



To: XXXXXXXXXXXXXXXX

Job: XXXXXXXXXXXXXXXX

From: Marko E. Vovk
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Civil Engineer / ASHI Certified Professional Home Inspector / 203K Certified / State Licensed Radon Inspector / State Licensed Lead Assessor / State Licensed Termite Inspector / Structural Inspector / Certified Indoor Environmentalist / Certified Air Balancer / Over 7500 Building and Home Inspections Performed / Over 750 Environmental Inspections performed / Over 3000 Microbial Mold or particulate samples taken. Certified Carbon Monoxide & Combustion Analyst
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www.houseinvestigations.com

Date: 2-14-05

RE: Forensic Moisture Evaluation for Fungal Reservoirs.
1. Building Science Investigation
2. Microbial Investigation with Limited Sampling
3. **Executive summaries on pages 11 and 12**

Dear XXXXXXXXXXXXXXXX ,

On the afternoon of 2-14-05, you employed Civil Engineer and Certified Indoor Environmentalist (CIE) Marko E. Vovk from Ambassador Construction Consultants Inc. to visually perform a non-destructive, partial, and visual inspection of the property located at
XX

The purpose of this inspection was to determine if visual fungal reservoirs¹ could be seen or had conditions for amplification². Secondly, to determine what is causing the fungal reservoirs and if dwelling conditions exist that will permit further amplification.

Based on my education, training, and experience, I have made the following observations and conclusions about the above referenced property:

¹ Fungal Reservoirs means visual mold.

² Amplification means growing mold.

Building Science Section

The entire home was mapped for room temperature, room humidity, surface temperatures, dew point, and moisture content. The sling psychrometer was used for baseline testing results and the digital hygrometer was used for the data collection. All surface moisture mapping was conducted using the Tramex moisture-testing gauge and an infrared laser. All values are represented in mathematical terms to determine potential cause of fungal development. We only plotted the basement location. This location had the coldest surface temperature. This was also a location where microenvironments existed. See digital essay for microenvironment locations.

The basement wall insulation is not allowing the basement concrete foundation and basement band joist to dry. The high basement humidity is condensating on the concrete foundation walls and on the band joists.

The following are field data from moisture and humidity mapping. These are the actual authentic field notes from mapping to decrease duplicating error.

N=NORTH	W=WEST	S=SOUTH	E=EAST
1= level one	2= level two	3= level 3	
L=LIVING ROOM	D=DINNING ROOM	K=KITCHEN	BT=BASEMENT
B1=BEDROOM#1	B2=BEDROOM#2	B3=BEDROOM#4	B4=BEDROOM#4
G=GARAGE	DEN=DEN	OFF=OFFICE	CL=CLOSET
EX=EXTERIOR	EXAMPLE -1 B3SE means bedroom #3 on the south east side of the home.		
M=MOLD	I=INNER WALL	EX=EXTERIOR WALL	ST=SURFACE TEMPERATURE
ALL TESTING IN COUNTERCLOCKWISE ROTATION FOR ALL RESULTS			
N=NORTH	W=WEST	S=SOUTH	E=EAST
			RH=RELATIVE HUMIDITY

LOCATION	TEMP.	RH	DEW POINT	ST N	ST W	ST S	ST E	ST CEIL	ST FL	ST M
BASEMENT	71.2	41.0	45.9	62.0	63.8	63.4	62.8	70.2	68.8	
① FAMILY SE	71.7	39.3	45.6	72.0	71.6	71.6	65.2	69.6	71.8	①
① LIVING NE	72.2	39.0	46.0	70.6	71.4	72.2	70.4	70.6	72.0	②
① BED NW	71.8	39.8	46.1	69.4	70.6	70.4	70.4	71.0	70.6	③
② BED N	71.6	39.3	45.7	69.6	70.0	71	71.0	70.8	71.0	④
② BED SE	71.9	39.0	46.1	70.8	70.4	68.8	69.0	69.6	70.0	⑤
OUTSIDE	48.0	77.6	41.3							

Below we plotted the coldest obtained temperatures. This was done to see the mathematical representation of the conditions of the basement.

Basement conditions 71.2 F and 41.0 % humidity

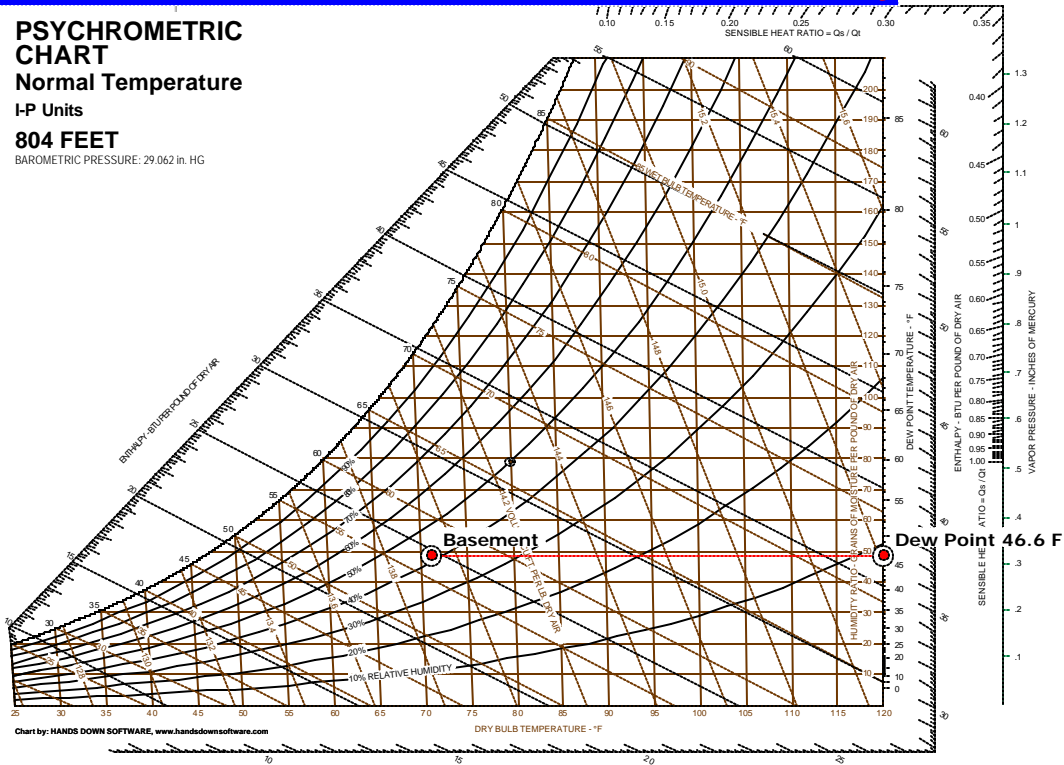
PSYCHROMETRIC CHART

Normal Temperature

I-P Units

804 FEET

BAROMETRIC PRESSURE: 29.062 in. HG



Report Date: Wednesday, February 16, 2005
 Project Information: Basement conditions 71.2 F and 41.0 % humidity

Altitude: 804 (Feet)
 Barometric Pressure: 29.062 (in.Hg)
 Atmospheric Pressure: 14.274 (psia)

1. Basement

STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (gr/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (in.Hg)	Absolute Humidity (gr/cu.ft.)
1,000	71.200	56.913	41.4	48.5	13.927	24.664	46.5850	0.0723	0.3190	3.483

2. Dew Point 46.6 F

STATE POINT DATA

Air Flow (Standard) (cfm)	Dry Bulb (°F)	Wet Bulb (°F)	Relative Humidity (%)	Humidity Ratio (gr/lb)	Specific Volume (cu.ft./lb)	Enthalpy (Btu/lb)	Dew Point (°F)	Density (lb/cu.ft.)	Vapor Pressure (in.Hg)	Absolute Humidity (gr/cu.ft.)
1,000	120.000	72.652	9.2	48.5	15.207	36.530	46.6000	0.0662	0.3192	3.192

Process: Connect States

Start Point Name	Total Energy (Btu/hr)	Sensible Energy (Btu/hr)	Latent Energy (Btu/hr)	Moisture Difference (lb/hr)	Sensible Heat Ratio	Enthalpy/Humidity Ratio (Btu/lb / lb/lb)
Basement	53,399	53,380	19	0.0	1.000	N/A


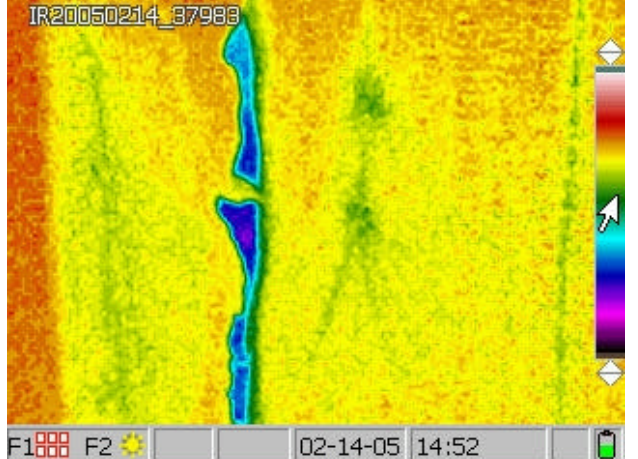
The above mathematical representation depicts that during our inspection, the dew point³ for the above attic condition was 46.6 F.

³ Dp = Dew Point Temperature: The temperature of moist air saturated at the same pressure and humidity ratio. Alternatively, more simply the temperature at which water vapor will begin to condense from a sample of air.

1. With the present basement humidity condition, the foundation wall surface temperatures will fall below this below this dew point and condensation will occur.
2. With the present basement humidity conditions, the band joist pocket temperatures will fall below this below this dew point and condensation will occur.

Dew point temperature and moisture are necessary for microbial amplification. At this time, dew points are allowing for some microbial development. Lowering the homes humidity level is advised and should be done immediately. By lowering the humidity, the fungal reservoir conditions should stop amplifying or slow down the amplification process.

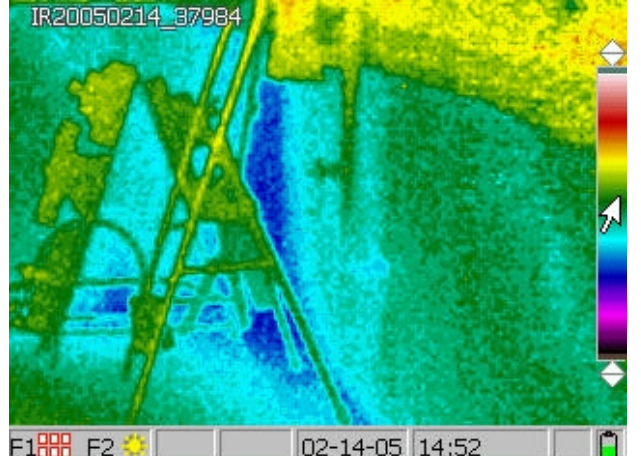
The following are several digital images taken of this dwelling. These images show ongoing conditions, fungal reservoirs, and other building science⁴ conditions. Below these images is an explanation of the condition.

	
<p>The interior insulation system is not optimal. This insulation system has a vapor barrier. Trapped moisture condensates behind this vapor barrier. Basements in cold weather climates such as OHIO should not have interior basement vapor barriers. If you choose to insulate the basement, it should be done on the exterior.</p>	<p>When walls become wet or damp they must dry. Unlike upper house wall, basement walls can only dry on one side. The exterior of a basement wall is waterproofed and will not dry. The interior basement wall must be able to dry. The present insulation installation, is not allowing for this drying process. The infrared image shows the cold wall behind the insulation.</p>

⁴ Building science for this report means moisture findings caused by building materials, construction methods, and moisture addition.



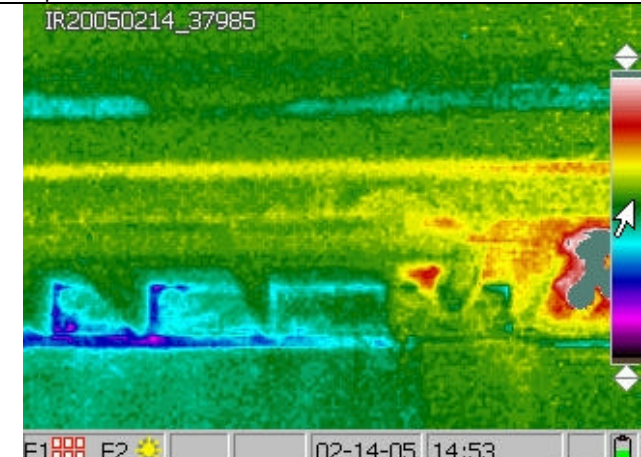
The wall temperatures behind the basement insulation were at or close to their respective dew points. When the dew point is reached, condensation will occur. If you have condensation, fungal reservoirs will amplify.



The infrared image shows the cold wall behind the insulation. The basement humidity levels are excessive. If you lower the basement humidity, you will lower the dew point. Buy lowering the dew point you will lower the potential for fungal amplification.



We removed the installation at the band joists. On cold days, this is the coldest part of the home. If the basement humidity high, condensation will occur. Many of these locations had amplifying fungal reservoirs.



The infrareds image show the cold the upper band joists.



The two basement sump pumps were very active. Both sump pump covers were not 100% sealed.



The active sump pump pipes were perforated and full of water. This is an interstitial pipe photograph of the drainpipes that lead to one of the sump pumps. The point is that these sump pumps communicate with the wet ground. If the tops of the sump pumps are not sealed, this wet ground communicates the inside of the home.



The humidity in the sump pump pits and drainpipes was 80%. This level of humidity is excessive.



The humidifier on the HVAC system was a large moisture generator. It is our opinion, that these units when operating are the number one cause of condensation problems in homes.



The cold air returns were not sealed with furnace tape. Everytime the HVAC system turns on; the cold air returns suck the basement. These cold returns also suck the humid air out of the sump pump pits.



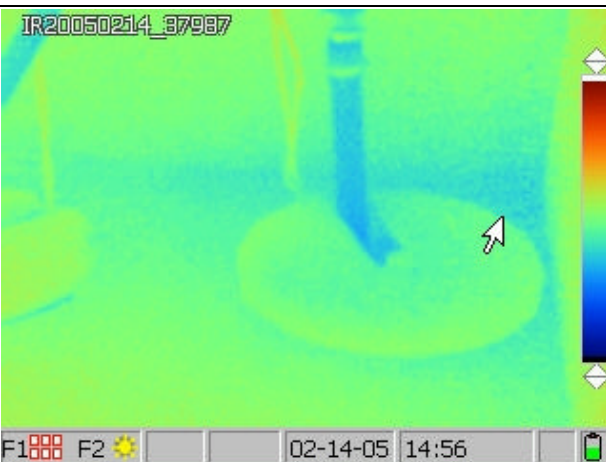
Exterior drainage needs to be better controlled.



Exterior drainage needs to be better controlled. This downspout is not connected



The interior metal doorframes show obvious condensation stains from past events. This home has had high humidity for many years.



Infrared image shows that this sump pump is very active.



Infrared image shows that this sump pump is very active.

APP (Aggressive Particle Profiling.)
Air-borne particulate
Particle Contamination Section

Scope and Purpose:

1. To sample with a laser particle counter the air in various locations of the dwelling;
2. To determine if there is contamination by airborne particulate;
3. To qualify the size and quantify the amounts of the contamination.

Laser particle count examination is critical to indoor air quality investigations. A particle investigation is designed to quantify air contamination by particle size. Particle counting effectively analyzes the effectiveness of the air handling filtration systems. The particle counter used for this project was an HHPC-6 ARTI Particle Counter. The device has six channels to read various size particles in microns. The channel sizes are .3, .5, .7, 1.0, 2.0, and 5.0. There is a variable pump rate, and was set to pump 2.83 liters per minute. This is equal to a volume 1/10th of a cubic foot.

The device quantifies particle contamination and allows the indoor air environmentalist to make determinations based on the results.

There is a distinct coordination between respiratory penetration and particle size. The symptoms and health affects of particulate inhalations vary from respiratory irritation, allergies, infections, and cancer. In general, respired particles affect us in the following ways:

- They can impair respiratory functions.
- Particle may cause a chemical or mechanical irritation of tissues. Nerve endings at the deposition site can also be damaged.
- They can aggravate existing respiratory or cardiovascular disease. They can impact our immune system and cause more morphological changes in lung tissue.

Health exposure to contaminate falls into two categories. Indoor air quality exposure (which is non-occupational) and occupational. Wallace (1991), and Wilkins (1993), showed that inhaling particles are associated with increased prevalence of "sick building syndrome." The symptoms are mucus irritation, difficulty in concentration, and distraction of occupancy by annoyance odors. Particulate contamination breaks down as follows in the human body:

- >10, um may be respirable but do not penetrate
- 7 to 11 um particles, penetrate nasal passages
- 4.7 to 7 um particles penetrate the pharynx
- 3.3 to 4.7 um particles penetrate trachea and primary bronchi
- 2.1 to 3.3 um particles penetrate secondary bronchi
- 1.1 to 2.1 um particles penetrate terminal brochi
- 0.65 to 1.1 um particles penetrate bronchioli
- 0.43 to 0.65 um particles penetrate alveoli

A study of high-rise office buildings (Armstrong, Sherertz, and Llewellyn 1989) showed that high levels of particulate resulted in sinus and upper respiratory congestion and headaches. In 1993, Gravessen, Ipsen and Skov found that macromolecular organic dust correlated significantly with the number of occupant's complaints consisting of:

- Extreme fatigue
- Itching eyes

- Nasal congestion
- Headache
- Sore and irritated throats

Two categories of particles are of particular concern: microbial and combustion by-product. Microbial particulate causes irritation, allergenic illness, infectious illness, and has toxic effects on the body. Combustion by-products (that is particulate from vehicle exhaust, tobacco smoke, heating appliances, office machinery, and cooking appliances) creates polycyclic aromatic hydrocarbons or PAH's.

Particulate testing is particularly critical to ASHRAE Standard 52.2-1999, titled "Method of Testing General Ventilation Air-Cleaning Devices For Removal Efficiency By Particle Size."

Readings were taken of outside air to compare. We are also comparing the readings to exterior air. The general observation of counting the particle was that there are many irregular and unequal conditions relating to air quality.

The following are field data from aggressive particle profiling . These are the actual authentic field notes from mapping to decrease duplicating error.

Location	3	5	7	1.0	3.0	5.0	TH
BASINMENT	8575	918	626	477	317	37	
① FAMILY RM	9610	1101	792	661	473	87	
① LIVING RM	8636	1897	1547	1338	997	210	
② BED NW	12352	1008	386	241	148	20	
② BED N	10575	1013	457	292	186	25	
② BED SE	8233	1145	746	578	391	67	
OUTSIDE	28034	1129	359	178	75	9	

The following are conclusions to be drawn from the air particle testing:

1. There is some airborne particulate contamination in this dwelling.
2. Particulate includes, mold spores, construction dust, drywall dust, glass fibers, pollen, and other debris. Higher airborne particulate can be found in homes with upper levels of humidity. Higher airborne particulate can also be found in homes with pets.
3. The living room was found to have the highest dust content.
4. Particulate cleaning with the use of HEPA and other cleaning techniques is recommended.
5. Duct cleaning is recommended

Recommendations regarding this information:

- The sources of the airborne particulate should be identified and mitigated.
- Review the recommendations in the mold report and in executive summary.
- The document ACR 2002 Assessment, Cleaning & Restoration of HVAC Systems should be purchased and reviewed. The National Air Duct Cleaners Association publishes this document: NADCA. Their recommended procedures should be used and guidelines.

- If you are an immune compromised individual, proper air scrubbing apparatus should be used to clean the particulate contamination in your dwelling. Portable air scrubbers are available.
- We are not health specialists. The conclusions and opinions stated in this report are based on information gathered over time and the review of similar situations and conditions.
- Ambassador Construction Consultants Inc. does not accept any responsibility for the financial or health consequences of subsequent action taken by the client or its consultants based on this report, test results, opinions or recommendations. We strongly recommend second opinions.

Microbial Data Microbial Section

On 2-13-04, there were four mold tests taken at the above address. At the end of this report section, and in front of the attached remediation plan suggestions are the four microbial laboratory test results for this home.

1. One air test taken in basement.
2. One air test taken on the clean exterior for comparison.
3. One swab taken of fungal reservoirs behind the basement insulation.
4. One swab taken of fungal reservoirs behind insulation in floor joist and band joist pocket (microenvironment).

Testing air was done using non-viable air-o-cell cassettes. Air testing is not a proven science and data has the potential to change daily. By having more fungal spores indoors than outdoors indicates that an amplifying reservoir exists or has existed in the past..

Spore growth is cultivated by the presence of a sympathetic environment. Food, (cellulose or wallpaper paste), moisture and limited light are conditions in which spores thrive. This is whether they enter from the exterior or any other means. Events such as dusting, opening the windows, vacuuming, and manipulating the contaminated areas, are conditions that stimulate spore movement throughout the house.

There are no thresholds for mold contamination levels. This is all individual difference and the health affects should be considered by a health specialist.

These are the following where visual fungal reservoirs were observed.

EXECUTIVE SUMMARY MOLD SECTION

1. **The mold found behind the insulation was found to be (Aspergillus or Penicillium), Cladosporium, Basidiospores and (Pithomyces or Ulocladium). From our literature, these fungi are typical allergen type fungi found indoors when moisture events occur. We have attached the lab results. The fungi encountered were expected due to the present building science conditions. Removing all basement wall insulation and removing all band joist pocket insulation is recommended. The walls and band joists will be permitted to dry and breathe. Decreasing the moisture burden in this home must also be done. The fungal reservoir can be cleaned and encapsulated. I have attached a scope of work for one method of remediation. Most contractors have their own remediation plans that also tend to be successful. Bleach solution cleaning is also a method that is widely practiced.**

Due to visual fungal reservoirs and calculated optimal conditions for fungal amplification, a full microbial assessment can be done. Tape lift testing, swab testing, viable air, and non-viable air testing can be conducted at some future date if deemed. It is our professional opinion⁵, that if you see mold or smell mold you pretty much have mold. It is also our opinion that all molds are bad and moisture maintenance must be implemented. We are not doctors and will comment of the effect of fungal exposure.

Ambassador Construction Consultants Inc. does not accept any responsibility for the financial or health consequences of subsequent action taken by the client or its consultants based on these mold test results, opinions, or recommendations. We strongly recommend second opinions. This report is not transferable and all third parties should procure their own microbial investigations.

All repairs to this property should be monitored by a third party in regards to compliance to existing building codes; industry established standards of practice and for good and workmanlike manner. Please read and review all sections of this report.

EXECUTIVE SUMMARY BUILDING SCIENCE SECTION

It is my professional opinion that;

- 2. The HVAC humidifier when on can cause condensation conditions. It is recommended not to use this unit unless absolute necessary.**
- 3. The sump pump covers are not sealed. Grains of moisture are leaving these sump pumps and contributing to the basement condensation conditions. Sealing both sump pump covers is recommended.**
- 4. The HVAC cold air return is infiltrating some basement air causing a depressurization condition. Sealing the cold air return with furnace tape is recommended. Balancing HVAC systems are also good protocol.**
- 5. Removing the insulation from the upper foundation walls is advised. As stated earlier, this insulation serves as a vapor barrier on a wall that cannot dry. If you choose to insulate the basement, it is recommended doing this on the exterior. The fungal reservoirs can be cleaned and painted.**
- 6. Removing the insulation from the upper band joist is advised. The fungal reservoirs can be cleaned and painted.**
- 7. Running a basement de-humidifier will remove much of the homes humidity conditions and lower this homes hydrick buffer capacity⁶.**

DISCLAIMER

This inspection should be considered partial, time-limited, non-destructive, and strictly opinion oriented. All opinions were generated from visual and non-destructive testing. We can at some future date perform destructive testing the would include soil borings, water table monitoring, soil analysis, pecculation studiers and full review by a geo-technical engineer. We can also at some future date, generate a more extensive report with other observed conditions from our field notes, digital photographs, and additional inspections. We can at some future date conduct a full building inspection of all building components such as attic, roof, plumbing, interiors, floors, walls, joists, beams, headers, stairs, exterior,

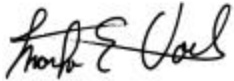
⁵ Marko Emil Vovk is the co-author of “The Illustrated Mold Handbook “ and has the capability to form opinions on mold.

⁶ Hydrick Buffer Capacity (HBC) is the amount of moisture a home could hold without causing adverse reactions such as condensation. All homes have different HBC’s depending on construction material types.

grounds, garage, stairs, heating, cooling, appliances, lead paint, radon gas, pest, or any other home inspection related field constituents. We cannot be held liable for misunderstanding or the omission of any item pertaining to the above said structure. We encourage that you obtain second opinions as we do all our clients for all our inspections. This report is not intended for third parties and is not transferable. Third parties should obtain their own reports from their own inspectors. This report is not intended to be; a design mitigation repair, an exact repair estimate, an full environmental inspection, a load study, a determination of footing size or footing depth, a determination of possible future conditions, a determination of future wall settlement, a code inspection, a prediction of additional cracking, a geotechnical soil investigation, and engineering calculation, a prediction of settlement, a run-off study, a boring inspection, a water table evaluation, and underground sewer exploration, basement seepage exploration a camera study, or any other technically exhaustive inspection that may require a more precise investigation. Furthermore, this inspection only includes visual conditions that can promote fungal development, fungal amplification, and musty odors. I have taken over 85 digital images. Furthermore, this is not a full microbial assessment. We can in the future conduct additional sampling for additional fees. This report does not take into account past basement floods, sump pump failures, foundation leaks, or other moisture events that would have caused visible or interstitial microbial proliferation or amplification.

If you have any questions pertaining to this matter, please feel free to contact me at 216-924-TEST / 216-431-TEST / 216-521-0790 FAX.

Respectfully submitted,



Marko E. Vovk
Civil Engineer / ASHI Certified / CIE / Building Scientist

THE FOLLOWING ARE THE LABORATORY MOLD RESULTS