Final Report

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BACKGROUND INFORMATION

The Pleasant Point Reservation is located in Franklin, Hancock, Penobscot, Somerset, and Washington counties in Eastern Maine. The region is part of an ecologically important east-west migratory flyway. The Reservation is located near the mouth of the St. Croix River on the Atlantic Ocean in an area covered with lakes, coniferous and hardwood forests, and vast wetlands. The average annual precipitation is 44.08 inches. The average annual snowfall is 70.7 inches. The average maximum temperature is 86.9°F and the average minimum temperature is 35.8°F. Approximately 1,884 Native Americans reside on the Pleasant Point Reservation. The housing authority maintains 175 homes for the Tribe including Low Rent, Municipal, and Yomkyo II units.

The assessment team responded to a request from the Passamaquoddy Tribal Council (PTC) at the University of Illinois at Urbana-Champaign and Paul Knott from Magna Systems, Inc. to conduct a site visit at the Pleasant Point Passamaquoddy Reservation Housing Authority (PPPRAA) on July 30, 2003. The PPPRAA administers the housing programs for the Pleasant Point Passamaquoddy Indian Tribe. The assessment team provided technical assistance to the housing authority in assessing mold and moisture conditions in housing units. This report summarizes activities and issues addressed while on site. A detailed analysis of findings and recommendations is found in PART II: Pleasant Point Passamaquoddy Reservation Housing Authority Technical Housing Assessment Report: Examining Mold and Moisture Conditions of Homes on the Pleasant Point Reservation.
PART I

PLEASANT POINT PASSAMAQUODDY RESERVATION HOUSING AUTHORITY TRIP REPORT

INTRODUCTION

Anthony Corso from the Building Research Council (BRC) at the University of Illinois Urbana-Champaign and Paul Knight from Magna Systems, Inc. conducted a site visit at the Pleasant Point Passamaquoddy Reservation Housing Authority (PPPRHA) on July 30, 2003. The PPPRHA administers the housing programs for the Pleasant Point Passamaquoddy Indian Tribe. The assessment team provided technical assistance to the housing authority in assessing mold and moisture conditions in housing units. This report summarizes activities and issues addressed while on site. A detailed analysis of findings and recommendations is found in PART II: Pleasant Point Passamaquoddy Reservation Housing Authority Technical Housing Assessment Report: Examining Mold and Moisture Conditions of Homes on the Pleasant Point Reservation.

BACKGROUND INFORMATION

The Pleasant Point Reservation is located in Franklin, Hancock, Penobscot, Somerset, and Washington counties in Eastern Maine. The region is part of an ecologically important east coast migratory flyway. The Reservation is located near the mouth of the St. Croix River on the Atlantic Ocean in an area covered with lakes, coniferous and hardwood forests, and vast wetlands. The average annual precipitation is 44.34 inches. The average annual snowfall is 70.7 inches. The average maximum temperature is 54.9°F and the average minimum temperature is 35.8°F. Approximately 1184 Native Americans reside on the Pleasant Point Reservation. The housing authority maintains 172 homes for the Tribe including Low Rent, Mutual Help, and Turnkey III units.

The assessment team responded to a request from the Eastern/Woodlands Office of Native American Programs to assess site and housing conditions contributing to mold and moisture problems at the Pleasant Point Reservation. Four homes were visited including three Home Ownership units and one Low Rent unit. The four homes investigated included four and five bedroom dwellings. Three homes were built with basements and one home was built with a slab-on-grade. The primary source of heat in the homes was a fuel oil hydronic system with baseboard convectors. Occasionally a wood stove was used as for supplemental heating. The units visited ranged in age from 22 years old to approximately 31 years old.

Day 1: Wednesday, July 30, 2003

The assessment team arrived at the PPPRHA Office on the Pleasant Point Reservation, Maine on Wednesday afternoon. The team met with Clayton Cleaves, Executive Director
for the PPPRHA, to discuss the afternoon’s activities, outline the team’s role while on the reservation, and address the housing authority’s concerns regarding the site visit. Also in attendance were Elton Jones and Jerry Milstein from the Eastern/Woodlands ONAP Office in Chicago. Following the meeting at the PPPRHA, the assessment team, Clayton Cleaves, Elton Jones, and Jerry Milstein met with Melvin Frances Sr., Tribal Governor, and Melvin Frances Jr., PPPRHA Housing Coordinator, at the Tribal Center. Melvin Frances Sr. outlined the problems with air, water, and snow infiltration, radon, and construction defects in the housing at the Pleasant Point Reservation. Following the discussion at the Tribal Center, the assessment team accompanied by Elton Jones, Jerry Milstein, Melvin Frances Jr. and Melvin Frances Jr. inspected three Home Ownership units and one Low Rent unit.

Digital photographs were taken to record conditions in all four homes. The inspection process also involved visual assessments of both interior and exterior conditions and measurements pertaining to exhaust fan air-flow and discussions with available residents. PART II: Pleasant Point Passamaquoddy Reservation Housing Authority Technical Housing Assessment Report: Examining Mold and Moisture Conditions of Homes on the Pleasant Point Reservation provides a detailed analysis of findings and recommendations for the homes investigated on the Reservation.

FINDINGS

An overview of findings and recommendations for the site visit follows. PART II: Pleasant Point Passamaquoddy Reservation Housing Authority Technical Housing Assessment Report provides a more detailed discussion and analysis of the findings.

Pleasant Point Reservation

Principal findings from the site inspections include:

1. Poor attic insulation
   - Batt insulation was poorly installed in all four attics.
   - Insulation was missing in sections and compressed over top plates.
   - Numerous attic bypasses were found.
   - Poor attic insulation is believed to be a major cause of ceiling mold and ice dam problems reported by PPPRHA.

2. Attic ventilation would be a non-issue if the insulation and bypass problems are solved.

3. Bathroom exhaust fans were in poor condition or were never installed.
• One home did not have bathroom fans.
• Existing bathroom fans performed poorly, if at all.
• Some bathroom fans vented to the attic.

4. Site drainage was poor.
• All four homes had site drainage problems (site grading identified as flat or sloping towards the house and/or having depressions along the foundation walls). The sites have had hydrostatic pressure problems due to the high clay content in the soil.
• None of the homes had complete roof rainwater drainage systems (gutters, downspouts, leaders, and splashblocks).

5. General Maintenance and Plumbing Problems
• One home had a significant soot problem.
• Brick veneer homes were built without weep holes.
• Three homes had plumbing leaks and/or water damage from previous leaks.
• The mechanical systems of many homes had neglected maintenance issues.

6. Homeowner/Tenant Education
• Many tenants did not understand the functions and controls of their homes’ mechanical systems and were not familiar with the required maintenance.

PROGRAMMATIC RECOMMENDATIONS

A particular challenge to all housing authorities is the development of a prompt and effective service delivery system to address mold and moisture conditions. This requires a partnership between the housing authority and residents. A system could be established that includes training for the maintenance staff on how to implement the technical recommendations and training for residents on their roles and responsibilities as homeowners and tenants. In many cases, moisture problems develop, but go unreported and unrepaired, which may result in significant mold contamination that could have been avoided. Some strategies to address this problem include:
1. Mandatory attendance at annual homeowner/tenant clinics as part of the annual recertification process. At these clinics, provide instruction on home maintenance issues, such as identifying and repairing leaks and maintaining gutters.

2. During the annual recertification process, ask occupants to complete a survey based on Housing Quality Standards (HQS) with additional questions on mold and moisture conditions in their homes. Completing the survey further engages residents in their own home maintenance. Furthermore, the survey responses provide additional information to the housing authority on unreported problems, especially leaks and inoperable fans that might contribute to an unsafe, unhealthy home environment.
PART II

PLEASANT POINT PASSAMAQUODDY RESERVATION HOUSING AUTHORITY

TECHNICAL HOUSING ASSESSMENT REPORT:

EXAMINING MOLD AND MOISTURE CONDITIONS IN HOMES OF THE MILLE LACS RESERVATION

Executive Summary

Introduction

Section 1: Methodology

Section 2: Pleasant Point Passamaquoddy Reservation Housing Authority Housing Types

Section 3: Findings

Section 4: Technical Discussion and Recommendations

Section 5: Discussion of Common Problems

Appendix A: Housing Survey Summary Site Visit Report

Appendix B: Housing Assessment Results
EXECUTIVE SUMMARY

Four homes were inspected for mold and moisture problems for the Pleasant Point Passamaquoddy Reservation Housing Authority (PPPRHA) that administers the housing program for the Pleasant Point Passamaquoddy Indian Tribe. The investigation was conducted on July 30th by Paul Knight (Magna Systems) and Anthony Corso (Building Research Council). The inspection process involved visual assessment of both interior and exterior conditions, air flow measurement of bathroom exhaust fans and resident interviews where possible.

All four inspected homes were stick-built. Two homes had brick veneer with no weep holes. The homes had oil-fired hot water systems. The boilers also provided domestic hot water in some of the homes. Heat recovery ventilators (HRV’s) were found in two of the homes. Both systems were turned-off and appeared to be in need of servicing.

Mold was found in three of the four homes. Mold had just been remediated in the fourth home.

All the inspected homes had significant attic insulation problems. The condition of the attic insulation is believed to be a major cause of the ceiling mold and ice dam problems reported by PPPRHA. Gable and some soffit vents had been covered with plywood to keep wind driven rain and snow from getting into the attics. These covered vents are not considered to be a major issue with the conditions found in the attics and in the homes.

All six homes had site drainage problems. None of the homes had gutter systems. Gutters had been tried in the past by PPPRHA but have been unsuccessful due to ice dam problems and high winds common to this coastal area.

One of the four homes had a severe sooting problem on the ceiling of the lower level.

Principal findings include:

1. Attic insulation was poor in all four attics. Batt insulation was poorly installed, missing in sections and compressed over top plates. Numerous attic bypasses were found. Poor attic insulation is believed to be a major cause of ceiling mold and ice dam problems reported by PPPRHA.

2. Attic ventilation would be a non-issue if the insulation and bypass problems are solved.

3. One home did not have bathroom fans. The remaining homes had bathroom fans which performed poorly or not at all. Some bathroom fans vented to the outside; others vented into the attic or floor cavity. Two kitchen fans vented to the outside, one vented into the attic and the fourth was a recirculating fan.
4. Site drainage was poor at all the homes. Gutter systems are not used on the homes.

5. One home had a significant soot problem. Soot stains were found in similar housing stock at the Indian Township Passamaquoddy Housing Authority where homes are also heated by oil-fired boilers. Soot stains may also occur in other PPPRA homes.

6. The brick veneer homes were built without weep holes. Mold problems on the interior surfaces of the walls had been reported in these homes.

7. Occupant lifestyles may be contributing to the moisture and soot problems.

The report provides technical recommendations and discussions focusing on these items. Appendix A includes a summary of findings at each inspected home. Appendix B provides observations and recommendations for each home.
INTRODUCTION

The Building Research Council (BRC) responded to a request from the Eastern/Woodlands Office of Native American Programs to assess site and structural conditions contributing to mold and moisture problems in the Pleasant Point Passamaquoddy Reservation Housing Authority’s (PPPRHA) homes. The investigation was conducted on July 30th, 2003, by Paul Knight (Magna Systems) and Anthony Corso (Building Research Council). Melvin Frances Jr. of the PPPRHA escorted the inspection team. The Housing Authority pre-selected the homes for inspection.

The assessment team found mold in three of the four inspected homes.

All the homes had significant attic insulation problems. Batt insulation was poorly installed, missing in sections and compressed over top plates. Numerous attic bypasses were found. Gable and some soffit vents had been covered with plywood to keep wind driven rain and snow from getting into the attics. However, this was not considered to be a major problem.

Bathroom fans were not installed, performed poorly or did not work at all.

All four homes had site drainage problems. None of the homes had gutter systems. Occasional water leakage into the basements was reported in some of the homes.

One home had a severe sooting problem on the ceiling of the lower level.

SECTION 1 – METHODOLOGY

Visual inspection was used to assess mold and moisture conditions in the homes.

The results of the mold and moisture assessments were compiled on a spreadsheet, with broad categories of common moisture problems noted. This data is presented in Appendix A of this report. Findings and recommendations for individually inspected houses are presented in Appendix B.

Visual Inspection

Housing inspections consisted of visual assessment of mold and moisture conditions. Assessment forms developed for the Chicago Mold and Moisture Project (a HUD Healthy Homes Program) were used to record information. The assessment forms are organized for a room-by-room inspection. All rooms were examined for water damage and evidence of mold. Assessment of kitchens, bathrooms, basements, utility rooms and attics included additional inspection relating to plumbing, localized ventilation, water entry and other moisture source issues.

The exterior of the houses were inspected for rain water and snow melt management, including site grading, roof condition and gutter system.
Whenever possible, residents were interviewed to gather history on moisture problems, plumbing leaks, winter condensation, health issues, number of occupants and other useful information that could be offered.

Digital photographs were taken at each house to visually record notable conditions.

**Measurements**

Actual ventilation rates of bathroom fans were measured with an exhaust fan flow meter. The flow meter consists of a gasketed pan that is placed tightly over an operating exhaust fan. The pan has a variable orifice and a connection for a digital manometer. The manometer measures the pressure difference between the pan and the house during fan operation. Based on the setting of the variable orifice and the measured pressure difference at the fan, the cubic feet of air per minute (CFM) exhaust by the fan is calculated.

**SECTION 2 – HOUSE DESCRIPTIONS**

The Pleasant Point Reservation is located in Franklin, Hancock, Penobscot, Somerset, and Washington counties in Eastern Maine. The housing authority maintains 172 homes for the Tribe including Low Rent, Mutual Help, and Turnkey III units.

The four homes investigated included four and five bedroom dwellings. The units visited ranged in age from 22 years old to approximately 31 years old.

Four homes with three different designs were inspected. Two homes were single story ranches built over basements with a brick veneer exterior finish. One home was slab-on-grade, often referred to as the “chicken coop” design (Figure 1). The fourth home was two levels with the lower level half below grade. The lower level was finished as living space, including a “tuck-under” garage that had been converted to a bedroom.

The two brick veneer homes were 2” x 4” construction. The other two homes were 2” x 6” construction. R11 fiberglass batt insulation could be seen in one of the brick veneer sidewalls. The walls in the 2” x 6” homes could not be inspected and is assumed to be R19 fiberglass batts. Attics were insulated to R30 with fiberglass batts. The attics were originally vented with a combination soffit, gable and ridge vents. Many of the vents have been sealed with plywood.

![Figure 1 – “Chicken coop” built over slab-on-grade; note gable vents sealed with plywood](image)
Three homes were built over basements with poured concrete walls. Exposed basement walls were insulated with 1" polyisocyanurate (R7.2) (Figure 2). The "chicken coop" home was slab-on-grade. It was unclear whether the slab was insulated.

Homes were heated with oil-fired boilers with retention head burners and baseboard convectors (Figure 3). Some of the boilers also provided domestic hot water.

Two homes had heat recovery ventilators (HRVs) in the basements. Both HRVs appeared to be well over 10 years of age (Figure 4). Both systems were turned-off. Access panels for the filters could not be found. The intake and exhaust ducts to the outside were located in the same grille (Figure 5).

SECTION 3 – FINDINGS

3.1 Attic Insulation

R30 batt insulation was common in the attics. The condition of the attic insulation is believed to be a major cause of the ceiling mold and ice dam problems reported on the homes. Attic insulation installation was deficient in three areas. Two other problem areas, strapping and metal gusset plates, were found in one house and may also be present in other attics. These deficiencies are discussed here as they were found in modular housing at Indian Township and may be present in Pleasant Point homes.
3.1.1 General Poor Installation

In all cases, the attic insulation was poorly installed (Figure 6). Insulation was not uniform and numerous gaps between batts were found. Sections of ceilings were uninsulated (Figure 7). Insulation was compressed over the top plates to maintain a ventilation passageway from the soffit vents (compressed insulation has a significantly lower insulation efficiency).

3.1.2 Attic Bypasses

Bypasses are holes and gaps in the ceiling. Warm, moist air from the house can move up into the attic through these holes, thus "bypassing" the insulation. Besides wasting energy, bypasses can cause moisture to condense on the underside of the roof sheathing and can cause ice dams.

Any hole or gap in the ceiling is a bypass. Common bypasses found in the Pleasant Point homes include chimneys (Figures 8 & 9), plumbing stacks, wiring penetrations, fan housings and junction boxes. Bypasses should be sealed with a solid material such as expanding foam or scrap plywood or gypsum board (see section 4.1.2 Sealing Bypasses). Insulation does not seal a bypass or stop air flow. The insulation simply filters the air as it moves through it. In fact, dirty insulation often indicates a bypass (Figure 10). The dirt should not be confused with mold.
3.1.3 Attic hatches

Attic hatches were not insulated or weatherstripped. In addition, the ceiling around the hatch was often uninsulated. An uninsulated attic hatch causes unnecessary heat loss. A non-weatherstripped attic hatch is another bypass by which warm moist air moves into an attic.

3.1.4 Strapping

Strapping (either 1” x 3” or 1” x 2”) is installed perpendicular to the bottom of the truss cords. The ceiling gypsum board is then attached to the furring. Batt insulation is not able to make direct contact with the gypsum board due to the presence of the furring (Figure 11). As a result, there is an air space between the insulation and the gypsum board. Insulation must make contact with a surface to be effective. The resulting air space can create a cold ceiling surface for mold growth.

3.1.5 Metal Gusset Plates

Metal gusset plates were used to attach cord members on trusses. The plates were exposed above the insulation and the space between the plates is not insulated. The lack of insulation and the thermal bridge created by the gusset plates caused cold spots on the ceiling surface (Figure 12).

3.2 Attic Ventilation

A problem encountered by the PPPRHA was wind-driven rain and snow entering the attic through vents, particularly gable vents, and causing moisture damage in the home. The homes are located near the coast and are subjected to high winds. Gable vents have been covered with plywood (Figure 13) and in some cases, the soffit vents have been covered as well. In one instance, a metal box with an open top was placed over the gable vent on the interior to act as a baffle – letting in air, but keeping rain and snow out of the attic. According to the PPPRHA, these baffles have not kept rain and snow out of the attic.
Correcting the insulation and bypass problems are more crucial than solving the attic ventilation problem. In fact, the attic ventilation would be a non-issue in these homes if the insulation and bypass problems are solved. According to the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Journal, October 2002¹,

"unvented attics could have an advantage in wet, cold coastal climates as long as indoor humidity is controlled by ventilation or dehumidification".

This same study found that for homes in wet, cold coastal climates:

"The higher ventilation rates (from attic ventilation) produced colder attics without sufficiently lowering attic water vapor pressures, resulting in high attic relative humidity and moisture content in sheathing."

### 3.3 Bathroom and Kitchen Exhaust Fans

Typical bathroom exhaust fans installed in the homes were rated at 70 cubic feet of air per minute (CFM). Properly operating exhaust fans help remove moisture from the bathroom during showers. An exhaust fan flow meter was used to measure actual CFM exhausted by the bathroom fans (the fan flow meter does not fit over the kitchen exhaust fans). The measured exhaust ranged between 0 CFM and 37 CFM. In addition, the bathroom fans were quite noisy. Occupants tend not to use noisy fans. Table 1 lists the Measured CFM flow of the bathroom fans as well as the type of kitchen fan.

<table>
<thead>
<tr>
<th>Inspection number</th>
<th>Bath Fan CFM Flow</th>
<th>Kitchen Fan Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>Non-operable¹</td>
<td>Vented to outside</td>
</tr>
<tr>
<td>1-2</td>
<td>No fans</td>
<td>Recirculating</td>
</tr>
<tr>
<td>1-3</td>
<td>37 &amp; 28</td>
<td>Vented to outside</td>
</tr>
<tr>
<td>1-4</td>
<td>Non-operable² and 0</td>
<td>Vented to attic</td>
</tr>
</tbody>
</table>

¹ - fans were non-operational due to remodeling work being done in the bathrooms
² - occupant had taped over the fan; fan was vented into the attic

None of the bathroom exhaust fans are operating at or near their rated CFM. This is not unique to Pleasant Point and is commonly seen in all housing types, regardless of economic strata. Bathroom fans that do vent outside are vented through the soffit because of the wind driven rain and snow problem (Figure 14).

¹ "Venting of Attics and Cathedral Ceilings" by William Rose & Anton TenWolde, ASHRAE Journal, October 2002
The “chicken coop” house had no bathroom fans but did have a recirculating kitchen fan. This home had mold growth on the bathroom ceilings as well as on the wood windows. Moldy windows could be found throughout the house.

Two of the kitchen fans vented to the outside. One was a recirculating fan. The other vented to the attic (Figure 15). All dryers vented to the outside.

### 3.4 Site Drainage

Site drainage was poor at all four homes. Site drainage was generally flat with holes and depressions adjacent to the foundations (Figure 16). None of the homes had gutter systems. One home had the remnants of a gutter system.

Basements were dry during the inspection. There were reports of floor drains backing-up and water entry through foundation walls after heavy rains or snow melts. Many homes had 18” exposed foundation, including the slab-on-grade home. Re-grading around the homes to improve site drainage is a possibility given the distance between grade and the exterior siding.

### 3.5 Soot Stains

A severe soot stain was found in one house in the lower level workshop. The oil-fired boiler and a Bunsen burner were located in this space. The entire ceiling was covered in soot (Figures 17 & 18). Soot stains were also visible in other areas in the home. One home had a wood stove with a disconnected vent. Occupants indicated that the stove had only been used twice in the past heating season and the vent became disconnected when it was moved.

Burning candles are often the source of soot but candles were not found in the
home. It would appear that the source of the soot could be the Bunsen burner (incomplete combustion), boiler (improper draft and firing) and the wood stove (non-airtight door, loose vent).

3.6 Weep Holes

Two houses were wood frame with brick veneer as an exterior finish. Weep holes were not installed at the foundation or above windows and doors. Flashing was also not apparent where the brick rested on the foundation wall (Figure 19). The PPPRHA reported recurring problems with mold growing on the inside of the wall at the base in this type of home.

Weep holes serve two purposes. First, masonry walls leak and weep holes allow the water to drain to daylight. Secondly, weep holes help equalize air pressure on both sides of the masonry, making it less likely that wind driven rain will enter the wall cavity.

One home had a small patch of missing gypsum board in the kitchen. Water stains were visible on the wall stud. The wall was insulated with fiberglass batts and covered with a polyethylene vapor retarder. The staining may be the result of water being trapped in the wall cavity.

3.7 Occupant Education

Occupant lifestyles may also contribute to moisture and other indoor air quality issues. Occupants should be educated about the following items to assist in solving and eliminating moisture and soot problems in their homes. A number of occupant related items found during the site visits include:

- Soot potential caused by Bunsen burners, improperly vented wood stove and oil-fired boilers
- Boiler fuel leaks
- Clutter in basements and items stored in cardboard boxes
- Storage of firewood outside
- Non-use of bathroom exhaust fans
- Reports of minor plumbing and roof leaks
SECTION 4 – TECHNICAL RECOMMENDATIONS

4.1 Re-insulate Attics with Blown Insulation

Properly installed attic insulation will save energy, reduce the potential for ice dams and mold growth on roof sheathing and elevate the interior ceiling surface temperature reducing the potential for mold growth.

- Remove existing batt insulation from attics.
- Insulate to R49\(^1\) with blown insulation. Blown insulations include cellulose, rock wool or glass fiber. R49 is approximately 14” to 16” of insulation depending upon insulation type used.
- Ensure that all cavities created by strapping, blocking and truss members are filled with insulation.
- Completely cover metal gusset places with insulation to eliminate the thermal break caused by exposed metal gussets.

Take the following three steps after removing the existing batt insulation and before installing blown insulation.

**Step 1: Install insulation baffles**

Attic insulation must cover the top plates of exterior walls while not falling into the eaves or blocking ventilation passageways from the eaves. See section 5.1.1 “Insulation Baffles” for additional information.

- Install insulation foam baffles (sometimes called “eave chutes”) to underside of roof sheathing in each rafter cavity (Figure 20).
- Install 1” rigid foam blocking over top plate to seal gap between plate and insulation baffles.
- Seal gap with low expanding spray foam.

**Step 2: Air-seal attic bypasses**

Bypasses are holes and gaps in the ceiling prior to installing blown insulation. Seal these bypasses with strong air-barrier materials like plywood, gypsum board or foam

\(^1\) – Department of Energy recommendation for attic insulation in existing homes with oil fired heat in the Indian Township region of Maine.
sheathing. Smaller bypasses can be sealed with expanding foam or caulk. Typical bypasses found in the Pleasant Point attics include:

- Chimneys (Figure 21)
- Plumbing stacks
- Wiring penetrations
- Fan housings
- Junction boxes

Additional information regarding attic bypass sealing may be found in section 5.1.2 Attic Bypass Sealing.

**Step 3: Block, insulate and air seal attic hatches**

Blocking was not found around any of the attic hatches. None of the hatches were insulated or air sealed. In many cases, the ceiling around the hatch was also uninsulated.

- Install permanent blocking around attic access hatch.
- Use rigid materials for blocking, such as plywood, that will support the weight of a person.
- The blocking should extend at least 3” above the level of the blown insulation to prevent the insulation from falling out of the attic when the attic hatch is opened.

4.2 Attic Ventilation

No recommendations are being made with respect to attic ventilation. Sealing attic bypasses and properly installing attic insulation outweighs the questionable benefits of attic ventilation in this climate. For additional information, see http://brc.arch.uiuc.edu/billrose/Issues.pdf

**4.3 Bathroom & Kitchen Exhaust Fans/Dryer Vents**

Bathrooms and kitchens generate large amounts of moisture. Properly operating exhaust fans are key to removing moisture from these spaces.

- Immediately replace inoperable exhaust fans (Figure 22). None of the measured operating exhaust fans performed at their desired exhaust rate and should be replaced on an ongoing basis or as part of bathroom rehab work. Fans should be rated for a minimum 70 CFM at 0.25” of

Figure 21 – Bypass adjacent to chimney – note dirty insulation

Figure 22 – Bathroom fan taped over; note mold growth on ceiling
static pressure (the rating provided on the box is generally at 0.10" of static pressure).

- New bathroom fans should have sone ratings no higher than 1.5. Sone is a rating for sound – the lower the sone rating, the quieter the fan. Occupants tend not to use loud fans. Low-sone fans include Broan Solitaire and Panasonic WhisperCeiling and WhisperLite series. Low-sone fans generally cost between $75 and $100.

- Replace plastic ribbed vent with smooth metal vent. Use of round, smooth sheet metal ductwork and minimize duct length, turns and bends in the ductwork. Smooth ducts provide less resistance and improved flow over ribbed ductwork (Figure 23). Routinely clean dust and lint from intake grille.

- Replace existing bathroom light/fan switch with a fan delay timer. The fan delay timer is a two function switch wired to both the fan and the light. When the switch is turned on, both the light and exhaust fan are on. When the switch is turned off, the light goes off but the fan continues to operate for a set period of time, from 1 to 60 minutes. Fan delay timers are about $35.

- A 60 minute timer switch may be used if the bathroom fan has a separate on/off switch. Timer switches cost between $15 and $50.

- Replace kitchen recirculating fans with fans that vent to the outside. Kitchen exhaust fans should be rated at 150 CFM. Kitchen fans generally do not have sone ratings. However the Broan Allure series has sone ratings ranging from 0.4 to 1.5.

- Periodically inspect all bathroom and kitchen exhaust fan ducts. Ensure that exhaust ducts are properly attached and sealed to the exhaust fan housing and to roof vent caps. All ducts should terminate outside the house and not below roof vents.

- Exhaust venting taken through the roof eaves should be sealed to an eave vent designed for exhaust fan termination.

- Periodically inspect dryer vents. Correct crimped, disconnected, and incorrectly vented dryer vents when found. Replace plastic ribbed dryer vents with smooth metal ones.
4.4 Site Drainage

All four homes had site drainage problems. None had a gutter system with reports of occasional water leakage into the basements was. Efforts to improve site drainage include:

- Overall site grading to prevent water from flowing toward the houses.
- Grade directly at the foundation to ensure a soil pitch away from the foundations. This is possible as there is often 18” to 24” of exposed foundation wall above grade on these homes.
- Fill in a number of holes and dips adjacent to foundations even if site drainage work cannot be done or is not planned for the immediate future.

If positive drainage can move water away from the home, a gutter system may not be needed. If positive drainage cannot be provided, a gutter system will help direct water away from foundations.

Recommendations for a gutter system appropriate for snow/ice conditions and wind in this region of Maine include:

- Use a minimum of 0.027 gauge aluminum gutters. The heavier gauge 0.032 is preferred because of the ice and wind conditions.
- Half-round gutters are least affected by snow and ice (Figure 24). If unavailable or too costly, the K-style gutters may be used (Figure 25).
- Use the heavier versions of the hidden hangers and secure every 18”. At a minimum, use the heavier hangers at stress points, such as corners and at downspouts.
- Secure downspouts with three fasteners, rather than two.
- Use one downspout for every 40 feet of gutter.
- Use a leaf guard system in forested areas to help keep gutters free of debris.
- Use leaders and splash blocks to direct water...
away from the home. Water from downspouts should go out at least 3 feet away from houses that have slabs and 5 feet away from homes with basements.

- Use “flip-up” leaders that may be raised to cut grass (Figures 26 & 27).

**Figure 26 – Flip-up leader in down position**

**Figure 27 – Flip-up leader in up position**

### 4.5 Soot Stains

To eliminating the source of the soot:

- **Bunsen Burners:**
  
  1. Provide exhaust ventilation with an open window in the area when using a Bunsen Burner.

- **Service boilers:**
  
  1. Assure that the boilers draft properly under the worst case draft conditions (winter condition – all windows and doors closed, exhaust fans and clothes dryer turned on). Follow house depressurization protocol.
  2. Check for correct oil pressure at burner start-up. Lower pressure results in poor atomization and possible soot production. Likewise, ensure that oil supply is effectively turned-off at burner shut-down so that oil is not siphoned over the hot nozzle with no combustion air.

- **Wood stoves:**
  
  1. Inspect vent connector and chimney or flue for leaks and seal leaks with a high-temperature sealant designed for use with metal or masonry.
  2. Check condition of gaskets on wood stove doors and replace as necessary.
3. Check draft and improve if necessary (follow house depressurization protocol).

- Candles:
  1. Request that occupants temporarily not burn candles once soot has been cleaned and surface repainted to see if soot reappears.
  2. Instruct occupants to not burn candles if they leave a soot stain on the neck of the glass container.
  3. Use beeswax candles since they create less soot.
  4. Keep candle wicks trimmed to less than \( \frac{1}{4} \) inch.

4.6 Weep Holes

- Install weep holes on the bottom course of brick and above and below windows and doors.
- Use vertical weep holes by cutting out the mortar between bricks every 48 inches on the bottom course of brick. The mortar should be removed, opening the cavity behind the brick to the outside.

4.7 Occupant Education

Recommended occupant lifestyles changes to reduce the moisture and soot problems.

- Store firewood outside.
- Use bathroom and kitchen operable and outside venting exhaust fans during and after bathing and cooking activities to remove moisture from these spaces. Replace inoperable, non-effective and ventless fans and provide similar instructions.
- Promptly report plumbing and roof leaks. Recognize the difference between plumbing leaks and sweaty pipes and fixtures. Wipe-up moisture from sweating pipes and fixtures.
- Promptly report boiler fuel leaks.
- Advise residents of soot potential from Bunsen burners, improperly vented wood stoves, oil-fired boilers and candles.
SECTION 5 – DISCUSSION OF COMMON PROBLEMS

5.1 Re-insulate Attics with Blown Insulation

Take the following steps prior to installing attic insulation.

- Block top plates and install insulation chutes.
- Seal all attic bypasses.
- Install blocking around attic access hatches.

Install blown cellulose or rock wool to 3.25 to 3.75 lbs/ft\(^3\) or blown fiberglass to 1.6 lb/ft\(^3\). Install insulation to a uniform depth according to manufacturers’ specifications (bags per square foot ratio) to attain the desired R-value at settled density. This information is listed on the insulation bag.

Insert attic insulation measuring sticks in the insulation to show insulation depth (Figure 28). Note that insulation will settle over time. Therefore, insulation should be blown to installed density, not to settled density.

5.1.1 Insulation baffles

Insulation baffles keep the exterior wall/ceiling juncture warm and eliminate condensation and mold growth. Lowering the moisture load in the house and reducing the relative humidity, also help prevent wintertime mold and moisture problems.

High relative humidity and cold surfaces can lead to mold growth. If a surface approaches the dew point temperature based on the relative humidity, water will condense, be quickly absorbed by the material, and raise the moisture content of the surface. At some point, the moisture content can be sufficient to promote mold growth. This process often occurs at the wall/ceiling juncture on exterior walls.

There are at least three reasons why the exterior wall/ceiling juncture gets cold:

1. Cold wind may enter through soffit vents and pass through the porous insulation material, degrading its thermal performance.
2. The insulation may have been poorly installed resulting in reduced amounts of insulation in the corner.
3. The geometry of the corner usually means that slow-moving currents of warm air may not...
reach into the corners, particularly in homes with hydronic heating systems (Figure 29).

The dark spots occur where the interior surfaces are the coldest. The exterior edges of the attics are difficult to insulate, especially in homes with low-pitch roofs. With batt insulation, use special pusher sticks to get the insulation into the edges of the roof. With loose fill insulation, prepare the outside edge correctly so that it is packed with insulation.

Figure 29: Wall-ceiling corners are cold because of 1. Wind movement through soffit vents, 2. Smaller amounts of insulation at the corner and 3. Corner is outside the movement of warm air currents indoors.

If access can be gained from the attic, install insulation baffle, cut 1 inch foam insulation to block around baffle, and seal the attic from the eave cavity. Use low expanding foam to seal edges of the foam block to the framing, ceiling surface and roof sheathing.

If access cannot be gained due to a low-pitch roof, remove the soffit material from the outside. Install foam blocks and air seal as described above. Insulation may then be blown against the foam blocks. This insulation process maximizes over top plates, but does not allow insulation to
fall into eaves. In addition, wind-washing through the insulation has been eliminated. Ensure that the top of the insulation baffle remains open (Figure 30).

Many individuals and organizations (including model codes) stress the importance of attic ventilation. While it has some benefits, it also has some drawbacks. Wind washing of insulation at the edge is one major drawback. Design without attic ventilation may improve the performance of the eave area, and most designs without ventilation rely on verified airtightness of the ceiling plane for good moisture performance. For more information about the benefits and drawbacks of attic ventilation see “Venting of Attics and Cathedral Ceilings” at http://brc.arch.uiuc.edu/billrose/Issues.pdf.

Figure 30: Insulation retrofit for the juncture between the exterior wall and the roof-ceiling assembly. Note that this retrofit is done from the outside.
5.1.2 Attic Bypass Sealing

Attic bypasses are holes or gaps in the top floor ceiling that allow warm moist air to move around and through insulation into the attic cavity (batt or blown insulation will not stop air flow). Energy is lost and ice dams can result. In addition, moisture can condense on the underside of the roof sheathing.

Strong air-barrier materials like plywood, gypsum board or foam insulation board can be used to seal attic bypasses. These materials should be attached with mechanical and/or adhesive bonds.

The following are some examples of attic bypasses and how to seal them. The chimney (Figure 31) and soil stack bypasses were found in most of the inspected Pleasant Point homes.

- Chimney: Seal chimney bypass with sheet metal (minimum 28 gauge thickness) and seal to chimney or flue and ceiling structure with high temperature sealant or chimney cement.

- Soil stacks, plumbing vents, open plumbing walls: Seal joints with expanding foam or caulk. If joint is too large, stuff with fiberglass insulation and foam over the top. Large openings may also be sealed with insulated foam board or scrap gypsum board (Figure 32).

- Housing of exhaust fans and recessed lights: Caulk joints where housing comes in contact with ceiling.

- Box around recessed light fixtures to prevent overheating and/or fire. Use gypsum board to construct the box. Provide a minimum 3” clearance between the box and the sides of the fixture. The box should be constructed to a height that will be 4” above the installed insulation. Cover the box with gypsum board and seal to the sides of the box. The box is not to be covered with insulation. If there is insufficient clearance to install a box 4” higher than the insulation, do not cover the box and use an appropriate barrier to keep the insulation 3” away from the fixture.

- Wiring and conduit penetrations: Seal joint with caulk or low expanding foam.
5.1.3 Insulate & Air Seal attic Hatches

A non-air sealed attic hatch is another type of bypass. Mold can condense on access hatch blocking if not air sealed (Figure 33).

Air seal the hatches with weatherstripping or a gasket (Figure 34). Install latches to lock the hatches in place and provide positive closure.

Insulate attic hatches to a maximum of R38 but no less than R19. A lightweight attic hatch may be cut from damaged insulated foam core doors (Figure 35). The door has an R-value around 7. Batt insulation may be attached to the back of the door panel to achieve the desired R-value. The door panel is pre-finished, light-weight and requires no additional painting.

5.2 Bathroom & Kitchen Exhaust Fans/Dryer Vents

Several rooms in a house are natural moisture sources simply due to the nature of their function. Showers are taken in bathrooms resulting in 100% humidity there. Kitchens are used for cooking and cleaning. In laundry rooms, clothes dryers must remove large quantities of water from wet clothes. By removing moisture in these areas, exhaust ventilation serves as a source control strategy. Exhaust ventilation dilutes the moisture and places the room in a negative pressure, thus limiting the spread of moisture to the rest of the house until most of the moisture has been removed to the outside.

Vent bathroom exhaust fans, kitchen exhaust fans and clothes dryers to the outside rather than into the living space. Venting to the basement, crawl space and attic can lead to moisture problems in these areas. For this reason, localized exhaust ventilation requires ductwork.

The effectiveness of exhaust fans is based on the power of the exhaust fan, length and type of exhaust duct and cleanliness of the fan grille. The exhaust fan motor may not be powerful enough to vent sufficient airflow through the duct, if there is excessive resistance in the ductwork. The longer the duct, the greater the static pressure in the duct and the less air flows...
through the duct. Turns and bends in the ductwork also increase the static pressure and reduce flow. In contrast, a smooth duct provides less resistance and improved flow over ribbed ductwork. Round, smooth sheet metal ductwork is recommended for all types of exhaust ventilation. A dirty intake grille will also increase resistance and reduce airflow.

Fan capacity is typically listed at 0.10" and 0.25" of static pressure. Bathroom exhaust fans should provide a minimum ventilation rate of 70 CFM at 0.25" of static pressure. Selecting a fan capacity at 0.10" static pressure is appropriate only if the exhaust duct is smooth, straight (no more than one elbow) and less than 15' in length. For example, a bathroom fan with an exhaust ventilation rate of 90 CFM or 100 CFM (at 0.10") may be necessary to obtain 70 CFM at 0.25" of static pressure if there are numerous elbows, the exhaust duct is ribbed and the length is over 15'. Fan performance curves should be reviewed to determine ventilation rates at 0.25".

Replace range hoods whenever possible with outside venting. The hoods should have a minimum exhaust capacity of 150 CFM. Under no circumstances should recirculating fans be installed in place of an existing range hood.

Dryer vents should exhaust through smooth-surfaced rigid ducts. Non-combustible flexible metal ducts approved for dryer venting may also be used. Duct joints should be in the direction of air flow. Do not fasten ducts with screws or fasteners that extend into the ducts. Minimize the duct length, especially when using flexible metal ducts. Install flexible metal duct without dips or sags. Insulate dryer vents that extend through non-conditioned spaces.

Minimum duct diameter should be 4 inches and length should not exceed 25 feet from the dryer outlet to the termination point. If duct length is greater than 25 feet, 5 inch diameter ducts should be used.

Dryer vent caps should have a backdraft damper that closes when the dryer is not being used. Do not install insect screens or small wire cages over the vent cap.

5.3 Site Drainage

Design and build the roof so that water landing on the roof moves out to the edge of the roof. When rain falls on a soil surface, some will percolate downward through the soil—more in sandy soils and less in clayey soils. The water that does not percolate downward will move along the soil surface following the slope, out to the downhill edge of the site. The best way to prevent mold and moisture problems in houses is to make sure that rainwater moves off the roof and across the site and off the property. The houses with problems are those that accumulate water in the soil in contact with the foundation. The soil in contact with the foundation should be the driest soil on the site following a rainstorm. Houses with dry foundations (basements, crawl spaces and slabs) are usually dry houses. Keeping the foundation dry is the key to a good indoor environment in most houses. To keep the foundation dry, keep the soil next to the foundation dry.

Keeping the soil next to the foundation dry involves a few general rules, together with some specific guidelines.
The first general rule is the rule of concentration - damage is worse where greater quantities of water are concentrated. A valley on a roof acts like a funnel, with the greatest concentration of water at the base of the valley. Gutters act like funnels that collect water from the edge of the roof and concentrate it in the downspout. On the land, valleys and swales act like collectors or funnels that concentrate the water on the site. If the water management design makes use of funnels (such as valleys, gutters or swales) then they require maintenance to make sure they work as they are intended. Damage is worst where a valley, gutter or swale is blocked.

The second general rule is the “ground-roof” rule - treat the soil surface as if it were a low-slope roof surface. Pitch the surface away from the house - the steeper the pitch, the better the drainage. Imagine all the water moving to the low edge of the site, and imagine how best to get it there. Avoid areas near the building that can act as water collectors.

Specific site drainage guidelines include:

- Build the house on a crown, not in a hole. If there is sufficient exposed foundation, site grading at the house can be improved. If the house hugs the ground, improvements at the foundation are more difficult. There should be a minimum of eight inches of exposed foundation between the ground and the beginning of the siding.

- Identify localized dips and holes immediately adjacent to the foundation and fill with dirt. Tamp the fill material to prevent future settling. Provide sufficient fill material such that drainage occurs away from the foundation.

- If the house has no gutters, then the base of the soil around the house has to serve as a gutter. It should have a surface that helps prevent splash back onto the siding of the house. It should be designed with pitch so that it effectively moves water away from the house.

- Good tamping or compaction of the backfill is very helpful because it helps keep water up on the surface where it can be managed by slope. Soil at the outside corners of the foundation, where the downspouts are usually found, can always be tamped because the corner will never collapse inward.

- Bushes and other plantings may be very helpful, especially if their root balls soak up a lot of water. Also they can be planted strategically near downspouts so that the downspout extenders are less likely to be kicked off or removed during lawn mowing.

Collect and distribute rain water and snow melt from the roof away from the foundation with a gutter system. Flashings around chimneys and vents should be watertight.

- Include waterproofing underlayment at the eaves and in valleys as part of re-roofing to help prevent water damage caused by ice dams.

- Gutters can be an effective rain water/snow management system. Pitch the gutters to the downspout. Short gutters may be hung level. In hip roof houses, consider using downspouts only on the downhill side not on the uphill side. In areas with a moderate amount of trees.
consider large gutters and downspouts where leaves and debris can be flushed more easily. Make sure the gutter hangers are solid to keep the gutter from sagging.

- Secure downspouts to the house. They should never be undersized, and some oversizing never hurts. Fasten elbows and straight sections together with pop rivets—screws that project into the downspout can lead to clogging.

- At the base of the downspout, direct the water away from the foundation of the building. It should be directed out past the backfill onto the undisturbed soil, which may be 3’ to 5’ out from the edge of the house. If it is allowed to dump water close to the foundation, into the backfill, it will concentrate the water next to the foundation—precisely the wrong place for the water to be. The traditional way to discharge the water away from the house involves using downspout extenders (sections of straight downspout) or splash blocks. Both of these are often disturbed when lawns get mowed. A notched section of downspout that is hinged to the elbow at the base of the downspout can solve this problem. The soil at the base of the downspout should be sloped away from the house at a minimum of 5% slope. Six inches of fall in the first 10’ away from the house gives a 5% slope.

- Keeping gutters clean in wooded areas can be a maintenance issue. A gutter guard system can help keep debris out of the gutter, thus minimizing maintenance, while allowing water to drain into the gutter.

Two such gutter guard systems are the PermFlow Gutter Guard System (Figure 36) and the WaterFall Gutter Guard System (Figure 37). These systems cost about $4.50 per 3’ section and are designed for a 5” K style gutter (8’ sections are sold to contractors).

5.4 Sooting

For a detailed discussion on sooting, see Section 4.5 “Sootstains” and refer to http://homeenergy.org/archive/hem.dis.anl.gov/eehem/98/980109.html
5.5 Occupant Items

A number of occupant items were identified that can cause moisture and mold problems. Occupants should be educated on the following issues to assist in solving and eliminating moisture and mold problems in their homes.

- What is mold and what causes it?
- Potential of soot production from burning candles and types of candles to burn to minimize soot production
- Use of exhaust fans
- Storage of items in basements
- Use of rugs in basements
- Difference between plumbing leaks and water condensation on pipes
## SUMMARY

### Site Visit Report

**DATE:** July 30, 2003

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<th>HUD Program</th>
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<th>Occupancy</th>
<th>Foundation Type</th>
<th>Framing and Model Type</th>
<th>Heat Type</th>
<th>Site Drainage Problems</th>
<th>Gutter System Problems</th>
<th>Leaks from Exterior</th>
<th>Wet Basement or Crawl Space</th>
<th>Plumbing Problems</th>
<th>Bathroom Problems</th>
<th>Exterior Wall/Ceiling Problems</th>
<th>Attic Problems</th>
<th>Visible Mold</th>
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**Inspection Number:** 1-1
**Address:** Unknown
**Age:** 31 years
**House Type:** Home Ownership
**Condition:** Occupied
**Bedrooms:** 5

**Foundation:** Basement – poured concrete
**Heat Type:** Boiler - oil
**Construction:** Brick veneer, 2” x 4”

**Mold and Moisture Conditions:** The bathroom ceiling was moldy and being replaced. Some mold was found on a partition wall in the basement. Some interior gypsum board was missing in the kitchen. Water stains could be seen on the studs behind the polyethylene vapor retarder and adjacent to the fiberglass insulation. There were no weep holes in the brick veneer (Figure 2). Mold growth on the gypsum board on the exterior walls had been reported in the past.

**Rainwater Management:** There were remnants of a vinyl gutter system on the home. Site drainage was fairly flat with holes and depressions near the foundation.

**Basement:** The basement walls were insulated in the interior with 1 inch polyisocyanurate (R7.2). A small amount of mold was found on gypsum board on a partition wall in the basement (Figure 3). The basement floor drain had backed-up in the past. The dryer vented to the outside.

**Bathroom/Kitchen:** The bathroom was being rehabbed. Mold had been reported on the bathroom ceiling. The bathroom exhaust fans were non-operational due to the rehab work. Both fans vented to the outside through soffit
vents (Figure 4) and were the standard 70 CFM fans typically found in these homes. The baseboard convector was rusted. The kitchen fan was vented to the outside. The bathroom and kitchen sink cabinets were dry.

**Attic:** The attic was insulated with R30 batts. The insulation had numerous gaps and voids between batts (Figure 5). A chimney bypass was found. The attic hatch was uninsulated and not air sealed. Insulation was compressed over the top plates with scrap gypsum board. Open metal boxes were placed over the gable vents to prevent wind-driven rain and snow from entering the attic.

**Heating System:** The boiler was oil-fired and also provided domestic hot water. The vent was very rusted indicating flue condensation (Figure 6). The HRV system was turned-off. Access to the filters could not be found. The supply and exhaust to the HRV are adjacent to each other sharing the same grille (Figure 7).

**Occupant Notes:** The one occupant had asthma and other respiratory problems and had quit smoking two years ago.

**Recommendations:**

- Install better bathroom exhaust fans.

- Replace plastic ribbed vent with smooth metal vent.

- Re-insulate attic with blown insulation.
• Install insulation baffles.
• Air seal attic bypasses before re-insulating, especially around chimney.
• Insulate and air seal attic hatch.
• Service oil boiler – check for proper draft and flue gas temperature.
• Service HRV system.
• Install heavy gauge aluminum gutters.
• Improve site drainage.
• Install weep holes in brick veneer.
Appendix B: Pleasant Point/Passamaquoddy Reservation Technical Assessment Report

Inspection Number: 1-2
Address: Unknown
Age: 22 years
House Type: Home Ownership
Condition: Occupied
Bedrooms: 4
Foundation: Slab
Heat Type: Boiler - oil
Construction: Stick-built, 2” x 6”

Mold and Moisture Conditions: The first floor bathroom was very moldy. Signs of water problems were found in the second floor bathroom. Neither bathroom had an exhaust fan. Many of the wood framed windows in the home had mold (Figure 2). The water heater was leaking. Signs of water leakage were found on the ceiling/wall around the chimney (Figure 3). The gable vents were sealed to prevent wind driven rain and snow from entering the attic.

Rainwater Management: No gutters were on the home. Site drainage was fairly flat with holes and depressions near the slab edge.

Bathroom/Kitchen: The ceiling of the first floor bathroom was moldy (Figure 4). Signs of water damage were found in the second floor bathroom, although it appeared that the tub was not being used. Neither bathroom had exhaust fans. The kitchen fan was recirculating. The bathroom and kitchen sink...
cabinets were dry, although signs of a previous leak were found under the kitchen sink. The dryer vented outside.

**Attic:** Only one of the two attics could be accessed. The attic was insulated with R30 batts but had numerous gaps and voids between batts. Water stains were found on the ceiling on both levels as well as on the roof sheathing. The gable vents were covered with plywood to prevent wind driven rain and snow from entering the attic (Figure 5).

**Heating System:** The boiler was oil-fired. The water heater was leaking and rusted (Figure 6).

**Occupant Notes:** Two adults and two children living in the home reported no health problems.

**Recommendations:**
- Install bathroom exhaust fans in both bathrooms.
- Repair leak around chimney.
- Repair or replace water heater.
- Re-insulate attic with blown insulation.
- Install insulation baffles.
- Air seal attic bypasses before re-insulating, especially around chimney.
- Insulate and air seal attic hatch.
- Clean and refinish wood windows.
- Install heavy gauge aluminum gutters.
- Improve site drainage.

Figure 5 – Gable vent covered with plywood

Figure 6 – Leaky and rusted water heater
Inspection Number: 1-3  
Address: Unknown  
Age: 31 years  
House Type: Low Rent  
Condition: Occupied  
Bedrooms: 5  
Foundation: Basement – poured concrete  
Heat Type: Boiler - oil  
Construction: Brick veneer, 2” x 4”

Mold and Moisture Conditions: The bathroom ceiling was moldy but had been painted-over. There was a roof leak around the chimney (Figure 2). Water had been leaking into the basement near the back corner at the garage. The boiler was leaking fuel oil. An HRV system was present, but was turned-off.

Rainwater Management: There were no gutters on the home. Part of the site drained towards the home. Some holes and depressions were found near the foundation.

Basement: The basement walls were insulated in the interior with 1 inch polyisocyanurate (R7.2). The foundation leaked near the back corner near the garage (this location coincided with the spot where water drained towards the home).

Bathroom/Kitchen: One of the bathrooms had mold on the ceiling, but had been painted-over. The main bathroom fan measured 37 CFM and the fan in the master bedroom bathroom measured 28 CFM. Both fans vented to the outside through soffit vents. The kitchen fan also was vented to the outside. The bathroom and kitchen sink cabinets were dry.

Attic: The attic was insulated with R30 batts with numerous gaps and voids between batts. A number of bypasses were found, especially around the chimney (Figure 3).
**Heating System:** The boiler was oil-fired and also provided domestic hot water. The boiler leaked fuel oil (Figure 4). The hot water storage tank was rusted. The HRV system was turned off (Figure 5). Access to the filters could not be found. It appeared that the HRV served just part of the home. Humidity controls for the HRV were found in the kitchen and main bathroom. The supply and exhaust to the HRV are adjacent to each other sharing the same grille.

**Occupant Notes:** Two adults and three children living in the home reported no health problems.

**Recommendations:**

- Install better bathroom exhaust fans.
- Replace plastic ribbed vent with smooth metal vent.
- Air seal attic bypasses, especially around chimney, re-insulate attic with blown insulation and install insulation baffles.
- Insulate and air seal attic hatch.
- Inspect roof around chimney and patch leak.
- Service boiler and repair leaks.
- Repair or replace hot water storage tank.
- Service HRV system and provide additional ductwork to areas of home currently not served.
- Install heavy gauge aluminum gutters.
- Improve site drainage.
- Install weep holes in brick veneer.
Inspection Number: 1-4  
Address: 8 Sunset Road  
Age: 24 years  
House Type: Home Ownership  
Condition: Occupied  
Bedrooms: 5  
Foundation: Basement – poured concrete  
Heat Type: Boiler - oil  
Construction: 2-story stick-built, 2” x 6”

Mold and Moisture Conditions: The house had a terrible soot problem, especially in the lower level workshop (an oil-fired boiler also located in this area). The entire ceiling was covered in soot (Figures 2 & 3). Mold was found in the main level bathroom on the ceiling. Wind driven rain pushed water under the back door – it appears that the rear deck level is too close to the door threshold.

Rainwater Management: No gutters were on the home. Drainage was good except for rear of home.

Basement (lower level): Bedrooms, a bathroom and a workshop were located in the lower level. Soot covered the entire ceiling of the workshop area and was visible in other rooms, including upper level rooms.

Bathroom/Kitchen: The main level bathroom had mold on the ceiling. The bathroom fan was covered with plastic (Figure 4). Occupant indicated that cold air came in through the fan during the winter. This fan and the kitchen fan both vented into the attic. The lower level bathroom fan measured 0 CFM and vented into the floor cavity. The bathroom and kitchen sink cabinets were dry. The dryer vented to the outside, however, lint was found covering the wall (presence of lint indicates that the dryer vent may be disconnected).
Attic: The attic was insulated with R19 batts. Strapping (1 inch x 3 inch) was present on the bottom of the joists preventing the insulation from contacting the ceiling gypsum board. The insulation had numerous gaps and voids between batts (Figure 5). A number of bypasses were found (Figure 6). Insulation over top plates was compressed with scrap plywood. The ridge and eave vents appeared to be inadequate.

Heating System: The boiler was oil-fired. A wood stove with a disconnected vent was also present in the basement. Occupant indicated that the wood stove had been moved and that the vent had not been reconnected. The occupant also indicated that the wood stove had only been used twice this past heating season.

Occupant Notes: Seven adults and four children lived in the home. Five of the adults are smokers. One adult and two children were reported to be asthmatic.

Recommendations:
- Install bathroom and kitchen exhaust fans with smooth metal vents that vent to the outside
- Check for properly connected and vented dryer.
- Clean soot from all surfaces.
- Service oil-fired boiler and check for proper combustion and draft.
- Check operation and draft of wood stove; ensure that door is air-tight.
- Air seal attic bypasses before re-insulating, especially around chimney, re-insulate attic with blown insulation, install insulation baffles and insulate and air seal attic hatch..
- Install heavy gauge aluminum gutters and improve site drainage in rear of home.
- Install locking-type threshold on rear door.