely friable and unstable, with extensive crazing, alligatoring and peeling. There is a tremendous amount of loose paint and total paint failure or loss. The finishes applied over wood are bonded better than those over plaster, and remained intact during sampling and transport of material.

All finishes were matched to The Munsell Color Notation System using a 60X binocular microscope with a 6,500K artificial light source.

The exterior finishes of The Lighthouse are somewhat consistent, with the majority of painting campaigns having been executed with white or off white coatings. Evidence confirms the application of a contemporary whitewash coating on the tower and keeper's quarters.

In reviewing the interior chromachronology of the samples of the Keeper's Quarters it appears that the first and last painting campaigns will be much easier to identify as given schemes, while executing matches to the 1940-41 period of the first Passage paint campaign would require additional time.

Random testing of approximately 15 interior samples and 5 exterior samples resulted in the positive identification of the presence of lead. Due to the fact that the majority of finishes were applied to the structures prior to 1958, it is safe to conclude that the majority of coatings contain lead, with the exception of some of the earliest ceiling/wall finishes, which are pigmented or unpigmented whitewash.

In considering the request to address future use of latex paint at the light station, I can confirm that with appropriate surface preparation this will be a viable option as a material for repainting. Due to the varying conditions of the painted finishes of the ceilings/walls and those of the painted wood elements, it would be necessary to address the repainting of each of the given surfaces with separate specifications.

In general, there is good evidence present for determining several target periods for interpretation with reference to all interior surfaces. In some spaces traces of glazing were found in early finishes which indicates a more decorative treatment in those rooms (i.e.: first floor Dining Room and second floor Bedroom 204).

Reviewing the exterior chromachronology of all elements is more limited and difficult than on the interior. The lantern elements do not appear to have a significant number of finishes to qualify as a representative sample. The shutters have been documented as having been rebuilt or restored at an earlier date, and the entire exterior has received a whitewash in recent years.

The exterior window and door casings do contain a chromachronology consistent with a building of this period. These surfaces should be used as a guide for appropriate trim colors once a target period has been determined.

The Fog Signal Building was sampled on the interior of the original Machine Shop and on the exterior of the original Work Room at the direction of staff and consulting architects on site during the investigation.

In conclusion, it should be noted that there was a surprising number of extant finishes throughout The Lighthouse and Fog Signal Building. Once the period of interpretation has been determined, it will be easier to establish an appropriate paint treatment than with most buildings of this type and age.

SOUTH MANITOU ISLAND LIGHTHOUSE AND FOG SIGNAL BUILDING

Key To Abbreviations:

1, 2, 3, . . .	denotes first, second and third painting campaigns
P	denotes a primer layer
F	denotes a finish layer
G	denotes a glaze finish, usually pigmented
V	denotes a varnish layer
l t	denotes a light color hue
md	denotes a medium color hue
dk	denotes a dark color hue

SOUTH MANITOU ISLAND LIGHTHOUSE AND FOG SIGNAL BUILDING

CHROMACHRONOLOGY MATCHES TO MUNSELL COLOR NOTATION SYSTEM

July 15, 1997

ROOM	SURFACE	MUNSELL #
B01/STORAGE	Ceiling	1F white/dirty - N9.5
		2P lt yellow - 2.5Y 8.5/2
		2F lt yellow - 2.5Y 8.5/2
		3F lt green - 5GY 6/2
		4F lt green - 2.5G 7/2
		5F white - N9.5
	Walls	1P white - N9.5
		1F lt blue - 5B 8/2
		2F yellow/orange - 7.5YR 7/4
		3F lt green - 5GY 8/2
		4F med green - 5GY 6/2
		5F lt green - 7.5GY 7/4
		6F lt green - 2.5GY 7/2
		7F lt green - 2.5G 7/2
		8F off white - 10Y 9/1
	Window Casing	1P off white - 5Y 9/1
		1F med brown - 10YR 5/2
		1F dk brown(thin/glaze) - 10YR 2/1
		2F lt green/yellow - 10Y 9/1
		3P white - N9.5
		3F off white - 5Y 9/1
		4F white - N9.5
	Door Casing	1F lt yellow - 5Y 9/4
		1F med brown(thin/glaze) - 7.5YR 3/4
		2F lt yellow - 7.5Y 9/4
		3P off white - 10Y 9/1
		3F white - N9.5
	Doors	not available
	Wainscot	same as Door Casing
	Wainscot Cap	same as Door Casing
	Baseboard	not available
	Floor	1P lt gray - 5B 7/1
		1F dk gray - 5PB 4/1

ROOM	SURFACE	MUNSELL #
B02/STORAGE	Ceiling	1F white - N9.5 2P yellow/brown oil film - 10YR 4/6 2F white - N9.5 3P yellow/brown oil film - 10YR 4/6 3F lt yellow - 5Y 9/2
	Walls	1P white - N9.5 1F lt yellow - 5Y 9/2 2P yellow/brown oil film - 10YR 4/6 2F off white - 2.5Y 8.5/2 3F dk green - 5GY 4/4 4F lt green - 5GY 6/2
	Window Casing	not available
	Door Casing	1F clear coat/dirty/thin 2F white/dirty - N9.5 3F yellowed glaze/varnish - 2.5Y 7/4 4F off white - 5Y 9/2 4Flt yellow/brown glz/vrnsh - 10YR 4/6 5F lt green - 7.5GY 7/4 6F off white - 2.5Y 8.5/2
	Doors	not available
	Wainscot	1P med yellow/brown - 2.5Y 6/4 1F lt yellow - 5Y 9/4 2F med green - 5G 5/4 3F lt green - 7.5GY 7/4 4P lt green/thin - 5GY 6/2 4F lt green - 2.5G 7/2 5F lt green - 7.5GY 7/4 6F lt yellow/green - 2.5GY 8/2 7Fmed green/thin - 5GY 4/4 8F lt yellow - 2.5GY 8/2
	Wainscot Cap	same as Wainscot
	Baseboard	not available
	Floor	not available

ROOM	SURFACE	MUNSELL #
B03/SUBCELLAR	Ceiling	1F white - N 9.5 2F off white - 2.5Y 8.5/2 3F off white - 2.5Y 8.5/2
	Walls	1P off white - 2.5Y 8.5/2 1F lt brown - 2.5Y 7/4 2P off white - 2.5Y 8.5/2 3F white - N 9.5 4F off white - 2.5Y 8/4 5F lt green - 5GY 6/2 6F lt green - 5GY 7/2
	Window Casing	not available
	Door Casing	not available
	Doors	not available
	Baseboard	not available
	Floor/Steps	1F 5B 7/1 2F 10Y 6/1
B04/HALLWAY	Ceiling	1F brown - 10R 5/2 2F med green - 5G 5/4 3F yellow - 5Y 8.5/4 4F lt green - 2.5G 7/2 5F yellow - 5Y 8.5/8 6P off white - 10Y 7/1 6F orange/brown - 10YR 5/6 7P off white - 10Y 9/1 7F lt yellow/orange - 7.5YR 8/4
	Walls	1P off white - N7.75 1F lt pink - 2.5YR 9/2 2F lt brown/gray - 7.5YR 6/2 3F brown - 10R 5/2 4F med green - 5G 5/4 5F yellow - 5Y 8.5/4 6F lt green - 2.5G 7/2 7F yellow - 5Y 8.5/8 8P off white - 10Y 7/1 8F deep red - 5R 3/8 9P off white - 7.5YR 8/2 9F off white - 2.5Y 8/4 10F lt brown - 10YR 7/2
	Window Casing	not available

ROOM	SURFACE	MUNSELL #
B04/HALLWAY(cont.)	Door Casing	1P off white - 10YR 7/2
		1F lt grey - N6.25
		2F grey/green - 5GY6/1
		3F black - N2.25
		4F yellow - 5Y 8.5/8
		5F lt green - 5GY 8/2
		6P off white - 5Y 9/1
		6F orange/brown - 10YR 5/6
		7P off white - 2.5Y 8.5/2
		7F off white - 5Y 9/1
	Doors	1P off white - 2.5Y 8/2
		1F lt brown - 10YR 6/4
		2F gray - 5PB 6/1
		3F gray - 5Y 6/1
		4F gray - 10Y 6/1
	Baseboard	not available
	Floor	not available
	Stringer	1P off white - 10YR 7/2
		1F gray - 10Y 6/1
		2F gray/green - 5GY 6/1
		3F yellow - 5Y 9/4
		4F lt gray - N4.75
		5F dk gray - N2.5
	Tread	1F gray/green - 2.5BG 5/2
		2F md gray - 10PB 6/1
		3F off white - 10Y 8/1
		4F lt gray - 5Y 6/1
		5F lt gray - 5Y 6/1
		6F md gray - N4.25
		7F dk gray - 5PB 4/1
	Riser	1F dark gray - N4
		2F md gray/green - 5G 5/1
		3P off white - 10Y 8/1
		3F md gray/green - 5Y 6/1
		4P off white - 10Y 8/1
		4F md gray - N4.25
		5F dk gray - N2
		6F dk gray - 5PB 4/1

ROOM	SURFACE	MUNSELL #
B05/KITCHEN	Ceiling	1F lt green - 2.5GY 7/2
		2F lt green - 10Y 7/1
		3F green - 5G 7/4
		4F yellow - 5Y9/4
		5F orange/brown - 10YR 5/6
		6P off white - 10Y 9/1
		6F off white - 2.5Y 8.5/2
	Walls	1F lt green - 2.5GY 7/2
		2F lt green - 10Y 7/1
		3F green - 5G 7/4
		4F md green - 5G 5/4
		5F orange/brown - 10YR 5/6
		6F lt green - 7.5GY 7/2
		7F lt green - 10GY 9/2
	Window Casing	1P off white - 10Y 9/1
		1F lt brown - 10YR 7/2
		2F lt gray - 5PB 6/1
		3F lt gray/green - 5Y 6/1
		4P off white - 5Y 9/1
		4F md gray - 10YR 5/1
		5F dk gray - 5PB 3/1
		6F yellow - 5Y 9/4
		7F orange/brown - 7.5YR 4/4
		8P white - N9.5
		8F off white - 10Y 9/1
	Door Casing	same as window casing
	Doors	same as window casing
	Baseboard	1F lt brown - 10YR 7/2
		2F lt gray - N5.5
		3F lt gray - N5.75
	Floor	not available
	Fireplace Surround	1F lt brown - 2.5Y 7/4
		2F gray/green - 5Y 4/1
		3F lt gray/green - 5Y 5/1
		4P off white - 10Y 9/1
		4F black - N0.5
		5P lt yellow - 5Y 9/4
		5F orange/brown - 7.5YR 4/4
		6P off white - 2.5Y 8.5/2
		6F orange/brown - 7.5YR 4/4
		7P white - N9.5
		7F off white - 10Y 9/1

ROOM	SURFACE	MUNSELL #
B05/KITCHEN(cont.)	Mantel	same as Fireplace Surround
B05A/PANTRY	Ceiling	1F off white - 5Y 9/1 2F off white - 10Y 9/1 3P off white - 5Y 9/2 3F dk blue - 10B 2/2 4P off white - 5GY 6/1 4F gray/green - 5GY 6/2 5P off white - 5Y 9/2 5F off white - 5Y 9/2
	Walls	1F off white - 5Y 9/1 2F off white - 10Y 9/1 3F dk gray - 5PB 3/1 4P off white - 5GY 8/1 4F lt green - 2.5G 6/2 5P off white - 2.5GY 8/2 5F lt green - 5GY 6/2
	Window Casing	1F lt brown - 10YR 7/4 2F lt gray - 5PB 6/1 3F yellow/orange - 10YR 8/6 4F dk gray - 5PB 3/1 5F lt green - 7.5GY 7/2 6F lt green - 7.5GY 6/2
	Door Casing	1F lt brown - 10YR 7/4 2F lt gray - 5PB 6/1 3P off white - 5Y 9/2 3F dk gray - 5PB 3/1 4F lt green - 7.5GY 7/2 5P off white - 10Y 9/1 5F orange/brown - 10YR 4/6 6P white - N9.5 6F off white - 10Y 9/1
	Doors	not available
	Baseboard	1F lt brown - 10YR 7/4 2F lt gray - 5PB 6/1 3F yellow/orange - 10YR 8/6 4F dk gray - 5PB 3/1 5F lt green - 7.5GY 7/2
	Floor	1F clear yellowed finish

ROOM	SURFACE	MUNSELL #
B05A/PANTRY(cont.)	Cabinet Door	1F clr amber fnsh- close match 5YR 3/6 2P off white - 5Y9/2 2F lt green - 7.5GY 7/4 3F yellow/orange - 10YR 8/6 4P white - N9.5 4F off white - 10Y 9/1
	Cabinet Frame	same as Cabinet Door
B06/KITCHEN	Ceiling	1P lt yellow - 2.5Y 8/4 1F lt green - 2.5G 6/2 2P off white - 2.5Y 8.5/2 2F lt green - 2.5G 6/2 3P off white - 5Y 8/1 3F off white - 10Y 9/1 4P off white - 2.5Y 8/2 4F off white - 2.5Y 8.5/2
	Walls	1P off white - 10Y 8/1 1F md green - 5G 5/4 2P lt yellow - 2.5Y 8/2 2F md green - 5G 5/4 3P lt gray/green - 10GY 7/1 3F lt green - 7.5GY 7/2 4P lt gray/green - 2.5GY 7/2 4F lt green - 7.5GY 9/2
	Window Casing	1P yellow - 2.5Y 8/6 1F red/brown - 5YR 3/4 2P off white - 10Y 9/1 2F off white - 10Y 8/1 3P off white - 5Y 9/1 3F white - N9.5
	Door Casing	same as window casing
	Doors	1P lt brown - 10YR 7/4 1F lt gray - N5.75 2P lt gray/green - 10Y 6/1 2F dk gray/black - N1.5 3P md gray - N3.75 3F black - N0.75 4P yellow - 5Y 8/6 4F orange/brown - 7.5YR 4/4 5P off white - 2.5Y 8.5/2 5F off white - 2.5Y 8/2 6P lt gray - N9 6F off white - 5Y 8/1

ROOM	SURFACE	MUNSELL #
B06/KITCHEN(cont.)	Baseboard	not available
	Floor	1F traces of red/brown - 7.5YR 3/4
PASSAGE	Ceiling	1P white - 10Y 9/1 1F off white - 5R 9/1
	Walls	same as ceiling
	Window Casing	1P off white - 10Y 9/1 1F off white - 5Y 8.5/2 2P off white - 10Y 9/1 2F white - N9.5
	Door Casing	same as window casing
	Doors	same as window casing
	Coat Hook Board	same as window casing
	Floor	1P orange/brown - 10YR 6/8 1F yellow/orange - 2.5Y 8/8 2P gray - N5.25 2F dk gray - N2.25
101/HALL	Ceiling	1F blue - 2.5B 6/4 2P off white - 5Y 8.5/2 2F orange/brown - 10YR 6/8 3P white - N9.5 3F off white - 5Y 9/1 4P lt yellow - 5Y 8.5/4 4F off white - 5Y 8.5/2 5F white - N9.5
	Walls	1F lt green - 5G 8/2 2P off white - 2.5Y 8/4 2F red - 5R 3/6 3P off white - 2.5Y 8.5/2 3F lt red/brown - 10YR 9/2 4P off white - 5Y 9/1 4F lt red/brown - 7.5YR 7/4

ROOM	SURFACE	MUNSELL #
101/HALL(cont.)	Window Casing	1P white - N9.5 1F off white - 5Y 9/2 1V/G brown - 10YR 4/4 2P off white - 2.5Y 8.5/2 2F off white - 2.5Y 8.5/2 3P off white - 2.5Y 8.5/2 3F off white - 2.5Y 8.5/2 4P off white - 5Y 9/2 4F off white - 5Y 9/1
	Door Casing	same as Window Casing
	Doors	not available
	Baseboard	same as Window Casing
	Floor	1P pink - 7.5YR 7/4 1F red - 2.5YR 4/6 2P orange/brown - 10YR 6/8 2F yellow/orange - 2.5Y 8/8 3P gray - N5.25 3F dk gray - N2.25
	Newel Post	1G/V amber - similar to 3 lb cut shellac 2G/V brown - pigmented shellac similar to walnut
102/OFFICE	Ceiling	1F lt green - 5Y 7/4 2P off white - 5Y 8.5/2 2F yellow/brown - 10YR 6/8 3P white - N9.5 3F off white - 10YR 9/1
	Walls	1F blue - 5B 7/4 2P off white - 5Y 9/2 2F red - 5R 3/6 3P white - N9.5 (thin) 3F lt brown - 2.5Y 8/4
	Window Casing	1P off white - 10YR 9/1 1F off white - 5Y 8.5/2 2P off white - 10YR 9/2 2F off white - 10Y 9/1 3P off white - 10YR 9/2 3F white - N9.5

ROOM	SURFACE	MUNSELL #
102/OFFICE(cont.)	Door Casing	same as Window Casing
	Doors	not available
	Baseboard	same as Window Casing
	Floor	1P pink - 7.5YR 7/4 1F red - 2.5YR 4/6 2P orange/brown - 10YR 6/8 2F yellow/orange - 2.5Y 8/8 3P gray - N5.25 3F dk gray - N2.25
103/DINING RM	Ceiling	1F white - N9.5
	Walls	1F blue - 2.5B 6/4 2P/G/V lt green - 7.5GY 8/2 2F brown - 7.5YR 4/6 3P lt yellow/brown - 10YR 8/2 3F lt green - 7.5GY 8/2 4P lt yellow/brown - 10YR 7/4 4F lt yellow/brown - 10YR 8/4
	Window Casing	1P off white - 10Y 9/1 1F off white - 5Y 8.5/2 2P off white - 10Y 9/1 2F white - N9.5 3P off white - 10Y 9/1 3F white - N9.5 4P white - N9.5 4F white - N9.5
	Door Casing	same as Window Casing
	Doors	1P white - N9.5 1F white - N9.5
	Baseboard	1P off white - 10Y 9/1 1F white - N9.5
	Floor	1G/V clear varnish - yellow/brown hue

ROOM	SURFACE	MUNSELL #
103A/CLOSET	Ceiling	1F blue - 2.5B 6/4 2F lt green - 2.5G 7/2 3F brown - 7.5YR 4/6 4F lt brown - 10YR 8/4 5F lt green - 7.5GY 8/2 6F lt brown - 10YR 7/4
	Walls	same as Ceiling
	Door Casing	1P off white - 5Y 8.5/2 1F off white - 5Y 8.5/2 2P off white - 10Y 9/1 2F white - N9.5
	Doors	same as Door Casing
	Baseboard	1P off white - 2.5Y 8.5/2 1F gray - N5 2P off white - 5Y 9/2 2F white - N9.5
	Floor	not available - insufficient data
	Coat Hook Board	same as Door Casing
104/PARLOR	Ceiling	1F orange/yellow - 10YR 6/8 2P off white - 7.5Y 8.5/2 2F white - N9.5 3P off white - 5Y 8.5/4 3F white - N9.5
	Walls	1F green - 7.5GY 7/4 2F orange/brown - 10YR 6/8 3F green - 7.5GY 8/4 4F lt brown - 10YR 7.4
	Window Casing	1P off white - 7.5Y 8.5/2 1F white - N 9.5 2P off white - 7.5Y 8.5/2 2F white - N 9.5
	Door Casing	Same as Window Casing
	Doors	Not Available

ROOM	SURFACE	MUNSELL #
104/PARLOR(cont.)	Baseboard	1P off white - 7.5Y 8.5/2 1F white - N 9.5 2P off white - 7.5Y 8.5/2 2F white - N 9.5
	Floor	Not Available - Insufficient Data
	Fireplace Surround	1P off white - 7.5Y 8.5/2 1F white - N 9.5 2F white - N 9.5 3P off white - 7.5Y 8.5/2 3F off white 10Y 9/1
	Mantle	Same as Fireplace Surround
201	Ceiling	1F green - 7.5G 6/4 2P off white - 5Y 9/2 2F yellow - 5Y 8.5/6 3P off white - 5Y 9/2 3F white - N 9.5
	Walls	1F green - 10GY 7/2 2F brown - 5YR 2/4 3F light brown - 7.5YR 7/4 4P off white - 7.5Y 8/2 4F yellow - 5Y 8.5/6 5P white - N 9.5 5F white - N 9.5
	Window Casing	1P white - N 9.5 1F white - N 9.5
	Door Casing	Same as Window Casing
	Doors	Not Available
	Baseboard	Same as Window Casing
	Floor	1P brown - 2.5YR 4/4 1F green - 2.5 Y 5/6
201A/CLOSET	Ceiling	1F orange - 5YR 6/8 2F green - 10GY 5/2 3F yellolw - 7.5Y 5/6
	Walls	1P off white - 2.5Y 8/4 1F green - 10GY 7/2 2F brown - 5YR 2/4 3F off white 10Y 8/1

ROOM	SURFACE	MUNSELL #
202/HALL	Ceiling	1F blue - 5B 7/4 2P off white - 5Y 8/2 2F orange - 10YR 6/8 3P off white - 10YR 9/2 3F off white - N 9.5
	Walls	1F blue - 5B 7/4 2P off white - 5Y 8/2 2F red - 5R 3/6 3P off white 10YR 9/2 3F brown - 10YR 7/4
	Window Casing	1P off white - 10YR 8/1 1F white - N 9.5
	Door Casing	Same as Window Casing
	Doors	Not Available
	Baseboard	1P off white - 10YR 8/2 1F off white - 2.5 Y 8.5/2
	Floor	1F brown - 5YR 6/6 2P yellow - 2.5Y 8/8 2F brown - 5YR 6/6 3F yellow - 2.5 Y 7/8 4F grey - 2.5 PB 7/2
203/BEDROOM	Ceiling	1P off white - 5Y 8.5/2 1F yellow - 5Y 8.5/6 2F white - N 9.5
	Walls	1P off white - 10Y 9/1 1F blue - 5B 7/4 2P brown - 5YR 2/4 2F orange - 5YR 6/6 3F green - 10GY 7/4
	Window Casing	1P off white - 10Y 8/1 1F off white - 5Y 8/2 2P off white - 7.5 Y 8/2 2F off white - N 9.5
	Door Casing	Same as Window Casing
	Doors	Not Available

ROOM	SURFACE	MUNSELL #
203/BEDROOM(cont.)	Baseboard	Same as Window Casing
	Floor	1F brown - 5YR 6/6 2F yellow - 2.5Y 6/6 3P md grey - N 4.5 3F dk grey - N 2.25
203A/CLOSET	Ceiling	1F yellow - 7.5Y 8.5/6 2F off white - 5Y 8/2
	Walls	1P brown - 5YR 2/4 1F lt brown - 10YR 7/4 2F green - 10GY 8/4
204/BEDROOM	Ceiling	1F 5Y 8.5/4
	Walls	1P off white - 10YR 8/4 1F lt green - 10GY 7/4 2F dk green - 10GY 3/4 3F lt green - 10GY 7/4 4F lt green - 10GY 8/2 5P lt brown - 2.5YR 7/4 5F lt green - 10GY 7/4 6F lt green - 10GY 7/4 7F lt brown - 10YR 7/4
	Window Casing	1P off white - 10Y 9/1 1F white - N 9.5
	Door Casing	1P off white - 10Y 9/1 1F off white - 2.5Y 8.5/2 1G (glaze) brown - 2.5 YR 3/6 2P white - N 2.5 2F white - N 2.5
	Doors	Not Available
	Baseboard	1P off white - 10Y 9/1 1F off white - 5Y 9/1
	Floor	1F brown - 2.5 YR 4/4 2F yellow - 2.5Y 5/6 3P lt grey - N 3.75 3F dk grey - N 2.75 4P md grey - N 3.75 4F grey - 2.5G 5/2

ROOM	SURFACE	MUNSELL #
204A/CLOSET	Ceiling	1F yellow - 2.5Y 7/6 2F off white - 10YR 7/2
	Walls	1F dk green - 10GY 3/4 2F lt green - 10GY 7/4 3P lt brown - 5YR 6/6 3F lt green - 10GY 7/4 4F lt brown - 10YR 7/4
205/BEDROOM	Ceiling	1F orange - 10YR 6/8 2P off white - 2.5Y 8.5/2 2F yellow - 7.5 8.5/6 3P off white - 5Y 9/2 3F off white - 5Y 8/2
	Walls	1P off white - 10Y 9/1 1F dk green - 10GY 5/4 2F lt green - 10GY 7/4 3F lt brown - 2.5YR 7/4 4P off white - 5Y 8.5/2 4F lt brown - 10YR 7/4
	Window Casing	1P off white - 10YR 8/2 1F white - N 9.5
	Door Casing	Same as Window Casing
	Doors	Not Available
	Baseboard	1P off white - 10YR 8/2 1F off white - 5Y 8/2 2P off white 5Y 8.5/2 2F white - N 9.5

ROOM	SURFACE	MUNSELL #
205/BEDROOM(cont.)	Floor	1F brown - 2.5 YR 4/4 2F yellow - 2.5Y 5/6 3P lt grey - N 3.75 3F dk grey - N 2.75 4P grey - N 3.75 4F lt grey- N 8 5F lt grey - N 7.5 6P lt grey - N 7.5 6F dk grey -N 3.5 7P lt grey - N 7.5 7F md grey - N 5.5 8F dk grey - N 4
205A/CLOSET	Ceiling	1F yellow - 5Y 8.5/6 2P off white - 5Y 8.5/2 2F off white - 5Y 8/2
	Walls	1F lt green - 10GY 7/4 2F lt brown - 2.5YR 7/4 3P off white - 5Y 8.5/2 3F lt brown - 10YR 8/4
3RD FLOOR	Ceiling	1P off white - 10Y 9/1 1F lt green - 5G 8/2 2F orange/brown - 10YR 6/8 3F off white - 10YR 9/1
	Walls	1F white - N9.5 2P off white - 5Y 8.5/2 2F lt green - 5G 8/2 3F red - 5R 3/6 4F lt green - 7.5GY 7/4 5F lt green - 2.5G 9/2
	Window Casing	1P off white -10Y 9/1 1F lt gray - N7.25 2P off white - 5Y 8.5/2 2F white - N9.5 3F lt brown - 10YR 7/2
TOWER	Walls	1F white - N9.5 2F off white - 10Y 9/1 3F white - N9.5 All paint layers appear to be more contemporary. No traces evident other than white.

ROOM	SURFACE	MUNSELL #
TOWER(cont.)	Window Casing	1P off white - 10Y 9/1 1F off white - 5Y 8.5/2 2F off white - 5Y 8.5/2 3P lt green - 7.5GY 7/4 3F md green - 10GY 2/4 4P off white - 10Y9/1 4F off white - 10Y 9/1
	Lantern Beadboard	1P off white - 2.5Y 8.5/2 1Foff white - 10YR 9/1 2F off white - 2.5Y 8.5/2 3F off white - N9 4F white - N9.5
	Metal Lens Stand	1P orange/red - 2.5YR 4/8 1F green - 2.5G 3/4 2F green - 10GY 3/4 3P dk red/brown - 10R 3/4 3F gray - N6 4P red/brown - 10R 3/6 4F gray- N5.75
EXTERIOR	Lantern Elements	1P lt gray - N7 1F black - N2 2F black - N1 First primer and finish coating are likely not the original, although no traces of colors other than gray or black were found.
	Brick/Upper Tower	1F white - N9.5 2 to 4 - white to off white
	Brick/Lower Tower	same as Brick/Upper Tower
	Stone Foundation	1 white - N9.5 2 off white -10Y 8/1 3 white(followed by dirt layer) - N9.5 4 white - N9.5

ROOM	SURFACE	MUNSELL #
EXTERIOR(cont.)	Door Casing	1F off white - 10Y 9/1
		2F off white - 10Y 9/1
		3P off white - 10Y 8/1
		3F off white - 10Y 9/1
		4F md green - 10GY 5/4
		5F orange/brown - 7.5YR 4/6
		6P off white - 10Y 9/1
		6F white - N9.5
		7P off white - 10Y 9/1
		7F white - N9.5
	Shutter	1P off white - 2.5Y 8.5/2
		1F lt gray - N7
		2P off white - 10Y 9/1
		2F dk green - 10G 3/4
FOG SIGNAL BUILDING		
Interior/Machine Shop		
	Ceiling	1P red - 10R 3/6
		1F off white - 10Y 9/1
		2P yellow - 5Y 7/4
		2F off white - 5Y 8.5/4
		3P off white - 2.5Y 8.5/2
		3F off white - 5Y 9/1
		4P off white - 5Y 8.5/2
		4F white - N9.25
	Ceiling Beam	1P off white - 5Y 8.5/2
		1F yellow/brown - 2.5Y 8/4
		1G/V brown - 7.5YR 4/4
		2P off white - 2.5Y 8.5/2
		2F yellow/brown - 2.5Y 8/4
		3P white - N9.25
		3F white - N9.25
Exterior/Work Room		
	Fascia	1P yellow - 5Y 9/4
		1F dk grey - N2.75
		2F lt grey - N6.25
		3F dk grey - N4.5
		4F white - N9.5

ROOM	SURFACE	MUNSELL #
Exterior/Work Room (cont.)		
	Soffit	1F off white - 5Y 8.5/2
		2F dk grey - N2.25
		3F black (resinous pitch) - N2
		4F white - N9.25
		5F dk grey - N4.25
		6F dk green - 7.5G 3/4
		7F white - N9.5
		8F dk green - 7.5G 2/2
	Siding	1F off white (very dirty) - 5Y 8.5/2
		2F white (dirty) - N9.5
		3F white - N9.5
	Corner Board	1F dk grey - N3.25
		2F white - N9.5
	Door Casing	1F dk grey - N3.25
		2F lt grey - N5.75
		3F off white - 5Y 8.5/2
		4F dk grey - N3.25
		5F dk red - 10R 3/4
		6F med grey - N5.5
		7P off white (dirty) - 5Y 8.5/2
		7F white - N9.5
	Door Jamb	1F white (trace of whitewash?) - N9.5
		2F off white - 5Y 8.5/2
		3F dk grey - N2.75
		4F lt grey - N5.75
		5F dk yellow - 2.5Y 6/6
		6F black (resinous pitch) - N0.5
		7F white (dirty)- N9.5
		8F white - N9.5

Description of paint samples taken June 15, 1995
South Manitou Island Lighthouse

Exterior
1. Whitewash at foundation wall, approximately 5'- 0" above grade.
2. Brick at dwelling, approximately 1'- 0" above top of foundation.

Basement
3. Parging / paint covering masonry, approximately 6'- 0" above floor of adjacent stair landing, this parging is evident in patches throughout room.
4. Sample taken at edge of tread where it meets stringer.
5. Wood wainscot, sample taken approximately 3'- 0" above floor.
6. Sample taken from plaster surface at chimney, approximately 5' - 0" above floor.
7. Plaster ceiling, sample taken at approximate center of room.
8. Parging approximately 4'- 0" above floor, this parging covers entire surface on both south and east exterior walls.

Passageway
9. Ceiling sample taken where plaster has pulled loose.
10. Wood casing, sample taken approximately 4'- 6" above floor.
11. Two samples taken, one each from south and north walls, both approximately 5'- 0" above floor.
12. Wood baseboard.
13. Sample taken where several layers of paint remain.

First Floor
14. Sample taken at stair riser below linoleum / vinyl runner, different color paint than at edges of stair.
15. Plaster wall surface, sample taken approximately 5'- 0" above floor.
16. Sample taken at edge of stair tread alongside linoleum / vinyl runner
17. Wood casing, sample taken approximately 4'- 0" above floor.
18. Wood casing, typical at first floor rooms.
19. Plaster wall surface adjacent to lantern wood post, approximately 5'- 6" above floor.
20. Plaster wall surface approximately 5'- 0" above floor.
21. Wood mantle at fireplace, sample taken at surface facing floor.
22. Floor surface at buckling.
23. Sample taken where plaster pulling loose from lathe, approximately 3'- 0" above floor.
24. Caulk or other filler at joint where wood and plaster surfaces meet (fireplace).

Second Floor
25. Plaster wall surface at approximately 5'- 0" above floor.
26. Plaster wall surface approximately 4'- 0" above floor where there is ghosted image of former cabinets or shelves.
27. Plaster wall surface approximately 5'- 0" above floor.
28. Plaster wall surface approximately 5'- 0" above floor.
29. Plaster wall surface approximately 5'- 0" above floor.
30. Wood handrail, sample taken from surface facing floor.
31. Tread of ship's ladder, taken at darker strip running along center.
32. Plaster wall surface approximately 5'- 0" above floor.

Tower
33. Sample taken at (3) different cracks which have been infilled with dark gray compound which is currently pulling away from adjacent plaster surfaces.
34. Samples taken at (2) locations of interior tower surface where plaster easy to remove due to cracking.
35. Sample taken from interior surface of wood cabinet at work room of tower.

September 19, 1995

HISTORIC FINISHES DOCUMENTATION: South Manitou Island Lighthouse

Executed by: Steve Seebohm
SEEBOHM, Ltd.
PO Box 4763
East Lansing, MI 48826

Executed for: QUINN EVANS / ARCHITECTS
219 1/2 North Main Street
Ann Arbor, Michigan 48104

Description: Execution of Color matches to 35 paint samples taken by Quinn Evans employees on June 15, 1995.

Results:

Sample No.	Paint Layer No.	Munsell Color Notation
1	1	N9.5
	2	2.5Y 9/2
2	1	N9.5
	2	2.5Y 8.5/4
	3	2.5Y 9/2
3	1	2.5Y 9/2
	2	10YR 6/2
	3	N7.25
4	1	10BG 7/2
	2	10R 9/2
	3	10YR 5/4
	4	7.5BG 6/2
	5	5Y 9/6
	6 to 14	Numerous white, off-white & tan layers of paint.
5	1	10YR 6/2
	2	5Y 9/6
	3	2.5YR 4/6
	4	Three layers of off-white followed by one layer of 5YR 5/6.
6	1	7.5GY 7/2
	2	5GY 8/2
	3	10GY 8/1
7	1	N8.25
8	1	Same as Sample No. 7.

HISTORIC FINISHES DOCUMENTATION: South Manitou Island Lighthouse: Continued.

Sample No.	Paint Layer No.	Munsell Color Notation
9	1	10B 9/1
	2	2.5Y 9/2
10	1	10YR 7/2
	2	7.5Y 9/2
	3	10Y 9/1
11	1	N9.25
12	1	Same as Sample No. 10
13	1	10YR 6/6
	2	10YR 7/10
	3	N4.5
14	1	N3.75
	2	Nine layers following comprised of approximately three off-white and six grey.
15	1	2.5Y 8.5/4
	2	10BG 7/2
	3	2.5Y 8/2
	4	7.5R 3/8
	5	10YR 8/4
16	1	7.5Y 9/2
	2	Several layer of white and off-white.
17	1	Same as Sample No. 16.
18	1	Same as Sample No. 16.
19	1	5G 6/2
	2	7.5R 3/8
	3	10YR 8/4
20	1	10B 5/6
	2	5G 6/2
	3	10YR 5/4
	4	10YR 8/4
	5	5G 8/2
	6	10YR 8/4
21	1	Same as Sample No. 16.
22	Insufficient material present.	

HISTORIC FINISHES DOCUMENTATION: South Manitou Island Lighthouse: Continued.

Sample No.	Paint Layer No.	Munsell Color Notation
23	1	5G 6/2
	2	5G 6/4
	3	10YR 6/6
	4	5G 6/2
	5	10YR 8/4
24	Insuffficient material present.	
25	1	2.5Y 8.5/4
	2	5G 6/2
	3	5G 5/4
	4	5G 6/4
	5	5G 6/2
	6	2.5YR 7/4
	7	5G 6/4
	8	10YR 8/4
26	1	See Sample No. 25, Layer 1 to 3.
27	1	5G 7/2
	2	5G 6/2
	3	5YR 5/6
	4	10YR 6/6
	5	5G 6/4
28	1	2.5Y 8.5/4
	2	5G 7/2
	3	5G 6/4
	4	5G 7/2
	5	2.5YR 7/4
	6	10YR 8/4
29	1	5G 7/2
	2	10YR 5/4
	3	2.5YR 7/4
	4	2.5YR 8/2
	5	10YR 8/6
	6	N9.25
30	1	N6.75
	2	N3
	3	N4.75
31	1	N4.5

HISTORIC FINISHES DOCUMENTATION: South Manitou Island Lighthouse: Continued.

Sample No.	Paint Layer No.	Munsell Color Notation
32	1	5G 7/2
	2	7.5R 3/8
	3	10YR 8/4
33	Non-original material.	
34	1	N9.5
35	1	N9.25
	2	10YR 6/6
	3	7.5Y 9/2
	4	10GY 8/4
	5	N3.75

UNITED STATES GOVERNMENT

memorandum

DATE: June 23, 1978

REPLY TO ATTN OF: Facility Manager

SUBJECT: Details of work - historic structures

TO: B&U Foreman

In telecon today with Randy Biallas, Historic Architect, MWR, he approved the following materials and/or procedures:

1. Whistle Shed roof: use galvanized metal & paint according to spec per Biallas.

2. School House roof: re-roof using #1 (blue tag) sawn cedar shingles. Roof both main structure and porch.

3. Mortar formula for tuck pointing and masonary repair:
   1 part white cement, ASTM C-91
   1 part hydrated lime, ASTM C-207, type S
   6 parts sand (clean beach sand ok)

4. Paint for Lighthouse Tower and Walkway to be whitewash according to spec per Biallas.

5. Paint for residence walls to be masonry paint according to spec per Biallas.

Randy is working up a memo speaking to our work here that will include the specs. noted above. The memo should be here by Wednesday, ~~June 26~~ JUNE 29, 1978.

We can proceed with work as soon as our schedule allows.

Merline

Merline D. Schlange

T. Hums

UNITED STATES GOVERNMENT

memorandum

DATE: June 29, 1978

REPLY TO ATTN OF: Regional Historical Architect, Midwest Region

SUBJECT: Historic Structure Color Analysis

TO: Superintendent, Sleeping Bear Dunes National Lakeshore

MES, 7/7/78 copies to Pete and Proj File

In response to your blue envelope memorandum of June 5, I have examined the paint samples that you sent and recommend that we paint the structures the following colors:

1. HS-1A, Light Keeper's Residence, exterior brick walls yellow paint to match existing.

2. HS-1A, eave woodwork, white paint.

3. HS-1B, Lighthouse Walkway; HS-1C, Lighthouse, exterior brick walls, whitewash.

4. HS-4, Magazine, exterior brick walls, yellow.

5. HS-4, metal door and roof, red.

6. HS-5, Whistle Shed, exterior wood siding, white.

7. HS-5, exterior wood trim, green.

8. HS-6, 8, 9, 11, 12, 13, Life Saving Station Buildings, exterior wood trim, green.

9. HS-6, 8, 9, 11, 12, 13, exterior wood siding, white.

10. HS-8, 8, 11, 12, 13, wood shingles, red to match old shingle.

11. HS-15, Post Office, exterior wood siding, white.

12. HS-15, exterior wood trim, green.

I will send you color chips to match all non-white colors noted next week. However, I do want to visit the Lakeshore within the next few weeks to verify all of the above.

For items 2, 6, 7, 8, 9, 11, 12 above I recommend the following paint system:

<u>Exterior woodwork</u> (Product Code)

First coat: Benjamin Moore Moorwhite Primer (100)

Second coat: Benjamin Moore House Paint (110)
Third coat: Benjamin Moore House Paint (110)

For items 1, 4 above I recommend the following paint system:

Exterior painted masonry

First coat: Benjamin Moore Moorwhite Primer (100)
Second coat: Benjamin Moore House Paint (110)
Third coat: Benjamin Moore House Paint (110)

For item 3 above I recommend the following paint system:

Exterior whitewashed masonry

First coat and second coats: Dissolve 15 pounds of common salt in 7½ gallons of water. To this solution add 50 pounds (1 bag) of hydrated lime. Mix thoroughly until a thick paste is formed. Thin to desired consistency with fresh water.

For item 10 above I recommend the following paint system:

Stained Shingles

Coat: Moorwood Exterior Wood Stain (080)

For item 5 above I recommend the following paint system:

Ferrous Metal

First coat: Benjamin Moore Iron Clad Retardo Rust Inhibitive Paint (163)
Second coat: Benjamin Moore Impervo High Gloss Enamel (133)
Third coat: Benjamin Moore Impervo High Gloss Enamel (133)

For the new galvanized gutters and downspouts I recommend the following paint system:

Galvanized Metal

First coat: Benjamin Moore Iron Clad Galvanized Metal Primer (155)
Second coat: Benjamin Moore Impervo High Gloss Enamel (133)
Third coat: Benjamin Moore Impervo High Gloss Enamel (133)

If you can't get the Benjamin Moore paint, let me know what paint manufacturer you can get and I will pick out paint systems from their product. Get in touch.

Randall J. Biallas
Regional Historical Architect

Appendix E:
Mortar Testing

94117-01-D

soil and materials engineers, inc.
43980 Plymouth Oaks Blvd. Plymouth, MI 48170-2584 (313) 454-9900 FAX (313) 454-0629

Kenneth W. Kramer, PE
Frank A. Henderson, PG
Gerald M. Bellan, PE
Garrett H. Evans, PE
Larry P. Jedele, PE
Starr D. Kohn, PhD, PE
Edward S. Lindow, PE
Robert C. Rabuler, PE
Robert E. Zayko, PE

Timothy H. Bedenis, PE
J. William Coberly, CET
Chuck A. Gemayel, PE
Cheryl Kehres-Dietrich, CGWP
Gerard P. Madej, PE
Sheryl K. Fountain
Michael E. Gase, CWI
Julie A. Hartner
Cary T. Keller, PE
Mark K. Kramer, PE
Truman F. Maxwell, CPA
Michael S. Meddock, PE
Timothy J. Mitchell, PE
Thomas M. Peet, PE
Thomas M. Powell
Thomas P. Rozman, PE
John C. Zarzecki, CWI

1964 33 1997

July 21, 1997

Ms. Brenda Rigdon
Quinn Evans/ Architects, Inc.
219-1/2 North Main Street
Ann Arbor, Michigan 48104

Transmitted by Facsimile (313) 663-5044

RE: Masonry Mortar Evaluation
South Manitou Island Lighthouse
National Park Service
Project No. 94117-01
SME Project No. PM28351

Dear Ms. Rigdon:

In response to your June 13, 1997 transmittal, SME performed a laboratory evaluation and aggregate classification on the submitted 14 masonry mortar samples from the referenced project. The objective of the evaluation is to assist in selection of a restoration mortar.

We understand the submitted sample mortars are over 100 years old. The existing tower is reported to have been constructed in 1872, with the Keepers Quarters structure constructed in 1858. Both structures use brick masonry which has been coated. Samples were submitted in hardened form from fourteen locations within the structures. These locations were reported to SME with alphabetical identification only and are labeled here using the same identification letters.

AGGREGATE ANALYSIS

The current mortars in use are specified to meet ASTM C270 requirements. This specification requires the use of an aggregate which meets the gradation requirements of referenced ASTM C-144. The aggregate gradation obtained from four of the larger samples of the in-place mortar is presented in Table 1 and is compared to the C-144 gradation for natural sand.

TABLE 1
AGGREGATE GRADATION ASTM C-144 - PERCENT PASSING

SIEVE SIZE	NATURAL SAND	SAMPLE No.A	SAMPLE No.D	SAMPLE No.H	SAMPLE No.N
No.4	100	100	100	100	100
No.8	95 - 100	100	100	100	100
No.16	70 - 100	99.5	100	100	98.5
No.30	40 - 75	82.5	80.3	79.5	83.2
No.50	10 - 35	54.6	55.5	53.7	56.0
No.100	2 - 15	20.5	22.0	18.7	21.2
No.200	—	7.5	6.5	5.5	8.3

Based on the actual aggregate gradation in the historic mortar samples, the current ASTM C-144 aggregate materials contain course particles which far exceed the tested mortar aggregates. The tested aggregates were from a natural source, as they were noted to be semi-rounded and contained few sharp fractured particles. The analysis of the four aggregates indicates they were likely from the same source, as the variation on the individual sieves is only ± 2%.

The original aggregates can be classified as a glacial natural crystalline silica, with equal parts of quartz and dolomitic sand. Traces of feldspar, mica, and horneblende were also noted. The color appearance of the aggregates varied from a light brown to a dark brown. To simulate this aggregate in restoration mixes, we recommend using a natural masonry sand produced from local sources near Lake Michigan, which has been sieved to remove substantially all particles greater than a No.16 sieve.

CEMENTITIOUS ANALYSIS

Analysis of the mortar composition was performed using both the ASTM C 85, Maleic Acid Method and microscopic evaluation. The mortar mixes which were common to the 1870's used lime paste and Portland cements imported from Europe or natural cements. The production of Portland cement in the US did not begin until 1871. Natural cements were produced in approximately 12 states by the 1870's and was sometimes refereed to as Roman cement.

Based on the chemical cementitious classification of the mortars, the samples submitted appear to have four common ratios of cementitious material (Cement and Lime) to aggregate by volume. These proportions are presented in Table 2. The ratios are assumed to have a 1.5% error factor due to the possibility the mortar aggregates may yield dissolved calcium oxide and silica under the specific test conditions.

TABLE 2
CEMENTITIOUS : AGGREGATE RATIOS

MIXES SAMPLE Nos.	CEMENTITIOUS MATERIAL Natural Cement & Lime	SAND AGGREGATE (Natural)	RATIO Cement/Lime: Sand
No. L, H, M, & N	1 Part	3.0 Parts	1:3
No. A, F, D, K	1 Part	3-1/2 Parts	1:3-1/2
No C. I, J & E	1 Part	4.0 Parts	1:4
No. G & B	1 Part	4-1/2 Parts	1:4-1/2

Notes: Sample No. L was reviewed by optical procedures only. The amount of sample (2.3 grams) was not adequate for chemical analysis.

The mortar samples were observed to be carbonized, that is the majority of lime and cement has absorbed carbon dioxide and converted into a dolomitic limestone. The samples indicated a darker brown color to the paste which is indicative of a natural cement rather than a Portland cement. Portland cements have a characteristic color of gray or greenish gray. Due to the natural conversion of both the lime and cement into limestone by carbonation, the proportion of lime to cement could not be determined. The variation of the cementitious ratios can be attributed to the fact that, at the time the structures were constructed, all mortars were hand mixed in tubs with volumes determined by the number of shovels placed in the tub.

The use of natural cements for restoration work is impractical due to their unavailability. A repair mortar which uses a mix consisting of 1 part Portland cement, 1-1/2 parts hydrated lime, and 6 parts sand aggregate is recommended. This will produce a mortar which is compatible with all the samples and should perform well with the masonry brick. This recommended repair mortar is in keeping with the recommendations of the Technical Preservation Services Division of the Office of Archeology and Historic Preservation, National Park Service for extreme weather exposures.

To meet the requirement of blending in the repairs, the initial step would be to clean the existing mortars. The structures have been painted over the years with various coatings including early white-washes. Once cleaned, the darker mortar color of the original mortars can be matched using various mortar pigments or by addition of limestone dust to darken the new Portland and lime materials (Limestone dust is an aggregate addition.) If the structure is to be recoated, the matching of the color of the repair mortar will not be as critical and could be eliminated except in locations where the natural mortar color is exposed.

This report has been prepared in accordance with generally accepted masonry engineering practices to aid in the evaluation of mortar materials. In the process of performing the analysis for this report, procedures are followed that represent reasonable and accepted practice in the field of restoration engineering. If the reported design criteria is found to have changed, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions of this report are modified or approved in writing by our office.

If there are any questions with regard to this report or the services performed, please do not hesitate to contact us. Thank you for selecting SME for these services.

Very truly yours,

SOIL AND MATERIALS ENGINEERS, INC.

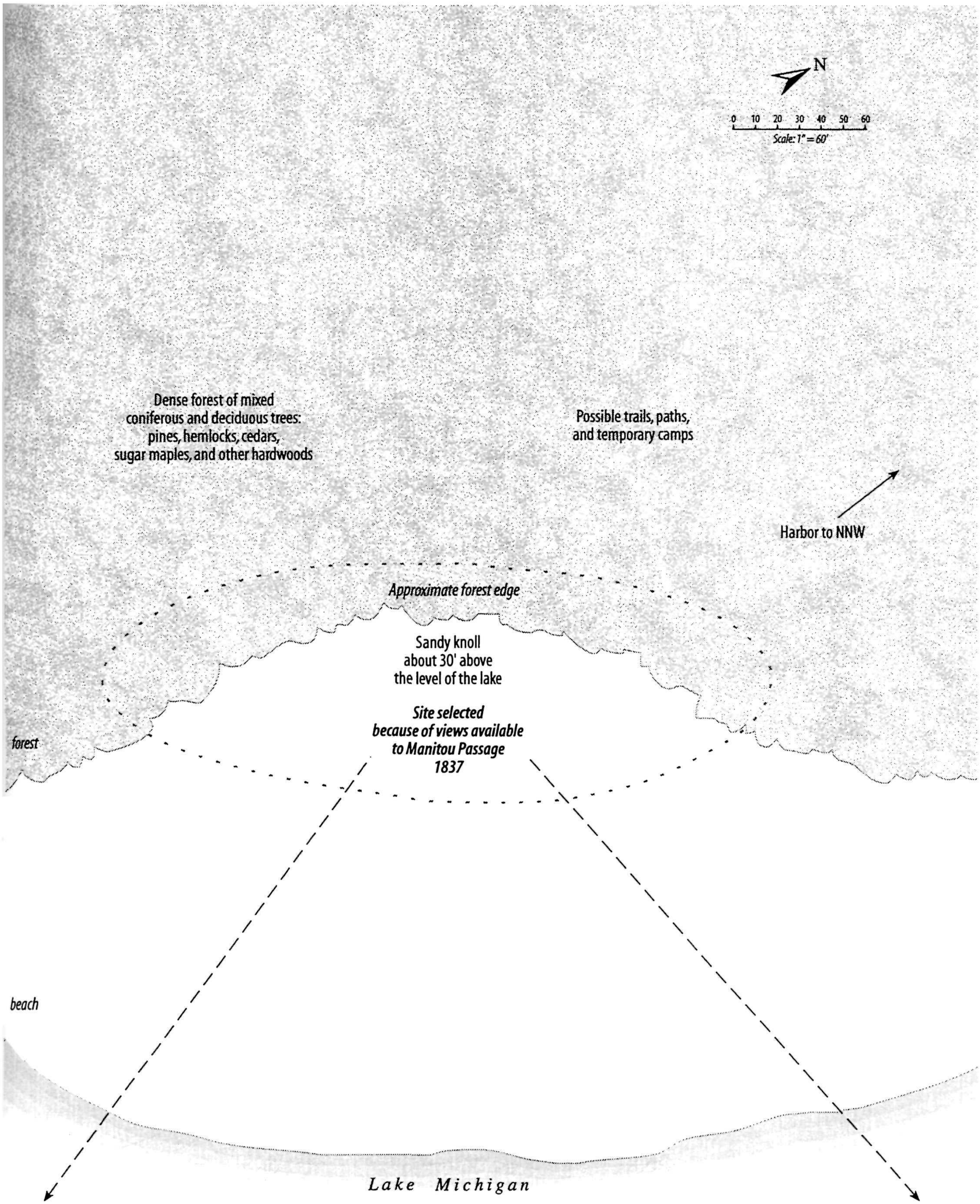
John C. Zarzecki, C.E.T.
Senior Materials Consultant

Edward S. Lindow/

Edward S. Lindow Jr., P.E.
Vice President

jcz/masn/28351-QE.doc

Appendix F:
Landscape Exhibits



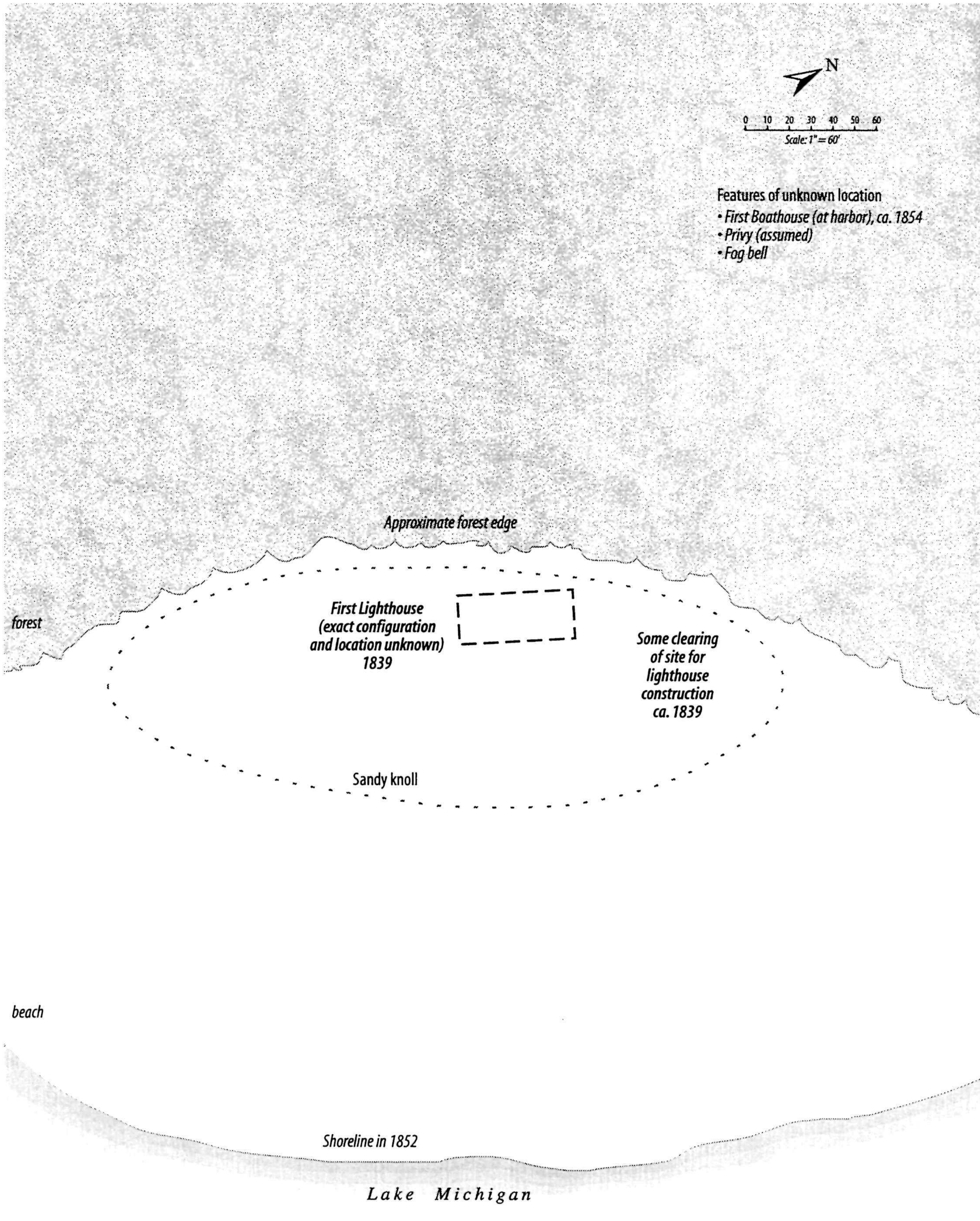
Map Sources:
Sketch Shewing [*sic*] Site at South Manitou Light-House, Lake Michigan, August 1874.

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 1

SOUTH MANITOU ISLAND LIGHT STATION

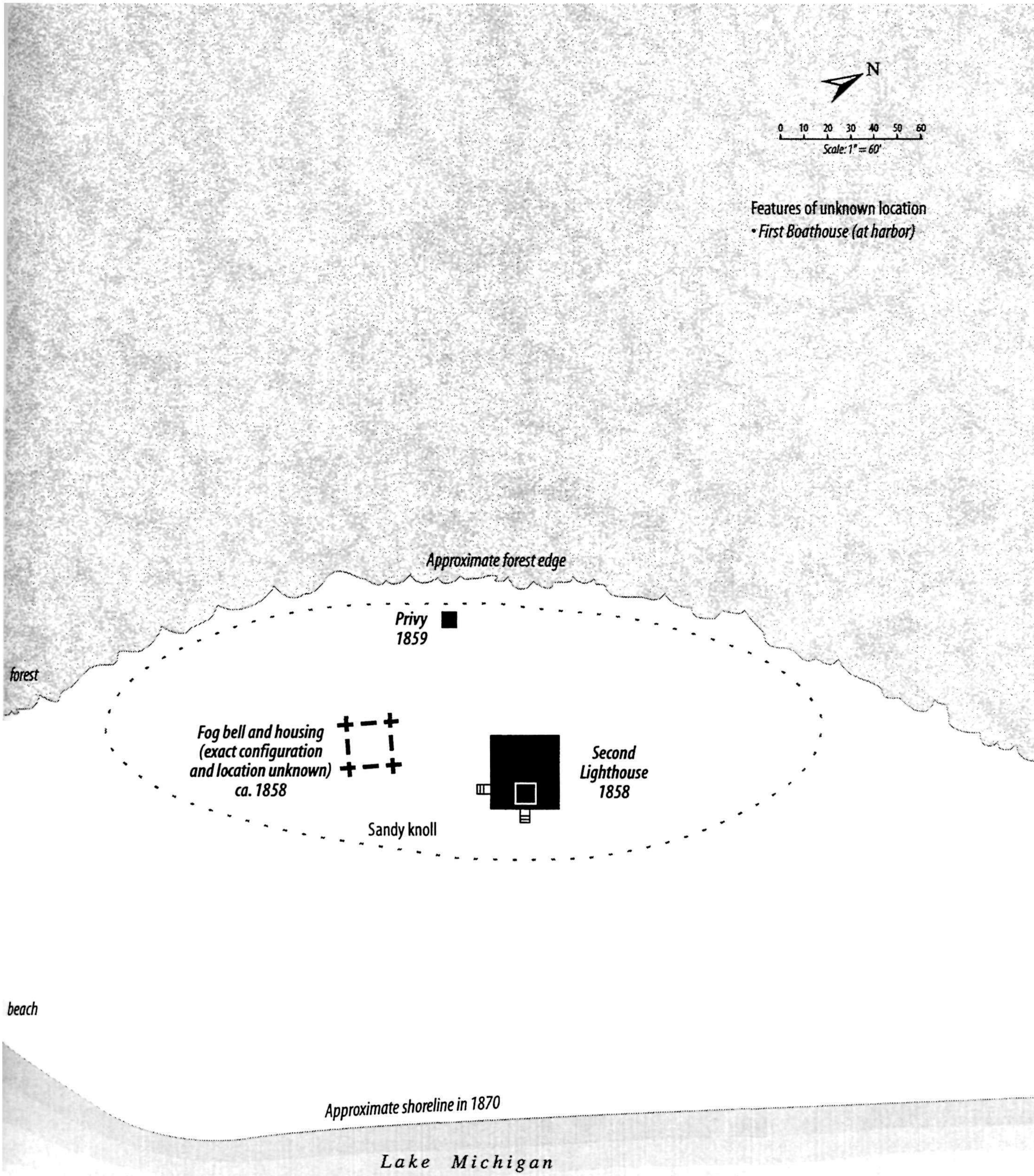
Landscape Chronology: Pre-1839



Map Sources:
Sketch Shewing [*sic*] Site at South Manitou Light-House, Lake Michigan, August 1874.

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 2
SOUTH MANITOU ISLAND LIGHT STATION
Landscape Chronology: 1839-1857



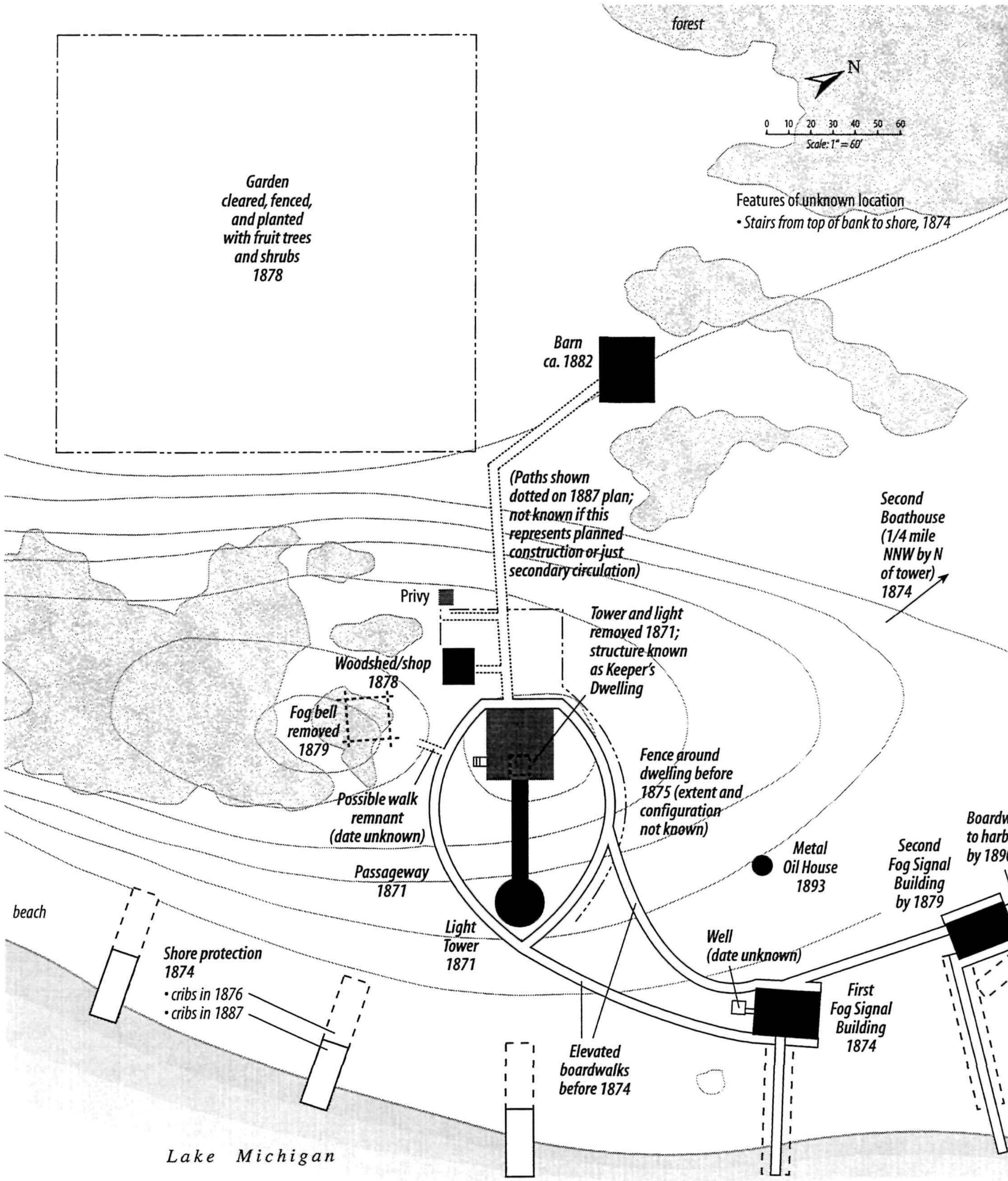
Map Sources:
Sketch Shewing [*sic*] Site at South Manitou Light-House, Lake Michigan, August 1874.
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 3

SOUTH MANITOU ISLAND LIGHT STATION

Landscape Chronology: 1858-1870



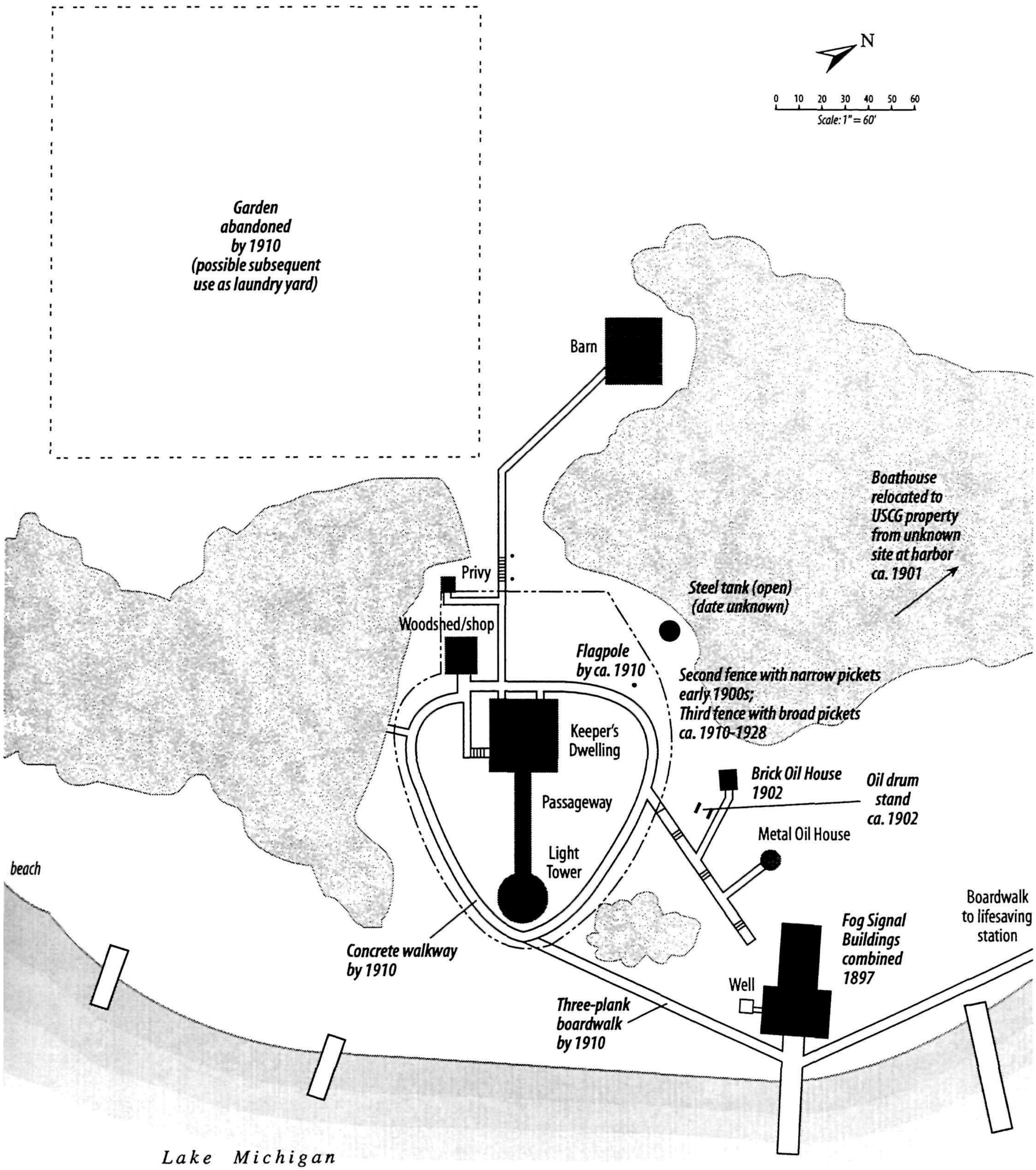
Map Sources:
South Manitou Light Station, Shore Protection, July 1, 1876.
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
SLBE Negative #s 1106, 1222, 1212 [Figures 1, 2, 4]
Undated photographs, collection of Glen Furst [Figures 3, 5]

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 4

SOUTH MANITOU ISLAND LIGHT STATION

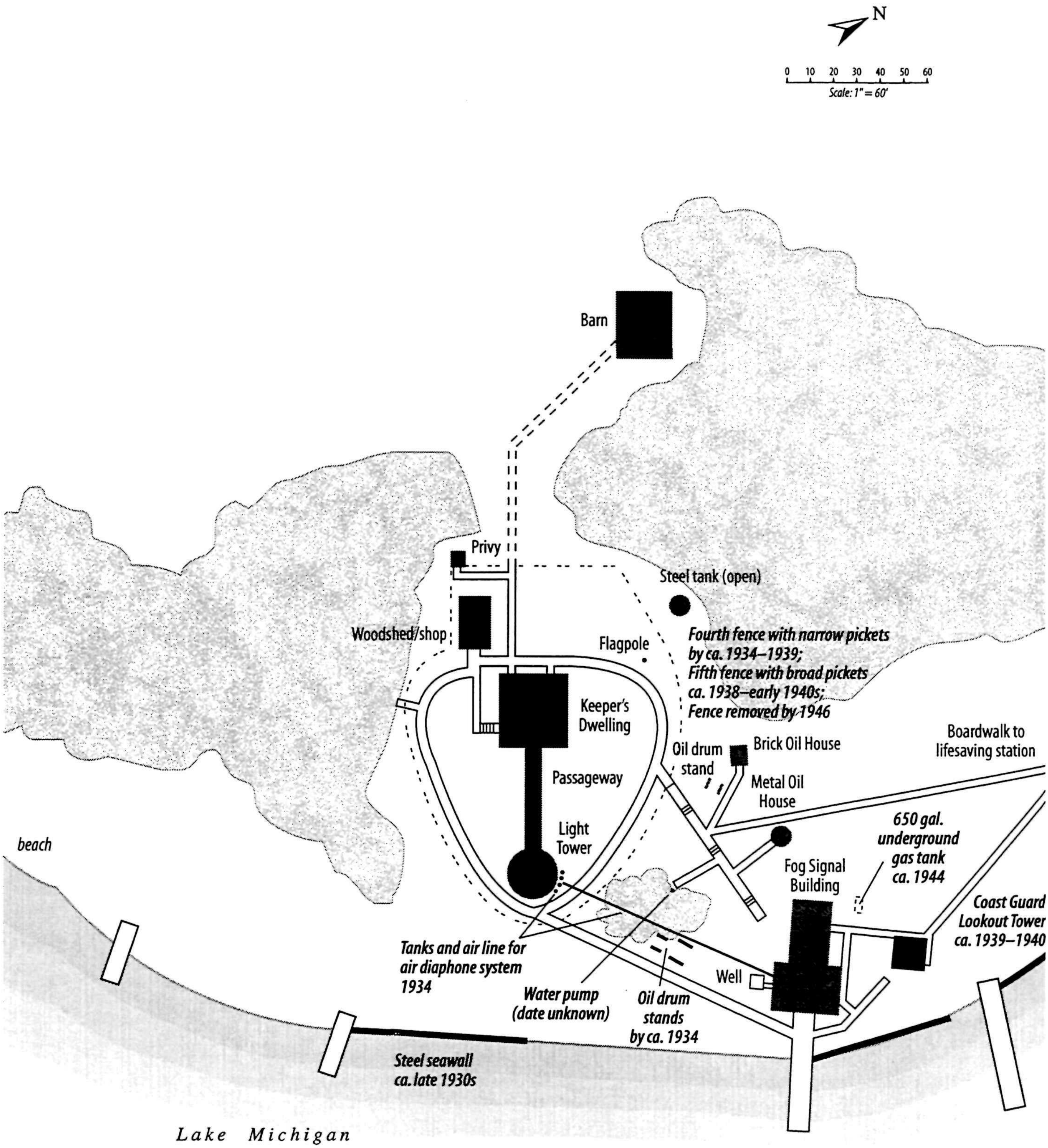
Landscape Chronology: 1871-1896



Map Sources:
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
SLBE Negative #s 3324, 2068, 1235, 1333, 2051 [Figures 7, 9, 10, 15, 16]
South Manitou Is. L.S., South Manitou, Mich., Plot Plan, June 27, 1944.

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 5
SOUTH MANITOU ISLAND LIGHT STATION
Landscape Chronology: 1897-1933



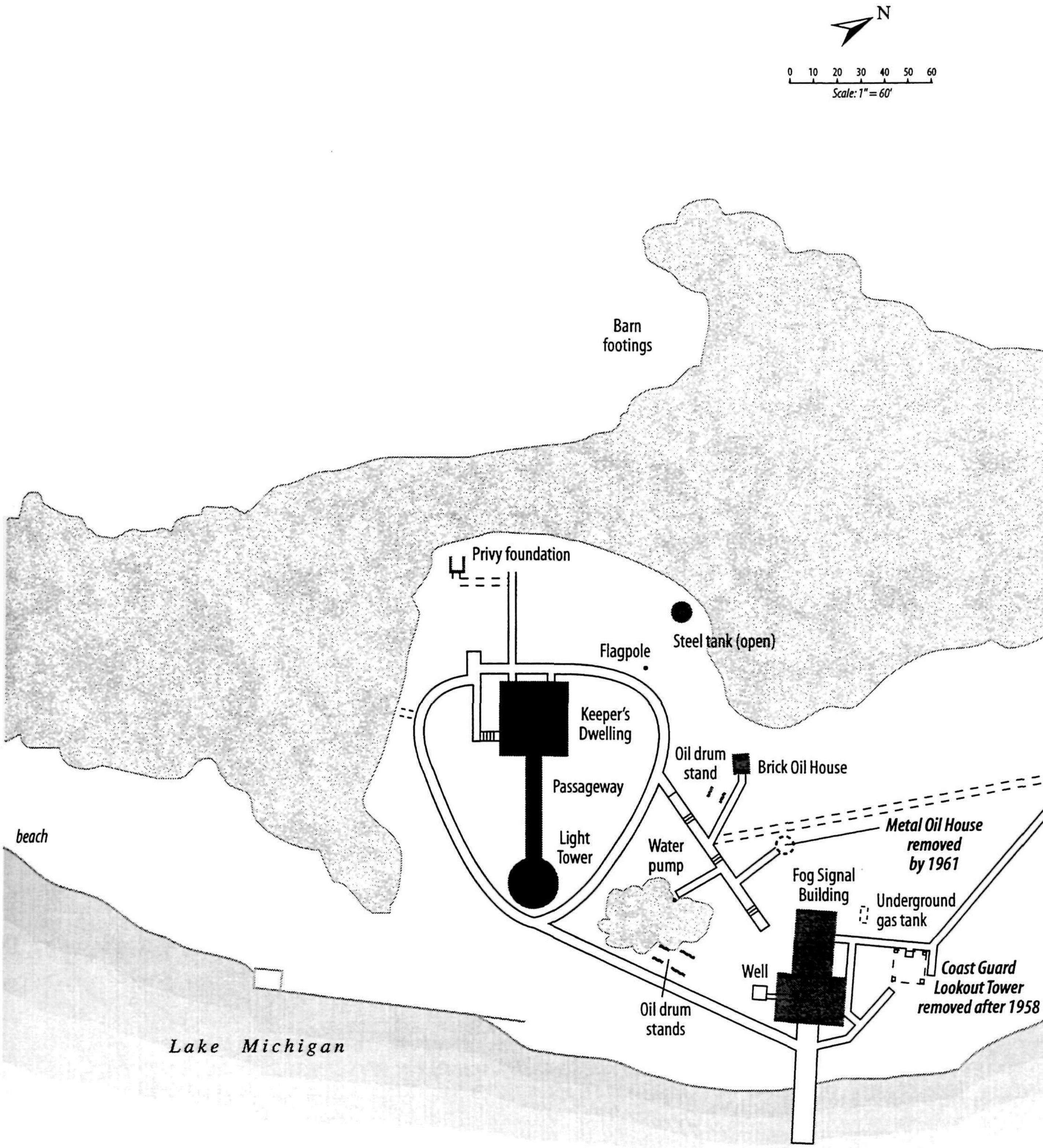
Map Sources:
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
South Manitou Is. L.S., South Manitou, Mich., Plot Plan, June 27, 1944.
SLBE Negative #s 2055, 1238, 1242, 1223, 3292, 2027, 2124 [Figures 8, 12, 13, 17–19, 21, 22]

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 6

SOUTH MANITOU ISLAND LIGHT STATION

Landscape Chronology: 1934-1958



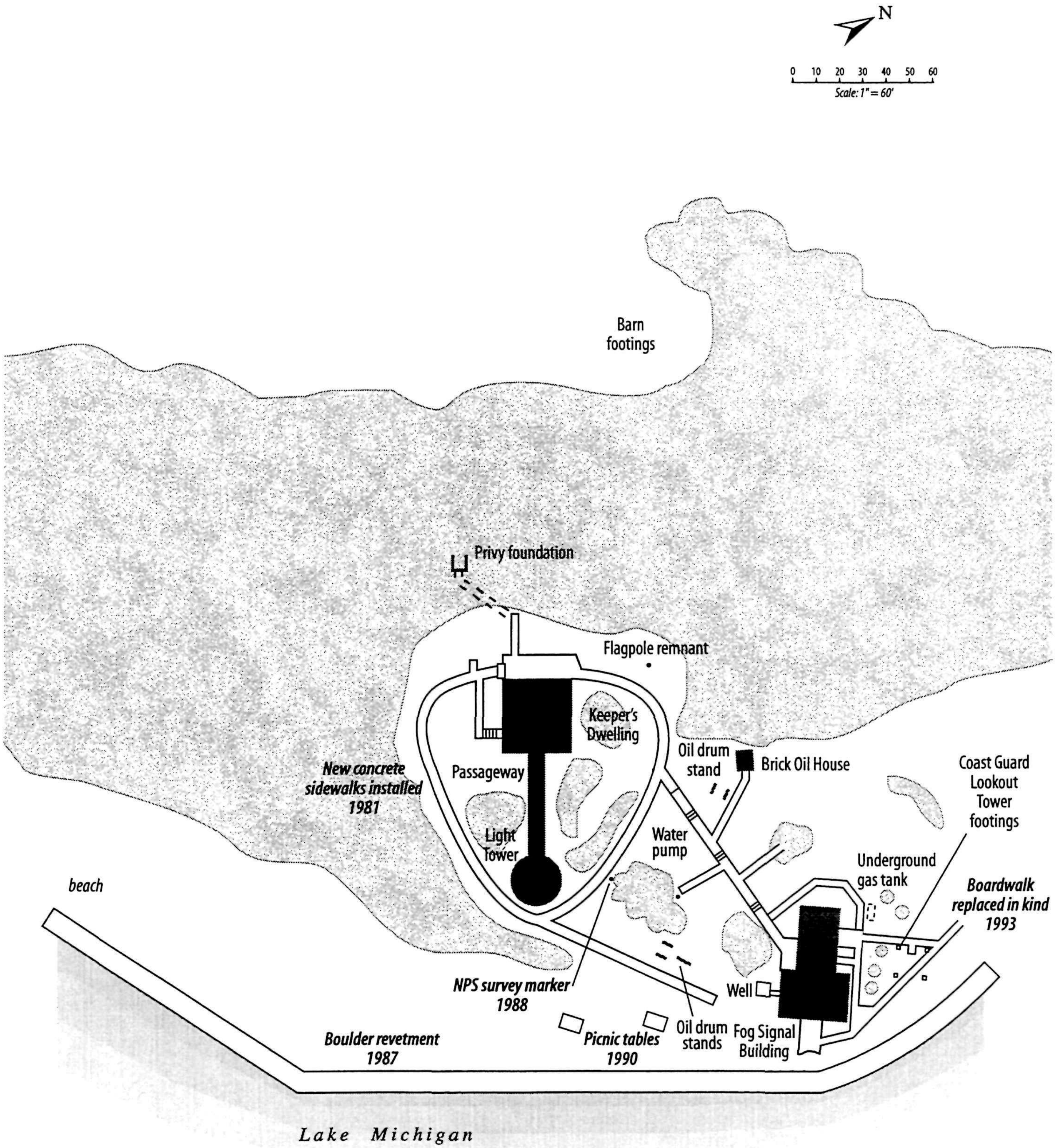
Map Sources:
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
South Manitou Is. L.S., South Manitou, Mich., Plot Plan, June 27, 1944.

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 7

SOUTH MANITOU ISLAND LIGHT STATION

Landscape Chronology: 1959-1969



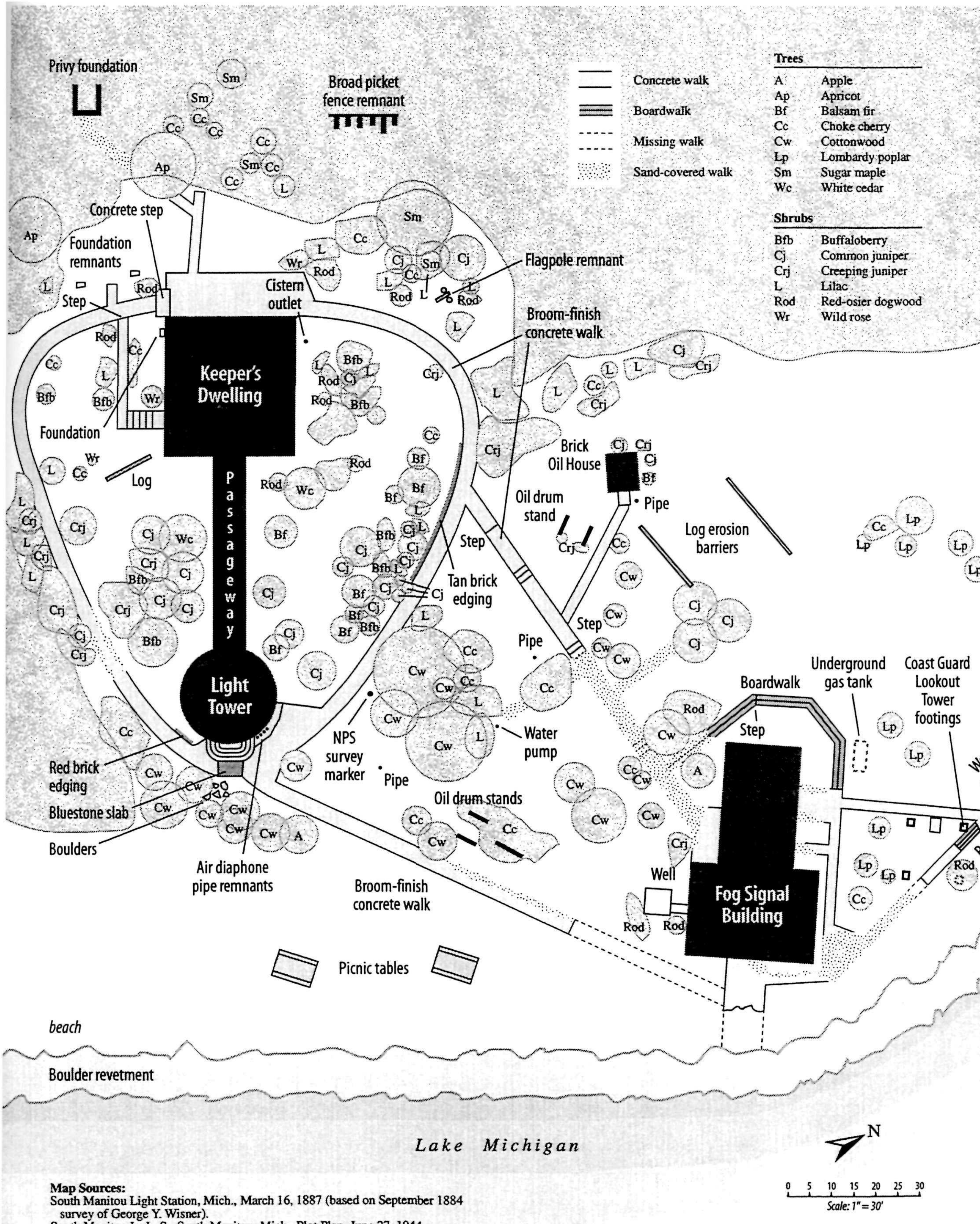
Map Sources:
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
South Manitou Is. L. S., South Manitou, Mich., Plot Plan, June 27, 1944.
South Manitou Is. L. S., South Manitou, Mich., Revised Plot Plan, May 10, 1965.
Photographs, Betty Kramer collection, 1980s.
U. S. Lighthouse Reservation, Historic American Buildings Survey, 1988.
Fieldwork conducted by Land and Community Associates, June 1995, June 1997.

Drawing prepared by Land and Community Associates, 1996. Revised February 1998.

Exhibit 8

SOUTH MANITOU ISLAND LIGHT STATION

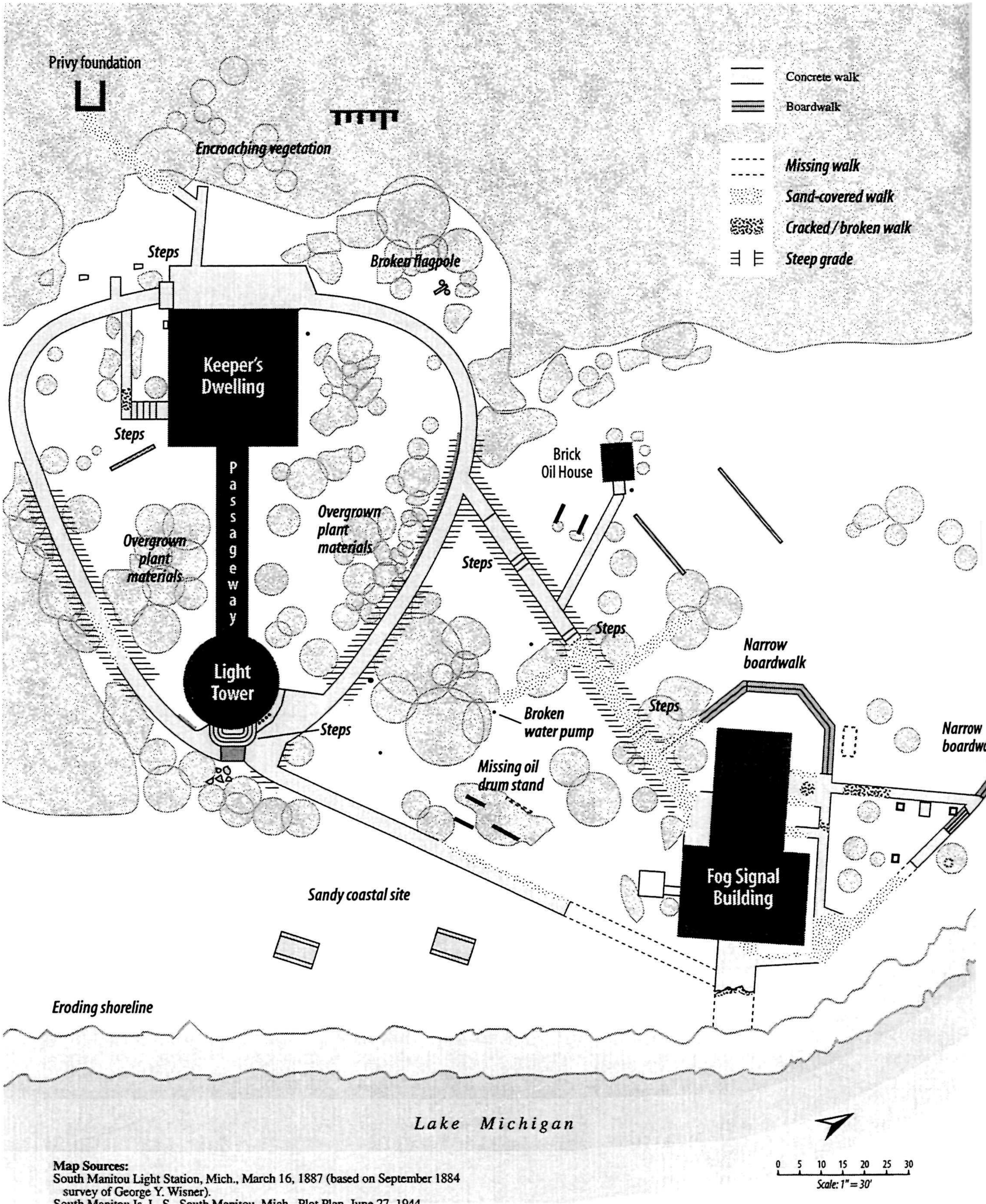
Landscape Chronology: 1970-1995



Map Sources:
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
South Manitou Is. L. S., South Manitou, Mich., Plot Plan, June 27, 1944.
South Manitou Is. L. S., South Manitou, Mich., Revised Plot Plan, May 10, 1965.
U. S. Lighthouse Reservation, Historic American Buildings Survey, 1988.
Fieldwork conducted by Land and Community Associates, June 1995, June 1997.

Drawing prepared by Land and Community Associates, 1996. Revised March 1998.

Exhibit 9
SOUTH MANITOU ISLAND LIGHT STATION
Landscape Existing Conditions 1997



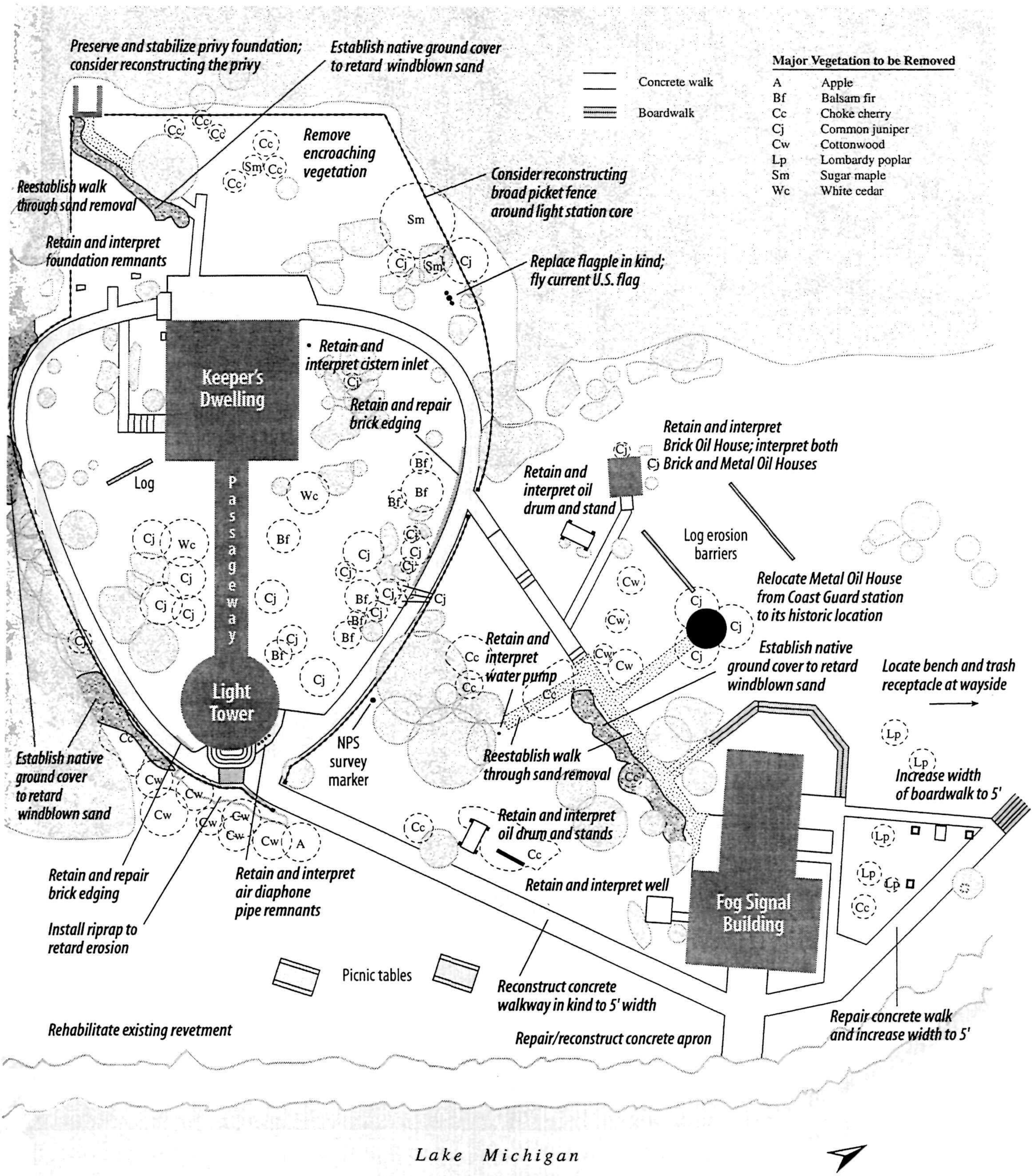
Map Sources:
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
South Manitou Is. L. S., South Manitou, Mich., Plot Plan, June 27, 1944.
South Manitou Is. L. S., South Manitou, Mich., Revised Plot Plan, May 10, 1965.
U. S. Lighthouse Reservation, Historic American Buildings Survey, 1988.
Fieldwork conducted by Land and Community Associates, June 1995, June 1997.

Drawing prepared by Land and Community Associates, 1996. Revised March 1998.

Exhibit 10

SOUTH MANITOU ISLAND LIGHT STATION

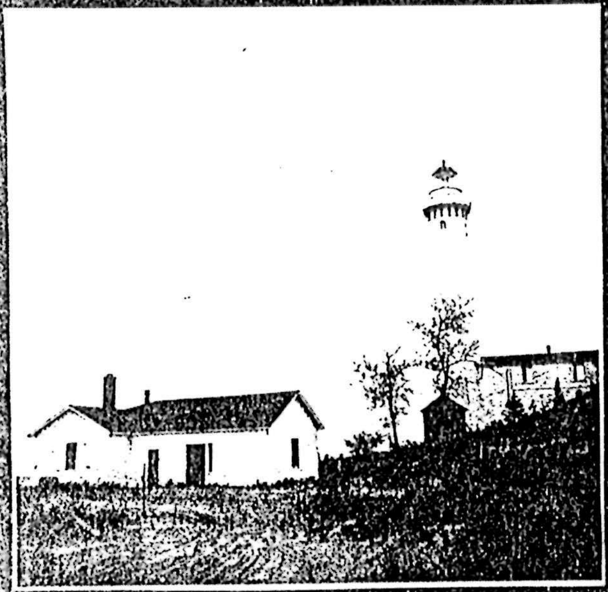
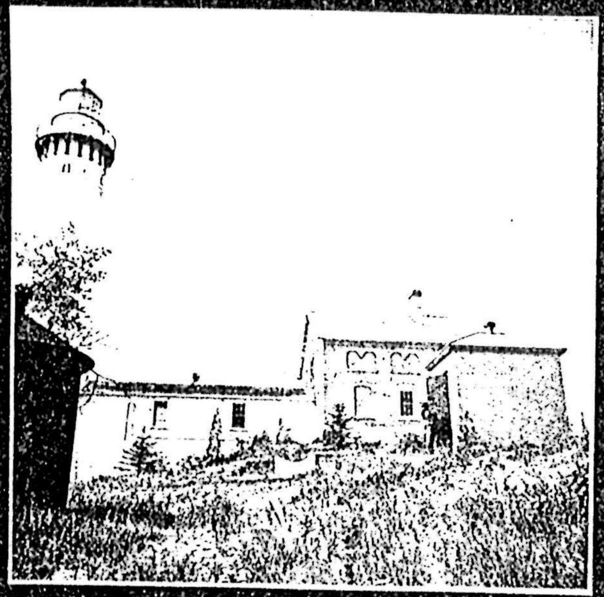
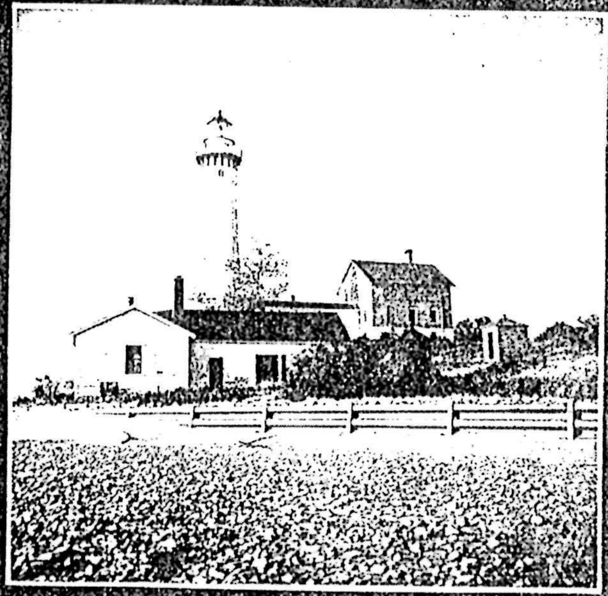
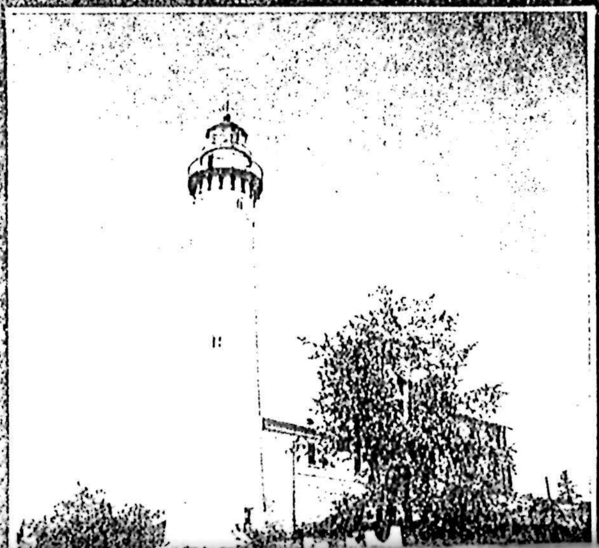
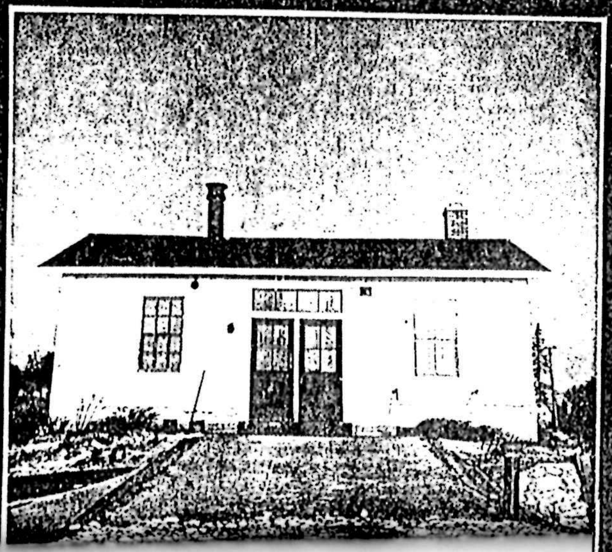
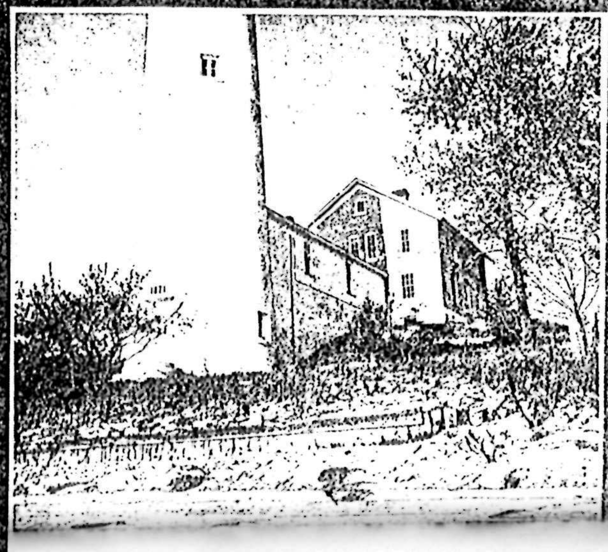
Site Deficiencies and Barriers

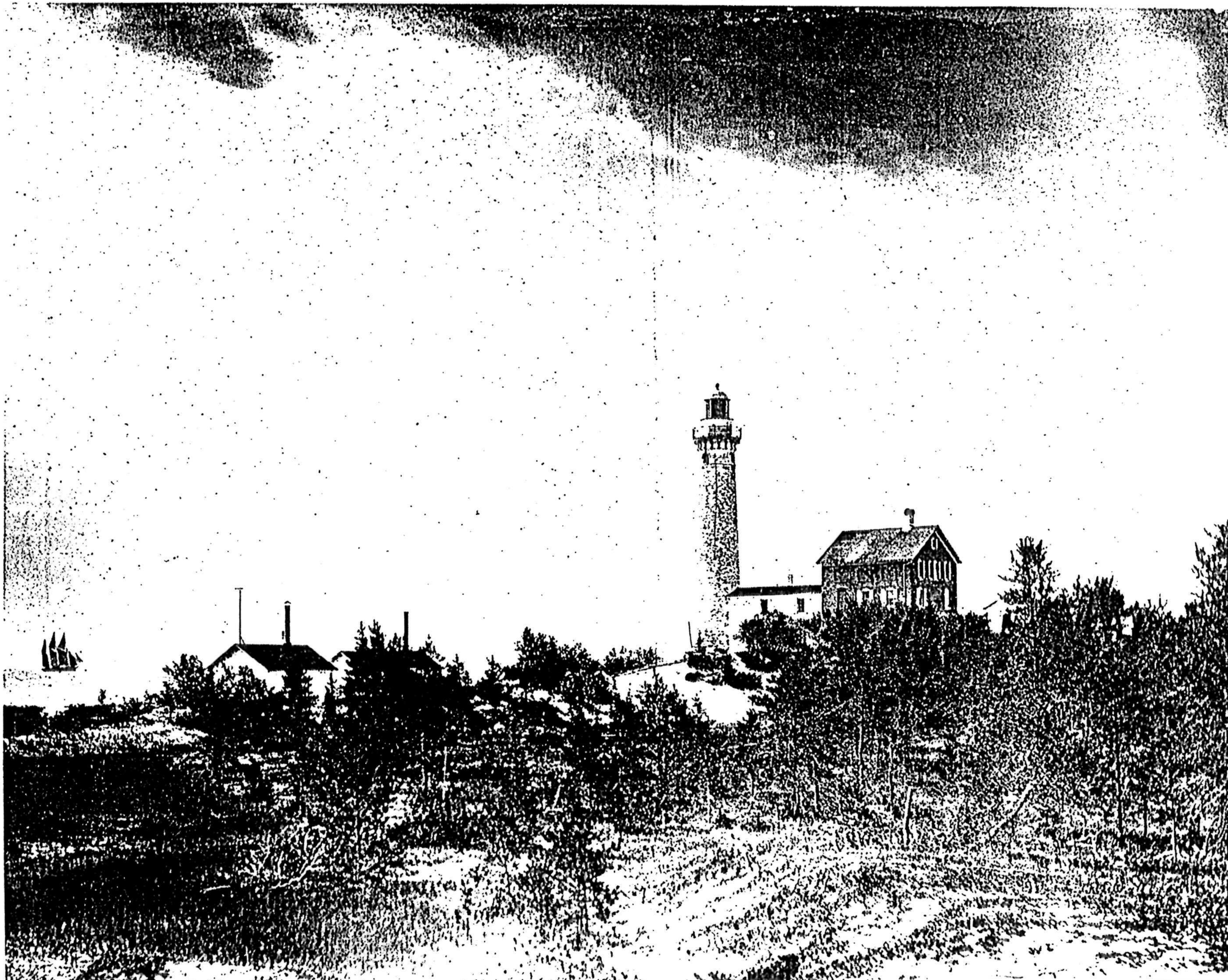


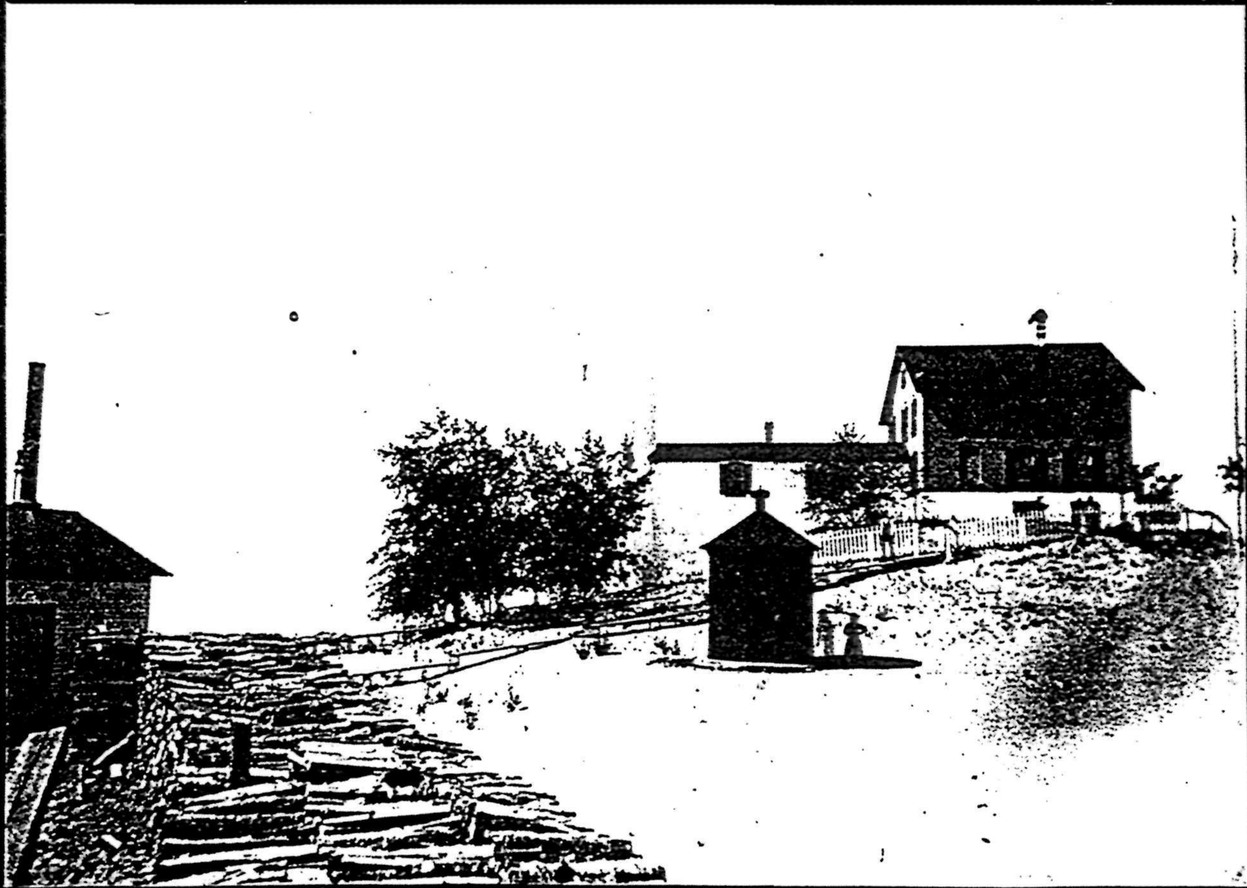
Map Sources:
South Manitou Light Station, Mich., March 16, 1887 (based on September 1884 survey of George Y. Wisner).
South Manitou Is. L. S., South Manitou, Mich., Plot Plan, June 27, 1944.
South Manitou Is. L. S., South Manitou, Mich., Revised Plot Plan, May 10, 1965.
U. S. Lighthouse Reservation, Historic American Buildings Survey, 1988.
Fieldwork conducted by Land and Community Associates, June 1995, June 1997.

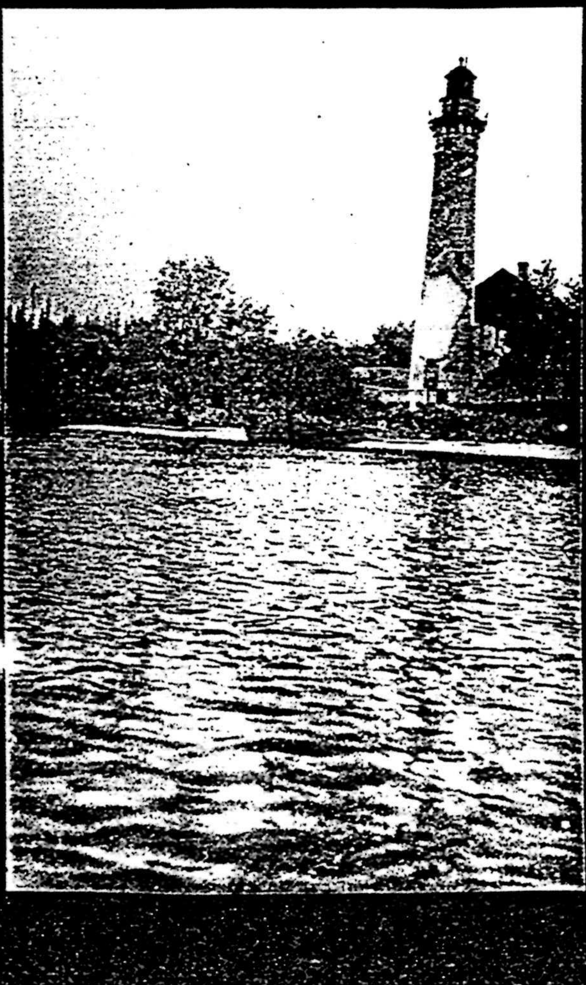
Drawing prepared by Land and Community Associates, 1998. Revised January 1999.

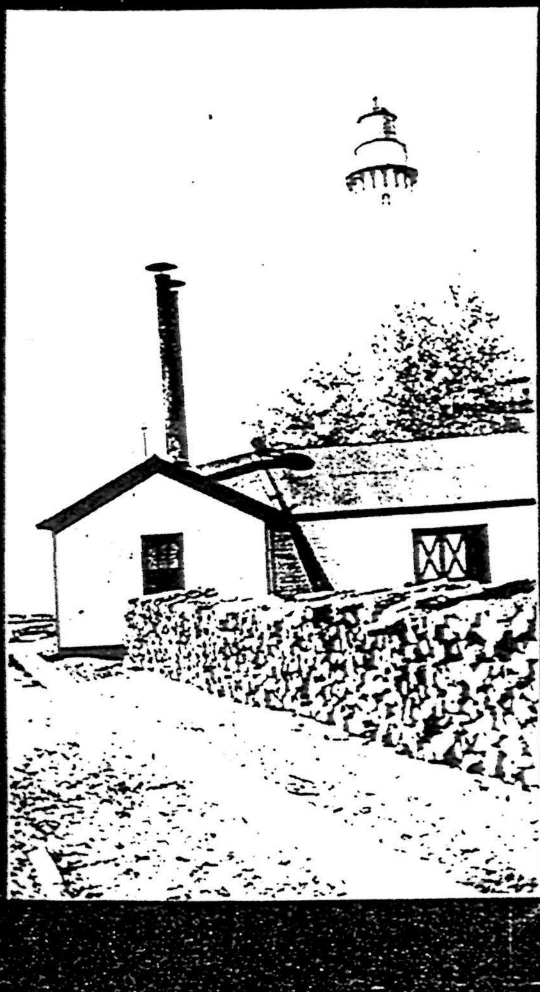
Exhibit 11
SOUTH MANITOU ISLAND LIGHT STATION
Landscape Design Recommendations

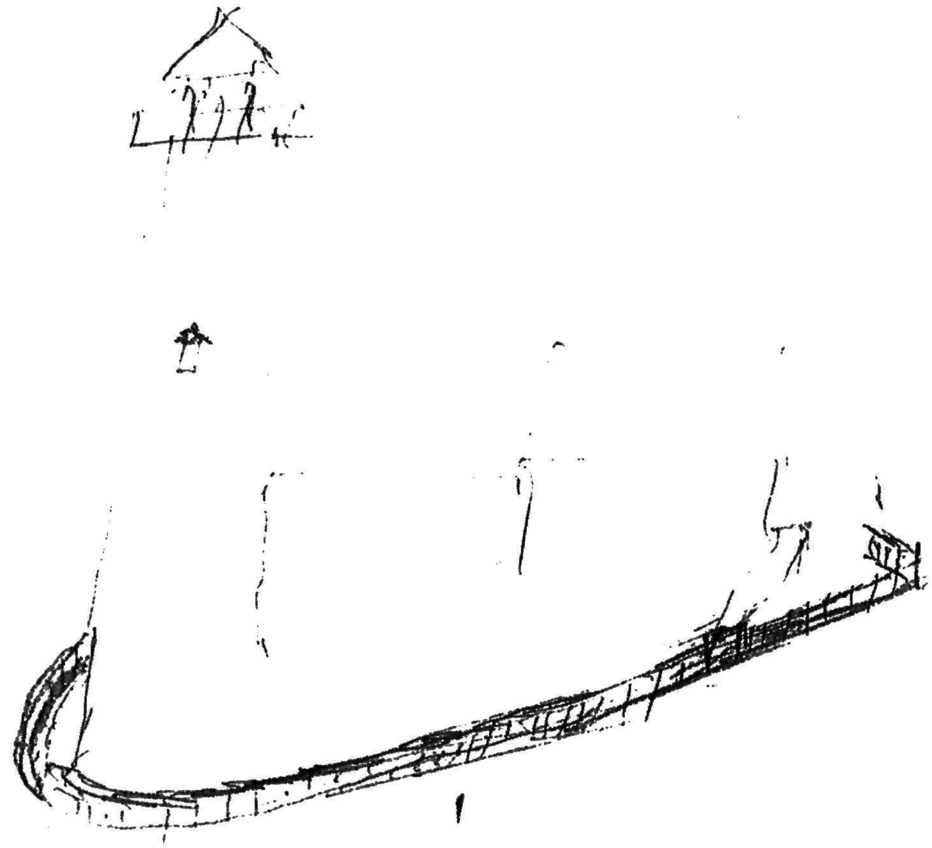











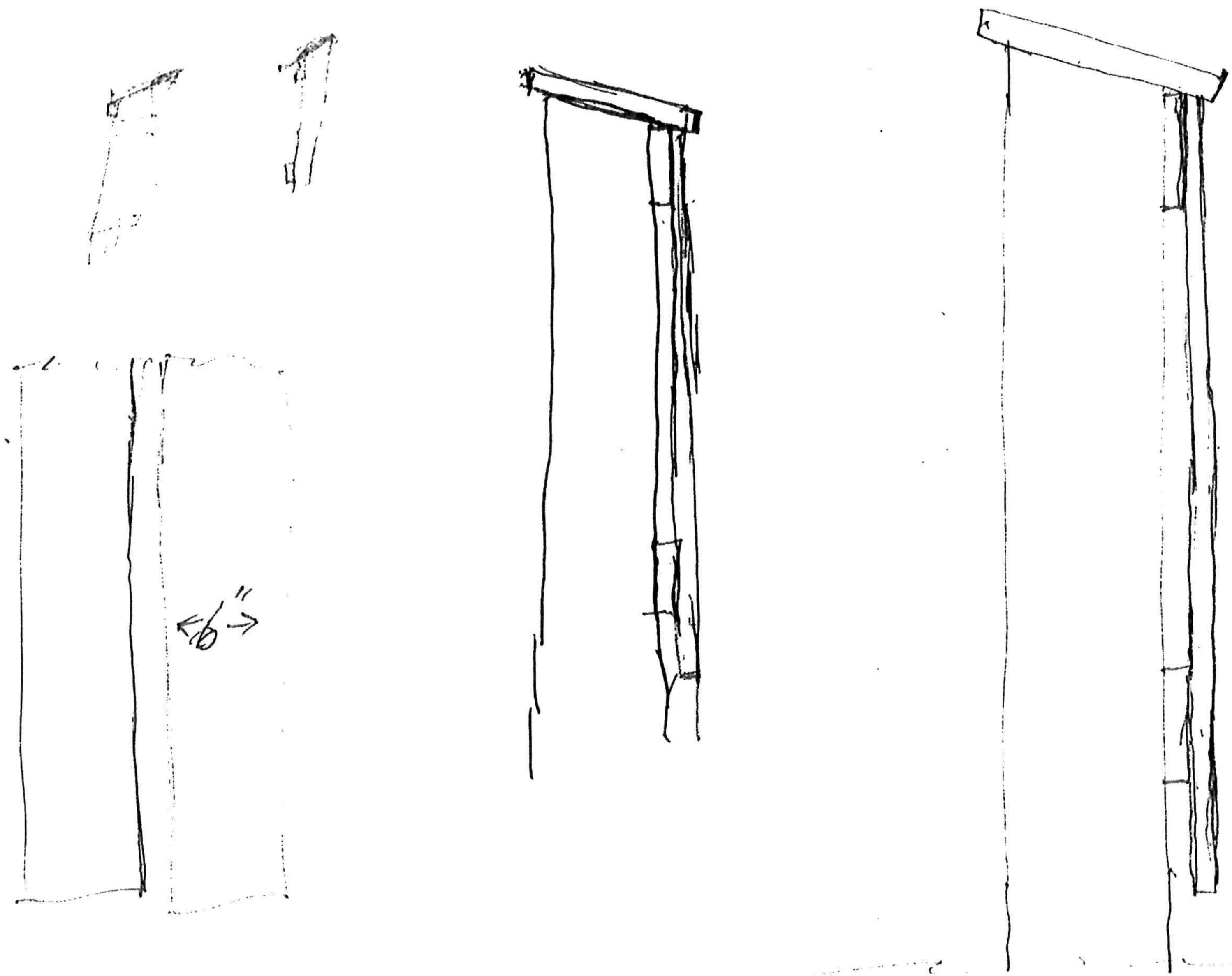






fence [illegible]

Comp[illegible] - Glenn Furst



construction
of lighthouse
fence
Glenn Forest
1978

Appendix G:
Preliminary Cost Estimates

OVERALL SITE	Qty	Unit	Cost/Unit	Subtotal	0.07 Gen Con	0.214 GC OVHD	0.257 Conting	Total	CSI Total
1 General Requirements (entire site)									**$143,804**
Permits.	80		$10	$800	$56	$171	$206	$1,233	
Equipment.	1		$1,500	$1,500	$105	$321	$386	$2,312	
Dumpsters.	1		$550	$550	$39	$118	$141	$848	
Debris Removal.	1		$3,000	$3,000	$210	$642	$771	$4,623	
General Hand Labor.	20	wk	$1,000	$20,000	$1,400	$4,280	$5,140	$30,820	
Supervision.	20	wk	$2,400	$48,000	$3,360	$10,272	$12,336	$73,968	
Insurance.	0.02	%		$30,000				$30,000	
2 Site Construction									**$189,932**
Broad picket fencing.	425	lf	$50	$21,250	$1,488	$4,548	$5,461	$32,747	
Clear encroaching vegetation.	0.40	ac	$2,000	$800	$56	$171	$206	$1,233	
Tree removal.	70	ea	$50	$3,500	$245	$749	$900	$5,394	
Plant native ground cover.	750	sf	$4	$3,000	$210	$642	$771	$4,623	
Remove sand from walks.	1200	cc	$2	$2,400	$168	$514	$617	$3,699	
Repair broken walks.	60	sf	$50	$3,000	$210	$642	$771	$4,623	
Reconstruct 5' wide walk.	190	lf	$200	$38,000	$2,660	$8,132	$9,766	$58,558	
Reconstruct Fog Signal Building apron.	220	sf	$40	$8,800	$616	$1,883	$2,262	$13,561	
Widen boardwalk by 3'.	1250	lf	$30	$37,500	$2,625	$8,025	$9,638	$57,788	
Rebuild narrow boardwalks.	60	lf	$20	$1,200	$84	$257	$308	$1,849	
Benches.	2	ea	$1,200	$2,400	$168	$514	$617	$3,699	
Trash receptacles.	2	ea	$700	$1,400	$98	$300	$360	$2,158	
Breakwater and shoreline protection	Allowance by owner.								
10 Specialties									**$14,177**
Wooden flagpole	1	ea	$4,200	$4,200	$294	$899	$1,079	$6,472	
New privy, handicapped-accessable.	1	ea	$5,000	$5,000	$350	$1,070	$1,285	$7,705	
OVERALL SITE TOTAL								**$347,913**	

KEEPER'S DWELLING	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
2 Site Construction									**$6,164**
UFAS compliant ramp at south elevation of Dwelling.	1	ea	$4,000	$4,000	$280	$856	$1,028	$6,164	
Lead abatement.	Allowance by owner.								

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
4 Masonry									**$299,724**
Remove all deteriorated parging.	2511	sf	$4	$10,044	$703	$2,149	$2,581	$15,477	
Repair foundation distress, surface spalls, and cracks as needed.	350	sf	$55	$19,250	$1,348	$4,120	$4,947	$29,665	
Repair spalled and deteriorated brick.	2162	sf	$55	$118,899	$8,323	$25,444	$30,557	$183,223	
Tuckpoint as required.	2511	sf	$8	$20,088	$1,406	$4,299	$5,163	$30,956	
Apply new parging to match historic appearance	2511	sf	$8	$20,088	$1,406	$4,299	$5,163	$30,956	
Repair keystone crack above south door.	1	ea	$300	$300	$21	$64	$77	$462	
Replace basement window sills and stone jambs	7	ea	$500	$3,500	$245	$749	$900	$5,394	
Replace upper level window sills.	6	lf	$55	$330	$23	$71	$85	$509	
Restore fireboxes.	2	ea	$1,000	$2,000	$140	$428	$514	$3,082	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
6 Wood and Plastics									**$31,862**
Provide header at chimney rafters.	7	lf	$100	$700	$49	$150	$180	$1,079	
Add joists to 2nd floor framing.	250	sf	$12	$3,000	$210	$642	$771	$4,623	
Add shoring beam and posts in basement.	8	lf	$150	$1,200	$84	$257	$308	$1,849	
Provide shutters and hardware to match historic shutters.	16	pair	$550	$8,800	$616	$1,883	$2,262	$13,561	
Widen door openings to 36" at basement and first floor to meet UFAS.	10	ea	$300	$3,000	$210	$642	$771	$4,623	
Repair baseboard, Room 001.	11	lf	$24	$264	$18	$56	$68	$406	
Install threshold, Door I-15.	3	lf	$24	$72	$5	$15	$19	$111	
Replace trim, Room 202.	70	lf	$24	$1,680	$118	$360	$432	$2,590	
Repair damaged flooring, Room 203.	136	sf	$10	$1,360	$95	$291	$350	$2,096	
Recreate stair handrail & balusters.	1	ea	$600	$600	$42	$128	$154	$924	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
7 Thermal and Moisture Protection									**$28,685**
Repair/replace any damaged areas of roof.	1478	sf	$8	$11,827	$828	$2,531	$3,040	$18,226	
Replace deteriorated areas of flashing at the chimney.	300	sf	$16	$4,800	$336	$1,027	$1,234	$7,397	
Install new gutters.	70	lf	$18	$1,267	$89	$271	$326	$1,953	
Install new downspouts.	45	lf	$16	$720	$50	$154	$185	$1,109	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
8 Doors and Windows									**$26,659**
Windows:									
Remove infill at window D-7.	1	ea	$100	$100	$7	$21	$26	$154	
Reconstruct sash to match historic sash.	16	ea	$300	$4,800	$336	$1,027	$1,234	$7,397	
Construct storm windows.	16	ea	$100	$1,600	$112	$342	$411	$2,465	
Reconstruct or consolidate all deteriorated jambs and sills as required.	16	ea	$300	$4,800	$336	$1,027	$1,234	$7,397	
Doors:									
New, wider doors at basement and first floor.	10	ea	$600	$6,000	$420	$1,284	$1,542	$9,246	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
9 Finishes									**$136,446**
Exterior:									
Paint exterior brick in accordance with the paint analysis.	2162	sf	$6	$12,972	$908	$2,776	$3,334	$19,990	
Whitewash exterior stone.	350	sf	$6	$2,100	$147	$449	$540	$3,236	
Paint window exteriors.	16	ea	$100	$1,600	$112	$342	$411	$2,465	
Interior:									
Document historic floor coverings.	2062	sf	$2	$4,124	$289	$883	$1,060	$6,356	
Stain and refinish floors that historically had natural finishes.	1533	sf	$10	$15,330	$1,073	$3,281	$3,940	$23,624	
Sand and repaint floors that historically had painted finishes.	529	sf	$8	$4,232	$296	$906	$1,088	$6,522	
Replace missing floor at Storage Room B-01.	55	sf	$7	$385	$27	$82	$99	$593	
Repair damaged floor, Room 103.	100	sf	$10	$1,000	$70	$214	$257	$1,541	

Remove unsound plaster at exterior walls, repair masonry substrate, replace rotted nailing strips, install new metal lath and plaster.	1920	sf	$12	$23,040	$1,613	$4,931	$5,921	$35,505	
Remove unsound plaster at interior walls, install new drywall, skim coat entire wall surface with plaster.	500	sf	$8	$4,000	$280	$856	$1,028	$6,164	
Install new metal lath and plaster ceiling in Room B-02.	45	sf	$8	$360	$25	$77	$93	$555	
Remove overfloor in Room 104 and Room 103-A.	240	sf	$4	$960	$67	$205	$247	$1,479	
Paint wall and ceiling surfaces throughout in accordance with the historic paint analysis and period of interpretation.	7300	sf	$2	$14,600	$1,022	$3,124	$3,752	$22,498	
Paint trim throughout in accordance with the historic paint analysis and period of interpretation.	1700	lf	$2	$3,400	$238	$728	$874	$5,240	
Remove paint buildup from basement stairs, repaint.	50	sf	$4	$200	$14	$43	$51	$308	
Finish new balusters and handrail to match existing newel post.	10	ea	$12	$120	$8	$26	$31	$185	
Repair and paint fireplace mantles.	5	lf	$24	$120	$8	$26	$31	$185	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
10 Specialties									**$617**
Recreate stair handrail & balusters	10	ea	$40	$400	$28	$86	$103	$617	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
11 Equipment									**$10,132**
Repair pantry B-05A cabinets and replace 2 missing doors.	21	ea	$75	$1,575	$110	$337	$405	$2,427	
Repair asst. keeper's kitchen cabinets, cast iron sink, pump, and counter.	1	ea	$5,000	$5,000	$350	$1,070	$1,285	$7,705	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
15 Mechanical									**$16,181**
Fire Suppression: base service.	1	ea	$5,000	$5,000	$350	$1,070	$1,285	$7,705	
Wet System	2000	sf	$2	$4,000	$280	$856	$1,028	$6,164	
Dry System	2000	sf	$4						
Pre-Action System	2000	sf	$7						
Fire Cycle System	2000	sf	$8						
Repair rusting duct.	1	ea	$1,500	$1,500	$105	$321	$386	$2,312	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
16 Electrical									**$21,961**
Electrical wiring throughout.	2000	sf	$3	$6,000	$420	$1,284	$1,542	$9,246	
Ceiling mounted light fixtures.	16	ea	$250	$4,000	$280	$856	$1,028	$6,164	
Exterior light fixtures.	3	ea	$250	$750	$53	$161	$193	$1,157	
Duplex outlets.	25	ea	$100	$2,500	$175	$535	$643	$3,853	
Electrical Distribution Panel.	1	ea	$1,000	$1,000	$70	$214	$257	$1,541	
Service to site.	Allowance by owner.								

DWELLING TOTAL **$578,431**

PASSAGEWAY

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
2 Site Construction									
Lead Abatement	Allowance by owner								

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
4 Masonry									**$157,241**
Exterior Brick Surfaces:									
Remove all deteriorated parging.	709.5	sf	$4	$2,838	$199	$607	$729	$4,373	
Repair spalled and deteriorated brick.	709.5	sf	$55	$39,023	$2,732	$8,351	$10,029	$60,135	
Tuckpoint as required.	709.5	sf	$8	$5,676	$397	$1,215	$1,459	$8,747	
Apply new scored parging.	709.5	sf	$8	$5,676	$397	$1,215	$1,459	$8,747	
Exterior Stone Surfaces:									
Remove all deteriorated parging.	697.5	sf	$4	$2,790	$195	$597	$717	$4,299	
Make stone repairs as needed.	697.5	sf	$50	$34,875	$2,441	$7,463	$8,963	$53,742	
Tuckpoint as required.	697.5	sf	$8	$5,580	$391	$1,194	$1,434	$8,599	
Apply to new parging to match the historic appearance.	697.5	sf	$8	$5,580	$391	$1,194	$1,434	$8,599	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
7 Thermal and Moisture Protection									**$10,647**
Repair/replace any damaged areas of roof.	540	sf	$5	$2,700	$189	$578	$694	$4,161	
Replace deteriorated areas of flashing at the chimney.	100	sf	$16	$1,600	$112	$342	$411	$2,465	
Install new gutters.	90	lf	$18	$1,620	$113	$347	$416	$2,496	
Install new downspouts.	66	lf	$15	$990	$69	$212	$254	$1,525	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
8 Doors and Windows									**$4,931**
Install fire-rated doors at either end of passageway.	2	ea	$1,000	$2,000	$140	$428	$514	$3,082	
Recontruct window sashes, sills, storms, and frames as needed.	4	ea	$300	$1,200	$84	$257	$308	$1,849	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
9 Finishes									**$31,440**
Exterior Brick Surfaces:									
Apply paint finish in accordance with paint analysis.	710	sf	$6	$4,260	$298	$912	$1,095	$6,565	
Exterior Stone Surfaces:									
Whitewash all exterior stone surfaces in accordance with the paint analysis.	700	sf	$6	$4,200	$294	$899	$1,079	$6,472	
Interior:									
Sand, seal, and refinish wood floor.	281	sf	$14	$3,934	$275	$842	$1,011	$6,062	
Ceiling:									
Remove all existing damaged plaster and lath.	281	sf	$2	$562	$39	$120	$144	$865	
Install new wooden lath and plaster.	281	sf	$6	$1,686	$118	$361	$433	$2,598	
Finish according to the paint report.	281	sf	$2	$562	$39	$120	$144	$865	
Walls:									
Repair plaster as needed.	650	sf	$6	$3,900	$273	$835	$1,002	$6,010	
Finish according to the paint report.	650	sf	$2	$1,300	$91	$278	$334	$2,003	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
15 Mechanical									**$865**
Fire Suppression: Wet System	281	sf	$2	$562	$39	$120	$144	$865	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
16 Electrical									**$4,305**
Electrical Wiring	281	sf	$3	$843	$59	$180	$217	$1,299	
Ceiling mounted light fixtures	3	ea	$250	$750	$53	$161	$193	$1,157	
Duplex outlets	2	ea	$100	$200	$14	$43	$51	$308	
Communications System.	1	ea	$1,000	$1,000	$70	$214	$257	$1,541	

PASSAGEWAY TOTAL **$209,429**

TOWER

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
2 Site Construction									
Lead Abatement	Allowance by owner								

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
4 Masonry									**$4,161**
Repoint foundation.	300	sf	$9	$2,700	$189	$578	$694	$4,161	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
5 Metals									**$4,931**
Repair/replace stair landing brackets.	8	ea	$400	$3,200	$224	$685	$822	$4,931	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
8 Doors and Windows									**$31,128**
Recreate historic sashes (2 pairs of casements per window).	7	pr	$1,600	$11,200	$784	$2,397	$2,878	$17,259	
Install double sash with tempered glass at lantern room (Approximately 30" x 70", 1/4" thick.)	9	pr	$1,000	$9,000	$630	$1,926	$2,313	$13,869	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
9 Finishes									**$102,939**
Exterior:									
Prepare and whitewash exterior masonry.	4500	sf	$8	$36,000	$2,520	$7,704	$9,252	$55,476	
Prepare and paint exterior metal surfaces.	1000	sf	$8	$8,000	$560	$1,712	$2,056	$12,328	
Interior:									
Remove existing patching compound, repair.	1000	sf	$10	$10,000	$700	$2,140	$2,570	$15,410	
Repair tower interior plaster.	300	sf	$6	$1,800	$126	$385	$463	$2,774	
Paint interior surfaces.	4000	sf	$2	$8,000	$560	$1,712	$2,056	$12,328	
Remove rust, prime and paint exposed metal surfaces.	500	sf	$6	$3,000	$210	$642	$771	$4,623	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
11 Equipment									**$9,246**
Reconstruct and install cabinet doors at Tower watchroom.	2	ea	$3,000	$6,000	$420	$1,284	$1,542	$9,246	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
15 Mechanical									**$308**
Fire Suppression: Wet System	100	sf	$2	$200	$14	$43	$51	$308	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
16 Electrical									$2,389
Electrical Wiring	200	sf	$3	$600	$42	$128	$154	$924	
Wall mounted light fixtures	3	ea	$250	$750	$53	$161	$193	$1,157	
Duplex outlets	2	ea	$100	$200	$14	$43	$51	$308	
TOWER TOTAL								**$155,102**	

FOG SIGNAL BUILDING

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
2 Site Construction									
Lead Abatement	Allowance by owner								

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
3 Concrete									$19,632
Repair crack below window F-8	50	sf	$6	$300	$21	$64	$77	$462	
Repair foundation crack	8	sf	$55	$440	$31	$94	$113	$678	
New foundation at west half	300	sf	$40	$12,000	$840	$2,568	$3,084	$18,492	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
6 Wood and Plastics									$45,136
Remove paint buildup on siding	1600	sf	$4	$6,400	$448	$1,370	$1,645	$9,863	
Repair clapboards	800	sf	$6	$4,800	$336	$1,027	$1,234	$7,397	
Remove infill between Rooms 102 & 103	1	ea	$150	$150	$11	$32	$39	$232	
Clean & repair window & door trim	314.8	lf	$6	$1,889	$132	$404	$485	$2,910	
Replace fog signal building rotted sill plates and beams	107	lf	$150	$16,050	$1,124	$3,435	$4,125	$24,734	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
7 Thermal and Moisture Protection									$3,883
Install new gutters and downspouts	140	lf	$18	$2,520	$176	$539	$648	$3,883	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
9 Finishes									$19,109
Sand, seal, paint clapboards	1600	sf	$4	$6,400	$448	$1,370	$1,645	$9,863	
Remove rust from metal ceiling, prime & finish	1000	sf	$6	$6,000	$420	$1,284	$1,542	$9,246	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
15 Mechanical									$3,390
Fire Suppression: Wet System	1100	sf	$2	$2,200	$154	$471	$565	$3,390	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
16 Electrical									$12,173
Electrical Wiring	1100	sf	$3	$3,300	$231	$706	$848	$5,085	
Ceiling mounted light fixtures	8	ea	$250	$2,000	$140	$428	$514	$3,082	
Duplex outlets	16	ea	$100	$1,600	$112	$342	$411	$2,465	
Electrical Distribution Panel	1	ea	$1,000	$1,000	$70	$214	$257	$1,541	
FOG SIGNAL BUILDING TOTAL								**$103,323**	

BRICK OIL HOUSE

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
2 Site Construction									
Lead Abatement	Allowance by owner								

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
4 Masonry									$30,974
Remove parge coat, repair spalling brick, tuckpoint.	300	sf	$67	$20,100	$1,407	$4,301	$5,166	$30,974	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
5 Metals									$690
Repair cornice.	32	lf	$14	$448	$31	$96	$115	$690	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
9 Finishes									$4,622
Remove rust, prime, and paint Brick Oil House roof	100	sf	$6	$600	$42	$128	$154	$924	
Paint Brick Oil House exterior	300	sf	$4	$1,200	$84	$257	$308	$1,849	
Paint Brick Oil House interior	300	sf	$4	$1,200	$84	$257	$308	$1,849	

BRICK OIL HOUSE TOTAL **$36,286**

METAL OIL HOUSE

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
2 Site									$7,705
Relocate Metal Oil House.	1	ea	$5,000	$5,000	$350	$1,070	$1,285	$7,705	
Lead Abatement	Allowance by owner								

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
3 Concrete									$2,118
New foundation.	25	lf	$55	$1,375	$96	$294	$353	$2,118	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
6 Wood and Plastics									$777
Install new wood floor.	63	sf	$8	$504	$35	$108	$130	$777	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
9 Finishes									$3,699
Remove rust, prime, and finish Metal Oil House exterior	400	sf	$6	$2,400	$168	$514	$617	$3,699	

	Qty	Unit	Cost/Unit	Subtotal	Gen Con	GC OVHD	Conting	Total	CSI Total
11 Equipment									$154
Restore curved shelving to Metal Oil House	2	ea	$50	$100	$7	$21	$26	$154	

METAL OIL HOUSE TOTAL **$14,453**

PROJECT TOTAL **$1,444,937**