INDOOR AIR QUALITY REASSESSMENT

Augustine Belmonte Middle School
29 Dow Street
Saugus, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
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Background/Introduction

At the request of Frank Giacalone, Director of Public Health, Saugus Health Department, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH) conducted an indoor air quality (IAQ) assessment at the Augustine Belmonte Middle School (BMS), 25 Dow Street, Saugus, Massachusetts. On January 22, 2010, Michael Feeney, Director of BEH's IAQ Program visited the school to conduct the assessment. During the assessment, Mr. Feeney was accompanied by Sharon Lee, an Environmental Analyst/Inspector within BEH's IAQ Program, as well as Mr. Giacalone, Ralph Materesse, Building Maintenance Supervisor, Town of Saugus, and Corey Fanjoy, School Custodian.

The school is a three-story cement slab building constructed in 1965. The south wing contains general classrooms, science rooms, library and offices. The north wing contains the gymnasium, cafeteria, auditorium, home economics, technical education, shop areas, music/band rooms and offices. Windows are openable throughout the building.

Summary of Historical Environmental Testing

BEH staff has conducted a number of IAQ assessments of the BMS. The Saugus Health Department has also provided BEH staff with copies of reports, letters, and memoranda concerning a number of IAQ investigations by private consulting firms conducted at the BMS dating from 1998 to 2006. These reports suggest that the BMS has a long history of concerns relating to IAQ issues. Based on a review of all information, the Saugus Public Schools (SPS) appear to have made numerous attempts to address air quality issues in response to these assessments.

In 1998, the SPS contracted with Covino Environmental Associates (CEA) to conduct an IAQ survey of the BMS. CEA made the following recommendations:

- Increase fresh air supply from the univents;
- Replace univent filters;
- Clean the interior of univents;
- Ensure that the boiler has proper combustion air and proper exhaust venting; and
- Examine the library univent for "burnt motor-like odor" (CEA, 1998).

The MDPH's IAQ Program conducted its first assessment of the BMS in 2000. One major finding of the MDPH assessment was that the crawlspace beneath the south wing was subject to extensive water penetration, which created a number of opportunities for mold growth and associated odors. In addition, the HVAC system was found to be operating poorly, which minimized the amount of air circulation in the building. A number of short-term and long-term recommendations were made to improve conditions in the building, including the following:

- Examine each univent for function. Consider consulting a heating, ventilation and air conditioning (HVAC) engineer concerning the calibration of univent fresh air control dampers school-wide.
- Inspect roof for proper drainage; examine periodically for standing water.
- Examine the feasibility of extending downspouts to ground level and directing water away from the base of the exterior wall.
- Replace missing ceiling tiles and fill utility holes and wall cracks to prevent the egress of dirt, dust and particulate matter between rooms and floors. Particular attention should be paid to sealing utility holes on the first floor to prevent potential crawlspace odors from entering occupied areas.

- Seal drains in abandoned sinks or pour water down them regularly to prevent sewer gas back up.
- Examine methods to eliminate water penetration into the building. Continue to examine options to ventilate the steam-pipe crawl space. Consult a ventilation engineer to provide increased ventilation. Be sure to provide ventilation that will not draw further moisture from the ground into the crawl space. Continue to explore options for providing a barrier between the dirt floor and crawl space. Consider consulting a building engineer, hydro-geologist and/or an environmental engineering firm about possible options to eliminate water accumulation in the crawlspace. Once water is removed, replace water damaged insulation. Consider replacing with a waterproof insulating material.
- Repair/replace broken and/or loose windows and replace missing or damaged window caulking to prevent water penetration through window frames (MDPH, 2000).

Subsequently, in 2001 the SPS hired another consultant, OccuHealth, Inc. (OccuHealth) to conduct indoor air quality testing at the BMS. OccuHealth made the following recommendations:

- Continuous dewatering of the crawlspace to prevent water accumulation;
- Treat the crawlspace with a biocide;
- Provide exhaust ventilation for the crawlspace;
- Cover the crawlspace with concrete. (OccuHealth, 2001).

Subsequent to the OccuHealth report, utility pipes for the heating system were moved from the crawlspace and re-located along the ceiling of first floor classrooms. The crawlspace was then filled with cement.

On February 4, 2002, the Saugus Fire Department (SFD) responded to a report of carbon monoxide at the BMS, resulting in shut down of the boilers (SFD, 2002a). On February 8, 2002, the BMS was visited again by the SFD to check for carbon monoxide (SFD, 2002b). SFD personnel found voids in the chimney/cafeteria wall which were leaking furnace exhaust into the building. Repairs to seal the voids reportedly occurred February 8, 2002, subsequent to the SFD visit. Concurrent to the SFD visit, the Massachusetts Department of Labor and Workforce Development (MDLWD), Division of Occupational Safety (DOS) sent a letter with recommendations concerning the furnace and generator. Based on correspondence with the SPS, DOS made the following recommendations:

- Acquire a new carbon dioxide detector for the cafeteria;
- Provide confirmation to DOS the planned furnace room improvements;
- Discontinue generator testing during school hours; and
- Consider relocating the generator to outdoors (MDLWD, 2002).

An emergency procurement waiver was submitted to the Massachusetts Division of Capital Asset Management to improve the furnace room (SPS, 2002).

Following this, the MDPH IAQ Program conducted a follow-up visit to address concerns regarding carbon monoxide and soot. The MDPH IAQ Program made the following recommendations concerning clean-up related to the boiler incident as well as other preventive repairs:

- Continue with plans to conduct structural repairs/replacement of flue (outlined in the Emergency Procurement Waiver) to prevent the possibility of future exposure to combustion products.

- Continue with plans to hire a professional cleaning/restoration firm to conduct a thorough cleaning of areas impacted by boiler blow back.
- Keep boiler room and loading dock doors closed at all times. Replace loading dock doors with tight-fitting doors that fit completely flush with threshold. Seal doors on all sides with foam tape, and/or weatherstripping.
- Once improvements to provide sufficient make-up air to the boiler plant are made, consider replacing boiler room doors with tight-fitting doors that prevent airflow from the boiler room into adjacent areas. Consider installing weather-stripping/door sweeps on both sides of doors to provide a dual barrier. Ensure tightness of doors by monitoring for light penetration and drafts around door frames.
- Ensure vehicle engines are off during loading/unloading operations to prevent entrainment of vehicle exhaust.
- Consider discontinuing use of dumbwaiter until boiler room improvements are made and boiler room and loading dock doors are replaced/sealed.
- Ensure all utility holes and wall cracks are properly sealed to eliminate pollutant paths of migration. Consider contacting a plumber to inspect the slop sink drain for integrity.
- Consider removing incinerator and completely seal abandoned chute in slop sink area. If not removed, ensure abandoned chute is sealed airtight to prevent the migration of boiler room pollutants/odors into slop room.
- Continue with plans to improve exhaust capabilities for kitchen equipment. Consider contacting a heating ventilation and air conditioning (HVAC) engineering firm specializing in proper food service/restaurant ventilation systems (MDPH 2002a).

On September 26, 2002, OccuHealth returned to assess the remediation efforts of the crawlspace. Air sampling conducted in classrooms above the crawlspace "were acceptable on the day of testing" (OccuHealth, 2002).

On October 10, 2002, MDPH IAQ Program staff visited the BMS to assess rooms 109-112, 247 and 316 concerning mold growth, which was attributed to classroom curtains (MDPH, 2002b). SPS reported that the classroom curtains were professionally cleaned in Spring 2002. MDPH IAQ Program staff made the following additional recommendations concerning conditions at the BMS:

- Install gutters and downspouts to direct rainwater at least five feet away from the foundation. In the case of the front of the south wing, extension of the downspout to empty over the curb is advised.
- Improve the grading of the ground away from the foundation at a rate of 6 inches per every 10 feet.
- Install a water impermeable layer on ground surface (clay cap) to prevent water saturation of ground near foundation. This may include paving over the small lawn at the rear of the south wing.
- Fresh air intakes at ground level should be opened and examined. Clean accumulated debris if present. Consideration should be given to installing a hood or other device over ground floor univent fresh air intakes to prevent rainwater intrusion.
- Take measures to prevent water intrusion through the building envelope. This may include sealing cracks along the foundation/exterior walls, repairing damaged brickwork and sealing around univents and wall/foundation junctions with an appropriate sealing compound.

- Seal wall seams beneath the stairwell and pipe penetration from the crawlspace.
- Continue to examine methods to eliminate water accumulation in the crawlspace, or take measures to create an airtight seal between the crawlspace and occupied areas.
- Clean mold growth in shower areas and repair leaking shower fixtures. Ensure local exhaust vents are activated when showers are in use to remove excess heat and moisture (MDPH, 2003).

In 2006, the SPS contracted with RPF Associates, Inc.(RPF) to conduct another indoor air quality survey of the BMS. Based on this survey, RPF made the following recommendations:

- Clean all horizontal surfaces in the basement level with build up of dust and debris.
- Implement ongoing maintenance plan for the HVAC system.
- Continue with cleaning of office space (RPF, 2006).

In 2006, the MDPH IAQ Program conducted IAQ assessments in all Saugus public schools in response to concerns relative to unsafe conditions. The BMS was reassessed as part of this effort on November 1, 2006. No safety conditions were identified during this assessment; however, a number of recommendations to improve the indoor environment were made:

- Continue with plans to make repairs to univents and exhaust vents that are on the repair list.
- Use openable windows in conjunction with classroom univents and exhaust vents to increase air exchange. Care should be taken to ensure windows are properly closed at night and on weekends to avoid the freezing of pipes and potential flooding.
- Remove all blockages from univents and exhaust vents to ensure adequate airflow.
- Continue to make repairs to window systems to eliminate/reduce water infiltration (e.g., 300 wing and 306-A, in particular).

- Ensure wooden storage cabinet in 306-A is dried completely to prevent mold growth. Remove items inside cabinet, inspect and discard if water damaged.
- Remediate any water damaged materials in room 306-A (and in any other areas) in a manner consistent with recommendations found in "Mold Remediation in Schools and Commercial Buildings" published by the US EPA.
- Clean/vacuum areas of efflorescence (mineral deposits) with a HEPA filtered vacuum cleaner. Monitor for reoccurrence of efflorescence to determine if current water penetration issues exist.
- Work with school staff to identify window leaks and make repairs to prevent further water infiltration.
- Refrain from storing porous items (boxes, papers, books, etc.) in areas of suspected water leaks (MDPH, 2007)

MDPH IAQ staff and consultants retained by the SPS have consistently recommended improving the operation of the HVAC system at the BMS.

Methods

Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were conducted with the TSI, Q-Trak, IAQ Monitor, Model 7565. Air tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520. BEH staff also performed visual inspection of building materials for water damage and/or microbial growth.

Results

This school has a student population of approximately 800 and a staff of approximately 80. The tests were taken under normal operating conditions. Test results appear in Table 1.

Discussion

Ventilation

It can be seen from the Table 1 that carbon dioxide levels were above 800 parts per million (ppm) in 21 of 69 areas surveyed, indicating a lack of adequate air exchange in these areas. It is important to note, that several areas were empty/sparsely populated, which can greatly reduce carbon dioxide levels. Carbon dioxide levels would be expected to increase with higher occupancy.

Fresh air in classrooms is supplied by unit ventilator (univent) systems (Figure 1). A univent draws air from the outdoors through a fresh air intake located on the exterior wall of the building and returns air through an air intake located at the base of the unit. Fresh and return air are mixed, filtered, heated and provided to classrooms through an air diffuser located in the top of the unit. Adjustable louvers control the ratio of outside to recirculated air.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while 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 was reportedly balanced in 2008.

The univents were installed when the building was originally constructed in 1965. According to the American Society of Heating, Refrigeration and Air-Conditioning Engineering (ASHRAE), the service life[1] for a unit heater, hot water or steam is 20 years, assuming routine maintenance of the equipment (ASHRAE, 1991). While SPS facilities personnel are maintaining the univents (i.e., cleaning univents and changing filters over vacations), the operational lifespan of this equipment has long passed. In a number of instances, bearings ceasing within the univents have caused fires to occur within the units. The fire is the result of friction produced between the fan belt, which is attached to an operating motor, and a fan flywheel which has ceased operating. These fires have necessitated visits from the local fire department and, in some cases, have resulted in disruptions in the school day. Given its age, continuing to maintaining the balance of fresh air to exhaust air will be difficult at best with equipment of this vintage.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or openable windows (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a

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[1] The service life is the median time during which a particular system or component of …[an HVAC]… system remains in its original service application and then is replaced. Replacement may occur for any reason, including, but not limited to, failure, general obsolescence, reduced reliability, excessive maintenance cost, and change system requirements due to such influences as building characteristics or energy prices (ASHRAE, 1991).

buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The MDPH uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, consult Appendix A.

Indoor temperature measurements ranged from 65º F to 76º F, which were below the MDPH recommended comfort guidelines in several areas on the day of the assessment (Table 1). The MDPH recommends that indoor air temperatures be maintained in a range of 70° F to 78° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity measured in the building ranged from 16 to 27 percent, which was below the MDPH recommended comfort range in all areas surveyed during the assessment (Table 1). The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

BEH staff examined each area within the BMS for water damage to building materials. Classrooms were found to be free of water damage or other moisture sources that have been denoted in previous assessments (MDPH 2000; MDPH 2002b; MDPH, 2003; MDPH, 2007). Repairs to the roof, window system and crawlspace appear to be successful in preventing further moisture penetration into the building, which in turn, would limit the potential for mold growth in classrooms.

The Administrative Office carpet had a musty odor that was noticeable upon entering this room. This odor is likely attributed to the carpet being repeatedly moistened with snow and water from shoes/boots of visitors to the building. Water-damaged carpeting can provide a source of mold and should be replaced after being repeatedly moistened.

The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If not dried within this time frame, mold growth may occur. Once mold has colonized porous materials, they are difficult to clean and should be removed and discarded.

Plants were noted in several classrooms (Table 1). Plants can be a source of pollen and mold which can be respiratory irritants to some individuals. Plants should be properly maintained and equipped with drip pans and should be located away from univents to prevent the aerosolization of dirt, pollen and mold.

Open seams between sink countertops and backsplashes were observed in several rooms (Table 1). Improper drainage or sink overflow can lead to water penetration into the countertop, cabinet interior and areas behind cabinets. If not watertight, moisture can penetrate through the seam, causing water damage and potential mold growth.

Other IAQ Evaluations

Indoor air quality can be negatively influenced by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion emissions include carbon monoxide, carbon dioxide, water vapor, and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the indoor environment, BEH staff obtained measurements for carbon monoxide and PM2.5.

Carbon Monoxide

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

The American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE) has adopted the National Ambient Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from six criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2006). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS levels (ASHRAE, 1989). The NAAQS were adopted by reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2006).

Carbon monoxide should not be present in a typical, indoor environment. If it *is* present, indoor carbon monoxide levels should be less than or equal to outdoor levels. Outdoor carbon monoxide concentrations were non-detect (ND) the day of the assessment (Table 1). No measureable levels of carbon monoxide were detected in the building during the assessment (Table 1).

Particulate Matter

The US EPA has established NAAQS limits for exposure to particulate matter. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. The NAAQS originally established exposure limits to particulate matter with a diameter of 10 μm or less (PM10). According to the NAAQS, PM10 levels should not exceed 150 microgram per cubic meter ($\mu g/m^3$) in a 24-hour average (US EPA, 2006). These standards were adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US EPA established a more protective standard for fine airborne particles. This more stringent PM2.5 standard requires outdoor air particle levels be maintained below 35 $\mu g/m^3$ over a 24-hour average (US EPA, 2006). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, MDPH uses the more protective PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment.

Outdoor PM2.5 concentrations were measured at 11 μg/m^3 (Table 1). PM2.5 levels measured indoors ranged from 4 to 44 μg/m^3 (Table 1), most of which were well below the NAAQS PM2.5 level of 35 μg/m^3 (only Room 216 exceeded the NAAQS) (Table 1). Room 216 had an art project containing dirt that was near the univent (Picture 1). As air passes over the art project, dirt and other particles can become aerosolized, accounting for the increased PM2.5 measurement. Frequently, indoor air levels of particulates (including PM2.5) can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur indoors can generate particulate during normal operations. Sources of indoor airborne particulates may include but are not limited to particles generated during the operation of fan belts in the HVAC system, cooking in the cafeteria stoves and microwave ovens; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner and heavy foot traffic indoors.

Volatile Organic Compounds

Indoor air concentrations can be greatly impacted by the use of products containing volatile organic compounds (VOCs). VOCs are carbon-containing substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. Materials containing VOCs were present in the school.

Of note was the distinct odor of hand disinfectant, which could be readily detected in hallways and classrooms (Picture 2). Hand disinfectant contains ethyl alcohol and fragrances, both of which can be eye and respiratory irritants to some individuals (Betco Corporation, 2007; Birchwood Laboratories, Inc., 2007; B4 Brands by AMA, 2006; Georgia-Pacific Consumer Products, 2007). According to MDPH recommendations concerning H1N1 Flu, protection from flu virus can be achieved by either washing your hands often with soap and water or using alcohol-based hand gel (MDPH, 2009, Appendix B).

Several classrooms contained dry erase boards and dry erase board markers. Materials such as permanent markers, dry erase markers and dry erase board cleaners may contain VOCs, such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999), which can be irritating to the eyes, nose and throat.

Cleaning products were also observed in a number of classrooms (Table 1). Like dry erase materials, cleaning products contain VOCs and other chemicals. These chemicals can be irritating to the eyes, nose and throat and should be kept out of reach of students. Additionally, a Material Safety Data Sheet (MSDS) should be available at a central location for each product in the event of an emergency. Consideration should be given to providing teaching staff with school issued cleaning products and supplies to prevent any potential for adverse chemical interactions between residues left from cleaners used by the schools facilities staff and those left by cleaners brought in by others.

Air fresheners and deodorizing materials were observed in a number of areas (Table 1). Air deodorizers contain chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. Many air fresheners contain 1,4-dichlorobenzene, a VOC which may cause reductions in lung function (NIH, 2006). Furthermore, deodorizing agents do not remove materials causing odors, but rather mask odors that may be present in the area.

Other Conditions

Other conditions that can affect indoor air quality were observed during the assessment. In several classrooms, items were observed on the floor, windowsills, tabletops, counters, bookcases and desks. The large number of items stored in classrooms provides a source for dusts to accumulate. These items (e.g., papers, folders, boxes) make it difficult for custodial staff to clean. Items should be relocated and/or be cleaned periodically to avoid excessive dust build up. In addition, these materials can accumulate on flat surfaces (e.g., desktops, shelving and carpets) in occupied areas and subsequently be re-aerosolized causing further irritation.

A number of air diffusers, exhaust vents and personal fans were observed to have accumulated dust/debris. These diffusers, vents and fans should be cleaned in order to prevent dust/debris from being aerosolized and redistributed throughout the room.

Conclusions/Recommendations

SPS officials, working in conjunction with the Saugus Building Department, private contractors, BMS administration, faculty members and school maintenance staff, have made improvements to building conditions based upon MDPH recommendations (MDPH, 2000; MDPH, 2002a; MDPH, 2002b; MDPH, 2003; MDPH, 2007). To date, the majority of the reports issued by the MDPH have documented a number of issues related to the functionality of the aging ventilation equipment. The SPS's Facilities Department have made a number of improvements and continued to maintain existing mechanical ventilation equipment; however, the capacity of such vintage equipment to provide adequate fresh air to classrooms is limited, as illustrated by assessments which repeatedly show inadequate fresh air provision (i.e., carbon dioxide levels above 800 ppm) to classrooms. More recent concerns regarding fires from fan bearings ceasing further indicate that the equipment is nearing the end of its useful life. Strong consideration should be given to replacing univents in the classrooms. Consideration should also be given to replacing exhaust units. In view of the findings at the time of this visit, the following additional recommendations are made to further improve indoor air quality:

1. Improve air exchange in classrooms. An increase in the percentage of fresh air supply and/or increased exhaust capabilities is recommended. Contact an HVAC engineering firm to determine if univents/exhaust motors can be modified to increase the introduction of fresh air and/or removal of stale classroom air.
2. Contact an HVAC engineering firm for a full building-wide ventilation systems assessment. Based on historical issues with air exchange/indoor air quality complaints, age, physical deterioration and availability of parts for ventilation components, such an evaluation is necessary to determine the operability and feasibility of replacing the equipment.
3. Operate all functional ventilation systems throughout the building (e.g., gym, cafeteria, classrooms) continuously during periods of school occupancy and independent of thermostat control. To increase airflow in classrooms, set univent controls to “high”.
4. Use openable windows in conjunction with classroom univents and exhaust vents to facilitate air exchange. Care should be taken to ensure windows are properly closed at night and weekends to avoid the freezing of pipes and potential flooding.

5. Set the thermostat for modular classrooms to the fan “on” position to operate the ventilation system continuously during the school day.
6. Inspect exhaust motors and belts for proper function. Repair and replace as necessary.
7. Remove all blockages in classrooms from univents and exhaust vents to ensure adequate airflow.
8. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).
9. Encourage hand washing consistent with MDPH guidelines to protect against H1N1 flu. These include:
    a. Get vaccinated when the vaccine becomes available, especially if you have a medical condition which makes health complications from the flu more likely.
    b. Wash your hands often with soap and water or use alcohol based hand gel.
    c. Cough or sneeze into a tissue or the inside of your elbow if you don’t have a tissue. Throw the tissue in the trash and wash your hands.
    d. Use a regular household cleaner to clean surfaces that may harbor flu virus like door knobs, phones, faucets and toys.
    e. Stay home from work or school if you get sick with a flu-like illness and avoid contact with others so the virus does not spread. Stay at home until you have been free from fever for at least 24 hours after your last dose of fever-reducing medication (like Tylenol, Advil or Motrin). For most people this will mean staying at home for approximately four days (MDPH, 2009).
10. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to

minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

11. Ensure plants are equipped with drip pans. Examine drip pans periodically for mold growth and disinfect with an appropriate antimicrobial, as needed. Move plants away from fresh air supply sources.
12. Seal areas around sinks to prevent water damage to the interior of cabinets and adjacent building materials.
13. Continue to remove/replace water damaged ceiling tiles.
14. Store cleaning products properly and out of reach of students. All cleaning products used at the facility should be approved by the school department with MSDS' available at a central location. Consider providing staff with SPS issued cleaners.
15. Refrain from using plug-in air fresheners or other air deodorizers.
16. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning of classrooms. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.
17. Clean accumulated dust and debris periodically from the surface of air diffusers, exhaust vents and blades of personal and ceiling fans.
18. Consider adopting the US EPA (2000) document, "Tools for Schools", as an instrument for maintaining a good indoor air quality environment in the building. This document is available at: http://www.epa.gov/iaq/schools/index.html.

19. Refer to resource manual and other related indoor air quality documents located on the MDPH's website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/iaq.

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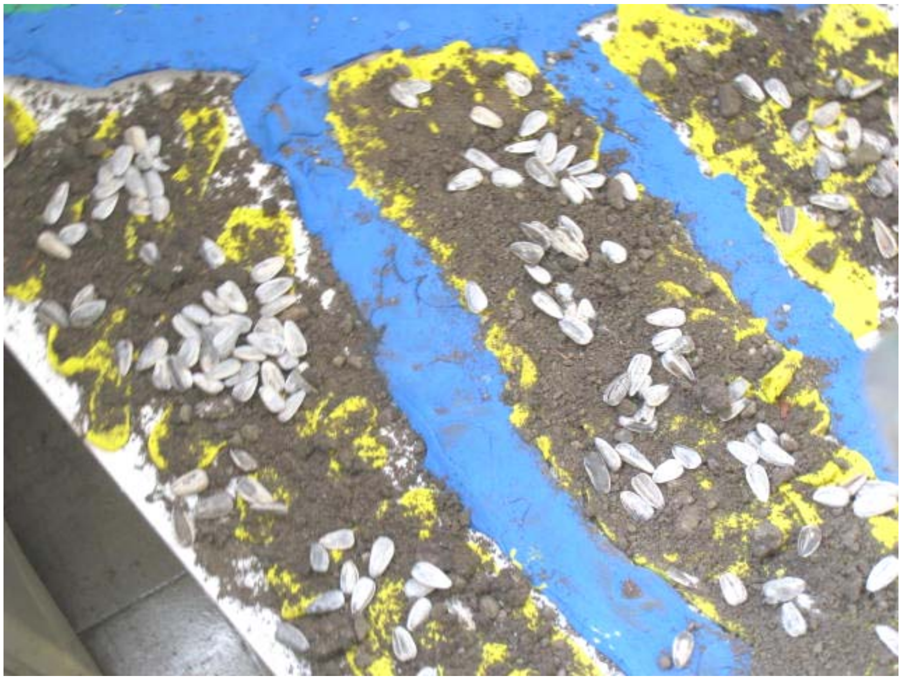
Picture 1



Art Project beneath Univent Return Air Vent

Picture 2

Hand Sanitizer Installed on Hallway Wall

Location: Augustine Belmonte Middle School **Indoor Air Results**

Address: 25 Dow Street, Saugus, MA **Date: 1/22/2010**

Table 1

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (ug/m3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Outside (Background)		36	30	331	ND	11				Sunny, breezy
Administration office	1	72	20	537	ND	7	Y	N	Y	Musty carpet odor, WAC
Auditorium	0	71	19	510	ND	10	Y	Y	Y	Supply off, exhaust off
Boiler room					ND	7 to 29		Y		
Cafeteria	400+	72	23	883	ND	12	Y	Y	Y	Supply off
Cafeteria-inner area	100+	71	20	984	ND	17	Y	Y	Y	
Cafeteria-outer area	100+	72	20	942	ND	12	Y	Y	Y	DO
Guidance	0	73	20	505	ND	7	Y	Y	Y	WAC, cleaners, AD
Gym	0	72	17	585	ND	10	N	Y	Y	DO
Library	3	71	17	482	ND	10	N	Y	Y	PF, CF
Library	4	72	17	563	ND	8	N	Y	Y	Supply off, exhaust off, rug odor
Nurse’s office	1	75	21	704	ND	12	Y	N	N	Cleaners, AD, DO, WAC
Nurse’s office	1	74	18	726	ND	6	N	Y	Y	DO
Principal’s office	2	73	21	547	ND	7	Y	N	N	WAC, DEM
1st floor vice principal office	0	70	21	621	ND	11	N	N	N	DO, AD

Location: Augustine Belmonte Middle School **Indoor Air Results**

Address: 25 Dow Street, Saugus, MA **Date: 1/22/2010**

Table 1 (continued)

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (ug/m3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
3rd floor vice principal office	0	71	21	709	ND	14	N	N	Y	Passive vent is air supply, DO
101	14	71	23	684	ND	9	Y	Y	Y	Cleaners, DEM, breach/sink
102	25	70	25	1213	ND	8	Y	Y	Y	PF, DEM, CD, plants, cleaners
103	23	70	21	629	ND	7	Y	Y	Y	DEM, cleaners, PF, plants
104	26	72	21	1078	ND	6	Y	Y	Y	DEM, cleaners
105	5	72	21	589	ND	6	Y	Y	Y	DEM
106	8	71	20	565	ND	8	Y	Y	Y	AD, exhaust had weak draw
107	2	72	20	496	ND	8	Y	Y	Y	DO, hand sanitizer odor, dehumidifier, cleaners
108	8	72	20	740	ND	8	Y	Y	Y	Cleaners, DO
109	21	73	19	945	ND	6	Y	Y	Y	Exhaust off

ppm = parts per million
WAC = window air conditioner
CD = chalk dust
AT = ajar ceiling tile
CF = ceiling fan
DO = door open
DEM = dry erase materials
GW = gypsum wallboard
MT = missing ceiling tile
ND = non detect
PC = photocopier
PF = personal fan
AD= air deodorizer
VL = vent location
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Augustine Belmonte Middle School **Indoor Air Results**

Address: 25 Dow Street, Saugus, MA **Date: 1/22/2010**

Table 1 (continued)

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (ug/m3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
110	22	74	20	1111	ND	6	Y	Y	Y	Cleaners, DEM
110 office	3	76	18	681	ND	8	N	N	N	AD, partitioned room
112	5	71	18	539	ND	7	Y	Y	Y	
113	22	71	21	808	ND	8	Y	Y	Y	DO
114	9	71	18	523	ND	8	Y	Y	Y	
115	23	71	24	787	ND	8	Y	Y	Y	DEM, DO
116	25	71	27	998	ND	8	Y	Y	Y	DO, DEM, CD, plants
140	4	68	23	747	ND	7	Y	Y	Y	WAC, PF, AD
142	2	72	19	515	ND	8	Y	N	N	DEM
176 tech shop	0	70	20	460	ND	8	Y	Y	Y	DEM

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Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Augustine Belmonte Middle School **Indoor Air Results**

Address: 25 Dow Street, Saugus, MA **Table 1 (continued)** **Date: 1/22/2010**

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (ug/m3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
177 tech classroom	0	69	21	472	ND	6	Y	Y	Y	Spray hood
178	0	65	21	420	ND	6	Y	Y	Y	PF
179 shop	0	69	19	361	ND	8	Y	Y	Y	Dust collector, wood dust
201 storage	0	72	17	365	ND	7	Y	Y	Y	Breach/sink
204	19	72	20	662	ND	6	Y	Y	Y	DEM, DO
205	20	73	19	759	ND	8	Y	Y	Y	Supply off
206	18	74	18	795	ND	5	Y	Y	Y	DEM
207	17	73	18	766	ND	7	Y	Y	Y	Cleaners, DEM, DO
208	6	73	18	766	ND	7	Y	Y	Y	Disinfectant, DO
209	23	73	22	1147	ND	11	Y	Y	Y	DO

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Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Table 1 (continued)

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (ug/m3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
209	26	73	21	1009	ND	9	Y	Y	Y	DO
210	6	71	18	727	ND	5	Y	Y	Y	Sanitizer odor, DO
211	5	73	17	530	ND	4	Y	Y	Y	Supply blocked by dry erase board, DO
213	22	73	22	1341	ND	7	Y	Y	Y	Supply off, exhaust off, DO
214	25	73	22	1294	ND	11	Y	Y	Y	CD
215	24	74	20	1168	ND	10	Y	Y	Y	Lysol
216	26	71	27	1347	ND	44	Y	Y	Y	Perfume odor, hand disinfectant; DEM; CD; food as art; breach around sink; clay
217	1	74	19	933	ND	10	N	N	N	DO
233	0	71	18	443	ND	9	N	Y	Y	DO, copier

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DEM = dry erase materials
ND = non detect
AD= air deodorizer
WAC = window air conditioner
CF = ceiling fan
GW = gypsum wallboard
PC = photocopier
VL = vent location
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PF = personal fan
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Comfort Guidelines

Carbon Dioxide:	< 600 ppm = preferred 600 - 800 ppm = acceptable > 800 ppm = indicative of ventilation problems	Temperature: Relative Humidity:	70 - 78 °F 40 - 60%

Table 1 (continued)

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (ug/m3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
246	22	72	19	918	ND	13	Y	Y	N	
249	25	72	21	1428	ND	10	Y	Y	Y	
301	25	73	23	822	ND	10	Y	Y	Y	Supply blocked DO, DEM, CD
302	21	73	21	781	ND	10	Y	Y	Y	Hand sanitizer odor DEM, CD
303	21	73	23	882	ND	9	Y	Y	Y	Clutter, AD
304	26	72	21	755	ND	11	Y	Y		DO, DEM, CD, PF
305	1	72	18	520	ND	8	Y	Y	Y	Exhaust blocked
306	2	72	19	558	ND	10	Y	Y	Y	
307	0	72	20	535	ND	6	Y	Y	Y	Cleaners
308	22	73	22	789	ND	9	Y	Y	Y	DO, DEM, CD, cleaner odors

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Carbon Dioxide: < 600 ppm = preferred
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Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Augustine Belmonte Middle School **Indoor Air Results**

Address: 25 Dow Street, Saugus, MA **Table 1 (continued)** **Date: 1/22/2010**

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (ug/m3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
309	2	71	21	504	ND	5	Y	Y	Y	DO, DEM
310	2	69	20	464	ND	7	Y	Y	Y	Plants, DO, DEM
311	22	73	17	837	ND	8	Y	Y	Y	DEM
312	11	72	23	778	ND	10	Y	Y	Y	Cleaners/lab odor DEM, CD, PF
314	5	71	19	579	ND	9	Y	Y	Y	Univent blocked, DEM, DO, CD
315	10	73	16	776	ND	11	Y	Y	Y	DEM
316	23	73	21	796	ND	11	Y	Y	Y	DO, PF, DEM, cleaners

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Appendix B

PUBLIC HEALTH FACT SHEET

H1N1 Flu
(Swine Flu)

Massachusetts Department of Public Health

What is H1N1 flu?

Flu is a disease of the body's breathing system, including the nose, throat and lungs. Flu is short for "influenza." H1N1 flu is caused by a new virus that was first recognized in April of 2009, and was called "swine flu." H1N1 flu quickly spread to many parts of the world and is now a "pandemic," or global outbreak. H1N1 flu is not the same as swine flu, which is a virus that pigs can get. It is not the same as "seasonal" flu which occurs every year, during the winter and early spring. But H1N1 flu causes symptoms that are similar to seasonal flu, is spread like seasonal flu, and can be prevented like seasonal flu.

What are the symptoms of H1N1 flu?

H1N1 flu symptoms are very similar to seasonal flu symptoms. Most common are fever, cough, and sore throat. Symptoms can also include body aches, headache, chills, runny nose and feeling very tired. Some people also have diarrhea and vomiting. Symptoms last from a few days to up to a week or more.

Is H1N1 flu serious?

Illness with H1N1 flu has ranged from mild to severe. While most people sick with H1N1 flu get better without needing medical treatment, severe illness and deaths have occurred in some people. Like seasonal flu, some people are at higher risk of serious health problems when they get the H1N1 flu. This includes pregnant women, infants, and people with medical conditions like asthma, diabetes, heart disease, kidney disease, muscle or nerve conditions that affect their breathing and weakened immune systems.

How does H1N1 flu spread?

The flu virus is in the wet spray (droplets of saliva and mucous) that comes out of the nose and mouth of someone who coughs or sneezes. If you are close enough to a person with the flu (3 - 6 feet) when they cough or sneeze, you can breathe in the virus and get sick. Flu symptoms start 1 - 4 days (usually 2 days) after a person breathes in the virus.

Flu is spread easily from person to person. The virus can also live for a short time on things you touch like doorknobs, phones and toys. After you touch these objects, you can catch the virus when you touch your mouth, nose, or eyes. However, when the wet droplets on these types of objects dry out, the virus can't cause infection. Adults with the H1N1 flu can spread it from about one day before symptoms appear to about one week after. Children can spread the flu even longer after they get sick.

How is H1N1 flu treated?

There are drugs available that your doctor may prescribe to treat H1N1 flu. The drugs work best if started soon after the start of symptoms. Your doctor can determine if you need treatment.

People sick with any type of flu should make sure to drink plenty of fluids, get plenty of rest, eat healthy foods, wash their hands frequently and stay home to avoid spreading the flu to other people. Over the counter pain relievers may help people with the flu feel more comfortable. Children and teens with the flu should never take aspirin, because a rare but serious disease called Reye syndrome can occur.

Is there a vaccine for H1N1 flu?

Yes. A vaccine helps your body to protect itself against a disease. There are two types of H1N1 vaccine available to protect against H1N1 flu. One is a "shot" that is given with a needle, usually in the arm. The other is a "nasal spray" (a spray inhaled through the nose). People 10 years of age and over will need one

Appendix B

dose of vaccine. Most children under the age of 10 will need two doses of H1N1 vaccine, separated by 3- 4 weeks. Getting flu vaccine will **not** give you the flu or any other type of illness. Ask your doctor which type of H1N1 vaccine is best for you and your family.

Who should get H1N1 flu vaccine?

Certain groups should get the H1N1 vaccine when it becomes available: pregnant women; people who live with or provide care for infants under 6 months of age (e.g., parents, siblings, and daycare providers); healthcare and emergency medical services personnel; people age 6 months to 24 years; and people age 25 to 64 years who have medical conditions that put them at higher risk for influenza-related complications. After these groups, it is expected that there will be enough H1N1 flu vaccine for anyone who chooses to get vaccinated. Please note that the groups listed above may change based on vaccine availability. *Note: current studies indicate the risk for infection among persons over 65 years of age is less than the risk for persons in younger age groups.*

How do I know if I have H1N1 flu?

If you have symptoms of flu, it could be seasonal or H1N1 flu. If you think you have the flu, stay home from work and school and avoid contact with others so you do not spread the virus. If you think you might have flu and you need to see your doctor, call ahead and let them know you might have the flu. That way, your doctor's office can take steps to avoid the spread of flu to others. The doctor may recommend that you be tested for influenza.

How do I protect myself from getting sick with H1N1 flu?

- Get vaccinated when the vaccine becomes available, especially if you have a medical condition which makes health complications from the flu more likely.
- Wash your hands often with soap and water or use alcohol based hand gel.
- Cough or sneeze into a tissue or the inside of your elbow if you don't have a tissue. Throw the tissue in the trash and wash your hands.
- Use a regular household cleaner to clean surfaces that might get flu virus on them like door knobs, phones, faucets and toys.
- **Stay home from work and school if you get sick with a flu-like illness and avoid contact with others so the virus does not spread. Stay at home until you have been free from fever for at least 24 hours after your last dose of fever-reducing medication (like Tylenol, Advil or Motrin).** For most people this will mean staying at home for about four days.

How do I take care of someone who is sick with H1N1 flu?

Flu: What You Can Do - Caring for People At Home is a booklet available in nine languages that gives you lots of information to help you care for someone who has the flu in their home. A video is also available in English and Spanish. *Flu: What You Can Do* information can be found at: mass.gov/flu

Where can I get more information?

- Mass 2-1-1 provides flu information for the general public: call 211 or 1-877-211-MASS (6277). Interpreter services available in many languages.
- Call your doctor, nurse or clinic, or your local board of health
- Call the MA Department of Public Health, Immunization Program at: (617) 983-6800 or toll-free at (888) 658-2850
- Massachusetts Department of Public Health website at mass.gov/flu
- Center for Disease Control and Prevention (CDC) at: www.cdc.gov/flu

For flu clinic information, visit the MassPRO Public Flu Clinic Finder website at: http://flu.masspro.org/

Updated November 6, 2009