

**Report For  
Indoor Air Quality Testing  
At The  
Green Meadow Elementary School  
Maynard, MA**

**Study Date**  
August 16, 2023

**Project# 223 596.00**

**STUDY CONDUCTED BY:**

***UNIVERSAL ENVIRONMENTAL CONSULTANTS***  
12 Brewster Road  
Framingham, Massachusetts

August 21, 2023

Mr. Robert Savoie  
Facilities Director  
Maynard Public Schools  
3-R Tiger Drive  
Maynard, MA 01754

Reference: Indoor Air Quality Testing  
Green Meadow Elementary School

Dear Mr. Savoie:

Thank you for the opportunity for Universal Environmental Consultants (UEC) to provide professional services.

Enclosed please find the report for Indoor Air Quality Testing at the Green Meadow Elementary School conducted on Wednesday, August 16, 2023.

Please do not hesitate to call should you have any questions.

Very truly yours,

Universal Environmental Consultants



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Ammar M. Dieb  
President

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Enclosure

**Scope:**

UEC was contracted to perform an Indoor Air Quality Testing at the Green Meadow Elementary School, Maynard, MA. Testing was performed at select areas within the school.

Testing was performed on Wednesday, August 16, 2023.

**Methodology:**

Testing for Total Volatile Organic Compounds (**TVOCs**) was performed using Q-Trak XP monitor manufactured by TSI Incorporated. This is a state-of-the-art instrument capable of detecting **TVOCs** in the ppb (parts per billion) and  $\mu\text{g}/\text{m}^3$  (micrograms per cubic meter) ranges. The instrument is a direct reading instrument and provides continuous results over an extended time. The unit is calibrated prior to use and serviced by an independent vendor annually.

Volatile organic compounds are a broad class of chemicals with diverse applications which are frequently emitted by new carpets, furniture, pressboards, varnishes, adhesives, and high gloss finishes. Other common products which may emit VOCs include construction materials, paints, paint strippers, other solvents, wood preservatives, aerosol sprays, cleansers, disinfectants, hand sanitizer, moth repellents, air fresheners, stored fuels, automotive products, hobby supplies, and dry-cleaned clothing. High levels of VOCs are a common Indoor Air Quality problem, especially in newly constructed, recently renovated, or currently being renovated buildings.

Carbon monoxide (**CO**), Carbon Dioxide (**CO<sub>2</sub>**), Temperature (**°F**), and Relative Humidity (**%RH**) were measured using a Q-Trak XP monitor manufactured by TSI Incorporated. The unit is calibrated prior to use and serviced by an independent vendor annually.

Airborne particulate matter (**PM**) levels for **PM<sub>10</sub>** and **PM<sub>2.5</sub>** were tested using a Q-Trak XP monitor manufactured by TSI Incorporated. This is a state-of-the-art instrument capable of simultaneously detecting **PM<sub>10</sub>** and **PM<sub>2.5</sub>** in the microgram per cubic meter ( $\mu\text{g}/\text{m}^3$ ) range. The instrument is a direct reading monitor and provided sampling readings at 1 second intervals over the duration of each test. The instrument was zeroed prior to testing and is serviced annually by the manufacturer or an independent vendor.

Real time **PM** Measurement is a useful comparative measure of indoor and outdoor dust levels as well as identifying indoor sources of **PM**.

Samples were collected for approximately 5 minutes at each test location. No TWA (8-hour time weighted average) or other types or methods of sampling were included in the scope of work.

**Results:****TEMPERATURE, RELATIVE HUMIDITY, CARBON MONOXIDE, CARBON DIOXIDE & TOTAL VOLATILE ORGANIC COMPOUNDS by PID**

Location	W	D	#	Temperature (°F)	Humidity %RH	CO (ppm)	CO <sub>2</sub> (ppm)	TVOCs (µg/m <sup>3</sup> )
Outside	-	-	0	70.5	79.4	0.0	368	0.0
Main Office	C	O	0	70.9	81.5	0.0	547	100
Room 7I	C	O	0	72.9	76.6	0.0	460	0.0
Room 7J	C	O	0	73.0	76.7	0.0	457	0.0
Room 7K	C	O	0	73.2	75.5	0.0	550	0.0
Room 7C	C	O	0	73.2	75.5	0.0	481	0.0
Room 7D	C	O	0	73.4	75.3	0.0	410	0.0
Room 7L	C	O	0	73.2	75.7	0.0	409	0.0
Room 7M	C	C	0	73.4	75.9	0.0	529	0.0
Room 7B	C	O	0	73.2	75.8	0.0	408	0.0
Room 7A	C	O	0	72.9	76.8	0.0	406	0.0
Room 6C	C	O	0	72.7	76.3	0.0	431	0.0
Room 6B	C	O	0	73.0	72.7	0.0	450	0.0
Room 6A	C	O	0	73.2	72.7	0.0	432	0.0
Room 5D	C	O	0	73.6	74.5	0.0	408	0.0
Room 5C	C	O	0	73.8	74.5	0.0	404	0.0
Room 5B	C	O	0	73.9	73.0	0.0	418	0.0
Room 5A	C	O	0	73.9	74.6	0.0	442	0.0
Room 4D	C	O	0	73.6	74.8	0.0	414	0.0
Room 4C	C	O	0	73.8	74.9	0.0	427	0.0
Room 4A	C	O	0	73.8	75.7	0.0	616	0.0
Room 3A	C	O	0	73.9	74.4	0.0	450	0.0
Room 3B	C	O	0	73.4	75.6	0.0	417	0.0
Room 3D	C	O	0	73.0	76.3	0.0	411	0.0
Room 2C	C	O	0	73.6	75.4	0.0	437	0.0
Room 2D	C	O	0	73.6	75.2	0.0	452	0.0
Room 2A	C	O	0	73.8	75.2	0.0	425	0.0
Room 2B	C	O	0	74.3	73.6	0.0	442	0.0
Room 1C	C	O	0	74.5	73.2	0.0	430	0.0
Room 1D	C	O	0	74.3	73.6	0.0	420	0.0
Room 1A	C	O	0	74.5	73.9	0.0	416	0.0
Room 1B	C	O	0	74.5	74.1	0.0	415	0.0
Room 1E	C	O	0	75.0	72.1	0.0	443	0.0
Library	C	O	0	73.8	74.2	0.0	436	0.0
Art Room	C	O	0	74.7	73.2	0.0	434	0.0
Gymnasium	C	O	0	74.7	73.0	0.0	450	0.0
Teacher's Lounge	C	O	0	74.1	73.8	0.0	823	0.0
Music Room	C	O	0	74.2	73.4	0.0	545	0.0
Cafeteria	C	O	0	74.1	73.7	0.0	510	0.0

**Total PM - PM<sub>10</sub>, Respirable, PM<sub>2.5</sub> and PM1**

<b>Location</b>	<b>PM 10 (mg/m<sup>3</sup>)</b>	<b>PM 2.5 (mg/m<sup>3</sup>)</b>	<b>PM1 (mg/m<sup>3</sup>)</b>
Main Office	0.002	0.002	0.001
Room 7I	0.006	0.005	0.004
Room 7J	0.003	0.003	0.002
Room 7K	0.002	0.002	0.001
Room 7C	0.004	0.004	0.003
Room 7D	0.006	0.006	0.005
Room 7L	0.004	0.003	0.003
Room 7M	0.005	0.004	0.004
Room 7B	0.005	0.005	0.004
Room 7A	0.004	0.004	0.004
Room 6C	0.004	0.004	0.003
Room 6B	0.004	0.004	0.004
Room 6A	0.003	0.003	0.003
Room 5D	0.005	0.005	0.004
Room 5C	0.003	0.003	0.003
Room 5B	0.002	0.002	0.002
Room 5A	0.003	0.003	0.003
Room 4D	0.003	0.002	0.002
Room 4C	0.003	0.003	0.003
Room 4B	0.004	0.004	0.003
Room 4A	0.003	0.003	0.003
Room 3A	0.005	0.005	0.004
Room 3B	0.004	0.004	0.002
Room 3C	0.006	0.005	0.004
Room 3D	0.003	0.003	0.002
Room 2C	0.005	0.005	0.004
Room 2D	0.005	0.004	0.003
Room 2A	0.004	0.004	0.004
Room 2B	0.004	0.003	0.003
Room 1C	0.003	0.003	0.003
Room 1D	0.004	0.004	0.003
Room 1A	0.005	0.004	0.004
Room 1B	0.003	0.003	0.003
Room 1E	0.002	0.002	0.002
Library	0.004	0.004	0.003
Art Room	0.004	0.003	0.003
Gymnasium	0.005	0.005	0.004
Teacher's Lounge	0.004	0.004	0.003
Music Room	0.005	0.005	0.003
Cafeteria	0.004	0.003	0.002

**Legend:**

W: Windows; D; Doors; # Number of Occupants (e.g., 25 Occupants = 25); O = Open; C = Closed.

mg/m<sup>3</sup> - milligrams per cubic meter; µg/m<sup>3</sup> - micrograms per cubic meter.

ppm - parts per million.

ppb - parts per billion.

CO OSHA PEL is 30 ppm and ACGIH TLV is 25 ppm.

CO<sub>2</sub> - OSHA PEL is 5000 ppm, Mass DOH Guideline is 800 ppm.

TVOC – Seifert “Target Guideline Value” of 300 ug/m<sup>3</sup>

## Observations and Interpretation of Results:

### Temperature and Relative Humidity (T & RH)

The outside **T** and **RH** were approximately 70.5°F and 79.4%. Massachusetts Department of Public Health (MDPH) recommends that indoor **T** be maintained in a range of 70 - 78 °F and 40 to 60 % for indoor **RH** to provide for the comfort of building occupants.

Indoor **T** and **RH** were 70.9°F – 75.0°F and 72.1% – 81.5% during the test period. Indoor **T** tests were within the MDPH recommended **T** range of 70 - 78 °F. Indoor **RH** tests were higher than the MDPH recommended **RH** range of 40 to 60 %.

### TVOCs

**TVOC** levels on this day were lower than the Seifert “Target Guideline Value” of 300-µg/m<sup>3</sup>. The Seifert Target Guideline Value (reference #3 and #8 below) is a widely recognized **TVOCs** guideline for pollutant levels based on Seifert's personal judgment, rather than on toxicological data, for long term exposure. Seifert proposed that 1 week after completion of construction or renovation **TVOC** concentration of 50 times higher be acceptable (i.e., 15,000 µg/m<sup>3</sup>.) and after 6 weeks, 10 times higher be acceptable (i.e., 3,000 µg/m<sup>3</sup>). **TVOCs** test levels were between 0 ug/m<sup>3</sup> and 100 ug/m<sup>3</sup>, lower than the Seifert target guideline of 300 ug/m<sup>3</sup>, and much lower than the 1-week post-construction/renovation acceptable limit of 15,000 ug/m<sup>3</sup>.

Neither OSHA (Occupational Safety and Health Administration) nor ACGIH (American Conference of Governmental Industrial Hygienists) promulgates exposure standards for **TVOCs** that relate to protection of the general population as opposed to industrial occupational standards. Both have limits on individual VOCs, but they relate to industrial occupational standard.

Testing conducted was of short duration and did not assess representative full-day occupancy levels. Measurements were made using a real-time, portable **TVOC** monitor referenced to isobutylene and not by sample collection for individual VOC analysis by gas chromatography technique and evaluation based on Seifert's chemical classes. Mølhave of Denmark reported at INDOOR AIR '90 (reference #8 below) on low levels of indoor air VOCs and human health. Bearg summarized Mølhave's findings as follows.

Table 4.5 Tentative Dose-Response Relationship for Discomfort Resulting from Exposure to Solvent-Like VOCs

Total concentration (ug/m <sup>3</sup> )	Irritation and discomfort	Exposure
< 200	No irritation or discomfort	The comfort range
200 – 3,000	Irritation and discomfort possible if other exposures interact	The multifactorial exposure range
3,000 – 25,000	Exposure effect and probable headache possible if other exposures interact	The discomfort range
> 25,000	Additional neurotoxic effects other than headache may occur	The toxic range

**TVOCs** test levels were between 0 ug/m<sup>3</sup> and 100 ug/m<sup>3</sup>.

### Carbon Monoxide

No **CO** levels were detected during testing.

### Carbon Dioxide

**CO<sub>2</sub>** levels were within the acceptable range. For comparative purposes, fresh outdoor air has approximately 400 ppm of **CO<sub>2</sub>**. All areas were well below the OSHA/NIOSH limit of 5000 ppm, and within the MDPH guideline of 800 ppm for publicly occupied buildings. MDPH recommends an optimal level of below 600 ppm. Exposure to high levels of **CO<sub>2</sub>** for prolonged periods could cause building occupants to become lethargic and generally uncomfortable. **CO<sub>2</sub>** levels will rise over the course of the day especially in those areas which have a high occupancy. **CO<sub>2</sub>** at these levels is a comfort as opposed to a health issue.

### ***Airborne Particulate Matter (Dust):***

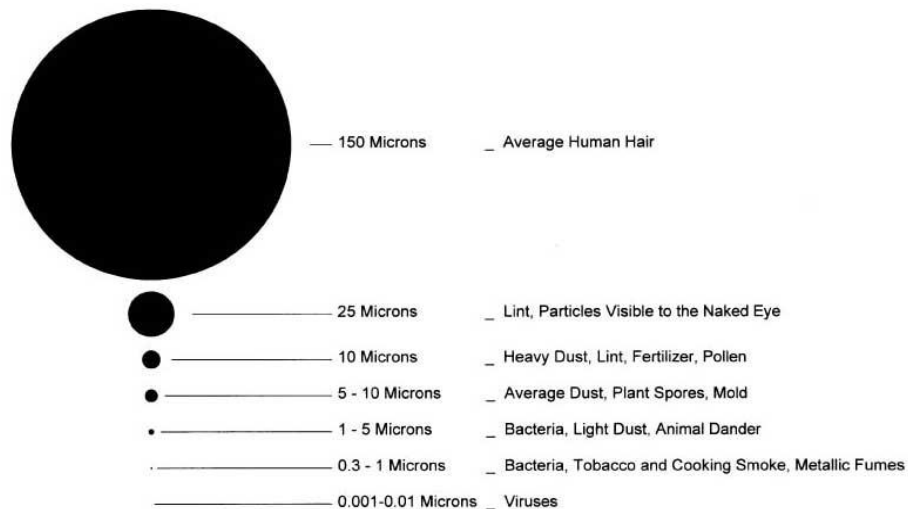
Dust monitoring is one aspect of air quality that an industrial hygienist can use to determine the amount of dust particles present in the workplace, cities or communities over a given period.

The Particulate Matter (PM) monitoring focused on measuring a range of particulate sizes in the air that are equal to or less than 10 micrometers (PM<sub>10</sub>) and equal to or less than 2.5 micrometers (PM<sub>2.5</sub>) in diameter (course dust and fine dust respectively), i.e., PM capable of penetrating the outer defenses of the respiratory tract, such as the mouth and nose, and can pass into the lungs based on PM size. PM air pollutants include but are not limited to soot, smoke, salts, metals, acids and soil and road dust. These pollutants are typically monitored along work site fence lines, industrial complexes, during wildfires, and high traffic areas (vehicle exhaust).

EPA's health-based National Ambient Air Quality Standard (NAAQS) for PM<sub>10</sub> is 150- $\mu\text{g}/\text{m}^3$  and for PM<sub>2.5</sub> is 35- $\mu\text{g}/\text{m}^3$  (measured as a 24-hours period concentration) for outdoor (ambient) air. The OSHA Permissible Exposure Limit (PEL) for occupational exposure for respirable dust is 5-mg/ $\text{m}^3$  (5,000- $\mu\text{g}/\text{m}^3$ ) for a time-weighted average (8 hour) exposure. While the EPA NAAQS is an outdoor, ambient air standard, it is a useful reference guide for acceptable air quality in general with limits far below OSHA worker compliance requirement levels.

The TSI Q-Trak XP monitor used in this survey can measure PM simultaneously as PM<sub>10</sub>, PM<sub>2.5</sub> and PM<sub>1</sub>, i.e., particles in the size range categories of 10, 2.5 and 1 micrometer diameter.

Figure 1.1-Visual Particle Size Comparison Chart.



Levels of PM<sub>10</sub> recorded in areas tested during the survey ranged from **2 to 6- $\mu\text{g}/\text{m}^3$  or 0.002 to 0.006 mg/ $\text{m}^3$** . EPA's health-based National Ambient Air Quality Standard (NAAQS) recommended level for PM<sub>10</sub> is **150- $\mu\text{g}/\text{m}^3$  or 0.150-mg/ $\text{m}^3$** . All areas tested during the survey were below the EPA recommended level.

Levels of PM<sub>2.5</sub> recorded in areas tested during the survey ranged from **2 to 5- $\mu\text{g}/\text{m}^3$  or 0.002 to 0.005-mg/ $\text{m}^3$** . EPA's health-based National Ambient Air Quality Standard (NAAQS) recommended level for PM<sub>2.5</sub> is **35- $\mu\text{g}/\text{m}^3$  or 0.035-mg/ $\text{m}^3$** . All areas tested during the survey were below the EPA recommended level.

Direct reading PM monitors are not a reference method for OSHA compliance Respirable Dust testing. However, the direct reading instrument is useful in providing accurate order of magnitude evaluation of Respirable Dust levels.

Samples were collected for approximately 5 minutes at each test location and results/levels are not based on TWA (8-hour time weighted average).



**Conclusions and Recommendations:**

Indoor ***RH*** tests were higher than the MDPH recommended ***RH*** range of 40 to 60 %. All other IAQ parameters tested were within the acceptable ranges.

**Limitations and Conditions:**

This report has been completed based on visual and physical observations made and information available at the time of the site visits. This report is intended to be used as a summary of available information on existing conditions with conclusions based on a reasonable and knowledgeable review of evidence found in accordance with normally accepted industry standards, state, and federal protocols, and within the scope and budget established by the client. Any additional data obtained by further review must be reviewed by UEC and the conclusions presented herein may be modified accordingly.

This report and attachments, prepared for the exclusive use of Owner for use in an environmental evaluation of the subject site, are an integral part of the inspections and opinions should not be formulated without reading the report in its entirety. No part of this report may be altered, used, copied, or relied upon without prior written permission from UEC, except that this report may be conveyed in its entirety to parties associated with Owner for this subject study.

**REFERENCES:**

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