UPPER SIOUX INDIAN COMMUNITY
TRIP REPORT
Assessment of Mold and Moisture Conditions

Final Report

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Prepared for:
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Office of Native American Programs

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UPPER SIOUX INDIAN COMMUNITY HOUSING DEPARTMENT TRIP REPORT

INTRODUCTION

Paul Francisco from the Building Research Council (BRC) at the University of Illinois Urbana-Champaign and Robert Nemeth from Magna Systems, Inc. conducted a site visit at the Upper Sioux Indian Community Housing Department (USICHD) on April 21-23, 2004. The USICHD administers the housing program for the Upper Sioux Indian Community. The site visit provided technical assistance to the housing department 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: Upper Sioux Indian Community Housing Department Technical Housing Assessment Report: Examining Mold and Moisture Conditions of Homes for the Upper Sioux Indian Community.*

BACKGROUND INFORMATION

The Upper Sioux Indian Community is located in Goodhue, Redwood, Renville Scott and Yellow Medicine counties in southwestern Minnesota, near the town of Granite Falls. The annual precipitation in Granite Falls averages 26.6 inches. The snowfall averages 45.4 inches. The annual maximum temperature averages 55.4° F and the annual minimum temperature averages 35.7° F. Approximately 808 Native Americans reside at the Upper Sioux Indian Community. The housing department maintains 15 Mutual Help 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 Upper Sioux Indian Community. Lucy Bennett, Housing Director, requested technical assistance to address mold and moisture conditions. The team met with Mrs. Bennett and Walter Labatte, Jr., Project Manager.

The assessment team visited 12 homes ranging in age from relatively new to over 100 years old. Some homes had crawl spaces and others had basements. Two homes were modular.

Following the assessment, the team provided a two-hour training session to the maintenance staff.

Day 1: Wednesday, April 21, 2004

Wednesday was a travel day.

Day 2: Thursday: April 22, 2004

The assessment team arrived at the USICHD in on Thursday morning to meet with Lucy Bennett and Walter Labatte, Jr. to discuss the day's activities, to outline the team's role while on the Reservation, and to address the Housing Department's concerns regarding the site visit. The housing staff selected several units for inspection. All homes were in the HUD Low Rent program. Following the meeting, the assessment team, guided by Walter Labatte, Jr., inspected 9 homes in the Upper Sioux Indian Community.

Day 3: Friday: April 23, 2004

On Friday morning the assessment team, accompanied by Walter Labatte, Jr., inspected 3 homes. The team presented a two hour training the housing staff in the afternoon.

Digital photographs were taken to record conditions in all 12 homes. The inspection process also involved visual assessments of both interior and exterior conditions. *PART II: Upper Sioux Indian Community Housing Department Technical Housing Assessment Report: Examining Mold and Moisture Conditions of Homes at the Upper Sioux Indian Community* provides a detailed analysis of findings and recommendations for the homes investigated.

FINDINGS

An overview of findings and recommendations for the site visit follows. *PART II: Upper Sioux Indian Community Housing Department Technical Housing Assessment Report: Examining Mold and Moisture Conditions of Homes at the Upper Sioux Indian Community* provides a more detailed discussion and analysis of the findings.

Upper Sioux Community

None of the homes had significant mold. The only community-wide problem was poor to non-existent gutter systems. While there was little evidence of problems at most sites, this may change in the future. Several homes have recently been raised due to recent flooding of the nearby river.

MOLD TESTING

The assessment team agrees that if there is mold inside a building, it should be cleaned. Generally, identifying the species of mold growing in a residence is unnecessary. No baseline exists for acceptable or unacceptable mold concentrations in a home. This message concurs with other federal agencies and experts as documented below. *Attachment 1* is a copy of *The Measurement Problem Regarding Mold.*

The Bemidji Area Indian Health Service Office of Environmental Health and Engineering, Environmental Health Services Section (BAIHS EHSS*), Guidelines on Assessment and Remediation of Fungi in Indoor Environments,* takes this position on testing:

> Consistent with Center for Disease Control (CDC) and Environmental Protection Agency, BAIHS EHSS does not recommend testing as the first response to an indoor air quality concern. Instead, careful detailed visual inspection and recognition of moldy odors should be used to find problems needing correction. Efforts should focus on areas where there are signs of moisture or high humidity or where moisture problems are suspected. The investigation goals should be to locate indoor mold growth to determine how to correct the moisture problem and remove contamination safely and effectively.

The Adverse Human Health Effects Associated with Molds in the Indoor Environment by the American College of Occupational and Environmental Medicine, states that to successfully remediate mold and moisture conditions, the water and moisture sources must be identified and corrected.

> Mold spores are present in all indoor environments and cannot be eliminated from them. Normal building materials and furnishing provide ample nutrition for many species of molds, but they can grow and amplify indoors only when there is an adequate supply of moisture. Where mold grows indoors, there is an inappropriate source of water and moisture that must be identified and corrected before remediation of the mold colonization can succeed. Mold growth in the home, school, or office environment should not be tolerated because mold physically destroys the building materials on which it grows, mold growth is unsightly and may produce offensive odors and mold is likely to sensitize and produce allergic responses in allergic individuals. Except for persons with severely impaired immune systems, indoor mold is not a source of fungal infections. Current scientific evidence does not support the proposition that human health has been adversely affected by inhaled mycotoxins in home, school, or office environment.

BAIHS EHSS Guidelines on Assessment and Remediation of Fungi in Indoor Environments discusses the limitations of testing as follows:

> Mold testing only provides a snap-shot estimate for a single point in time and a single location. How well the test represents other locations and times is uncertain since the amounts and types of mold in the environment are always changing. Furthermore, there is no basis for setting a baseline of acceptable or unacceptable mold concentrations. The variability can be especially large for airborne molds, with significant changes occurring over the course of hours or less. Caution must also be used in interpreting surface testing results, since mold growth or deposition may not be uniform over an area and may increase or decrease as time passes. Unless many samples are taken over a period of time and the investigator has been mindful of building operations and activities during the testing, the results might not be very representative of typical conditions; in addition, tests reflecting typical conditions may also miss evidence of problems that only occur infrequently (water leaks during rain storms).

Mold testing is often expensive. Dollars spent on unnecessary or poorly done testing, reduces the amount of money available for remediation and repairs. The following web sites and references provide further information on mold remediation and testing:

Indoor Air Quality:

Ball State University Indoor Environment Notebook - General resource on a number of topics related to indoor air quality.
http://publish.bsu.edu/ien/archives/archive_list.htm *(will open a new browser window)*

Mold:

EPA - Mold Remediation in Schools and Commercial Buildings
http://www.epa.gov/iaq/molds/index.html *(will open a new browser window)*

New York City Department of Health Bureau of Environmental & Occupational Disease Epidemiology - Guidelines on Assessment and Remediation of Fungi in Indoor Environments http://www.ci.nyc.ny.us/html/doh/html/epi/moldrpt1.html *(will open a new browser window*

References:

Bemidji Area Indian Health Service Office of Environmental Health and Engineering, Environmental Health Services Section, *Guidelines on Assessment and Remediation of Fungi in Indoor Environments*

The Measurement Problem Regarding Mold, by William B. Rose, Research Architect, Building Research Council/School of Architecture, University of Illinois, Urbana-Champaign Campus, 2003.

Adverse Human Health Effects Associated with Mold in the Indoor Environment: Position Statement by Hardin, Kelman, and Saxon, American College of Occupational and Environmental Medicine, 2002.

Future Housing Department Actions

The USICHD staff was very organized and helpful during the site visit. The housing department had addressed any mold problems that had existed in their units with positive actions. Much of the discussion between the team and the housing department served to confirm that the steps the housing department took had been appropriate. The capabilities of the housing department are sufficient to meet the needs of the community. The primary change to current actions that would be beneficial in the future would be to assure that gutter systems are installed completely and properly at each home.

Attachment 1

APPENDIX C: LIMITATIONS OF MOLD SAMPLING

The Measurement Problem Regarding Mold

By William B. Rose, Research Architect
Building Research Council/School of Architecture
University of Illinois, Urbana-Champaign

When complaints of mold problems occur, two courses of action are appropriate: 1) visually assess the site, remove the mold, and correct the conditions that led to the mold and 2) contact health professionals for allergy or respiratory problems. The proper action is to discover sites of mold growth. Where this approach has been used, the outcome has been, in every case, improvement of indoor environment conditions (though the improvements may take time) and improvement of health conditions. This is the recommended approach for dealing with mold problems in housing in Indian areas.

Techniques for sampling biological aerosols were developed for industrial and agricultural settings. They were designed to help industrial hygienists determine the safety of workplaces and other environments. The value of their work was evident in determining the causes of the Legionella outbreak of 20 years ago, and in sampling for biological warfare agents at present. Sampling produces counts of mold material from samples taken in the air or on surfaces. It may determine the number of viable spores in a sample from the air or a surface. And it may be used to identify genus and species of mold found in the sample.

Neither of the two recognized guidelines for mold remediation, the NYC Department of Health's *Guidelines on Assessment and Remediation of Fungi in Indoor Environments* and the USEPA's *Mold Remediation in Schools and Commercial Buildings*, calls for environmental sampling for routine mold problems. Both guidelines discourage environmental sampling in most cases. This opinion is summarized on the CDC website:

> Generally, it is not necessary to identify the species of mold growing in a residence, and CDC does not recommend routine sampling for molds. Current evidence indicates that allergies are the type of diseases most often associated with molds. Since the susceptibility of individuals can vary greatly either because of the amount or type of mold, sampling and culturing are not reliable in determining health risk . . . reliable sampling for mold can be expensive, and standards for judging what is and what is not an acceptable or tolerable quantity of mold have not been established.

In general, the use of mold sampling must be discouraged. There are several reasons for this. First, aside from allergic effects, the health outcomes of mold in homes, schools or offices have not been established. Second, given those circumstances, there is no basis for setting a baseline of acceptable or unacceptable mold concentrations. Third, the internal repeatability of mold sampling results has not been shown in the literature. Fourth, weaknesses in the visual assessment protocols have not been demonstrated.

Mold sampling has been done in residential settings, leading to conclusions about the presence of mold, about the presence of individual species of mold, and about high concentrations of mold in some locations. However, much of the information provided by sampling is already known from common sense. The following are some facts about mold in indoor environments that are known even before measurements are taken:

1. Mold is everywhere. The outdoor air contains rather high concentrations of mold spores, which are naturally occurring. By contrast, most building interiors contain lower concentrations, though the concentrations indoors and outdoors vary over time. Indoor air comes from the outdoors. If the indoor is cleaner than the outdoors, something served as a filter, accumulating mold, dust and airborne material over time. Some commercial buildings have filtration systems designed to clean air as it passes from outdoors to indoors. But in most buildings, the outdoor air infiltrates through cracks and cavities in the building envelope as it travels indoors. If the indoor air is cleaner, then the building envelope acts like a filter. Therefore, when a sample of indoor air is taken, mold spores will be found. The conclusion "This building has mold" can be made of all buildings.

2. Dust, dirt, mold spores and other particulates accumulate in building cavities over time. There is no passive cleaning process for building cavities to match this cumulative process. Because the walls and roofs filter outdoor air as it moves indoors, all building cavities must be considered as sites with high concentrations of mold spores and other airborne material.

3. Evidence indicates that where proper conditions are in place, sooner or later the species that typically inhabit such spaces will arrive. *Stachybotrys* is known to inhabit pulpy cellulose materials that are maintained at a high water activity level. With the right quantity of water, the paper facing of gypsum products generally shows the growth of *Stachybotrys*. Where the appropriate conditions are maintained for a long enough time, *Stachbotrys* and other species appear and grow. "Wet it, and they will come."

4. It is logically impossible to prove a negative statement. There are no tests that allow one to draw the conclusion that absolutely no mold spores representing a species are to be found in a space. Even if a test should turn up no spores of a given species that does not provide conclusive evidence of the total absence of that species from the interior space. And conditions may change from one hour to another. So a finding in a room or building of any given species, including *Stachybotrys*, should not be considered exceptional. The absence of a species from a space can be determined statistically to a pre-selected degree of confidence, requiring several tests.

What, then, remains to be discovered through mold measurement? It is already determined, for all buildings, that mold is contained in the air, that any species may be found in the air or on the surface, and that high concentrations of mold are contained in the cavity. If a tenant or occupant complains about living conditions, it is clear that any unit that occupant will move to will have mold in the air, will have all common species of mold in the air or on surfaces, and will have high concentrations of mold in the building cavities. It is wrong to presume that buildings are sterile simply by virtue of their never having been measured.

Measurements of mold are not useful if the purpose of the measurement is to determine any or all of the following:

1) if the building has mold,
2) if a certain species, say, *Stachybotrys*, is present, or
3) if the building cavities have high concentrations

For the measurement criteria above, no measurements should be made, as the results will be dismissed as being of no use.

Possible Occasions for Mold Measurement

After the effective implementation of visual assessment and remediation of mold as described above and conditions of mold are suspected to still exist, it is possible (though unlikely) that a visual assessment will overlook a cause of distress. If that happens, one strong possibility is that the distress is not related to mold in the first place. However, in the case where a mold problem has not been accurately identified and remediated through visual assessment, three scenarios are often suggested as possible occasions for mold measurement:

1. Active mold growth is usually accompanied by amplification, the strong increase in mold of one or two species out of proportion to the background taxa.

2. Mold may have an odd source, such as air conditioning ductwork, and may be present in the building only when that source contributes to the space, or

3. An investigator may use a fixed level as a measure of acceptability or cleanliness (though it bears repetition: there are not exposure limits set by any authorities).

In each of these cases, mold measurement may be able to provide some insight.

The statistics of mold measurement

For mold measurement to provide insight, or to provide material for decision-making, the results of mold testing must be statistically significant. One measurement is never statistically significant. Understanding the notion of statistical significance requires understanding error and bias.

Two samples of the same space will never provide the same results. There is always some spread (or precision error) in the data. The mold sampling industry generally fails to make public their estimates of the precision error in their sampling methods. It would be good to know, for the same equipment, same operator, same laboratory, same technician, what the estimate of the error would be. That information is not presently available. In addition to precision error, there are many other factors that tend to bias the results one way or another. These include the following:

1. Time of the day (ascomycetes tend to release spores in the afternoon, basidiomycetes in the morning)
2. Season (lower during winter)
3. Snow cover (greatly reduces outdoor concentrations)
4. Sampling technique (lowest with culturable samples, medium with impactors, highest with PCR)
5. Variations over space (highest, usually, in basements and crawl spaces)
6. Variations by surface (highest near carpets)
7. Disturbance (greatly higher with scuffing and fluffing of carpets, etc.)
8. Variations by wetness (higher concentrations on wetter materials)
9. Laboratory
10. Technician

It is evident that achieving statistically significant results requires considerable care, in addition to thoroughly accounting for variables. All proposals for mold study that involve sampling must contain information that describes:

1. The yardstick, or baseline values, that will be used for interpretation,
2. The variables that are accounted for in the study,
3. The error estimate associated with those variables,
4. The confidence interval to be used (95% confidence in the results is recommended),
5. How the study will deliver that level of confidence.

Sampling campaigns that give numbers without giving statistical significance to those numbers are worse than worthless. They come at a financial and social cost and are very disruptive to the lives of individuals, families and tribes.

The range of concentrations often found in mold measurements is several orders of magnitude—sometimes several dozen spores or colony-forming-units (CFUs) per unit of mass or volume out to several million. Most guidance advises representing the distribution as lognormal; that is, if the data values are represented not as numbers with zeroes but as powers of ten, then the exponents occur in a normal distribution. This is quite helpful, as one of the tails of the distribution never drops below zero.

Let us presume that an environmental consultant hypothesizes that the airborne mold spore concentration in a room exceeds a certain value. Of course, the consultant would be obliged to cite the reference for the value selected. Taking a single sample gives a distinct reading for the sample but says nothing about the concentration in the room. A second sample, with a result different from the first, proves that a single sample cannot characterize the actual concentration. Also, clearly, the more samples that are taken, the more sure one can be that the mean of the measured values represents the actual value, and can be used in this comparison test.

Let us also presume that the confidence interval used is 0.05 ($\alpha = 0.05$). That means that 5% of the time the confidence in the veracity of the finding will be misguided. Nevertheless, many scientific and management findings use a 0.05 confidence interval. Tribal leaders or others who are entertaining proposals from environmental consultants might consider having a stated confidence interval at the time of the work proposal, perhaps of 5%.

Then standard statistics allows us to calculate the confidence interval. The result is usually expressed as a value $y \pm z$ ($\alpha = 0.05$). The value y is the mean (average) of the sample values. The value z is composed of the Standard Error (SE, equal to the standard deviation divided by square root of the count-1) times a factor called "student's-t" (t). This factor is commonly used in statistics when the number of samples is small; it is found in textbooks of statistics and as a common spreadsheet function. The value z is equal to (t) * (SE).

An environmental consultant may wish to sample to determine if a certain species is present or not. Common species of mold should always be deemed to be present, but may be proved to be absent, if indeed they are absent, to any selected degree of confidence (never for certain).

Testing is expensive. So there is a strong tendency on the part of both consultants and clients to conduct testing without regard to the statistical significance. This practice should end, as the results cannot be used for decision-making. If testing is to be done at all, then the testing campaign must be designed to have the power to provide answers to the critical questions.

All mold testing must include a minimum of two samples per measurement site. Taking only one sample leaves the impression that the value is somehow elevated above error. With two samples per site, the issue of error is inescapable. In addition all mold testing should:

- State the question or hypothesis that is being answered or addressed through testing
- State the criteria (absolute or comparison) used to address the hypothesis
- State the proposed confidence level.
- List the errors and biases that are accounted for (or controlled for) in the testing.
- Calculate the margin of error.
- Report the findings with the margin of error.
- Attach statistical significance to the conclusions.

July, 2003

PART II

UPPER SIOUX INDIAN COMMUNITY HOUSING DEPARTMENT

TECHNICAL HOUSING ASSESSMENT REPORT

EXAMINING MOLD AND MOISTURE CONDITIONS IN HOMES AT THE UPPER SIOUX INDIAN COMMUNITY

EXECUTIVE SUMMARY

The assessment team inspected twelve homes for mold and moisture problems, as requested by the Upper Sioux Indian Community Housing Department (USICHD) and the Eastern/Woodlands Office of Native American Programs. USICHD administers the housing program for the Upper Sioux Indian Community. Paul Francisco of the Building Research Council and Robert Nemeth of Magna Systems conducted the investigation on April 22nd and 23rd. The inspection process involved visual assessment of both interior and exterior conditions and resident interviews when possible.

The homes varied widely in construction and vintage. Some homes were relatively new, while others were in excess of 100 years old. Two homes were modular. Some homes had crawl spaces, while others had basements. The homes were heated with forced-air gas furnaces.

The only community-wide principal finding was poor to non-existent gutter systems. Several homes had been raised due to recent flooding, and, as a result, few houses had significant site drainage problems. Mold or moisture problems were found in only two homes.

This report provides technical discussions based on the inspections. Appendix A includes a summary of findings at each inspected home. Appendix B provides observations and recommendations for each home.

INTRODUCTION

The Eastern/Woodlands Office of Native American Programs requested that the Building Research Council (BRC) assess mold and moisture problems in USICHD homes. Paul Francisco and Robert Nemeth conducted the site visit on April 22nd and 23rd, 2004, with Walter Labatte, Jr., of the USICHD as their escort. USICHD had pre-selected the houses. The following is a brief list of findings:

- Minor mold was found in only two inspected homes. One additional home had mildew on the vinyl siding on the north face.
- One home had a water leak through the roof around the chimney, resulting in significant damage to the wall stacks through which the chimney ran. The roof sheathing was also damaged at this home.
- Two homes had flashing details that should be addressed. One was around windows and the other was where the exterior wall met the front porch. The first home also had missing fascia at one gable end and missing siding and trim around windows and doors at the back of the house.
- One home reportedly had occasional water in the basement and a sub-slab drainage system that reportedly did not function properly.
- One home had a persistent slow drip in a plumbing fitting in the basement.
- Other homes had conditions that could potentially lead to problems, such as site drainage issues, carpeted basements, cracks in foundation walls, etc., but had no noticeable problems at the time of the inspection.

SECTION 1 – METHODOLOGY

Visual inspections were used to assess mold and mildew conditions in the homes. Since few problems were identified, and there were many homes to inspect, fan flows were not measured.

The results of the mold and moisture assessments are compiled in Appendix A, with broad categories of common moisture problems noted. Findings and recommendations for individually inspected houses are presented in Appendix B.

Visual Inspection

Housing inspections consisted of a 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, thus 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 rainwater and snowmelt management, including site grading, roof conditions and gutter systems.

Whenever possible, residents were interviewed to gather history on moisture problems, plumbing leaks, winter condensation, health issues, number of occupants and other useful information.

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

SECTION 2 – HOUSE DESCRIPTIONS

The USICHD manages 15 Mutual Help units. Approximately 808 Native Americans reside in the Upper Sioux Indian Community.

Twelve homes were inspected. The homes varied widely in construction and vintage. Some homes were relatively new, while others were in excess of 100 years old. Two homes were modular. Some homes had crawl spaces, while others had basements. The homes were heated with forced-air gas or propane furnaces.

SECTION 3 – FINDINGS

3.1 Bathroom & Kitchen Exhaust Fans; Clothes Dryers

Properly operating and vented exhaust fans and clothes dryers remove moisture from bathrooms and homes. Not all homes had exhaust fans in each of these places. Though there was no mold evident due to the lack of these fans, they are still highly recommended as a way to remove both moisture and pollutants such as those from cooking. Some range hoods were recirculating the air rather than exhausting it to the outside.

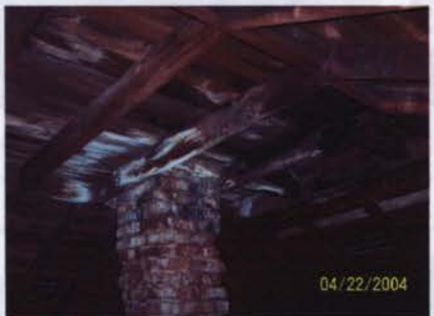

Figure 1 - Water damage under roof and on chimney due to roof

3.2 Attics

Only one attic had leakage problems around the chimney where it went through the roof (Figure 1), which, in turn, caused significant damage to the walls through which the chimney stack was located (Figure 2).

Figure 2 - Water damage from leaky roof around chimney

3.3 Gutter Systems

Nearly all homes had missing or incomplete gutter systems, though some homes did have gutters to keep visitors from getting wet while waiting at the door (Figures 3 & 4). Gutters are important tools for moving water away from the house and need to be fully installed.

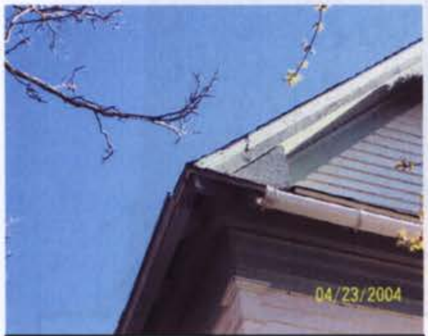

Figure 3 - Home with incomplete gutter system

3.4 Site Drainage

Site drainage is critical to maintaining a dry foundation that in turn helps maintain a dry home. Some homes had been severely damaged in a flood several years ago and were raised creating excellent site drainage (Figure 4). Others also had good site drainage (Figure 5). However, two homes had site drainage problems. One had the ground sloping toward the house. The other had a sub-slab drainage system that reportedly did not function properly.

Figure 4 - Home with gutter over doorway; home was raised to improve the site drainage.

3.5 Exteriors

A few homes had problems on the exterior of the buildings. One building had algae growth on the north face siding (Figure 6). Another house was missing trim around several of the windows in the rear of the home (Figure 7), was missing flashing at the deck, and was missing fascia on the gable end (Figure 8). One home had flashing at the front porch that collected

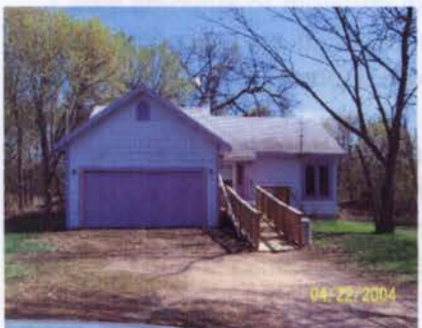

Figure 5 - Home with good site drainage

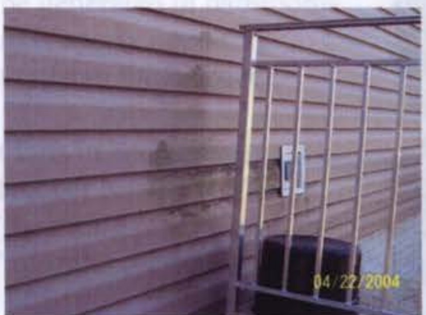

Figure 6 - Algae growing on north face

Figure 7 - Missing trim around windows

Figure 8 - Missing fascia at gable end

water at the house instead of shedding it away (Figure 9).

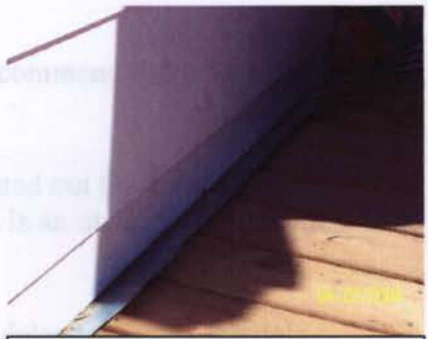

Figure 9 - Poorly installed flashing collects water.

3.6 Heating Systems

The homes had propane or gas-fired forced-air heating systems with central return air systems.

Three problems with these systems were identified:

1. At one home the furnace flue had a gap covered up by failing duct tape (Figure 10). This created a risk of flue gases being pulled back into the home if there was significant depressurization in the basement.

Figure 10 - Gap in furnace flue

2. Furnace filter slots were typically not capped (Figure 11). These uncapped filter slots were a hole in the return system drawing air from the basement into the distribution system.

3. Many return systems used panned returns, which consist of sheet metal attached to joists. These tend to be leaky and need to be sealed or replaced.

SECTION 4 – TECHNICAL RECOMMENDATIONS

4.1 Bathroom & Kitchen Exhaust Fans; Clothes Dryers

Large amounts of moisture can be generated in bathrooms and kitchens given their function. Properly operating exhaust fans help remove moisture from these spaces.

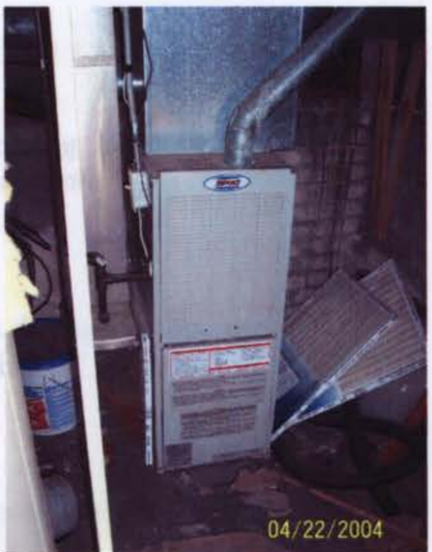

Figure 11 - Uncapped filter slot at furnace

- Install bathroom exhaust fans in bathrooms with a minimum rate 70 cubic feet per minute (CFM) at 0.25" of static pressure (the rating provided on the box is generally at 0.10" of static pressure).

- Ensure that the new bathroom fans 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 to not use loud fans. Low-sone fans include Broan *Solitaire* and Panasonic *WhisperCeiling* and *WhisperLite* series. Low-sone fans generally cost between $75 and $100.

- Use smooth, round sheet metal ducts rather than plastic ribbed ducts. Minimize long duct length, turns and bends in the ductwork. Smooth ducts provide less resistance and improve flow over ribbed ductwork. Recommend that occupants clean dust and lint off intake grilles regularly.

- Ensure that exhaust fans that run through attics are ducted out through the roof. Terminating bathroom exhaust fans beneath roof vents is an unacceptable method for venting exhaust fans.

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

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

- Periodically inspect all bathroom and kitchen exhaust fan ducts. Ensure that exhaust ducts are vented outside and are properly attached and sealed to the exhaust fan housing and to roof vent caps. Repair disconnected ducts.

- Periodically inspect dryer vents. Correct the following conditions as follows:

  - Install new dryer vent when missing or damaged.
  - Replace crimped or cracked dryer vents.
  - Reconnect disconnected dryer vents.
  - Reinstall vents to vent only to the outside of the building.
  - Replace plastic ribbed dyer vents with smooth metal vents.

4.2 Attics

Repair or replace the roof and the plaster walls that have been damaged at one site. Inspect the chimney for structural integrity, then repair or replace, if necessary.

4.3 Gutters

Replace damaged gutters, missing downspouts, and leaders. Install splash blocks.

Given the snow/ice conditions in this region of Minnesota, the recommendations for a gutter system are:

- Use minimum 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 12). If unavailable or too costly, the K-style gutters may be used (Figure 13).

Figure 12 – Half-round gutter

Figure 13 – Traditional K-style gutter

- Use the heavier versions of the hidden hangers and secure every 18 inches. At a minimum, use the heavier hangers at stress points, such as corners and at downspouts.
- Secure downspouts with 3 fasteners not 2.
- Use one downspout for every 40 feet of gutter.
- Use a leaf guard system to keep gutters free of debris.
- Use leaders and splash blocks at the base of downspouts to direct water at least 3 feet away from a house that has a crawl space and 5 feet away from homes with basements.
- Use flip-up leaders that may be raised to cut grass (Figures 14 & 15).

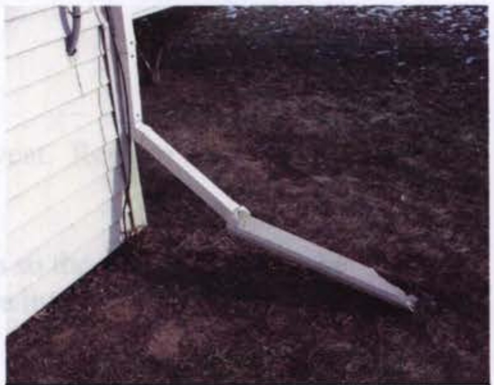

Figure 14 – Flip-up leader in down position

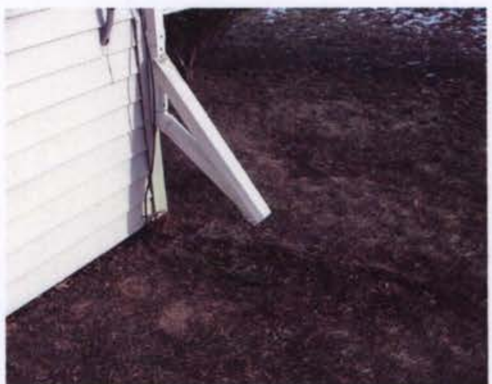

Figure 15 – Flip-up leader in up position

4.4 Site Drainage

Most homes had good site drainage, but two homes had reported flooding in the basement:

One home requires moving the mechanical systems out of the basement and into the living space. This can be accomplished by building a small addition to the rear of the house. A good gutter system designed to take the water away from the house will be helpful and a sump pump may be required to keep the basement dry.

Place acrylic covers over the window wells to shed water away from the house instead of collecting it in the wells and place horizontal insulation approximately one foot below the surface to shed water away from the foundation. During installation of the horizontal insulation, seal the upper portion of the block wall while it is exposed.

4.5 Exteriors

Remove the algae at the rear of one house by washing.

Install trim around the windows and sliding glass door at one house. Install flashing where it is missing beneath the deck and replace the fascia on the gable end.

Repair the flashing at the front deck of another house to shed water away.

4.6 Heating Systems

Three recommendations for the heating systems include:

1. Repair the flue at one site to remove the gap with B-vent. Replace sections of the flue as necessary.

2. Modify return air slots to accept properly fitted filters so the slot opening can be capped with a piece of metal. Eliminate filters that are internal to the furnace since they are difficult to change.

3. Seal panned returns with mastic where the metal meets the joists or replace them with ducting.

1	2	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
Inspection Number	Address	Building Age	Occupancy	Foundation Type	Model and Framing Type	Heat Type	Site Drainage Problems	Gutter System Problems	Leaks from Exterior	Wet Basement or Crawl Space	Plumbing Problems	Bathroom Problems	Exhaust Ventilation	Exterior wall/ceiling problems	Attic Problems	Visible Mold (Column #)
1-1	5392 240th Ave.	129	unoccupied	Basement	Two-story wood frame	Propane	No	Yes	No	No	No	No	No	No	No	inactive in kitchen
1-2	Rt. 2 Box 108D (595th Ave.)	70+	1	Basement	Ranch; wood frame	Propane	No	Yes	No	No	No	No	No	No	No	none
1-3	5654 266th Ave.	100	1	Crawl Space	Ranch; wood frame	Propane	No	Yes	No	No	Yes	No	No	No	No	none
1-4	5660 266th Ave.	<10	2	Crawl Space	Modular	Propane	No	Yes	N/A	No	N/A	N/A	N/A	N/A	N/A	N/A
1-5	5696 266th Ave.	<10	2	Crawl Space	Ranch; wood frame	Propane	No	Yes	No	No	No	No	Bath	No	No	none
1-6	5676 266th Ave.	10	2	Crawl Space	Modular	Propane	No	Yes	No	No	No	No	Bath	No	No	none
1-7	143 Washington	114	3	Basement	Two-story wood frame	Nat. Gas	No	Yes	No	No	No	No	Yes	No	No	none
1-8	1092 6th St.	Unknown	1	1/2 Basement, 1/2 Crawl	Ranch; wood frame	Nat. Gas	Yes	Yes	Yes	Yes	No	No	Bath	No	No	none
1-9	Rt. 2	Unknown	5	Basement	Two-story wood frame	Propane	No	Yes	No	No	No	No	Bath	No	No	window

2-1	207 2nd Ave., Echo		2	Basement	Two-story wood frame	Nat. Gas	No	Yes	No	No	No	No	No	No	No	none
2-2	5723 Travers Lane		4	Basement	Ranch; wood frame	Propane	Yes	Yes	Yes	Yes	No	No	Bath	No	No	none
2-3	940 Prentice St.		1	Basement	Two-story wood frame	Nat. Gas	No	Yes	Yes	No	No	No		No	No	none

H = mutual help LR = Low Rent

Inspection Number: 1-1
Address: 5392 240th Ave.
Age: 129 years
House Type: Two-story
Condition: Undergoing renovation
Foundation: Basement
Heat Type: FA furnace (propane)
Construction: Stick-built
Occupants: 0

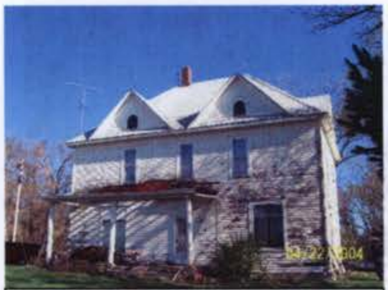

Figure 1 – 5392 240th Ave.

Mold and Moisture Conditions: A small patch of very old mold was found on the wallpaper in the kitchen, but no new growth of mold.

Rainwater Management: Site drainage was good. There was no gutter system. The porch roof was in disrepair.

Basement: The basement was cluttered, which could lead to mold growth in the future.

Bathroom/Kitchen: No exhaust fans were in the home.

Heating System: The forced air system was a combination propane fired furnace that had been recalled and was to be replaced.

Occupant Notes: The home was unoccupied.

Recommendations:

- Install low-sone bathroom exhaust fans in the bathrooms with fan delay timers, and a range hood in the kitchen vented to outside.
- Install a gutter system with leaders at the base of the downspouts.
- Clear the basement of clutter.
- Rebuild the front porch roof.
- Wet, remove, and discard the wallpaper with the old dormant mold.

Inspection Number: 1-2
Address: 595th Ave.
Age: 70+ years
House Type: Ranch
Condition: Occupied
Foundation: Basement
Heat Type: FA furnace (propane)
Construction: Stick-built
Occupants: 1

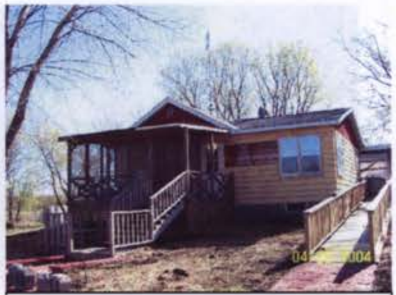

Figure 1 - 595th Ave.

Mold and Moisture Conditions: No mold was found.

Rainwater Management: The site drainage was excellent since the home was raised 4 feet after a flood. No gutter system was present.

Basement: The basement was dry. It was previously flooded prior to being raised. The walls were furred out with 2 inch x 4 inch studs with fiberglass insulation. Vapor barriers were on both sides of the insulation (Figure 2). This could lead to trapping moisture within the basement walls.

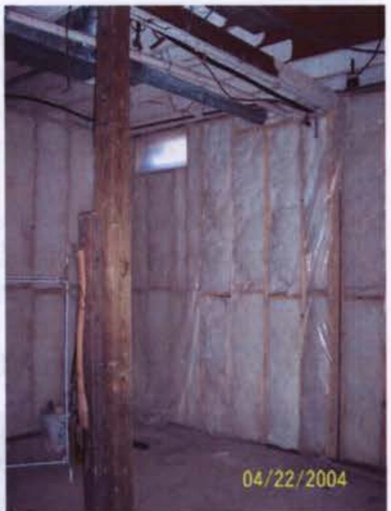

Figure 2 - Vapor barriers on the basement studs

Bathroom/Kitchen: No exhaust fans were present.

Heating System: The forced air system was a new propane fired furnace.

Occupant Notes: One person lived at this home.

Recommendations:

- Install low-sone bathroom exhaust fan in the bathroom with a fan delay timer and a range hood in the kitchen that is vented to outside.

- Install a gutter system with leaders at the base of the downspouts.

- Remove the inner vapor barrier from the basement walls before installation of the drywall.

Inspection Number: 1-3
Address: 5654 266th Ave.
Age: 100 years
House Type: Ranch
Condition: Occupied
Foundation: Crawl Space
Heat Type: FA furnace (propane)
Construction: Stick-built
Occupants: 1

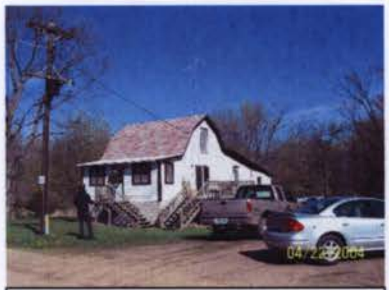

Figure 1 - 5654 266th Ave.

Mold and Moisture Conditions: No mold was found.

Rainwater Management: The site drainage was excellent since the home was raised 4 feet after a flood. The gutter system was minimal and had no downspouts.

Crawl space: The crawl space was dry now, but previously flooded prior to being raised.

Bathroom/Kitchen: No exhaust fans were present. There was a severe water quality problem; the well water smelled like sulfur. The occupant flushed the pipes every morning. There was evidence of a prior leak under the kitchen sink.

Heating System: The forced air system was a propane fired furnace.

Other notes: The floor joists were sagging (Figure 2). The dryer exhaust port on the exterior of the house was stuck in the open position (Figure 3).

Figure 2 - Sagging beam in crawl space.

Occupant Notes: One person lived at the home.

Recommendations:

- Install a low-sone bathroom exhaust fan in the bathroom with a fan delay timer and a range hood in the kitchen that is vented to outside.
- Install a gutter system with leaders at the base of all downspouts.
- Repair or replace the dryer vent termination.
- Place new beams and supports below the sagging floor joists.
- Get the water problem checked and determine how best to solve the problem.

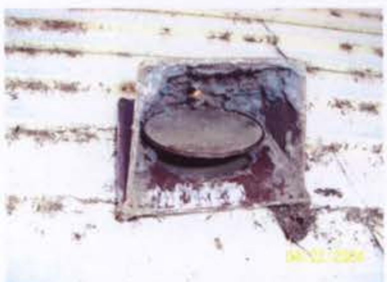

Figure 3 - Dryer vent port in open position.

Inspection Number: 1-4
Address: 5660 266th Ave.
Age: <10 years
House Type: Modular
Condition: Occupied
Foundation: Crawl Space
Heat Type: FA furnace (propane)
Construction: Modular
Occupants: 2

Figure 4 - 5660 266th Ave.

No occupants were home, so the inspection was limited to the exterior.

Rainwater Management: The site drainage was good. Gutters were incomplete.

Occupant Notes: Two people lived in the home, but were not home during the site visit.

Recommendations:

- Finish installing the gutters and properly install downspouts and leaders.

Inspection Number: 1-5
Address: 5696 266th Ave.
Age: 10 years
House Type: Ranch
Condition: Occupied
Foundation: Crawl Space
Heat Type: FA furnace (propane)
Construction: Stick-built
Occupants: 1

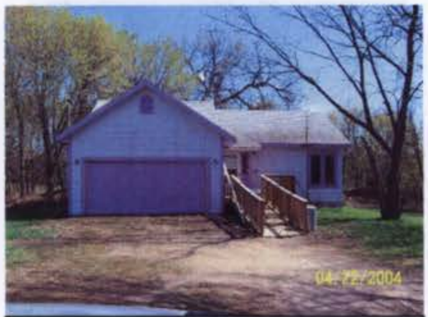

Figure 1 - 5696 266th Ave.

Mold and Moisture Conditions: No mold was found.

Rainwater Management: The site drainage was good. A gutter system was present, but was missing downspouts (Figure 2). There was poorly-installed flashing at the front deck (Figure 3).

Crawl space: The crawl space was dry, but the vapor barrier had been moved aside, exposing the soil.

Bathroom/Kitchen: The bathroom had a working exhaust fan. The kitchen fan was recirculating.

Heating System: The forced air system was a propane fired furnace.

Occupant Notes: Two people lived in the home.

Figure 2 - Missing downspout.

Recommendations:

- Replace the recirculating kitchen range hood with one that exhausts to the outside.
- Install downspouts with leaders.
- Fix the problems with the flashing.
- Put the vapor barrier back over all of the soil and seal it to the perimeter of the crawl space.

Figure 3 - Poorly installed flashing.

Inspection Number: 1-6
Address: 5676 266th Ave.
Age: <10 years
House Type: Modular
Condition: Occupied
Foundation: Crawl Space
Heat Type: FA furnace (propane)
Construction: Modular
Occupants: 2

Figure 1 - 5676 266th Ave.

Mold and Moisture Conditions: No mold or moisture problems were found inside the house, but some algae grew on the exterior siding on the north face of the house.

Rainwater Management: The site drainage was good. There were no gutters on the house.

Crawl Space: The crawl space was dry.

Heating System: The forced air system was a propane fired furnace.

Occupant Notes: Two people lived in the home.

Recommendations:

- Install a gutter system with downspouts and leaders.
- Wash the back side of the house.

Inspection Number: 1-7
Address: 143 Washington
Age: 114 years
House Type: Two-story
Condition: Occupied
Foundation: Basement
Heat Type: FA furnace (natural gas)
Construction: Stick-built
Occupants: 3

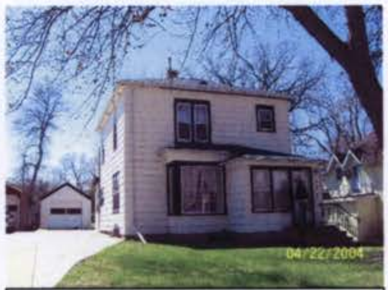

Figure 1 - 143 Washington

Mold and Moisture Conditions: Mold was not found in the home, but significant moisture damage was on the walls on the second floor through which the chimney ran (Figure 2).

Rainwater Management: The site drainage and gutter system were good. Some damage was present at the base of the exterior siding (Figure 3) and below the second story window on the front of the house (Figure 4).

Figure 2 - Moisture damage on walls due to roof leak.

Basement: The basement was dry.

Bathroom/Kitchen: The bathroom had an exhaust fan with uninsulated ducting to the outside. The kitchen fan was a recirculating range hood.

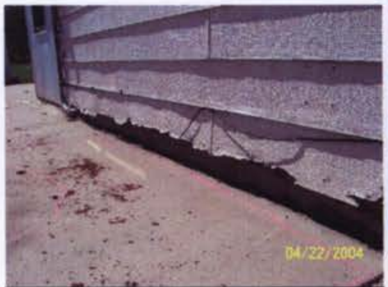

Figure 3 - Damaged siding.

Figure 4 - Water damage below 2nd story windows.

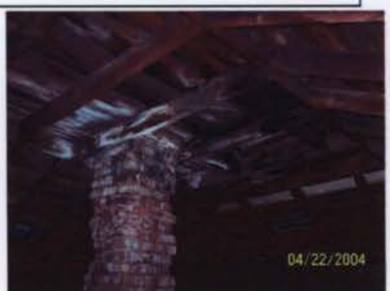

Figure 5 - Water damage under roof.

Figure 6 - Gap in furnace flue in basement.

Attic: The attic had moisture damage under the roof where the chimney went through the roof (Figure 5).

Heating System: The forced air system was a natural gas fired furnace. A gap was found in the flue that allowed combustion gases to enter the basement (Figure 6).

Occupant Notes: Three people lived in the home.

Recommendations:

- Repair the roof, walls, and chimney as needed.
- Repair furnace flue with B-vent duct.
- Install a kitchen exhaust fan that vents to the outside.
- Replace bath fan exhaust duct with insulated duct.
- Replace siding at the base of the house and under the second story window at the front of the house.

Inspection Number: 1-8
Address: 1092 6th St.
House Type: Two-story
Condition: Occupied
Foundation: ½ Basement, ½ Crawl Space
Heat Type: FA furnace (natural gas)
Construction: Stick-built, 2" x 4"
Occupants: 1

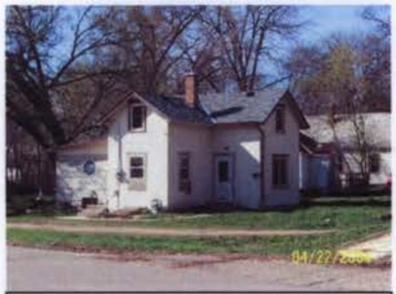

Figure 6 - 1092 6th St.

Mold and Moisture Conditions: No mold was found in the home.

Rainwater Management: The site drainage was poor, with the house sitting in a depression. No gutters were present.

Basement/Crawl space: The basement was dry, but has experienced flooding in the past. The basement is accessed from the outside.

Bathroom/Kitchen: The bathroom has a working exhaust fan. The kitchen has no vented exhaust fan.

Heating System: The forced air system was a natural gas fired furnace, located on the floor of the basement. It had a very leaky panned joist return system.

Occupant Notes: One person lived in the home.

Recommendations:

- Build an addition onto the back of the home and relocate the mechanical systems to this addition.
- Install a gutter system with downspouts and leaders designed to take the water well away from the building.

Inspection Number: 1-9
Address: Rt. 2
House Type: Ranch
Condition: Occupied
Foundation: Conditioned basement
Heat Type: FA furnace (propane)
Construction: Stick-built
Occupants: 5

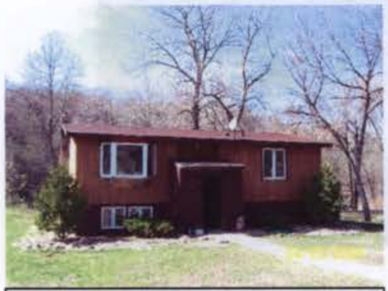

Figure 1 - Site 1-9, Rt. 2

Mold and Moisture Conditions: Minor mold was found at one of the lower floor windows due to missing flashing. There was missing trim around windows and the sliding glass door (Figure 2). There was missing fascia on one gable end (Figure 3).

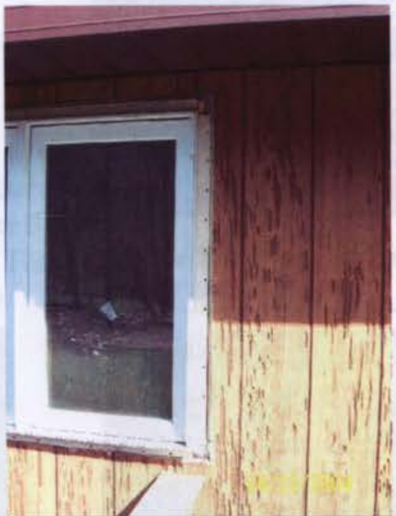

Figure 2 - Missing trim around windows.

Rainwater Management: The site drainage was acceptable. No gutter system was installed.

Basement: The conditioned basement was dry.

Heating System: The forced air system was a propane fired furnace.

Occupant Notes: Five people lived in the home.

Recommendations:

- Install flashing above window beneath the deck on the rear of house.
- Install a gutter system with downspouts and leaders.
- Finish installing the trim around the windows and the sliding glass door.
- Repair the fascia on the gable end.

Figure 3 - Missing fascia on gable end.

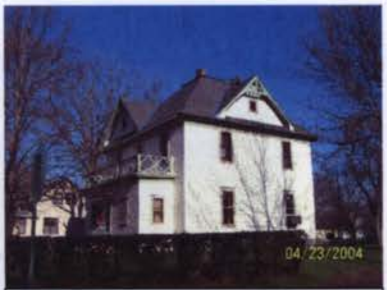

Figure 1 - 207 2nd Ave., Echo

Inspection Number: 2-1
Address: 207 2nd Ave., Echo.
House Type: Two-story
Condition: Occupied
Foundation: Basement
Heat Type: FA furnace (natural gas)
Construction: Stick-built
Occupants: 2

Mold and Moisture Conditions: No mold was found in the home.

Figure 2 - Missing section of gutter and downspout.

Rainwater Management: The site drainage was adequate. The gutter system was incomplete (Figure 2) and had no downspouts.

Basement: The basement was dry with carpets and cardboard boxes on the floor increasing the potential for mold (Figure 3). There was also a crack in the foundation wall (Figure 4). The termination port for the dryer vent was clogged (Figure 5).

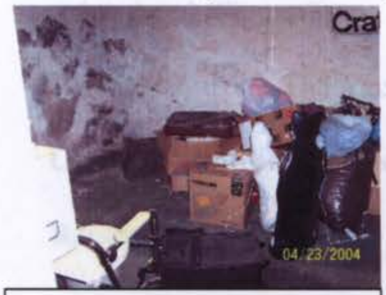

Figure 3 - Clutter and cardboard boxes in

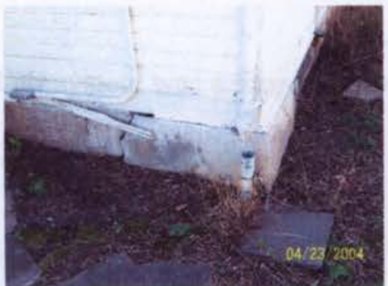

Figure 4 - Cracked foundation

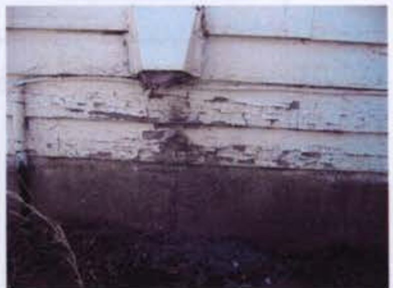

Figure 5 - Clogged dryer vent.

Bathroom/Kitchen: There were no working exhaust fans in the house.

Heating System: The forced air system was a natural gas fired furnace.

Occupant Notes: Two people lived in the home.

Recommendations:

- Finish gutter system, including downspouts and leaders.
- Remove carpet and cardboard boxes from basement floor.
- Repair cracked foundation wall.
- Unclog dryer termination port.

Inspection Number: 2-2
Address: 5723 Travers Lane
House Type: Ranch
Condition: Occupied
Foundation: Basement
Heat Type: FA furnace (propane)
Construction: Stick-built
Occupants: 4

Figure 1 - 5723 Travers Lane.

Mold and Moisture Conditions: No mold was found in the home.

Rainwater Management: There were reports of occasional flooding in the basement and that the sub-slab drainage system was not functioning properly. The gutter system was good but did not have leaders from the downspouts.

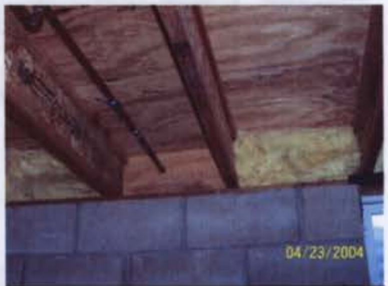

Figure 2 - Uninsulated band joist

Basement: The basement was dry. There were locations in the basement where the band joist was uninsulated (Figure 2).

Heating System: The forced air system was a propane fired furnace.

Occupant Notes: Four people lived in the home.

Recommendations:

- Put a garden hose in the drain in the window well and see if the water ends up in the sump pit. This will help to determine whether the sub-slab drainage system is at all functional.
- Place horizontal insulation approximately 1 foot beneath the surface to shed water away from the perimeter and seal the upper portion of the block wall, while it is exposed during this installation.
- Insulate the portions of band joist that are currently uninsulated.

Inspection Number: 2-3
Address: 940 Prentice St.
House Type: Two-story
Condition: Occupied
Foundation: Basement
Heat Type: FA furnace (natural gas)
Construction: Stick-built
Occupants: 1

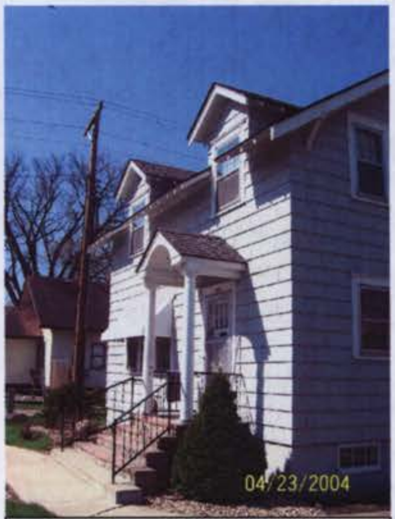

Figure 1 - 940 Prentice St.

Mold and Moisture Conditions: No mold was found in the home.

Rainwater Management: The site drainage was adequate. There was no gutter system.

Basement: The basement was dry. There was a leaky cold joint in the foundation wall through which water was entering from outside (Figure 2).

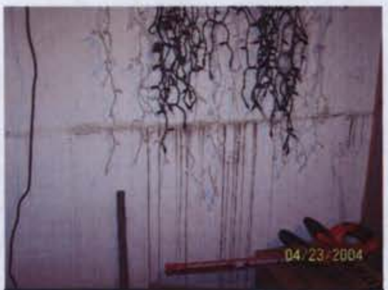

Figure 2 - Leaky cold joint in basement wall.

Heating System: The forced air system was a natural gas fired furnace. It was using standard Schedule 40 PVC piping for the flue.

Occupant Notes: One person lived in the home.

Recommendations:

- Install gutter system, including downspouts and leaders.
- Grind out a 3/8" "V" at the cold joint and seal with a high quality concrete sealant.
- Check the furnace specifications to determine whether the Schedule 40 PVC piping is permissible.