

Fungal Investigation

**1501 Voght Street, Merritt, B.C.
Central Elementary School**



Prepared for

School District 58 (Nicola-Similkameen)
P.O. Box 4100
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Island EHS Project: 55160

Issue Date: February 21, 2024



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Executive Summary

Island EHS was engaged by School District 58 (Nicola-Similkameen) to carry out a fungal investigation within Central Elementary School, located at 1501 Voght Street, Merritt, B.C. This sampling was conducted to address the Client's complaints of a musty-mildew odor that was presumed to be originating from the crawlspace, and prior to beginning scheduled fungal remediation work within the crawlspace. Three (3) fungal spore trap samples were collected; one (1) from the crawlspace entry hatch near the playground entrance, one (1) from the playground entrance hallway, and one (1) from the exterior playground. The building was occupied at the time of the sampling. This sampling was carried out on February 16, 2024.

Spore trap samples were collected from the crawlspace entry hatch and hallway near the playground entrance, with an outdoor sample also collected for comparative purposes. Samples were collected to assess for the concentration and type of mould spores present.

The results revealed typical spore counts and musty odours were present in the investigated areas. Based on the results of the visual inspection, we recommend the following:

- Prior to entry into the crawlspace for investigation purposes, remediation work, or any other work activities, engage in a qualified person to conduct a confined space hazard assessment and develop confined space entry procedures as per Section 9 of the WorkSafe BC Occupational Health and Safety Regulation.
- Also prior to any disturbance, all suspect asbestos containing materials and other hazardous materials (such as lead paint) must be identified, removed, and disposed of as per the WorkSafeBC Occupational Health and Safety Regulation 20.112.
- Engage in a qualified person to conduct an investigation throughout the crawlspace for the presence of moisture/water damage or potential fungal contamination sources.
- Consider engaging in a qualified engineer to investigate and address water infiltration source within the crawlspace.

Laboratory results for samples collected on February 16, 2024 are appended.

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1.0 Introduction

Island EHS was engaged by School District 58 (Nicola-Similkameen) to carry out a fungal investigation within Central Elementary School, located at 1501 Voght Street, Merritt, B.C. This sampling was conducted to address the Client's complaints of a musty-mildew odor that was presumed to be originating from the crawlspace, and prior to beginning scheduled fungal remediation work within the crawlspace. Three (3) fungal spore trap samples were collected; one (1) from the crawlspace entry hatch near the playground entrance, one (1) from the playground entrance hallway, and one (1) from the exterior playground. The building was occupied at the time of the sampling on February 16, 2024.

2.0 Site History and Description

The subject building was owned and occupied by School District 58 and operated as a public elementary school since the 1960s when it was originally constructed. The building was wood framed with a concrete crawlspace. The exterior was finished with stucco, wood, brick and mortar. Interior finishes within the hallway sampling area included ceiling tile, drywall and sheet flooring. The crawlspace was presumed to be a confined space and was not accessed; visual observations were conducted from the entry hatch only. Poly sheeting with vapour barrier placed over top was observed on the floor of the crawlspace. The poly sheeting was taped to the wall with tuck tape. Wood boards were observed lying on top of the poly and vapour sheets. The walls were partially spray-foamed with some exposed brick and mortar. Synthetic fibre insulation was observed between wood floor joists on the ceiling.

The building was impacted by a large-scale flood event in November 2021 and was temporarily closed until September 2022, while flood restoration work and repairs were conducted. During the flood event, mud, water, and debris reportedly filled the crawlspace. Repeated fungal remediation efforts have been conducted in the crawlspace following the original flood remediation work (dates unknown); however, a re-occurring musty-mildew odor has been reported by occupants and school district employees. The Client reported several water incursion events seeping up from the floor of the crawlspace since the original flood.

3.0 Background

Mould is prevalent throughout our environment. It occurs naturally with mould spores being present everywhere. Mould is nature's way of breaking down and recycling materials. Mould spores require moisture and a food source to begin growing. Water leaks (even very minor leaks) and moisture accumulation are usually sufficient for mould to begin growing.

There are no special waste disposal requirements for mould waste.

3.1 Airborne Fungal Spore Trap Sampling

Fungi are plant-like but lack chlorophyll. Each fungal "colony" is a mass of interwoven mycelium, made up of millions of tiny branching filaments, known as hyphae. The group includes many familiar types such as mushrooms, toadstools, puffballs, bracket fungi, morels, truffles, and yeasts. Those genera most commonly found growing in indoor environments are often called moulds (i.e.: *Cladosporium*, *Penicillium* and *Aspergillus*).

Fungal growth is normally attributed to several environmental conditions such as the presence of water, the humidity, the temperature, the efficiency of the ventilation system and the materials present. Under favourable environmental conditions, hyphal strands and fungal spores develop.

During this process, the hyphal strands absorb water, become activated and begin to multiply. Eventually flowering bodies form and release spores to the environment.

Inhalation or ingestion is a principal route of exposure to fungal propagules. The role of indoor fungi in irritative disorders i.e. primarily non-infective diseases such as allergy and asthma, has long been recognized. Bioaerosols of fungal origin, consisting of spores and hyphal fragments, are readily respirable and are potent generators of bronchial irritation and allergy. There are millions of fungal species, but only a few hundred of them are known to make people sick. Moulds, yeasts, and mushrooms are all types of fungi.

Fungi can cause different types of illnesses, including asthma or allergies, rashes or infections on the skin and nails, lung infections (pneumonia) with symptoms like the flu or tuberculosis, bloodstream infections, meningitis, rheumatic diseases. Fungal infections are described as opportunistic or primary. Opportunistic fungal infections take advantage of the weakened immune system. They are common in people whose immune system has been compromised, for example, because of HIV (Human Immunodeficiency Virus) or AIDS (Acquired Immune Deficiency Syndrome) or other medical problems. Opportunistic fungal infections include aspergillosis, candidiasis, and mucormycosis. Primary fungal infections can occur in people with a normal immune system. Primary fungal infections tend to develop at a slow rate. In some cases, months or years may pass before a person seeks medical attention. For most people with a normal immune system, the fungal infections do not spread to organs deep in the body.

Airborne fungal spores originate from many sources, most of which are located outdoors, such as decaying leaves or disturbed soil. In healthy indoor environments, the levels of fungal spores should be less than the level detected outdoors. In buildings with doors and windows that are opened regularly, such as schools and homes, the levels of fungal spores indoors are often like the levels detected outdoors. In buildings with filtered ventilation systems, such as large office buildings, the levels indoors are normally much lower than the levels outdoors. If fungi have colonized in building materials there may, however, be higher concentrations, and species of spores indoors than those found outdoors.

4.0 Sampling Methodology

4.1 Visual Assessment

Entry into the crawlspace was restricted due to confined space entry considerations. A visual and olfactory inspection of the entry to the crawlspace and adjoining hallway was conducted. Our observations were documented on site with photographs (Appendix 1) and written notes.

4.2 Fungal spores

Spore traps capture and enable quantification of a broad spectrum of fungal spores in air.

One (1) spore trap sample was collected from the crawlspace entry hatch near the playground entrance (55160-ST2), one (1) was collected from the playground entrance hallway (55160-ST1), and one (1) was collected from the exterior playground for comparative purposes (55160-ST3).

Spore trap samples were collected using AllergencoD spore trap cassettes (manufactured by Environmental Monitoring Systems) connected to an air sampling pump pre and post calibrated using an in-line secondary flow meter. Sampling was conducted for ten (10) minutes at a flow rate of 15 litres per minute, for a total sampling volume of 150 litres per sample. The cassettes were positioned 65 cm above ground level facing down with a 45° angle.

Spore sampling cassettes were analyzed by the Island EHS Ltd. Laboratory in Victoria, BC.

5.0 Results

5.1 Visual Inspection

A visual inspection of the entrance to the crawlspace and adjoining hallway near the playground entrance was performed on February 16, 2024, to identify the conditions present at the time of the investigation. No visible water damage or suspect mould growth were observed.

Weather outdoors during sampling activities was sunny and approximately -5°C, with a slight SE wind. The ground was partially snow covered.

Photographs from the visual inspection can be found in Appendix 1.

The IICRC's S500 publication "Standard for Professional Water damage Restoration" (5th edition 2021) categorizes types of water depending on their assumed level of contamination based on the water's originating source, contents, history, and characterization. These categories are:

- **Category 1 "Clean"**: water that originates from a sanitary water source (freshwater line, rainwater, etc.) and does not pose substantial risk from dermal exposure, ingestion, or inhalation exposure.
- **Category 2 "Grey"**: water that contains significant contamination and has the potential to cause discomfort or sickness if contacted or consumed by humans. Examples include discharges or overflows from washing machines or dishwashers, overflows from toilet bowls with some urine but no feces, or seepage from hydrostatic pressure.
- **Category 3 "Black"**: water that is grossly contaminated and can contain pathogenic, toxigenic, or other harmful agents and can cause significant adverse reactions to humans if contacted or consumed. Examples include sewage and all forms of flooding from seawater or risking water from rivers or streams.

If water damage is not promptly addressed, Category 1 water can deteriorate to Category 2 or 3 water. The 2021 flood event would be classified as a Category 3 black water event.

5.2 Fungal spores

Total airborne fungal spore counts in the sample collected from the playground entrance hallway was 226 counts/m³ and crawlspace entry hatch in the playground entrance hallway was 32 counts/m³. For comparison purposes, the concentration of fungal spores in the outdoor playground sample was 353 counts/m³.

The crawlspace entry hatch in the playground entrance hallway and the playground entrance hallway samples were qualitatively similar and quantitatively lower from the sample collected outdoors.

The details of the different spores found are summarized in Table 1, below. A full account of the airborne fungal spore trap laboratory results is available in Appendix 2.

Table 1: Fungal Spores Sampling Results (counts/m³)

Spore Categories	55190-ST1 Playground Entrance – Hall (counts/m ³)	55190-ST2 Crawlspace Entry Hatch - Hall (counts/m ³)	55190-ST3 Exterior – Playground/ Courtyard (COMPARATIVE) (counts/m ³)
<i>Ascospores</i>	97	-	64
<i>Aspergillus/Penicillium-like</i>	-	-	193
<i>Basidiospores</i>	97	32	-
<i>Cladosporium</i>	-	-	64
<i>Hyphal Fragments</i>	32	-	32
Total Fungal Spores	226	32	353
Laboratory Comments	Moderate Debris	Trace Debris	Moderate Debris

Note: The parameters found below the limit of detection are not reported.

* Debris refer to dust / particulates / fibres other than mould spores which are also collected on the filters during sampling

6.0 Conclusions and Recommendations

The results of the fungal spore trap air samples collected on February 16, 2024 revealed typical spore counts and musty odours were present in the investigated areas. Based on the results of the visual inspection, we recommend the following:

- Prior to entry into the crawlspace for investigation purposes, remediation work, or any other work activities, engage in a qualified person to conduct a confined space hazard assessment and develop a confined space entry procedures as per Section 9 of the WorkSafe BC Occupational Health and Safety Regulation.
- Also prior to any disturbance, all suspect asbestos containing materials and other hazardous materials (such as lead paint) must be identified, removed, and disposed of as per the WorkSafeBC Occupational Health and Safety Regulation 20.112.
- Engage in a qualified person to conduct an investigation throughout the crawlspace for the presence of moisture/water damage or potential fungal contamination sources.
- Consider engaging in a qualified engineer to investigate and address water infiltration source within the crawlspace.

7.0 Limitations

The following limitations apply to this investigation:

1. **Non-destructive testing and assessment methods were used.**
2. Evaluations methodologies applied are only able to give a “snapshot” of fungal activities based on conditions at the time and date of this investigation.

8.0 Closure

This report has been prepared in accordance with established Industrial Hygiene and Mycological practices. It is intended for the exclusive use of the client to assist in complying with the current accepted industry guidelines for the assessment of air quality in indoor environments. The use of this document for any other purposes is at the sole risk of the user.

Yours Truly,

Island Environmental Health and Safety Ltd.



Janice Ferneyhough
Occupational Hygiene Technologist
Field Investigation & Report



Ted Letourneau, BSc., ROH
Senior Occupational Hygienist
Report Review

Appendix 1

Photographs



Photo: 1
Sample: 55160-ST1
Location: Playground Entrance - Hall
Description: Fungal Spore Trap Sample



Photo: 2
Sample: 55160-ST3
Location: Crawlspace Entry Hatch – Hall
Description: Fungal Spore Trap Sample



Photo: 3
Sample: 55160-ST3
Location: Exterior – Playground/ Courtyard
Description: Fungal Spore Trap Sample

Appendix 2

Airborne Fungal Spore Trap Sample Laboratory Results

Airborne Mould Sample Report

Project #: 55160
Client: School District 58
Site: Central Elementary School

Sampled by: JF
Date Sampled: 16-Feb-2024
Analyst: JLH

201 – 990 Hillside Avenue
Victoria, B.C. V8T 2A1
778-406-0933
admin@islandehs.ca

Sample #	Sample description/Location	Comments - dust and spore levels
55160-ST1	Playground entrance - Hall	Moderate debris
55160-ST2	Crawlspace entry hatch - Hall	Trace debris
55160-ST3	Exterior - Playground/Courtyard	Moderate debris

Sample #	55160-ST1		55160-ST2		55160-ST3	
	Playground entrance - Hall		Crawlspace entry hatch - Hall		Exterior - Playground/Courtyard	
Location						
Total counts (cts/m ³)	226		32		353	
	Raw count	Total (cts/m ³)	Raw count	Total (cts/m ³)	Raw count	Total (cts/m ³)
Spore Categories						
Alternaria						
Ascospores	3	97			2	64
Aspergillus/Penicillium-like					6	193
Basidiospores	3	97	1	32		
Chaetomium						
Cladosporium					2	64
Curvularia						
Dreschlera/Bipolaris - like						
Smuts/Myxomycetes/Periconia						
Stachybotrys/Memnoniella						
Ulocladium						
Misc/Unidentified fungi						
Hyphal Fragments	1	32			1	32

Analysis parameters	55160-ST1	55160-ST2	55160-ST3
Sampling time (minutes)	10	10	10
Sample flow rate (L/min)	15	15	15
Sample volume (L)	150	150	150
Width of FOV um (40x)	100	100	100
# of traces counted	30	30	30
Length of trace (mm)	14.5	14.5	14.5
% of trace counted	21	21	21
Counts per sample	5	5	5
Counts per m ³ (minimum detection)	32	32	32



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Victoria, B.C. V8T 2A1
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Samples received in good condition.
Analyzed according to ASTM D7391-20.

Appendix 3

Additional Information

Fungi

Background

Fungi are plant-like but lack chlorophyll. Each fungal “colony” is a mass of interwoven mycelium, made up of millions of tiny branching filaments, known as hyphae. The group includes many familiar types such as the mushrooms, toadstools, puffballs, bracket fungi, morels, truffles and yeasts. Those most commonly found growing in indoor environments are often called moulds (i.e.: *Cladosporium*, *Penicillium* and *Aspergillus*).

Most fungi gain their energy by breaking down “dead” organic material, including both plant and animal matter and, thus, perform many important functions in nature. Fungi are also economically important as they are used to produce beer, wine and cheese. They are also medically important as many important drugs, including penicillin and cyclosporine (used to treat organ rejection) are derived from fungi.

Fungi grow very quickly almost anywhere, including inside buildings. One of the reasons fungi are so successful is their ability to produce and disperse huge numbers of microscopic spores, which can be transported vast distances. By their sheer numbers, fungi can quickly take advantage of any new food supplies that become available, as all they need to colonize a material is water and a source of carbon, which is present in many building materials.

The air we breathe can contain tens of thousands of spores per cubic meter, while soil holds vast numbers. Many of the spores produced by fungi remain viable for years, therefore, there will always be fungal spores present in the air that we breathe, both outdoors and indoors and it is almost impossible to completely exclude fungi from any environment (including the cheese we seal in plastic and put in the refrigerator).

Fungi and Human Health

There are several ways in which fungi can affect the health of building occupants. The primary route of exposure to fungi is the inhalation of the fungal spores, hyphal fragments and portions of other fungal structures. This exposure may result in allergic reactions, increased asthma, upper respiratory tract irritation and even fungal infections in some people. The exact mechanism that results in the health effects is still being researched, but there are likely many contributing factors. These include the mycotoxins produced by the fungi, antigens on the surface of the fungi as well as the presence of B-glucans in the cell walls.

The health effects experienced by people vary significantly. Some people are unaffected by high levels, yet others are affected by low levels of fungal spores. As the exposure duration and concentration of fungal spore's increases, so do symptoms. The most common symptom is allergies, particularly allergic rhinitis. Allergy-related problems become particularly apparent, when the concentration of airborne spores is relatively high, and the majority consists of only 1 or 2 species.

The following are some of the fungal genera which grow indoors and are implicated in causing respiratory problems:

- *Alternaria*
- *Aspergillus*
- *Chaetomium*
- *Cladosporium*
- *Epicoccum*
- *Fusarium*
- *Mucor*
- *Penicillium*
- *Phoma*
- *Pithomyces*
- *Stachybotrys*
- *Trichoderma*

Some fungi can be quite pathogenic (cause systemic illness in people), including *Histoplasma*, *Cryptococcus*, *Sporothrix*, *Blastomyces* and *Candida*. At least three species of *Aspergillus* (*A. fumigatus*, *A. niger* and *A. flavus*) can be included in this group, however, most others (there are between 100 and 200 species of *Aspergillus*) are relatively benign. People with compromised immune systems are at the greatest risk for fungal infections.

Repeated inhalation and sensitization to a wide variety of organic material, including fungi, can cause hypersensitivity pneumonitis (HP), a lung disease, in a small percentage of exposed people. Additional health effects caused by fungi may include aggravation of pre-existing asthma, sinusitis, histoplasmosis and rhinitis.

Other substances produced by fungi, besides spores, can also cause health problems. These include mycotoxins (substances produced by fungi which may interfere with the growth of other fungi or bacteria) and Volatile Organic Compounds (VOC's – responsible for the musty odour characteristic of fungi). Note however, that health effects associated with mycotoxins are typically associated with only very high exposures that are likely only to occur during the consumption of fungal contaminated food or during high risk activities, such as fungal remediation.

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