SPORE TRAP SAMPLING REPORT FOR CENTENNIAL LANE ELEMENTARY SCHOOL 3825 CENTENNIAL LANE ELLICOTT CITY, MARYLAND 21042

PREPARED FOR:

HOWARD COUNTY PUBLIC SCHOOL SYSTEM 10910 ROUTE 108 ELLICOTT CITY, MD 21043

PREPARED BY:



ARIA ENVIRONMENTAL, INC. PO BOX 286 WOODBINE, MD 21797

MAY 31, 2016

J16-947

TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
I. BACKGROUND	1
II. OBSERVATIONS AND MEASUREMENTS	1
A. Observations and Measurements on May 19, 2016	1
B. Air Monitoring for Fungal Identification and Counting on May 19, 2016	
III. CONCLUSIONS AND RECOMMENDATIONS	5
IV. LIMITATIONS	6

Tables

Table 1–Acceptable Ranges of Temperature and Relative Humidity in Summer and Winter

Table 2 –Temperature, Relative Humidity, Carbon Dioxide and Carbon Monoxide Measurements Collected at Centennial Lane Elementary School on May 19, 2016

Table 3-Particle Measurements Collected at Centennial Lane Elementary School on May 19, 2016

Table 4–Results of Spore Trap Sampling at Centennial Lane Elementary School on May 19, 2016

Attachments

A: Report of Analysis and Chain of Custody Forms May 19, 2016

EXECUTIVE SUMMARY

Aria Environmental, Inc. (AE) was contracted by the Howard County Public School System (HCPSS) to perform an investigation with spore trap sampling at the Centennial Lane Elementary School in Ellicott City, Maryland due to the discovery of a small amount of mold growth on a wall behind a poster. AE made measurements for temperature, humidity, carbon monoxide, carbon dioxide and particles and collected microbial spore trap samples for fungal spore identification and counting on May 19, 2016. This report presents the results of the visual inspection and air sampling.

I. BACKGROUND

A representative from Aria Environmental, Inc. (AE) visited Centennial Lane Elementary School on May 19, 2016 to perform air monitoring in response to a request from the Howard County Public School System. Measurements for temperature, humidity, carbon monoxide, carbon dioxide and microbial spore trap sampling for fungal identification and counting was performed in two portable classrooms (88 and 90) and outdoors as a comparison. Samples were collected with the HVAC systems operating, after school and while unoccupied. An outdoor air sample was also collected on the front ramp of portable classroom 90 for comparison purposes. This monitoring was performed because a small amount of mold had been discovered in one of the portable classrooms on a wall behind a poster.

The wall in Portable Classroom 90 where mold growth had been discovered approximately two days prior to sampling had some dark staining but no visible mold growth on the day of monitoring. A custodian reported cleaning the wall approximately two days prior to the air sampling. Air sampling was performed in Portable Classroom 88 as a comparison. Slightly musty odors were observed in both portable classrooms. Weather on the day of monitoring was sunny and mild. An air cleaner was operating in Portable Classroom 88.

II. OBSERVATIONS AND MEASUREMENTS

A. Observations and Measurements on May 19, 2016

Industry guidelines or standards for seasonal temperature and humidity ranges for thermal comfort are established by the American Society for Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) standard 55-2013. These ranges are presented in Table 1. The U.S. Environmental Protection Agency (EPA) recommends maintaining indoor relative humidity below 60% and ideally between 30 and 50%. The room air temperature measured in Portable Classroom 90 at 5:50 PM was 69.6° F, and was 71.6° F in Portable Classroom 88 at 5:55PM. The indoor relative humidity was 51.4 and 59.0 percent in Portable Classroom 88 and 90, respectively. The temperature and relative humidity measurements were within the comfort ranges established by ASHRAE. The comfort ranges are only established for the Summer and Winter seasons when temperatures are usually consistent. There are no Fall or Spring ranges because these seasons can include both heating and cooling modes of HVAC operation. The outdoor temperature at 6:00 PM was 68.0° F and the outdoor relative humidity was 44.2% at the front door of Portable Classroom 90. Results of temperature, relative humidity, carbon dioxide and carbon monoxide monitoring are presented in Table 2.

Table 1- Acceptable Ranges of Temperature and Relative Humidity in Summer and Winter^a

- Kelalive II	Relative Horniary in Sommer and Willer						
Relative	Winter	Summer					
Humidity	Temperature	Temperature					
30%	68.5°F – 76.0°F	74.0°F – 80°F					
40%	68.5°F - 75.5°F	73.5°F – 79.5°F					
50%	68.5°F - 74.5°F	73.0°F – 79.0°F					
60%	68.0°F - 74.0°F	72.5°F – 78.0°F					

adapted from ASHRAE Standard 55-2013

Carbon dioxide and carbon monoxide measurements are used to assess ventilation system performance. The exhaled breath of building occupants is the main indoor source of carbon dioxide; therefore, the build-up of carbon dioxide indicates inadequate ventilation. Carbon dioxide concentrations were 350 and 2,485 ppm in Portable Classrooms 90 and 88 respectively.

The concentration of concern for carbon dioxide is set by ASHRAE standard 62.1–2013 as 700 ppm above outdoor air. On the day of monitoring, the outdoor air concentration of carbon dioxide was 345 ppm. Carbon dioxide concentrations were within the comfort parameters established by ASHRAE in Portable Classroom 90 but above the concentration of concern in Portable Classroom 88. The classrooms were both unoccupied during monitoring. Classroom 90 was not used on the day of monitoring during the school day, and Classroom 88 was used. The outdoor air setting should be examined on Classroom 88 and set to allow more fresh air exchange.

Carbon monoxide is mainly attributed to incomplete combustion. Concentrations of CO were consistently 0.0 ppm indoors and outdoors. CO concentrations were below the ASHRAE concentration of concern of 9 ppm.

Table 2: Temperature, Relative Humidity, Carbon Dioxide and Carbon Monoxide Measurements Collected at Centennial Lane Elementary School on May 19, 2016

	<u> </u>	, 0011001 011 1	nay 17, 2010		
Location	Time	T (°F)	Rh (%)	CO (ppm)	CO ₂ (ppm)
Portable Classroom 90	5:50 PM	69.6	59.0	0.0	350
Portable Classroom 88	5:55 PM	71.6	51.4	0.0	2,485
Outdoors on Front Ramp of Portable Classroom 90	6:00 PM	68.0	44.2	0.0	345

Bold type indicates measurements above the guidelines

Particulate matter or PM is the term for a mixture of solid particles and liquid droplets found in the air. It does not distinguish between the types of particles in the air (e.g., pollen, skin cells, mold spores, soil, etc.). Particulate matter includes "inhalable coarse particles," with diameters larger than 2.5 micrometers and smaller than 10 micrometers (PM 10) and "fine particles," with diameters that are 2.5 micrometers and smaller (PM 2.5). Particle loads expected to be a part of the school environment include carpet and clothing fiber, soil tracked from outside, and dust and fibers from building materials. ASHRAE Standard 62.1–2013 suggests target indoor concentrations for PM 2.5 and PM 10 of 15 μ g/m³ and 50 μ g/m³, respectively. These concentrations are taken from the EPA's National Ambient Air Quality Standards (NAAQS) based on annual arithmetic means deemed acceptable for outdoor air quality. Occupational standards and guidelines for particles are nearly an order of magnitude higher than concentrations typically found in non-occupational settings and are not appropriate for comparison.

Particle measurements were taken with an Aerocet 531 particulate monitor. The particle monitor takes a two minute averaged sample of particle concentrations in 5 size fractions (PM 1, PM 2.5, PM 7, PM 10 and total suspended particles (TSP)). Results of particulate monitoring, presented in Table 3, revealed that PM 2.5 and PM 10 particle concentrations were well below the ASHRAE target concentrations in all areas monitored.

Table 3 – Results of Particulate Monitoring at Centennial Lane Elementary School on May 19, 2016

Earle Elementary School on May 17, 2010						
		PM1	PM2.5	PM7	PM10	TSP
Location	Time	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)
Portable Classroom 90	5:50 PM	0	0	1	2	2
Portable Classroom 88	5:55 PM	0	0	4	6	9
Outdoors on Front Ramp of Portable Classroom 90	6:00 PM	0	0	2	2	3

Concentrations in bold are above the particle guidelines

B. Air Monitoring for Fungal Identification and Counting on May 19, 2016

Spore trap samples were collected from Portable Classroom 88, Portable Classroom 90 and outside to determine whether there was a difference between mold spore loads inside the portable classrooms versus outside. The spore trap samples were collected using AllergenCo-D cassettes attached to a Buck BioAire™ sampling pump calibrated to 15 liter per minute (LPM) air flow. The samples were collected for a period of ten minutes, the time period recommended for spore trap sampling in a clean indoor environment. The spore trap samples were submitted to Aerobiology Laboratory for analysis. The sample results are reported as the spores per cubic meter of air (spores per m³) of hyphal fragments and total fungal spores. Depending upon the morphology of the spores, they were counted by their unique genus or were grouped into spores exhibiting common characteristics (e.g., Penicillium/Aspergillus group). Table 4 presents the results of the spore trap samples collected at Centennial Lane Elementary School on May 19, 2016.

Indoor spore counts ranged from 120 to 213 total spores per cubic meter of air (m³) on May 19, 2016. Both indoor portable classroom samples had total spore counts below the outdoor sample (24,008 spores/m³). Penicillium/Aspergillus group spores were higher in the Portable Classroom 90 sample (40 spores/m³) compared to the outdoor sample (33 spores/m³). All other individual spore types detected indoors had counts lower than the outdoor sample. Note: 7 spores/m³ is the equivalent to one spore detected in the sample. Windows were not open during sampling.

No secondary colonizers including Chaetomium or Stachybotrys were detected in the indoor air samples. Hyphal elements were detected in both portable classroom indoor samples, ranging from 7 to 20 hyphal elements per m³. The hyphal element count in the Portable Classroom 88 sample (20 elements/m³) was slightly higher than the outdoor sample hyphal element count (7 elements/m³). Variations in outdoor spore concentrations are a function of diurnal rhythms of spore release, weather-related factors (e.g., wind, rain, snow cover, temperature), and physical spatial factors. Certificates of analysis are included as Attachment B.

Table 3: Results of Spore Trap Sampling at Centennial Lane Elementary School on May 19, 2016

Location	Sample 03 Outdoors at Portable Classroom 90	Sample 01 Portable Classroom 90	Sample 02 Portable Classroom 88
Spore Type	Spores /m³	Spores /m³	Spores /m³
Alternaria	7	20	-
Ascospores	5,325	7	40
Basidiospores	16,187	20	53
Cladosporium	2,343	7	60

Table 3: Results of Spore Trap Sampling at Centennial Lane Elementary School on May 19, 2016

Location	Sample 03 Outdoors at Portable Classroom 90	Sample 01 Portable Classroom 90	Sample 02 Portable Classroom 88
Spore Type	Spores /m³	Spores /m³	Spores /m³
Colorless	7	-	-
Epicoccum	40	-	-
Hyphal Elements	7	7	20
Penicillium/ Aspergillus group	33	40	27
Smuts, Periconia, myxomycetes	53	20	13
Torula	7	-	-
Total Fungi	24,008	120	213

Bold numbers represent spore concentrations above the outdoor counts.

Dashes designate none detected.

III. CONCLUSIONS AND RECOMMENDATIONS

Aria Environmental, Inc. (AE) was contracted by the Howard County Public School System to perform spore trap sampling at Centennial Lane Elementary School due to the discovery of a small amount of mold growth under a poster in a portable classroom. AE made measurements for temperature, humidity, carbon monoxide, carbon dioxide and particles and collected microbial spore trap samples on May 19, 2016.

Thermal comfort parameters of temperature and humidity were measured and found to be within the comfort ranges established by ASHRAE. Carbon dioxide, carbon monoxide and particle measurements were within acceptable ranges for good indoor air quality in all areas monitored except for the carbon dioxide measurement in Portable Classroom 88 (2,485 ppm) which was above the concentration of concern. The outdoor air damper may be closed in this classroom. More fresh air exchange is recommended.

Spore counts in the two portable classrooms ranged from 120 to 213 total spores per cubic meter of air (m³) on May 19, 2016. These total spore counts were below the outdoor sample (24,008 spores/m³). Penicillium/Aspergillus group spores were slightly higher in the Portable Classroom 90 sample (40 spores/m³) compared to the outdoor sample count (33 spores/m³). All other individual spore types detected indoors had counts lower than the outdoor sample. Hyphal elements were higher in the Portable Classroom 88 sample (20 elements/m³) compared to the outdoor hyphal element count (7 elements/m³). Although slightly above outdoor counts, the Penicillium/Aspergillus spores and hyphal element counts were generally low and not considered problematic.

IV. LIMITATIONS

This report has been prepared for the exclusive use of the Howard County Public School System and/or its agents. This service has been performed in accordance with generally accepted environmental practices. No other warranty, expressed or implied, is made. Our conclusions and recommendations are based, in part, upon information provided to us by others and our site observations. We have not verified the completeness or accuracy of the information provided

to us by others, unless otherwise noted. Our observations and recommendations are based upon conditions readily visible at the site at the time of our site visit, and upon current industry standards. Destructive sampling was not performed as part of this survey. No observations were made behind solid walls, ceilings or in pipe chases that weren't already openly visible.

By virtue of providing the services described in this report, the preparer does not assume the responsibility of the person(s) in charge of the site, or otherwise undertake responsibility for reporting to any local, state, or federal public agencies any conditions at the site that my present a potential danger to public health, safety, or the environment. It is the Client's responsibility to notify the appropriate local, state, or federal public agencies as required by law, or otherwise to disclose, in a timely manner, any information that may be necessary to prevent any danger to public health, safety, or the environment. Under this scope of services, the preparer assumes no responsibility regarding response actions (e.g. abatement, removal, etc.) initiated as a result of these findings. Response actions are the sole responsibility of the Client and should be conducted in accordance with local, state, and/or federal requirements, and should be performed by appropriately licensed personnel as warranted.

Attachment A:

Report of Analysis and Chain of Custody Forms May 19, 2016



Certificate of Analysis EMLAP# 102977

43760 Trade Center Place Suite 100 Sterling, Virginia 20166 (877) 648-9150 www.aerobiology.net

Aria Environmental
P.O. Box 286
Woodhine Manyland 21

Woodbine, Maryland 21797

Attn: Julie Barth

Project: J16-947 CLES

Condition of Sample(s) Upon Receipt: Acceptable

Date Collected: 04/27/2016
Date Received: 05/23/2016
Date Analyzed: 05/26/2016
Date Reported: 05/26/2016

Project ID: 16015353 Page 1 of 3

1054 Spore Trap Analysis: SOP 3.8

Client Sample Number	1004 0	01 001	ily 313. O	01 0.0		03		
Sample Location	P	Portable Classroom 90				Outside Po	CR 90	
Sample Volume (L)		150				150		
Lab Sample Number		16015353-	001			16015353	-003	
Spore Identification	Raw Ct	spr/m³	% Ttl	In/Out	Raw Ct	spr/m³	% Ttl	In/Out
Alternaria	3	20	17	3/1	1	7	<1	-
ascospores	1	7	6	1/799	25	5325	22	-
basidiospores	3	20	17	1/809	76	16187	67	-
Cladosporium	1	7	6	1/351	11	2343	10	-
Colorless	-	-	-	-	1	7	<1	-
Epicoccum	-	-	-	-	6	40	<1	-
hyphal elements	1	7	6	1/1	1	7	<1	-
Penicillium/Aspergillus group	6	40	33	1/1	5	33	<1	-
Smuts,Periconia,Myxomycetes	3	20	17	1/3	8	53	<1	-
Torula	-	-	-	-	1	7	<1	-
		Debris Ratir	ng 2			Debris Rati	ng 2	
Analytical Sensitivity	Analytical Sensitivity: 7 spr/m³		Analy	tical Sensitiv	ty: 7 sp	or/m³		
Comments								
Total *See Footnotes	18	120	~100%	1/200	135	24008	~100%	-



Certificate of Analysis EMLAP# 102977

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Date Analyzed: 05/26/2016
Date Reported: 05/26/2016
Project ID: 16015353

Page 2 of 3

Client Sample Number		02				03		
Sample Location	P	Portable Classroom 88				Outside PO	CR 90	
Sample Volume (L)		150				150		
Lab Sample Number		16015353-	002			16015353	-003	
Spore Identification	Raw Ct	spr/m³	% Ttl	In/Out	Raw Ct	spr/m³	% Ttl	In/Out
Alternaria	-	-	-	-	1	7	<1	-
ascospores	6	40	19	1/133	25	5325	22	-
basidiospores	8	53	25	1/304	76	16187	67	-
Cladosporium	9	60	28	1/39	11	2343	10	-
Colorless	-	-	_	-	1	7	<1	-
Epicoccum	-	-	_	_	6	40	<1	-
hyphal elements	3	20	9	3/1	1	7	<1	-
Penicillium/Aspergillus group	4	27	12	1/1	5	33	<1	-
Smuts,Periconia,Myxomycetes	2	13	6	1/4	8	53	<1	-
Torula	-	-	-	_	1	7	<1	-
		Debris Ratir	ng 3			Debris Rati	ng 2	
Analytical Sensitivity	Analytical Sensitivity: 7 spr/m³		Analy	tical Sensitivi	ty: 7 sp	or/m³		
Comments	Large	amount of pa		and				
Total *See Footnotes	32	213	~100%	1/113	135	24008	~100%	-



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Footnotes and Additional Report Information

Debris Rating Table

1	Minimal (<5%) particular present	Present Reported values are minimally affected by particulate load.			
2	5% to 25% of the trace occluded with particulate	Negative bias is expected. The degree of bias increases directly with the perceit of the trace that is occluded.			
3	26% to 75% of the trace occluded with particulate	Negative bias is expected. The degree of bias increases directly with the percent of the trace that is occluded.			
4	75% to 90% of the trace occluded with particulate	Negative bias is expected. The degree of bias increases directly with the percent of the trace that is occluded.			
5	Greater than 90% of the trace occluded with particulate	Quantification not possible due to large negative bias. A new sample should be collected at a shorter time interval or other measures taken to reduce particulate load.			

- 1. Penicillium/Aspergillus group spores are characterized by their small size, round to ovoid shape, being unicellular, and usually colorless to lightly pigmented. There are numerous genera of fungi whose spore morphology is similar to that of the Penicillium/Aspergillus type. Two common examples would be Paecilomyces and Acremonium. Although the majority of spores placed in this group are Penicillium, Aspergillus, or a combination of both. Keep in mind that these are not the only two possibilities.
- 2. Ascospores are sexually produced fungal spores formed within an ascus. An ascus is a sac-like structure designed to discharge the ascospores into the environment, e.g. Ascobolus.
- 3. Basidiospores are typically blown indoors from outdoors and rarely have an indoor source. However, in certain situations a high basidiospore count indoors may be indicative of a wood decay problem or wet soil.
- 4. The colorless group contains colorless spores which were unidentifiable to a specific genus. Examples of this group include Acremonium, Aphanocladium, Beauveria, Chrysosporium, Engyodontium microconidia, yeast, some arthrospores, as well as many others.
- 5. Hyphae are the vegetative mode of fungi. Hyphal elements are fragments of individual Hyphae. They can break apart and become airborne much like spores and are potentially allergenic. A mass of hyphal elements is termed the mycelium. Hyphae in high concentration may be indicative of colonization.
- 6. Dash (-) in this report, under raw count column means 'not detected (ND)'; otherwise 'not applicable' (NA).
- 7. The positive-hole correction factor is a statistical tool which calculates a probable count from the raw count, taking into consideration that multiple particles can impact on the same hole; for this reason the sum of the calculated counts may be less than the positive hole corrected total.
- 8. Due to rounding totals may not equal 100%.
- 9. Analytical Sensitivity for each spores is different for Non-viable sample when the spores are read at different percentage. Analytical Sensitivity is calculated as spr/m³ divided by raw count. spr/m³ = raw counts x (100/ % read) x (1000/Sample volume). If Analytical Sensitivity is 13 spr/m³ at 100% read, Analytical Sensitivity at 50% read would be 27 spr/m³, which is 2 times higher.
- 10. Minimum Reporting Limits (MRL) for BULKS, DUSTS, SWABS, and WATER samples are a calculation based on the sample size and the dilution plate on which the organism was counted. Results are a compilation of counts taken from multiple dilutions and multiple medias. This means that every genus of fungi or bacteria recovered can be counted on the plate on which it is best represented.
- 11. If the final quantitative result is corrected for contamination based on the blank, the blank correction is stated in the sample comments section of the report.
- 12. Analysis conducted on non-viable spore traps is completed using Indoor Environmental Standards Organization (IESO) Standard 2210.
- 13. The results in this report are related to this project and these samples only.
- 14. For samples with an air volume of < 100L, the number of significant figures in the result should be considered (2) two. For samples with air volumes between 100-999L, the number of significant figures in the result should considered (3) three. For example, a sample with a result of 55,443 spr/m³ from a 75L sample using significant figures should be considered 55,000. The same result of 55,443 from a 150L sample using significant figures should be considered 55,400 spr/m³.
- 15. If the In/Out ratio is greater than 100 times it is indicated >100/1, rather than showing the real value.

Terminology Used in Direct Exam Reporting

Conidiophores are a type of modified hyphae from which spores are born. When seen on a surface sample in moderate to numerous concentrations they may be indicative of fungal growth.

Suzanne S. Blevins, B.S., SM (ASCP) Laboratory Director

Sunn 5. Polining



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ELITE

LAB #192683 (CO) LAB #102977 (GA) LAB #163063 (VA)

of :

NVLAP Lab Code 200829-0 (VA)

AZ, CO, GA, VA, NJ LAB #210229 (AZ) Aerobiology Client Aria Environmental, Inc. NVI AP Lab Code 500097-0 (AZ) Relinquished By/Date: Collected By/Date: 04/27/16 04/27/16 Julie Barth Field Contact Relinquished By/Date 27/16 Received By/Date: Reporting 5/23/16 PO Box 286 Address Other AllergencoD Andersen SampleAire Sampler Woodbine, MD 21797 BioCulture SAS Aero Trap Type Address PO#/Job#: J16-947 410-549-5774/410-549-4488 Phone/Fax Project Name: CLES Reporting ibarth@ariaenviro.com Email (s) Notes: 5 Day 2 Hou Routine (4 Hou 24 Hour Same Day CC Info: SAMPLING LOCATION ZIP CODE 21042

Γ	Sample No.	Test Code	Sample Location	Total Volume/Area
1	01	1054	Portable Classroom 90	150 L
2	02	1054	Portable Classroom 88	150 L
3	03	1054	Outside PCR 90	150 L
4				
5				
6				
7				
8				
9				
0				
1				
2				
3				
4				

1054	Direct, Non-viable Spore Trap	1015	Culture - WATER Legionella
1051	Direct, Qualitative- Swab/Tape	1017	Culture - SWAB Legionella
1050	Direct, Qualitative- Bulk	1010	WATER - Potable - E. coli/total coliforms
1005	AIR Culture - Bacterial Count w/ ID's	1012	SWAB - E. coli/total coliforms
1030	AIR Culture - Fungal Count w/ ID's	1028	Sewage Screen (E. coli/Enterococcus/fecal coliforms)
1006	SWAB Culture - Bacterial Count w/ ID's	2056	Heterotrophic Plate Count
1031	SWAB Culture - Fungal Count w/ ID's	3001	ASBESTOS - Point count
1008	BULK Culture - Bacterial Count w/ ID's	3002	ASBESTOS - PLM Analysis
1093	BULK Culture - Fungal Count w/ ID's	3003	ASBESTOS - Particle characterization
1007	WATER Culture - Bacterial Count w/ID's	3004	ASBESTOS - PCM Analysis

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