BOATHOUSE

Chronology of Alterations and Use

Original Construction

The Devils Island Boathouse was constructed in 1891, the same year that the Fresnel lens was installed in the temporary wood tower and put into service.[35]

The Boathouse's dock was rehabilitated in 1978 as it appears the planking was lost or damaged and needed to be restored. The cribs and timber structure of the dock are visible in the 1978 image. (Historic Image DI-20)

There are no available historic drawings for this building.

Significant Alterations / Current condition

One alteration to the Devils Island Boathouse is the cedar shingle reroofing that occurred in 2006. This was completed by the Historic Structure Preservation Team of the NPS. The spaced sheathing indicates the original roofing was wood shingle.

The Boathouse has never contained mechanical or electrical systems.

There is currently a large boulder underwater that is directly in the path of the boat ramp, preventing access into the building and corresponding boat storage (the primary function of the building). If the Boathouse is to be rehabilitated so as to be functional again, the boulder must be removed.

[35] List of Classified Structures, National Park Service, 2009.

Summary of Documented Work on the Building

Date	Work Described	Source of Information
Annual Report of 1898	"*Devils Island, Lake Superior, Wisconsin…* A crib for extension to the boat landing was built, sunk in place, and filled with ballast stone and a superstructure was built above the water line. Some 36 feet of the old landing that was out of level were raised 26 inches on the west side and 8 inches on the east side and refilled with ballast stone. The center truss of the boathouse was repaired and the roof was painted."	"1898 Annual Report of the Lighthouse Board," Devils Island listings in Lighthouse Establishment Annual Reports 1890-1914
1952, October 10	"Built anchor for hoist in top of boat house."	USCG Log, summarized by Bob Mackreth, 2004
1953, June 2	"New hoist for boathouse."	USCG Log, summarized by Bob Mackreth, 2004
1953, October 21	"Repaired rotted deck in S end of boathouse. Parts of foundation found to be rotted and should be repaired; letter will be sent."	USCG Log, summarized by Bob Mackreth, 2004
1955, September	Monthly report – "Boathouse badly needs new roof. Wood shingles are rotten and patching is little help. Should be reroofed next year."	USCG Log, summarized by Bob Mackreth, 2004
1978-1979	Reroofed with asphalt shingles and exterior battens repaired and painted	Historic Image DI-22 and APIS/NPS Business Office File # D3423 – Devils)
2006	Reroofed with cedar shingles	HSPT Reports, 2009

General Physical Description

This building is a one-story, one room, rectangular, utilitarian wood frame structure with a timber foundation. It has a simple gable roof with boxed rafter tails and board and batten siding. There is a boat door on the south elevation and a beadboard main door on the north elevation.

Physical Description -- Architecture

Architecture – Roof
The Boathouse was reroofed in 2006 with 5" exposure cedar shingles. The current roof has a prefinished red metal drip edge flashing at the starter course that extends 7" up the roof. The sheathing is spaced. Tie-off rings were installed at the ridge, though they do not appear to meet OSHA requirements, and there is a wood ridge cap. There is 1x6 frieze board and 1 x 4 ½" fascia at the gables and eaves. (DI-BH-15)

Architecture – Exterior Walls
The exterior walls are wood frame with board and batten siding. The battens are shaped and have an ogee profile.

Architecture – Window
The window in this building is a two- over two-lite, fixed sash, original to the building. It is located on the west side of the building. The sash is painted on both the interior and exterior faces. The exterior trim is 1 1/8" x 4 ½". The window is 2'1" x 3' 1". A paint sample taken at the exterior window trim indicates nine layers of paint, either dark green or white, with extremely weathered wood beneath. (DI-BH-11)

Architecture – Exterior Doors

Entry Door. This door is made of vertical tongue and groove wood planks, 3 ½" wide with bead, and is original to the building. The door has two strap hinges and a spring-loaded handle. There is a wood sill and the exterior trim is 1 1/8" x 4 ½", painted. The door is 2'7 ½" x 6'8" x ¾". A paint sample taken at the exterior door trim shows an impressive number of paint layers, especially for an exterior sample. The oldest layer of paint is gray and the wood beneath is heavily weathered. A sample from the eave trim indicates that its oldest layer of paint was the same shade of gray. (DI-BH-09 and 13)

Boat Doors. This set of two doors are made of vertical tongue and groove wood planks, ¾" x 5 ¼", and are original to the building. The door has no drip edge trim at the header but has a 1x4 base trim. The doors each have three strap hinges and they are currently barred and roped shut. The exterior trim is ¾" x 3 ½" painted wood. Each door is 4'3" x 7'3" x ¾". (DI-BH-14)

Architecture – Exterior Trim

The exterior trim consists of the base trim (has no slope) and the 1x4 corner boards. All the trim is wood and is painted. (DI-BH-08)

Architecture – Wall Finishes

There are no finished wall surfaces inside the Boathouse, but the unfinished rough framing and back sides of the vertical boards that side the exterior of the building are visible.

Architecture – Ceiling Finishes

There is no ceiling finish as the wood rafters, joists, sheathing, and roofing planks are exposed. This roof structure is original to the building.

Architecture – Interior Trim

There is no interior trim in this building. The wall framing is exposed.

Architecture – Floor

The floor is made of wood planks varying in size from 5 ½" to 1' wide. There is a boat ramp in the center of the floor that is 4'3" wide and angles up the length of the building to end at the hoisting mechanism located along the north wall. The floor and boat ramp are original to the building.

Architecture – Stairs

Exterior Stairs to Entry Door. These stairs are wood and unpainted. The stairs are recessed into the hillside and also help to act as a small retaining wall around the door area. There is one triangular tread (1'7" wide, 3" thick) attached to a wood frame structure that forms a triangle with the door. The distance from the ground to the top of the tread is 8 ½". The distance from the top of the tread to the top of the wood frame is 5". The distance between the door's threshold and the edge of the tread is 1'5". These stairs are not original to the building. (DI-BH-10)

Architecture – Accessibility

The building is currently not accessible. The north entry door opening is 2'7 ½" clear with a grade to finished floor elevation change of 1'1 ½".

Physical Description -- Structural

Structural – Foundation

The floor framing of the Boathouse is supported by wood beams that rest directly on the ground or are supported by wood timbers placed on the ground. The beams are not accessible and could not be measured.

Structural – Floor Framing

The floor framing was not accessible and could not be measured. The floor is sheathed with FS 2x12 planks.

Structural – Roof Framing

The roof framing consists of FS 2x4 rafters spaced at about 24". The rafters span approximately seven feet. The rafters are supported on the exterior wood-framed walls. The rafters are sheathed with spaced solid wood underlayment.

Structural – Wall Framing

The walls are constructed of FS 4x4 posts spaced at anywhere from three feet to nine feet. A FS 4x4 girt spans across the top of the posts. FS 4x4 girts span between the posts at mid-height and at the floor. The walls are sheathed with vertical FS 1x solid wood siding.

Structural – Lateral System

Lateral stability for the building is provided by the exterior wood-framed walls.

Structural – Load Requirements

The required floor load capacity for the boathouse is 125 psf if it used for light storage. The required roof snow load capacity is 36 psf.

Physical Description -- Mechanical

Mechanical – Plumbing Systems

None in the building.

Mechanical – HVAC

None in the building.

Mechanical – Fire Suppression

None in the building.

Mechanical – Other

The Boathouse contains a cast iron hand operated gear winch at the north end of the building that would have been used to pull boats up a ramp into the Boathouse.

Physical Description -- Electrical

Electrical – System Configuration
None in the building.

Electrical – Conductor Insulation
None in the building.

Electrical – Overcurrent Protection
None in the building.

Electrical – Lighting Systems
None in the building.

Electrical – Telecommunications
None in the building.

Electrical – Fire Alarm System
None in the building.

Electrical – Lightning Protection
None on the building.

Physical Description -- Hazardous Materials

The Boathouse was not accessed or observed during the September 2009 Site Inspections by Landmark Environmental.

Character Defining Features

Mass/Form. A simple utilitarian gable roof structure on the water's edge.

Exterior Materials. Wood board and batten siding painted white, exterior trim painted green and wood shingles at the roof.

Openings. One fixed four-lite sash painted green; one pair of doors at the launch and one entry door all constructed out of tongue and groove boards and painted green.

Interior Materials. Exposed wood framing at walls and roof and wood boards at the floor.

General Condition Assessment

In general, the Devils Island Boathouse is in fair condition due to the effects of the exposed location and the consistently moist condition on the wood doors, window and floor boards.

Mechanically, there are no systems in the Boathouse except a hand-operated metal winch.

Electrically, there are no systems in the Boathouse.

The following section is a discipline-by-discipline, component-by-component condition assessment of the building. Refer to Volume I, Chapter 2: Methodology for definitions of the condition ratings.

Condition Assessment -- Architecture

Architecture – Roof
Condition: *Good*
This roof is in good condition. However, the tie offs on the roof should not be used for life safety anchors until they can be certified as meeting OSHA requirements.

Architecture – Exterior Walls
Condition: *Good to Fair*
The exterior walls are in good condition. The batten is split over the west window. Some battens and trim at the base of the wall are rotting due to moisture wicking from level top of base trim (refer to structural assessment for wall framing issues).

Architecture – Window
Condition: *Fair*
The window is in fair condition as the glazing compound is brittle and failing and the sill is weathered.

Architecture – Exterior Doors
Condition: *Poor*
Entry Door. The base of the door panel is rotting away and the base of the exterior trim is rotted and split off. Overall, the door is in poor condition.

Boat Doors. This set of doors has badly peeling paint and the bases of the doors are weathering. These doors are also in poor condition.

Architecture – Exterior Trim
Condition: *Good*
The trim is in good condition.

Architecture – Floor
Condition: *Fair*
The wood floor is in fair condition as the northeast section of flooring has some rotting planks.

Architecture – Stairs
Condition: *Poor*
Exterior Stairs to Entry Door. These stairs, while in good condition, do not meet code/functional needs without a wider landing.

Architecture – Accessibility
Condition: *Poor*
This building is not accessible.

Condition Assessment -- Structural

Structural – Foundation
Condition: *Good and Unknown*
The visible portions of the wood timbers supporting the first floor at the water line are in good condition. The balance of the floor framing appears to rest directly on the ground but was not accessible, thus its condition is not known.

Structural – Floor Framing
Condition: *Unknown*
The floor framing could not be observed, thus its condition is unknown. No obvious signs of distress or damage were observed. The floor sheathing is in fair condition. The sheathing in the northeast corner was deteriorated.

Structural – Roof Framing
Condition: *Fair*
The roof framing is in fair condition. There did not appear to be enough collar ties to keep the walls from spreading out.

Structural – Wall Framing
Condition: *Good*
The walls are in good condition.

Structural – Lateral System
<u>*Condition:*</u> *Fair*
Lateral stability of the building is fair. The capacity of the exterior wood-framed walls is questionable.

Structural – Load Requirements
<u>*Condition:*</u> *Good*
The roof framing has adequate capacity to support the required loads. The floor framing could not be observed, thus its condition is unknown.

Condition Assessment -- Mechanical

Mechanical – Plumbing Systems, HVAC, and Fire Suppression
<u>*Condition:*</u> *N/A*

Mechanical – Other
<u>*Condition:*</u> *Poor*
The cast iron hand operated gear winch at the north end of the building is in poor condition with considerable rust damage.

Condition Assessment -- Electrical

N/A

Condition Assessment -- Hazardous Materials

The Boathouse was not accessed or observed during the September 2009 Site Inspections by Landmark Environmental.

Ultimate Treatment and Use

The Boathouse was originally built in 1891 to provide access to the site for construction crews. It has served as a boathouse and docking area since then, and has undergone many restorations and repairs due to the severe weather conditions that characterize its location.

Currently, the Boathouse's water entrance is blocked due to rocks in the way of the ramp. It is used by the NPS for storage. The proposed use for the Boathouse is to preserve its historic character and maintain its current use as a storage facility.

Preservation is the recommended treatment for the building.

Requirements for Treatment

Compliance requirements for treatment currently include laws, regulations, and standards as outlined by the NPS and listed in Volume I, Administrative Data section of this report.

The recommended treatments are tailored to the Preferred Alternative as the outcome of the Value Analysis/CBA for the project. As individual buildings are rehabilitated, specific alternatives will present themselves during design and construction. The following section is a discipline-by-discipline, component-by-component description of the treatments proposed for the preservation (stabilization) of the building. Refer to Volume I, Chapter 2: Methodology for the priority rating definitions.

Treatment Recommendations -- Architecture

Architecture – Roof
Priority: *Low*
Verify/provide proper blocking for roof tie offs. Scrape, sand and repaint fascia, soffit and frieze board.

Architecture – Exterior Walls
Priority: *Low*
Coordinate exterior wall repair with foundation and wall framing work. Once walls are stabilized, repair damaged boards and battens. Scrape, sand and repaint.

Architecture – Window
Priority: *Moderate*
Epoxy stabilize the sill. Remove the glazing compound and replace. Scrape, sand and paint.

Architecture – Exterior Doors
Priority: *Moderate*
Epoxy stabilize the bases of the doors. Scrape, sand and paint.

Architecture – Exterior Trim
Priority: *Low*
Scrape, sand and paint.

Architecture – Wall Finish
Priority: *Low*
No recommendations at this time other than the wall framing mitigation.

Architecture – Ceiling Finish
Priority: *Low*
No recommendations at this time.

Architecture – Interior Trim
Priority: *Low*
No recommendations at this time.

Architecture – Floor
Priority: *Low*
Replace rotting floor planks in-kind.

Architecture – Stairs
Priority: *Low*
Excavate a code compliant landing and build a new wood stair of treated lumber.

Architecture – Accessibility
Priority: *Low*
Provide program access through interpretive exhibits and waysides at the Visitor Center.

Treatment Recommendations -- Structural

Structural – Foundation
Priority: *Low*
The foundation of the Boathouse should be replaced with construction that will meet IBC and NPS requirements.

Structural – Floor Framing
Priority: *Low*
The floor framing of the Boathouse should be investigated further and if needed, replaced with construction that will meet IEBC and NPS requirements. The deteriorated floor sheathing should be replaced.

Structural – Roof Framing
Priority: *Low*
The roof framing of the Boathouse should be investigated further and if needed, upgraded to meet IEBC and NPS requirements.

Structural – Wall Framing
<u>Priority:</u> *Low*
The wall framing of the Boathouse should be investigated further and if needed, replaced with construction that will meet IBC and NPS requirements.

Structural – Lateral System
<u>Priority:</u> *Low*
Lateral load resisting system of the building should be investigated further and if needed, replaced with construction that will meet IBC and NPS requirements.

Treatment Recommendations -- Mechanical

Mechanical – Plumbing Systems, HVAC, and Fire Suppression
<u>Priority:</u> *N/A*

Mechanical – Other
<u>Priority:</u> *Low*
No recommendations at this time.

Treatment Recommendations -- Electrical

N/A

Treatment Recommendations -- Hazardous Materials

The Boathouse was not accessed or observed during the September 2009 Site Inspections by Landmark Environmental.

Alternatives for Treatment

Reconsider altering the stair/landing due to preservation/stabilization only of this structure.

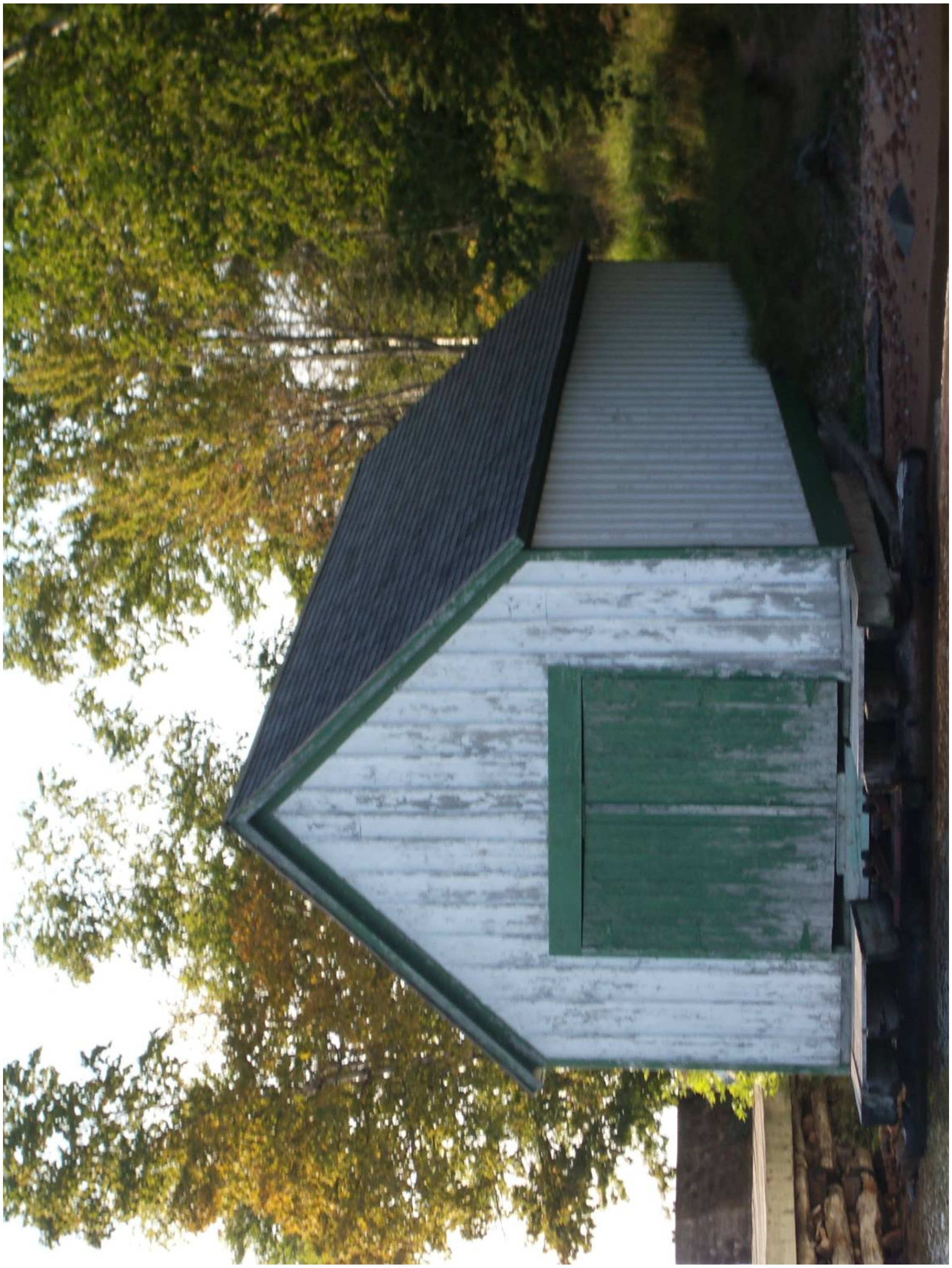
Assessment of Effects for Recommended Treatments

The following table includes an analysis of the major treatment recommendations which affect Section 106 Compliance:

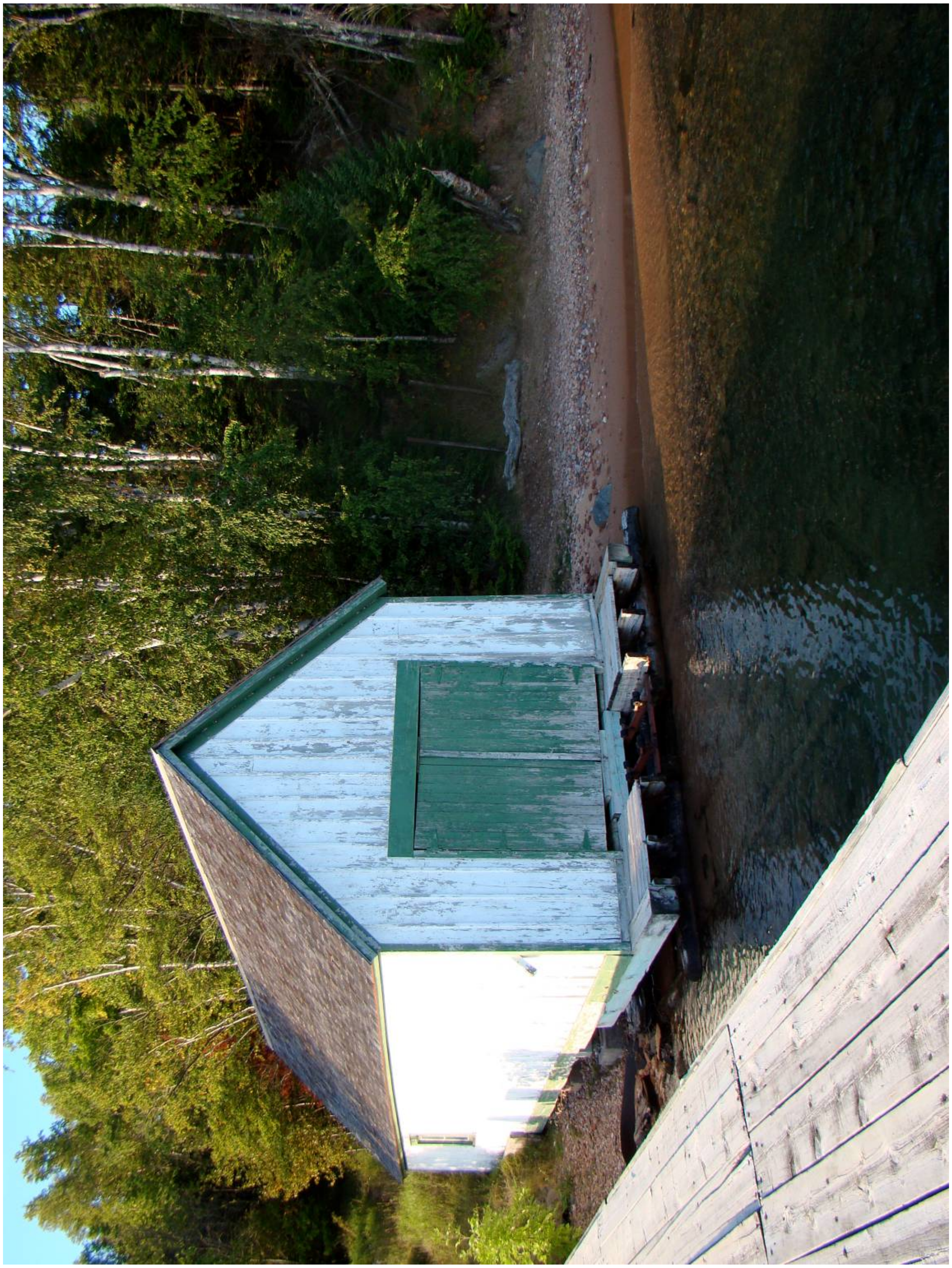
Recommended Treatment	Potential Effects	Mitigating Measures	Beneficial Effects
1. Installation of a new foundation	A new foundation could affect the relationship to grade and water level. A new foundation would require removal of existing base materials.	A new foundation will need to be evaluated for its benefit and implemented sensitively to minimize damage to the resource and its environment. Archeological monitoring with the excavations will be required. A foundation design, which, when completed, has the elevations of the sills, thresholds, etc. to match existing should be provided.	- Improves safety for visitors and staff - New foundation will aid in the preservation of the structure

Boathouse Photographs, 2009

DI-BH-01: Approach from the west, 2009 (Source: A&A IMGP2944)



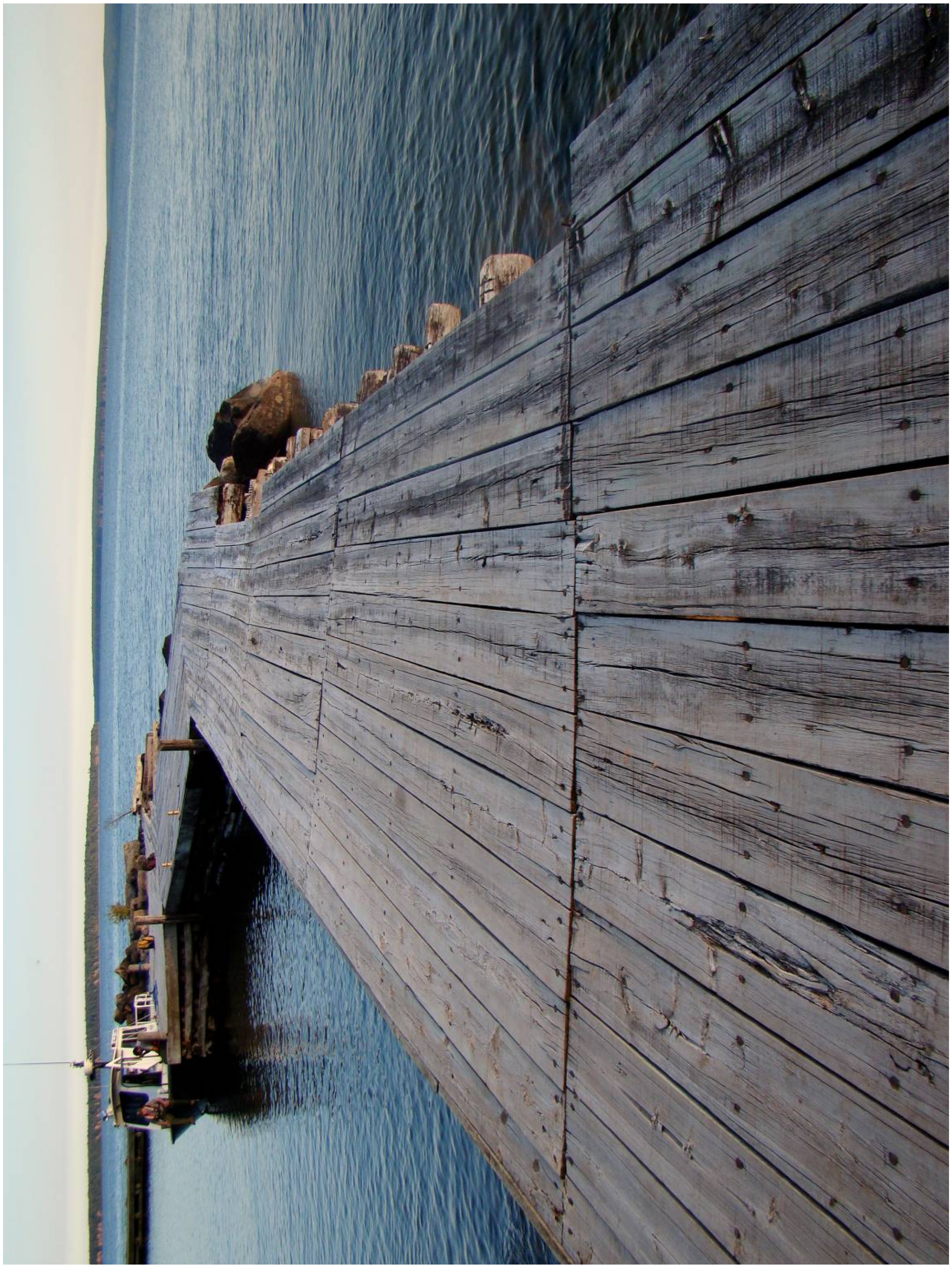
DI-BH-02: South elevation, 2009 (Source: A&A IMGP2946)



DI-BH-03: West elevation, 2009 (Source: A&A DSC01043)

DI-BH-04: North elevation, 2009 (Source: A&A IMGP2948)

DI-BH-05: East elevation, 2009 (Source: A&A DSC01040)



DI-BH-06: Dock, looking south, 2009 (Source: A&A DSC01067)

DI-BH-07: Stone retaining wall, looking northeast (Source: A&A DSC01076)

DI-BH-08: North elevation trim and roof detail (Source: A&A IMGP2951)

DI-BH-09: North elevation entry door trim detail (Source: A&A IMGP2955)

DI-BH-10: Entry door stair detail (Source: A&A DSC01062)

DI-BH-11: West elevation window, exterior (Source: A&A IMGP2954-A)

DI-BH-12: Entry door and hoisting mechanism, north elevation (Source: A&A DSC01053)

DI-BH-13: Entry door, interior (Source: A&A DSC01058)

DI-BH-14: Boathouse door, interior (Source: A&A DSC01046)

DI-BH-15: Roof framing, looking south (Source: A&A DSC01051)

1

GLOSSARY OF TERMS

PRIMARY TREATMENT APPROACH – PRESERVATION

Preservation standards include 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. Preservation requires the retention of the greatest amount of historic fabric, including the landscape's historic form, features, and details as they have evolved over time. Limited and sensitive upgrading of mechanical, electrical and plumbing systems and other code-required work is permitted.

HOW TERMINOLOGY IS USED IN THE PRESERVATION APPROACH

Maintain – are those standard maintenance practices that are necessary to retain the features of a property as a contributing resource. Maintenance activities are usually not classified as repair, however minor repair such as replacement of posts or railings or segments of paving are included. Limited and sensitive upgrading of building systems (mechanical, electrical, plumbing) and other code related work is appropriate.

Plant – the removal and replanting of landscape plantings and vegetation as part of maintenance activities

Protect – short term and minimal measures used to stabilize and protect features, such as fencing around landscape features

Relocate – the removal and resetting of noncontributing features

Remove – the removal of nonhistoric features

Repair – features, components of features and materials that require additional work. These may include declining building features (e.g., roofing, foundation, mechanical systems) structures, small-scale features (e.g., repair of a railing) or landscape plantings (e.g., repair mass planting by adding infill plantings). Features that are repaired will match the old in design, color, texture, and if possible, material. Distinctive features that are repaired will match the old in design, color, texture, and if possible, material.

Retain – are those actions that are necessary to allow for a feature (contributing or noncontributing) to remain in place in its contributing current configuration and condition.

Stabilize – immediate measures (more than standard maintenance practices) are needed to prevent deterioration, failure, or loss of features.

PRIMARY TREATMENT APPROACH – REHABILITATION

Rehabilitation in intended to return a property to a state of utility, through repair or alteration, which makes possible an efficient contemporary use while preserving those portions and features of the property which are significant to its historic, architectural, and cultural values. Rehabilitation allows for repairs, alterations, restoration of missing features, and additions necessary to enable a compatible use for a property as long as the portions or features which convey the historical, cultural, or architectural values are preserved. Limited and sensitive upgrading of mechanical, electrical and plumbing systems and other code-required work is permitted.

HOW TERMINOLOGY IS USED IN THE REHABILITATION APPROACH

Maintain – are those standard maintenance practices that are necessary to retain the features of a property as a contributing resource. Maintenance activities are usually not classified as repair, however minor repair such as replacement of posts or railings or segments of paving are included. Limited and sensitive upgrading of building systems (mechanical, electrical, plumbing) and other code related work is appropriate.

Plant – the removal and replanting of landscape plantings and vegetation as part of maintenance activities or the restoration of missing features.

Reestablish – are those measures necessary to depict a landscape feature as it occurred historically. Reestablishment may include the replacement of missing landscape features such as views, planting patterns, spatial relationships, or small scale features.

Relocate – remove and reset noncontributing features

Remove – removal of nonhistoric features

Repair – features, components of features and materials that require additional work. These may include declining building features (e.g., roofing, foundation, mechanical systems) structures, small-scale features (e.g., repair of a railing) or landscape plantings (e.g., repair mass planting by adding infill plantings). Features that are repaired will match the old in design, color, texture, and if possible, material. Distinctive features that are repaired will match the old in design, color, texture, and if possible, material.

Restore – are those measures necessary to depict a feature or area as it occurred historically. Restoration may include repair of a feature so that it appears as it did historically or it may include replacement of missing features or qualities.

Retain –are those actions that are necessary to allow for a feature (contributing or noncontributing) to remain in place in its contributing current configuration and condition.

Stabilize – immediate, more extensive measures (more than standard maintenance practices) are needed to prevent deterioration, failure, or loss of features.

PRIMARY TREATMENT APPROACH – RESTORATION

Restoration standards allow for the accurate depiction of a property as it appeared at a particular time in its history by means of the removal of features from other periods in its history and reconstruction of missing features from the period of significance. The limited and sensitive upgrading of systems (mechanical, electrical, plumbing) and other code related work is appropriate.

HOW TERMINOLOGY IS USED IN THE RESTORATION APPROACH

Maintain – are those standard maintenance practices that are necessary to retain the features of a property as a contributing resource. Maintenance activities are usually not classified as repair, however minor repair such as replacement of posts or railings or segments of paving are included. Limited and sensitive upgrading of building systems (mechanical, electrical, plumbing) and other code related work is appropriate.

Plant – the removal and replanting of landscape plantings and vegetation as part of maintenance activities or the restoration of missing features

Relocate – remove and reset noncontributing features

Remove – removal of nonhistoric features

Reestablish – are those measures necessary to depict a landscape feature as it occurred historically. Reestablishment may include the replacement of missing landscape features such as views, planting patterns, spatial relationships, or small scale features.

Repair – features, components of features and materials that require additional work. These may include declining building features (e.g., roofing, foundation, mechanical systems) structures, small-scale features (e.g., repair of a railing) or landscape plantings (e.g., repair mass planting by adding infill plantings). Features that are repaired will match the old in design, color, texture, and if possible, material. Distinctive features that are repaired will match the old in design, color, texture, and if possible, material.

Restore – are those measures necessary to depict a feature or area as it occurred historically. Restoration may include repair of a feature so that it appears as it did historically or it may include replacement of missing features or qualities.

Retain –are those actions that are necessary to allow for a feature (contributing or noncontributing) to remain in place in its contributing current configuration and condition.

Stabilize – immediate, more extensive measures (more than standard maintenance practices) are needed to prevent deterioration, failure, or loss of features.

CONDITION ASSESSMENT DESCRIPTION LEVELS

Feature Condition Definitions
(Note: These terms are also applied to the overall structure/building.)

GOOD The feature is intact, structurally sound and performing its intended purpose. The feature needs no repair or rehabilitation, but only routine or preventive maintenance.

FAIR The feature is in fair condition if either of the following conditions is present:

- There are early signs of wear, failure or deterioration though the feature is generally structurally sound and performing its intended purpose – or –
- There is failure of a portion of the feature.

POOR The feature is in poor condition if any of the following conditions is present:

- The feature is no longer performing its intended purpose – or –
- Significant elements of the feature are missing – or –
- Deterioration or damage affects more than 25% of the feature – or –
- The feature shows signs of imminent failure or breakdown.

UNKNOWN Not enough information is available to make an evaluation.

RATINGS OF TREATMENT SEVERITY

An impact is a detectable result of an agent or series of agents having a negative effect on the significant characteristics or integrity of a structure and for which some form of mitigation or preventative action is possible. The assessment should include only those impacts likely to affect the structure within the next five years.

The Level of Impact Severity and their definitions are given below. For all levels, except UNKNOWN, two criteria are given. At least one of the criteria must be met for the declared Level of Impact Severity.

SEVERE	1. The structure/feature will be significantly damaged or irretrievably lost if action is not taken within two (2) years. 2. There is an immediate and severe threat to visitor or staff safety.
MODERATE	1. The structure/feature will be significantly damaged or irretrievably lost if action is not taken within five (5) years. 2. The situation caused y the impact is potentially threatening to visitor or staff safety.
LOW	1. The continuing effect of the impact is known and will not result in significant damage to the structure/feature. 2. The impact and its effects are not a direct threat to visitor or staff safety.
UNKNOWN	Not enough information is available to make an evaluation.

DEFINITIONS OF TERMS

A

AAS: Atomic Absorption Spectroscopy

AC: Alternating current; the movement of current through an electrical circuit that periodically reverses direction. Alternating current is the form of electric power that is delivered to businesses and residences.

ACM: Asbestos Containing Material

Accessibility: a term used to describe facilities or amenities to assist people with disabilities and can extend to Braille signage, wheelchair ramps, elevators/lifts, walkway contours, reading accessibility, etc. According to its website, the Park Service is "committed to making all practicable efforts to make NPS facilities, programs, services, employment, and meaningful work opportunities accessible and usable by all people, including those with disabilities. This policy reflects the commitment to provide access to the widest cross section of the public and to ensure compliance with the Architectural Barriers Act of 1968, the Rehabilitation Act of 1973, the Equal Employment Opportunity Act of 1972, and the Americans with Disabilities Act of 1990. The Park Service will also comply with section 507 of the Americans with Disabilities Act (42 USC 12207), which relates specifically to the operation and management of federal wilderness areas. The accessibility of commercial services within national parks are also covered under all applicable federal, state and local laws" (source: http://www.nps.gov/aboutus/eeo.htm).

AES-ICP: Atomic Emission Spectroscopy – Inductively Coupled Plasma

AIHA: American Industrial Hygiene Association

Air Terminal: A rod that extends above a surface to attract lightning strikes.

AL: Action Level

B

Beam: a structural member, usually horizontal, with a main function to carry loads cross-ways to its longitudinal axis.

Branch Circuit: Insulated conductors used to carry electricity to an associated device or devices that originate from a single circuit breaker.

BTUH: British Thermal Unit per Hour; A traditional unit of energy.

BX Cable: Cable with flexible steel armored outer tube with individual copper conductors insulated with rubber and covered with a cotton braided sheath.

C

Cantilever: refers to the part of a member that extends freely over a beam or wall, which is not supported at its end.

Cast Iron: a large group of ferrous alloys that are easily cast. Cast iron tends to be brittle and is resistant to destruction and weakening by oxidation. The amount of carbon in cast irons is 2.1 to 4 wt%.

CFR: Code of Federal Regulation

Cistern: An underground receptacle for storage of liquids, usually water.

Clay Sewer: Sewer pipe made from vitrified clay that is highly resistant to corrosion.

Column: a main vertical member that carries axial loads from beams or girders to the foundation parallel to its longitudinal axis.

D

DC: Direct current; the unidirectional flow of current through an electrical circuit. Direct current is produced through such sources as batteries, thermocouples, or photovoltaic solar cells.

Dead Load: describes the loads from the weight of the permanent components of the structure.

Deflection: the displacement of a structural member or system under a load.

DRO: Diesel-Range Organics

E

ELPAT: Environmental Lead Proficiency Analytical Testing

EMT: Electro-metallic tubing; A metallic tube raceway that is used to carry and protect current carrying conductors or cables.

EPA: Environmental Protection Agency

F

Flue Vent: A duct or pipe conveying combustion by-products from a heater or furnace.

Fluorescent: A source of light that emits light radiation at longer wavelengths and lower energy.

Footing: a slab of concrete or an assortment of stones under a column, wall, or other structural member to transfer the loads of the member into the surrounding soil.

Foundation*:* supports a building or structure.

FRP: Fiberglass reinforced plastic

Full Sawn (FS): Lumber cut, in the rough, to its full nominal size.

G

Gable: located above the elevation of the eave line of a double-sloped roof.

Galvanized Steel: Steel coated with zinc carbonate to resist corrosion.

GPM: Gallon per minute; a standard unit of volumetric liquid flow rate.

Grade: the ground elevation of the soil.

Gravity Vent: Openings in a roof intended to vent hot air by the action of convection.

Gray Water: Wastewater generated from domestic washing activities and not containing human waste.

GRO: Gasoline Range Organics

H

Header: a member that carries joists, rafters or beams and is placed between other joists, rafters or beams.

Hip Roof: a roof sloping from all four sides of a building.

HUD: Housing and Urban Development

HVAC: Heating, Ventilation, and Air Conditioning.

I

IAQ: Indoor Air Quality

IEUBK: Integrated Exposure Uptake Biokinetic

Incandescent: A source of light that works by incandescence, or works by a heat-driven light emission through black-body radiation.

Inverter: A device that converts electrical direct current (DC) to electrical alternating current (AC).

J

Joist: a horizontal structural load-carrying member which supports floors and ceilings.

K

kVA: Kilovolt-ampere equal to 1,000 volt-amperes. kVA is a unit to express the apparent power consumed in an electrical circuit or electrical device.

kW: Kilowatt equal to 1,000 watts. A kilowatt is typically used to express the output power consumption of large devices or electrical systems.

L

LBP: Lead-Based Paint

LCP: Lead-Containing Paint

LCS: Lead-Contaminated Soils

Leach Field: A drain field used to remove contaminants and impurities from liquid that emerges from a septic tank.

LED: Light emitting diode; a semiconductor light source that can emit light in various colors and brightness.

Live Load: nonpermanent loads on a structure created by the use of the structure.

Load: an outside force that affects the structure or its members.

Louver: An opening with horizontal slats angled to allow passage of air while keeping out rain and snow.

M

Mg/kg: Milligrams per Kilogram

N

NEC: National Electric Code.

NESHAP: National Emission Standards for Hazardous Air Pollutants

Nonpotable Water: Water that has not been approved for safe human consumption.

NVLAP: National Voluntary Laboratory Accreditation Program

O

OSHA: Occupational Safety and Health Administration

Overcurrent Protection: A fuse, circuit breaker or relay that will open the electrical circuit when the downstream electrical current exceeds the stated current rating.

P

Passive Ventilation: Ventilation of a building without the use of a fan or other mechanical system.

Pitch: the slope of a member defined as the ratio of the total rise to the total run.

PLM: Polarized Light Microscopy

PV: Photovoltaic; An array of solar modules or cells that collect solar energy and convert the energy into direct current electricity.

PVC: Polyvinyl Chloride; A biologically and chemically resistant plastic widely used for household sewage pipe.

R

Rafter: a sloped structural load-carrying member which supports the roof.

RBM: Regulated/Hazardous Material

Reaction: the force or moment developed at the points of a support.

RLM: Industrial stem mounted reflector.

Romex: Wiring with rubber insulated conductors in an overall sheath of braided cotton fiber.

S

Seismic Load: loads produced during the seismic movements of an earthquake.

Septic Tank: A sewage tank containing anaerobic bacteria which decomposed waste discharged into the tank.

Shear: forces resulting in two touching parts of a material to slide in opposite directions parallel to their plane of contact.

Snow Load: loads produced from the accumulation of snow.

Span: the distance between supports.

Step-down Transformer: A device that converts a high voltage down to a lower voltage through a series of winding coils.

Structural Steel**:** an iron alloy with a carbon content of 0.16% to 0.29%. Steel is malleable, and easily welded.

Strut: a structural brace that resists axial forces.

Stud: a vertical wall member used to construct partitions and walls.

<u>T</u>

Thermal Expansion Tank: A tank used in a closed water heating system to absorb excess water pressure caused by thermal expansion.

TSI: Thermal System Insulation

Turbine Vent: Vents utilizing rotating wind vanes to create air flow.

<u>V</u>

Vent Stack: A vertical pipe proving ventilation.

<u>W</u>

WAC: Wisconsin Administrative Code

WDNR: Wisconsin Department of Natural Resources

Wrought Iron: an iron alloy with very low carbon content, in comparison to steel. Wrought iron is tough, malleable, ductile, and easily welded.

<u>X</u>

XRF: X-ray fluorescence analyzer

<u>Other</u>

30 µg/m3: 30 micrograms per cubic meter

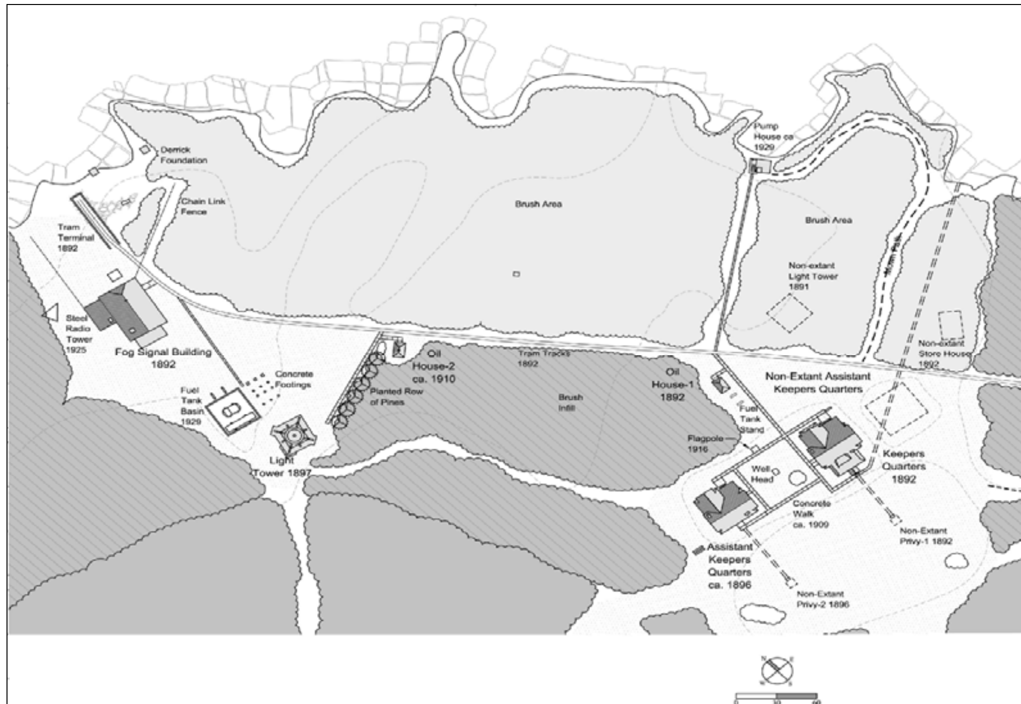
µg/SF: Micrograms of Lead Dust per Square Foot of Floor Space

1x: Piece of dimensional lumber 1” (nominal) / ¾” (actual) thick

1

APPENDIX A: MATRIX OF TREATMENT ALTERNATIVE

REVISED 03.08.2011



Existing Conditions Site Plan - for reference only

General Description:
This treatment alternative proposes rehabilitating each island's cultural landscape to best portray the continuum of navigational history that characterizes the Apostle Islands as a system of light stations. Each island (and each light station) conveys specific characteristics related to particular periods of development in the navigation of the archipelago. This treatment will reveal this continuum by restoring missing historic features, and by repairing or altering others to convey the full historical significance of the system. Additions that are necessary to enable the compatible use of the light stations or islands are allowed as long as portions or features that convey the historical, cultural, or architectural values are preserved.

Period of Significance: 1892 - 1978

Please refer to the proposed treatments below.

	Tower	Keepers Quarters	Assistant Keepers Quarters	Fog Signal Building	Oil House #1	Oil House #2	Tramway Engine Building	Boathouse
Proposed Use of Building	Rehabilitate for guided visitor use.	Rehabilitate for guided visitor use 1st floor; staff housing 2nd floor and 1st kitchen/bath.	Rehabilitate for self guided visitor use.	Rehabilitate for self guided visitor use.	Preserve and maintain current use as NPS storage.	Preserve and add a plexi panel at door for visitor visual access.	Preserve and maintain current use as vacant, no visitor access.	Preserve and maintain current use as NPS storage.
Architecture	Increase ventilation; Repair/replace the lantern glazing and glass; repair/replace broken/missing mullions; repaint exterior complete; repair operability to windows; investigate replacing one sash with a secure louver; repair doors and paint; Investigate limiting visitor access to Fresnel lens and enhancing visitor viewing of lens from the exterior.	Replace south entry roof shingles; install gutter and downspout system (?); repair windows and doors and repaint; add handrail to porch; repair basement hatch; repair interior doors; retain and repair modern and historic wall, ceiling and floor finishes.	Add gutter and downspout to porch; repoint masonry (minimal); repair porch floor; repaint wall shingles and trim; repair windows and doors and repaint; replace missing interior trim, doors and fixtures in kind; patch and repair damaged plaster at walls and ceilings; refinish wood trim, casework and wood flooring; repair resilient flooring.	Install missing eave closure trim; repair framing at south shed; repoint chimney and exposed brick foundation; repair chipped siding shingles; repair windows and doors and repaint; repaint exterior trim, repair interior doors, walls and ceiling finishes; paint interior complete; add handrail to stair. Install the original fog signal equipment currently stored on Sand Island, though system is not intended to be operational.	Repair door. Repoint masonry.	Provide new roof shingles to match existing. Repaint door. Install plexi-panel system(operable) to allow visitors to see Coast Guard era equipment but maintain security and weather tight closure.	Repaint soffit and overhangs; repoint chimney and repair cap; repair sills and glazing at windows; replace missing hardware at door and repaint.	Address roofing and siding as needed after structural mitigation is complete; repair doors, window and sill; repaint exterior complete.
Structural	Investigate structural significance of concrete foundation cracking	Repair first floor framing at cut beam, repair porch joists and decking, properly support first floor joists at windows and cistern, repair damaged first floor joists	Repair porch joists and decking, properly support first floor joists at windows, repair damaged first floor joists, repairs stair posts in basement, repoint cracked masonry	Replace south addition, strengthen ceiling joists and roof rafters of west addition	No action at this time	No action at this time	Monitor stress crack at southeast.	Construct a concrete foundation, repair and strengthen first floor joists and deck, strengthen or reframe walls, strengthen or reframe roof
Mechanical	Increase ventilation for moisture control.	Increase ventilation for moisture control. Clean, inspect, and test sewer/septic system. Perform repairs as needed for operational septic system. Replace or refurbish historic radiators. Remove propane piping to refrigerator and stove.	Increase ventilation for moisture control. Clean historic radiators as interpretative props. Remove or reinstall unattached plumbing fixtures. Cap or remove open plumbing piping.	No action at this time.	No action at this time.	No action at this time.	No action at this time.	No action at this time.
Electrical	Provide additional PV power to facilitate running of new ventilation equipment. Engage an LPI (Lightning Protection Institute) certified inspector to perform an inspection of the lightning protection system and provide findings and recommendations in accordance with LPI-175.	Provide new power wiring, receptacles and lighting for visitor areas and staff housing areas and for new refrigerator and stove. Provide required life safety systems including single station fire alarm and CO sensors. Leave existing fire alarm system in place to maintain historic context. Verify that existing PV system including inverter and power distribution system is suitably sized and fully operational, and extend system to building equipment. Engage an LPI (Lightning Protection Institute) certified inspector to perform an inspection of the lightning protection system and provide findings and recommendations in accordance with LPI-175.	Provide additional PV power to facilitate running of new ventilation equipment. Replace broken or missing lighting fixtures and receptacles with period fixtures and receptacles. If required, provide building power distribution and wiring and connect building to site PV system. Engage an LPI (Lightning Protection Institute) certified inspector to perform an inspection of the lightning protection system and provide findings and recommendations in accordance with LPI-175.	Replace broken lighting fixtures and rehabilitate wiring systems.	No action at this time.	No action at this time.	No action at this time.	No action at this time.
HazMat	Soil characterization (lead); field screen of tank storage area for hydrocarbon characterization	Soil characterization (lead); asbestos sampling of materials to be preserved/stabilized; remove lead paint	Soil characterization (lead); asbestos sampling of materials to be preserved/stabilized; remove/stabilize lead paint	Soil characterization (lead); asbestos sampling of materials to be preserved/stabilized; abatement of damaged asbestos siding; remove lead paint (interior of structure)	Remove/stabilize lead paint	Remove/stabilize lead paint	Asbestos sampling of materials to be preserved/stabilized; remove/stabilize lead paint	Remove/stabilize lead paint
Accessibility	Program access through interpretive wayside exhibits.	Program access through interpretive wayside exhibits.	Program access through interpretive wayside exhibits.	Program access through interpretive wayside exhibits.	Program access through interpretive wayside exhibits.	Program access through interpretive wayside exhibits.	Program access through interpretive wayside exhibits.	Program access through interpretive wayside exhibits.
	Spatial Organization/ Views and Vistas/ Clearing/ Topography	**Circulation/ Site Accessibility**	**Structures**	**Small Scale Features**	**Station Vegetation**			
Landscape	1. Clear trees between Keepers Quarters and Tower. Maintain as low brush 2. Maintain low vegetation along shoreline to open views to the light station from lake. Maintain as low brush 3. Clear trees to wilderness boundary west of Tower and Keepers' Quarters. Maintain as low brush 4. Increase lawn clearing south of Light Tower 5. Maintain all lawn areas 6. Clear trees along tram track corridor from Keepers Quarters to Tramway Engine Building 7. Clear trees to brush 30' from Tramway Engine Building	1. Maintain footpath and corridor to Boat House (10' width) 2. Maintain cleared footpaths at Light Station 3. Maintain tram tracks (remove vegetation and topdress with gravel) 4. Maintain concrete walks (leveling; weed control)	1. New concrete corner markers showing location of non-extant Assistant Keepers' Quarters 2. Maintain pump house 3. Maintain radio tower 4. New NPS accessible privy (location TBD by NPS) Boat Dock Area 1. Repair boat dock (decking/structure) 2. Maintain stone jetty 3. Maintain stone wall (pointing) 4. Stabilize Boat House (roof/structure)	1. Stabilize derrick footings (prevent from falling into water) 2. Repair stone tram terminal (remove vegetation, point masonry) 3. Remove fencing at Fog Signal Building 4. Maintain Beacon 5. Maintain fuel basin and footings north of Tower 6. Retain oil tank footings south of Oil House 1 7. Maintain flagpole (paint) 8. Maintain well head (paint) 9. Retain concrete tramway anchor on rock outcrop east of Tramway Engine Building 10. Retain solar panel and battery unit in current location 11. Retain fire pit	1. Maintain landscape plantings at Oil House 2 2. Maintain lawn clearing areas 3. Maintain lilac west of Keepers Quarters			

APPENDIX B: SUMMARY OF HAZARDOUS MATERIAL FINDINGS

1

LIGHT STATION TOWER

Building Number	LCS ID 017081
Building Name	Devils Island Light Station Tower
>1% Asbestos Confirmed	
Asbestos Assumed[36]	Adhesives, Insulation, and Caulking
Detectable Lead in Paint Confirmed	
Detectable Lead in Paint Assumed	*
Lead Dust on Floors >40 µg/SF Confirmed [37]	
Lead Dust on Floors >40 µg/SF Assumed [2]	Yes
Lead Dust on Floors <40 µg/SF Confirmed [2]	
Visual Mold	
Lead in Soils >50 mg/kg[38]	Roof Dripline and 5'-0" Out from Roof Dripline
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	

< = Greater Than
< = Less Than
µg/SF = Micrograms of Lead Dust per Square Foot of Floor Space
mg/kg = Milligrams of Lead per Kilogram of Soil

[36] Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment
[37] In accordance with EPA 40 CFR part 457 the clearance level for lead dust on floors in child occupied housing is 40 micrograms of lead dust per square foot of floor space.
[38] In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.
* Apostle Islands National Lakeshore Staff reported that abatement of lead containing paint on the Devils Island Tower occurred in 2003. Testing to confirm the absence of lead paint was not conducted during the September 15, 2009 site assessment.

KEEPERS QUARTERS

Building Number	LCS ID 017082
Building Name	Devils Island Keepers Quarters
>1% Asbestos Confirmed	Floor Tile
Asbestos Assumed[39]	Plaster, Brick/Block Filler, Drywall, Adhesives, Insulation, Lay-in Ceiling Panels, Tar and Tar Paper and Caulking
Detectable Lead in Paint Confirmed	Walls, Ceilings, Doors, Door Trims, Window Trims and Window Sashes
Detectable Lead in Paint Assumed	Interior Painted Surfaces and Exterior Painted Surfaces
Lead Dust on Floors >40 µg/SF Confirmed [40]	
Lead Dust on Floors >40 µg/SF Assumed [2]	
Lead Dust on Floors <40 µg/SF Confirmed [2]	Floors
Visual Mold	
Lead in Soils >50 mg/kg[41]	
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	Yes

< = Greater Than
< = Less Than
µg/SF = Micrograms of Lead Dust per Square Foot of Floor Space
mg/kg = Milligrams of Lead per Kilogram of Soil

[39] Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment
[40] In accordance with EPA 40 CFR part 457 the clearance level for lead dust on floors in child occupied housing is 40 micrograms of lead dust per square foot of floor space.
[41] In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

ASSISTANT KEEPERS QUARTERS

Building Number	LCS ID 017083
Building Name	Devils Island Assistant Keepers Quarters
>1% Asbestos Confirmed	
Asbestos Assumed[42]	Plaster, Brick/Block Filler, Drywall, Adhesives, Insulation, Sheet Flooring, Tar and Tar Paper and Caulking
Detectable Lead in Paint Confirmed	
Detectable Lead in Paint Assumed	Interior Painted Surfaces and Exterior Painted Surfaces
Lead Dust on Floors >40 µg/SF Confirmed [43]	
Lead Dust on Floors >40 µg/SF Assumed [2]	Yes
Lead Dust on Floors <40 µg/SF Confirmed [2]	
Visual Mold	Yes
Lead in Soils >50 mg/kg[44]	
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	Yes

< = Greater Than
< = Less Than
µg/SF = Micrograms of Lead Dust per Square Foot of Floor Space
mg/kg = Milligrams of Lead per Kilogram of Soil

[42] Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment
[43] In accordance with EPA 40 CFR part 457 the clearance level for lead dust on floors in child occupied housing is 40 micrograms of lead dust per square foot of floor space.
[44] In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

FOG SIGNAL BUILDING

Building Number	LCS ID 017084
Building Name	Devils Island Fog Signal Building
>1% Asbestos Confirmed	
Asbestos Assumed[45]	Transite, Caulk and Adhesives
Detectable Lead in Paint Confirmed	
Detectable Lead in Paint Assumed	Interior Painted Surfaces and Exterior Painted Surfaces
Lead Dust on Floors >40 µg/SF Confirmed [46]	
Lead Dust on Floors >40 µg/SF Assumed [2]	Yes
Lead Dust on Floors <40 µg/SF Confirmed [2]	
Visual Mold	
Lead in Soils >50 mg/kg[47]	
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	Yes

< = Greater Than
< = Less Than
µg/SF = Micrograms of Lead Dust per Square Foot of Floor Space
mg/kg = Milligrams of Lead per Kilogram of Soil

[45] Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment
[46] In accordance with EPA 40 CFR part 457 the clearance level for lead dust on floors in child occupied housing is 40 micrograms of lead dust per square foot of floor space.
[47] In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

OIL HOUSE #1

Building Number	LCS ID 017085
Building Name	Devils Island Oil House #1
>1% Asbestos Confirmed	
Asbestos Assumed[48]	
Detectable Lead in Paint Confirmed	
Detectable Lead in Paint Assumed	Interior Painted Surfaces and Exterior Painted Surfaces
Lead Dust on Floors >40 µg/SF Confirmed [49]	
Lead Dust on Floors >40 µg/SF Assumed [2]	Yes
Lead Dust on Floors <40 µg/SF Confirmed [2]	
Visual Mold	
Lead in Soils >50 mg/kg[50]	
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	Yes

< = Greater Than
< = Less Than
µg/SF = Micrograms of Lead Dust per Square Foot of Floor Space
mg/kg = Milligrams of Lead per Kilogram of Soil

[48] Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment
[49] In accordance with EPA 40 CFR part 457 the clearance level for lead dust on floors in child occupied housing is 40 micrograms of lead dust per square foot of floor space.
[50] In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

OIL HOUSE #2

Building Number	LCS ID 017086
Building Name	Devils Island Oil House #2
>1% Asbestos Confirmed	
Asbestos Assumed[51]	
Detectable Lead in Paint Confirmed	
Detectable Lead in Paint Assumed	Interior Painted Surfaces and Exterior Painted Surfaces
Lead Dust on Floors >40 µg/SF Confirmed [52]	
Lead Dust on Floors >40 µg/SF Assumed [2]	Yes
Lead Dust on Floors <40 µg/SF Confirmed [2]	
Visual Mold	
Lead in Soils >50 mg/kg[53]	
Lead in Soils <50 mg/kg	
Lead in Soils Assumed	Yes

< = Greater Than
< = Less Than
µg/SF = Micrograms of Lead Dust per Square Foot of Floor Space
mg/kg = Milligrams of Lead per Kilogram of Soil

[51] Materials listed are those identified or assumed to be present during the September 15, 2009 site assessment
[52] In accordance with EPA 40 CFR part 457 the clearance level for lead dust on floors in child occupied housing is 40 micrograms of lead dust per square foot of floor space.
[53] In accordance with NR720, WIS. Adm Code; 50 milligrams per kilogram, is the conservative acceptable residual containment level for lead in soil based on human health risk from direct contact (ingestion or inhalation) related to nonindustrial land use and considering more than one contaminant may be present in the soil. However, site specific Risk Assessment is recommended to identify the site specific clean up levels for lead contaminated soil at each of these sites.

APPENDIX C: MATERIAL ANALYSIS REPORTS, DEVILS ISLAND

1

DEVILS ISLAND ACM SAMPLE CHART

Sample #	Sample Date	API ID	Sample Location	Material Description	Laboratory Result
B-DIAKQ-WP1-01	9/15/2009	25192	Assistant Keepers Quarters	White granular plaster w/ white paint	ND
B-DIAKQ-DW1-01	9/15/2009	25192	Assistant Keepers Quarters	White granular plaster w/ white paint	ND
B-DIAKQ-WT1-01	9/15/2009	25192	Assistant Keepers Quarters	White/multi-colored paint and White plaster	ND
B-DIAKQ-SF1-01	9/15/2009	25192	Assistant Keepers Quarters	Tan/multi-colored sheet vinyl and Tan fibrous woven backing	ND
B-DIFSB-FT1-01	9/15/2009	25196	Fog Signal Building	Tan tile w/ yellow adhesive and Gray leveling compound	ND
B-DIKQ-FT1-01	9/15/2009	25191	Keepers Quarters	Black Tile	12% Chrysotile
B-DIKQ-FT2-01	9/15/2009	25191	Keepers Quarters-First floor bedroom	White tile and Yellow mastic	ND
B-DIKQ-FT3-01	9/15/2009	25191	Keepers Quarters-Kitchen	White tile and Amber mastic	ND
B-DIKQ-FT4-01	9/15/2009	25191	Keepers Quarters-Second Floor	Green tile and Yellow mastic	4% Chrysotile in Green tile
B-DIKQ-FT5-01	9/15/2009	25191	Keepers Quarters-Second Floor	Brown/tan tile and Black mastic	Trace Chrysotile in Black mastic, 7% chrysotile in Brown/tan tile
B-DIKQ-FT6-01	9/15/2009	25191	Keepers Quarters	Green sheet vinyl w/ black fibrous backing	ND
B-DIKQ-WT1-01	9/15/2009	25191	Keepers Quarters-First floor bedroom	White/multi-colored paint and White plaster	ND

ND=None Detected
TR=Trace, <1% Visual Estimate

DEVILS ISLAND LEAD SAMPLE CHART

Sample ID	Sample Type	API ID	Sample Location	Sample Date	Sample Area (sq ft)	Lead (ug)	Reporting Limit (ug/sq ft)	Lead Concentration (ug/sq ft)
W-091509-DIKQ-01	Composite Wipe	25191	Keepers Quarters	9/15/2009	0.33	5	15	16

APPENDIX D: FABRIC ANALYSIS

1

Fabric Analysis
Devils Island Light Set #1
Apostle Island National Lakeshore
October 12, 2009

On Tuesday, October 6, 2009, David Arbogast, architectural conservator, of Davenport, Iowa, received a large box containing paint and mortar samples from Elizabeth Hallas, AIA, LEED AP. Senior Associate of Andrews & Anderson Architects, PC of Golden, Colorado. She is in the process of preparing Historic Structures Reports for the historic lighthouse complexes of the Apostle Islands National Lakeshore, headquartered in Bayfield, Wisconsin. As part of the HSRs paint and mortar/plaster analysis is required in an attempt to ascertain historic finishes, mortars, and plasters for the subject structures. The samples were divided into sets contained within large manila mailing envelopes. The analysis follows the order in which the large envelopes have been arranged. The fourth and fifth sets which are contained within this report were from the first and second sets of samples collected from the complex at the Devils Island Light. There were 27 samples in the first of these two sets (nos. 64 – 90), of which 24 were paint samples and three (nos. 82, 84, and 85) were of plaster and mortar. The second set (nos. 91 – 119) contained 29 samples, of which 23 were paint samples and six (nos. 100, 101, 102, 103, 104, and 106) were of plaster and mortar.

During the preceding twenty or more years Mr. Arbogast has performed paint analyses for various structures at the Apostles Islands. Those samples and his reports are in the archives at the headquarters in Bayfield and may be examined in relation to the findings from this analysis.

The first set of paint samples was visually examined on Monday, October 12 and Tuesday, October 13, utilizing the same procedures used for the first set of samples. Numbering of the samples followed the order established with the first three sets, beginning with 64 and ending with 90. The following results were obtained from the analysis:

Keeper's Quarters

Sample 64	**Munsell**
Dark gray	N 5.0/
White	5Y 9/1

Sample 64 was collected from the exterior handrail of the keeper's quarters. It retained only two layers of paint of which the older was white.

Keeper's Quarters

Sample 65	**Munsell**
Dark green	2.5G 4/4
Gray	5Y 7/1
White	5Y 9/1

Sample 65 came from the exterior window trim of the keeper's quarters. Its analysis revealed three layers of paint with white being the oldest of the three. The substrate was extremely weathered wood.

Keeper's Quarters

Sample 66	**Munsell**
Dark green	2.5G 4/4
Gray	5Y 7/1
Gray	5Y 6/1
White	5Y 9/1

Gray	5Y 7/1
Gray	5Y 6/1
Charcoal	5Y 3/1
Gray	5Y 7/1

Sample 66 was removed from the exterior door trim of the keeper's quarters. It retained eight paint layers of which the oldest was a standard gray color seen in many other samples.

Keeper's Quarters

Sample 67	**Munsell**
Dark green	2.5G 4/4
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Black	N 1.0/
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Charcoal	5Y 3/1
Charcoal	5Y 3/1
Charcoal	5Y 3/1
White	5Y 9/1

Sample 67 was from the exterior vent trim of the keeper's quarters. Its analysis revealed an extremely large number of fine, evenly applied paint layers of which the oldest was white.

Keeper's Quarters

Sample 68	**Munsell**
Yellow	2.5Y 8.5/6
Off-white	5Y 8.5/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Dark gray-green	5GY 4/1
White	5Y 9/1
Dark gray-green	5GY 4/1
Light gray-green	5GY 8/1
Gray-green	5GY 7/1
White	5Y 9/1
Golden varnish	--------
Golden varnish	--------

Sample 68 was found on the entry wall. Its quality was truly outstanding, with the upper set of white layers clearly demarcated by thin dirt layers. The large number of layers was also most impressive. Of greatest interest were the two golden varnish layers which appeared as remnants beneath the oldest white layer.

Keeper's Quarters

Sample 69	**Munsell**
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Gray-green	5GY 6/1
Gray-green	5GY 6/1
White	5Y 9/1
Golden varnish	--------
Golden varnish	--------

Sample 69 was collected from the entry door. Its oldest layers were comparable with those of its predecessor, sample 68, with remnants of a pair of golden varnish layers underneath a layer of white paint.

Keeper's Quarters

Sample 70	**Munsell**
Peach	10YR 8/4
Peach	10YR 8/4
Peach	10YR 8/4
White	5Y 9/1
Tan	2.5Y 7/2
Tan	2.5Y 7/2
Tan	2.5Y 7/2

Sample 70 was collected from the kitchen wall. The oldest trio of tan layers was relatively coarse and thick and filled with microbubbles. They reacted with hydrochloric acid, giving clear indication that they were probably calcimine paint.

Keeper's Quarters

Sample 71	**Munsell**
Gray	N 6.0/
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1

Sample 71 was from the exit wall. Its oldest set of four layers were similar to the tan layers of sample 70, being relatively thick and coarse with a violent reaction with hydrochloric acid indicating in this case probable whitewash.

Keeper's Quarters

Sample 72	Munsell
Yellow	2.5Y 8.5/6
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1

Sample 72 was removed from the exit wall. It varied from its counterpart, sample 71 only in its most recent layer which was yellow rather than gray. In this case the oldest four layers matched the apparent whitewash of sample 71.

Keeper's Quarters

Sample 73	Munsell
White	5Y 9/1
Yellow	2.5Y 8.5/6
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Light blue	5B 8/2

Sample 73 was taken from the office wall/ceiling. Beneath layers of white and yellow paint was a set of three apparent layers of whitewash with a light blue calcimine layer at the bottom.

Keeper's Quarters

Sample 74	Munsell
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Dark gray-green	5GY 4/1
Gray-green	5GY 5/1
White	5Y 9/1
White	5Y 9/1
Gray	5Y 7/1
Light blue	5BG 8/2
White	5Y 9/1
Golden varnish	--------
Golden varnish	--------

Sample 74 was collected from the office trim/baseboard. It was excellent in its quality with crisp layers delaminating from each other in many cases. As was the case with samples 58 and 69 there were remnants of a pair of golden varnish coats beneath the oldest layer of white paint.

Keeper's Quarters

Sample 75	Munsell
Pastel pink	2.5YR 9/2
Light blue	5BG 8/2
White	5Y 9/1

White	5Y 9/1
Paper	--------

Sample 75 came from the first floor bedroom wall. Above a substrate of paper was a set of four paint layers with pastel pink being the most recent.

Keeper's Quarters

Sample 76	**Munsell**
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Paper	--------

Sample 76 was removed from the first floor bathroom wall/ceiling. Above a substrate of paper was a set of four calcimine layers with four off-white paint layers above it. There were also black spots on the paint layers, which may be mold or mildew.

Keeper's Quarters

Sample 77	**Munsell**
Pastel peach	10YR 9/2
White	5Y 9/1
White	5Y 9/1
Pastel peach	10YR 8/2
Dark gray-green	5GY 4/1
Gray-green	5GY 6/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Golden varnish	--------
Golden varnish	--------

Sample 77 was from the second floor hall door trim. The top layer of pastel peach was unusually shiny. Beneath a relatively large number of paint layers was a pair of golden varnish layers.

Keeper's Quarters

Sample 78	**Munsell**
Light green	5GY 7.5/2
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1

Paper	--------

Sample 76 was found on the wall of bedroom #2. The base layer of paper was detached from the paint layers above it, of which the oldest four white layers were whitewash or calcimine paint.

Keeper's Quarters

Sample 79	**Munsell**
White	N 9.5/
Light green	5GY 7.5/2
Paper	--------

Sample 79 was taken from the wall of bedroom #1 of the second floor. There were two very thin paint layers firmly bonded to the paper substrate.

Keeper's Quarters

Sample 80	**Munsell**
Yellow	2.5Y 8.5/6
Tan	2.5Y 7/4
Light green	5GY 7.5/2
Gray-green	5GY 6/1

Sample 80 was collected from the second floor closet. Beneath four paint layers was a stark white substrate which was relatively thick. This may have been the skim coat of plaster or multiple coats of whitewash. It tested positively for lime content.

Keeper's Quarters

Sample 81	**Munsell**
Blue	5B 6/7
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Golden varnish	--------
Golden varnish	--------

Sample 81 came from the first floor bedroom door of the keeper's quarters. The top layer was a thin layer of bright blue paint beneath which was four layers of white paint. At the bottom was a uniform pair of golden varnish layers.

Sample 82 was the first of the plaster and mortar samples of the set. It was analyzed on Tuesday, October 14, using the standard testing procedure developed by E. Blaine Cliver, Regional Historical Architect of the North Atlantic Region of the National Park Service. The sample was from the second floor closet plaster of the keeper's quarters. It was off-white in color and consisted of small bits of plaster and a small amount of hair. There was a nonmeasurable reaction with the hydrochloric acid, indicating a mixture of gypsum and sand as opposed to lime and sand. The sand sieve analysis revealed relatively fine sand. All of it passed the largest sieve and almost 11% passed all of the sieves.

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 82
Building: Keeper's Quarters, Devils Island, Apostle Islands NL
Location: Second floor closet plaster
Sample Description: Off-white, soft, miniscule reaction, extremely fast filtering time

Test No. 1 – Soluble Fraction

Data:

1. 185.5 Container A weight
2. 202.4 Container A and sample
3. 771.65 Barometric pressure
4. 23 Temperature
5. 0.00 Liters of water displaced
6. Off-white Filtrate color
7. Gray Fines color
8. Yes Hair or fiber ______ type
9. 2.9 Fines and paper weight
10. 2.8 Filter paper weight
11. 198.5 Sand and Container A weight
12. 9.9 cc. of sand
13. 41.7 Weight of graduated cylinder and sand
14. 28.7 Weight of graduated cylinder

Computations:

15. 16.9 Starting weight of sample: No. 2 – No. 1
16. 0.1 Weight of fines: No. 9 – No. 10
17. 13.0 Weight of sand: No. 11 – No. 1
18. .76154 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 6.9 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.00 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0 00 Gram weight of CaCO3: 100 x No. 20
22. 6.9 Gram weight of Ca(OH)2: No. 19 – No. 21
23. .0932 Mols. of Ca(OH)2: No. 22 divided by 74
24. 6.9 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.00 Gram weight CO2: No. 20 x 44
26. 4.10 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. ------ %CO2 gain: No. 25 divided by No. 26

Conclusions:

28. 16.90 Gram weight of sample: No. 15 – No. 25
29. 0.59 Fine parts/volume: No. 16 divided by No. 28
30. 58.58 Sand parts/volume: (No. 17 divided by No. 28) x No. 18
31. ______ Lime parts/volume: (No. 24 divided by No. 28) x 1.1

Cement (if present)

32. ______ Portland cement parts/volume: (No. 16 divided by No. 28) x 0.78
33. ______ Natural cement parts/volume: (No. 16 divided by No. 28) x 0.86
34. ______ Lime with cement parts/volume: (No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	106.8	106.8	0.0	0
No. 20	107.4	106.4	1.0	7.81

No. 30	102.5	99.3	3.2	25.00
No. 40	104.9	100.7	4.2	32.81
No. 50	96.2	93.2	3.0	23.44
Base	72.6	71.2	1.4	10.94

Keeper's Quarters

Sample 83	**Munsell**
Tan	2.5Y 8/5

Sample 83 continued the paint samples and was found on the basement stair wall of the keeper's quarters. Beneath a layer of tan paint was a stark white substrate which was relatively thick. This may have been the skim coat of plaster or multiple coats of whitewash. It tested positively for lime content.

Sample 84 was a mortar sample taken from the masonry of the keeper's quarters. Its analysis revealed a composition of approximately two parts of sand to each part of lime by volume. Its sand sieve analysis revealed moderately fine sand of which all passed the largest sieve and almost 9% passed all of the sieves.

Sample 85 was of the mortar patch from the keeper's quarters. It differed significantly from its counterpart, sample 84. Rather than being composed of lime and sand it gave strong evidence of being composed of Portland cement in addition to the lime and sand. This is a typical late twentieth century mortar formula for restoration. The sand sieve analysis revealed an extraordinarily fine sand of which all easily passed the two largest sieves. Well over a third of it pass all of the sieves and well over half of it was trapped in the finest sieve.

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 84
Building: Keeper's Quarters, Devils Island, Apostle Islands NL
Location: Masonry mortar
Sample Description: Tan, soft, fast and bubbly reaction, rapid filtering time

Test No. 1 – Soluble Fraction

Data:

1. 188.9 Container A weight
2. 201.4 Container A and sample
3. 771.65 Barometric pressure
4. 23 Temperature
5. 0.15 Liters of water displaced
6. Champagne Filtrate color
7. Dark tan Fines color
8. No Hair or fiber ______ type
9. 3.1 Fines and paper weight
10. 2.6 Filter paper weight
11. 197.7 Sand and Container A weight
12. 6.2 cc. of sand
13. 37.5 Weight of graduated cylinder and sand
14. 28.7 Weight of graduated cylinder

Computations:

15. 12.5 Starting weight of sample: No. 2 – No. 1

16. 0.5 Weight of fines: No. 9 – No. 10
17. 8.8 Weight of sand: No. 11 – No. 1
18. .7045 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 3.2 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.00625 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0.625 Gram weight of CaCO3: 100 x No. 20
22. 2.575 Gram weight of Ca(OH)2: No. 19 – No. 21
23. .0348 Mols. of Ca(OH)2: No. 22 divided by 74
24. 3.04 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.28 Gram weight CO2: No. 20 x 44
26. 1.81 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 15.47 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28. 12.22	Gram weight of sample:	No. 15 – No. 25
29. 4.09	Fine parts/volume:	No. 16 divided by No. 28
30. 50.74	Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31. 27.36	Lime parts/volume:	(No. 24 divided by No. 28) x 1.1

Cement (if present)

32. ______	Portland cement parts/volume:	(No. 16 divided by No. 28) x 0.78
33. ______	Natural cement parts/volume:	(No. 16 divided by No. 28) x 0.86
34. ______	Lime with cement parts/volume:	(No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	106.8	106.8	0.0	0.00
No. 20	108.1	106.4	1.7	21.52
No. 30	101.9	99.2	1.7	21.52
No. 40	103.4	100.7	2.7	34.18
No. 50	94.3	93.2	1.1	13.92
Base	71.9	71.2	0.7	8.86

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 85
Building: Keeper's Quarters, Devils Island, Apostle Islands NL
Location: Mortar patch
Sample Description: Off-white, soft, fast and bubbly reaction, moderate filtering time

Test No. 1 – Soluble Fraction

Data:

1. 185.1 Container A weight	8. Yes Hair or fiber ______ type
2. 195.9 Container A and sample	9. 3.1 Fines and paper weight
3. 771.65 Barometric pressure	10. 2.7 Filter paper weight

4. 23 Temperature
5. 0.40 Liters of water displaced
6. Off-white Filtrate color
7. Pastel pink Fines color

11. 191.3 Sand and Container A weight
12. 3.6 cc. of sand
13. 34.9 Weight of graduated cylinder and sand
14. 28.7 Weight of graduated cylinder

Computations:

15. 10.4 Starting weight of sample: No. 2 – No. 1
16. 0.4 Weight of fines: No. 9 – No. 10
17. 6.2 Weight of sand: No. 11 – No. 1
18. .5806 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 3.8 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.016675 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 1.67 Gram weight of CaCO3: 100 x No. 20
22. 2.13 Gram weight of Ca(OH)2: No. 19 – No. 21
23. .0288 Mols. of Ca(OH)2: No. 22 divided by 74
24. 3.37 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.73 Gram weight CO2: No. 20 x 44
26. 2.00 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 36.50 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28.	9.67	Gram weight of sample:	No. 15 – No. 25
29.	4.14	Fine parts/volume:	No. 16 divided by No. 28
30.	37.23	Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31.		Lime parts/volume:	(No. 24 divided by No. 28) x 1.1

Cement (if present)

32.		Portland cement parts/volume:	(No. 16 divided by No. 28) x 0.78
33.		Natural cement parts/volume:	(No. 16 divided by No. 28) x 0.86
34.	4.55	Lime with cement parts/volume:	(No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	106.8	106.8	0.0	0.00
No. 20	106.4	106.4	0.0	0.00
No. 30	99.3	99.2	0.1	1.64
No. 40	101.2	100.7	0.5	8.20
No. 50	96.5	93.2	3.3	54.10
Base	73.4	71.2	2.2	36.07

Assistant Keeper's Quarters

Sample 86	**Munsell**
White	N 9.5/
White	N 9.5/
Charcoal	5Y 2/1
Gray	5Y 7/1
Black	N 0.5/
Black	N 0.5/
Charcoal	5Y 3/1

Sample 86 resumed the paint sample series and was taken from the porch post of the assistant keeper's quarters. Beneath a pair of stark white layers was a series of black and charcoal colored layers with a gray sandwiched between them.

Assistant Keeper's Quarters

Sample 87	**Munsell**
Dark green	2.5G 3/4
White	N 9.5/

Sample 87 was collected from the exterior window trim of the assistant keeper's quarters. Above a very weathered wood substrate were two thin layers of which the older was stark white.

Assistant Keeper's Quarters

Sample 88	**Munsell**
Black	N 0.5/
White	N 9.5/

Sample 88 came from the exterior window trim paint of the assistant keeper's quarters. Like its counterpart, sample 87 it retained only two paint layers on its wood surface.

Assistant Keeper's Quarters

Sample 89	**Munsell**
Dark green	2.5G 3/4
White	N 9.5/

Sample 89 was removed from the exterior door trim of the assistant keeper's quarters. It was identical to sample 87, including the weathered wood substrate.

Assistant Keeper's Quarters

Sample 90	**Munsell**
Pink	2.5R 8.5/3
Yellow	2.5Y 8.5/4
Light green	7.5G 8/2
Gray	5Y 6/1
Light gray	5Y 8/1
Tan	2.5Y 8/4
Tan	2.5Y 8/4
Dark green	7.5G 3/2
Green	7.5G 6/2

Sample 90 was from the sitting room of the assistant keeper's quarters. It retained a succession of paint layers which were very thin and evenly applied. The oldest surviving color was green.

Assistant Keeper's Quarters

Sample 91	**Munsell**
White	5Y 9/1
Tan	2.5Y 7/4

Tan	2.5Y 7/4
Yellow	2.5Y 8/6

Sample 91 was the first samples of the second set of samples from Devils Island. It was a paint sample collected from the first floor hallway of the assistant keeper's quarters. It retained four paint layers. The oldest yellow paint was quite variable in its thickness.

Assistant Keeper's Quarters

Sample 92	**Munsell**
White	5Y 9/1
Tan	2.5Y 7/4
Tan	2.5Y 7/4

Sample 92 came from the second floor stair/hallway of the assistant keeper's quarters. Its analysis revealed three layers of paint with tan being the oldest of the three.

Assistant Keeper's Quarters

Sample 93	**Munsell**
Dark green	2.5G 4/4
Tan	2.5Y 7/4
Tan	2.5Y 7/4

Sample 93 was removed from the second floor sitting room wall of the assistant keeper's quarters. It was similar to its counterpart, sample 92, but with a dark green layer on its surface rather than white. There was a distinct dirt film on the dark green layer.

Assistant Keeper's Quarters

Sample 94	**Munsell**
White	5Y 9/1

Sample 94 was from the second floor sitting room ceiling of the assistant keeper's quarters. It revealed only a single layer of white paint which was firmly adhered to its plaster substrate.

Assistant Keeper's Quarters

Sample 95	**Munsell**
Blue-green	2.5BG 6/4
White	5Y 9/1

Sample 95 was found on the wall of bedroom 2 of the assistant keeper's quarters. In addition to the white layer seen in its counterpart, sample 94 there was a blue-green layer above it.

Assistant Keeper's Quarters

Sample 96	**Munsell**
Pastel green	5G 9/1
White	5Y 9/1

Sample 97 was collected from the second floor bathroom of the assistant keeper's quarters. Beneath a layer of pastel green paint was a typical white layer.

Assistant Keeper's Quarters

Sample 97	**Munsell**
Green	10G 7/2
White	5Y 9/1
Gray	N 5.5/
White	5Y 9/1

Sample 97 was collected from bedroom #1 of the second floor of the assistant keeper's quarters. It revealed four paint layers of which a typical white color was the oldest layer.

Assistant Keeper's Quarters

Sample 98	**Munsell**
White	5Y 9/1
White	5Y 9/1
Pastel green	5G 9/1
Dark gray	5Y 5/1
Charcoal	N 3.5/

Sample 98 was from the stair to the basement of the assistant keeper's quarters. Its analysis revealed five thinly-applied layers. The oldest charcoal-colored paint was cleanly disengaged from its substrate.

Assistant Keeper's Quarters

Sample 99	**Munsell**
Gray	N 6.0/
Dark gray	N 4.5/
Gray	5Y 5.5/1
Dark gray	5Y 5/1
Black	N 1.0/
Tan	2.5Y 7/4
Charcoal	N 3.5/

Sample 99 was removed from the stair to the basement of the assistant keeper's quarters. Other than its oldest charcoal-colored layers it was quite dissimilar to its counterpart, sample 98. Here again the oldest layer did not retain any substrate beneath it.

Sample 100 continued the mortar and plaster series and was from the first floor hallway plaster of the assistant keeper's quarters. It was tan in color. Unlike other plaster samples, this sample had a fast and bubbly reaction, indicating the presence of lime along with the sand. The fines, which were minimal, contained a small amount of hair. An approximate ratio of four parts of lime to seven parts of sand was revealed. The sand sieve analysis revealed surprisingly coarse sand of which almost 7% failed to pass any of the sieves and almost half was trapped in sieve #20, the second largest sieve. Only slightly over 4% made it through all of the sieves.

Sample 101 was taken from the mortar of the assistant keeper's quarters. It was dark tan in color and was relatively soft. The softness in addition to a fast and bubble reaction indicated a lime and sand mixture of which there was approximately three times as much sand as there was lime, by volume. There was an unusually large proportion of fines produced which have been assumed to be dirt associated with the original sand. The sand sieve analysis revealed very fine sand of which over 18% passed all of the sieves, almost 32% was trapped in the finest sieve and less than 2% failed to pass any sieve.

Sample 102 was collected from the mortar patch of the assistant keeper's quarters. It was off-white in color and was relatively soft. It gave clear evidence of being composed of sand, lime, and Portland cement. The relatively large water displacement is typical of lime mortars, but the prolonged reaction is typical of Portland cement mortars. A lime mortar typically has a rapid filtering time. This had a moderate filtering time. There were, however, no gelatinous by-products which characterize some Portland cement mortars but not all. The sand sieve analysis revealed very fine sand of which over 16% passed all of the sieves and slightly over 41% was trapped in the finest sieve.

Sample 103 came from the mortar of oil house #1. It was very soft and was off-white in color. It was also well below average in size (20.0 grams being the standard size). It had a fast and bubbly reaction and a rapid filtering time, both of which a typical indications of a lime and sand mortar. There was a proportionally large amount of fines which were probably dirt in association with the sand. If so, then the approximate mixture was five parts of lime to eight parts of sand, by volume, or, roughly, one part of lime to two parts of sand. The sand sieve analysis revealed coarse sand. Although all of it passed the largest sieve, slightly over one-fifth was trapped in the next sieve, #20. Over 37% was trapped in sieve #30 and over one-quarter was trapped in sieve #40.

Sample 104 was removed from the mortar patch of oil house #1. It was off-white in color and was relatively soft. It gave clear evidence of being composed of sand, lime, and Portland cement. The relatively large water displacement is typical of lime mortars, but the prolonged reaction is typical of Portland cement mortars. A lime mortar typically has a rapid filtering time. This had a moderate filtering time. There were, however, no gelatinous by-products which characterize some Portland cement mortars but not all. The sand sieve analysis revealed very fine sand of which over 32% passed all of the sieves and over 46% was trapped in the finest sieve.

Sample 106 was the mortar from oil house #2. It was gray and hard, which are both indications of a Portland cement and sand mortar. Although the sample size was small it had a minimal water displacement, a prolonged reaction and only moderate filtering time which are also indications of a Portland cement and sand sample. The sand sieve analysis revealed fine sand of which all passed the largest sieve and over one-fifth passed all of the sieves. Almost 45% was trapped in the finest sieve, #50 and almost one-quarter was trapped in the next finest sieve, #40.

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 100
Building: Assistant Keeper's Quarters, Devils Island, Apostle Islands NL
Location: First floor hallway plaster
Sample Description: Tan with pieces of thin white skim coat, soft, fast and bubbly reaction, extremely fast filtering time

Test No. 1 – Soluble Fraction

Data:

1. 187.8 Container A weight
2. 221.5 Container A and sample
3. 771.65 Barometric pressure
4. 23 Temperature
5. 0.40 Liters of water displaced
6. Off-white Filtrate color
7. Pink-tan Fines color
8. Yes Hair or fiber ______ type
9. 2.7 Fines and paper weight
10. 2.7 Filter paper weight
11. 214.7 Sand and Container A weight
12. 16.0 cc. of sand
13. 55.6 Weight of graduated cylinder and sand
14. 28.7 Weight of graduated cylinder

Computations:

15. 33.7 Starting weight of sample: No. 2 – No. 1
16. 0.o Weight of fines: No. 9 – No. 10
17. 26.9 Weight of sand: No. 11 – No. 1
18. .5948 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 6.8 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0166753 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 1 67 Gram weight of CaCO3: 100 x No. 20
22. 5.13 Gram weight of Ca(OH)2: No. 19 – No. 21
23. 0.0693577 Mols. of Ca(OH)2: No. 22 divided by 74
24. 6.37 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.73 Gram weight CO2: No. 20 x 44
26. 3.79 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 19.26 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28. 32.97 Gram weight of sample: No. 15 – No. 25
29. 0.00 Fine parts/volume: No. 16 divided by No. 28
30. 48.53 Sand parts/volume: (No. 17 divided by No. 28) x No. 18
31. 27.25 Lime parts/volume: (No. 24 divided by No. 28) x 1.1

Cement (if present)

32. ______ Portland cement parts/volume: (No. 16 divided by No. 28) x 0.78
33. ______ Natural cement parts/volume: (No. 16 divided by No. 28) x 0.86
34. ______ Lime with cement parts/volume: (No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	108.6	106.8	1.8	6.77
No. 20	119.4	106.4	13.0	48.87
No. 30	104.5	99.3	5.2	19.55
No. 40	104.4	100.8	3.6	13.53
No. 50	95.1	93.2	1.9	7.14
Base	72.3	71.2	1.1	4.14

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 101

Building: Assistant Keeper's Quarters, Devils Island, Apostle Islands NL

Location: Mortar

Sample Description: Dark tan, soft, fast and bubbly reaction, extremely rapid filtering time

Test No. 1 – Soluble Fraction

Data:

1. 192.0 Container A weight
2. 209.3 Container A and sample
3. 771.65 Barometric pressure
4. 23 Temperature
5. 0.23 Liters of water displaced
6. Off-white Filtrate color
7. Pink-tan Fines color
8. No Hair or fiber ______ type
9. 3.6 Fines and paper weight
10. 2.7 Filter paper weight
11. 205.2 Sand and Container A weight
12. 8.7 cc. of sand
13. 41.9 Weight of graduated cylinder and sand
14. 28.7 Weight of graduated cylinder

Computations:

15. 17.3 Starting weight of sample: No. 2 – No. 1
16. 0.9 Weight of fines: No. 9 – No. 10
17. 13.2 Weight of sand: No. 11 – No. 1
18. .659 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 3.2 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0095883 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0.96 Gram weight of CaCO3: 100 x No. 20
22. 2.24 Gram weight of Ca(OH)2: No. 19 – No. 21
23. 0.030286 Mols. of Ca(OH)2: No. 22 divided by 74
24. 2.95 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.42 Gram weight CO2: No. 20 x 44
26. 1.75 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 24 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28. 16.88	Gram weight of sample:	No. 15 – No. 25
29. 5.33	Fine parts/volume:	No. 16 divided by No. 28
30. 51.78	Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31. 19.22	Lime parts/volume:	(No. 24 divided by No. 28) x 1.1

Cement (if present)

32. ______	Portland cement parts/volume:	(No. 16 divided by No. 28) x 0.78
33. ______	Natural cement parts/volume:	(No. 16 divided by No. 28) x 0.86
34. ______	Lime with cement parts/volume:	(No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	107.0	106.8	0.2	1.51
No. 20	107.8	106.4	1.4	10.61
No. 30	100.9	99.3	1.6	12.12
No. 40	104.2	100.8	3.4	25.76
No. 50	07.4	93.2	4.2	31.82
Base	73.6	71.2	2.4	18.18

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 102
Building: Assistant Keeper's Quarters, Devils Island, Apostle Islands NL
Location: Mortar patch
Sample Description: Off-white, soft, fast and bubbly reaction followed by prolonged reaction, moderate filtering time

Test No. 1 – Soluble Fraction

Data:

1. 185.5	Container A weight	8. No	Hair or fiber ______ type
2. 205.7	Container A and sample	9. 3.3	Fines and paper weight
3. 760.99	Barometric pressure	10. 2.8	Filter paper weight
4. 23	Temperature	11. 198.9	Sand and Container A weight
5. 0.66	Liters of water displaced	12. 8.1	cc. of sand
6. Off-white	Filtrate color	13. 42.2	Weight of graduated cylinder and sand
7. Light gray	Fines color	14. 28.7	Weight of graduated cylinder

Computations:

15. 20.2 Starting weight of sample: No. 2 – No. 1
16. 0.5 Weight of fines: No. 9 – No. 10
17. 13.4 Weight of sand: No. 11 – No. 1
18. .6045 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 6.3 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0271341 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 2 71 Gram weight of CaCO3: 100 x No. 20
22. 3.59 Gram weight of Ca(OH)2: No. 19 – No. 21
23. .0485 Mols. of Ca(OH)2: No. 22 divided by 74
24. 5.59 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 1.19 Gram weight CO2: No. 20 x 44
26. 3.33 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 35.74 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28. 19.01	Gram weight of sample:	No. 15 – No. 25
29. 2.62	Fine parts/volume:	No. 16 divided by No. 28
30. 42.63	Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31. ______	Lime parts/volume:	(No. 24 divided by No. 28) x 1.1

Cement (if present)

32. ______	Portland cement parts/volume:	(No. 16 divided by No. 28) x 0.78
33. ______	Natural cement parts/volume:	(No. 16 divided by No. 28) x 0.86
34. 0.58	Lime with cement parts/volume:	(No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio

No. 10	107.2	106.8	0.4	2.99
No. 20	107.0	106.4	0.6	4.48
No. 30	100.1	99.3	0.8	5.97
No. 40	104.7	100.8	3.9	29.10
No. 50	98.7	93.2	5.5	41.04
Base	73.4	71.2	2.2	16.42

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 103
Building: Oil House #1, Devils Island, Apostle Islands NL
Location: Mortar
Sample Description: Off-white, very soft, fast and bubbly reaction, rapid filtering time

Test No. 1 – Soluble Fraction

Data:

1. 188.9 Container A weight
2. 197.5 Container A and sample
3. 760.99 Barometric pressure
4. 23 Temperature
5. 0.17 Liters of water displaced
6. Champagne Filtrate color
7. Tan Fines color
8. No Hair or fiber ______ type
9. 3.1 Fines and paper weight
10. 2.6 Filter paper weight
11. 194.4 Sand and Container A weight
12. 3.9 cc. of sand
13. 34.3 Weight of graduated cylinder and sand
14. 28.7 Weight of graduated cylinder

Computations:

15. 8.6 Starting weight of sample: No. 2 – No. 1
16. 0.5 Weight of fines: No. 9 – No. 10
17. 5.5 Weight of sand: No. 11 – No. 1
18. .709 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 2.2 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0069891 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0.70 Gram weight of CaCO3: 100 x No. 20
22. 1.50 Gram weight of Ca(OH)2: No. 19 – No. 21
23. .0203 Mols. of Ca(OH)2: No. 22 divided by 74
24. 2.02 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 0.31 Gram weight CO2: No. 20 x 44
26. 1.20 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 25.83 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28. 8.29 Gram weight of sample: No. 15 – No. 25
29. 6.03 Fine parts/volume: No. 16 divided by No. 28
30. 47.04 Sand parts/volume: (No. 17 divided by No. 28) x No. 18
31. 33.04 Lime parts/volume: (No. 24 divided by No. 28) x 1.1

Cement (if present)

32. ______ Portland cement parts/volume: (No. 16 divided by No. 28) x 0.78

33.____________Natural cement parts/volume: (No. 16 divided by No. 28) x 0.86

34.____________Lime with cement parts/volume: (No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	106.8	106.8	0.0	0.00
No. 20	107.5	106.4	1.1	20.37
No. 30	101.3	99.3	2.0	37.04
No. 40	102.2	100.8	1.4	25.93
No. 50	93.7	93.2	0.5	9.26
Base	71.6	71.2	0.4	7.41

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 104

Building: Oil House #1, Devils Island, Apostle Islands NL

Location: Mortar patch

Sample Description: Off-white, soft, fast and bubbly reaction followed by prolonged reaction, moderate filtering time

Test No. 1 – Soluble Fraction

Data:

1. 185.1 Container A weight
2. 206.3 Container A and sample
3. 760.99 Barometric pressure
4. 23 Temperature
5. 0.80 Liters of water displaced
6. Off-white Filtrate color
7. Pastel pink Fines color
8. No Hair or fiber______type
9. 3.3 Fines and paper weight
10. 1.9 Filter paper weight
11. 198.4 Sand and Container A weight
12. 8.1 cc. of sand
13. 42.0 Weight of graduated cylinder and sand
14. 28.7 Weight of graduated cylinder

Computations:

15. 21.2 Starting weight of sample: No. 2 – No. 1
16. 1.4 Weight of fines: No. 9 – No. 10
17. 13.3 Weight of sand: No. 11 – No. 1
18. .609 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 6.5 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0328898 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 3.29 Gram weight of CaCO3: 100 x No. 20
22. 3.21 Gram weight of Ca(OH)2: No. 19 – No. 21
23. .0434 Mols. of Ca(OH)2: No. 22 divided by 74
24. 5.64 Gram total weight of Ca(OH)2: 74 x (No. 20 + No. 23)
25. 1.45 Gram weight CO2: No. 20 x 44
26. 3.36 Gram weight total possible CO2: 44 x (No. 20 + No. 23)
27. 43.15 %CO2 gain: No. 25 divided by No. 26

Conclusions:

28. 19.75 Gram weight of sample: No. 15 – No. 25
29. 7.09 Fine parts/volume: No. 16 divided by No. 28
30. 41.01 Sand parts/volume: (No. 17 divided by No. 28) x No. 18
31. ____ Lime parts/volume: (No. 24 divided by No. 28) x 1.1

Cement (if present)
32. ____ Portland cement parts/volume: (No. 16 divided by No. 28) x 0.78
33. ____ Natural cement parts/volume: (No. 16 divided by No. 28) x 0.86
34. 2.52 Lime with cement parts/volume: (No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	106.8	106.8	0.0	0.00
No. 20	106.7	106.4	0.3	2.27
No. 30	99.8	99.3	0.5	3.79
No. 40	102.8	100.8	2.0	15.15
No. 50	99.3	93.2	6.1	46.21
Base	75.5	71.2	4.3	32.58

Mortar/Plaster/Stucco Analysis Test Sheet

Sample No. 106
Building: Oil House #2, Devils Island, Apostle Islands NL
Location: Mortar
Sample Description: gray, hard, fast and bubbly reaction followed by prolonged reaction, rapid filtering time

Test No. 1 – Soluble Fraction

Data:
1. 187.8 Container A weight
2. 195.7 Container A and sample
3. 760.99 Barometric pressure
4. 23 Temperature
5. 0.05 Liters of water displaced
6. Off-white Filtrate color
7. Light gray Fines color
8. No Hair or fiber ____ type
9. 2.2 Fines and paper weight
10. 1.8 Filter paper weight
11. 191.7 Sand and Container A weight
12. 3.4 cc. of sand
13. 32.7 Weight of graduated cylinder and sand
14. 28.8 Weight of graduated cylinder

Computations:
15. 7.9 Starting weight of sample: No. 2 – No. 1
16. 0.4 Weight of fines: No. 9 – No. 10
17. 3.9 Weight of sand: No. 11 – No. 1
18. .8718 Sand density: No. 12 divided by (No. 13 – No. 14)
19. 3.6 Weight of soluble content: No. 15 – (No. 16 + No. 17)
20. 0.0020556 Mols. Of CO2: No. 5 x No. 3. x 0.016 divided by (No. 4 + 273.16 C.)
21. 0 21 Gram weight of CaCO3: 100 x No. 20
22. 3.39 Gram weight of Ca(OH)2: No. 19 – No. 21

23. 0.04587 Mols. of $Ca(OH)_2$: No. 22 divided by 74
24. 3.55 Gram total weight of $Ca(OH)_2$: 74 x (No. 20 + No. 23)
25. 0.09 Gram weight CO_2: No. 20 x 44
26. 2.11 Gram weight total possible CO_2: 44 x (No. 20 + No. 23)
27. 4.27 %CO_2 gain: No. 25 divided by No. 26

Conclusions:

28. 7.81	Gram weight of sample:	No. 15 – No. 25
29. 5.12	Fine parts/volume:	No. 16 divided by No. 28
30. 43.53	Sand parts/volume:	(No. 17 divided by No. 28) x No. 18
31. ____	Lime parts/volume:	(No. 24 divided by No. 28) x 1.1

Cement (if present)

32. 3.99	Portland cement parts/volume:	(No. 16 divided by No. 28) x 0.78
33. ____	Natural cement parts/volume:	(No. 16 divided by No. 28) x 0.86
34. ____	Lime with cement parts/volume:	(No. 16 x o.2) divided by No. 28 x 1.1

Test No. 2 – Sand Sieve Analysis

Sieve	Sieve w/ sand weight	Sieve weight	Sand weight	Sand ratio
No. 10	106.8	106.8	0.0	0.00
No. 20	106.6	106.4	0.2	5.26
No. 30	99.5	99.3	0.2	5.26
No. 40	100.7	100.8	0.9	23.68
No. 50	94.9	93.2	1.7	44.74
Base	72.0	71.2	0.8	21.05

Oil House #1

Sample 105	**Munsell**
Dark green	2.5G 4/4
White	5Y 9/1

Sample 105 resumed the paint sample series. It was taken from the trim of the oil house #1. It analysis showed only two, thin layers of paint with white being the older of the two.

Oil House #2

Sample 107	**Munsell**
Maroon	7.5R 3/5
Yellow-orange	10YR 7/8
Maroon	7.5R 3/5
Yellow-orange	10YR 7/8
Yellow-orange	10YR 7/8
Dark green	2.5G 4/4
Yellow-orange	10YR 7/8
Dark green	2.5G 4/4
Dark green	2.5G 4/4
Dark green	2.5G 4/3
Dark green	2.5G 4/3
Dark green	2.5G 4/2

Dark green	2.5G 3/2
Gray	5Y 6/1
Dark gray	5Y 4/1
Dark gray	5Y 4/1
White	5Y 9/1
White	5Y 9/1

Sample 107 was collected from the trim of oil house #2. It was very good in its quality with only the oldest pair of white layers exhibiting marked deterioration. The layer number of thin, evenly-applied layers was quite impressive both for the number and for the variety of colors.

Lighthouse

Sample 108	**Munsell**
White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/
Tan	10YR 8/4
Tan	10YR 8/4
Tan	10YR 8/4
Tan	10YR 8/4
Red	7.5R 5/5
White	5Y 9/1

Sample 108 came from the interior of the lighthouse. Beneath a set of stark white paint layers was another set of warm tan layers. Beneath that set was a variable layer of red, below which was a layer of oil-based white paint.

Lighthouse

Sample 109	**Munsell**
Gray	N 6.0/
Gray	N 6.0/
Charcoal	N 1.5/
Dull red	7.5R 6/3
Gray	N 6.0/
Charcoal	N 2.0/
Gray	N 6.0/
Charcoal	N 3.0/

Sample 109 came from the floor/stair of the lighthouse. It was extremely challenging in its quality. The top pair of gray layers were in excellent condition but the layers beneath them were in extremely poor condition. The intermediate gray layers were extremely thin and the other layers were thick and flaky.

Fog Signal

Sample 110	**Munsell**
White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/

White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/
Dark tan	2.5Y 6/4
Dark tan	2.5Y 6/4
Off-white	5Y 8.5/1
Off-white	5Y 8.5/1
Off-white	5Y 8.5/1
Off-white	5Y 8.5/1
Off-white	5Y 8.5/1
Off-white	5Y 8.5/2
Light gray	5Y 8/2
Light gray	5Y 8/2
Brown	2.5Y 5/4
Dark tan	2.5Y 6/2
Dark gray	N 4.0/
Gray	N 5.5/
Charcoal	N 2.0/
White	5Y 9/1
Very dark maroon	10R 2/2

Sample 110 was removed from the interior of the fog signal. Its quality was truly outstanding with clear layers of thinly applied paint. The oldest very dark maroon layer retained no substrate beneath it and was variable in color with some black areas as well.

Fog Signal

Sample 111	**Munsell**
Gray	N 5.0/
Dark gray	N 4.0/
Gray	N 5.0/
Gray	N 5.0/
Gray	N 5.0/
Gray	N 5.0/
Dark gray	N 4.0/
Gray	N 5.0/
Dark gray	N 4.0/
Dark gray	N 4.5/
Dark gray	N 4.0/
Gray	5Y 6/1
Gray	5Y 6/1
Gray	5Y 6/1
Light gray	5Y 8/1
Gray	5Y 6/1
Dark maroon	7.5R 3/4
Dark maroon	7.5R 3/4
Dark green	2.5G 3/4
Dark green	2.5G 3/4
Dark green	2.5G 3/4
Dark maroon	7.5R 3/4
Dark glossy varnish	--------

Sample 111 was from the interior of the fog signal. Like sample 100 it revealed a large set of clearly distinct layers. The oldest layer was a very dark varnish with an extremely high gloss so that no substrate remained beneath it.

Fog Signal

Sample 112	**Munsell**
White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/
White	N 9.5/
Dark tan	2.5Y 6/4
Dark tan	2.5Y 6/4
Off-white	5Y 8.5/1
Off-white	5Y 8.5/1
Off-white	5Y 8.5/1
Off-white	5Y 8.5/1
Off-white	5Y 8.5/1

Sample 112 was found on the new addition interior of the fog signal. It matched sample 110 layer for layer until it ended at an off-white layer.

Fog Signal

Sample 113	**Munsell**
Dark green	2.5G 3/4
White	N 9.5/
White	N 9.5/
White	5Y 9/1

Sample 113 was taken from the door trim of the fog signal. There were two paint layers – dark green and stark white atop a thick collection of stark white, whitewash layers which was above another collection of slightly off-white whitewash layers.

Fog Signal

Sample 114	**Munsell**
Dark green	2.5G 3/4
Dark green	2.5G 4/4
Dark green	2.5G 4/4

Sample 114 was collected from the window trim of the fog signal. It revealed three extremely thin layers of dark green paint.

Boat House

Sample 115	**Munsell**

White	N 9.5/
White	N 9.5/

Sample 115 came from the exterior siding of the boat house. It retained a thin layer of stark white paint atop a thick encrustation of whitewash layers.

Boat House

Sample 116	**Munsell**
Dark green	2.5G 3/4
White	N 9.5/
Dark green	2.5G 3/4
White	5Y 9/1
Dark green	2.5G 3/4
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Dark green	2.5G 3/4

Sample 116 was removed from the exterior wood trim of the boat house. Beneath a set of nine paint layers was extremely weathered wood.

Boat House

Sample 117	**Munsell**
Dark green	2.5G 3/4
White	N 9.5/
Gray	5Y 5/1
Tan	2.5Y 7/6
Tan	2.5Y 7/6
Brown	10YR 5/2
Charcoal	N 2.0/
White	5Y 9/1
White	5Y 9/1
White	5Y 9/1
Dark green	2.5G 3/4
Gray	5Y 7/1

Sample 117 was from the exterior door trim of the boat house. It revealed an impressive number of paint layers, especially for an exterior sample. The oldest gray layer was applied to heavily weathered wood.

Boat House

Sample 118	**Munsell**
Tan	2.5Y 7/6
Tan	2.5Y 7/6

Sample 118 was found on the interior door trim of the boat house. It retained only two layers of tan paint which matched the pair of tan layers in its counterpart, sample 117.

Boat House

Sample 119	**Munsell**

Dark green	2.5G 3/4
Dark green	2.5G 3/4
White	N 9.5/
White	N 9.5/
White	N 9.5/
Dark green	2.5G 3/4
Gray	5Y 9/1

Sample 119 was taken from the eave trim of the boat house. It retained gray paint on its weathered wood surface as in sample 117.

A number of conclusions can be drawn from the analysis, as follow:

1. There was a fair degree of consistency between the several of the samples, making it possible to draw some firm conclusions.

2. A number of samples had so few layers that one of the following conclusions can be reached:

    a. The oldest layers had either weathered away over time, which is probable with exterior paint.

    b. They may have been stripped. This would be especially true if the older finish was a calcimine paint, which is impossible to cover with any coating, including calcimine paint itself. It was an extremely popular paint for interior plaster surfaces during the nineteenth and early twentieth centuries. In light of the use of whitewash, which is a related waterborne paint, the probability of calcimine paint here is very high.

    c. The element itself had been replaced or is of recent date.

    d. Other coverings such as wallpaper or calcimine paint may have preceded the paint and were removed prior to painting. Wallpaper was a popular covering, especially for damaged plaster.

    e. Because very little is known today about calcimine paint a few comments are in order to explain it.

    It was immensely popular throughout the nineteenth century and into the early twentieth century. It was cheap, easily applied and removed, had a very soft and lustrous sheen, and could be mixed and used by the average homeowner who could not afford a painter. In this case it could have been applied by Coast Guard personnel rather than painters. Decorative painters frequently used it because of its sheen. It is still in production to this day, although it is very rarely used.

    It is waterborne glue distemper paint which, unlike its cousin, whitewash, must be entirely removed prior to repainting. The difference between calcimine paint and whitewash is in the formulation. Calcimine paint was developed for interior use only and was developed to carry a pigment whereas the high lime content of whitewash prevented it from taking on a pigment. Whitewash was primarily used for exteriors and for dark service areas of interiors.

    Nothing will stick to it, including calcimine paint. Its absence, therefore, is about the only means of its detection. This is a real Catch-22. Because it was typically removed prior to repainting its presence is usually indicated either through historic documentation (which is very rare) or the very small number of layers where many would normally be found or where other, similar surfaces retain considerably more.

3. There is no doubt that at least one element (the door trim – Sample 113) of the fog signal was whitewashed as its probable original finish.

4. Many samples revealed lengthy sequences of paint layers with some of these samples having an exterior exposure. These are most likely to have retained original finishes and stand in contrast with those samples with very few layers which, logically, probably did not reveal original finishes.

5. Of some interest was the apparent original golden varnish layers seen on several samples from the keeper's quarters. Although golden varnish was typically used on woodwork, it was also found on wall surfaces.

6. As can be seen with many of the mortar sample discussions no relative ratios of sand to Portland cement or sand to Portland cement and lime has been state. The acid reduction method which was used is better than other methods for determining lime to sand ratios. Hence, they were provided for those samples composed of sand and lime. For samples containing Portland cement, the best this form of testing can do is to indicate the presence of Portland cement and the sand itself.

   The primary goal in repointing is to achieve a compatible mortar. This can be done for lime and sand samples that were analyzed. It can also be done for Portland cement samples with a bit of trial and error. If the mortar is very hard then a higher ratio of Portland cement to sand will work. One must take into consideration any deterioration of the masonry as a result of the mortar. If this has been the case it may be advisable to use a softer mortar for repointing.

   The other primary mode of mortar analysis is spectrographic testing. Unfortunately, it also cannot accurately determine exact ratios of Portland cement to sand and/or to lime.

   The secondary goal is to match the appearance of the mortar, which depends to a very large extent on the sand. This is where acid reduction testing shines. It provides and exact calculation of the sand grain sizes as well as a sample of the sand for matching of color. If the sand is carefully matched then the appearance will be successful. This is especially critical in partial repointing and patching.

7. There are instances where the narrative of the mortar make up refers to Portland – but the data sheet following does not include it in line #32. The reason for this is that rather than a number for lime content, the calculation is made for lime with Portland cement content. If the sample merely had Portland cement and sand there would be a number for Portland cement

1

As the nation's principal conservation agency, the Department of the Interior has the responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NPS D-633/106,232 / March 2011