INDOOR AIR QUALITY ASSESSMENT

Timony Grammar School

45 Pleasant View Street
Methuen, MA
April 2025

Prepared by:
Massachusetts Department of Public Health
Bureau of Climate and Environmental Health
Division of Environmental Health Regulations and Standards

Contents

EXECUTIVE SUMMARY

The Massachusetts Department of Public Health's (MDPH) Division of Environmental Health, Regulations and Standards (EHRS) conducted an Indoor Air Quality (IAQ) assessment of Timony Grammar School located at 45 Pleasant View Street in Methuen on February 28, 2025. This assessment was requested by Superintendent Dr. Brandi Kwong and the Methuen City Mayor, DJ Beauregard's Office. It is also important to note that prior to the MDPH assessment, the Mayor has created a School Health and Safety Task Force (School Health and Safety Task Force | Methuen, MA) the goal of which is to "*...address long-standing facilities-related issues in Methuen's public schools. The goal of this page is to provide the entire community with a transparent overview of what has been done to begin addressing those problems - and what is being done to ultimately fix them".*

Any building can have IAQ issues. These issues can be made worse through conditions common to marginalized communities (Environmental Justice communities or EJ) such as inequitable exposure to outdoor air pollution and a greater likelihood of poor building conditions leading to deterioration of IAQ resulting in higher asthma rates. The city of Methuen contains a number of EJ communities (https://matracking.ehs.state.ma.us/Environmental-Data/ej-vulnerable-health/environmental-justice.html). Note that the pediatric asthma rate for this school as of 2023 is 6.8%. Which is statistically significantly lower than the statewide pediatric asthma prevalence rate of 9.6% (MAEPHT, 2024).

The assessment was conducted by evaluating several key elements within the school: a visual inspection of the heating, cooling, and ventilation (HVAC) systems, water/microbial damage, cleanliness, point sources of respiratory irritants such as chemicals, and electronic measurement of carbon dioxide (CO_2), carbon monoxide (CO), temperature, relative humidity (RH), and small particulate matter (PM2.5) all taken with a Qtrak XP monitor. Data is collected in this manner to identify potential asthma triggers,

allergens, and other environmental factors that can cause indoor air quality symptoms. Please refer to the Indoor Air Quality Manual on the MDPH website for methods, sampling procedures, and interpretation of results.

It is important to note that the Methuen Public School District has made an important commitment to improving IAQ by replacing some HVAC components and control systems. However, during the assessment many supply and exhaust components of the mechanical ventilation system were deactivated or not operating. This limits capacity to dilute and remove typical indoor pollutants as well as outdoor pollutants, such as vehicle exhaust, pollen, mold spores, and wildfire smoke. In addition, excess water vapor during hot, humid weather may also build up in the building and lead to water damage/mold growth to building materials over summer months. Several areas with visible water damage and signs of mold growth were noted during the assessment. MDPH staff provided verbal recommendations at the time, which are reiterated in this report. (Results and Discussion).

Like many school buildings in the Commonwealth, it is also important to note that some building components, such as windows, parts of the heating, ventilation, and air conditioning (HVAC) system and the roof are past their service life and in need of replacement.

As a result of this assessment, there are several findings typical of elementary schools of this age and type. Upon review of these findings, several primary recommendations are made to optimize existing systems and improve indoor air quality. (Conclusions and Recommendations)

- Operate all supply and exhaust ventilation equipment *continuously* during occupied hours.
- Repair exhaust vents or activate them, and ensure they are not blocked by items.
- Work with an HVAC engineering firm to determine the operational lifespan of existing equipment (e.g., unit ventilators and air handling units) and the feasibility of repair vs. replacement.
- Use air purifiers in occupied rooms to supplement mechanical ventilation.
- Remediate water-damaged/mold-colonized items and building materials using the US EPA's "Mold Remediation in Schools and Commercial Buildings". Available at: http://www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide

- Replace original windows with modern energy efficient ones.
- Make repairs to the building envelope to restore watertight integrity.
- Ensure the principles of integrated pest management (IPM) are followed in accordance with state regulations.

As climate change and global warming intensifies, the urgent need for modern, energy-efficient solutions becomes clear, without significant repair of the building envelope and repair/upgrade of interior HVAC components, building conditions and indoor air quality will continue to degrade.

(Conclusions and Recommendations)

Please note: this report contains a series of recommendations that should serve as *Best Practices* that apply to most public-school buildings across the Commonwealth and should be shared amongst other buildings in the school district.

BACKGROUND

Building:	Timony Grammar School (TGS)
Address:	45 Pleasant View Street, Massachusetts
Coordinated Via:	Superintendent and Mayor's Office
Reason for Request:	Rodent issues and general indoor air quality (IAQ) concerns
Date of Assessment:	February 28, 2025
Massachusetts Department of Public Health/Bureau of Climate and Environmental Health (MDPH/BCEH) Staff Conducting Assessment:	Cory Holmes, Amy Riordan, Ruth Alfasso, Kerry Wagner, Bharathi Patimala-Dipali, and Thomas Murphy, Division of Environmental Health Regulations and Standards (EHRS)
Building Description:	The TGS is a two-story red brick building originally constructed in 1964. The building underwent renovations in 1996-1997. The building contains general classrooms, music room, library, art rooms, office space, kitchen, cafeteria, gymnasium, and an auditorium.
Windows:	Windows in the building are openable.

RESULTS AND DISCUSSION

The following is a summary of indoor air testing results (Table 1)

• ***Carbon dioxide (CO_2)***	*a measure of the adequacy of ventilation*	Levels were above the MDPH guideline of 800 parts per million (ppm) in more than half of the areas surveyed, indicating a lack of air exchange in these areas.
• ***Temperature***	*a measure of comfort*	Most areas measured were within the MDPH recommended range of 70°F to 78°F, however some were above and some below that range.
• ***Relative humidity***	*a measure of comfort and, when in excess for an extended period, a way to reflect the potential for mold and fungal growth*	Was below the MDPH recommended range of 40 to 60% in areas tested. Low relative humidity is common indoors during the heating season. Relative humidity would be expected to be higher during hot, humid weather.
• ***Carbon monoxide (CO)***	*a product of combustion that can result in acute and long term cardiovascular, respiratory, and neurological symptoms*	Levels were non-detect (ND) in all areas tested.
• ***Particulate matter (PM2.5)***	*a way to measure inhalable particle distribution in the air*	Concentrations were below the National Ambient Air Quality Standard (NAAQS) of 35 micrograms per cubic meter ($\mu g/m^3$) in all areas tested.

Ventilation

Ventilation refers to both the supply of fresh air and the removal of stale air from a room. The introduction of fresh air into an occupied space will dilute normally occurring pollutants that are generated by occupancy and other activities. In addition, an HVAC system will remove pollutants from a building if operating appropriately. All ventilation systems throughout the building should operate continuously during periods of occupancy.

The majority of classrooms are equipped with unit ventilators (univent, Picture 1). Univents bring in fresh air from a vent on the outside of the building (Picture 2), filter it, heat or cool it, and supply the air through a vent on the top. Some room air is recirculated along with the fresh air through a vent at the bottom (Figure 1).

Ventilation for interior rooms and common areas is provided by rooftop air handling units (AHUs) (Picture 3). Fresh air is drawn in through air intakes and distributed to classrooms and common areas via ceiling or wall-mounted air diffusers (Picture 4).

Wall or ceiling-mounted exhaust vents remove stale air from classrooms to provide air exchange (Picture 5). Many exhaust vents were not active during the assessment. (Table 1). It was not known whether these vents were not functional or just deactivated.

Two rooms were equipped with mini-split (ductless) air conditioners located in the ceiling (Table 1). While these units are effective at cooling, they do not provide any fresh air.

Most classrooms are equipped with openable windows (Table 1). Windows can introduce fresh air into classrooms when outdoor conditions are amenable. Windows should not be opened during very hot, very cold, or very humid conditions and should also stay closed when outdoor air quality is poor due to smoke, high pollen counts, or outdoor maintenance activities.

Without proper supply and exhaust ventilation, normally occurring environmental pollutants can build up and lead to indoor air quality/comfort complaints. In addition, without proper exhaust ventilation, excess moisture cannot be removed from the building, which can lead to mold growth conditions over the summer.

The various types of ventilation components as well as devices that can move/redirect airflow that were identified in the building are listed in Table 2A, Table 2B and Table 2C.

HVAC System Maintenance

- During the assessment, some univents were deactivated (Table 1), therefore no means of mechanical fresh air was being provided.
- The univents are reported to be controlled by a computerized management system.
- MDPH recommends that filters of at least a Minimum Efficiency Rating Value (MERV) of 8 be used as these are adequate to filter out pollen, mold, and similar particulates (ASHRAE, 2012). A few univents were opened and the filter examined (Picture 6). MERV 8 filters in good condition were found. Facility staff report that these are changed 2-4 times a year.
- It was reported that MERV 13 filters (Picture 7) are used in roof-mounted AHUs and replaced quarterly. MDPH recommends that filters be changed two to four times a year or as per the manufacturers' recommendations.
- It was reported that rooftop AHU are equipped with sensors for carbon dioxide.
- Many univents were blocked with items and furniture along the top or front (Picture 8). Blocked univents are much less effective at circulating air through a classroom. In addition, items such as plants (Picture 9), cardboard, and plastic can be a source of odors which can be distributed throughout the room by the operation of the univent, especially when heated.
- Many wall-mounted exhaust vents were blocked by furniture or items, often a white storage cabinet found in most classrooms (Picture 10). Blocked exhaust vents do not function well to remove stale air.
- Some ceiling-mounted vents were blocked by items piled on top of furniture (Picture 11). This not only reduces the effectiveness of the vent but items this close to the ceiling may be against the fire code.

- Conditions were found that would compromise the function of the rooftop AHUs. The equipment was showing signs of age including rust and ductwork falling away from the main units (Picture 12).
- Newer insulation had been added to the units, but it had holes and gaps. This appears to be damage done by animals.

HVAC Types and Specific Conditions

(see Ventilation pictures)

Additional HVAC Conditions:

- **As mentioned, a number of univents and exhaust vents appeared to be in the off-cycle or not functioning at the time of assessment** (Table 1). To maximize air exchange, BCEH recommends that both supply and exhaust ventilation operate *continuously* during periods of occupancy.

> **Balancing**
> To have proper ventilation with a mechanical supply and exhaust system, a system must be balanced to provide an adequate amount of fresh air to the interior of a room while also removing stale air from the room. It is recommended that HVAC systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

- **The system should be balanced** once the installation and programming of new electronic HVAC thermostats and controls are complete.
- **Any carbon dioxide sensors in AHUs or elsewhere should be calibrated or replaced as recommended by the manufacturer.**
- **Both univents and rooftop AHUs are likely beyond their service life.** According to the American Society of Heating, Refrigeration, and Air-Conditioning Engineering (ASHRAE), the service life of this type of unit is 15-20 years, assuming routine maintenance of the equipment (ASHRAE, 1991).

Water Damage and Moisture Concerns

Please note that the MDPH does not recommend conducting mold testing in a typical water damage remediation. For details, please consult Guidance Regarding Testing for Mold in Water-Damaged Public Buildings | Mass.gov
The application of a mildewcide to moldy porous materials is not recommended.

Molds are found naturally in our environment both indoors and outdoors. Inside, mold growth may occur when items, particularly porous products such as paper or gypsum wallboard, are exposed to moisture. Typical water sources include leaks, floods, and condensation. To avoid mold growth, dry all water-damaged items and affected areas within 24-48 hours and reduce indoor humidity. Some people with chronic respiratory conditions,

such as asthma, are more likely to experience health symptoms associated with molds, including allergic reactions and respiratory irritation. Controlling moisture is the key to preventing mold growth and potential health symptoms.

Hot humid summers are becoming more frequent due to climate change. Massachusetts has experienced hot, humid, and rainy summers in 2018, 2021, and 2023. July of 2021 was the wettest ever recorded in Massachusetts, and the three-month period from June through August, known as the meteorological summer, was the fourth wettest on record, according to the National Oceanic and Atmospheric Administration's (NOAA) Centers for Environmental Information (NOAA, 2021). The summer of 2023 was also hot, and wet, being measured as the second rainiest on record (WBUR, 2023). The summer of 2024 also had significant stretches of hot, humid weather. These conditions are challenging for buildings, particularly those without central air conditioning.

During these hot and wet summers, extended periods of outdoor relative humidity above 70% occurred. Under these weather periods, public buildings experienced extended periods of water vapor exposure from high relative humidity. When exposed to these conditions, porous materials such as gypsum wallboard, cardboard, and other materials may become prone to developing mold colonization, particularly if located in areas that are prone to developing condensation on floors and walls (e.g., below grade space).

It was reported that a number of proactive actions were taken by Administrative and Custodial staff to reduce moisture/leaks, monitor conditions, and help prevent mold growth in the building. These included:

- Frequent walkthroughs of the building, particularly after rain events to note areas of water infiltration;
- The deployment of dehumidifiers in classrooms most susceptible to moisture. These dehumidifiers are stationed on countertops to allow continuous drainage into sink drains;
- Long-term replacement of carpeting;
- The use of MERV 13 filters in HVAC equipment; and
- Making high-efficiency particulate arrestance (HEPA) air purifiers available for use. These remove up to 99% of airborne contaminants as small as 0.1 microns including airborne mold spores.

In addition to these steps, If possible, this computerized system should be utilized to monitor *real-time measurements* for temperature to track trends and take actions to prevent excess moisture conditions that can lead to mold growth over summer months.

All rooms examined were assessed for the presence of either mold or visible water damage and the following issues were noted.

- **Water-damaged ceiling tiles were found in some locations (Pictures 13 and 14; Table 1),** which can indicate current/historic roof/plumbing leaks or other water infiltration. Water-damaged ceiling tiles can provide a source of mold and should be replaced after a water leak is discovered and repaired.

- Water-damaged plaster/efflorescence was noted (Picture 15), and other water stains on building materials (Picture 16).
- Active leaks were noted in a few rooms (Table 1) and buckets were being used to catch water. Active leaks should be repaired as soon as possible to avoid ongoing water damage as well as slipping hazards.
- On the ground floor, evidence of water damage in areas close to classroom exterior doors was noted. Various water-damaged materials were found including walls, coving, cabinets, and ceilings (Pictures 17 and 18). While majority of the materials found around the exterior doors were mostly non-porous and not conducive to mold growth (e.g., concrete and tile), this area should be kept clean of dust and debris (which can grow mold) and should be monitored after heavy rains to ensure prompt clean up and drying, and avoid moisture spreading to other areas with porous building materials, which may be conducive to mold growth.
- Two ground floor classrooms had wall-to-wall carpeting. The carpeting may not be insulated underneath between the floor and the soil. Therefore, during hot, humid weather, the ground may be cold enough to develop condensation. Porous items on the floor, including carpeting and classroom materials, may become water-damaged and mold-colonized. Wall-to-wall carpeting is generally not recommended for classrooms, especially on the ground floor due to this and other issues. However, the carpeting in these rooms did not have odors and showed no other signs of water damage.
- Many classrooms had sinks. Damaged backsplashes were observed in some sinks (Picture 19). If a backsplash is damaged, it becomes very difficult to keep clean, and can lead to additional damage to the material underneath.
- Cabinets for classroom sinks were often in poor condition. Water damaged building material was found underneath many of them (Picture 20). Many doors on sink cabinets could not be opened and closed properly. Uneven surfaces cannot be adequately cleaned, and any breaches can serve as pathways for pests and rodents into occupied areas.
- In addition to water-damaged building materials, porous items were found under many sinks (Picture 21). Storing items in a moist environment can create conditions conducive to mold growth. An excess of items can also prevent leak detection and allow rodents a place to hide.
- Some sinks also could not be turned off completely (Table 1) which adds moisture to the environment. Plumbing leaks should be repaired.
- Plants were found in some classrooms and offices (Picture 9; Table 1). Plants should not be placed on ventilation equipment, should be well-maintained, and placed on non-porous drip pans that are cleaned frequently.
- Bowed ceiling tiles (Picture 22; Table 1) were noted in many classrooms and hallways. This is a sign of chronic exposure to high humidity. In some cases, the tiles were warped enough that they no longer fit securely in the ceiling tile grid. This can allow dust and debris from above the ceiling tile grid into occupied spaces.

An exterior evaluation was also conducted to identify potential pathways for water penetration and pest entry. The following issues were noted.

- **While most of the brickwork was in good condition, some was water-stained or damaged (Picture 23).**
- As a part of the rodent exclusion efforts for Methuen schools**, heavy-duty metal door sweeps were added to exterior doors in this building.** No light was visible beneath them. Good door-sweeps/weatherstripping can not only exclude pests but can keep unconditioned outside air and moisture from entering the building.
- **Damaged wood and delaminating paint/stain were found along the roof eaves and trim around windows (Picture 24),** which can accelerate water damage and rot allowing a pathway for drafts, moisture, and pest entry into the building.
- **Large trees were noted in the courtyard of the building and near the exterior (Picture 25 and 26). Ivy was noted growing on the building in one area.** Plants near or on the building can cause water damage to brickwork and mortar. In addition, plants shading exterior walls can slow drying. Water can eventually penetrate the brick, subsequently freezing and thawing during the winter. This freezing/thawing action can weaken and damage bricks and mortar.
- **Trees overhanging the roof may also be providing transportation to pests** leading to damage noted to AHU insulation.
- **The presence of trees near the building along both the exterior and the courtyard pose several hazards/issues:**
    - Leaves and other debris accumulate around roof drains, which inhibits rainwater drainage from the roof. Ineffective drains can lead to water leaks inside the building.
    - Trees prevent sunlight from drying walls and soil.
    - The trees are a possible danger due to the distance from exterior walls:
    - The recommended safe distance that any tree should be planted is the minimum of the expected maximum growth height of the species from the exterior of a building (BI, 2015).
    - Soil subsidence may also be caused by tree roots, which can undermine the structure of a building to cause wall and floor cracking and related damage. To prevent subsidence, a sufficient distance appropriate for the tree species is recommended (Williams, 2006).
    - Severe weather may result in the tree falling onto the building or the tree roots damaging the foundation. Due to the height of the trees, each is likely located closer than recommended distances.
    - In general, a tree root system will spread out in all directions from its trunk. In some cases, tree roots can extend for over 100 feet from its trunk. Any structure disrupting the root structure may make the tree unstable if subjected to high winds from a certain direction. Based on the location, the foundation walls likely disrupt the roots of several trees.
    - The Federal Emergency Management Agency (FEMA) provides several recommendations to prepare for severe thunderstorms. Of note FEMA recommends “Cut down or trim trees that may be in danger of falling on your

[building]" (FEMA, 2018). Given the proximity to exterior walls, removal of trees from the exterior should be strongly considered.

These conditions represent potential water penetration sources. Over time, these conditions can undermine the integrity of the building envelope and provide a means of water entry into the building via capillary action through foundation concrete and masonry (Lstiburek & Brennan, 2001).

A list of water damage issues identified inside and outside the building is included as Table 3.

(see Water Damage Pictures)

Mold Growth
Porous materials (e.g., gypsum wallboard, ceiling tiles and carpeting) can be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2008).
If porous materials are not dried within this time frame, mold growth may occur.

Sources of Respiratory Irritants/Possible Asthma Triggers

Asthma is a lung disease that can make breathing difficult. Without careful management of asthma, some people can have symptoms, like a tight feeling in the chest, shortness of breath, coughing, or wheezing. Although there is no cure for asthma, people with asthma can live healthy, active lives. A safe and healthy environment helps to reduce asthma symptoms.

Comparison of Local and State-wide Asthma Rates (2023-2024 school year/MAEPHT 2025)

Methuen	Timony Grammar School	Massachusetts
8.5% of children have asthma.	6.8% of children have asthma.	9.6% of children have asthma.

- **Sometimes, learning tools and personal items in a classroom can be a source of irritants.** For example, a bird or insect nest is a great learning tool for students but may harbor microbes and allergens, as does a fish tank which could be a source of odors. Similarly, food-based projects can attract pests that carry disease or trigger allergies.
- **Dust, a common respiratory and eye irritant, can collect on surfaces and items.** Although janitorial and maintenance staff perform routine cleaning in classrooms, they may not be able to clean as effectively if classroom items are not picked up or surfaces are cluttered.
- Even with a properly functioning ventilation system, it is necessary to reduce the use of materials that can be a source of respiratory irritants to prevent symptoms in individuals who have sensitivity to such pollutants. **Without operational mechanical exhaust in most areas, irritants can linger.**

For guidance on maintaining an asthma-friendly healthy school environment, please consult the MDPH Asthma Prevention and Control Program's Clearing the Air: An Asthma Toolkit for Healthy Schools.

Possible asthma triggers and/or airborne pollutants exist in the building. These are listed below as well as in (Table 4).

(see Sources of Respiratory Irritant Pictures)

- **It was reported that rodent infestation is a concern for schools in the district.** Note that rodent infestation, because of materials present in wastes, can produce indoor air quality-related symptoms. Mouse urine contains a protein that is a known sensitizer (US EPA, 1992). A sensitizer is a material that can produce symptoms in exposed individuals (e.g. running nose or skin rashes) after repeated exposures. To reduce issues related to rodents, the animals first need to be excluded from and removed from a building. Then thorough cleaning needs to be performed to remove wastes and dander. The district has been working with a professional pest contractor to institute a pest management plan. Removing and excluding rodents will be an ongoing process. Occupants can assist by:
    - Keeping all food and food waste in tightly-closed mouse-proof containers,
    - Cleaning crumbs and removing trash daily,
    - Ensuring doors are closed tightly and open windows are equipped with intact screens, and
    - Reporting pest sightings or new gaps in the building envelope to facility management.
- **Some areas are covered with wall-to-wall carpet that is soiled/stained and past its service life (Picture 27).** Carpeting has a service life of approximately 10-11 years (IICRC, 2002). Carpeting that is beyond its service life becomes increasingly difficult to clean and may release fibers which can be irritating if airborne. Carpets should be vacuumed regularly with a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner and cleaned annually (or semi-annually in soiled/high traffic areas) in accordance with Institute of Inspection, Cleaning and Restoration Certification (IICRC) recommendations (IICRC, 2012).

- **Area rugs and plush items were also noted in some classrooms (Picture 28; Table 8).** These need to be cleaned regularly to remove dust and debris. Area rugs should be stored rolled up off the floor in a dry area during the summer. Used area rugs and plush items should not be brought into schools to prevent transferring allergens such as pet hair.

- **Plug-ins and other air fresheners were noted in classrooms (Picture 29; Table 1). Exposure to low levels of total volatile organic compounds (TVOCs)** may produce eye, nose, throat, and/or respiratory irritation in some sensitive individuals. MDPH staff examined rooms for products containing VOCs and noted hand sanitizers, air fresheners, cleaners, and dry erase materials in use within the building (Picture 32). These products have the potential to be irritants to the eyes, nose, throat, and

respiratory system of sensitive individuals. Consult "Clean Air Is Odor Free" for more information on fragrances in schools and other building.

- **Cleaning products, including unlabeled bottles or bottles where the labels had worn off were found in many classrooms, frequently under the sink (Picture 21).** Cleaning products should be kept out of the reach of children. All products used in the school should have Safety Data Sheets (SDS) available in case of spills or misuse. All bottles should be properly labeled as to contents.

- **Supply, exhaust, return vents and surrounding ceiling tiles had accumulations of dust and debris (Pictures 30 and 31; Table 1).** This dust/debris can be aerosolized under certain conditions, and should be cleaned periodically (e.g., during regular filter changes). It is important to note that the location of these tiles *directly in the airstream* of mechanical ventilation makes them more susceptible to collecting dust due to constant airflow over the surface of the tile. If these tiles cannot be adequately cleaned, they should be replaced.

- **High-efficiency particulate arrestance (HEPA) air purifiers, were in use in several classrooms (Table 1).** HEPA units remove up to 99% of airborne contaminants as small as 0.1 microns including airborne mold spores. These are good choices for use in occupied areas. Air purifiers that may produce ozone should not be used (EPA, 2003). All air purifiers should be cleaned and maintained in accordance with manufacturers' instructions.

- **In a few classrooms, tennis balls were found sliced open and placed on chair legs to reduce noise (Table 1).** Tennis balls are made of materials that may be a source of respiratory irritants. Constant wearing of tennis balls can produce fibers and off-gas VOCs. Tennis balls are made with a natural rubber latex bladder, which becomes abraded when used as a chair leg pad. Use of tennis balls in this manner may introduce latex dust into the school environment. Some individuals are highly allergic to latex (e.g., spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited to reduce the potential for symptoms in sensitive individuals (NIOSH, 1997). Latex-free glides should be used for this purpose.

- **A washer and dryer were noted in a room off a former home economics classroom.** The washer was in use at the time of the assessment. Clothes dryers need to be vented outside the building, which this one appeared to be. A build-up of lint in a long dryer vent hose can reduce the effectiveness of the dryer and can be a fire hazard. In addition, the terminus of the exhaust vent needs to be inspected and cleared periodically to ensure proper removal of pollutants.

Other IAQ Issues

Radon

Radon is a naturally occurring radioactive gas that seeps into buildings from the surrounding soil and at elevated levels can increase the risk of lung cancer.

The Environmental Protection Agency (EPA) conducted a National School Radon Survey "in which it discovered nearly one in five schools has at least one schoolroom with a short-term radon level above the action level of 4pCi/L (picocuries per liter) – the level at which the EPA recommends that schools take action to reduce the level" (US EPA, 1993).

The MDPH therefore recommends that every school be tested for radon, and that this testing be conducted during the heating season while school is in session in a manner consistent with US EPA radon testing guidelines. Radon measurement specialists and other information can be found at www.nrsb.org and http://aarst-nrpp.com/wp, with additional information at: https://www.mass.gov/radon.

CONCLUSIONS AND RECOMMENDATIONS

Please note: this report contains a series of recommendations that should serve as *Best Practices* that apply to most public-school buildings across the Commonwealth and should be shared amongst other buildings in the Methuen School District. Note that activities that require removal/replacement of building materials may generate dust, debris, or odors, and should be conducted while areas are unoccupied.

Short-term recommendations can be implemented as soon as practicable, however **long-term measures** are more complex and will require planning and resources to adequately address overall indoor air quality issues within the building.

Short-term Recommendations

	HVAC System	Helpful Links
1.	Continue to use the electronic HVAC management system to control, track and help staff to determine proper temperature regulation and comfort control.	
2.	Operate all supply and exhaust ventilation equipment continuously during occupied hours.	
3.	Periodically check the function of all classroom and restroom exhaust vents and repair as needed.	

4.	Close classroom doors for improved exhaust vent function and air exchange.	
5.	Remove blockages from univents and exhaust vents, including classroom storage cabinets and ceiling-high stacks of stored materials.	
6.	Change HVAC filters 2-4 times a year using MERV 8 or the best MERV-rating that can work with current equipment.	ANSI/ASHRAE Standard 52.2-2017
7.	During filter changes, clean dust and debris from the inside of univent and HVAC system cabinets.	
8.	Repair damage to rooftop AHU ducts and insulation.	
9.	Use openable windows for additional fresh air during temperate weather when outdoor air quality is good. Tightly close windows at the end of the day and avoid opening windows when air conditioning is in use to prevent condensation and mold growth and during extreme cold to prevent freezing of pipes.	https://www.airnow.gov/
10.	Air purifiers that use HEPA filters, with or without carbon filters, are good choices for occupied areas. Units that may produce ozone should not be used. Maintain all in accordance with the manufacturer's instructions.	https://www.epa.gov/indoor-air-quality-iaq/ozone-generators-are-sold-air-cleaners
11.	Clean dust and debris from vents and surrounding ceiling tiles periodically. If ceiling tiles cannot be adequality cleaned, replace.	

Water damage

12.	Remove or clean any mold-contaminated material in accordance with the US EPA's "Mold Remediation in Schools and Commercial Buildings". • When performing activities that may generate large amounts of airborne dust/debris, seal off area (if possible) and deactivate HVAC system (or seal vents) and/or use *depressurization* techniques to vent away from occupied areas and out of the building (if possible).	http://www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide

	• When removing/replacing water-damaged materials items should be placed in plastic bags for transport. • Operate/flush out the HVAC system and change filters prior to reoccupancy. • Once remediation activities are concluded, clean all items and surfaces with a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner combined with wet wiping prior to reoccupation.	
13.	Ensure any roof and plumbing leaks are repaired promptly and replace any remaining water-damaged suspended ceiling tiles or other porous building materials.	
14.	Clean and patch water-damaged plaster to remove efflorescence.	
15.	Continue to monitor areas of active leaks until repairs to building envelope are complete. Any buckets or hoses used to capture water should be emptied and cleaned at least daily to prevent odors.	
16.	Remove and replace water-damaged particleboard under sinks. Clean and repair any water-damaged metal materials.	
17.	Replace missing/damaged caulking around classroom sinks or reseal with appropriate material.	
18.	Avoid storing porous items or large amounts of items under sinks.	
19.	Repair plumbing so all sinks shut off easily.	
20.	Keep classroom plants in good condition, avoid overwatering, and place on non-porous drip pans away from the airstream of univents.	
21.	Conduct a thorough building envelope evaluation to make repairs/repointing efforts to eliminate leaks. Building occupants should ensure they report active leaks to building management for investigation and repairs.	
22.	Repair/refinish delaminated wood around window frames to prevent water damage and wood rot.	

23.	Remove trees and plants from away from exterior walls to allow for better drying of building materials and prevent pollen and odors from being drawn into the building. Consider removing large trees from the courtyard.	
24.	Use the computerized HVAC management system to monitor real-time measurements for temperature and relative humidity to track trends and take actions to prevent excess moisture conditions that can lead to mold growth.	
25.	Do not store books, cardboard, or other porous items directly on ground-level floors or up against walls to prevent mold growth due to condensation on cool surfaces, Elevate items with pallets or store on shelving.	
26.	During summer months, pull furniture away (1 to 2 inches) from walls to prevent mold growth due to lack of airflow and remove impermeable wall coverings that can trap moisture such as laminated posters.	
27.	Continue to use dehumidifiers in combination with fans and AC during summer months/periods of elevated relative humidity. Clean and maintain portable dehumidifying units in accordance with manufacturers' recommendations or drain into sinks/floor drains to reduce daily maintenance.	

Respiratory Irritants/Possible Asthma Triggers

28.	Clean supply, return, exhaust vents and surrounding ceiling tiles regularly to remove accumulated dust/debris. If ceiling tiles cannot be adequately cleaned, replace.	
29.	Reduce use of products and equipment that create irritating volatile organic compounds (VOCs) and only use in well-ventilated areas. Minimize the use of air fresheners (e.g., plug-ins), deodorizers and scented products.	https://www.mass.gov/cleaner-greener-healthier-schools Clean Air Is Odor Free
30.	Use only District-approved cleaning products. Keep spray bottles properly labeled and out of the reach of children.	

31.	Reduce clutter. Periodically remove unwanted items. Store remaining items neatly and off the floor. Where rooms have a history of moisture issues, consider storing items in waterproof totes.	
32.	Supplement mechanical ventilation with portable air purifiers equipped with high efficiency particulate arrestance (HEPA) filters. While these do not supply fresh air, they can remove particles including mold spores and microbes. If used, ensure filters are changed and equipment is cleaned in accordance with manufacturers' instructions.	
33.	Ensure the principles of integrated pest management (IPM) are followed in accordance with state regulations. Continue with district-wide plans to work with a professional pest contractor to address rodent infestation issues, including: • reducing harborages inside and outside the building, • sealing breaches and pathways of entry, • centralizing food prep appliances to central location, • reducing/eliminating eating in classrooms, and • improving cleaning protocols	https://massnrc.org/ipm/docs/ipmkitforbuildingmanagers.pdf
34.	Remove tennis balls from chair legs and use latex-free glides.	
35.	Ensure exhaust ducts for clothes dryers are vented to the outside the building, and exhaust ductwork and terminus are inspected and cleared periodically to ensure proper removal of pollutants.	

Other Recommendations to Improve Air Quality Conditions

36.	Test the school for radon by a certified radon measurement specialist during the heating season when school is in session.	Radon measurement specialists and other information can be found at: www.nrsb.org, and http://aarst-nrpp.com/wp
37.	To learn more about radon, review the MDPH's Radon in Schools and Childcare Programs factsheet.	https://www.mass.gov/info-details/radon-in-schools

38.	Utilize the US EPA's (2000), "Tools for Schools" as an instrument for maintaining a good IAQ environment in the building.	https://www.epa.gov/iaq-schools.
39.	For guidance on maintaining an asthma-friendly healthy school environment, please consult the MDPH Asthma Prevention and Control Program's Clearing the Air: An Asthma Toolkit for Healthy Schools.	https://www.maasthma.org/schooltoolkit
40.	Include an IAQ component in the school's Wellness Advisory Committee program. An IAQ plan should have an IAQ liaison/teacher representative, a member of maintenance/facilities and administration that conduct regular walk-throughs to identify on-going and/or potential environmental issues.	

Long-term Recommendations

41.	Replace original single-paned windows with modern energy efficient windows.	
42.	Work with an HVAC engineering firm to determine the operational lifespan of existing equipment (e.g., AHUs, univents, and exhaust motors) and the feasibility of repair vs. replacement.	
43.	Replace roof.	

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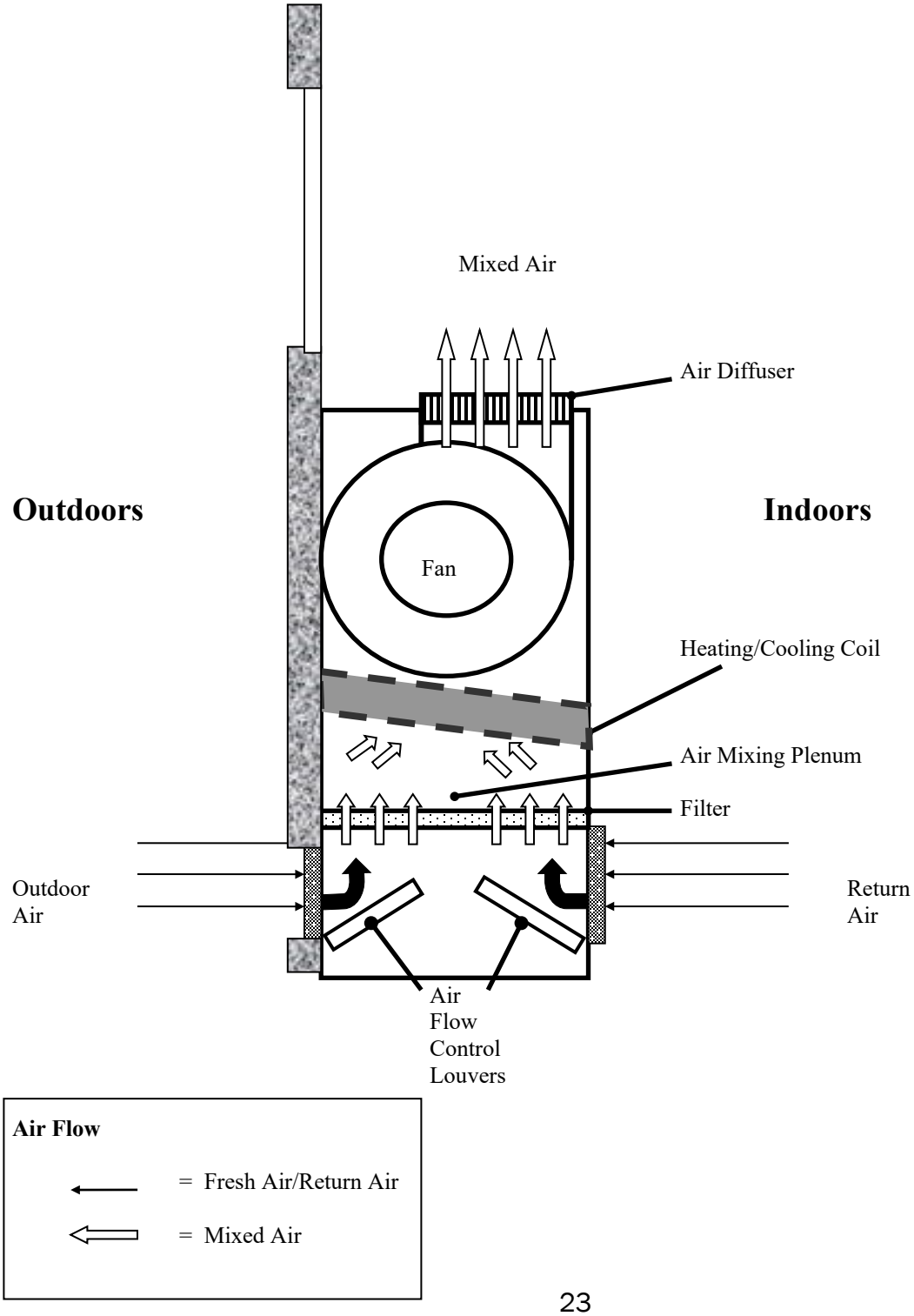
FIGURES

Figure 1

Unit Ventilator (Univent)



PICTURES

Ventilation Pictures

Picture 1

Classroom unit ventilator (univent)

Picture 2

Univent vent on the outside of the building

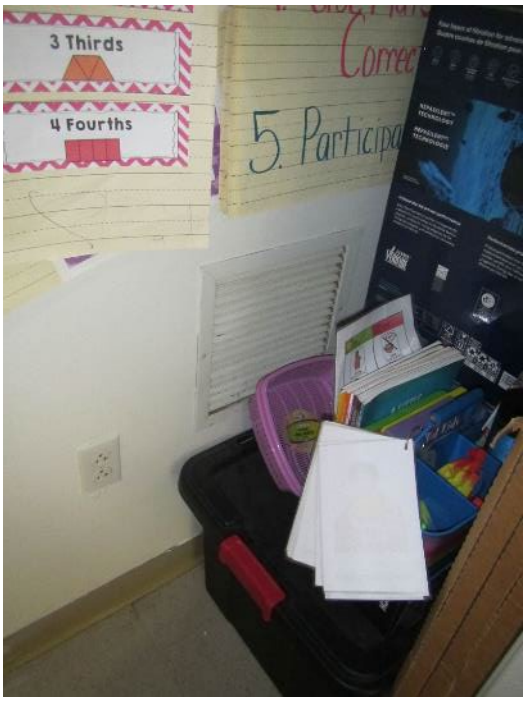
Picture 3

Air handing unit on the roof

Picture 4

Typical supply vent

Picture 5



Typical classroom exhaust vent

Picture 6

MERV 8 univent filter

Picture 7

MERV 13 filter in rooftop AHU

Picture 8

Univent (on the right side of picture) blocked by furniture

Picture 9

Plants on a univent

Picture 10

Exhaust vent blocked by a cabinet

Picture 11

items piled near ceiling and supply vent

Picture 12

Damaged ductwork for rooftop AHU

Water Damage pictures

Picture 13

Water-damaged ceiling tiles

Picture 14

Water-damaged ceiling tiles

Picture 15

Water-damaged plaster

Picture 16

Staining from roof leak on wall in room 203

Picture 17

Water-damaged wall on the lower level

Picture 18

Water-damaged wall and loose coving on the lower level

Picture 19

Water-damaged backsplash on a classroom sink

Picture 20

Water-damaged, rusted, and bent material underneath a classroom sink

Picture 21

Items, including porous items, cleaning products, and unlabeled bottles under a classroom sink

Picture 22

Bowing ceiling tiles in a hallway

Picture 23

Water damage and stains on brickwork

Picture 24

Damaged wooden trim and eves at the top of the building edge

Picture 25

Large trees in the courtyard

Picture 26

Large trees in the courtyard

Respiratory Irritant Pictures

Picture 27

Threadbare, worn carpet

Picture 28

Area rug in a classroom

Picture 29

Plug-in air freshener

Picture 30

Dusty exhaust vent

Picture 31

Dusty vent with dusty tiles

Table 1
IAQ Testing Results
Timony Grammar School
Methuen

Click to link back to report
Table 1

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Background (outside)	430	ND	45	45	2					
Ground floor										
1	526	ND	73	35	ND	0	Y	Y on	Y	BCT, area rug
2	544	ND	72	31	ND	2	Y	Y	Y off	WD CT, PF, WD around exterior door
3	833	ND	77	27	ND	25	Y open	Y	Y off, dusty	BCT, dehumidifier, area rug,
4	1094	ND	75	34	ND	20	Y	Y	Y off	BCT, dehumidifier, area rug, attached restrooms
5	963	ND	72	34	ND	16	Y	Y	Y off, dusty	WD CT, BCT, area rug, upholstered furniture, attached restrooms
6	764	ND	70	34	ND	0	Y	Y blocked	Y off, dusty	BCT, dirty area rug, dehumidifier, furniture, PF
7	695	ND	69	29	ND	0	Y open	Y	Y off, dusty	WD CT, BCT, area rug, dehumidifier, WD materials, peeling ceiling

ppm = parts per million
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Comfort Guidelines

Carbon Dioxide:	<800 ppm = preferable	Temperature:	70 - 78 °F
	> 800 ppm = may be indicative of ventilation problems	Relative Humidity:	40 - 60%

Table 1
Test Results (continued)...

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
8	1019	ND	70	36	ND	0	Y	Y blocked	Y off	BCT, dehumidifier, area rug, dry erase markers
9	582	ND	70	30	ND	0	Y	Y partially blocked	Y dusty	BCT, dehumidifier filter dirty, area rug, cleaning wipes
10	654	ND	75	30	ND	16	Y	Y	Y dusty	BCT, area rug, HS, furniture, cleaning wipes, efflorescence on interior brick, tile floor next to exterior door temp 58, area rug temp 71
11	575	ND	72	26	ND	2	Y	Y not UV	Y off, dusty	Wall to wall carpeting, no exterior door, UV off, dehumidifier, carpet floor temp 67
Hallway between room 11 and 13								Y	Y off dusty	BCT
13	637	ND	72	27	ND	1	N	Y	Y dusty	BCT, missing CT, dehumidifier
14	987	ND	72	34	ND	13	N	Y	Y off, dusty	BCT, hole in CT, peeling coving in at least 2 areas, furniture, dusty PF, peeling material from metal ceiling, flies around exterior door
15	750	ND	72	34	ND	16	Y	Y	Y off, dusty	BCT, hole in CT, HS, refrigerator, hole in coving, area rug

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Test Results (continued)...

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
16	1048	ND	73	36	ND	22	Y	Y min. airflow	Y off, dusty	Wall to wall carpeting, plants, dehumidifier, mold on pipe material near upper back right ceiling corner, BCT, scent odor, no exterior door
First floor										
100	930	ND	74	25	ND	0	Y	Y		Plug-in, area rug, sweeper (not-HEPA), fridge on carpet, food
101	902	ND	74	26	ND	0	N	Y covered	Y off	PF, NC, DEM, plant
102	820	ND	73	24	ND	20	Y	Y on	Y off, blocked	Area rug, WD under sink
103	824	ND	73	26	ND	2	Y	Y on	Y off, blocked	Carpet and area rugs, sink, loose carpet
104	1028	ND	73	26	ND	21	Y	Y on	Y off, blocked	Sink with items underneath, CP, area rugs, DEM
105	1407	ND	74	28	ND	23	Y	Y	Y off, blocked	Carpet and area rug, sink, bowed CT, DEM
106	1011	ND	73	26	ND	25	Y	Y on	Y on	Carpet, sink, PF, AP, items
107	937	ND	73	27	ND	0	Y	Y on	Y on blocked	Carpet, area rug, items under sink

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Table 1
Test Results (continued)...

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								Supply	Exhaust	
108	722	ND	74	24	ND	Entering	Y	Y on	Y on	Carpet and area rug, items/CP under sink
109	1064	ND	77	24	ND	16	Y 1 open	Y on	Y	PF, DEM, paper under sink, sink dripping, HS
110	781	ND	76	24	ND	2	Y 2 open	Y	Y off, blocked	Carpet, area rug, upholstered items
111	766	ND	76	22	ND	0	Y	Y on	Y blocked	Carpet and area rug, sink with bottles (unlabeled)
112	849	ND	79	23	ND	0	Y	Y on	Y off, blocked	Carpet and area rug, DEM, electrical outlet box ajar
113	826	ND	73	26	ND	1	Y	Y on, blocked	Y off, dusty	Worn carpet, DEM, CPs, HS
114	737	ND	73	26	ND	0	Y	Y UV blocked	Y on	Sink (dripping), dehumidifier, worn carpet, DEM, items under sink, CPs
115	802	ND	73	26	ND	1	N	Y	Y	Sinks, 3 WD CT, WD floor, small fridge, microwave
Lower gym	915	ND	74	27	ND	30	N	Y	Y	
Girls' restroom						0	N		Y on	
Staff restroom									Y off	AF

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								Supply	Exhaust	
120	1063	ND	73	25	ND	21	Y	Y	Y very dusty	2 sinks, DEM, stove (not used), NC.
121	1092	ND	72	28	ND	20	Y	Y on	Y on	Washer and dryer, dryer vented into ceiling
122	1555	ND	73	29	ND	21	Y	Y on	Y on	Worn carpet, DEM
123	1615	ND	73	28	ND	19	Y	Y on	Y on	DEM, worn carpet
124	1474	ND	74	31	ND	21	Y	Y	Y on	DEM, worn carpet
125	1569	ND	73	30	ND	22	Y	Y on	Y off	Worn carpet
Band	838	ND	74	23	ND	26	Y	Y	Y	Carpet
Music office	845	ND	74	22	ND	0	N	Y	Y	4 WD CT, carpet, items,
Custodian's office	807	ND	74	23	ND	2	Y	Y		
Concert sp?	785	ND	74	23	ND	0	N	Y	Y	AF strong odor, plants, carpet
130 Art	642	ND	60	34	ND	6	Y	Y	Y	NC, dirty floor, sink drips. Art storage is full

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								Supply	Exhaust	
131	860	ND	72	26	ND	18	Y	Y damaged, on	Y	NC, sinks with items underneath
132	901	ND	74	24	ND	0	N	Y	Y	DEM, NC, dirty floor
133	614	ND	74	21	ND	1	Y	Y on	Y dusty	Buckets for active leaks from roof, DEM, sink cabinet damaged
134	567	ND	70	22	ND	0	Y	Y on	Y	NC, DEM
136	586	ND	70	21	ND	2	Y	Y	Y dusty	NC
Auditorium	631	ND	70	27	ND	0	N	Y	Y off	Carpet, upholstered seats
PTO closet						0	Door			items
Custodian storage						0	N			WD CT with mold stains
Upper Gym	804	ND	70	30	ND	2	N	Y	Some off, some on	
Big storage area						0	Doors			Some missing CTs, perfume odor
140 music	748	ND	73	23	ND	0	Y and door	Y off	Y	Worn carpet

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								Supply	Exhaust	
141	793	ND	73	24	ND	0	Y	Y on	Y on	Carpet, DEM, plant
142	754	ND	75	19	ND	3	Y	Y on	Y	New carpet, AF (aromatherapy unit), plants, mats
143	722	ND	79	19	ND	1	Y	Y on	Y	Plug-in, carpet and area rug, plant
144	660	ND	77	22	ND	0	N	Y	Y	Storage near ceiling, PF, WD CT, mini-splits in ceiling
145	920	ND	80	23	ND	5	Y	Y	Y	Carpet
147	653	ND	79	19	ND	0	Y	Y on	Y off	Carpet and area rug, DEM
148	695	ND	76	23	ND	0	N	Y dusty	Y	Mini-splits in ceiling, new carpet
Upper CAF	865	ND	75	23	ND	~150	Doors	Y	Y	
Faculty dining	610	ND	79	18	ND	1	Doors	Y	Y	NC
Lower CAFE	865	ND	78	22	ND	~120	Doors	Y	Y	
Media Center	552	ND	73	30	ND	0	Y	Y	Y	Wall to wall carpeting, WD CT, cardboard boxes on floor,
Media Center Office # 2	730	ND	73	32	ND	1	N	Y	Y	Air purifier, carpeted, electrostatic dust on supply vent and ceiling

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								Supply	Exhaust	
Media Center Workroom	653	ND	73	30	ND	0	N	Y	Y	Refrigerator, dirty microwave, electrostatic dust on ceiling
Media Center Office # 1	617	ND	74	30	ND	1	N	Y	Y	Electrostatic dust on ceiling
Upper School Office	663	ND	75	30	ND	0	Y	Y	Y	Plants, NC, copier
Upper School Associate Principal	622	ND	77	28	ND	0	Y	Y	Y	BCT, Area rug, hole in CT, NC
Upper School Conference Room	631	ND	77	29	ND	0	Y	Y	Y	WD CT, missing CTs, reported persistent water leak from ceiling, NC, electrostatic dust on ceiling
Main Office	752	ND	76	26	ND	1	Y	Y	Y	BCT, area rug, copier
Main Office - Office # 1	759	ND	76	27	ND	0	Y	Y off	Y off	BCT, carpeted
Main Office Conference Room	715	ND	75	27	ND	0	N	Y off	Y off	BCT, missing CT, NC
Main Office – Office # 2	716	ND	75	27	ND	0	Y	Y off	Y off	BCT, carpeted
Dragon's Lair	621	ND	73	25	ND	0	Y	Y	Y	NC

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								Supply	Exhaust	
Nurse's Office	858	ND	74	33	ND	9	Y	Y	Y off	
Conference Room – left side	732	ND	73	28	ND	1	Y	Y	Y	WD CT, carpeted
Other Conference Room	708	ND	73	26	ND	0	N	Y	Y	WD CT, BCT, carpeted
Staff Workroom	677	ND	73	27	ND	1	N	Y	Y	NC, copier, scanner
Guidance	665	ND	77	26	ND	0	N	Y	Y	Carpeted, copier, scanner
Guidance Room # 4	658	ND	77	25	ND	3	Y open	Y	Y off	Carpeted
Lower School Office	677	ND	76	25	ND	1	Y	Y	Y dusty	Electrostatic dust on supply, BCT, plants
Lower School Associate Principal	1062	ND	76	29	ND	3	Y	Y	Y	Area rug, peeling coving
Second floor										
200	954	ND	80	24	ND	3	Y	Y off	Y off	WD CT, dust/debris around vent
201	533	ND	78	21	ND	0	Y	Y	Y	2 plug-ins, strong odors

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								Supply	Exhaust	
202	508	ND	77	17	ND	8	Y	Y	Y weak	5 WD CT, carpet, dust/debris duct leaks
203	974	ND	73	23	ND	18	Y	Y	Y	Area rug, stains over window from roof leak, rec painting, WD under sink
204	931	ND	73	27	ND	18	Y	Y	Y	Carpet (old, worn, stained), WD under sink/leak, 4 WD CTs
205	999	ND	73	28	ND	20	Y	Y	Y off	Carpet, area rug
206	1295	ND	73	31	ND	18	Y	Y	Y off	Spray CPs under sink, carpet, area rug
207	996	ND	73	28	ND	0	Y	Y	Y	Occupants at lunch, plants, mouse droppings under sink, leaky sink, dirty sink
208	850	ND	73	26	ND	0	Y	Y	Y weak	Occupants at lunch, carpet
209	998	ND	73	27	ND	1	Y	Y	Y dusty	Carpet, CP, occupants at lunch
210	1005	ND	73	29	ND	0	Y	Y	Y	Carpet, area rug, hole around pipes under sink, hole in CT, mouse droppings under sink
211	1143	ND	74	29	ND	0	Y	Y	Y off	Plug-in, carpet, faucet leaking

ppm = parts per million
µg/m³ = micrograms per cubic meter
ND = non-detect
AF = air freshener
AP = air purifier
BCT = bowed ceiling tiles
CP = cleaning products
CT = ceiling tile
DEM = dry erase materials
DO – door open
HS = hand sanitizer
MT = missing ceiling tile
PF = personal fan
UV = univent
WD = water-damaged

Comfort Guidelines

Carbon Dioxide:	<800 ppm = preferable	Temperature:	70 - 78 °F
	> 800 ppm = may be indicative of ventilation problems	Relative Humidity:	40 - 60%

Table 1
Test Results (continued)...

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
212	608	ND	77	20	ND	1	Y open	Y	Y off	Heat complaint, DO, carpet tiles, 2 WD CT, AF plug in, bowed CTs
213	1389	ND	75	30	ND	29	Y	Y	Y off	Plug-in, area rug, CP under sink, WD CT
214	1304	ND	73	30	ND	19	Y	Y	Y off	DO, carpet, MT, area rug, WD under cabinet, CP/paint
215	1204	ND	73	30	ND	21	Y	Y	Y off	Carpet, area rug, 2 WD CT
216	1185	ND	73	30	ND	0	Y	Y	Y	Area rug
220	1358	ND	73	25	ND	13	Y	Y on	Y on	Old carpet
226	1018	ND	73	29	ND	0	Y	Y	Y	Carpeted, cardboard boxes on floor
231	859	ND	74	22	1	0	Y	Y on	Y dusty	Old carpet, DEM
232	860	ND	72	24	ND	1	Y	Y	Y, blocked with furniture	2 occupants just left, plants, carpet
233	816	ND	76	16	ND	0	Y 2 open	Y on	Y on, dusty	NC, DEM
234	547	ND	72	21	ND	0	Y	Y	Y	NC

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Table 1
Test Results (continued)...

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
235	1160	ND	77	22	ND	0	Y	Y on	Y part blocked and off	Old carpet, plug-in
236	664	ND	72	19	ND		Y	Y	Y	Plants, dusty vents, sinks
237	695	ND	73	19	ND	0	Y	Y	Y	Science sinks
238	602	ND	72	23	ND	20	Y	Y	Y off	Carpeted, plug-in
239	867	ND	74	19	ND	5	Y	Y	Y	Old carpet, DEM
240	1153	ND	73	22	ND	22	Y	Y	Y	NC, DEM, plant
241	1585	ND	73	25	ND	20	Y	Y	Y off	NC
242	2381	ND	75	26	ND	26	Y	Y	Y off	
243	1125	ND	72	22	1	1	Y	Y	Y	Reports of cold temps
244	1780	ND	73	30	ND	24	Y open	Y	Y	Tennis balls as chair glides, PFs, plants
245	1950	ND	73	28	ND	21	Y	Y	Y	DEM
246	1227	ND	74	28	ND	20	Y	Y	Y	Dusty PF

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Table 1
Test Results (continued)...

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
English zone	749	ND	74	16	1	0	Y 1 open	Y dusty		NC, DEM

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Table 2A
Supply Ventilation
Types and/or Components

(Click to link back to report)

Table 2A

Equipment Present in Building (X = Yes)	Type of Heating/Cooling Ventilation Equipment	Fresh Air Supply (X = Yes)	Type of Location(s)	Air Filters Installed MERV Rating (1-15, U*) (X = Yes)	Comments
X	Univents	X	Classrooms	8	
X	Rooftop Air Handling Units	X	Various rooms & common areas	13	
	Outdoor, Ground-Installed Air Handling Units				
	Attic/Crawlspace Air Handling Units				
	Ceiling-Mounted Air Handling Units (including inside plenum)				
	Basement/Crawlspace-Installed Air Handling Units				
	Mechanical Room-installed Air Handling Units				
	Fan Coil Units				
	Window-Mounted Air Conditioners				
	Portable air conditioners				
	Wall Louver-Controlled Gravity Air Supply				
X	Windows	X	Most rooms		
	Fan in window (blowing in)				
	Built in wall fan (switched)				
	Heat recovery ventilator unit				
	Energy recovery ventilator unit				
	Chilled Beam				
	Passive combustion supply vent in basement/boiler room				

*U = Filter Rating underdetermined due to inaccessibility during building visit

Table 2B
Exhaust Vents
Types and/or Components

Table 2B

Equipment Present in Building (X = Yes)	Type of Exhaust Ventilation Equipment	Ducted To Outdoors (X = Yes)	Type of Location(s)	Comments
X	Rooftop Motors/Fans	X	Classrooms and common areas	Many not functioning
	Unit Exhaust			
X	Ceiling Return Vent			
	Ceiling Return Vent, Plenum			
	Wall Return Vent			
	Kitchen Stove Hood			
X	Restroom Exhaust Vent	X		
	Photocopier Exhaust Vent			
	Garage			
	Chemical Hood(s)			
	Locker Rooms			
	Showers			
X	Clothes Dryers	X	Home ec classroom	
	Gas Water Heaters			
	Furnace-Flue to Chimney			
	Furnace/Boiler direct vent or power vent (no combustion air supply)			
	Kiln, Pottery			
	Dark Room			
	Generator Room			
	Wood Shop Dust Collector			
	Spray Paint Booths			
	Fan in window (blowing out)			

Table 2C

Free Standing Equipment that Circulates or Filters Air

Table 2C

Equipment Present in Building (X = Yes)	Type of Equipment	Type of Location(s)	Comments
	Floor Fans, pedestal		
X	Floor Fans, portable	Classrooms, offices	
X	Air Purifier (HEPA, other)	Classrooms, offices	
	Floor heaters, portable		
X	Refrigerators, Cold Beverage Vending Machines		
	Radiator, wall-mounted		
	Radiator, floor-mounted		
	Passive Vents (Wall/Door)		

Table 3

Water-Damaged Materials in Building

(Click to link back to report)

Table 3

Found in Building X = Yes	Water-Damaged Materials, Building Components or Stored Materials	Location	Visible Microbial Growth? X = Yes	Musty odor detected? X = Yes	Comments
	Books-other bound materials				
X	Brick walls – broken, missing mortar	Exterior			
	Brick walls – blocked weep holes				
	Cardboard boxes				
	Carpet tiles				
X	Carpet - Area rugs	Various classrooms & rooms			
X	Carpet wall-to-wall	Various classrooms & rooms			
	Ceiling tiles - affixed directly to ceiling surface				
X	Ceiling tiles - bowing-in suspended ceiling	Classrooms and hallways			
	Ceiling tiles - water-stained in splined ceiling				
X	Ceiling tiles - water-stained in suspended ceiling	Classrooms and hallways			
X	Chairs - laminated				
	Cloth				
X	Countertops (around sinks)	Classrooms			
	Curtains				
	Dust/debris within AHU, uninvent, HVAC, chilled beam units, etc. (WD through condensation, humidity, or leaks)				
X	Efflorescence (i.e., mineral deposits)	200A, 10, exterior brick			
X	Engineered woods - particleboard, plywood, Masonite	Classrooms and Media Center	X		Many water-damaged areas under sinks in classroom, cabinets
	Flooring – loosened tiles				
	Flooring - wooden				
	Furniture - laminated				
	Furniture - upholstered				

Table 3

Water-Damaged Materials in Building

(continued)...

Found in Building X = Yes	Water-Damaged Materials, Building Components or Stored Materials	Location	Visible Microbial Growth? X = Yes	Musty odor detected? X = Yes	Comments
X	Gypsum wallboard - ceiling				
	Gypsum wallboard - restroom wall				
	Gypsum wallboard - interior wall				
	Gypsum wallboard – located on exterior wall				
	HVAC drain pan – lack of draining				
	HVAC filters				
	Insulation- attic (paper-backed)				
	Insulation - inside air handling unit				
	Insulation - on pipe(s) fiberglass				
X	Insulation - on pipe(s) other/plaster-like material				
	Insulation - wall cavity				
	Insulation – ceiling plenum				
	Modular furniture – walls/cloth partitions				
	Musical instrument cases				
	Plaster ceilings				
	Records/files				
	Refrigerator - door gasket				
	Refrigerator - drip pan				
	Refrigerator - Interior surfaces				
	Room divider - ceiling-mounted, sliding				
X	Sink backsplash	Classroom			Damaged caulking
	Tables – laminated				
	Wallpaper				
	Wood - attic/roof materials				
	Wood - floor joists in basement ceiling				
	Wood - wall framing				
	Wood - window sills				
	Wood - window-mounted air conditioner framing				
X	OTHER	Exterior trim			Delaminating

Table 4

Identification of Asthma Triggers by MDPH During Building Assessments and Recommendations to Reduce or Eliminate from the Indoor Environment

WHAT ARE ENVIRONMENTAL ASTHMA TRIGGERS?

Asthma triggers are any chemical, pollutant, or allergen that can make your asthma worse. Asthma triggers can also be strong chemical smells, dust, or pets. Your asthma triggers may be different from those of other people. Not all asthma triggers affect people the same way. Environmental asthma triggers are found both indoors and outdoors. DPH link: Asthma and Your Environment (mass.gov)

(click to link back to report)

Table 4

Condition Present X = Yes	Possible asthma symptom-inducing environmental pollutant	Recommendation to reduce or eliminate the pollutant
X	Water Damage and/or Mold (allergen)	Identify water source and repair to eliminate. Clean non-porous materials. Remove and replace porous materials susceptible to mold growth. Perform regular water damage assessments as a tool to ensure timely mitigation as needed. Use NIOSH water damage assessment protocol as a guide: NIOSH water damage assessment guideline.
X	Moistening of building components during hot, humid weather (>2 days in length) (mold, allergen)	Remove materials not dried in <2 days in a manner consistent with US EPA Mold Removal in Commercial Buildings guideline. Use dehumidification in occupied basement areas and other areas with chronic dampness.
X	Vegetation against exterior of building (water damage-mold)	Remove all vegetation preventing building exterior drying. Remove all vegetation capable of falling onto a building or depositing debris onto the roof.
	Personal humidifiers (lack of proper maintenance) (pollutant and allergen)	Clean and maintain properly. Use distilled water to eliminate metal and water treatment odors. Maintain hydration by increasing water consumption.
X	Drains: Floor drains, Sink drains (abandoned use) Water bubblers (abandoned use)	If in use, pour water into drain at least twice a week. If not in use, seal the drain with an appropriate material in accordance with Massachusetts Plumbing Code (248 CMR 10.00).
	Live Animals (turtles, gerbils, birds, rabbits, etc.)	Ensure cleanliness or remove animals from the location.
	Improperly maintained aquariums and terrariums (allergen)	Maintain such equipment properly to eliminate odor. Discontinue use.

Table 4

Identification of Asthma Triggers by MDPH During Building Assessments and Recommendations to Reduce or Eliminate from the Indoor Environment

Condition Present X = Yes	Possible asthma symptom-inducing environmental pollutant	Recommendation to reduce or eliminate the pollutant
X	Plants and flowers (allergen and mold)	Keep indoor plants well maintained and not overwatered. Monitor for signs of mold and pests. Ensure water for cut flowers does not become stagnant. Ensure dried plant material is free of odors, mold, and pests and handled carefully If asthma risks are high, eliminate plants and flowers.
X	HVAC system moisture issues (mold, allergen)	Consult ASHRAE's minimum standards for HVAC maintenance and inspection of commercial HVAC systems (https://www.ashrae.org/technical-resources/bookstore/standards-180-and-211).
	HVAC system contaminant issues (allergen)	Consult ASHRAE's minimum standards for HVAC maintenance and inspection of commercial HVAC systems (https://www.ashrae.org/technical-resources/bookstore/standards-180-and-211).
	Indoor swimming pool odors outside of swimming pool (mold, chemical)	Maintain and operate pool HVAC systems to vent odors from building. Ensure locker room exhaust vents are operating during building hours. All doors leading to pool should be rendered airtight and be closed.
X	Pollen (allergen)	Recommend installation of MERV 8 or better filters if HVAC engineer confirms HVAC system can be so equipped without adversely affecting function. Cut grass after hours. Cut grass in a pattern to direct clippings away from exterior wall. Remove trees and shrubs from in front of windows and air intakes.
X	Dry air	Maintain hydration. Avoid overheating of air.
X	Dust mites (allergen)	Recommendation to remove non-official upholstered furniture, area rugs, pillows, cushions, etc. Cleaning with use of HEPA-filtered vacuum cleaner. Eliminating clutter, storing items in dust and moisture-proof containers, and regularly removing dust through wet wiping.

Table 4

Identification of Asthma Triggers by MDPH During Building Assessments and Recommendations to Reduce or Eliminate from the Indoor Environment

Condition Present X = Yes	Possible asthma symptom-inducing environmental pollutant	Recommendation to reduce or eliminate the pollutant
X	Pests, including rodents and cockroaches (allergen)	Use of integrated pest management guidelines, including: • Proper disposal of food containers • Proper storage of food products in airtight containers • Elimination of use of food as art projects • Remove pest harborages/clutter • Regular monitoring for pests EPA IPM guideline link
X	Latex-containing materials	Remove tennis balls from furniture legs.
X	Fragrances (chemical)	Eliminate point sources, such as: • Plug-in air fresheners • Aroma/oil reed diffusers • Scented sprays • Discontinue use of other scented materials • Consult DPH fragrance guideline: *Clean air is odor-free*
X	Strong smells from /use of Chemicals (such as cleaning products) (chemical)	Use building-issued cleaning products. Use products in accordance with manufacturer's instructions including dilution, application, and ventilation. Avoid using products that are stronger than needed for the situation.
	Strong odors from new building materials (carpeting/furniture) (chemical)	Use low VOC-emitting materials. Air out materials (outside or in unoccupied area) prior to installation.
	Tobacco smoke Secondhand Smoke (pollutant)	Eliminate tobacco smoking. Seal all shared wall penetrations.
X	Products with a strong odor such as paint, perfume, hairspray, air fresheners, bug-spray, laminators, candles, wax melters, dry erase markers and other VOC-containing products (chemical)	If essential: • Provide proper exhaust ventilation to eject aerosolized product directly outdoors. • Avoid/reduce use during occupied hours. If not necessary, remove and eliminate.
	Vehicle exhaust (pollutant)	Enforce anti-idling regulations and post signs to give notice. Relocate vehicles away from fresh air intakes. Require cars to park face-in at building walls. MA anti-idling law FAQs

Table 4

Identification of Asthma Triggers by MDPH During Building Assessments and Recommendations to Reduce or Eliminate from the Indoor Environment

Condition Present X = Yes	Possible asthma symptom-inducing environmental pollutant	Recommendation to reduce or eliminate the pollutant
	Vapors and or fumes from gas, oil, or kerosene stoves (pollutant)	Operate stove hood when stove in use. Install stove hood if not present. Ensure equipment is in good working order.
	Ozone (pollutant)	Eliminate use of ozone generating equipment.
	Window Air Conditioners (if not properly maintained) (allergen)	Equip with proper filter and clean periodically. Clean drip pans. Install in window with weathertight, non-mold-growth sustaining material.
	Pottery (pollutant)	Do not operate kiln during occupied hours. Operate kiln with exhaust system activated. Seal all seams and holes in kiln vent. Ensure kiln exhaust discharge terminates outdoors.
X	Carpeting (allergen)	Clean carpeting in a manner consistent with IICRC standards, including regular vacuuming with a high efficiency particulate air (HEPA) filtered vacuum in combination with annual cleaning or semi-annual cleaning in soiled high traffic areas.
	Sweeping/dusting vs HEPA vacuuming/wet wiping (allergen or pollutant)	Refrain from using feather dusters or brooms. Utilize HEPA vacuums and wet wiping to minimize aerosolizing particulate matter.
X	Lack of adequate air exchange/mechanical ventilation	Make repairs as necessary and ensure all HVAC system components are operating continuously when building is occupied.
	Lack of local exhaust at source of pollution (vocational shop activities, kitchen exhaust hood) (all)	Recommend installation of exhaust ventilation to direct pollutants directly outdoors.
	Renovating buildings while occupied (chemical)	Use all SMACNA guidelines for Renovation While Buildings Are Occupied. For information, visit https://www.mass.gov/service-details/construction-and-renovation-generated-pollutants-in-occupied-buildings.
	Chemistry program chemical storage (chemical)	Repair (if needed) and operate chemical storeroom vents appropriately. Reduce or eliminate unneeded or overstocked chemicals. Store all chemicals in a manner to separate incompatible chemicals. Keep chemical storerooms clean.
X	Photocopiers/duplicating machines	All machines should have dedicated exhaust vents.