INDIAN TOWNSHIP PASSAMAQUODDY RESERVATION TRIP REPORT
Assessment of Mold and Moisture Conditions

Final Report

Date:
July 29-30, 2003

Prepared for:
U.S. Department of Housing & Urban Development
Office of Native American Programs

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INTRODUCTION

Anthony Corso from the Building Research Council (BRC) at the University of Illinois, and Environmental Design Systems, Inc. conducted a site visit at the Indian Township Passamaquoddy Housing Authority (ITPHA) on July 29-30, 2003. The ITPHA administers the housing programs for the Passamaquoddy Indian Tribe. The site visit 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: Indian Township Passamaquoddy Housing Authority Technical Housing Assessment Report: Examining Mold and Moisture Conditions of Homes on the Indian Township Reservation.

BACKGROUND INFORMATION

The Indian Township Reservation is located in Washington County in Eastern Maine. The region is part of an ecologically important east coast migratory flyway. The Reservation is located west of the St. Croix River in an area covered with lakes, coniferous and hardwood forests, and vast wetlands. The average annual precipitation is 43.34 inches. The average annual snowfall is 70.7 inches. The average maximum temperature is 84.9°F and the average minimum temperature is 35.8°F. Approximately 625 Native Americans reside on the Indian Township Reservation. The housing authority maintains 165 homes for the Tribe including Low Rent, Mutual Help, and Title II 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 Indian Township Reservation. Nine homes were visited including Mutual Help and Low Rent homes. The occupants of three homes were unavailable for an interview. The nine surveyed homes included three and four bedroom dwellings and a one bedroom apartment. Two homes were built over crawl spaces and 7 homes were built with basements. The primary source of heat in the homes was a fuel oil hydronic system with baseboard units. Some homes use a wood stove for supplemental heating. The units visited ranged in age from 4 to 30 years old to approximately twenty-five years old.

Day 1: Monday, July 28, 1983

Monday was a travel day.
PART I

INDIAN TOWNSHIP/PASSAMAQUODDY 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 Indian Township Passamaquoddy Housing Authority (ITPHA) on July 29-30, 2003. The ITPHA administers the housing programs for the Passamaquoddy Indian Tribe. The site visit 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: Indian Township Passamaquoddy Housing Authority Technical Housing Assessment Report: Examining Mold and Moisture Conditions of Homes on the Indian Township Reservation.

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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 Indian Township Reservation. Nine homes were visited including Mutual Help and Low Rent homes. The occupants at three homes were unavailable for an interview. The nine inspected homes included three and four bedroom dwellings and a one bedroom apartment. Two homes were built over crawl spaces and 7 homes were built with basements. The primary source of heat in the homes was a fuel oil hydronic system with baseboard units. Some homes use a wood stove for supplemental heating. The units visited ranged in age from nine years old to approximately twenty-five years old.

Day 1: Monday, July 28, 2003

Monday was a travel day.
Day 2: Tuesday, July 29, 2003

The assessment team arrived at the ITPHA Office on the Indian Township Reservation, Maine on Tuesday morning. The team met with Ernest Neptune, Executive Director for the ITPHA, and Sam Newell, the Maintenance Supervisor for the ITPHA, to discuss the day’s activities, outline the team’s role while on the reservation, and address the housing authority’s concerns regarding the site visit. Following the meeting, the assessment team, guided by Sam Newell, inspected six homes including five Low Rent units and one Mutual Help unit.

Day 3: Wednesday, July 30, 2003

Wednesday morning the assessment team met Sam Newell at the ITPHA office. The assessment team, guided by Sam Newell, investigated 3 Mutual Help units on the Reservation.

Digital photographs were taken to record conditions in all 9 homes. The inspection process also involved visual assessments of both interior and exterior conditions, measurements pertaining to exhaust fan air-flow and discussions with available residents. PART II: Indian Township Passamaquoddy Housing Authority Technical Housing Assessment Report: Examining Mold and Moisture Conditions of Homes on the Indian Township 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: Indian Township Passamaquoddy Housing Authority Technical Housing Assessment Report provides a more detailed discussion and analysis of the findings.

Indian Township Reservation

Principal findings from the site inspections include:

1. Rainwater Management Problems
   - All nine homes had site drainage problems (site grading identified as flat and/or having depressions along the foundation walls). The sites all had well drained soil types.
   - None of the homes had complete roof rainwater drainage systems (gutters, downspouts, leaders, and splashblocks).

2. General Maintenance and Plumbing Problems
   - Three homes had plumbing leaks and/or water damage from previous leaks.
Many homes had neglected mechanical systems maintenance issues.

3. Ventilation Problems

- Many homes had problems with kitchen and bathroom exhaust fans.
- In heavily used or overcrowded conditions, exterior venting fans are critical to avoid moisture problems.
- Air-flow and circulation problems within conditioned spaces.
- Many fans were nonfunctional or functioned below desired performance.

4. 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

INDIAN TOWNSHIP PASSAMAQUODY RESERVATION HOUSING AUTHORITY

TECHNICAL HOUSING ASSESSMENT REPORT:

EXAMINING MOLD AND MOISTURE CONDITIONS IN HOMES OF THE INDIAN TOWNSHIP PASSAMAQUODY RESERVATION

Executive Summary

Introduction

Section 1: Methodology

Section 2: Indian Township Passamaquody 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

Nine homes were inspected for mold and moisture problems for the Indian Township Passamaquoddy Housing Authority (ITPHA) that administers the housing program for the Passamaquoddy Indian Tribe. The investigation was conducted on July 29th and 30th by Paul Knight (Magna Systems) and Anthony Corso (Building Research Council). Exterior and interior inspections were conducted for all of the homes. Occupants were not home at three homes. The inspection process involved visual assessment of both interior and exterior conditions, air flow measurement of bathroom exhaust fans and resident interviews where possible.

Mold was found in eight of the nine homes. Mold had recently been remediated in the home where none was found.

Four of the nine homes had sooting problems at the exterior wall/ceiling joint or along the joint where the two modular halves were joined.

Six of the nine homes were modular; three were stick-built. The homes had been converted in 1998-99 to oil-fired hot water systems from electric heating.

All homes had significant attic insulation problems. Mold was found on the roof decking in four of the nine attics. The condition of the attic insulation is believed to be a major cause of the mold and soot stains found on the ceilings and on the roof decks of the inspected homes.

All nine homes had site drainage problems. None of the homes had gutter systems. However, only three wet basements/crawl spaces were found. All the sites had well drained soil types. Occasional water leakage into the basement/crawl space was reported in some of the homes.

Principal findings include:

1. Attic insulation was poor in all nine attics. Batt insulation was poorly installed, missing in sections and compressed over top plates. Numerous attic bypasses were found. Exposed metal gusset plates on the roof trusses provided thermal bridges in the modular homes.

2. Although soot stains are cleaned and surfaces repainted on a regular basis by the occupants, four of the nine homes had recurring soot problems. Poor attic insulation may be a major cause of the mold and soot stains found in the homes.

3. All of the bathroom fans perform poorly. The bathroom fans vented to the outside. Eight of the nine homes had kitchen fans that vented to the outside.

4. Site drainage was poor at all the homes. Gutter systems are not used on the homes.
INTRODUCTION

The Technical Housing Assessment Report provides technical recommendations and discussions that focus on these items. Appendix A includes a summary of findings at each inspected home. Appendix B provides observations and recommendations for each home.

Nine homes were inspected. Mold was found in eight inspected homes.

All the homes had significant attic insulation problems. Rat insulation was poorly installed, missing in sections and compressed over top plates. Numerous attic bypasses were found. The roof decking in four of the nine attics had mold.

All the bathroom fans were performing poorly. One fan was inoperable.

Four of the nine homes had sooting problems at the exterior wall/ceiling joint or along the joint where the two modular houses were joined. The condition of the attic insulation is believed to be a major cause of the mold and soot stains found in the homes.

All nine homes had site drainage problems. None of the homes had gutter systems. However, only three sites had wet basements/crawl spaces. All the sites had well drained soil types. Occasional water leakage into the basement/crawl space was reported in some of the homes.

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 homes 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-funded and University of Illinois, Chicago) were used. A housing inspector and an engineer performed each inspection.

5. Boilers in crawl space homes were installed in very small closets off the kitchen. These boilers tend to overheat and shut down and have caused recurring mechanical problems. ITPHA actions to solve the problem have not worked.

6. Occupant lifestyles contributed to the moisture and soot problems. Candles were found in two of the homes with soot problems. Firewood was stored in two basements.
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 Indian Township Passamaquoddy Housing Authority's (ITPHA) homes (Figure 1). The investigation was conducted on July 29th and 30th, 2003, by Paul Knight (Magna Systems) and Anthony Corso (Building Research Council). Sam Newell of the ITPHA escorted the inspection team. ITPHA were pre-selected the houses.

Nine homes were inspected. Mold was found in eight 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. The roof decking in four of the nine attics had mold.

All the bathroom fans were performing poorly. One fan was inoperable.

Four of the nine homes had sooting problems at the exterior wall/ceiling joint or along the joint where the two modular halves were joined. The condition of the attic insulation is believed to be a major cause of the mold and soot stains found in the homes.

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SECTION 1 – METHODOLOGY

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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, crawl spaces, utility rooms and attics included additional inspection of 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**

ITPHA manages 145 homes for the Tribe including Low Rent, Mutual Help, and Turnkey III units. Homes range in age from 5 years to in excess of 25 years. Approximately 626 Native Americans reside on the Indian Township Reservation.

Eight homes and one apartment were inspected over the day and a half site visit. These homes were built between 1978 and 1994. The homes were one-story ranches. Two homes were built over the crawl spaces. The remaining seven homes were built over basements. Six of the nine homes were modular; three were stick-built.

All but two homes were 2” x 4” construction. Two of the newer stick-built homes were 2” x 6”. Sidewall insulation could not be inspected and is assumed to be R11 fiberglass batts in the 2” x 4” walls and R19 fiberglass batts in the 2” x 6” walls. Attics were insulated to R30 with fiberglass batts and were vented with a combination soffit, gable and ridge vents.
Two of the homes were built over crawl spaces. The remaining seven homes were built over basements. The crawl spaces were accessible from outside the home. The floor above the crawl space was insulated to R19 in both crawl spaces, although one of the crawl spaces also had R10 foundation wall insulation. Both crawl spaces were unvented and both were dry. However, water stains were found on the walls in one of the crawl spaces.

Basement walls were poured concrete and uninsulated. One basement had interior R5 insulation for the top 3' of the foundation wall. Basement foundation insulation was not a standard item. Basements were generally dry but reports of occasional water entry and sweating floors were reported.

Homes were originally built with electric baseboard heating. However, due to the high cost of electricity, oil-fired boilers with baseboard convectors were installed in 1998-99 in the basements of the homes (Figure 2). The boilers have retention head burners and are also used for domestic hot water production.

Houses with crawl spaces had sealed combustion boilers installed in small closets adjacent to the kitchen (Figure 3). These boilers overheat causing the system to shut-down. To help solve this problem, exhaust fans were installed to vent the furnace closets to the outside when the temperature gets too hot (Figure 4). Relief grilles were installed to the attic, crawl space and living space to provide make-up air to the closets. In some cases, the relief grille to the living space was taped-over because the occupants felt cold drafts. Boilers in these closets have a ducted combustion air supply to the retention head burner and also provide domestic hot water. The storage tank is located beneath the boiler.

SECTION 3 – FINDINGS

3.1 Attic Insulation

R30 batt insulation was common in all of the attics (R19 batts were in the attic of the apartment building). The condition of the attic insulation is believed to be a major cause of the mold and soot stains found on the ceilings of the inspected homes. Attic insulation installation was deficient in five areas.
3.1.1 General Poor Installation

In all cases, the attic insulation was poorly installed (Figure 5). Not only were numerous gaps between batts were found, but sections of ceilings were uninsulated (Figure 6). Plywood was used to compress insulation over the top plates to maintain a ventilation passageway from the soffit vents (compressed insulation has a significantly lower R-value).

3.1.2 Strapping

Strapping (either 1” x 3” or 1” x 2”) was installed perpendicular to the bottom of the truss cords (Figure 7). The ceiling gypsum board is then attached to the furring. Batt insulation could make direct contact with the gypsum board due to the presence of the furring (Figure 8), resulting in an air space between the insulation and the gypsum board. Insulation should make contact with a surface to be effective. The resulting air space could create a cold ceiling surface for mold growth or soot staining.
3.1.3 Modular Connection

The two halves of the modular homes were joined laterally down the middle of the home. Insulation was missing over the top plates (Figure 9). Furthermore, metal gusset plates were used on the trusses. The plates were exposed above the insulation and the space between the plates was not insulated (Figure 10). The lack of insulation and thermal bridge provided by the gusset plates creates cold spots on the ceiling surface (Figure 11). Consequently, mold and soot stains occur down the middle of the home.

3.1.4 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. Mold was found on the roof sheathing in four of the nine inspected attics. Air moving through ventilated attics can also increase the rate at which conditioned air moves up into the attic.

Any hole or gap in the ceiling is a bypass. Common bypasses found in the Indian Township homes include chimneys (Figures 12 & 13), plumbing stacks, junctures of the modular...
halves, wiring penetrations, recessed lights, fan housings and junction boxes. Insulation does not seal a bypass nor stop air flow. The insulation simply filters the air as it moves through it. Dirty insulation indicates a bypass (Figures 14 & 15). The dirt should not be confused as mold. 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”).

3.1.5 Attic hatches

Attic hatches were not insulated or weatherstripped. In some homes, the ceiling around the hatch was often uninsulated (Figure 16). An uninsulated attic hatch causes unnecessary heat loss. A non-weatherstripped attic hatch creates a bypass through which warm moist air moves into an attic.

3.2 Soot Stains

Four homes had stains at the exterior wall/ceiling juncture and on the ceiling where the two modular halves are joined. According to the occupants, the stains re-occur following cleaning and painting of the surfaces. Two conditions allow sooting to occur; a mechanism for the soot to deposit itself on a surface and a source of the soot.

The soot stains generally followed the lines of studs and trusses (Figure 17). This pattern would indicate an electrostatic attraction created by a cold surface. The cooler surfaces attract soot particles and airborne dirt and dust. Also, mold can grow on these colder surfaces. The cooler surfaces are the result of thermal bypasses caused by poor insulation. For example, cold air moves around the insulation, often along framing members and cools...
the surface of the gypsum board. These bypasses were visible in the attic and were described in the previous section.

Although burning candles are often the source of soot, candles were found in only two homes where sooting was occurring. One candle had soot stains at the neck of the candle jar (Figure 18) indicating that it was producing soot. The occupants in one home indicated that the previous owner had soot stains as well, but did not burn candles.

Other sources of soot included incomplete combustion in furnaces and boilers, wood stoves, cigarettes, dirt and dust. Wood burners were found in two homes, where stains were not visible. All the homes had oil-fired boilers.

Homes were converted to oil-fired hydronic heating in 1998 and 1999. When questioned, staff members at ITPHA were not sure if soot stains were present prior to the conversion.

### 3.3 Bathroom and Kitchen Exhaust Fans

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 doesn’t fit over the kitchen exhaust fans). Typical bathroom exhaust fans (Figure 19) installed in the homes measured 70 cubic feet of air per minute (CFM). The measured exhaust of the fans ranged between 0 CFM and 40 CFM. In addition, the bathroom fans were loud. Occupants tend not to use noisy fans. Measured CFM flow of the bathroom fans and the type of kitchen fan are shown in Table 1.

<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>31</td>
<td>Vented to outside</td>
</tr>
<tr>
<td>1-2</td>
<td>33</td>
<td>Vented to outside</td>
</tr>
<tr>
<td>1-3</td>
<td>35</td>
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<tr>
<td>1-4</td>
<td>20</td>
<td>Vented to outside</td>
</tr>
<tr>
<td>1-5</td>
<td>17</td>
<td>Vented to outside</td>
</tr>
<tr>
<td>1-6</td>
<td>0</td>
<td>Recirculating (fan venting to outside had been removed)</td>
</tr>
<tr>
<td>2-1</td>
<td>6</td>
<td>Vented to outside</td>
</tr>
<tr>
<td>2-2</td>
<td>26 &amp; 40</td>
<td>Vented to outside</td>
</tr>
<tr>
<td>2-3</td>
<td>19</td>
<td>Vented to outside</td>
</tr>
</tbody>
</table>
None of the bathroom exhaust fans operated at or near their rated CFM. This is not unique to Indian Township and is commonly seen in all housing types, regardless of economic strata. The bathroom at the apartment had recently been remodeled because of the mold problem. The fan appeared to work but measured 0 CFM flow. All of the fans vented to the outside rather than into the attic cavity.

All the kitchen fans, excluding the fan in the apartment, vented to the outside. The fan in the apartment kitchen was recirculating. A vented fan had previously been in the kitchen as evidenced by the patch in the ceiling (Figure 20) and the abandoned exhaust fan duct found in the attic.

All but one clothes dryer vented to the outside (dryer vent was disconnected).

3.4 Site Drainage

Site drainage was poor at all nine homes. Site drainage was generally flat with holes and depressions adjacent to the foundations (Figure 21). None of the homes had gutter systems.

Only three homes had wet basements/crawl spaces. Occupants reported occasional water leakage into the basements. Many homes had 18” to 24” of exposed foundation wall above grade. Re-grading around the homes would improve site drainage. All the sites had well drained soil types.

3.5 Boilers in Crawl Space Homes

Houses with crawl spaces had boilers installed in small closets adjacent to the kitchen. These boilers are technically "sealed combustion" but the combustion air supply to the retention head burner had a vacuum relief valve. The boilers also provide domestic hot water to a storage tank located beneath the boilers (Figure 22).

These boilers overheat, causing the system to shutdown. Exhaust fans were installed to vent the closets to the outside when the temperature gets too hot. Relief grilles were installed to the attic, crawl space and living
space to provide make-up air to the closets (Figure 23). In some cases, the relief grille to the living space was taped-over because the occupants felt cold drafts.

ITPHA is considering relocating the boilers to small additions on the outside of the homes.

### 3.6 Occupant Education

Occupant lifestyles may also contribute to moisture, soot and other indoor air quality issues. Occupants should be educated in the following subjects to assist in solving and eliminating moisture and soot problems.

- Soot potential from burning candles, particularly candles with additives and metal wire inside the wicks.
- Clutter in basements and items stored in cardboard boxes.
- Storage of firewood outside.
- Non-use of bathroom exhaust fans.
- Minor plumbing leaks that are not reported.

## SECTION 4 – TECHNICAL RECOMMENDATIONS

The following recommendations are based on the site visit findings.

### 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 and soot stains.

- Remove existing batt insulation from attics.
- Insulate to R49 with blown insulation. Blown insulation types include cellulose, rock wool or glass fiber. R49 is approximately 14” to 16” of insulation depending upon insulation type used.
- Fill all cavities created by strapping, blocking and truss members with insulation.

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1 - Department of Energy recommendation for attic insulation in existing homes with oil fired heat in the Indian Township region of Maine.
• Insulate the gap between metal gusset plates over the bottom truss cord.
• Completely cover the metal gusset places with insulation eliminating the thermal break that currently exists.

After removing the existing insulation and before installing the blown insulation, do the following three steps:

4.1.1 Install Insulation Baffles

Cover the top plates of exterior walls with insulation, but do not allow the insulation to fall into the eaves or block 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 24).
• Install 1” rigid foam blocking over top plate to seal gap between plate and insulation baffles.
• Seal gap with low expanding spray foam.

4.1.2 Air-seal Attic Bypasses

Seal all bypasses with strong air-barrier materials like plywood, gypsum board or foam sheathing prior to installing blown insulation into holes and gaps in the ceiling. Seal smaller bypasses with expanding foam or caulk. Typical bypasses found in the Indian Township attics include:

• Chimneys
• Plumbing stacks
• Juncture of the modular halves
• Wiring penetrations
• Recessed lights (Figure 25)
• Fan housings
• Junction boxes

Additional information regarding attic bypass sealing may be found in section 5.1.2 Sealing Attic Bypasses.
4.1.3 Block, Insulate and Air Seal Attic Hatches

None of the attic hatches had blocking, insulation or air seals. In many cases, the ceiling around the hatch was also uninsulated.

- Install permanent blocking around attic access hatch.
- Use rigid materials like plywood that will support the weight of a person for blocking.
- Extend the blocking 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 Soot Stains

Two conditions are necessary for sooting to occur: a mechanism by which soot deposits itself on a surface and a source of the soot. The cold surfaces resulting from poor attic insulation is considered the mechanism. Re-insulating the attic as described above should elevate the surface temperatures of the ceilings where sooting presently occurs. The following recommendations will help to eliminate the source of the soot.

- Instruct occupants not to burn a candle if it leaves a soot stain on the neck of the glass container.
- Request that occupants temporarily not burn candles once soot has been cleaned and surface repainted to see if soot reappears.
- Use candles without additives (these candles often feel greasy to the touch). Beeswax candles create less soot.
- Keep candle wicks trimmed to less than ¼”.
- Service and maintain as follows:
  1. Ensure that the boilers draft properly under worst case draft conditions (winter condition – all windows and doors closed, exhaust fans and close dryer turned-on).
  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.
- Check wood stoves for the following items:
1. Inspect vent connector and chimney or flue for leaks. 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).

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

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

- Replace inoperable exhaust fans immediately. 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 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 because of the noise. Low-sone fans include Broan Solitaire and Panasonic WhisperCeiling and WhisperLite series. Low-sone fans generally cost between $75 and $100.

- Replace plastic ribbed ducts with round smooth metal ductwork. Minimize duct length, turns and bends in the ductwork (Figure 26). Smooth duct provides less resistance and better flow than ribbed ductwork. Recommend that occupants clean dust and lint from intake grilles.

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

Figure 26 – Plastic ribbed bathroom vent found in apartment. Note scrap gypsum board compressing vent and U-turn at exhaust fan outlet. Bathroom fan measured 0 CFM.
- Use a 60 minute timer switch when the bathroom fan has a separate on/off switch. Timer switches cost between $15 and $50.

- Replace the 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 (Figure 27). All ducts should terminate outside the house and not below roof vents.

- If exhaust is vented through the roof eaves, ensure that the ducts terminate and are sealed to an eave vent designed for exhaust fan termination.

- Periodically inspect clothes dryer vents. Correct the following conditions:
  - Crimped dryer vents
  - Disconnected dryer vents
  - Venting to some space other than to the outside of the building
  - Replacing plastic ribbed dryer vents with smooth metal vents

4.4 Site Drainage

All nine homes had site drainage problems. None of the homes had gutter systems. Despite this, only three homes had wet basements/crawl spaces. All the sites had well drained soil types. Occasional water leakage into the basements/crawl spaces was reported in some of the homes. Efforts to improve site drainage should 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, when possible as there is often 18” to 24” of exposed foundation wall above grade.
• Even if site drainage work cannot be done or is not planned for the immediate future, fill in holes and dips adjacent to the foundation (Figure 28).

If positive drainage can be provided to get water away from the home, a gutter system may not be needed because of the well draining soil type. If positive drainage cannot be provided, install gutter systems to direct water away from foundations.

The following gutter system recommendations take into consideration the snow/ice conditions and wind in this region of Maine.

• Use a minimum of 0.027 gauge aluminum gutters. The heavier gauge 0.032 is preferred because of the ice and snow conditions.

• Half-round gutters are least affected by snow and ice (Figure 29). If unavailable or too costly, the K-style gutters may be used (Figure 30).

• 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’ 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 to at least 3’ away from a house that has a crawl space and 5’ away from homes with basements.
• Use “flip-up” leaders that may be raised to cut grass (Figures 31 & 32).

4.5 Boilers in Crawl Space Homes

Boilers in crawl space homes were installed in very small closets off the kitchen. The boilers also provide domestic hot water to a storage tank located beneath the boiler. Unfortunately the boilers tend to overheat and shut down, resulting in recurring mechanical problems.

Some homes had an exhaust fan in the exterior wall installed to vent the closet to the outside when the closet reached a certain temperature. Make-up air grilles to the home, attic and crawl space were also installed. These fans, however, do not have the intended effect and a make-up grille to the house was found sealed because of cold drafts. The current situation also causes increased space heating costs as conditioned air from the home cooled the boiler closet space and then exhausted outside.

ITPHA is now considering constructing additions to the homes and relocating the boilers there. The rooms would not be conditioned, so the outside weather would naturally help cool the boiler space. The following are recommendations to cool the boiler space:

1. Modify burner controls

The boilers are controlled by an aquastat on the return line to the boiler. Aquastats monitor the temperature of the return water. When the water temperature drops below the aquastat setting, the boiler is fired to increase the temperature.

Modify the controls so that the space heating thermostat fires the boiler when space heating is required. A separate control would monitor the temperature of the water in the storage tank. If the temperature of the water in the storage tank drops below 120°F, for example, the boiler would fire to increase the water temperature. The aquastat would no longer be necessary.

2. Recapture heat for space heating
When the air temperature within the closet reaches a certain point, a temperature activated fan exhausts excess heat to the outside. Make-up air is drawn through grilles located in the common wall to the living space, in the ceiling to the attic and in the floor to the crawl space.

To capture the closet heat and distribute it to the home, eliminate the exhaust fan and transfer grilles. Install a louvered door to the closet and a duct in the attic with registers to the bedrooms. Connect the duct to a grille in the attic wall to the outside. Insulate and bury the duct under the recommended R49 blown insulation. Seal all duct joints with duct mastic, not duct tape.

The closet duct opens with a temperature activated fan. A “T” fitting with a damper is above the fan. The damper directs air to the bedrooms (winter) or to the outside (summer). Make-up air is drawn through the louvered door from the house and/or a pressure activated damper installed in the outside closet wall. The pressure activated damper prevents excess negative air in the closet. The system works as follows:

- Winter (Figure 33)

![Figure 33 - Winter Operation](image)

The damper is in position to direct air to the bedrooms. The temperature in the closet reaches the set-point that activates the fan. Heated air from the closet is distributed to the bedrooms. Air from the bedrooms is drawn back to the furnace closet through the louvered door. There is not enough air drawn back to the closet (bedroom doors
closed, for example), negative pressure builds-up in the closet and the pressure activated damper opens, drawing in outside air to relieve the pressure.

- Summer (Figure 34)

The damper is in position to direct air to the outside. The temperature in the closet reaches the set-point that activates the fan. If windows are open, make-up air is drawn from the house into the closet, helping to cool that space. If windows are closed and negative pressure builds-up in closet, the pressure activated damper opens drawing in outside air to relieve the pressure.

**Figure 34 – Summer Operation**

1. **Temperature Activated Exhaust Fan**
2. **Relief Damper to Eliminate Negative Pressure in Closet**
3. **Eliminate Existing Exhaust Fan and Transfer Grille to House Attic and Crawl Space**

- Air from the boiler circulated to the house through the closet to the HRV unit, after which it is exhausted to the outside. The temperature of the HRV exhaust and the temperature of the air circulated to the HRV unit are monitored by a automated system, and any deviation from the set points triggers a notification.

- Install an insulated and air-sealed supply duct system in the attic to provide fresh air in the bedrooms and living room.

- Seal existing make-up air grilles to the attic and crawl spaces. Maintain make-up air grilles in the house.

- Replace existing boiler closet doors with louvered doors.

**Winter Operation**

1. Air is drawn from the house through the closet to the HRV unit, after which it is exhausted to the outside.
2. Heat in this air stream is transferred to incoming air drawn from the outside.
3. The warmed, fresh air is delivered to the bedrooms and living room as additional heat and ventilation air. Insulate and seal joints. Embed the ducts in the concrete to prevent cold running in the recirculation duct.
3. Install heat recovery ventilation (HRV). An HRV system is similar to the system described in 4.5.2, but the HRV brings fresh air into the home. No fresh air is brought into the home with the system described in 4.5.2. Adding fresh to the home helps dilute and exhaust moist, stale air during the winter and recaptures some of the heat.

- Install a wall hung HRV unit above the washer/dryer where space is available (Figure 35).
- Air from the boiler closet is drawn into the HRV, transferring the heat to the fresh air drawn in from outside.
- Install an insulated and air-sealed supply duct system in the attic to provide fresh air to the bedrooms and living room.
- Seal existing make-up air grilles to the attic and crawl space. Replace existing boiler closet doors with louvered doors.
- Replace existing boiler closet fan with temperature activated damper.

An HRV system would operate as follows:

**Winter Operation**

1. Air is drawn from the house through the closet to the HRV unit. If the temperature of the boiler closet reaches a certain pre-set temperature, the damper to the outside opens to provide additional cooling to the closet.
2. Heat in this air stream is transferred to incoming air drawn from the outside.
3. The warmed, fresh air is ducted to the bedrooms and living room as additional heat and ventilation air. Insulate these ducts with sealed joints. Embed the ducts in the recommended R49 blown insulation.

**Summer Operation**

1. Since heat is not needed in the home during the summer, the boiler only provides domestic hot water and helps move heat to the outside rather than into the home.
2. Damper to the outside is fully open.
3. Air is drawn from the house and outside through the boiler closet and exhausted outside through the HRV.
4. The fan drawing outdoor air into the HRV is turned off, so the heat is not captured and returned to the home.

The above recommendations were proposed as alternatives to constructing room additions and relocating boilers. The recommendations may be less expensive to install, while helping save the occupants money on their heating bills and providing a ventilation system that removes moisture and other indoor air contaminants from the home. However, HRV systems require maintenance by both of the occupants and housing authorities. HRV systems are common problems in other Native American housing. However, lack of maintenance and occupant knowledge of the proper operation of these systems creates maintenance issues. These maintenance requirements include:

- Regularly clean filters in HRV units.
- Regularly clean dirt and debris from outside fresh air intakes.
- Train occupants on the proper use of HRV systems.

Unfortunately dirty filters, clogged fresh air intakes and unused HRV systems are common in tribal housing where these systems have been installed. Nonetheless, properly installed and maintained HRV systems offer a significant benefit to improving both energy use and indoor air quality in the homes.

4.6 Occupant Education

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

- After cleaning and repainting, advise occupants not to burn candles to determine if the candles are the source of the sooting.
- Store firewood outside.
- Instruct occupants on the importance of using operable, outside venting bathroom and kitchen exhaust fans during and after bathing and cooking activities to remove excess moisture. As inoperable, non-effective and ventless fans are replaced, provide similar instructions.
- Discourage the use of rugs in basements. If rugs are used in these spaces, the occupant should inspect the underside of the rugs on a periodic basis for the presence of mold. Discard moldy rugs.
- Promptly report plumbing leaks. Recognize the difference between plumbing leaks and sweaty pipes and fixtures. Wipe-up moisture from sweating pipes and fixtures.
SECTION 5 – DISCUSSION OF COMMON PROBLEMS

5.1 Re-insulate Attics with Blown Insulation

Ensure that the following items have been done prior to installing attic insulation.

- Block top plates and install insulation chutes prior to reinsulating attics.
- Seal all attic bypasses.
- Install blocking around attic access hatch.

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 the insulation to a uniform depth according to the manufacturer’s specifications (bags per square foot ratio) in order to attain the desired R-value at settled density. This information is listed on the insulation bag.

Include attic insulation measuring sticks in the insulation to show insulation depth (Figure 36). 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 the sites of condensation and soot stains. Lowering the moisture load in the house and reducing the relative humidity also helps prevent wintertime mold, moisture and soot 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 junction 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 often prevents slow-moving currents of warm air from reaching into the corners, particularly in homes with hydronic heating systems (Figure 37).

The dark spots occur where the interior surfaces are the coldest. These cold surfaces occur where it is the hardest to insulate effectively. For example, it is difficult to carefully insulate the exterior edge of the attic, especially in homes with low-pitch roofs. With batt insulation, special pusher sticks can get the insulation out to the edge. With loose fill insulation, the outside edge should be prepared correctly so that it is packed with insulation.

![Diagram showing wall-ceiling corners and issues with insulation]

**Figure 37:** 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.
Consider using the following strategy illustrated in Figure 38. If access can be gained from the attic, install insulation baffle and cut 1” foam insulation to block around baffle and seal attic from the eave cavity. Use low expanding foam to seal edges of foam block to framing, ceiling surface and roof sheathing. If access cannot be gained due to a low-pitch roof, the work may be done from the outside. Remove the soffit material. Install foam blocks and air seal as described above. Insulation may then be blown against the foam blocks. Insulation is maximized over the top plates without falling into the eaves. In addition, wind-washing through the insulation has been eliminated. Ensure that the top of the insulation baffle remains open.

Many individuals, model codes, and organizations 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 of the major drawbacks. A design without attic ventilation may improve the performance of the eave area. 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” (http://brc.arch.uiuc.edu/billrose/Issues.pdf).

Figure 38: 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 Sealing Attic Bypasses

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. Chimney (Figure 39) and soil stack bypasses were found in most of the inspected Indian Township 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 40).

- 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. Construct the box so it will be 4” above the installed insulation. Cover the box with gypsum board and seal to the sides of the box. Do not cover the box 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 an access hatch if it is not air sealed (Figure 41).

The hatches should be air sealed with weatherstripping or gaskets as shown in Figure 42. Latches should be installed to lock the hatches in place and provide positive closure.

Attic hatches shall be insulated to a minimum of R38 but no less than R19. A lightweight attic hatch may be cut from damaged insulated foam core doors (Figure 43). 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 Sooting

For a detailed discussion on sooting, see http://homeenergy.org/archive/hem.dis.anl.gov/eehem/98/980109.html

5.3 Bathroom & Kitchen Exhaust Fans/Dryer Vents

Kitchens, bathrooms and laundry areas are natural moisture sources. Showers result in 100% humidity in the bath. Cooking and cleaning in kitchens create moisture. In laundryrooms, clothes dryers must remove large quantities of water from wet clothes. By removing moisture at the source 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 also 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 length, the greater the static pressure in the duct and the less air flow 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. Use round, smooth sheet metal ductwork for all types of exhaust ventilation. A dirty intake grille also greatly increases 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 required 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'.

Whenever possible replace range hoods vented to the outside. The hoods should have a minimum exhaust capacity of 150 CFM. Under no circumstances should recirculating fans be installed in place of the existing range hoods.

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

The minimum duct diameter should be 4" and the length should not exceed 25' from the dryer outlet to the termination point. If duct length is greater than 25', use 5" diameter duct.

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.

5.4 Site Drainage

The roof should be designed and built so that the water that lands on the roof moves out to the edge of the roof. When rain falls on a soil surface, some of it 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. Houses that have problems are those that allow water to accumulate in the soil that is in contact with the foundation (Figure 44). The soil that contacts the

![Figure 44 - Low spot adjacent to basement foundation wall](image-url)
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 dry that is next to the foundation.

Keeping the soil that touches 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. Water management systems that use funnels (such as valleys, gutters or swales) require maintenance to make sure they work as intended. Extensive damage can occur 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 serves as a gutter. It should have a surface that prevents splash back onto the siding of the house with a pitch that moves water away from the house.

- Good tamping or compaction of the backfill improves drainage because it keeps 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 rainwater 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 so that they keep the gutter from sagging.

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

• At the base of the downspout, direct the water away from the foundation, 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, particularly in wooded areas. 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 45) and the WaterFall Gutter Guard System (Figure 46). These systems cost about $4.50 per 3’ section and are designed for a 5” K style gutter (8’ sections are sold to contractors).

5.5 Heat Recovery Ventilators

In cold winter climates, excess airborne water vapor (relative humidity) can be considered a pollutant which can contribute to mold.
contamination. An HRV system provides fresh outdoor air for dilution of pollutants and improved indoor air quality. An HRV brings fresh air into a building and exhausts stale air from the building, passing the two airstreams simultaneously through a heat recovery core. This processes 50% to 80% of the heat that would otherwise be exhausted with the stale air. Mechanical ventilation augments the natural infiltration of outside air that occurs in buildings. In tight buildings with limited natural infiltration, mechanical ventilation can dilute airborne water vapor and reduce the potential for interior mold contamination.

For most effective operation, a mechanical ventilation system should supply fresh air to all the main living spaces, such as bedrooms, living, dining and family rooms. The distribution should be designed to ensure mixing of the fresh air. Exhaust should remove air from spaces where moisture and odor are generated, such as kitchens, bathrooms and utility rooms. However, in the case of IHPHA homes, the exhaust can be drawn through the boiler closets to help remove the built-up heat in these spaces.

### 5.6 Occupant Items

A number of occupant items were identified that can cause moisture and mold problems. Occupants should be educated in the following items 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 condensing on pipes.
| Inspection Number | Address            | HUD Program | Building Age | Occupancy | Foundation Type | Framing and Model Type | Heat Type                  | Site Drainage Problems | Leaks from Exterior | Wet Basement or Crawl Space | Plumbing Problems | Exterior Wall/Ceiling Problems | Attic Problems | Visible Mold | Soot Problems | Bathroom Ventilation (CFM) |
|-------------------|--------------------|-------------|--------------|-----------|----------------|------------------------|----------------------------|-------------------------|-----------------------|-----------------------------|------------------|-------------------------------|---------------|-------------|---------------|----------------|------------------|
| 1-1               | 23 Hemlock Point Rd| LR          | 20 Years     | 1         | Site-cast Concrete Crawl Space | Wood Frame 2x4 Modular Ranch | Fuel Oil Boiler/ Hydronic Baseboard | Yes | No gutter system | No No | Yes Yes No Yes No | No No | 31 |
| 1-2               | 1009 Bear Ridge Rd| MH          | 9 Years      | 3         | Site-cast Concrete Basement | Wood Frame 2x6 Stick-Built Ranch | Fuel Oil Boiler/ Hydronic Baseboard | Yes | No gutter system | No No | Yes Yes Yes Yes Yes No | Yes Yes No 33 |
| 1-3               | 45 Wolf Avenue    | LR          | 22 Years     | 4         | Site-cast Concrete Crawl Space | Wood Frame 2x4 Modular Ranch | Fuel Oil Boiler/ Hydronic Baseboard | Yes | No gutter system | No No | Yes Yes No Yes Yes | Yes Yes No 35 |
| 1-4               | 75 Hemlock Point Rd| LR          | 20 Years     | 2         | Site-cast Concrete Basement | Wood Frame 2x4 Modular Ranch | Fuel Oil Boiler/ Hydronic Baseboard | Yes | No gutter system | No No | Yes Yes Yes Yes Yes | Yes Yes 20 |
| 1-5               | Apt 8B, 9 Maple Circle (T14-9 Peter Dana Point) | LR          | 25 Years     | 1         | Site-cast Concrete Basement | Wood Frame 2x4 Stick-Built Ranch Apt. Complex | Fuel Oil Boiler/ Hydronic Baseboard | Yes | No gutter system | Yes Yes No Yes No No Yes Yes | Yes 17 |
| 2-1               | 324 Peter Dana Point Rd (9518) | MH          | 13 Years     | 4         | Site-cast Concrete Basement | Wood Frame 2x6 Stick-Built Ranch | Fuel Oil Boiler/ Hydronic Baseboard | Yes | No gutter system | Yes No | Yes Yes Yes Yes Yes | Yes Yes Yes 6 |
| 2-2               | 375 Peter Dana Point Rd | MH          | 20 Years     | 5         | Site-cast Concrete Basement | Wood Frame 2x4 Modular Ranch | Fuel Oil Boiler/ Hydronic Baseboard | Yes | No gutter system | Yes No | Yes Yes Yes Yes Yes | Yes Yes Yes 26,40 |
| 2-3               | Unknown            | MH          | 20 Years     | Unknown | Site-cast Concrete Basement | Wood Frame 2x4 Modular Ranch | Fuel Oil Boiler/ Hydronic Baseboard | Yes | No gutter system | No Yes | Yes Yes Yes Yes Yes | Yes Yes Yes 19 |
Appendix B: Indian Township Passamaquoddy Housing Authority

Inspection Number: 1-1
Address: 23 Hemlock Point Road
Age: 20 years
House Type: Low Rent
Condition: Occupied
Bedrooms: 3
Foundation: Crawl space – poured concrete
Heat Type: Boiler - oil
Construction: Modular, 2” x 4”

Mold and Moisture Conditions: Mold was reported in the bathroom. Remodeling work was underway.

Rainwater Management: No gutter system was on the home. Site drainage was flat with some depressions around the home. Approximately two inches of the foundation wall was above grade.

Crawl Space: The crawl space was unvented except for one closed vent and dry except for some condensation from a cold water line. The floor above the crawl space was insulated with R19 batts and the floor assembly was then covered with a house wrap. The boiler pipes were insulated. A section of the floor was uninsulated near the water lines under the kitchen (Figure 2). The crawl space walls were uninsulated.

Bathroom/Kitchen: Mold was reported above the bathtub and on the wall next to the tub near the floor. Remediation work currently underway included cleaning the moldy surfaces and repainting. The baseboard convector was rusted near the toilet. The bathroom exhaust fan measured 31 CFM (the fan is rated at 70 CFM). A small leak was found under the kitchen sink. The kitchen fan vented outside.

Attic: The attic was insulated with R30 batts, but numerous gaps and voids remain between batts. No mold was found. The attic hatch was uninsulated and not air sealed. The ceiling around the attic was not insulated.

Heating System: The boiler was sealed combustion and oil-fired (Figure 3). The boiler also provided domestic hot water. A separate domestic hot water storage tank was located beneath the boiler. Make-up air grilles were located in the ceiling, floor to the crawl space and in the wall to the laundry.
closet. An exhaust fan was located in an exterior wall and it automatically turned on when the boiler room temperature reached a certain temperature to cool the space (Figures 3 & 4).

**Occupant Notes:** The one occupant was not at home.

**Recommendations:**

- Install better bathroom exhaust fan
- Improve site drainage
- Re-insulate attic and seal bypasses
- Investigate alternatives to cooling the boiler closet

Figure 4 – Exhaust fan is upper-left, combustion air & vent for boiler are on the lower right
Appendix B: Indian Township Passamaquoddy Housing Authority

Inspection Number: 1-2
Address: 60 Hemlock Point Road
Age: 20 years
House Type: Low Rent
Condition: Occupied
Bedrooms: 3
Foundation: Basement – poured concrete
Heat Type: Boiler - oil
Construction: Modular, 2” x 4”

Figure 1: 60 Hemlock Point Road

Mold and Moisture Conditions: Mold was found on the bathroom ceiling and underside of the roof sheathing. Sooting was found on the master bedroom ceiling. The occupant reported sooting on the ceilings in the living room, kitchen and back bedroom. The walls and ceiling were painted about a month prior to the site visit, but soot stains were re-appearing (Figure 2).

Rainwater Management: No gutter system was on the home. Site drainage was fairly good, but there were dips and holes around the foundation. Approximately 24 inches of the foundation wall was above grade.

Basement: The basement smelled musty. The dryer vent was disconnected (Figure 3). Water was found in one corner of the basement and behind the washer. Both instances appeared to be caused by depressions near the foundation wall.

Bathroom/Kitchen: A previous mold problem in the bathroom had been cleaned. The baseboard convector had rust stains. The bathroom exhaust fan measured 33 CFM (the fan was rated at 70 CFM). The fan was vented through a roof cap. It was reported that a common problem was snow backing-up to the roof cap preventing the fan from venting properly. There were signs of a previous leak under the kitchen sink.

Figure 2 – Soot stains on ceiling

Recommendations:

- Install better bathroom exhaust fan.
- Advise clients not to burn candles to deter mold growth.

Figure 3 – Disconnected dryer vent
Attic: Attic was insulated with R30 batts. The insulation had numerous gaps and voids left between batts (Figure 4). Insulation over the top plates was compressed with plywood to maintain an air space between the roof deck and insulation. The area around the bathroom fan was not insulated. The attic hatch was uninsulated and not air sealed. The ceiling around the attic was not insulated. The underside of the north side roof deck was moldy (Figure 5). No mold was found on the south side of the roof sheathing.

Heating System: The boiler was oil-fired and also provided domestic hot water. There was no storage tank for the domestic hot water.

Sooting Problem: Sooting stains were found on the master bedroom ceiling on the front exterior wall and on the wall between the bedroom and hallway. The sooting was pronounced at the trusses. The occupant reported similar problems in the living room, kitchen and back bedroom but and had recently painted these ceiling.

Sooting can often be caused by burning candles, although the occupant reported that the previous resident had the same problem, but did not burn candles. Two candles were found in the home. The occupant reported that candles were burned 3 to 4 times a week. The candle in the living room had soot stains at the neck of the candle container (Figure 6).

Occupant Notes: Three occupants, 2 adults and 1 child reported no health problems.

Recommendations:

- Install better bathroom exhaust fan.
- Advise clients not to burn candles to determine if this is the source of the soot.
- Air seal attic bypasses before re-insulating the attic with blown insulation.
- Install insulation baffles at eaves with dams to prevent wind-washing and to keep insulation from falling into the soffit.
- Improve site drainage.
- Service boiler with respect to proper combustion and draft.
- Reconnect the dryer vent with smooth round metal ducts.
Appendix B: Indian Township Passamaquoddy Housing Authority

Figure 1 – 1009 Bear Ridge Road

Mold and Moisture Conditions: Mold was found in the bathroom.

Rainwater Management: No gutter system was on the home. Site drainage was flat with dips and holes around the foundation. Approximately 24 inches of the foundation wall was above grade.

Basement: The basement smelled musty. The dryer was vented. Water marks from a previous basement leak were present. Firewood was stored in the basement for a wood heater used to heat the basement. The top three feet of the foundation wall was insulated with ½ inch foam insulation.

Bathroom/Kitchen: Mold was found on the bathroom ceiling (Figure 2). The bathroom exhaust fan measured 35 CFM and vented through a soffit vent. The kitchen fan vented to the outside. Cabinets under the kitchen and bathroom sinks were dry.

Attic: The attic was insulated with R30 batts with numerous gaps and voids between batts. Insulation was placed over strapping creating a 1-inch air space between the ceiling surface and insulation (Figure 3). This air space can cause the ceiling surface to get cold leading to mold growth on the ceiling surface. Use insulation baffles to maintain an air space between the insulation and roof deck. A bypass was found around the chimney (Figure 4). The ceiling around the attic hatch was not insulated. The attic hatch was uninsulated and not air sealed.

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**Heating System:** The boiler was oil-fired (Figure 5). The boiler also provided domestic hot water – there was no storage tank for the domestic hot water.

**Occupant Notes:** Two adults and one child in the home reported no health problems. Both adults smoked.

**Recommendations:**
- Install better bathroom exhaust fan and install proper eave vent cap.
- Re-insulate attic with blown insulation.
- Air seal attic bypasses before re-insulating, especially around chimney.
- Insulate and air seal attic hatch.
- Improve site drainage.
- Service boiler with respect to proper combustion and draft.
Appendix B: Indian Township Passamaquoddy Housing Authority July 29-30, 2003

**Inspection Number:** 1-4  
**Address:** 45 Wolf Ave.  
**Age:** 22 years  
**House Type:** Low Rent  
**Condition:** Occupied  
**Bedrooms:** 3  
**Foundation:** Crawl space – poured concrete  
**Heat Type:** Boiler - oil  
**Construction:** Modular, 2” x 4”

**Mold and Moisture Conditions:** Mold was found on the bathroom ceiling. Mold was also found on the underside of most of the roof sheathing. Water stains were found on the foundation wall insulation in the crawl space.

**Rainwater Management:** There is no gutter system on the home. Site drainage is flat around the home with some dips and depressions (Figure 2). Approximately 18” of the foundation wall is above grade.

**Crawl Space:** Crawl space is unvented. The floor above the crawl space was insulated with R19 batts. Three-quarters of the floor assembly was then covered with a house wrap. House wrap was found on the crawl space floor under the section that was not covered. Clutter and scraps of fiberglass insulation were found in the crawl space. The foundation walls were also insulated with 2” of extruded polystyrene (R10). Boiler pipes were insulated. Crawl space was dry, however, water stains were found on parts of the crawl space foundation wall insulation (Figure 3).

**Bathroom/Kitchen:** Mold was found on the ceiling above the bathtub (Figure 4). The bathroom exhaust fan measured 20 CFM (the fan was rated at 70 CFM). The gypsum board was cut too large for the fan housing. When looking at the fan from the attic, one can see through the fan grille into the bathroom. This represented a pass or a hole in the...
ceiling whereby warm, moist air moved into the attic during the winter. The kitchen fan vented outside. Both the bathroom and kitchen sink cabinets were dry.

**Attic:** The attic was insulated with R30 batts, but not done very well leaving numerous gaps and voids between batts. Roof sheathing was covered with mold (Figure 5). Insulation was compressed with scrap plywood over the top plates. The attic hatch was uninsulated and not air sealed. The ceiling around the attic was not insulated.

**Heating System:** The boiler was oil-fired. The boiler also provided domestic hot water. A separate domestic hot water storage tank was located beneath the boiler. Make-up air grilles were located in the ceiling, floor to the crawl space and in the wall to the laundry closet. The occupant covered the grille to the laundry room with plastic because of cold air drafts. An exhaust fan located in an exterior wall automatically turned on, when the boiler room temperature reached a certain temperature.

**Occupant Notes:** Two adults and two children lived in the home. One adult smoked. One adult and one child were asthmatic.

**Recommendations:**

- Install better bathroom exhaust fan and install new gypsum board if necessary to seal larger than necessary opening.
- Re-insulate attic.
- Clean out crawl space.
- Improve site drainage.
- Investigate alternatives to cooling the boiler closet.
Appendix B: Indian Township Passamaquoddy Housing Authority

July 29-30, 2003

Inspection Number: 1-5
Address: 73 Hemlock Point Rd.
Age: 20 years
House Type: Low Rent
Condition: Occupied
Bedrooms: 4
Foundation: Basement – poured concrete
Heat Type: Boiler - oil
Construction: Modular, 2” x 4”

Mold and Moisture Conditions: Mold was found on the bathroom ceiling (Figure 2). Soot stains were found on the hallway ceiling near the juncture of both modular halves. A small leak was found beneath the kitchen sink.

Rainwater Management: There is no gutter system on the home. Site drainage was very flat with dips and holes around the foundation. Approximately 18” of the foundation wall is above grade.

Basement: A room had been built in one corner of the basement. The room was built over a subfloor constructed on the basement slab. The clothes dryer was vented. An opening in the slab appeared to be for a sump pump, but no sump was present. Wood chips from carving were found in the basement. No signs of moisture problems were found in the basement.

Bathroom/Kitchen: Mold was found on the bathroom ceiling. The bathroom exhaust fan measured 17 CFM and vented through a soffit vent. The baseboard convector was quite rusted (Figure 3). The kitchen fan vented to the outside. The bathroom sink cabinet was dry. A small leak was found under the kitchen sink.

Attic: The attic was insulated with R30 batts with numerous gaps and voids between batts and between the batts and ceiling finish. Insulation was missing over parts of the bathroom ceiling. Insulation was very poor at the juncture between both modular halves, especially near the...
location of the sooting (Figure 4). The northwest quadrant of the roof sheathing was moldy. A bypass was found around the chimney. The ceiling around the attic hatch was not insulated. The attic hatch was uninsulated and not air sealed.

**Heating System:** The boiler was oil-fired. The boiler also provided domestic hot water, but no storage tank for the domestic hot water was present.

**Occupant Notes:** One adult and one child living in the home reported no health problems.

**Recommendations:**

- Install better bathroom exhaust fan and install proper eave vent cap.
- Re-insulate attic with blown insulation.
- Air seal attic bypasses before re-insulating, especially around chimney.
- Insulate and air seal attic hatch.
- Improve site drainage.
- Service boiler with respect to proper combustion and draft.
Appendix B: Indian Township Passamaquoddy Housing Authority

Inspection Number: 1-6
Address: Apt 9B, 9 Maple Circle
Age: 25 years
House Type: Low Rent
Condition: Occupied
Bedrooms: 2
Foundation: Basement – poured concrete
Heat Type: Boiler - oil
Construction: Stick built, 2” x 4”, apartments

Mold and Moisture Conditions: The bathroom had serious mold problems which prompted the housing authority to recently do a major rehabilitation of the bathroom. Some water damage was found between the bathtub and toilet. Water stains were beginning to appear on the bathroom ceiling on the joists and nail heads. The basement was damp with water stains on the floor. Mold was found on the gypsum board around the stairwell to the basement (Figure 2).

Rainwater Management: No gutter system was on the home. Site drainage was not too bad, but some dips and holes were found around the foundation. Approximately 12 inches of the foundation wall was above grade.

Basement: Three-quarters of the building had a basement with the remaining quarter being over an unvented crawl space. The crawl space felt damp. Water stains were found on the basement. The gypsum board between the stairwell and basement was very moldy. There was some clutter in the basement.

Bathroom/Kitchen: The bathroom had recently been rehabilitated because of the mold problem. Water damage was present between the bathtub and toilet (Figure 3). Water stains that can lead to mold growth were on the ceiling. The bathroom exhaust fan measured 0 CFM but was noisy. The fan vented through a plastic ribbed soffit vent that extended for more than 20 feet. A scrap piece of gypsum...
board was found lying on top of the vent (Figure 4). The kitchen fan was recirculating. A patch was found on the ceiling above the stove and an old kitchen exhaust duct was found in the attic. Thus, the vented kitchen fan had been replaced with a non-vented kitchen fan. The bathroom and kitchen sink cabinets were dry.

**Attic:** The attic was insulated with R19 batts. The insulation was missing over parts of the bathroom ceiling, near a recessed light in the bedroom and one over the bathroom (Figure 5). A bypass was found around the chimney. The attic hatch was uninsulated and not air sealed.

**Heating System:** Each apartment had a separate oil-fired boiler. The boilers also provided domestic hot water and had a separate hot water storage tank.

**Occupant Notes:** The one occupant was not at home.

**Recommendations:**

- Install a better bathroom exhaust fan and proper eave vent cap.
- Blow additional insulation over the existing insulation.
- Air seal attic bypasses before re-insulating, especially around chimney.
- Install gypsum board boxes over recessed lights before insulating.
- Insulate and air seal attic hatch.
- Install a kitchen exhaust fan vented to the outside.
- Remove all damaged gypsum board and clutter from basement.
- Improve site drainage.
- Service boiler with respect to proper combustion and draft.
- Clean mold.
Inspection Number: 2-1
Address: 324 Peter Dana Point Rd.
Age: 13 years
House Type: Mutual Help
Condition: Occupied
Bedrooms: 3
Foundation: Basement – poured concrete
Heat Type: Boiler - oil
Construction: Stick-built, 2” x 6”

Mold and Moisture Conditions: Mold in the bathroom had been painted-over. Soot stains were found on the hallway ceiling. Soot problems in the living room had also been painted-over, but sooting was found in other places in the home (Figure 2). Mold was found on the roof sheathing above the bathroom. The basement floor sweat and some water stains were found at the floor/wall joint in the basement. A small leak was found beneath the kitchen sink.

Rainwater Management: No gutter system was on the home. Site drainage was flat with dips and holes around the foundation. A low spot was near the front left corner of the home. Approximately 24 inches of the foundation wall was above grade.

Basement: The basement floor sweat. Water stains were found at the floor/wall joint (Figure 3). The basement was dry during the site visit. Firewood was stored in the basement for a small wood stove. The dryer vented to the outside. A back room had been built in the bathroom and was insulated with 1 inch foam board.

Bathroom/Kitchen: No mold was found on the bathroom ceiling. However, a previous mold problem here had been painted. The bathroom exhaust fan measured 6 CFM and vented to the outside. The baseboard convector was quite rusted. The kitchen fan was vented to the outside. The bathroom sink cabinet was dry. A small leak was found under the kitchen sink.
Attic: Attic was insulated with R30 batts with numerous gaps and voids between batts and between the batts and ceiling finish. Insulation was missing over parts of the bathroom ceiling. The roof sheathing above the bathroom was moldy. Bypasses were found around the chimney, junction boxes and plumbing stack (Figures 4 & 5). The attic hatch was uninsulated and not air sealed. There were no insulation chutes over the top plates.

Heating System: The boiler was oil-fired. The boiler also provided domestic hot water, but there was no storage tank for the domestic hot water.

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

Recommendations:
- Install better bathroom exhaust fan.
- 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.
- Improve site drainage.
- Suggest to occupants that wood be stored outside.
- Service boiler with respect to proper combustion and draft.
Appendix B: Indian Township Passamaquoddy Housing Authority

Inspection Number: 2-2
Address: 375 Peter Dana Point Rd.
Age: 20 years
House Type: Mutual Help
Condition: Occupied
Bedrooms: 4
Foundation: Basement – poured concrete
Heat Type: Boiler - oil
Construction: Modular, 2” x 4”

Mold and Moisture Conditions: Previous mold problems in the bathroom and hallway had been painted over. A mold problem on the basement walls had also been painted over. Although only a small amount of mold was found during the site visit, it was a recurring problem in all of these areas requiring consistent cleaning and painting. A soot problem was found in the master bedroom near the hallway.

Rainwater Management: No gutter system was on the home. A raised planter on the front of the house trapped water letting it drain against the foundation (Figure 2). Site drainage was flat with a depression near the back bedroom. Approximately 24 inches of the foundation wall was above grade.

Basement: Mold was a persistent problem on the basement walls requiring constant cleaning and repainting. Although no mold was found on the basement walls during the site visit, water stains were visible on the wall behind the washing machine. The dryer vented to the outside.

Bathroom/Kitchen: A small amount of mold was found on the bathroom ceiling. However, a previous mold problem here had been painted. The bathroom exhaust fan measured 26 CFM in the main bathroom and 40 CFM in the master bedroom bath. Both fans were vented to the outside. 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 with numerous gaps and voids between batts and between the batts and ceiling finish (Figure 3). Bypasses were found around the chimney, junction boxes and...
plumbing stack (Figure 4). The attic hatch was uninsulated and not air sealed. Insulation was compressed over the top plates with scrap gypsum board.

**Heating System:** The boiler was oil-fired. The boiler also provided domestic hot water and there was a storage tank for the domestic hot water (Figure 5).

**Occupant Notes:** Two adults and three children lived in the home. Several children had severe allergies that worsened while in the home.

**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.
- Improve site drainage.
- Service boiler with respect to proper combustion and draft.
Appendix B: Indian Township Passamaquoddy Housing Authority

Inspection Number: 2-3
Address: Unknown
Age: 20 years
House Type: Mutual Help
Condition: Occupied
Bedrooms: 3
Foundation: Basement – poured concrete
Heat Type: Boiler - oil
Construction: Modular, 2” x 4”

Mold and Moisture Conditions: A small amount of mold was found on the bathroom ceiling and walls. A plumbing leak under the tub was found in the basement.

Rainwater Management: No gutter system was on the home. Site drainage was good in front, but flat in the rear of the home. Approximately 18 inches of the foundation wall was above grade.

Basement: No mold was found in the basement. A leak was under the bathtub leaked on the basement floor. A disconnected and unused wood stove and firewood were in the basement. Pet rabbits were kept in the basement. Other items stored in the basement could lead to indoor air quality problems (Figure 2). The dryer vented to the outside.

Bathroom/Kitchen: A small amount of mold was found on the bathroom ceiling and walls (Figure 3). The bathroom exhaust fan measured 19 CFM. The fan vented to the outside. The baseboard convector was rusted. The kitchen fan 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 and between the batts and...
ceiling finish (Figure 4). Bypasses were found around the chimney, junction boxes and plumbing stack. The attic hatch was uninsulated and not air sealed (Figure 5). Insulation was compressed over the top plates with scrap gypsum board.

**Heating System:** The boiler was oil-fired. The boiler also provided domestic hot water, but no storage tank for the domestic hot water.

**Occupant Notes:** Unknown – occupants were not at home.

**Recommendations:**

- Install better bathroom exhaust fan.
- 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.
- Improve site drainage.
- Suggest to occupant that wood, lawn mower, gas container and other items be stored outside.
- Service boiler with respect to proper combustion and draft.