MICROBIAL INSPECTION

Town of Newbold

Site:
4608 Apperson Drive
Rhinelander, WI 54501

Work Area:
Town Hall
Throughout

Inspection Date: September 10, 2021
Report Date: September 17, 2021

NorthStar No. 210-994

Submitted By:
NorthStar Environmental Testing, LLC.

NORTHSTAR ENVIRONMENTAL TESTING, LLC
www.NorthStarTesting.com

Corporate Office: 1006 Western Avenue, Mosinee, WI 54455, Tel: 715.693.6112, info@NorthStarTesting.com
Fox Cities Branch: 1835 E. Edgewood Drive, Suite 10542, Appleton, WI 54913, Tel: 920.422.4888
Madison Branch: 1310 Mendota Street, Suite 121, Madison, WI 53714, Tel: 608.827.6761
Sheboygan Branch: 2109 Erie Avenue, Suite 103, Sheboygan, WI 53081, Tel: 920.422.4888

Asbestos • Lead Paint • Mold • Indoor Air Quality • Industrial Hygiene

September 17, 2021

Town of Newbold
c/o Dave Kroll
4588 Highway 47
Rhinelander, WI 54501

Project:	Microbial Inspection
Site:	4608 Apperson Drive Rhinelander, WI 54501
Work Area:	Town Hall Throughout
NorthStar No:	210-994

NorthStar Environmental Testing, LLC (NorthStar) was authorized by Dave Kroll on behalf of Town of Newbold to perform a limited indoor air quality assessment and sampling in response to indoor air quality concerns and the potential for elevated airborne microbial activity.

Our scope of services included:

- General visual assessment for the presence and extent of microbial activity within the affected areas of the building as directed by the client.
- Collection & analysis of applicable microbial samples.
- Preparation of a summary report.

PROJECT DISCUSSION:

Testing Date:	September 10, 2021	Technician:	Andrew Schilling
Building/Site:	4608 Apperson Drive Rhinelander, WI 54501	Building Type:	Commercial Property
Site Access and Project Information:	Kim Gauthier 715.362.1092		
Work Area:	Throughout		
Project History and Information:	Upon arriving at the site, NorthStar spoke with Kim Gauthier with regards to project background and was informed of the following: • Kim has been employed and working in the town hall for several years. • Within recent years she has started to develop health issues. • There have been water intrusions throughout the building (roof and basement) and areas of visible microbial growth. • Testing was requested to determine current air quality, and if necessary, recommendations for remediation.		
Health Issues:	Kim has been experiencing health symptoms while being in the building including:		

PROJECT DISCUSSION (continued):

Testing Results:	**Elevated levels of indoor airborne microbial spores**
Visual Result:	Areas of visible water damage and microbial growth were noted during our inspection. Please refer to the 'site observations' section in this report for specific details.
Recommend:	**Microbial remediation is deemed necessary at this time. Please refer to the 'recommendations' section further in this report for more specific details.**

SAMPLING SUMMARY:

Samples Collected:	5 spore-trap air samples (4 interior and 1 exterior)
Analysis Date:	September 16, 2021 (reported)
Laboratory:	Eurofins CEI, Inc. AIHA#103025

AIR SAMPLE RESULTS:

Sample ID	Location	Result (total sp/m³)	Comment
994-1	Shop Area	3,000	**Slightly elevated levels of *Aspergillus/Penicillium* type spores (247 sp/m³).**
994-2	Meeting Area	2,100	**Elevated levels of *Aspergillus/Penicillium* type spores (753 sp/m³) and the presence of *Trichoderma* type spores.**
994-3	Office	2,900	**Elevated levels of *Aspergillus/Penicillium* type spores (1597 sp/m³).**
994-4	Basement Center	6,500	**Elevated levels of *Aspergillus/Penicillium* type spores (6190 sp/m³).**
994-5	Exterior - Front	5,300	Outdoor control sample for comparison.

Results in spores per cubic meter
See the attached laboratory report for complete sample analysis data.

The results of the air sampling indicate elevated levels of ***Aspergillus/Penicillium* type spores** throughout the building when compared to general industry standards and the control sample collected from the building exterior.

Typically, the threshold level for appropriate indoor air quality is between 1,000 and 1,500 sp/m³. However, this is not the only measure of indoor air quality. Specific spore types, quantity, background debris, outdoor spore levels and other factors are considered when assessing the level and significance of indoor spores.

For *Aspergillus/Penicillium* type spores within our region, indoor levels higher than 200 to 400 sp/m³ are typically described as elevated.

Since the outdoor control sample showed only 60 sp/m³ *Aspergillus/Penicillium* type spores, it was determined that an elevation of *Aspergillus/Penicillium* type spores was present throughout the building, ranging from 247 sp/m³ to 6190 sp/m³ (see attached Laboratory Sample Results for more information).

Microbial species detected include a variety of spore types, as is common for this geographic region and season. ***Trichoderma*** type spores are commonly associated with water damage and are not typically found in an indoor environment.

SUMMARY OF SITE OBSERVATIONS:

Building Area:	Description of Visible or Discovered Microbial Activity:	
Shop Area sample 944-1	- The shop area is partially finished (a garage that is used at times for meetings, etc.) - Water damage is present in areas of the ceiling (ceiling tile and insulation) due to previous roof leaks. - Discoloration was noted on the fiberglass insulation around the exhaust pipe of the furnace. - Water damage/rust was noted on the interior steel siding walls of the garage, likely due to moisture from vehicles parked inside during winter months or from exterior water intrusions.	
	Temperature: 72°F	Humidity: 54%
Main Area and Office samples 944-2 944-3	- Water damage was noted in areas of the ceiling (ceiling tile and insulation) due to previous roof leaks. - Mice droppings and debris were noted in areas above the suspended ceiling tile. - The side entry door near the basement stairway had a strong odor (likely due to the mice above the suspended ceiling). - There appears to be minimal airflow in the main level of the building. Kim stated that there are times when the building may be closed for an extended amount of time with minimal airflow. - Microbial growth is present in Kim's office on the desk and underneath wood shelving. The growth is likely from condensation and lack of airflow. - Fixtures and other metal objects in the janitors closet were rusty, likely from condensation and lack of airflow.	
	Temperature: 71°F	Humidity: 53%
Basement sample 944-4	- The basement was primarily unfinished (concrete walls and ceilings). - Water intrusions were noted to be present through the concrete block walls in areas of the basement. Some areas near the walls appeared to be visibly wet. Kim stated that there were no gutters on the building which may be contributing to the water intrusions in the basement. - Microbial growth was noted on some stock ceiling tile that were on the floor of the basement. Microbial growth was noted on books and paper records in the storage areas. Suspect microbial growth was noted on areas of the concrete floor in the basement. - A dehumidifier was operating during our site visit.	
	Temperature: 68°F	Humidity: 51%

RECOMMENDATIONS:

Specific Recommendation:

Most importantly, all sources of water infiltration, elevated moisture, humidity or condensation related issues must be fixed in order for remediation efforts to be successful long-term.

Currently, elevated levels of certain airborne mold species suggest the presence of water damage throughout the building.

The following recommendations should be considered to ensure the future health of the building and its occupants:

Basement:

- Operate multiple HEPA filtered air-scrubbing machines throughout the course of remediation and for an additional 72 hours after completion (or until after a successful air clearance) to reduce any airborne spores displaced by remediation efforts. If possible, exhaust the HEPA filtered air-scrubbing machines to the exterior of the building to create negative air pressure within the containment.

- To avoid cross contamination, contain the area of mold remediation by placing poly barriers over doorways, HVAC vents and other penetrations between the work area and the rest of the structure. Shut off the HVAC system for the duration of the project (if possible). Personal protective equipment including Tyvek suits and respirators are to be worn by workers entering the containment and removed upon exiting

- Remove and dispose of all porous building materials showing signs of visible water staining, elevated surface moisture content and/or surface mold growth. This would include, but may not be limited to: drywall, paneling, fiberglass insulation, shelving and ceiling tiles. Continue to remove the affected building materials a minimum of twelve inches past the last visible signs of microbial growth. Remove any visible dust or debris from throughout the rooms utilizing a HEPA vacuum. Any remaining affected wood, concrete, concrete block or other porous materials in the immediate area, which are not being removed, should be cleaned with a HEPA vacuum and/or an approved fungicide. When building materials are completely dry they should then be treated with a mold inhibiting encapsulant/sealer to discourage future mold growth.

- Remove and dispose of all porous items and contents within the affected area that cannot be properly cleaned (books, furniture, etc.). Items that are deemed salvageable should be properly cleaned with a HEPA vacuum and/or an approved fungicide.

- After all the affected materials have been removed, clean all surfaces within the basement (horizontal and vertical) with an approved fungicide and HEPA vacuum to eliminate any microbial growth and reduce the presence of settled spores.

- Professional duct cleaning, sanitizing, and replacement of the HVAC filters is recommended at the completion of remediation.

- Consider consultation with a contractor about any humidity or water intrusion issues that may be contributing to microbial growth in the basement (possibly adding gutters, fixing any grading issues, adding additional airflow or dehumidification, etc).

RECOMMENDATIONS: CONTINUED

Specific Recommendation:

Main Level:

- Operate multiple HEPA filtered air-scrubbing machines throughout the course of remediation and for an additional 72 hours after completion (or until after a successful air clearance) to reduce any airborne spores displaced by remediation efforts. If possible, exhaust the HEPA filtered air-scrubbing machines to the exterior of the building to create negative air pressure within the containment.

- To avoid cross contamination, contain the area of mold remediation by placing poly barriers over doorways, HVAC vents and other penetrations between the work area and the rest of the structure. Shut off the HVAC system for the duration of the project (if possible). Personal protective equipment including Tyvek suits and respirators are to be worn by workers entering the containment and removed upon exiting.

- All affected ceiling tile and insulation in areas of the ceiling that show visible water damage should be removed. Consider further investigation above the suspended ceilings for water damage, microbial growth or rodent damage and remove the affected materials accordingly. If signs of water damage are near an adjoining wall, consider further investigation into the wall cavity for additional damages.

- Remove and dispose of all porous building materials showing signs of visible water staining, elevated surface moisture content and/or surface mold growth. This would include, but may not be limited to: drywall, paneling, fiberglass insulation, shelving and ceiling tiles. Continue to remove the affected building materials a minimum of twelve inches past the last visible signs of microbial growth. Remove any visible dust or debris from throughout the rooms utilizing a HEPA vacuum. Any remaining affected wood, concrete, concrete block or other porous materials in the immediate area, which are not being removed, should be cleaned with a HEPA vacuum and/or an approved fungicide. When building materials are completely dry they should then be treated with a mold inhibiting encapsulant/sealer to discourage future mold growth.

- After all the affected materials have been removed, clean all horizontal surfaces of the main level with an approved fungicide and HEPA vacuum to eliminate any microbial growth and reduce the presence of settled spores. Since microbial growth was noted due to condensation in the main level of the building, all vertical surfaces should be checked for microbial growth at a minimum and cleaned accordingly. If the insulation above the ceiling cannot be properly cleaned, then it should be removed to ensure that no settled spores, microbial growth or rodent issues remain.

- Consider consultation with a contractor about any roofing, condensation, lack of airflow, water intrusion, and rodent issues throughout the main level.

Ongoing suggested action may include:

- Periodic monitoring of remediated areas to ensure moisture intrusions have been corrected and no additional mold growth is present.
- Use of dehumidifiers and/or fans as necessary to maintain normal humidity and surface moisture levels. Continuous operation of a forced air furnace fan (where applicable) is a good way to increase air flow and filtration within a home. Utilizing timers on bathroom fans will help regulate indoor humidity and condensation.
- When storing items in the area, all porous materials should be stored in a raised position above the floor and away from perimeter foundation walls allowing for an air gap and natural ventilation. Utilize plastic storage containers in place of cardboard boxes.
- Additionally, problem areas may benefit from increased air exchanges or increased air filtration. Air quality may be further improved with the use of HEPA and/or charcoal filtration.

General Recommendation:
- In general, when remediation or cleaning procedures are necessary, they should: be conducted by a professional contractor utilizing EPA approved and industry standard techniques; and be performed by trained individuals using personal protective equipment including protective clothing and respiratory protection. - At the completion of any remediation activity, it is advisable to conduct visual inspection and air or surface sampling to confirm the effectiveness of the cleaning/remediation. - Prior to renovation or remediation activity, it is recommended that testing be performed for the presence of asbestos and lead paint on building material surfaces that will be disturbed. - Additional helpful information can be found online at WI Department of Health Services (www.dhs.wisconsin.gov/asbestos/index.htm and www.dhs.wisconsin.gov/lead/check-your-home.htm); US EPA (www.epa.gov/asbestos/protect-your-family-exposures-asbestos and www.epa.gov/lead/protect-your-family-exposures-lead).

SAMPLING PROTOCOL:

Sampling for airborne microbial activity was performed with a spore-trap type cassette utilizing a calibrated air sample pump. Total sampling time is 5 to 10 minutes depending on existing perceived conditions for a total air sample volume of 100 to 200 liters of air. Samples are sealed for shipment to the laboratory.

REMARKS:

The investigation was limited to spaces made accessible to us by the client. As microbial levels and growth patterns are subject to continual change, the testing and conclusions made are valid only for the actual time of our site visit. The building owner should be aware that variability of microbial levels is common over time and at various locations.

The testing performed and subsequent report has been performed according to applicable generally accepted industry standards and practices in this locality under similar conditions. Information provided to us by building owner/occupant, client or other interested party that may have been utilized in the performance and reporting of the testing was accepted in good faith and can only be assumed to be accurate. The findings and recommendations made are representative of our professional opinion based on currently available information; no other warranty is implied or intended.

Please contact us if you have any questions regarding the presented information or the project in general.

Sincerely,

NorthStar Environmental Testing, LLC.

Dave Barrett
Senior Project Manager

Andrew Schilling
Project Technician

attach: laboratory analysis
photo log
glossary of microbial spores

LABORATORY SAMPLE RESULTS

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MOLD SPORE TRAP REPORT: NONVIABLE DIRECT MICROSCOPY

CLIENT NorthStar Environmental Testing, LLC.
1006 Western Ave
Mosinee, WI 54455

Lab Code: I213235
Date Received: 09-14-21
Date Analyzed: 09-16-21
Date Reported: 09-16-21

PROJECT: Newbold - AA, 210-994

		Client ID	994-1				994-2				994-3			
		Lab ID	M159717				M159718				M159719			
		Location	Shop Area				Meeting Area				Office			
		Volume (L)	150				150				150			
	IDENTIFICATION		Raw Counts	% Analyzed	Spores per m³	% of Total	Raw Counts	% Analyzed	Spores per m³	% of Total	Raw Counts	% Analyzed	Spores per m³	% of Total
Predominantly Outdoor	*Alternaria*		3	100	20	1	2	100	13	1	2	100	13	<1
	Arthrinium													
	Ascospores		45	100	300	10	15	100	100	5	36	100	240	8
	Basidiospores		102	36	1889	64	42	100	280	13	45	100	300	10
	Bipolaris/Drechslera						1	100	7	<1				
	Cercospora		2	100	13	<1								
	Curvularia										1	100	7	<1
	Epicoccum		2	100	13	<1								
	*Helicomyces**													
	Nigrospora													
	Oidium/Peronospora													
	Periconia/Smuts**		4	100	27	1	5	100	33	2	1	100	7	<1
	Pithomyces						1	100	7	<1	1	100	7	<1
	Rusts										1	100	7	<1
	Spegazzinia													
	Stemphylium													
	Tetraploa													
	Torula													
	Unspecified spores		2	100	13	<1								
Indoor / Outdoor	*Aspergillus/Penicillium*		37	100	247	8	113	100	753	36	103	43	1597	55
	Cladosporium		67	100	447	15	127	100	847	40	108	100	720	25
	Fusarium													
Water Indicator	*Chaetomium*													
	Stachybotrys													
	Trichoderma						9	100	60	3				
	Ulocladium													
	Total		260		3000	100%	320		2100	100%	300		2900	100%
	Background Debris		4				3				3			
	Pollen Count		2											
	Hyphal Fragments													
	Analytical Sensitivity (Spores/m³)		7				7				7			

** Heliocomyces includes Helicosporium; ** Periconia/Smuts includes Myxomycetes*
Spores per m³ (final counts) reported to 2 significant figures
Spores of Aspergillus, Penicillium, and others are small with few distinguishing features and therefore can not be differentiated.
If % analyzed is <100%, spores per m³ is based on extrapolation and not actual count.
Information provided by customer includes customer sample ID, location, volume and area as well as date and time of sampling.

ANALYST: _____ Ariel Jones

APPROVED BY: _____ Tianbao Bai, Ph.D., Laboratory Director

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MOLD SPORE TRAP REPORT: NONVIABLE DIRECT MICROSCOPY

CLIENT NorthStar Environmental Testing, LLC.
1006 Western Ave
Mosinee, WI 54455

Lab Code: I213235
Date Received: 09-14-21
Date Analyzed: 09-16-21
Date Reported: 09-16-21

PROJECT: Newbold - AA, 210-994

		Client ID	994-4				994-5							
		Lab ID	M159720				M159721							
		Location	Basement Center				Exterior - Front							
		Volume (L)	150				150							
	IDENTIFICATION		Raw Counts	% Analyzed	Spores per m³	% of Total	Raw Counts	% Analyzed	Spores per m³	% of Total	Raw Counts	% Analyzed	Spores per m³	% of Total
Predominantly Outdoor	*Alternaria*		4	100	27	<1								
	Arthrinium													
	Ascospores		6	100	40	1	176	100	1173	22				
	Basidiospores		15	100	100	2	134	25	3573	67				
	Bipolaris/Drechslera													
	Cercospora													
	Curvularia						1	100	7	<1				
	Epicoccum		2	100	13	<1	4	100	27	1				
	*Helicomyces**													
	Nigrospora													
	Oidium/Peronospora													
	Periconia/Smuts**		2	100	13	<1	1	100	7	<1				
	Pithomyces		4	100	27	<1								
	Rusts						1	100	7	<1				
	Spegazzinia													
	Stemphylium													
	Tetraploa													
	Torula													
	Unspecified spores						1	100	7	<1				
Indoor / Outdoor	*Aspergillus/Penicillium*		130	14	6190	96	9	100	60	1				
	Cladosporium		9	100	60	1	71	100	473	9				
	Fusarium													
Water Indicator	*Chaetomium*													
	Stachybotrys													
	Trichoderma													
	Ulocladium													
	Total		170		6500	100%	400		5300	100%				
	Background Debris		3				3							
	Pollen Count													
	Hyphal Fragments													
	Analytical Sensitivity (Spores/m³)		7				7							

** Heliocomyces includes Helicosporium; ** Periconia/Smuts includes Myxomycetes*
Spores per m³ (final counts) reported to 2 significant figures
Spores of Aspergillus, Penicillium, and others are small with few distinguishing features and therefore can not be differentiated.
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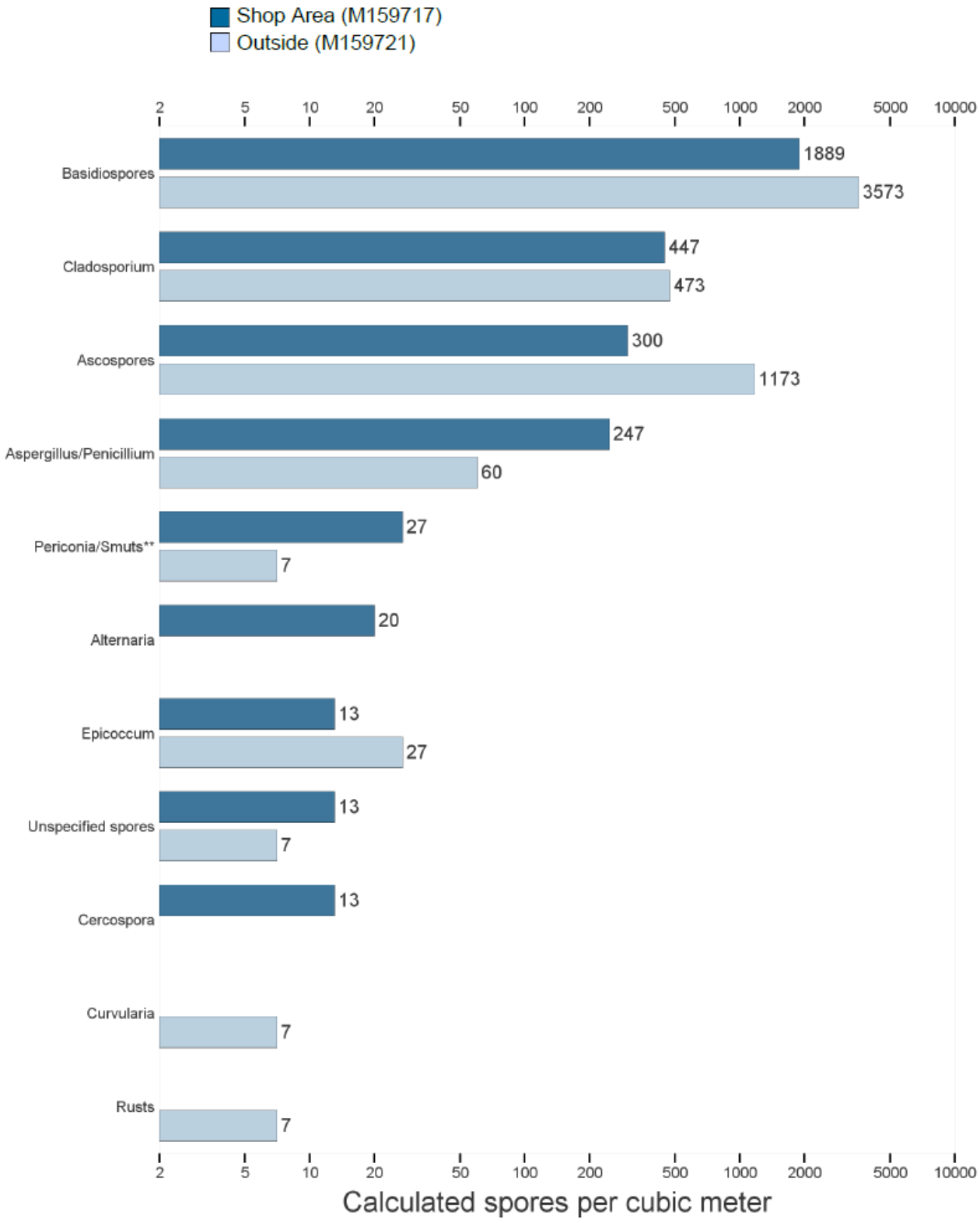
ANALYST: _____ Ariel Jones

APPROVED BY: _____ Tianbao Bai, Ph.D., Laboratory Director

Lab Code: I213235



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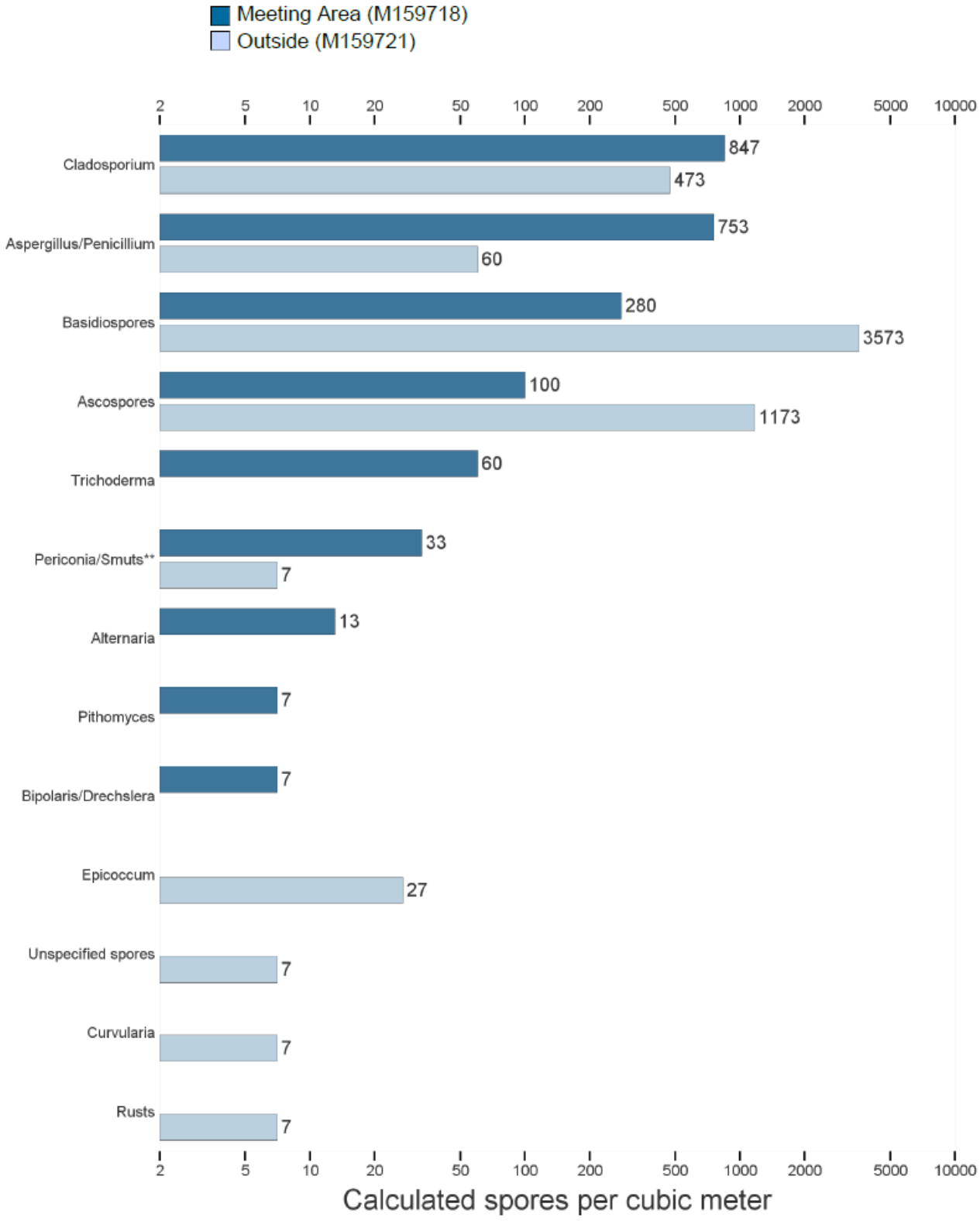

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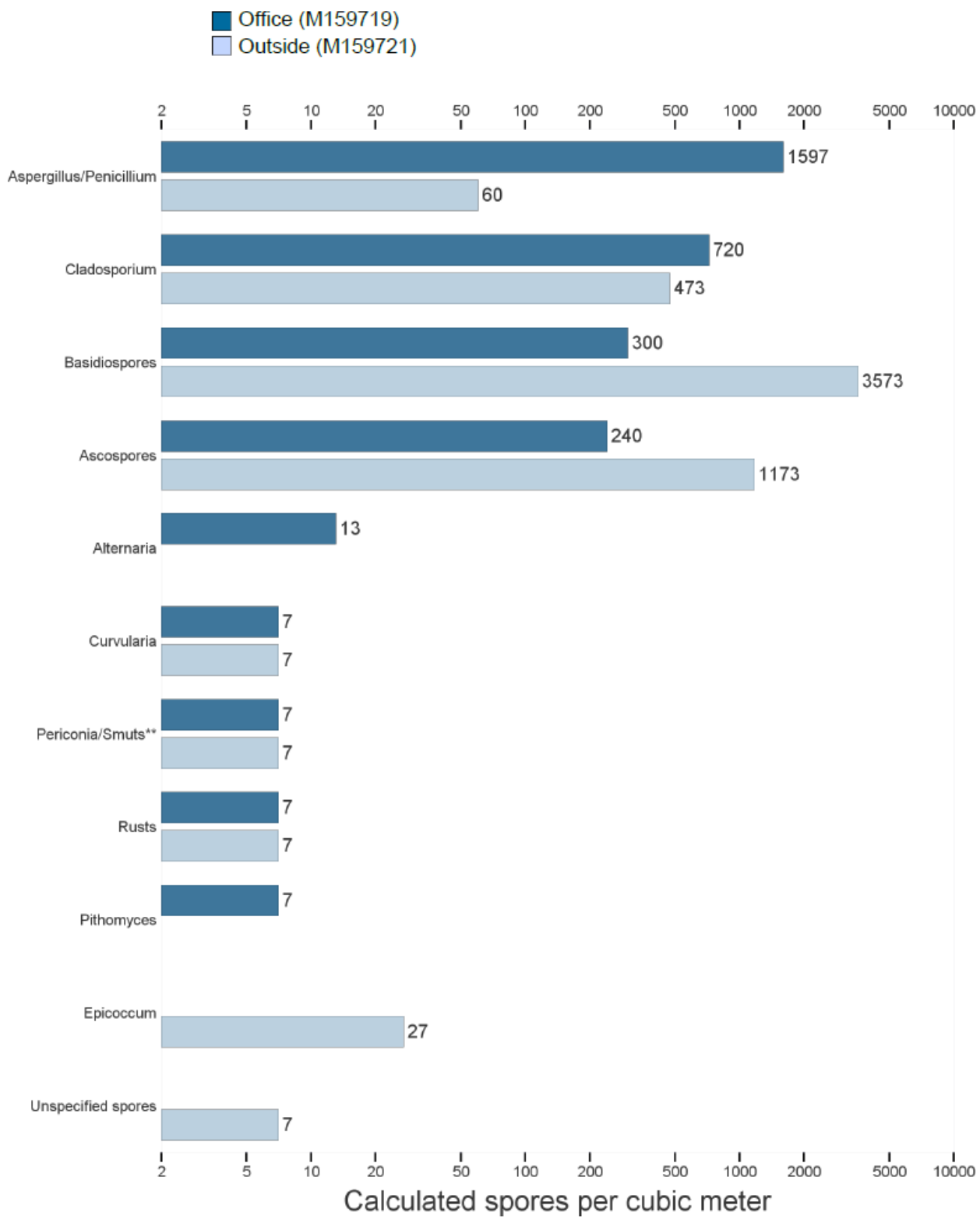

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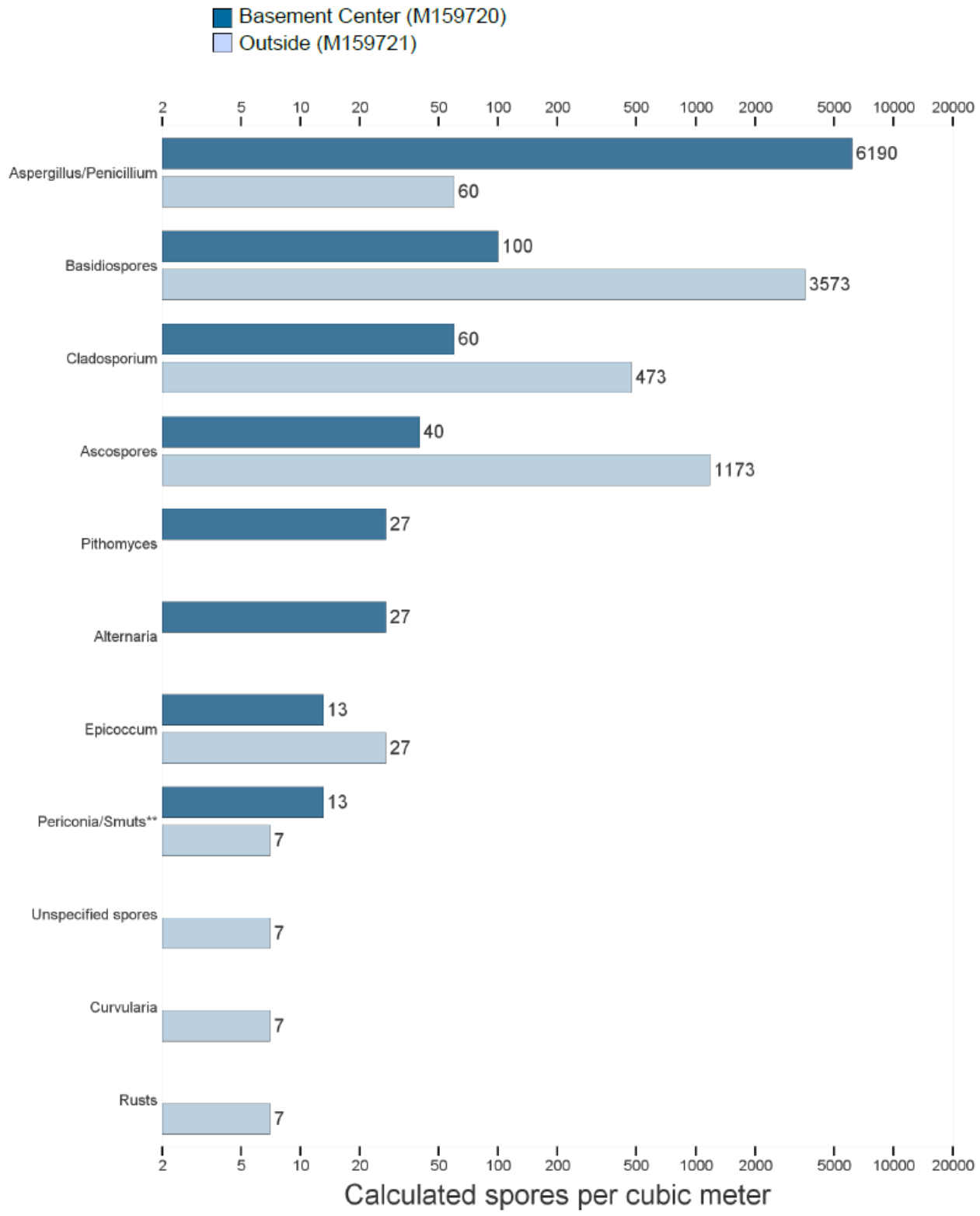

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SPORE CLASSIFICATION:

For purposes of this report, identified mold spores are classified into three general categories depending on environmental conditions the spore is most commonly associated with:

1) **PREDOMINANTLY OUTDOOR:** Most commonly found growing outdoors and are not usually associated with indoor mold sources.
2) **INDOOR / OUTDOOR:** Commonly grow in both indoor and outdoor environments.
3) **WATER INDICATOR**: Most commonly associated with indoor mold growth in buildings with long-term water intrusion issues.

PREDOMINANTLY OUTDOOR	INDOOR / OUTDOOR	WATER INDICATOR

BACKGROUND DEBRIS:

Background debris is the amount of non-fungal particulates present in the trace including dust, fibers, skin scales, dust mites, and insect parts. A debris rating is assigned each trace from 0 (lowest) to 5 (highest). A higher debris rating means samples are more difficult to analyze, and spores, especially smaller spores like *Aspergillus / Penicilium*, may be obscured. Counts with debris ratings of 4 or 5 should be regarded as minimal counts with actual counts assumed to be significantly higher. A further explanation of the debris rating is listed below:

0 - None Detected. No debris observed.
1 - Trace. Field of view obscured < 5%. Counts unaffected.
2 - Light. Field of view obscured 5% to 25%. Counts slightly affected.
3 - Moderate. Field of view obscured 25% to 75% . Actual counts may be higher than reported counts.
4- Heavy. Field of view obscured 75% to 90% . Actual counts may be significantly higher than reported counts.
5 - Very Heavy. Field of view obscured > 90% . Actual counts may be significantly higher than reported counts. Resampling may be necessary.

DEFINITION OF TERMS:

Analytical Sensitivity: Spore per cubic meter (concentration) divided by raw count.
Limit of Detection: One Spore
Hyphal Fragments: Hyphal fragments are broken pieces of fungal hyphae and constitute the vegetative structure of the fungus.
Pollen Count: Pollen grains (Pollen) are the male reproductive structures of Angiosperm plants. These are counted only as pollen and not classified to Genus level.
Raw Counts: The number of spores counted by the analyst.
% Analyzed: The amount of the trace that was analyzed for each individual spore type. If large amounts of any spore type(s) exist, counts may be extrapolated.
% of Total: Percentage of the sample that is made up of each spore type.

INDOOR AND OUTDOOR COMPARISONS:

There are no current Federal standards regarding permissible levels of airborne fungi that may be present in buildings. Mold spores are ubiquitous to our planet and it is expected that some spores will be present in normal indoor environments. A general guideline that is widely accepted in the industrial hygiene industry is that the types and numbers of mold spores present in the indoor environment should be similar to those present in the outdoor environment. If inside spore counts are significantly higher than outside counts this may indicate a potential mold problem. The comparison of outdoor and indoor spore types and concentrations is a useful tool in assessing abnormal mold contamination; however, it should not be the sole determining factor in evaluating health risks and remediation strategies.

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SPORE INFORMATION

	SPORE NAME	COMMON HABITAT	ALLERGENIC POTENTIAL	MYCOTOXIN POTENTIAL
Predominantly Outdoor	*Alternaria*	Soil, seeds, plants, carpet, textiles, window frames, air	X	X
	Arthrinium	Soil, plant materials, decaying wood	X	
	Ascospores	Plants, soil, cellulose-containing materials, air		
	Basidiospores	Soil, plants, wood, cellulose-containing materials, air		
	Bipolaris/Drechslera	Grasses, plant material, decaying food, soil		
	Cercospora	Plants		
	Curvularia	Soil, plant materials, cellulose-containing materials	X	
	Epicoccum	Plants, soil, seeds, carpet, air	X	
	*Helicomyces**	Plants		
	Nigrospora	Plants, soil		
	Oidium/Peronospora	Plants		
	Periconia/Smuts**	Plants, air	X	
	Pithomyces	Soil, plant material, air		
	Rusts	Grasses, trees, other plants	X	
	Spegazzinia	Soil, plants		
	Stemphylium	Dead plants, cellulose-containing materials		
	Tetraploa	Plants		
	Torula	Soil, plants		
	Unspecified spores	Various		
	** Heliocomyces includes Helicosporium; * Periconia/Smuts includes Myxomycetes*			
Indoor / Outdoor	*Aspergillus/Penicillium*	Soil, food, carpet, HVAC, air	X	X
	Cladosporium	Plants, woody plants, food, soil, paint, textiles, carpet, HVAC, air	X	
	Fusarium	Soil, plants, seed, fruits, grains		X
Water Indicator	*Chaetomium*	Cellulose-containing materials, soil, seeds, dung	X	X
	Stachybotrys	Paper, wallpaper, gypsum board	X	X
	Trichoderma	Soil, decaying wood, plant material, cellulose-containing materials	X	X
	Ulocladium	Soil, grasses, wood, paper		

PHOTO LOG

Photo 1: Location: Shop Area – Ceiling
Item: Water damage on ceiling tiles from roof leak.

Photo 2: Location: Shop Area – Ceiling
Item: Exhaust leak in furnace darkening the insulation.

Photo 3: Location: Shop Area – Ceiling
Item: Water damage on insulation above ceiling tile.

Photo 4: Main Level – Meeting Room Area
Item: Overall View – Ceiling tiles sagging possibly due to previous humidity issues.

Photo 5: Main Level – Meeting Room Area
Item: Water damage on insulation above ceiling tile.

Photo 6: Location: Main Level – Office
Item: Visible microbial growth on wood shelving unit likely caused by condensation.

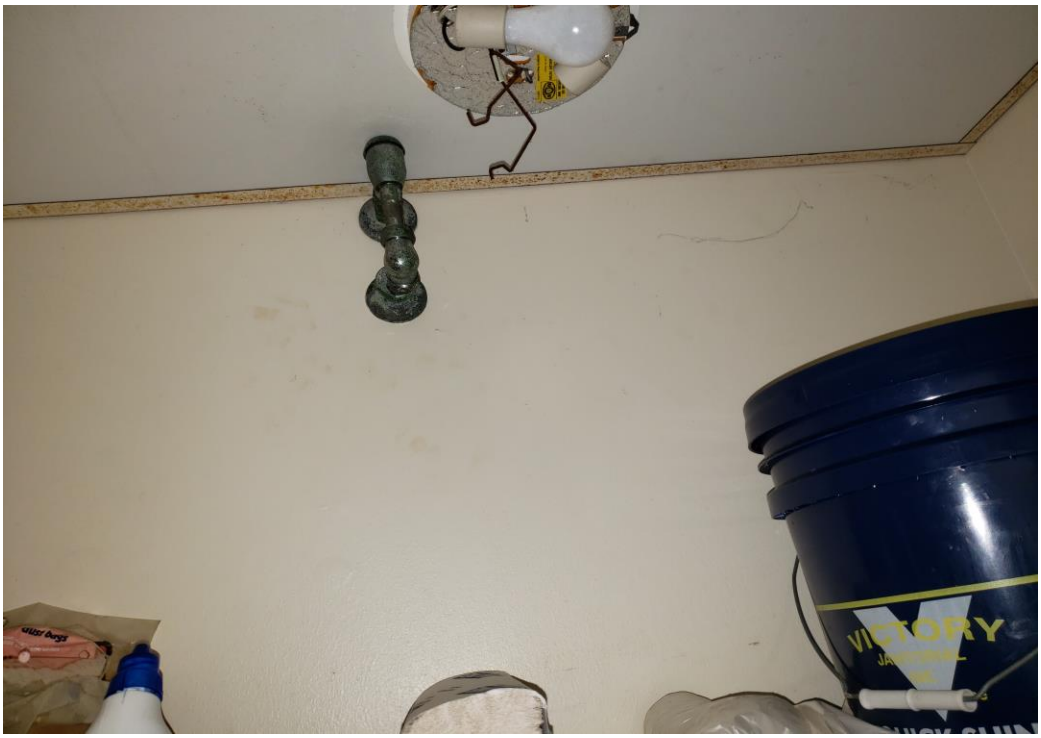

Photo 7: Location: Main Level – Janitor Closet
Item: Rusted fixtures and ceiling grid due to condensation.

Photo 8: Location: Basement – Exterior Wall
Item: Water intrusion through concrete block wall.

Photo 9: Location: Basement
Item: Visible microbial growth on extra ceiling tiles.

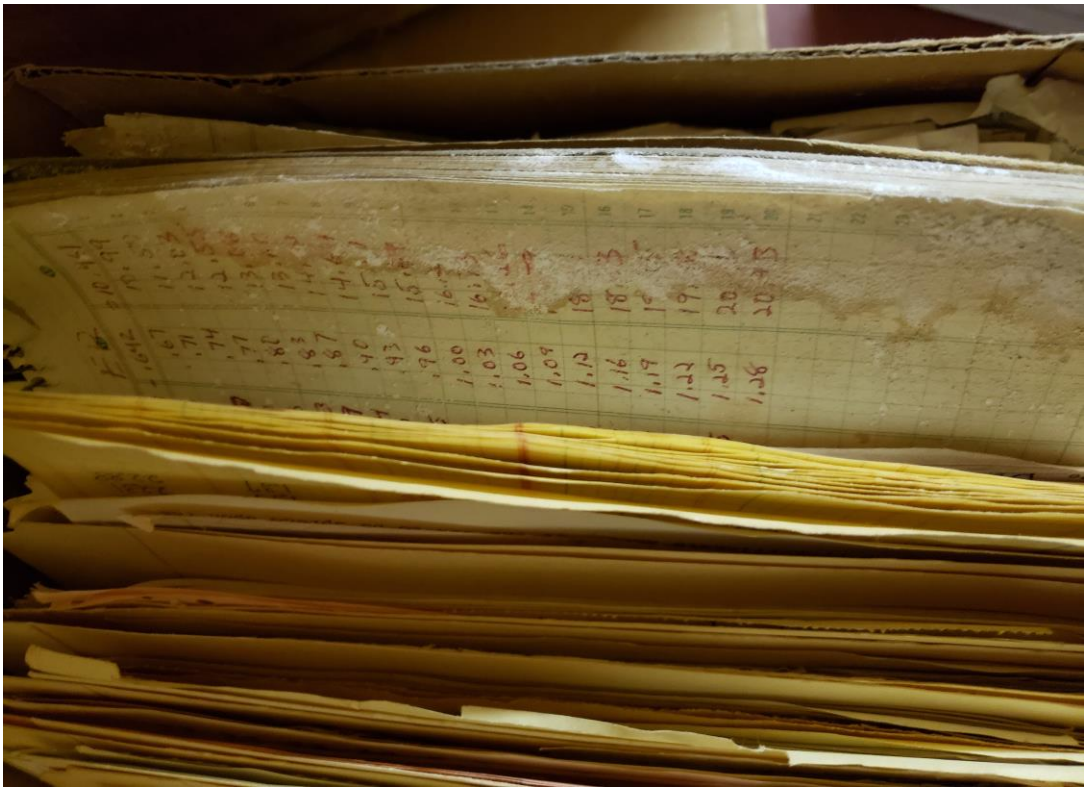

Photo 10: Location: Basement
Item: Microbial growth on paper records.

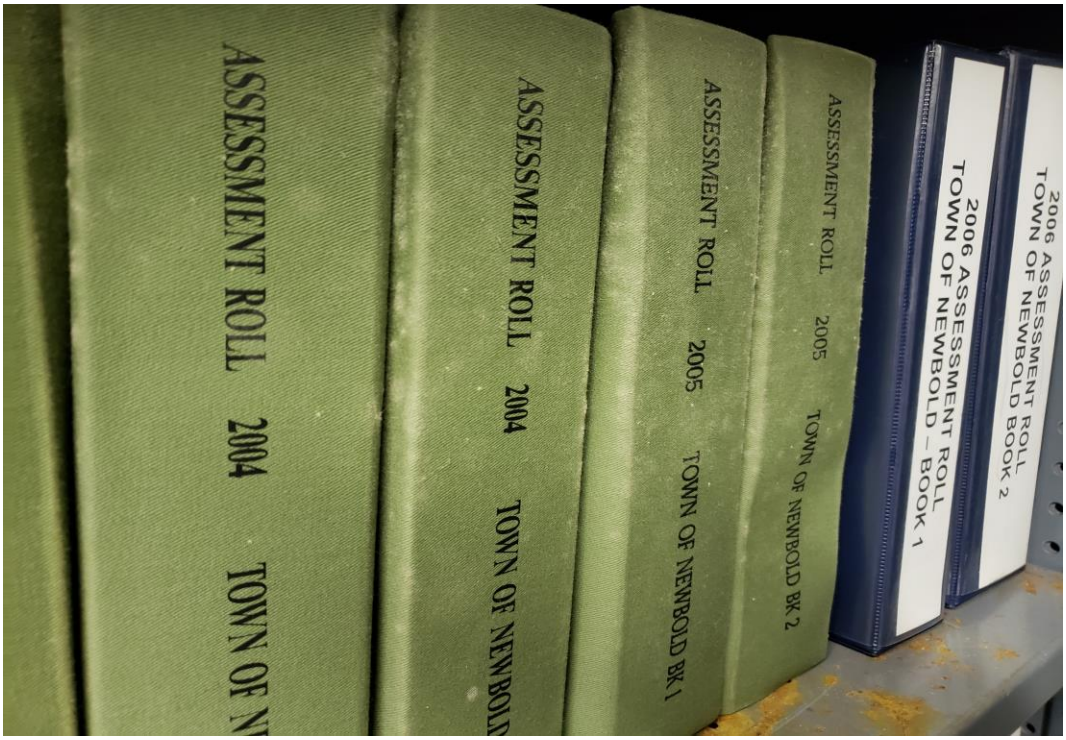

Photo 11: Location: Basement
Item: Microbial growth on books.

Photo 12: Location: Basement
Item: Water staining on concrete floor from water intrusions.

Glossary of Microbial Species

Predominantly Exterior:

Alternaria

Alternaria are widespread in the environment and are normal agents of decay and decomposition. The spores are airborne and common outdoors than indoors isolated from plants, soil, and food. Indoors, the spores are found in house dust, carpets, textiles, wallboard and window frames. The production of melanin-like (black) pigment is one of its major identifying characteristics. The club-shaped spores (conidia) are single or in long chains. They can grow thick colonies which start as grayish-white surfaces and later darken to greenish black or olive brown colors.

Health Effects: Allergies are common, but serious infections are rare, except in people with compromised immune systems. Certain species of this genus are often prolific producers of a variety of toxic compounds whose effects on human health are not well known.

Arthrinium

Arthrinium is a cosmopolitan (common) filamentous fungus isolated from plant debris and soil having approximately 20+ species. It is widespread in the environment and commonly dispersed by wind. Grows well under favorable conditions. IAQ significance: It will grow in the same conditions as Stachybotrys (wet cellulose) and amplified amounts in indoor air could be a warning that conditions do exist for Stachybotrys growth. It grows rapidly, reaching a colony size of 3 to 9 cm in diameter following incubation at 77ºF for 7 days on potato glucose agar. The colonies are woolly to cottony and white with brown spots on the surface. The reverse side is pale. It is a contaminant, found commonly on dead plants and in soil. Rarely found growing indoors.

Health Effects: It is a potential allergen, no toxins from this mold have been reported.

Ascospores

Ascospores are spores formed inside an ascus (asci-plural) or sac-like cell which is contained inside a fruiting body called an ascocarp or an ascoma (ascomata-plural). An ascus typically contains a definite number of ascospores, usually eight. Ascospores are unique in shape, size, and color as to the Genus/species they represent. These spores are specific to fungi classified as Ascomycetes. They are ubiquitous (widespread) in nature. Many decay organic matter, others are plant or animal pathogens. They can grow indoors on damp materials. Transportation of ascospores are common by forcible ejection and dispersed by wind, water, animals and other agents.

Health Effects: Depending on the Genera, Ascospores may be allergenic.

Basidiospores

Basidiospores are reproductive spores produced by a group of fungi called basidiomycetes. This group includes the mushrooms, shelf fungi and various other macrofungi. Basidiospores serve as the main air (wind) dispersal units for the fungi and their release is dependent upon moisture. The structure of the spore complex can develop in various manners resulting in different appearances. It is often found growing in soil, decaying plant debris, compost piles and fruit rot. Indoors, it can be found on water damaged building materials (chipboard /OSB, plywood, wallpaper, and glue) as well as on food items (dried foods, cheeses, fruits, herbs, spices, cereals).

Health Effects: Some basidiospores may produce toxins and can act as allergens. They have not been reported to be pathogens.

Bipolaris/Drechslera

Bipolaris, Drechslera, and Helminthosporium are found on grasses, grains, various plants, and decaying food. They tend to grow in semi-dry environments and some species can be found indoors. Because of their microscopic similarities, these three genera are grouped together on both viable and non-viable analysis. Microscopically, the spores are cylindrical, fusiform, or club-shaped with protrusions.

Health Effects: Can cause hay fever and asthma, allergic fungal sinusitis, and pathogenic sinusitis.

Cercospora

Cercospora is a cosmopolitan (common), fungus isolated from agricultural areas, especially during harvest. Several species of this genus cause plant diseases, mostly forms of leaf spot. The spores are colorless or pale, smooth, cylindrical often with abroad end point or almost club-shaped.

Health Effects: The health effects of this spore are not well documented or studied.

Curvularia

Curvularia is a ubiquitous (widespread) fungus commonly found with dead plant material. It is often found outside growing in soil, seeds, plant litter, and decaying plants as well as on leaves. Indoors, it is found on a variety of building materials, especially those with cellulose surfaces. Colonies are expanding with olive-green to brown or black, with pinkish gray color and woolly or hairy in texture. The conidia (spores) are large and appear curved due to expanded central cells. This feature and the presence of edge to edge septations on the conidia walls distinguishes Curvularia from Biopolaris.

Health Effects: This mold is a potential allergen. Some people may experience hay fever, asthma and or allergic fungal sinusitis.

Epicoccum

Epicoccum is a cosmopolitan (common) fungus that is often found growing outside in soil, plant litter, decaying plants, and damaged plant tissue. Indoors, it can be found growing on a variety of building materials including paper and textiles. Colonies have a rapid growth rate with cottony texture, initially yellow or orange becoming brown to black in color. Conidiophores or fruiting bodies produce dense masses where conidia (spores) arise. Spores are round to pear-shaped, smooth to warty, brown to black in color and muriform (partitioned in both directions, like a soccer ball).

Health Effects: This mold can act as a potential allergen. Some people may experience hay fever and or asthma. This mold has not been linked to any human or animal infection.

Helicomyces/Helicosporium

A genus of hyphomycetous fungi which have a creeping mycelium with short, erect, dark-colored conidiophores bearing curled or spiral, hyaline or colored septate spores. About 40 species have been described. They occur mostly on decaying wood.

Health Effects: No information is available regarding health effects or toxicity.

Nigrospora

Nigrospora is a ubiquitous (widespread), filamentous, dark colored fungus commonly isolated from soil, decaying plants, and seeds. Indoors, it is considered a laboratory contaminant. Colonies grow rapidly, initially white and woolly, later turning gray with black areas, and eventually turning black (both front and reverse). Its conidia are black, solitary, unicellular, slightly flattened horizontally, and have a thin equatorial germ slit.

Health Effects: This mold may be a potential allergen. It is uncertain whether it is pathogenic to humans.

Oidium /Peronospora

Peronospora and Oidium are plant pathogens that cause downy or powdery mildew (a disease that affects a wide range of plants). Both affect the leaves, stems, flowers, and fruits of plants and trees. They have distinctive morphologies. The spores may also be seen in dust as part of the normal influx of outdoor microbial particles.

Health Effects: No information is available regarding health effects or toxicity.

Periconia/ Smuts /Myxomycetes

Smuts, Periconia, and Myxomycetes spores are grouped together due to their similar round, brown morphology. Smuts are outdoor parasitic plant pathogens. They rarely grow indoors but may grow on host plants if appropriate conditions are present. They are parasitic plant pathogens. They can be found on cereal crops, grasses, flowing plants, weed, and other fungi. They can cause allergies. Periconia are found in soils, dead herbaceous stems and leaf spots, and grasses. They have wind dispersed dry spores. Their spores are abundant in the air but it is not known if they are allergenic. Myxomycetes are found on decaying logs, stumps and dead leaves. They have wind-dispersed dry spores and wet motile (amoebic phase) spores. During favorable conditions they move about like amoebae. They form dry airborne spores when conditions are unfavorable. They are rarely found indoors.

Health Effects: They may cause Type 1 allergies (hay fever, asthma). No human infections have been reported.

Pithomyces

Pithomyces is a cosmopolitan (common), dark-walled fungus often found growing outside in soil, decaying leaves, and grasses. It is rarely found growing indoors, but will grow on paper given the right conditions. Colonies grow rapidly, cottony in texture with light to dark brownish black surface color. Spores are single, oval yellow to dark brown, multi-celled, and usually rough. One identification feature of the spores is the resemblance to barrels. Another identifying character is beak-like structures on young spores. Spores of Pithomyces chartarum are most common and are identified by distinctive transverse septa. This species has been linked to facial eczema in sheep.

Health Effects: It is a potential but not well-studied allergen or human pathogen.

Rusts

Rusts are of the order Uredinales. Certain species produce spores that are often reddish in color and resemble the corrosion process known as rust. This is how this group derived its common name-Rusts. The spores are airborne and can travel long distances. Some spores slightly resemble Smuts. Rusts are plant parasites and may require two or more different plant hosts to complete their life cycle. Their complex life cycle includes production of five different spore stages. Their infection rate is enhanced by wet weather.

Health Effects: Rusts can cause allergen type I allergies (hay fever, asthma). No human infection and known toxins have been reported.

Spegazzinia

Spegazzinia is a genus of mitosporic Ascomycota. The widely distributed genus contains seven species. This genus is somewhat related to other lobed or ornamented genera such as *Candelabrum*. *Spegazzinia* is usually identified on spore trap samples where it is seen every few weeks (spores have very distinctive morphology). It may also be found in air by culturable (Andersen) samples if a long enough incubation period is provided so that sporulation occurs. Laboratories have never found this organism growing on indoor environmental surfaces. Natural habitat includes soil and many kinds of trees and plants.

Health Effects: No information is available regarding health effects or toxicity. Allergenicity has not been studied.

Stemphylium

Stemphylium is a dark colored, filamentous plant pathogen isolated from soil and widely distributed on decaying vegetation as well. Colonies are grown rapidly, gray, brownish black, or black, with cottony to velvety texture. Spores are single, light brown to black in color, muriform, smooth to rough walled, oblong or sub-spherical and rounded at the tip, and constricted in the center. The presence of a broad scar at the base is distinctive of this spore.

Health Effects: Stemphylium may cause some mycotic infection in humans.

Tetraploa

Tetraploa species comprise a very small proportion of the fungal biota. This genus is somewhat related to Triposporium and Diplocladiella. Usually identified on spore trap samples where it is seen every few weeks. Spores have very distinctive morphology. Laboratories have never found this organism growing on indoor environmental surfaces. Natural habitat includes leaf bases and stems just above the soil on many kinds of plants and trees.

Health Effects: No information is available regarding other health effects or toxicity. Allergenicity has not been studied.

Torula

Torula mold is widespread and common. It grows well on general cellulose surfaces but spores may take special nutrients to develop or may be completely absent. Often found growing in soil, dead herbaceous stems, wood, grasses, sugar beet root, groundnuts and oats. Grows indoors on cellulose containing materials such as jute, old sacking, wicker, straw baskets, wood, and paper.

Health Effects: Some people may experience hay fever or asthma. Rare cases reported of phaeohyphomycotic sinusitis.

Interior/Exterior:

Aspergillus/Penicillium
Penicillium and Aspergillus are ubiquitous (widespread), filamentous fungi that are found in soil, decaying plant debris, compost piles, and in the air. Indoors, spores are commonly found in house dust, in water-damaged buildings (wallpaper, wallpaper glue, decaying fabrics, moist chipboards, and behind paint) as well as fruit and grains. They are the most common fungal species worldwide. Both produce chains of spores that are small, round to oval, colorless or slightly pigmented, and smooth to rough walled. These spores are indistinguishable between the two as well as other genera, such as Gliocladium, Trichoderma, Paecilomyces, and Scopulariopsis. They differ as to their conidiophores or fruiting bodies. While, Aspergillus spores are produced from phialides supported on conidia heads or swollen vesicles, Penicillium spores are produced on finger-like projections. Depending on species, typical colonies of Aspergillus are initially white and later turn to either shades of green, yellow, orange, brown or black. Texture is usually velvety to cottony. Typical colonies of Penicillium, other than Penicillium marneffei (yeast-like at 37ºC), grow rapidly, white in color at first, later becoming bluish green with white borders with velvety to powdery textures depending on species. Some species produce radial patterns.

Health Effects: Both Aspergillus and Penicillium are potential allergens. Several species of Aspergillus (A. flavus and A. parasiticus) produce aflatoxins or naturally occurring mycotoxins that are toxic and carcinogenic. These are found in contaminated foodstuff and are hazardous to consumers. Penicillium has only one known species that is pathogenic to humans (P. marneffei) that causes lethal systemic infection (Penicilliosis) in immune compromised individuals.

Cladosporium

Cladosporium is the most common indoor and outdoor mold. The spores are wind dispersed and are often extremely abundant in outdoor air. Many species are commonly found on living and dead plant material. Indoors, they may grow on surfaces with high moisture or high humidity levels such as damp window sills, poorly ventilated bathrooms and soiled refrigerators. It produces powdery or velvety olive-green to brown or black colonies. The conidia (spores) vary depending on the species and are formed in simple or branching chains with multi-attachment points.

Health Effects: Cladosporium species are rarely pathogenic to humans, but have been reported to occasionally cause sinusitis and pulmonary infections as well as infections of the skin and toenails. The airborne spores are significant allergens, and in large amounts they may severely affect asthmatics and people with respiratory diseases.

Fusarium

Fusarium is a large genus of filamentous fungi widely distributed in soil and in association with plants. Most species are harmless saprobes, and are relatively abundant members of the soil microbial community. Some species produce mycotoxins in cereal crops that can affect human and animal health if they enter the food chain. The main toxins produced by these Fusarium species are fumonisins and trichothecenes.

Health Effects: Some species may cause a range of opportunistic infections in humans. In humans with normal immune systems, fusarial infections may occur in the nails and in the cornea. Occasionally, in people whose immune systems are weakened in a particular way, aggressive fusarial infections may penetrate the entire body and bloodstream.

Water Damage:

Chaetomium

Chaetomium is a genus of ascomycete fungi. It is a cosmopolitan (common), dark colored fungus (grayish-green to brown) commonly isolated from soil, seeds, dung, wood, and straw materials. Indoors, it is very commonly found on damp sheetrock and paper or cellulose-containing materials. There are certain characteristics such as color, shape, and size of the Chaetomium ascopores, asci, and ascomata that are unique in identification of the different species. Wind, insects, and water aid dispersal of spores. Due to their large size, they settle out of the air after just a few minutes. As a consequence, airborne mold levels are usually low even in infested environments. Due to this, exposure levels are likely to be low as well.

Health Effects: Chaetomium does produce a variety of mycotoxins called chaetoglobsins, whose health effects on humans are unknown. Due to its toxigenic nature, special precautions may be required during remediation.

Stachybotrys

Stachybotrys is known as black mold or toxic black mold. It is a worldwide, filamentous fungus that is commonly found growing on water damaged materials such as ceiling tiles, insulation, wallpaper, wood, and sheetrock. It is highly cellulolytic (has the capacity to degrade cellulose) and commonly isolated on wet materials containing cellulose, such as wallboard, jute carpet backing along with associated glues, straw baskets, and paper materials. The spores are slimy, ellipsoidal to subspherical in shape, single-celled, gray to black in color, and smooth to rough walled. They usually form in clusters on the phialides. Colonies have a powdery to cottony texture and are white in color at first, later turning dark gray to black.

Health Effects: Certain species of Stachybotrys produce mycotoxins that may be harmful to human and animal after ingestion. They can cause allergic and asthmatic reactions in sensitive individuals.

Trichoderma

Trichoderma is a filamentous fungus that is widely distributed in the soil, plant material, decaying vegetation, and wood. Many species in this genus can be characterized as opportunistic avirulent plant symbionts. The common house mould, *Trichoderma longibrachiatum*, produces small toxic peptides containing amino acids not found in common proteins. Cultures are typically fast growing at 25-30°C, but will not grow at 35°C. Colonies are transparent at first on media such as cornmeal dextrose agar or white on richer media such as potato dextrose agar. Conidiophores are highly branched and thus difficult to define or measure, loosely or compactly tufted. Main branches of the conidiophores produce lateral side branches that may be paired or not, the longest branches distant from the tip and often phialides arising directly from the main axis near the tip. The branches may rebranch, with the secondary branches often paired and longest secondary branches being closest to the main axis. All primary and secondary branches arise at or near 90° with respect to the main axis. The typical *Trichoderma* conidiophore, with paired branches assumes a pyramidal aspect.

Health Effects: Very few human cases due to *Trichoderma* have been identified. Although it is commonly considered as a contaminant, *Trichoderma* may cause infections in the presence of certain predisposing factors.

Ulocladium

Ulocladium includes approximately 9+ species, is common and widespread. Species of this genus contain both plant pathogens and food spoilage agents. As to shape and size, species of *Ulocladium* closely resemble those of the genus *Alternaria.* Typically grows well on general cellulose surfaces. Often found growing in soil, dun, paint, grasses, fibers, wood, decaying plant material, paper, and textiles. Grows indoors on cellulose containing materials such as gypsum board, paper, paint, tapestries, jute, and other straw materials. Ulocladium has a high water requirement.

Health Effects: Some people may experience hay fever or asthma. This type of mold cross reacts with Alternaria, adding to the allergenic burden of Alternaria-sensitive patients.