Preliminary Microbial Investigation & Moisture Assessment

Project Report

Prepared for

Highland Central School District

At

Highland Elementary School
16 Lockhart Lane
Highland, NY

Conducted by

Quality Environmental Solutions & Technologies Inc.
1376 Route 9
Wappingers Falls, NY 12590

QuES&T Project # Q16-0950

Project Manager:

Kenneth C. Eck CIH, CSP, CFPS, CHMM, DABFE, FACFEI, LEED AP
Director, Safety, Environmental and Educational Services
NYS Mold Assessor # MA00531
Executive Summary

A preliminary microbial investigation and moisture assessment consisting of a visual inspection and the collection of pertinent analytical data was conducted at the Highland CSD Elementary School, 16 Lockhart Lane, Highland, NY. The purpose of this investigation was to assess 1) moisture impact on installed building materials and 2) evaluate the impacted areas for the presence of microbial growth due to employee concerns. The assessment of the impacted spaces was conducted using a variety of investigative techniques, including 1) Visual Inspection of the interior areas of concern, 2) Moisture level evaluation of installed building materials using a thermal imaging camera (TIC) and 3) Collection of pertinent analytical data and environmental samples.

Based on information provided by the client, a roof leak in Room 305 had impacted an area of ceiling tiles and sheetrock walls within the room and a ceiling tile with visible suspected microbial was reported to have been present within the room. A sample was reported to have been collected from the tile by a staff member and forwarded to a laboratory for fungal analysis; however, the reported method of sample collection and storage appears to be inconsistent with accepted practices and a chain of custody form was not transmitted to the laboratory with the sample. Additionally, the impacted tile had been removed prior to the assessment and was not available for sampling by QuES&T. Therefore, QuES&T cannot evaluate the validity of the sample results and will make no discussion of the results within this report. Visual inspection within Room 305 identified an active roof leak and visible suspected mold growth on the upper portion of the sheetrock on the Northwest corner of the room.

Analytical results for samples collected by QuES&T, identified the presence of Ulocladium, Cladosporium and Unidentified fungi with the growth classified as slight to moderate. Visual inspection of the space above the installed ceiling did not identify any other visible suspected microbial growth. At the request of the client, a sample of a green foam material was collected from within the space and analyzed for fungal content. The sample identified the presence of Basidiospores and Cladosporium. The sample value was calculated for cts/gram and showed a slight elevation in fungal levels above background levels.

At the request of the client, additional spaces were examined during the assessment, including but not limited to; the Library, the Computer Room, Rooms 117/118, Room 208 and Room 210. Based on client concerns regarding visible suspected microbial growth on the tracks of the computer tables, a tape lift sample was collected and sent to the laboratory for analysis. The sample did not identify the presence of fungi and had a normal background level. A detectable odor was noted in the room; however, the source has not yet been identified. The ceiling mounted air conditioning unit within the Computer Room was examined and visible suspected mold growth was observed. A swab sample was collected from within the unit and sent to the laboratory for analysis. The total fungal spore count for the sample was 7,400,000 cts./in² (counts per square inch) and identified Cladosporium, Basidiospores, Hyphal Fragments and Aspergillus/Penicillium/Yeast like fungi. This level of fungi combined with the elevated level of Hyphal Fragments is an indication that the growth at this location may be active. Culturing of the sample is in process and results will be added to the final report for this project.

Inspection within the other spaces requested by the client did not identify the presence of visible suspected microbial growth and/or wet building materials when observed with the TIC.

In addition to concern regarding microbial impact, a general concern regarding the indoor environmental quality of the school was expressed by client representatives. During the preliminary visual inspection, conditions that may adversely impact the spaces were observed. Some of the preliminary observations were; 1) Unit ventilators were blocked by materials placed on top and in front of the units, 2) Stained ceiling tiles were observed in the Library, 3)
Air fresheners and cleaning chemicals were observed in various rooms, 4) Dust was observed on horizontal surfaces, 5) Large amounts of materials, including papers were stored in classroom spaces, 6) Alcohol based hand sanitizers and wipes were observed in several classrooms, 7) Dust was observed on the interior of the unit ventilators and 8) stored classroom materials that may contribute to dust/allergen production and loading such as stuffed animals, carpet tiles, etc were present.

1.0 Introduction:

Quality Environmental Solutions & Technologies Inc. (QuES&T) was retained by the Highland CSD to perform a preliminary microbial investigation and moisture assessment at the Highland CSD Elementary School, 16 Lockhart Lane, Highland, NY. The investigation and assessment was conducted in response to specific concerns regarding the presence of moisture impacted building materials and the potential for impact to the indoor environment. The investigation, performed by QuES&T, included 1) Visual inspection of the preliminary areas of concern within the building, 2) Use of a Thermal Imaging Camera to evaluate moisture levels of installed building materials and 3) Collection of Bulk, Swab and Tape Lift Samples for evaluation. Information provided by the Client indicated that the preliminary areas of concern were Rooms 305, 210, 208, the lower floor of the new wing, the library and the computer room.

QuES&T conducted an initial site assessment on November 29, 2016 which included a visual inspection, evaluation of the areas with the use of a FLIR B-400 Thermal Imaging Camera and collection of environmental samples for analysis. The assessment identified the presence of wet sheetrock, with staining, discoloration and visible suspected mold growth in the Northwest Corner of Room 305. Microbial impact was also identified at an elevated level in the air conditioning unit in the computer room.

2.0 Data Collection:

2.1 Surface Gel Tape-Lift Samples

Two (2) surface tape lifts were collected from areas of concern based upon the visual inspection and as requested by the client. The samples were collected using an Accuscience Triple-Gel Tape: each Gel Tape sample consists of three (3) 1.5 cm² strips. The sample is collected by carefully pressing the Gel Tape onto the surface to be sampled. Upon completion of sampling, all samples were forwarded to Q-Lab Environmental Microbiology of Metuchen, NJ for analysis. The following provides a discussion of sampling results, investigation findings and recommendations for consideration by the Client. Results of all sampling conducted are included within Appendix A.

2.2 Surface Swab Sample

One surface swab sample was collected from within the air conditioning unit mounted in the ceiling of the computer room. The sample was collected using a sterile swab moistened with a buffer solution. The swab was then used to wipe and area of approximately 1 inch square. Samples were forwarded to QLab Environmental Microbiology of Metuchen, NJ. The swab sample was analyzed using optical microscopy and was submitted for enumeration and identification of viable fungal organisms and fungal spores. The surface swab sample for microbial analysis will be cultured on both Malt Extract Agar (MEA) and Dichloran 18% Glycerol Agar (DG18). The preliminary results of the swab sample analysis are attached in Appendix A of this report.
2.3 Bulk Sample

At the request of the client, a bulk sample of a green foam material observed on the top surface of the ceiling tiles above the student coat rack was collected and submitted for fungal analysis. The sample was forwarded to QLab Environmental Microbiology of Metuchen, NJ. Copies of the analysis are contained in appendix A of this report.

3.0 Visual Inspection

The visual inspection was conducted on Tuesday, November 29th, 2016 by Kenneth Eck, of QuES&T. Based on information provided by the Client, QuES&T conducted a limited visual inspection of the areas of concern; which consisted of Room 305, Library, Computer Room, Rooms 117/118, Room 208 and Room 210.

The visual inspection identified the presence of an active water leak with visible suspected microbial growth on the sheetrock in the Northwest corner of Room 305. Visual inspection of the area above the installed ceiling did not identify the presence of any visible suspected microbial growth; however, dust, foam debris and other materials were observed on the upper surface of the ceiling tiles. Stained ceiling tiles were observed in the library along with cupping of the ceiling tiles. Visible suspected mold growth as observed on the HVAC ceiling mounted unit in the computer room and a buildup on the tracks of the keyboard trays in the computer room of an unknown materials was also observed. Dust on horizontal surfaces was observed in numerous locations. Decaying plant material was observed in rooms 208 and 210 in the area of the heating vents. A large amount of books, stuffed animals and other materials were observed in many of the spaces. Unit ventilators were blocked either on top of the unit, in front of the unit and in some location both on top and in front. Alcohol based hand sanitizers and wipes were observed along with air fresheners. Visual inspection of the interior of one of the unit ventilators identified dust in and around the fan units.

4.0 Data Analysis:

4.1 Surface Gel Tape-Lift Samples

Two surface gel tape-lift samples were collected during the assessment, as described above in section 2.1, one from the upper wall surface in Room 305 and one from the keyboard shelf tracks in the Computer Room. The samples were sent to the laboratory for microbial analysis by optical microscopy.

Upon receipt of all data, QuES&T reviewed the laboratory data for the gel tape-lift samples collected, copies of which are attached in Appendix A. As discussed previously, due to a number of factors, establishment of a health-based standard for the evaluation of acceptable exposure to microbial contamination is not feasible. Therefore, in the absence of specific regulatory and health-based standards regarding acceptable indoor levels of microbiological contaminants, careful qualitative evaluation of the data obtained is used to determine if bio-amplification is occurring.

The article “Assessment and Sampling Approaches for Indoor Microbiological Assessments”, G. Clark, The Synergist, November 2001 provides numerical guidelines which can be helpful. (Table 1)
Table 1 – Proposed Guidelines for Fungal Spores from *The Synergist.*

<table>
<thead>
<tr>
<th>Type</th>
<th>Normal Background*</th>
<th>Possible Contamination Source</th>
<th>Probable Contamination Source</th>
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<td>Air Samples from</td>
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<tr>
<td>Residential Bldgs</td>
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<td>5,000-10,000 spores/m³</td>
<td>&gt;10,000 spores/m³</td>
</tr>
<tr>
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<td>500-1,000 cfu/m³</td>
<td>&gt;1,000 cfu/m³</td>
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<tr>
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<td>2,500-10,000 spores/m³</td>
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</tr>
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<td>250-1,000 cfu/m³</td>
<td>&gt;1,000 cfu/m³</td>
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<tr>
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<td>&gt;1,000,000 spores/g</td>
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<tr>
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<td>50,000-100,000 mycelial frags/g</td>
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<tr>
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<tr>
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<td>Swab Samples</td>
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<td>25-100%</td>
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<td>&lt;1,500 cfu/cm²</td>
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<td>Tape Samples</td>
<td>NSFM or NSFB**</td>
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<tr>
<td></td>
<td>1-5%</td>
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</table>

*Types and relative proportions of fungal spores should be similar to outdoors.**NSFM = no significant fungal material; NSFB = no significant fungal biomass

The results of the tape lift sample from the computer room did not identify any significant fungal mass and was representative of normal background fungal levels. The sample collected in Room 305 indicated the presence of Ulocladium, Cladopsorium and unidentified fungi which would require culturing for identification. The fungal biomass level was described as slight to moderate.

The combined findings of the microbiological testing and visual inspection appears to indicate that a localized area of bio-amplification may be occurring, on the sheetrock in the area of the active water leak in Room 305.

### 4.2 Fungal Swab Analysis

One (1) surface swab samples was collected from the HVAC system serving the computer room area. The surface swab samples were cultured on both Malt Extract Agar (MEA) and Dichloran 18% Glycerol Agar (DG18) in order to determine the number and identity of viable fungal species. In addition, enumeration and identification of fungal spores was also performed on the surface swab samples.

MEA is a versatile, all-purpose medium that selects for a variety of fungi associated with medium to high moisture conditions. DG18 is an all-purpose medium selective for xerophilic fungi or fungi that are marginally xerophilic. Fungi that do not require free water for growth are sometimes called xerophilic fungi. Xerophilic fungi grow in air that has more than 60% relative humidity. The common xerophilic fungi belong to the genera Aspergillus and Penicillium.

“For fungal growth to occur, a certain level of free water (the liquid water found inside plant cells, not in their walls, which is not bound to other molecules) needs to be present. The water that is available to support microbial life in building materials is commonly expressed as water activity (aw). Water activity compares the physical properties of water in the material in question with that of pure water to generate a scale from 0 - 1.0. Pure distilled water has a value of 1.0 and as the value moves closer to 0, more and more solutes are present in the water and less and less water is available for an organism to use, thereby preventing the growth of many fungi..."
A definitive aw threshold does not exist for fungal growth. Studies have indicated that fungal growth can occur at and above aw=0.65. The most basic factor to consider when contemplating the potential of growth is the specific type of fungus being examined. Different fungi have different water requirements. These varying requirements allow them to be grouped into three broad categories. Fungi that require aw higher than 0.9 are known as hydrophilic fungi. Some common examples are many yeasts, Stachybotrys chartarum, Fusarium species, and Chaetomium globosum. Fungi that can grow between 0.8 and 0.9 are known as mesophilic fungi, which include species of Alternaria, Cladosporium, some species of Penicillium and Aspergillus, and many other fungi. Finally, fungi that can grow at aw below 0.8 are known as xerophilic fungi. Examples include Wallemia species, Aspergillus restrictus, A. repens and many others, as well as some species of Penicillium.” (Water and Fungi; by Chris March, EmLab P&K)

Laboratory results for the surface swab sample is summarized in Appendix A. The laboratory data summary sheets contain information regarding the identification to genus level. The sample is currently being cultured for further analysis to the species level and will be updated upon receipt of the laboratory results. The sample collected identified a total fungal spore count of 7,400,000 cts/ in². The moisture indicating species Apergillus/Penicillium/Yeast like fungi was identified in the swab sample collected from the unit. Cladosporium was also identified on the sample which may be an indication that condensation is occurring in the unit; as Cladosporium tend to grow in droplets of water.

4.3 Bulk Fungal Sample Analysis

A bulk sample of a green foam material laying on top of the installed ceiling in Room 305 was also collected for analysis for total fungal spore levels. The total fungal spore level for the sample was 21,000 cts/smp and identified the presence of Basidospores and Cladosporium. Due to concerns expressed by staff and the fact that the foam sample was in the same ceiling area as the leak in Room 305, the sample was additionally re-calculated on a gravimetric basis. The sample had a total fungal level of 220,000 cts/g of Basidospores and 56,000 cts/g of Cladosporium. No visible mold growth was observed on the sample either at the time of collection or during analysis as confirmed by the laboratory. This level of spores is slightly above the background level of 100,000 cts/g and well below the upper guideline of 1,000,000 cts/g. Basidiospores are a typical outdoor fungi and may be an indication of dust and air infiltration into the space. Cladosporium was also identified on the area of suspected visible growth on the sheetrock which may be contributing spores to the area above the ceiling space. Further evaluation of this and other ceiling spaces should be conducted in future investigations.

5.0 Conclusions:

Based on the visual inspection and the data collected the following conclusions can be made.

- Visible suspected fungal growth and an active water leak were identified in Room 305. The total area of suspected growth is less than ten (10) square feet and does not meet the definition of a mold project in accordance with both the NYS Mold Law and general industry guidelines. However, as a precaution prior to recommending the removal, bulk samples of the material were collected and identified that the taping compound used in that area is positive for the presence of asbestos. Therefore the sheetrock must be removed as an Asbestos Containing Material in accordance with NYS Code Rule 56 and other applicable regulations. The mold will be removed and disposed of with the ACM.

- Visible suspected mold was observed on the interior of the air handling unit in the computer room. This was confirmed by laboratory analysis.
A sample collected from the track of the computer tables in the computer room showed normal background levels of fungi with no specific organisms identified at that location.

The green foam insulation debris collected from above the installed ceiling showed no fungal growth present, but did indicate a slightly elevated level of fungal spores present, the majority of which appear to be from the outdoor environment.

The following preliminary observations were made and should be further evaluated throughout the building.

- Unit ventilators were frequently covered with materials on top of or in front of the unit. This resulted in blocked and obstructed unit ventilation equipment supply and return registers. Blocked unit ventilators reduce the effectiveness of the ventilation within the space.

- Visible dust accumulation was observed on horizontal surfaces. Dust contains potential respiratory irritants and allergens.

- Large quantities of stored materials were observed in the classrooms and closets that may contribute to dust collection and/or dust production (e.g. paper products, stuffed animals, etc.). These materials may contribute to ambient dust levels and may also reduce the effectiveness of cleaning activities.

- Hand sanitizer liquids and wipe type sanitizers were observed in the majority of rooms inspected. These materials contain large amounts of alcohol and scents both of which can be respiratory irritants.

- Dust was observed on the interior of the unit ventilators.

6.0 Recommendations:

The following recommendations are provided for consideration by the Client;

- The sheetrock in the area of the water leak in Room 305 should be removed. The taping compound in this area tested positive for the presence of asbestos. Any work completed in this area must be accomplished by certified individuals and a company with a valid asbestos license to work in NY.

- Cleaning of Room 305 should be conducted to reduce the level of dust present within the space to reduce the potential for adverse reactions by persons sensitive to dust.

- The air handling unit in the computer room should be cleaned using a company trained in the cleaning of HVAC equipment and should be done in accordance with the NYC Guidelines for Assessment and Remediation of Fungi in Indoor Environments and The Guidelines established by the National Air Duct Cleaning Association (NADCA).

- Quantities of materials stored in classrooms should be reduced to reduce dust production and optimize cleaning activities. Materials such as stuffed animals, etc. that may accumulate dust should be stored in sealed containers between uses.
• Highland CSD personnel should be advised to immediately notify building custodial or maintenance personnel upon identification of water leaks or spills affecting building materials or areas.

• All water damaged building materials identified within the structure, as applicable, should either be thoroughly dried or removed and replaced. The general industry guideline recommends that these actions be completed within 48 hours of the wetting incident.

• The building should be cleaned to reduce levels of dust within the building and routine cleaning performed to maintain dust levels at a minimum.

• Air fresheners and other odor producing substances should be removed from the rooms and not used.

• The distribution and use of hand sanitizers should be reviewed by the district. The use of these materials should be limited to areas that do not have ready access to a sink with soap and water. If hand sanitizers are deemed necessary by the district, they should not contain any harsh chemicals which may impact the indoor environment.

• The Highland CSD should consider a complete Indoor Environmental Quality assessment to continue to evaluate the remainder of the building and further evaluate the conditions identified.
**Report Limitations and Disclaimer**

Microbiological organisms are ubiquitous opportunistic allergenic organisms whose concentration is greatly affected by changes in localized ambient environmental conditions. Assessment for microbiological contamination is limited to collection and evaluation of data relating to general ambient environmental conditions, detected as present, at the time of the evaluation. Demolition or disassembly of building surfaces and installed equipment are not performed as part of the evaluation. QuES&T believes this report is based on reliable current industry practices/references/sources and accurately reflects the general conditions existing in the area inspected at the time of our assessment. However, unobserved or concealed conditions and/or variations in localized ambient environmental conditions may significantly affect reported microbiological contamination levels.

QuES&T is not a physician and does not provide medical advice, and while health related symptoms potentially related to microbiological agent exposures may be reduced by remediation of areas of suspected microbiological contamination, no guarantee, implied or express is made.
Appendix A: Analytical Results
**Analysis Report**

**Analysis:** AccuScience Premium Quantitative Direct Exam™

**Client:** QuES&T  
Wappingers Falls, NY

**Contact:** Eck, Kenneth

**Project ID:** Q16-0950 Highland Elementary

**Reviewed by:** WT  
**Approved by:** Wei-Chih Tang, Ph.D., Lab Director

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<td>Green Foam Insulation</td>
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<tr>
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<td>Surface (Sweep-Swab HC)</td>
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<td>1 SMP</td>
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<td>1,000 4.26</td>
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<td>Detection Limit (DL)</td>
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<td>Total Concentration</td>
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**Identification**

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<th>cts./sample</th>
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<tr>
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<td><strong>Major Hydrophilic Fungi</strong></td>
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<tr>
<td>Stachybotrys</td>
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</tr>
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<td>Unidentifiable without culturing</td>
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**Note**

*: Raw counts: total number of structures observed on a portion of the prepared subsample.  ***: All concentrations are rounded to two digits of significant figures. Total concentrations/percentages may not be equal to the sum of individual concentrations/percentages due to rounding. #: Water-loving fungi (min Aw >0.89). Absence of Water-Damage Indicator does not exclude the possibility of a water damage history. ##: Includes Aspergillus, Penicillium, Acremonium, yeasts and others fungal cells with similar morphology.
### Summary

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<th>(2) Overall Coverage</th>
<th>(2) Overall Coverage</th>
<th>(2) Overall Coverage</th>
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<td>50 mm²</td>
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### Identification

#### Major Hydrophilic Fungi:***

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<th>Spores</th>
<th>Hyphae/Structure</th>
<th>Spores</th>
<th>Hyphae/Structure</th>
<th>Spores</th>
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#### Other Fungi:

- Aspergillus/Penicillium-like
- Aspergillus
- Penicillium
- Cladosporium
- Alternaria
- Curvularia
- Epicoccum
- Myxomycetes/smuts/Periconia
- Nigrospora
- Pithomyces
- Unidentifiable w/o culturing

### Note

- **Peak Density**: Peak density of fungal biomass (spores, reproduction structures, hyphae, etc.) observed under the microscope within the viewfield of 200X magnification (approximately 1 mm in diameter).
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- 
- **Sample Coverage of Fungi/Debris**: Overall coverage of fungal biomass/debris collected on the tape samples
- Tape/slide samples are taken from bulk/swab samples received and then analyzed under microscope.
- **Hydrophilic Fungi**: Water-loving fungi, Min. Aw >0.89. Absence of hydrophilic fungi does not exclude the possibility of a water damage history.
## Analysis Report

**Analysis:** AccuScience Premium Direct Exam (FD-02HP-TRI)

**Client:** QuES&T  
Wappingers Falls, NY

**Contact:** Eck, Kenneth  

**Project ID:** Q16-0950 Highland Elementary

---

| Lab Sample No. | 0950-003 |
| Sample Location | Room 305 Top of Sheet Rock |
| Sample Type (Device) | Surface (Triple Gel-Tapes) |
| Date Analyzed | 11/30/2016 |

### Identification

<table>
<thead>
<tr>
<th>Major Hydrophilic Fungi:***</th>
<th>Spores</th>
<th>Hyphae/Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stachybotrys</td>
<td></td>
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<tr>
<td>Chaetomium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ulocladium</td>
<td>+++</td>
<td>++</td>
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<tr>
<td>Acremonium</td>
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<tr>
<td>Trichoderma</td>
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<tr>
<td>Aureobasidium</td>
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**Other Fungi:**

- Aspergillus/Penicillium-like
- Aspergillus
- Penicillium
- Cladosporium

### Summary

<table>
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<tr>
<th>Sample Size Examined</th>
<th>50 mm²</th>
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<tr>
<td>Mycologix™ Fungal Biomass Level</td>
<td>3B: Moderate Growth</td>
<td>3A: Slight Growth</td>
<td>3A: Slight Growth</td>
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<tr>
<td>Mold/Yeast Growth Observed</td>
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<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sample Mold/Yeast Coverage**</td>
<td>Medium: 10 - 50%</td>
<td>Low: 3 - 10%</td>
<td>Low: 3 - 10%</td>
</tr>
<tr>
<td>Sample Debris Coverage**</td>
<td>High: &gt; 50%</td>
<td>High: &gt; 50%</td>
<td>High: &gt; 50%</td>
</tr>
</tbody>
</table>

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### Note

*Peak Density:* Peak density of fungal biomass (spores, reproduction structures, hyphae, etc.) observed under the microscope within the viewfield of 200X magnification (approximately 1 mm in diameter).

++++, ++++, ++, +: Biomass covering >50%, 10-50%, 3-10%, <3% of the 200X viewfield, respectively

**Sample Coverage of Fungi/Debris:** Overall coverage of fungal biomass/debris collected on the tape samples.

Tape/slide samples are taken from bulk/swab samples received and then analyzed under microscope.

High, Medium, Low, Trace: Biomass/debris covering >50%, 10-50%, 3-10%, <3% of the entire sample, respectively

***Hydrophilic Fungi:* Water-loving fungi, Min. Aw >0.89. Absence of hydrophilic fungi does not exclude the possibility of a water damage history.
## Chain of Custody

**Lab Job No.:** CH16-1130-01  
**Telephone No.:** (845) 298-6031  
**Company Contact:** Kenneth C. Eck  

**Company Name:** QuES&T  
**Company Address:** 1376 Route 9, Wappingers Falls, NY 12590  
**Fax No.:** 845-298-6251  
**Email address:** Lab@Qualityenv.com  

**Project ID:** Q16-0950 Highland Elementary  
**Date/Time sampled:** 11/29/2016 15:00

### Sample Information

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Sample Location</th>
<th>Analysis Code</th>
<th>Turnaround Time (Std, 1-2 Day, 3-6 Hr)</th>
<th>Sample Type (see below)</th>
<th>Volume (L) or Area (in²)</th>
<th>Note (e.g.: material type, weather, etc.)</th>
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</thead>
<tbody>
<tr>
<td>0950-001</td>
<td>Computer Room Table Track</td>
<td>FD-04HP</td>
<td>Std 3-6 Day 3-6 Hr</td>
<td>Tape Lift</td>
<td>1in²</td>
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<tr>
<td>0950-002</td>
<td>Computer Room HVAC Unit</td>
<td>FDC-12HP MEA/DG-18</td>
<td>3-6 Day 3-6 Hr</td>
<td>Swab</td>
<td>1in²</td>
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<tr>
<td>0950-003</td>
<td>Room 305 Top of Sheet Rock</td>
<td>FD-04HP</td>
<td>3-6 Day 3-6 Hr</td>
<td>Tape Lift</td>
<td>1in²</td>
<td></td>
</tr>
<tr>
<td>0950-004</td>
<td>Green Foam Insulation</td>
<td>FD-04HP</td>
<td>3-6 Day 3-6 Hr</td>
<td>Bulk</td>
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</tbody>
</table>

**Sample Types:** Air-O-Cell, Bio-Tape, swab, Andersen, bulk, dust, filter cassette, potable water, non-potable water, etc.  
**Material Types:** wood, paper, etc.

**Common Analysis Codes:**  
- **Fungi, Direct Exam:** (1) Spore Trap: FD-01HP; (2) Tape-lift: FD-02HP; (3) Swab, Bulk, Dust: FD-04HP.  
- **Fungi, Culture:** (1) Andersen/plate: FC-11; (2) Swab, Bulk, Dust: FC-12

**Submitted by:** (sign) [Signature] (print) [Name]  
**Date submitted:** 11/27/16  
**Received by:** (sign) [Signature] (print) [Name]  
**Date and time received:** 11/30/16 9:06
Appendix B: NYC Guidelines
Guidelines

on

Assessment and Remediation of Fungi in Indoor Environments

New York City Department of Health and Mental Hygiene

November 2008
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Preface

This 2008 document revises existing guidelines and supersedes all prior editions. It is based both on a review of the current literature regarding fungi (mold) and on comments from a review panel consisting of experts in the fields of mycology/microbiology, environmental health sciences, environmental/occupational medicine, industrial hygiene, and environmental remediation.

These guidelines are intended for use by building owners and managers, environmental contractors and environmental consultants. It is also available for general distribution to anyone concerned about indoor mold growth. The attached fact sheet, “Mold Growth: Prevention and Cleanup for Building Owners and Managers,” is a simplified summary of these guidelines, which may be useful for building owners, managers and workers. It is strongly recommended that the complete guidelines be referred to before addressing the assessment or remediation of indoor mold growth.

In 1993, the New York City Department of Health and Mental Hygiene (DOHMH) first issued recommendations on addressing mold growth indoors. In 2000, DOHMH made major revisions to the initial guidance and made minor edits in 2002.

The terms fungi and mold are used interchangeably throughout this document.

This document should be used only as guidance. It is not a substitute for a site-specific assessment and remediation plan and is not intended for use in critical care facilities such as intensive care units, transplant units, or surgical suites. Currently there are no United States Federal, New York State, or New York City regulations for the assessment or remediation of mold growth.

These guidelines are available to the public, but may not be reprinted or used for any commercial purpose except with the express written permission of the DOHMH. These guidelines are subject to change as more information regarding this topic becomes available.
The New York City Department of Health and Mental Hygiene would like to thank the following individuals and organizations for participating in the revision of these guidelines. Please note that these guidelines do not necessarily reflect the opinions of the participants or their organizations.

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Donald Ahearn, PhD</td>
<td>Georgia State University</td>
</tr>
<tr>
<td>Scott Armour, MS</td>
<td>Armour Applied Science LLC</td>
</tr>
<tr>
<td>John Banta, CAIH</td>
<td>Restoration Consultants</td>
</tr>
<tr>
<td>Don Bremner</td>
<td>Environmental Abatement Council of Ontario – Resto</td>
</tr>
<tr>
<td>Terry Brennan, MS</td>
<td>Camroden Associates Inc.</td>
</tr>
<tr>
<td>Armando Chamorro, CIH</td>
<td>CIH Environmental</td>
</tr>
<tr>
<td>Ginger Chew, ScD</td>
<td>Columbia University</td>
</tr>
<tr>
<td>Sidney Crow, PhD</td>
<td>Georgia State University</td>
</tr>
<tr>
<td>Susan Conrath, PhD, MPH</td>
<td>US Public Health Service, Indoor Environments Div</td>
</tr>
<tr>
<td>Dorr Dearborn, MD</td>
<td>Rainbow Childrens Hospital</td>
</tr>
<tr>
<td>Marie-Alix d'Halewyn</td>
<td>Institut National de Santé Publique du Québec</td>
</tr>
<tr>
<td>Eric Esswein, MPH, CIH</td>
<td>US National Institute for Occupational Safety and</td>
</tr>
<tr>
<td>Elissa Favata, MD</td>
<td>Environmental and Occupational Health Associates</td>
</tr>
<tr>
<td>Jean Goldberg, MS, CSP, CIH</td>
<td>The New York University Langone Medical Center</td>
</tr>
<tr>
<td>Ling-Ling Hung, PhD</td>
<td>US Public Health Service, Division of Federal Oc</td>
</tr>
<tr>
<td>Bruce Jarvis, PhD</td>
<td>University of Maryland at College Park Dept of Ch</td>
</tr>
<tr>
<td>Eckardt Johanning, MD, MS</td>
<td>Fungal Research Group Foundation, Inc.</td>
</tr>
<tr>
<td>Susan Kitzman, DrPH</td>
<td>Hunter College of the City University of New York</td>
</tr>
<tr>
<td>Laura Kolb, MPH</td>
<td>US Environmental Protection Agency, Indoor Environ</td>
</tr>
<tr>
<td>Ed Light, CIH</td>
<td>Building Dynamics</td>
</tr>
<tr>
<td>Bruce Lippy, PhD</td>
<td>The Lippy Group</td>
</tr>
<tr>
<td>Gerald Llewellyn, PhD</td>
<td>State of Delaware, Division of Public Health</td>
</tr>
<tr>
<td>J David Miller, PhD</td>
<td>Carleton University, Department of Chemistry</td>
</tr>
<tr>
<td>Philip Morey, PhD, CIH</td>
<td>Environ Corporation</td>
</tr>
<tr>
<td>David Newman, MA, MS</td>
<td>New York Committee for Occupational Safety and H</td>
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<tr>
<td>Ted Outwater</td>
<td>US National Institute of Environmental Health Sc</td>
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<tr>
<td>Alex Potievsky</td>
<td>New York City, Citywide Office of Occupational S</td>
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<tr>
<td>Ken Ruest</td>
<td>Canada Mortgage and Housing Corporation</td>
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<tr>
<td>Virginia Salares, PhD</td>
<td>Canada Mortgage and Housing Corporation</td>
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<tr>
<td>AnnMarie Santiago</td>
<td>New York City Department of Housing Preservation &amp;</td>
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<tr>
<td>Bill Sothern, MS, CIH</td>
<td>Microecologies Inc.</td>
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<tr>
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</tr>
<tr>
<td>John Tancredi</td>
<td>Environmental Contractors Association of New York</td>
</tr>
<tr>
<td>Donald Weekes, CIH, CSP</td>
<td>InAIR Environmental Ltd.</td>
</tr>
<tr>
<td>Chin Yang, Ph.D.</td>
<td>Prestige EnviroMicrobiology Inc</td>
</tr>
</tbody>
</table>

We would also like to thank the many others who offered opinions, comments, and assistance at various stages during the development of these guidelines.

These guidelines were prepared by the Environmental and Occupational Disease Epidemiology Unit of the New York City Department of Health and Mental Hygiene. This document, and any future revisions, is available online at [nyc.gov/health](http://nyc.gov/health). For further information please call 311 or (212) NEW-YORK (from outside the City).

November 2009
Introduction

Fungi (mold) are present almost everywhere. In an indoor environment hundreds of different kinds of mold are able to grow wherever there is moisture and an organic substrate (food source). They can grow on building and other materials, including: the paper on gypsum wallboard (drywall); ceiling tiles; wood products; paint; wallpaper; carpeting; some furnishings; books/papers; clothes; and other fabrics. Mold can also grow on moist, dirty surfaces such as concrete, fiberglass insulation, and ceramic tiles. It is neither possible nor warranted to eliminate the presence of all indoor fungal spores and fragments; however, mold growth indoors can and should be prevented and removed if present.

The purpose of these guidelines is to provide an approach to address potential and observed mold growth on structural materials in commercial, school, and residential buildings. Mold growth in critical care areas of health-care facilities such as intensive care units or surgery suites may pose significant health concerns to patients. This document is not intended for such situations. Please visit the US Centers for Disease Control and Prevention (CDC) at www.cdc.gov for more information on dealing with mold growth and its cleanup in health-care facilities. Mold on bathroom tile grout, in shower stalls, and on bathtubs is a common occurrence. Occupants can control this growth through frequent use of household cleaners.

Water accumulation in indoor environments can lead to mold growth (and other environmental problems), which has been associated with human health effects (see Appendix A). Indoor mold growth can be prevented or minimized, however, by actively maintaining, inspecting, and correcting buildings for moisture problems and immediately drying and managing water-damaged materials. In the event that mold growth does occur, this guide is intended to assist those responsible for maintaining facilities in evaluating and correcting this problem.

Removing mold growth and correcting the underlying cause of water accumulation can help to reduce mold exposures and related health symptoms. Prompt remediation of mold-damaged materials and infrastructure repair should be the primary response to mold growth in buildings. The simplest, most expedient remediation that properly and safely removes mold growth from buildings should be used. Extensive mold growth poses more difficult problems that should be addressed on a case-by-case basis in consultation with an appropriate building or environmental health professional. In all situations, the source of water must be identified and corrected or the mold growth will recur.

Effective communication with building occupants is an important component of all remedial efforts. Individuals who believe they have mold-related health problems should see their physicians. Individuals who may have an occupationally related illness should be referred to an occupational/environmental physician for evaluation, following any needed initial care. Clinic contact information is available from the New York State Department of Health at www.health.state.ny.us/environmental/workplace/clinic_network.
Environmental Assessment

The presence of mold growth, water damage, or musty odors should be addressed quickly. In all instances, any sources of water must be identified and corrected and the extent of water damage and any mold growth determined. Water-damaged materials should be removed or cleaned and dried. For additional information on cleaning water-damaged materials and personal belongings, refer to the EPA document “Mold Remediation in Schools and Commercial Buildings.”

A trained building or environmental health professional may be helpful in assessing the extent of the moisture problem and mold growth and developing a site-specific work plan. The presence of a trained professional to provide oversight during remediation can also be helpful to ensure quality work and compliance with the work plan. According to the American Industrial Hygiene Association a trained professional should have, at a minimum, a relevant science or engineering degree and two years of full-time supervised experience in mold assessment.

Visual Inspection

A visual inspection is the most important initial step in identifying a possible mold problem and in determining remedial strategies. The extent of any water damage and mold growth should be visually assessed and the affected building materials identified. A visual inspection should also include observations of hidden areas where damages may be present, such as crawl spaces, attics, and behind wallboard. Carpet backing and padding, wallpaper, moldings (e.g. baseboards), insulation and other materials that are suspected of hiding mold growth should also be assessed.

Ceiling tiles, paper-covered gypsum wallboard (drywall), structural wood, and other cellulose-containing surfaces should be given careful attention during a visual inspection. Ventilation systems should be visually checked for damp conditions and/or mold growth on system components such as filters, insulation, and coils/fins, as well as for overall cleanliness.

Equipment such as a moisture meter or infrared camera (to detect moisture in building materials) or a borescope (to view spaces in ductwork or behind walls) may be helpful in identifying hidden sources of mold growth, the extent of water damage, and in determining if the water source is active.

Using personal protective equipment such as gloves and respiratory protection (e.g. N-95 disposable respirator) should be considered if assessment work might disturb mold. Efforts should also be made to minimize the generation and migration of any dust and mold.

Environmental Sampling

Environmental sampling is not usually necessary to proceed with remediation of visually identified mold growth or water-damaged materials. Decisions about appropriate remediation strategies can generally be made on the basis of a thorough visual inspection. Environmental sampling may be helpful in some cases, such as, to confirm the presence of visually identified
mold or if the source of perceived indoor mold growth cannot be visually identified.

If environmental samples will be collected, a sampling plan should be developed that includes a clear purpose, sampling strategy, and addresses the interpretation of results. Many types of sampling can be performed (e.g. air, surface, dust, and bulk materials) on a variety of fungal components and metabolites, using diverse sampling methodologies. Sampling methods for fungi are not well standardized, however, and may yield highly variable results that can be difficult to interpret. Currently, there are no standards, or clear and widely accepted guidelines with which to compare results for health or environmental assessments.

Environmental sampling should be conducted by an individual who is trained in the appropriate sampling methods and is aware of the limitations of the methods used. Using a laboratory that specializes in environmental mycology is also recommended. The laboratory should be accredited in microbiology by an independent and reputable certifying organization.

For additional information on sampling, refer to the American Conference of Governmental Industrial Hygienists’ publication, “Bioaerosols: Assessment and Control” and the American Industrial Hygiene Association’s “Field Guide for the Determination of Biological Contaminants in Environmental Samples.”

**Remediation**

The goal of remediation is to remove or clean mold-damaged materials using work practices that protect occupants by controlling the dispersion of mold from the work area and protect remediation workers from exposures to mold. The listed remediation methods were designed to achieve this goal; however, they are not meant to exclude other similarly effective methods and are not a substitute for a site-specific work plan. Since little scientific information exists that evaluates the effectiveness and best practices for mold remediation, these guidelines are based on principles used to remediate common indoor environmental hazards. These guidelines are not intended for use in critical care facilities such as intensive care units, transplant units, or surgical suites.

Prior to any remediation, consideration must be given to the potential presence of other environmental hazards, such as asbestos and lead. These guidelines are based on possible health risks from mold exposure and may be superseded by standard procedures for the remediation of other indoor environmental hazards.

**Moisture Control and Building Repair**

In all situations, the underlying moisture problem must be corrected to prevent recurring mold growth. Indoor moisture can result from numerous causes, such as: façade and roof leaks; plumbing leaks; floods; condensation; and high relative humidity. An appropriate building expert may be needed to identify and repair building problems. An immediate response
and thorough cleaning, drying, and/or removal of water-damaged materials will prevent or limit microbial growth.

Relative humidity should generally be maintained at levels below 65% to inhibit mold growth.\textsuperscript{19} Short-term periods of higher humidity would not be expected to result in mold growth.\textsuperscript{50} However, condensation on cold surfaces could result in water accumulation at much lower relative humidity levels. Relative humidity should be kept low enough to prevent condensation on windows and other surfaces.

Emphasis should be placed on ensuring proper repairs of the building infrastructure so that water intrusion and moisture accumulation is stopped and does not recur.

**Worker Training**

Proper training of workers is critical in successfully and safely remediating mold growth.\textsuperscript{21,22} Training topics that should be addressed include:

- Causes of moisture intrusion and mold growth
- Health concerns related to mold exposure
- The use of appropriate personal protective equipment
- Mold remediation work practices, procedures, and methods

For additional information, the National Institute of Environmental Health Sciences’ publication, “Guidelines for the Protection and Training of Workers Engaged in Maintenance and Remediation Work Associated with Mold” lists minimum training criteria for building maintenance and mold remediation workers that should be completed before addressing indoor mold growth.\textsuperscript{23}

Trained building maintenance staff can address limited and occasional mold growth. For larger jobs, more extensively trained mold remediation workers may be needed.

**Cleaning Methods**

Non-porous materials (\textit{e.g.} metals, glass, and hard plastics) can almost always be cleaned. Semi-porous and porous structural materials, such as wood and concrete can be cleaned if they are structurally sound. Porous materials, such as ceiling tiles and insulation, and wallboards (with more than a small area of mold growth) should be removed and discarded. Wallboard should be cleaned or removed at least six inches beyond visually assessed mold growth (including hidden areas, see \textit{Visual Inspection}) or wet or water-damaged areas.\textsuperscript{24} A professional restoration consultant should be contacted to restore valuable items that have been damaged.

Cleaning should be done using a soap or detergent solution. Use the gentlest cleaning method that effectively removes the mold to limit dust generation. All materials to be reused should be dry and visibly free from mold. Consideration should also be given to cleaning surfaces and materials adjacent to areas of mold growth for settled spores and fungal fragments. A vacuum
equipped with a High-Efficiency Particulate Air (HEPA) filter could also be used to clean these adjacent areas.

Disinfectants are seldom needed to perform an effective remediation because removal of fungal growth remains the most effective way to prevent exposure. Disinfectant use is recommended when addressing certain specific concerns such as mold growth resulting from sewage waters. If disinfectants are considered necessary, additional measures to protect workers and occupants may also be required. Disinfectants must be registered for use by the United States Environmental Protection Agency (EPA). Any antimicrobial products used in a HVAC system must be EPA-registered specifically for that use.

The use of gaseous, vapor-phase, or aerosolized (e.g. fogging) biocides for remedial purposes is not recommended. Using biocides in this manner can pose health concerns for people in occupied spaces of the building and for people returning to the treated space. Furthermore, the effectiveness of these treatments is unproven and does not address the possible health concerns from the presence of the remaining non-viable mold.

**Quality Assurance Indicators**

Measures to ensure the quality and effectiveness of remediation should be undertaken regardless of the project size. Evaluations during as well as after remediation should be conducted to confirm the effectiveness of remedial work, particularly for large-scale remediation. At minimum, these quality assurance indicators should be followed and documented:

- The underlying moisture problem was identified and eliminated
- Isolation of the work area was appropriate and effective
- Mold removal and worksite cleanup was performed according to the site-specific plan
- Any additional moisture or mold damage discovered during remediation was properly addressed
- Upon completion of remediation, surfaces are free from visible dust and debris.
- If environmental sampling was performed, the results of such sampling were evaluated by a trained building or environmental health professional.10

**Restoring Treated Spaces**

After completing mold remediation and correcting moisture problems, building materials that were removed should be replaced and brought to an intact and finished condition. The use of new building materials that do not promote mold growth should be considered. Anti-microbial paints are usually unnecessary after proper mold remediation. They should not be used in lieu of mold removal and proper moisture control, but may be useful in areas that are reasonably expected to be subject to moisture.

**Remediation Procedures**
Three different sizes of remediation and the remediation of heating, ventilation, and air-conditioning (HVAC) systems are described below. Currently, existing research does not relate the amount of mold growth to the frequency or severity of health effects. However, as the presence of moldy materials increases, so does the potential for exposure and the need to limit the spread of mold-containing dusts and worker exposures. As such, the size of the area impacted by mold growth as well as practical considerations were used to help define remedial procedures.

Since the following areas were arbitrarily selected, site-specific conditions must be considered in choosing adequate remediation procedures. For more information on the unique characteristics of building types and occupancies that may influence remediation procedures refer to the American Industrial Hygiene Association’s publication, “Recognition, Evaluation, and Control of Indoor Mold.”

**Small Isolated Areas** (less than 10 square feet) – e.g. ceiling tiles, small areas on walls

(a) Remediation can be conducted by trained building maintenance staff. Such persons should receive training on proper cleaning methods, personal protection, and potential health hazards associated with mold exposure. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

(b) Respiratory protection (e.g., N-95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection should also be worn.

(c) The work area should be unoccupied.

(d) If work may impact difficult-to-clean surfaces or items (e.g. carpeting, electronic equipment), the floor of the work area, egress pathways, and other identified materials/belongings should be removed or covered with plastic sheeting and sealed with tape before remediation.

(e) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.

(f) Moldy materials that can be cleaned should be cleaned using a soap or detergent solution. Materials that cannot be cleaned should be removed from the building in a sealed plastic bag(s). Plastic sheeting should be discarded after use. There are no special requirements for the disposal of moldy materials.
(g) The work area and areas used by workers for egress should be HEPA-vacuumed (a vacuum equipped with a High-Efficiency Particulate Air filter) or cleaned with a damp cloth and/or mop and a soap or detergent solution.

(h) All areas should be left dry and visibly free from mold, dust, and debris. Check that other quality assurance indicators (see Quality Insurance Indicators) have also been met.

Medium-Sized Isolated Areas (10 – 100 square feet)

(a) Remediation can be conducted by trained building maintenance staff. Such persons should receive training on proper cleaning methods, personal protection, and potential health hazards associated with mold exposure. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

(b) Respiratory protection (e.g., N-95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection should also be worn.

(c) The work area should be unoccupied.

(d) Cover the floor, egress pathways, and items left in the work area with plastic sheeting and seal with tape before remediation.

(e) Seal ventilation ducts/grills and other openings in the work area with plastic sheeting. The HVAC system servicing this area may need to be shut down to properly seal vents.

(f) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.

(g) Moldy materials that can be cleaned should be cleaned using a soap or detergent solution. Materials that cannot be cleaned should be removed from the building in sealed plastic bags. Plastic sheeting should be discarded after use. There are no special requirements for disposal of moldy materials.

(h) The work area and areas used by workers for egress should be HEPA-vacuumed and cleaned with a damp cloth and/or mop and a soap or detergent solution.

(i) All areas should be left dry and visibly free from mold, dust, and debris. Check that other quality assurance indicators (see Quality Insurance Indicators) have also been met.
**Large Areas** (greater than 100 square feet in a contiguous area) – e.g. on separate walls in a single room

Properly trained and equipped mold remediation workers should conduct the remediation. The presence of a trained building or environmental health professional (see *Environmental Assessment*) to provide oversight during remediation may be helpful to ensure quality work and compliance with the work plan. The following procedures are recommended:

(a) Personnel trained in the handling of mold-damaged materials equipped with:

i. A minimum of half-face elastomeric respirators with P-100 filters used in accordance with the OSHA respiratory protection standard (29 CFR 1910.134)

ii. Full body coveralls with head and foot coverings

iii. Gloves and eye protection

(b) Containment of the affected area:

i. The HVAC system servicing this area should be shut down during remediation.

ii. Isolation of the work area using plastic sheeting sealed with duct tape. Furnishings should be removed from the area. Ventilation ducts/grills, any other openings, and remaining fixtures/furnishings should be covered with plastic sheeting sealed with duct tape.

iii. Consider using an exhaust fan equipped with a HEPA filter to generate negative pressurization.

iv. Consider using airlocks and a clean changing room.

v. Egress pathways should also be covered if a clean changing room is not used.

(c) The work area should be unoccupied.

(d) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.

(e) Moldy materials, that can be cleaned, should be cleaned using a soap or detergent solution. Materials that cannot be cleaned should be removed from the building in sealed plastic bags. The outside of the bags should be cleaned with a damp cloth and a soap or detergent solution or HEPA-vacuumed in the work area (or clean changing room) prior to their transport to unaffected areas of the building. There are no special requirements for the disposal of moldy materials.
(f) Before leaving isolated areas, workers should remove disposable clothing to prevent the tracking of mold-containing dusts outside of the work area.

(g) The work area and egress pathways (and clean changing room if present) should be HEPA-vacuumed and cleaned with a damp cloth and/or mop with a soap or detergent solution and be visibly clean prior to the removal of isolation barriers. Plastic sheeting should be discarded after use.

(h) All areas should be left dry and visibly free from mold, dust, and debris. Check that other quality assurance indicators (see **Quality Insurance Indicators**) have also been met.

**Remediation of HVAC Systems**

Mold growth in heating, ventilation, and air-conditioning (HVAC) systems can pose building-wide problems. Obtaining professional help should always be considered in addressing even small amounts of mold growth or moisture problems within an HVAC system. Recurring problems, regardless of size, may indicate a systemic problem and appropriate professional help should be sought.

**Small Isolated Area of Mold Growth in the HVAC System** (<10 square feet) – e.g. box filter, small area on insulation

(a) Remediation can be conducted by trained building maintenance staff that are familiar with the design and function of the impacted HVAC system. Such persons should receive training on proper cleaning methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

(b) Respiratory protection (e.g. N-95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection should be worn.

(c) The HVAC system should be shut down prior to any remedial activities.

(d) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.

(e) The use of plastic sheeting to isolate other sections of the system should be considered.
(f) Moldy materials that can be cleaned should be cleaned using a soap or detergent solution. Growth-supporting materials that are moldy, such as the insulation of interior-lined ducts, flexible ducts, and filters, should be removed and sealed in plastic bags. There are no special requirements for the disposal of moldy materials.

(g) The work area and areas used for egress should be HEPA-vacuumed and cleaned with a damp cloth and/or mop and a soap or detergent solution. Any plastic sheeting should be discarded after use.

(h) All areas should be left dry and visibly free from mold, dust and debris. Check that other quality assurance indicators (see Quality Insurance Indicators) have also been met.

Large Area of Mold Growth in the HVAC System (>10 square feet)

Properly trained and equipped mold remediation workers with specific training and experience in HVAC systems, should conduct the remediation. The presence of a trained building or environmental health professional (see Environmental Assessment) with experience and specific knowledge of HVAC systems, to provide oversight during remediation can be helpful to ensure quality work and compliance with the work plan. The following procedures are recommended:

(a) Personnel trained in the handling of mold-damaged materials equipped with:

   i. A minimum of half-face elastomeric respirators with P-100 filters used in accordance with the OSHA respiratory protection standard (29 CFR 1910.134)
   ii. Full body coveralls with head and foot coverings
   iii. Gloves and eye protection

(b) The HVAC system should be shut down prior to any remedial activities.

(c) Containment of the affected area:

   i. Isolation of work area from the other areas of the HVAC system using plastic sheeting sealed with duct tape
   ii. The use of an exhaust fan equipped with a HEPA filter to generate negative pressurization should be considered
   iii. Consider using airlocks and a clean changing room
   iv. Egress pathways should also be covered if a clean changing room is not used

(d) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that
create excessive dust should be avoided.

(e) Moldy materials that can be cleaned should be cleaned using a soap or detergent solution. Growth-supporting materials that are moldy, such as the insulation of interior-lined ducts, flexible ducts, and filters, should be removed in sealed plastic bags. The outside of the bags should be cleaned with a damp cloth and a soap or detergent solution or HEPA-vacuumed prior to their removal from the isolated work area. There are no special requirements for the disposal of moldy materials.

(f) Before leaving isolated areas, workers should remove disposable clothing to prevent the tracking of mold-containing dust outside of the work area.

(g) The work area and egress pathways (and clean changing room if present) should be HEPA-vacuumed and cleaned with a damp cloth and/or mop and a soap or detergent solution prior to the removal of isolation barriers. Plastic sheeting should be discarded after use.

(h) All areas should be left dry and visibly free from mold, dust, and debris. Check that other quality assurance indicators (see Quality Insurance Indicators) have also been met.

Communication with Building Occupants

Communication with occupants of affected spaces is important regardless of the size of the project but is especially important when mold growth requiring large-scale remediation is found. When large-scale remediation is performed, the building owner, management, and/or employer should notify occupants in the building. Notification should include a description of the remedial measures to be taken and a timetable for completion. Group meetings, held before and after remediation, with full disclosure of plans and results, can be an effective communication mechanism. Building occupants should be provided with a copy of all inspection reports upon request. For more detailed information on risk communication refer to the American Industrial Hygiene Association’s publication, “Recognition, Evaluation, and Control of Indoor Mold.”
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Appendix A

Health Effects

Several comprehensive reviews of the scientific literature on the health effects of mold in indoor spaces have been published in recent years.1-3 This appendix reflects these reviews but has also considered more recently published articles.

Potential for Exposure and Health Effects

Fungi are common in both indoor and outdoor environments and play a vital role in the earth’s ecology by decomposing organic matter such as dead trees and leaves. As a result, all people have routine exposure to fungi, which may occur through inhalation, ingestion, and touching moldy surfaces. The main route of exposure to mold for people living or working in moldy indoor environments is inhalation of airborne fungal spores, fragments, or metabolites.2 Ingestion and dermal exposures are less understood in these scenarios and can easily be minimized or prevented by workers through proper hygiene and work practices. Therefore, the remaining discussion will focus on the adverse health effects of mold due to inhalational exposure.

Adverse health effects may include: allergic reactions; toxic effects and irritation; and infections.1-5 The mere presence of mold growth does not necessarily indicate that people present in the area will exhibit adverse health effects. However, as the amount of mold-impacted materials increases, so do potential exposures. Certain exposures may represent a significant risk such as occupational exposures to high concentrations of fungi and chronic (long-term) exposures, especially of individuals with underlying health conditions such as asthma, compromised immune systems, or allergies.

Evidence linking mold exposures to severe human health effects is documented in reports of occupational disease, particularly in forestry and agricultural settings where inhalation exposures were typically high and/or chronic.2,6-11 The intensity of mold exposure and associated health effects experienced in undisturbed indoor environments is usually much less severe than that experienced by agricultural or forestry workers.2,7,12-14 With the possible exception of exposures from mold remediation work, such high-level exposures are not expected indoors.15-16 Although high-level exposures are unlikely to occur in undisturbed indoor settings, chronic exposures to lower levels may still raise health concerns.

Several factors influence the likelihood that individuals might experience health effects following exposure to mold in indoor environments. These include: the nature of the fungal material (e.g., allergenic, toxic/irritant, or infectious); the degree of exposure (amount and duration); and the susceptibility of exposed people. Susceptibility varies with genetic predisposition, age, state of health, concurrent exposures, and previous sensitization. It is not possible to determine “safe” or “unsafe” levels of exposure for the general public because of variation of individual susceptibility, lack of standardized and validated environmental exposure sampling methods, and lack of reliable biological markers.17
In addition to the adverse health effects associated with exposure to mold, in 2004, the Institute of Medicine (IOM) reported health risks associated with living in damp indoor environments. The IOM reported evidence suggesting an association between damp indoor environments and the development of asthma. Reported respiratory symptoms included, wheezing, coughing, and exacerbation of asthma.\(^2\)

**Allergic and Hypersensitivity Effects**

It is well established that fungi can cause allergic reactions in humans. The most common symptoms associated with allergic reactions include runny nose, sneezing, post-nasal drip with sore throat, eye irritation, cough, wheeze, and other symptoms associated with the aggravation of asthma.\(^2,13,18-23\) Immunological responses to mold include allergic rhinitis, hypersensitivity pneumonitis, and asthma exacerbations. These conditions require prior exposure for sensitization. These symptoms may persist for some time after removal from the source.

Allergic rhinitis is a group of symptoms that mostly affects the mucous membranes of nasal passages and may result from an allergic reaction to fungi. Symptoms often associated with “hay fever” such as congestion, runny nose, and sneezing may occur.\(^5,24\)

Hypersensitivity pneumonitis (HP) is a rare lung disease with delayed onset (3-8 hours) of fever, shortness of breath, cough, chest tightness, chills, and general malaise. With continued exposure, HP can lead to permanent lung disease. The occurrence of HP, even among those that are highly exposed to fungi, is rare. HP has typically been associated with repeated heavy exposures in forestry and agricultural settings, which raises concerns for workers routinely performing mold remediation, but has also been reported in indoor settings with lower level chronic exposures.\(^5,11,18,25-27\)

Allergic bronchopulmonary aspergillosis (ABPA) and allergic fungal sinusitis (AFS) are examples of rarely occurring allergic reactions to non-invasive fungal growth in the respiratory system. Most symptoms are non-specific resembling asthma or chronic sinusitis. In addition, ABPA and AFS usually occur in those with underlying medical problems. In the case of ABPA, this includes cystic fibrosis, asthma, and other predisposing medical conditions.\(^28,29\)

Recent studies, which have suggested an association between the presence of indoor mold and the development of asthma or allergies, are limited and difficult to interpret. Stark *et al.* found higher concentrations of dust-borne mold in infants’ homes were associated with development of allergic rhinitis, which is a known risk factor for childhood asthma.\(^24\) However, other studies have shown higher concentrations of dust-borne fungi and other microorganisms in infants’ homes were associated with a decreased risk for asthma and wheezing.\(^30,31\) Jaakkola et al. reported an association between a moldy odor in the home and development of asthma, but no association with visible mold or water damage was found. Although the sample size for this subset was small, it suggests that active mold growth might be a stronger risk factor for certain health effects than presence of nonviable or inactive mold alone.\(^35\) This also is supported by recent studies that have shown allergen production is significantly increased during active growth.\(^33,34\)
Though available, allergy testing for molds is limited, subject to high rates of error, and can be difficult to interpret. Preparations for skin testing or the specific antigen in blood tests may be different from the mold to which an individual is sensitive. A positive test indicates an allergic response but does not definitively link a specific mold exposure to an individual’s current health condition.\textsuperscript{5}

**Irritant and Toxic Effects**

**Irritant Effects**

Indoor growth of mold can lead to the production of volatile organic compounds (VOCs), also referred to as microbial VOCs (MVOCs), and the presence of fungal glucans.\textsuperscript{13,35-38} Glucans are components of many fungal cell walls. Some studies have reported an association with the inhalation of glucans and airway irritation and inflammation, but results have been mixed and may not be applicable to expected indoor concentrations. Observed effects may also be the result of exposure to or contact with other fungal components, metabolites, or synergistic effects with other microbial agents.\textsuperscript{17,36,39} Resolution of irritant symptoms upon removal from the source can help distinguish irritant effects from allergic symptoms.\textsuperscript{5}

MVOCs are responsible for the musty odor often associated with mold growth, which may be noticeable at very low concentrations. Many of the MVOCs are common to other sources in the home.\textsuperscript{40} The very low levels usually found indoors have not been shown to cause health effects.\textsuperscript{35,37}

**Toxic Effects**

Some symptoms and maladies have been attributed to the toxic effects of fungi in indoor environments. Certain fungi can produce toxins (mycotoxins) at varying levels that are dependent on many complex environmental and biological factors.\textsuperscript{41} The reported symptoms from exposure to mycotoxins indoors include headaches, irritation, and nausea/loss of appetite, but are often non-specific (\textit{e.g.} fatigue, inability to concentrate/remember), and may be caused by other environmental and non-environmental agents.\textsuperscript{2,42-46} Although health effects from exposures to mycotoxins have been associated with certain occupational exposures or ingestion of mold-contaminated food, scientific support for the reported effects in indoor environments has not been established. This may be due to the lower levels of exposure and different routes of exposure.\textsuperscript{2,5,13,21,27,46-49}

\textit{Stachybotrys} is colloquially referred to as “black mold” or “toxic mold.” It has been suggested that toxins produced by this mold are associated with specific health effects. Acute Idiopathic Pulmonary Hemorrhage (AIPH) in infants has been described in several reports suggesting a relationship with \textit{Stachybotrys}. AIPH is an uncommon condition that results in bleeding in the lungs. The IOM reviewed the existing studies and concluded that there was insufficient evidence to determine if mold exposure was associated with AIPH.\textsuperscript{2,3} The evidence is also insufficient for an association between inhalation of \textit{Stachybotrys} toxins indoors and neurological damage.\textsuperscript{2,26,49} Although severe health effects from the inhalation exposures to
Stachybotrys toxins indoors is plausible, it is not well-supported, and the issue remains controversial.\textsuperscript{2,3,5,27,49,50}

Organic dust toxic syndrome (ODTS) describes the abrupt onset of fever, flu-like symptoms, and respiratory symptoms in the hours following a single, heavy exposure to dust-containing fungi and other microorganisms. Unlike HP, ODTS does not require repeated exposures to bioaerosols and can occur after the first exposure. ODTS has been documented in farm workers handling contaminated material, but may also affect workers performing remediation of building materials with widespread mold growth.\textsuperscript{2,11,27} ODTS is a self-limited illness, which usually improves within 24 hours after the discontinuation of exposure. It may be underreported among workers exposed to fungi, but would not be expected in occupants of buildings with mold growth.\textsuperscript{11,27}

\textbf{Infectious Disease}

Only a small number of fungi have been associated with infectious disease. Few of these fungi are typically found in the indoor environment.\textsuperscript{51,52} Several species of \textit{Aspergillus} are known to cause aspergillosis, most commonly \textit{A. fumigatus}, \textit{A. flavus}, and rarely, other species. Aspergillosis is a disease that generally affects severely immunosuppressed persons. Exposure to these molds, even in high concentrations, is unlikely to cause infection in healthy individuals.\textsuperscript{21,53} Heavy exposure to fungi associated with bird and bat droppings (\textit{e.g.} \textit{Histoplasma capsulatum} and \textit{Cryptococcus neoformans}) can lead to health effects, usually transient flu-like illnesses, in healthy individuals. More severe health effects are primarily encountered in immunocompromised persons.\textsuperscript{18,54}

\textbf{Appendix A References}


Preventing and Cleaning Mold Growth
Fact Sheet for Building Owners and Managers

Mold (mildew) is a fungus that can grow inside building on wet or damp surfaces. Mold can cause allergic reactions, trigger asthma attacks, or cause other health problems in some people.

Mold needs water or moisture to grow. Stop indoor mold growth by fixing leaks, drying damp or wet areas and controlling humidity. Before a clean-up, refer to the complete “Mold Guidelines” at nyc.gov/health.

PREVENT MOLD GROWTH
Fix Water Problems Immediately
- Correct water leaks.
- Dry any and all water-damaged items or areas.

Control Moisture Sources
- In bathrooms without windows, check that bathroom fans or exhaust vents are working.
- In bathrooms with windows, check that the window can be opened.
- Use a dehumidifier to lower humidity levels in basements.

CHECK THE SIZE OF THE AREA WITH MOLD GROWTH AND WATER DAMAGE
- Look for hidden mold and water damage
- If the amount of mold observed covers a large area (more than 100 square feet), is in the HVAC system, or is difficult to get to, you may need professional help.
- If there is less than 100 square feet of mold growth, trained building staff should be able to do the cleanup job.

FOLLOW THE PROPER STEPS TO CLEAN MOLD GROWTH
- Tell people living or working in the building about the plan to clean the mold growth.
- Tenants and others should leave the work area before cleaning begins.
- Cover or remove difficult-to-clean surfaces or items (e.g. carpeting, electronics) from the work area before cleaning begins.
- Use safety goggles, gloves, and a disposable respirator when removing mold growth.
- Clean mold growth with soap or a detergent, and water.
- Remove and throw away porous materials (e.g. ceiling tiles, insulation) with mold growth on them.
- Dispose of any plastic sheeting, moldy materials, and used sponges or rags in sealed heavy-duty plastic bags.
- Always fix water problems immediately. If the mold returns quickly or spreads, you may have an ongoing water problem.

If more than 10 square feet of mold growth is present also:
- Cover the floor in the work area with plastic sheeting.
- Cover entry and exit pathways with plastic sheeting.
- Seal any ventilation ducts with plastic sheeting.
- Mop and/or HEPA-vacuum the work area and pathways.

CLEAN MOLD GROWTH WITH PROPER SUPPLIES
- Soap or detergent
- Disposable rags/sponges and scrub brush
- Buckets
- Heavy-duty plastic garbage bags
- Protective gear (e.g. goggles, rubber gloves, N95 respirator)

FOR MORE INFORMATION
Visit our web site at nyc.gov/health for the complete “Mold Guidelines” or call 311.