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REPORT ON MOISTURE CONDITIONS WENTWORTH-COOLIDGE MANSION PORTSMOUTH, NEW HAMPSHIRE

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This report is based on inspections of the Wentworth-Coolidge Mansion on August 27 and November 13, 1996. Also present at the first inspection were Tom Mattson, Seacoast Regional Manager for the New Hampshire Division of Parks and Recreation (and tenant in the house); Alanson Sturgis, vice chair of the Wentworth-Coolidge Commission and chairman of the Commission's Maintenance Committee; and Paige W. Roberts, consultant for the Wentworth-Coolidge Commission and site manager for the 1996 season. The second inspection was carried out by Tom Mattson and James Garvin following a severe coastal rainstorm that had occurred on October 19 and 20, 1996. The purpose of the inspections was to evaluate the management of rainwater, to assess moisture conditions in the house, especially within its cellars, and to make recommendations for controlling water and moisture in order to reduce future damage to the building and deterioration of exterior paint on the house.

Summary: The Wentworth-Coolidge Mansion is in generally sound condition. Water and moisture conditions, while serious in some areas and requiring immediate correction, are not catastrophic. Most water problems in and around the building result from lack of maintenance of systems that were installed in a major restoration effort in 1966, or from damage to these systems. Some problems are caused by inadequate insulation in occupied areas of the building, resulting in ice dams in the wintertime. With repair and maintenance of existing systems, and with knowledgeable inspection and maintenance in the future, the house can be protected from damaging water and moisture conditions for an indefinite period.

A summary of recommended steps to correct existing problems will be found on page 21.

Causes of the Investigation: During the winter of 1995-6, large quantities of water flooded one of the cellars under the main house--Room Number 9 in the attached basement plan. Water rose above the oil burner of the forced-hot-air furnace here, necessitating the replacement of a four-year-old burner motor on January 29, 1996.

At the time of this flooding, it was assumed that the influx of water resulted from changes in drainage caused by the installation of a large septic leaching field west of the house during the preceding autumn. It has since been found that the water entered the cellar because of a plugged storm sewer in the courtyard outside the house, between the cellar and the tenant's apartment of the house, and because of damage to another storm sewer line that is intended to collect and discharge water from the area of the upper parking lot. The altered grades west of the house, as such, apparently had little connection with the flooding, but damage to the sewer line from the upper parking lot (described below) greatly increased the problem by disabling part of an overall drainage system, thereby permitting a large accumulation of surface water to run toward the house.

A second concern has been the widespread failure of the coats of paint that were applied to the house in the summer of 1988. The paint has failed excessively in several areas, including the northwest wall of the kitchen and the southwest wall of the tenant's wing, adjacent to a bathroom.

Other areas of concern include hidden leaks that have been discovered from time to time beneath windows or at the juncture of various sections of the house, stoppage of perimeter drains, and failure of eaves gutters or damage to gutters.

The winter of 1995-6 was notable for heavy snows that lasted until a February thaw. During that winter, severe ice dams developed along the eaves of the heated tenant's apartment at the northwestern end of the complex. These ice dams apparently caused water to enter the wall cavity in some areas, worsening exterior paint losses that were already evident.

The inspection committee was also concerned that conditions of general wetness and/or condensation, which were evident in the basements of the house as recently as 1984 and were addressed at that time, might have recurred.

The following outline is an attempt to trace moisture conditions in and around the house from 1954, when the property was received as a gift by the State of New Hampshire, and to describe attempts to control moisture from initial assessment of the property, done in 1954, through the extensive restoration work of 1966 and the remedial work of 1984 (when polyethylene sheets were laid over the earth floors of several damp cellars), to the complete re-roofing of the house in 1991. This summary also describes changes to the heating system over this span of years, since the heating facilities of the house are closely related to the basements and to conditions in the basements.

I. History of Moisture-Related Repairs to the Wentworth-Coolidge Mansion

Basement Conditions During Coolidge Ownership: Record drawings prepared as parts of a report of 1954 by the Public Works Division of the New Hampshire Department of Public Works and Highways, immediately following acquisition of the Wentworth-Coolidge property by the State of New Hampshire, indicate arrangements under the house before the major changes undertaken by the State of New Hampshire in 1966. A copy of the basement plan, and the key to that plan, are attached.

According to that report, the heating system of the house at the time of public acquisition was composed of "a combination of three coal-burning gravity hot air furnaces, stoves, and fireplaces. About one-third of the rooms are served by the furnaces. Some rooms have no means of heating." The building then had eight bathrooms.

One of the coal-burning furnaces mentioned in the report of 1954 was located under the "billiard room" on the first story. It is indicated as Number 5 on the attached basement plan. This furnace was vented through a chimney that once rose against the southeast outside wall of the billiard room. This chimney is visible in various unpublished photographs, and in Figure 110 of John Mead Howells' *The Architectural Heritage of the Piscataqua* (1937). The chimney was removed in 1966.

The second coal-burning furnace was located in a small cellar between Areas 1 and 7 on the accompanying plan, and is indicated as Number 2 on that plan. This furnace was vented into the large kitchen chimney of the house through a nearly horizontal tunnel-like flue built of bricks across the floor of the partly-unexcavated crawl space marked as Area 7 on the plan. This flue remains intact, but now has no appliance connected to it.

The third coal-fired furnace was located in a concrete-lined pit under the northwestern cellar of the servants' wing, indicated as Number 16 in Area 15 on the attached plan. In 1966, this furnace was vented through a chimney that rose against the exterior of the southeast wall of Area 15, near the cellar door. (The plan of 1954 indicates the chimney for this furnace as rising through a closet between two bedrooms of that wing, perhaps an earlier arrangement.) The chimney for this part of the house was removed in 1966.

Before 1966, the house was also served by a coal-fired hot water heater located in a basement laundry room, indicated as Area 12 on the accompanying plan. The heater was located in Area 15, and was served by a coal bin indicated as Area 14. The coal bin was filled through a chute connected to an exterior coal house that stood on a foundation indicated as Area 17. Room 12 is presently used as a laundry and furnace room, but the pre-1966 plumbing arrangements have been entirely removed and replaced.

All of the furnaces noted in 1954 have been removed. New furnaces were installed in 1966 (see below).

Basement Changes Made in the Restoration of 1966: Restoration work carried out in 1966 is recorded in a set of sixteen contract drawings, supplemented by six heating and ventilating drawings, prepared by architect Edward Benton Miles of Exeter, New Hampshire. These twenty-two drawings are dated April 1, 1966, and together record most of the changes that were carried out during the most extensive repair campaign that the State of New Hampshire has undertaken on the house thus far.

These drawings reveal some aspects of drainage around the building, but regrettably do not record the means or routes of disposal of storm water drainage except in limited areas. They do not, for example, show the disposition of water collected at several present or former catch basins above the house, where the driveway formerly entered the property from Little Harbor Road, nor do they indicate the position of the outfalls from the several storm sewers that pass under the house or carry water away from its northeasterly side, facing the back channel.

In addition to improving drainage around the building, the work of 1966 equipped the entire structure to be heated by new forced-hot-air furnaces with registers in almost every room or space. To judge by the lack of thermal insulation except in the ceilings of the tenant's apartment, it appears that intermittent heating, for special occasions only, was contemplated for the historic portions of the house. The apartment, by contrast, was intended to be occupied year-round and to be heated throughout the cold season. It has been heated every winter since 1966.

The Miles drawings indicate that the following changes were made in basement areas in 1966:

1. An areaway extending along the dining room wall, southwest of the house, was deepened and paved with concrete. It is unclear just when this areaway was first created, but it seems likely that a retaining wall was built some distance from the foundation wall early in the twentieth century, when the Coolidge family changed and raised the contours of the ground west of the house (see Martha E. Pinello, "Report of Preliminary Archaeological Investigations of the Historic Landscape at the Wentworth-Coolidge Mansion, Portsmouth, New Hampshire" [December 1992]). It would have been evident during that landscaping project that new fill had to be kept well away from the foundations and sills of the house.

Two drains were installed in the new concrete floor of the areaway in 1966, and connected to a four-inch cast iron storm sewer that is carried under the house, through the former furnace room between Area 1 and Area 7. The drain pierces the northeast wall of this room to connect with a then-existing storm sewer outside the house; from there, water is carried parallel to the Council Chamber wall to an unidentified outfall.

2. Northeast of the present tenant's wing, an existing sanitary sewer was connected to a new 1000-gallon precast concrete septic tank that was buried in the terrace. The tank was connected to a new concrete block seepage pit measuring six feet in diameter by five feet deep and constructed a few feet from the tank. This arrangement apparently bypassed a former sewer outfall that discharged household waste into the channel. A cast iron outfall, probably the original house sewer, is still visible at low tide below the sea wall.

3. Several kitchen sinks were removed from the house. These included a sink in the stew stove room, below and between the two windows; a sink to the left of the large kitchen fireplace; and a sink under a window adjacent to the exterior door leading into the present toilet room area. The room where public toilets were installed had formerly been a Coolidge-era kitchen.

In addition to the sink located near the window, this kitchen included a cooking range connected to a chimney built where the present door leads to the historic kitchen. The chimney was removed above the first floor, but its base can still be seen in the cellar below. There is a slight depression in the ridge line in the area where this former chimney pierced the roof, perhaps reflecting some irregularity in the roof framing where the chimney passed through the roof, or possibly revealing some structural weakness that had developed from old leaks around the now-missing chimney.

4. All three coal-fired gravity warm air furnaces, shown on the DPWH drawings of 1954, were removed from the cellar of the house.

Three new Lennox oil-fired forced-hot-air furnaces were installed to replace the old coal-fired furnaces, together with appropriate supply and return ducting. The three new furnaces were installed in Room 12, Room 9, and Room 4.

The pit for the former coal furnace (Number 16 on the 1954 plan) remains in Area 15.

Existing plastered ceilings and walls were removed from Room 12 when the new Lennox furnace was installed here in 1966; former laundry set tubs were also removed from this area.

The breeching of the new Lennox furnace in Room 9 was connected through a crawl space to the same chimney flue that had served the old coal furnace (Number 2 on the plan) beyond Area 7.

The third Lennox oil-fired furnace was placed near the location of the former coal-fired furnace (Number 5 on the plan), below the Council Chamber. The former chimney on the exterior wall of the Council Chamber was removed, and the breeching of the new furnace was connected to a new eight-inch-square flue cut into the hallway side of the Council Chamber/Parlor chimney. One of the Miles heating/ventilating plans indicates that a mechanical draft inducer was installed on the breeching of this furnace to provide proper combustion.

The Miles drawings indicate the following changes to the roof areas of the building:

1. A new roof of “wooden” (apparently western red cedar) shingles was installed throughout the entire building, with the exception of the Council Chamber wing. There, an earlier roof of heavy, split “shakes,” probably installed during earlier repairs in 1959, was retained in place. The drawings do not provide details for installation of the new wood-

shingled roof, but inspections in the 1980s suggested that most of the shingles were installed over an impervious membrane of aluminum foil, perhaps intended as a barrier against heat loss. This roof was in failing condition by the late 1980s, and was replaced in 1991.

2. Perimeter rainwater gutters and leaders or downspouts were installed on the eaves around the entire building except for the Council Chamber wing, which apparently already had gutters as well as a relatively new roof of thick “shakes.” The new roof gutters were formed of copper, held by brass hardware, and flagstone splash blocks about 18 inches square were placed below the outlets of the leaders.

3. The ceiling over the heated apartment was insulated with fiberglass batt insulation measuring 3-7/8 inches deep and having an R13 insulating value. Descriptions of this insulation on the Miles drawings suggest that it is unfaced, with no vapor barrier. Inspection on August 27 revealed that the upper surface of the insulation is unfaced, and that electrical wires were run through the attic of the apartment across the top of the insulation and the ceiling joists.

4. A photograph by Douglas Armsden dated June, 1966, shows the chimney above the Council Chamber disassembled to the roof, and seems to indicate that the kitchen chimney had just been rebuilt. Prior photographs show these two principal chimneys covered with stucco or exterior rendering. It is therefore evident that the chimneys were rebuilt from the roof upward in the summer of 1966. As will be noted below, this rebuilding seems to have inaugurated a twenty-year period of chronic leakage and saturation of both stacks.

State Coastal Properties Project of 1983: In 1983, the New Hampshire Department of Resources and Economic Development obtained a grant from the Office of Coastal Zone Management to obtain studies and reports on several crucial coastal properties administered by DRED. These properties were the Wentworth-Coolidge Mansion, Leach’s and Clampit Islands, Fort Stark in New Castle, and Fort Dearborn at Odiorne’s Point State Park in Rye. The contract to research and prepare these reports was awarded to The Thoresen Group, planning consultants of Portsmouth.

The Thoresen report on the Wentworth-Coolidge property was the first attempt to summarize all that had been learned by 1983 about the site. While the Thoresen report did not address the physical condition and needs of the Wentworth-Coolidge Mansion in any depth, the report provided a summary of the history of the site which has proven to be of consistent value in all subsequent planning.

Changes Made in 1984: Federal funds became available late in 1983 through the “Emergency Jobs Act of 1983.” A total of $57,000--$28,500 in federal monies and $28,500 in non-federal matching funds contributed by the Wentworth-Coolidge Commission--was allocated to preservation work at the Wentworth-Coolidge Mansion, although this amount was later reduced by changes to the scope of work. Boston architect David McLaren Hart was employed as supervising architect for this work, and submitted an “Assessment of Needs and Outline Specifications for Repairs” in October, 1983.

Details of the design and execution of the "Jobs Bill" work are recorded in the file on "FY 1983 Jobs Bill Project 50723," available at the office of the New Hampshire Division of Historical Resources.

Work identified as necessary under this "Jobs Bill" funding included elimination of chronic leaks around chimneys through capping open chimney flues and repairing flashing and counter-flashing at the roof levels; repairs to eaves gutters and leaders; re-routing of selected rainwater drainage routes; laying of vapor barriers over most cellar floors; some roof repairs; and construction of a steel truss to support the summer beam above the Council Chamber.

The portions of this work that addressed moisture problems included:

1. Placement of blue sandstone caps over open (but inactive) chimney flues. Open flues were identified as the primary point of entry for water that apparently had kept the major chimneys saturated since the restoration of 1966.

2. Repair or replacement of flashing and counter-flashing at the juncture of chimney stacks and the wood-shingled roofs.

3. Replacement of warped and twisted saddle boards at the ridges with new preservative-treated saddle boards of eastern white pine. The Miles contract drawings of 1966 had specified that the saddle boards installed at that time were to be cypress. Architect Hart noted that he felt that it was "highly improbable" that cypress had actually been used in 1966.

Replacement of the saddle boards entailed temporary removal and replacement of lightning rods and cables.

4. Repair of damaged or defective copper eaves gutters and leaders, with provision of larger splash blocks beneath the feet of certain leaders where water threatened to pool around the foundation walls and find its way back into the cellars or crawl spaces.

5. Cleaning and reactivation of the drains in the areaway beside the dining room foundation. These drains had become clogged with silt and were inoperable.

During the course of the work, it was decided that these drains should be bypassed. In a note of January 31, 1984, to Judy S. Cummings of the New Hampshire Division of Parks and Recreation, architect Hart stated that the "subsurface drains have been cleaned by DRED staff. They will, however, be abandoned as they are inadequate. The drainage will be handled by rerouting the downspouts, capping subsurface drains, and regrading areas near the foundation."

6. Selective re-grading around the house to improve natural drainage.

7. Laying of a vapor barrier of 8-mil black polyethylene over the exposed dirt floors of the cellars beneath the historic portions of the mansion, with a covering of two inches of washed pea stone for protection of the plastic. This part of the contract was intended to seal chronic soil dampness and minimize condensation that had been observed in the cellars of the house.

8. Selective repointing of areas of the stone foundation walls and basement window areaway walls of the house.

The work outlined above was carried out during the summer of 1984. Other proposed work, including the insulation of long runs of hot-air ductwork beneath the house, was omitted.

As will be noted below, lack of maintenance since 1984 has caused the failure of changes made under Items 4 and 5, above.

Emergency Repairs and Historic Structure Report of 1987: In the spring of 1985, it became evident that water infiltration was continuing to a serious degree in and around the two main chimneys of the historic mansion. In addition, a leak was detected at the juncture between the roof of the Council Chamber wing and the adjacent wall of the separate frame that encloses the entry and stairhall.

An area of mildew growth, attributed to leakage at a cracked clapboard, had also been observed on the historic flocked wallpaper between two windows on the southeast wall of the Parlor.

Architect David M. Hart was called back to inspect these problems. Hart confirmed these leaks in a letter of April 22, 1985, to engineer Richard Antonia of the Department of Resources and Economic Development. In his letter, Hart noted that the cause of water infiltration around the two chimneys, which had recently been inspected and presumably repaired under the Jobs Bill funding of the previous summer, was inexplicable. Hart also stated that the leak at the juncture of the Council Chamber roof and the adjacent wall had been noted the previous summer above the door leading from the entry and stairhall into the Council Chamber. "At that point," Hart noted, "the project was out of funds," so investigation of the problem had had to be limited to a simple (and inconclusive) inspection by the contractor who was on the job in 1984.

Hart also inspected the area of mildew on the Parlor wallpaper with a moisture meter. He found moisture levels to be very low in the paper and underlying plaster. He therefore concluded that the growth of mildew had been caused by dampness that had resulted from condensation rather than from a water leak. He attributed this condensation to the effects of a jet of cold winter air entering through the cracked clapboard and a joint between the underlying sheathing boards; the resulting chilling of the plaster and wallpaper had evidently caused localized condensation of ambient water vapor in the air within the Parlor.

In March 1986, reacting to these problems, the Wentworth-Coolidge Commission prepared a grant proposal to the New Hampshire Coastal Program for funding to address two pressing concerns: 1. the need for further repairs to arrest ongoing water infiltration, especially around the chimneys and in the area around the Parlor and the "Governor's Bedchamber;" and 2. the need for a historic structure report to set standards and guide all future maintenance of the mansion.

In response to this application, the New Hampshire Office of State Planning (which administers the Coastal Program) provided the Department of Resources and Economic Development with a Coastal Zone Planning Grant of $15,000, to be matched with state funds of $3,750.

Only one complete proposal to provide these items was submitted in response to a request for proposals. McGinley Hart & Associates of Boston, the successor firm to David McLaren Hart & Associates, was awarded the contract to provide 1. emergency specifications for repairs to be undertaken during the winter of 1986-7, and 2. a full historic structure report on the Wentworth-Coolidge Mansion.

The emergency specifications addressed the following needed repairs:

1. Repair or replacement of 16-ounce lead-coated copper flashing around the two historic chimneys, around roof crickets, around roof scuttles or skylights, above window caps as needed, and at the juncture of intersecting roofs and walls.

2. Repair or replacement of clapboards in zones where leakage was known or suspected.

3. New gutters or leaders in selected areas.

4. New eastern white cedar shingles on the high shed roof above the Council Chamber chimney.

5. Painting of all new clapboards and exposed flashing.

The historic structure report that formed the major part of this contract was completed in February 1987. It included a management plan and generic specifications for all future work to be carried out on the house, as well as chapters dealing with the history and evolution of the property, existing conditions, and future needs.

Among the recommendations for long-term maintenance of the building were the statements that "the plastic sheeting should be checked periodically and when it deteriorates to the point where it is transmitting water vapor, replaced. The drainage system should be checked to ensure that roof water is being deflected away from the foundation."

Another recommendation of the McGinley Hart historic structure report concerned replacement of the wood shingle roof, parts of which presumably dated from 1959 and parts from 1966. As noted above, the shingles of the high, shed-roofed portion of the building were replaced under the emergency specifications that accompanied the historic structure report. Of the roof in general, the report said that "the wood shake roof (from 1959) above the Council Chamber wing . . . appears to be in deteriorated condition with shingles lifting. Their replacement should be considered in the near future." The remaining wooden shingles, installed in 1966 "are in poor condition and they should be replaced. Replacement should be smooth, No. 1 white cedar with proper exposure (5" or as determined by research)."

Of the chimneys, the report stated, "All chimneys were capped with stone and mortar in 1984. They continued to leak, and these in turn were replaced by metal caps in 1985. The newer metal caps have stopped the leaks."

The report enumerated other components of the building that required immediate or quick attention: failing paint, split clapboards, missing or damaged exterior window blinds, deteriorated door sills and window sashes, damp cellar window frames and sashes, and extensive decay in the below-grade portions of the Coolidge guest wing beyond the "billiard room." The report included an inspection and maintenance schedule for the house. For the benefit of present and future caretakers of the property, the McGinley-Hart inspection and maintenance schedule is reproduced as an Appendix to this report.

Repainting of 1988: During the summer of 1988 the Department of Resources and Economic Development employed McGinley Hart & Associates to develop specifications and oversee the job of repainting the exterior of the Wentworth-Coolidge Mansion according to the recommendations the firm had made in the historic structure report of 1987. During the course of this work, some clapboard and other carpentry repairs were made by the Design, Development & Maintenance crews of DRED.

During the course of re-painting, the exterior door that opened on the lower entry outside the Council Chamber was stripped of its accumulated paint, apparently without the express approval of the architect, DRED, or the Division of Historical Resources. The accumulated paint was found to have contributed much to the rigidity of the door. Loss of the paint left the door in a weakened and flexible condition and revealed that periodic re-fitting of the door to its increasingly out-of-square opening had caused so much cutting of top and bottom rails that the tenons were exposed. After much study and consideration, it was decided to replace the original door with a replica designed by the Division of Historical Resources and made by Robert Adam, a faculty member at the North Bennett Street School in Boston. The original door was placed in the house as an exhibit.

During the course of repainting, the paneled exterior window blinds of the house were repaired sufficiently to be re-hung for cosmetic effect, with the knowledge that many were in failing condition and would require eventual replacement. Most of the blinds were found to be twentieth-century reproductions, but their unusual raised-panel design conforms to that seen in the oldest photographs of the house, dating from the 1880s. Since the design is characteristic of eighteenth-century paneling, it is assumed that blinds of this design have been hung on the house since 1800 or earlier.

Re-roofing of 1991: The entire roof covering of the Wentworth-Coolidge Mansion was replaced in 1991 in keeping with the recommendations of the historic structure report of 1987. The re-roofing project was administered by the Design, Development & Maintenance bureau of the Department of Resources and Economic Development. The new roof covering was western red cedar shingles, and these shingles were applied over a system of wooden strapping designed by Thomas Mansfield, architect of DD&M, in consultation with the Division of Historical Resources. This raised roofing system was designed to ensure good ventilation beneath the shingles in the belief that such air circulation would extend shingle life beyond the twenty-five year limit seen on the former roof. All impervious coverings on the roof sheathing boards were to be removed before application of the strapping and shingles to permit air to move between the attics and the voids under the shingles, although strips of Bituthene ice and water shield, an impervious, self-adhering rubberized membrane, were applied at raking eaves, horizontal eaves, and valleys.

In addition, the new shingles were dipped in a red preservative stain before application. This process had a twofold purpose. First, it was intended to duplicate the red color seen on eighteenth-century shingles that still adhere to the rear slope of the roof of the kitchen portion of the house, protected under a roof that connects that part of the house with the adjacent dining room section. Second, the preservative stain was intended to render the shingles less susceptible to damage from dampness and from the effects of ultraviolet light, and thereby to extend their life.

New Septic System, 1995: In 1994, Matt Moore of the Bureau of Public Works of the Department of Transportation designed a septic system that would serve both the house and the soon-to-be-created Coolidge Center in the former Barn/Garage. Replacing the 1000-gallon septic tank of 1966, which is located northeast of the tenant's apartment, this new system is located southwest of the house in an open field that was tested archaeologically prior to excavation. The new system includes a 2000-gallon tank located near the house; this receives effluent from both the house and the Coolidge Center to the west. Because the tank is located below the level of the chambered leaching bed, a pump station is located between the tank and the bed to lift effluent to the latter.

Placement of the new septic tank on the opposite side of the house from the tank of 1966 necessitated the re-routing of drains in the basement of the house. The new primary exit sewer line extends through a former cistern in the basement (Area 8 on the basement floor plan) and pierces the southwest foundation wall to connect to the new tank.

Creation of the new leaching bed above existing grade necessitated the building of a mound of soil southwest of the house and the alteration of surface contours almost to the water's edge. As noted earlier, flooding of the cellar in Areas 8 and 9 during the winter of 1995-6 was initially attributed to this change of grade near the house.

II. Current Moisture Problems at the Wentworth-Coolidge Mansion and Suggested Treatments

The following detrimental conditions were noted during the inspection of August 27, 1996:

1. Water and dampness remain in the former kitchen cistern, now Room 8 on the attached plan.

The floor of this room retains a small amount of standing water. Because this room was a former cistern (the door to the room is an opening cut through the cistern wall), it is to be expected that the floor of the space is water-tight. The water seen here in August is probably a residue from the flooded conditions that occurred throughout Rooms 8, 9, and 11 when an outside catch basin and drain became clogged during the winter of 1995-6. More water entered this room during the heavy rains of October 19 and 20, 1996. Tom Mattson theorizes that this water penetrated the stone foundation walls above the parged sides of the brick cistern, and then ran down the inside walls of the cistern to become trapped on the cistern floor.

Areas adjacent to Room 8 have generally dried out well, although some damp soil is evident adjacent to the cistern wall. Room 8, however, is an unventilated space with waterproof construction and no movement of air. If the room does not dry out during the winter, it would therefore be worthwhile to leave the exterior door to Room 11 open during dry spring days, and to place a large box fan in Room 8 on such a way as to keep the air in Room 8 agitated until the standing water has evaporated.

The same effect could be gained by use of a dehumidifier in this space, except that the refrigerating coils of dehumidifiers tend to become clogged with ice in cool basements. Icing reduces the efficiency of the dehumidifier and causes extra electrical consumption. Because of this tendency, and because the condensate from a dehumidifier needs to be emptied to conducted to a drain, a simple fan is often the better way to dry out a damp cellar area, providing the outside humidity is relatively low.

2. Outside catch basins and drains appear to be unmaintained.

It appears that no one understands the drainage system that carries water away from the roadways above the house and from the perimeter of the building.

There are several outfalls of vitrified clay pipe projecting through the stonework of the dry-laid seawalls below the house. Some of these pipes undoubtedly connect to drains close to the perimeter of the building. As noted above, the drains from the areaway outside the dining room were connected by cast iron piping to an existing drain on the opposite side of the building in 1966. The latter drain was described as running toward the channel parallel to the wall of the council chamber, but its exact route is uncertain. A cast iron drain passes through the crawl space next to Room 6 on the attached basement plan, and this may be assumed to be the drain that receives water from both sides of the dining room area.

Those responsible for maintenance of the house need to trace both these smaller perimeter drains around the building and also the storm sewers leading from the catch basins near the structure, especially the one that drains the courtyard outside the tenant's apartment; stoppage of the latter was largely responsible for damaging flooding last winter.

There was formerly a system of catch basins and storm sewers that drained the old driveway that approached the house from the end of Little Harbor Road, and some of this system was covered up during construction of the septic leaching field in 1995. It will be important to try to learn what was done with the old piping of this system when the leach field fill was placed. If earth was simply bulldozed over the catch basins, the storm sewers may have become filled with silt and this may have contributed to the stoppage of the lower catch basin near the house. Construction drawings for the new septic system make no reference to the existing drainage system.

Even though the greater amount of roof water from the southwest side of the house, near the dining room, has been carried away from the building by leaders since 1984, when architect Hart altered the 1966 drainage system, the areaway drains near the house, which are now clogged and covered with debris, must be cleaned and made operable. Even if the greater amount of roof water continues to be carried away from the areaway by leaders, a certain amount of rain water and snow melt collects in the areaway and needs to be conducted away from the house.

3. A storm sewer leading from the area of the upper parking lot was broken during laying of the sanitary sewer line from the Coolidge Center, and must be repaired.

A six-inch storm sewer line runs from a point a few feet south of the upper (public) parking lot in a general southeasterly direction toward the catch basin in the driveway near the grove of cedar trees. This line is intended to gather water from the upper driveway by way of the open end of the line, which is placed in a shallow pit (not a catch basin) near the upper parking lot. Other water is added from the catchment area in the lower driveway, near the cedar grove, by means of the catch basin there. From that point, the destination of the water is unknown, but the line is thought to discharge at an outfall in the sea wall east of a large red oak tree that stands not far from the house.

It is not known whether this storm sewer is connected with the catch basin in the courtyard outside the tenant's apartment, or with one or more now-buried catch basins that once drained the driveway that formerly connected with the end of Little Harbor Road at the Fardelmann House. As mentioned above, these basins appear simply to have been buried when the septic tank was installed in 1995, but excavations for the septic system may have removed some or all of the storm sewer line.

In 1995, a new sewer line was run southerly from the Coolidge Center to the new septic tank. The excavation for this line crossed the storm sewer that leads from the upper parking lot, and the excavator broke the storm sewer near the lower driveway. The line remains broken. Tom Mattson has marked the approximate point of the break with a wooden stake.

Mr. Mattson observed the effects of the heavy rains on October 19 and 20. During this storm (which dropped at least twelve inches of rain in Portsmouth), large quantities of rainwater ran toward the house from all sides of the natural basin that surrounds the building on the north and west sides. Because of the broken and clogged storm sewer just described, little of the water from the upper parking lot and driveway was discharged properly. Instead, large rivulets ran along the gravel driveway, rutting the road surface deeply in some areas. Due to lack of catch basins or water bars in most parts of the driveway, much of the accumulated water ran toward the house and penetrated the cellar walls on the vicinity of Room 8, the former kitchen cistern, adding to water that had stood there all summer and was noted on August 27.

What water did enter the storm sewer near the upper parking lot evidently forced itself out of the ground at the break in the line due to the considerable hydrostatic pressure in the line.

It is important to repair the break in this storm sewer as soon as possible.

It is also important to trace the routes of all storm sewers that collect water above the house or near the house, and to know which storm sewer outfalls are active. If no other means are available, this tracing may have to be done with water hoses and vegetable dyes. After the system is traced, a plan should be made for future reference. The entire storm sewer system needs to be maintained and flushed periodically to prevent its silting up.

4. The gutters of the house need repair, followed by regular inspection and maintenance.

Our inspection noted two areas of failure of the gutters, both associated with the expansion joints built into the system of copper guttering in 1966.

The first area of failure has occurred on the northwest wall of the old kitchen. Here, water clearly leaks through the expansion joint in times of heavy rain and cascades down the face of the clapboards. The visible result has been the rapid failure of the exterior paint in a vertical band below the leak. Invisible results may be leaks around windows or behind clapboards, damage to the sills of the house, and general saturation of the foundation area below the leak.

The second area of leakage occurs at the expansion joint near the center of the gutter over the southwest wall of the dining room. This leak releases water above a window--the most dangerous area for concentrated water flow over an exterior wall. The entire gutter and leader system of this area is in damaged condition, and is creating several other problems (see below).

Architect Miles' plans of 1966 show a total of six expansion joints in the guttering system of the house that was installed in 1966. These drawings do not indicate guttering for the council chamber wing, since that zone had been re-roofed earlier.

Expansion joints in metal gutters are intended to be placed at the highest points of the gutters; the gutters slope away from the joints toward leaders that conduct the water to the ground. If the slope of the gutters has been altered over the years, from whatever cause, or if the leader heads have become clogged with debris, water may back up at the joints and leaks will result. This has happened on at least two of the expansion joints on the house, and the others should be checked during heavy rain storms. All gutters should be checked once or twice a season for debris, and proper water flow should be maintained. Particular attention should be paid to the expansion joints. Failure to keep the guttering system in proper operation will result in the kinds of damage now being seen on the exterior house paint in at least two areas of leakage.

As mentioned above, the gutter and leader system on the southwest side of the house, adjacent to the dining room, has other problems. This system was reconfigured in 1984 when it was found that the floor drains of the concrete areaway were inadequate to handle the great volume of roof water that was delivered to the areaway from the three major roof surfaces that drain toward this part of the house.

The first problem is that two leaders, one attached to the gutter at the rear slope of the kitchen roof and the second attached to the gutter over the dining room, have become detached at a point halfway up the wall. Thus, all the water from these roofs drops into the areaway, where the floor drains are clogged. These broken leaders must be repaired immediately.

The second problem is that there appears to be leakage at the end cap of the gutter above the dining room. This appears to throw water against the adjacent projecting side wall of the parlor wing.

The third problem is that the horizontal run of the rainwater leader adjacent to the rear wall of the kitchen has dropped, and now slants backward toward the house. Thus, even if the broken leaders above were still properly connected, roof water would not drain away from the building.

5. There are symptoms of excess humidity and condensation in the tenant's apartment.

Problems in the tenant's apartment include excessively high wintertime humidification, insufficient exhausting of humid air during the winter, condensation on single-glazed windows, and excessive heat loss through the roof, leading to ice dams and water infiltration.

The most obvious symptom of these problems is excessive paint failure on the outside wall adjacent to the bathroom and the cellar stairhall. This paint loss appears to be caused by a combination of condensation of water vapor in the wall cavity in this location, and water infiltration into the wall cavity, caused by ice dams above this particular area.

Paint loss in a concentrated zone is often symptomatic of excessive interior moisture that penetrates the inside wall plaster and then condenses within the cold wall cavity, causing saturation of the sheathing and clapboards. Unless protected by impervious water vapor retarders on the warm sides of their walls, kitchens and bathrooms are typically the areas where such condensation is most extreme.

The bathroom of the tenant's apartment, which contains a bath tub and shower, is ventilated by a fan. The motor of this fan appears adequate, but very little air is exhausted from the room. This appears to be due to the fact that the pleated vent conduit from the fan is bent at an extreme curve rather than leading from the fan to the exterior vent in a direct line. This conduit should be straightened.

The problem is exacerbated by the fact that the forced-hot-air furnace serving the tenant's apartment is equipped with an automatic humidifier inserted in its plenum, and this is controlled by a humidistat upstairs. Thus, extreme levels of humidity may be maintained in the apartment with no effort. The amount of rusting now seen around the humidifier suggests that the level of humidity in the apartment has been kept relatively high. In addition to inadequate removal of water vapor from the bathroom, this general humidification of the apartment has certainly been conducive to condensation within the wall cavity, and almost certainly within the unventilated attic as well.

The windows on the southwest side of the apartment have no had storm windows. They have consequently suffered from excessive condensation on their cold glass. Despite the paint loss that has resulted from this chronic wetness in the wintertime, the sashes appear to be sound.

Installation of exterior storm windows should cut down condensation on the wooden sashes. Because this apartment is screened from public view, the storm windows will not be noticeable and may be triple-track aluminum units.

As noted above, the tenant's apartment suffers from ice dams during snowy winters. Ice dams occur when heat escapes through the roof membrane and melts snow adjacent to the shingles. When the meltwater reaches the colder eaves of the house, it re-freezes. If the house has gutters, these typically fill with ice first, and then the accumulated ice begins to encroach on the roof forming a frozen mound or dam. As more meltwater reaches the dam, it backs up and eventually works its way beneath the shingles, causing a leak within the wall cavity or within the rooms.

There is evidence that ice damming has been pronounced above the cellar stairhall, adjacent to the bathroom. The excessive heat that rises in this stairwell from the furnace below probably creates a zone of concentrated heat loss in this area, worsening ice dams here. The fact that the chimney exits the roof near the ridge in this area probably adds to the melting of snow in this zone.

The final result of excessive humidity in the bathroom and ice damming above the cellar stairs has been concentrated dampness in the wall in this area, followed by the worst failure of paint to be seen anywhere on the building.

There are three ways to reduce the hazard of ice damming. The first, the installation of an ice and water barrier at the eaves of a roof, was taken when the Wentworth-Coolidge Mansion was re-shingled in 1991.

The second means of reducing the hazard is through increasing the insulation in the floor of the attic. This both retains more heat in the living apartments below, lowering fuel bills, and reduces heat loss through the roof membrane, cutting down on melting of snow on the roof.

As noted earlier, the fiberglass batt insulation that was installed above the ceilings of the apartment in 1966 was specified to be about four inches deep, with an R value of 13. Today, it is generally recommended that a heated living area have attic insulation with an R value of about 30, corresponding to about ten inches of fiberglass insulation. Thus, the ceiling above the apartment could benefit from having about six additional inches of fiberglass insulation placed over the present material.

Because no vapor barrier--a coating of aluminum foil or Kraft paper-- was specified in 1966, it may be assumed that none is present in the ceiling above the apartment. A vapor barrier, if employed, should be placed against the upper surface of the ceiling, or against the warm side of the total thickness of insulation. Proper installation of a vapor barrier above the apartment would therefore entail removing all the fiberglass batts installed in 1966, followed by installation of sheets of polyethylene of aluminum foil. The labor costs entailed in doing this would be high. The difficulty of doing this job would be compounded by the fact that new wiring was laid over the tops of the joists and the insulating blanket in 1966.

Thus, it is prudent to leave the existing batts in place. New insulating batts up to six inches thick should be laid over the existing material in such a way that they could be folded back if it became necessary to expose the electric wires. Access to various parts of the attic is possible through small board-and-batten doors in the gables of the intersecting roofs of the apartment wing.

Because there is a danger that water vapor from the apartment may find its way into the attic even with reduced general humidification and better ventilation of the bathroom, the attic spaces should be ventilated above the insulating blanket. Ventilation serves two purposes; first, it carries off water vapor before it can condense as frost over the roof framing, and, second, it helps to keep the roof surface sufficiently cold that snow will not melt and form ice dams. In the summertime, of course, attic ventilation allows excess heat to escape and reduces warming of the rooms below. The temperature in a sealed attic can easily exceed 115 degrees F. on a sunny summer day.

As noted above, each gable of the intersecting roofs of the apartment wing has an access door. As designed, each door is solidly made of tongued-and-grooved matched boarding. Thus, these doors currently offer little ventilation of their respective attic areas. As an added safeguard against ice dams, then, these doors ought to be fitted with louvered and screened openings, or else the doors themselves ought to be replaced by new wooden doors with integral louvers. Architect Edward Benton Miles specified in 1966 that the board-and-batten door above the apartment living room be replaced by a wooden louver, but allowed all the other doors to remain in place. With enhanced attic insulation, it would be beneficial to provide for ventilation at *all* such doors.

6. Rapid exterior paint failure on the historic sections of the house suggests excessive internal moisture.

A professionally applied paint job, done in 1988 by the Commercial Painting Company of Portsmouth under the supervision of Wendall Kalsow of McGinley Hart & Associates, began to fail noticeably by 1993. Although the painters had been required to use the best grade of Sherwin Williams exterior house paints, the job showed noticeable peeling, cracking and chalking. Some of this failure appeared on the south side of the house and was attributed, in part, to the effects of sunlight. Some failure appeared elsewhere, and appeared to be caused by moisture.

As noted above, excessive moisture was noted in the cellars of the house in 1984. An attempt was made at that time to correct the problem by improving drainage of roof water and by laying 8-mil black polyethylene sheets across all cellar floors to seal down dampness in the soil. In general, these simple methods appear to have reduced or eliminated condensation in cellar areas and to have made the house much dryer.

As noted previously, however, architect David Hart attributed a spot of mildew that was damaging the wallpaper in the parlor in 1985 to condensation of ambient moisture in the parlor caused by an unusually cold spot on the wall; this cold spot, in turn, was thought to have been caused by a jet of cold air entering through cracks in a split clapboard and underlying sheathing boards.

Such condensation on a cold plastered surface suggests a comparable level of condensation on the cold surfaces within the wall cavity. The accumulation of frost in the wall cavity would result in damp conditions during the spring months when the frost melted. Thus, in turn, could contribute to outward migration of water that would hasten the failure of paint on the clapboards.

A professional consultant has found through study of comparable problems in the Pierce Homestead in Hillsborough that cellar moisture constantly emanates upward through the first and even the second story of that house, in large part determining the climatic conditions in the entire building. Although the Pierce house is much smaller than the Wentworth-Coolidge Mansion, it too has suffered from chronic paint failure and excessive condensation in the cellar, leading, as at the Wentworth-Coolidge Mansion, to some decay of the first floor framing. As at the Wentworth-Coolidge Mansion, the cellar floor of the

Pierce House has been covered with black polyethylene. As at the Mansion, the application of this vapor barrier caused a marked improvement in the apparent conditions throughout the cellar and the entire building.

Apparent conditions, however, can be deceiving. Initial moisture measurements in the Pierce House during the summer of 1996 showed very high relative humidity readings throughout the structure. It may be surmised that in the wintertime the accumulated moisture held within the fabric of such a building, and within its contents, will migrate forcefully toward the dry outside air, contributing to paint failure.

Until a corresponding architectural conservator's report is in hand, and until atmospheric conditions in the Pierce House have been monitored for at least a full year, no recommendations will be made for the management of moisture in the building. Similarly, it would be prudent to examine the root causes of paint failure on the Wentworth-Coolidge Mansion through employment of conservators, or at least through collection of accurate data on temperature and relative humidity at various points throughout the building over a period of at least a year. After data are in hand and have been interpreted, it may be possible to control internal moisture in the house in a way that will be beneficial to the interior surfaces, to the collections, and to the exterior paint.

In the meantime, it will be necessary to re-paint the Wentworth-Coolidge Mansion soon, especially in areas of severe paint loss caused by the gutter leaks, ice dams, and excessive condensation described above.

7. The heating system of the house has partly failed.

As noted earlier, restoration in 1966 included the installation of three Lennox oil-fired forced-hot-air furnaces in the house.

One of these, serving the tenant's apartment, continues in service.

The second, serving the northwesterly end of the house, was apparently replaced in 1992. Its burner motor was replaced in 1996 due to the basement flooding mentioned previously.

The third furnace, under the Council Chamber, is in failing condition. Its inspection port, above the oil burner, has rusted and blown off the furnace, probably because of a small explosion caused by delayed ignition of the fuel at some time. The breeching is in suspect condition. A major trunk line of the delivery ducting, serving the billiard room and the Coolidge guest apartment beyond, has fallen from its attachments and broken off the main supply duct near the plenum. The stub of the broken duct has been plugged with fiberglass insulation to keep heat from being wasted in the basement. This situation has caused an imbalance between the volume of return air returned to the furnace and the volume supplied to various parts of the house. The oil burner is therefore no longer sized properly for the heating load placed upon it. For these reasons, no attempt should be made to use this furnace or to warm this part of the building until the heating unit has been repaired or replaced.

8. The house has a history of chronic, hidden leaks in its exterior skin.

As mentioned above, architect David Hart commented on a previously-undiscovered leak at the juncture of wall and roof between the Council Chamber wing and the adjacent stairhall entry in the spring of 1985. This leak had continued for many years, perhaps being repaired from time to time and then recurring, before it was discovered during repairs in 1984. The wall above the door between the entry and the Council Chamber was opened up during cosmetic repainting in the entry in the spring of 1989, after the source of the leak had been traced to a window opening in the small bathroom above the entry. At that time, James Garvin of the Division of Historical Resources studied structural damage that had occurred slowly within the wall. Garvin found that decay of a diagonal brace, wall studs, and a girt had resulted in nearly total destruction of these members over the years. Fortunately, the destroyed wooden members are not subjected to high stresses, and the Council Chamber wing has its own, independent frame. Thus, it appears that little structural weakening occurred because of this chronic leak, but the full extent of damage has never been assessed. The window above the leak has been boarded up to exclude rain from the window's frame, where the water presumably entered the wall cavity. This, of course, is not a proper long-term solution to the problem.

Similarly, an area of decayed clapboards was noted about 1993 by Wentworth-Coolidge Commission Vice Chair Alanson Sturgis. The area of decay was approximately at the second floor level above basement Room 7 on the accompanying plan. Upon removing these clapboards, the contractor discovered that a chronic leak around a second-story window had allowed water to damage the girt at this location and had caused some brown rot decay in the eighteenth-century sheathing boards beneath the clapboards. The damaged clapboards dated from the restoration of 1966, but it is likely that these clapboards had been placed over already-damaged sheathing and that the leak had been progressing slowly over many years.

Discoveries like these suggest that many other areas of the house may have ongoing problems of water infiltration, or else old leaks that caused damage that has never been detected and repaired.

Attached to this report are selected photographs taken by Kittery Point photographer Douglas Armsden during the restoration of 1966. These photographs reveal some extensive repairs that were necessary at that time, and forcefully indicate the dangers of deferred maintenance.

III. Summary of Recommendations given above for correcting water-related problems at the Wentworth-Coolidge Mansion:

1. Ventilate or dehumidify the old kitchen cistern (Room 8 on the basement plan).

2. Trace the routes of storm sewers outside the house and be sure that all drains flow properly.

3. Clean the drains in the areaway adjacent to the dining room and ensure their proper operation.

4. Repair the broken storm sewer line near the lower driveway and be sure the line is clear to its outfall.

5. Clean eaves gutters and leaders.

6. Correct leaks at expansion joints or end caps of eaves gutters.

7. Repair the broken leader system on the southwest side of the house, adjacent to the dining room, being sure that the feet of the leaders are sloped to carry roof water away from the house.

8. Adjust the humidifier in the plenum of the furnace in the tenant's apartment for minimum humidification, or disconnect the humidifier completely.

9. Install storm windows in the tenant's apartment, if not already done.

10. Straighten the exhaust duct from the bathroom of the tenant's apartment and test to ensure good air flow to the outlet.

11. Add a six-inch layer of unfaced fiberglass roll or batt insulation in the attics of the tenant's apartment, above the existing fiberglass insulation.

12. Install screened wooden louvers in the existing attic gable doors, or replace the doors with new wooden doors having integral louvers backed with fly screening.

13. Replace the defective forced-hot-air furnace under the Council Chamber wing and repair the fallen and damaged ductwork in this area.

14. Evaluate the forced-hot-air furnace in the tenant's apartment for efficiency; replace with a new furnace if the old one is found to be in failing condition.

Appendix 1
Photographs Taken By Douglas Armsden
During the Restoration of 1966

(The following photograph dates before the restoration of 1966.
All subsequent photographs were taken in June, 1966.)

Appendix 2
Inspection and Maintenance Schedule for the Wentworth-Coolidge Mansion
as suggested in
McGinley Hart & Associates
WENTWORTH-COOLIDGE MANSION
HISTORIC STRUCTURE REPORT
February 25, 1987

Item	**Procedure**	**Frequency**
Foundation, exterior, interior	Inspect for deteriorated mortar	Yearly
Basement floor plastic sheet	Inspect for damp rising	Yearly, in summer
Roofing	Inspect for leaks and deterioration	Spring and fall
Drainage system, downspouts	Inspect for broken gutters, joints downspouts, missing splash blocks; clean out debris	During rainstorms; spring and fall
Structural system	Inspect for new plaster cracks (1/4” or greater), separation of moldings, deflection of walls	Yearly
Chimneys	Inspect for interior leakage; Inspect for exterior deterioration of mortar	During rainstorms; yearly
Fire, intrusion alarm	Monitor controls	Yearly by alarm maintenance company
Sidewalls: paint	Inspect for peeling, loose, flaking paint	Yearly, spring
Sidewalls: wooden siding, trim	Inspect for loose clapboards, trim, missing pieces	Yearly, spring
Windows	Inspect for leaks, loose members	Yearly, spring
Doors	Inspect for leaks, looseness, operation; locks	Every six months
Plumbing	Inspect for leaks, corrosion; drain during winter periods of disuse	Spring and fall

Item	Procedure	Frequency
Heating	Inspect heating units, flues, ducts, fuel tanks	Yearly by heating contractor