INDOOR AIR QUALITY ASSESSMENT
INCIDENT RESPONSE

Hayden-McFadden Elementary School
361 Cedar Grove Street
New Bedford, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
April 2012

Background/Introduction

On Thursday March 22, 2012, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH), Indoor Air Quality (IAQ) Program was contacted by Deb Brown, Business Manager, New Bedford Public Schools, regarding a flooding event and electrical outage that occurred overnight at the Hayden-McFadden Elementary School located at 361 Cedar Grove Street, New Bedford Massachusetts.

It was reported that at about 6:30 on the morning of March 22, 2012, the day-shift custodian noted flooding as a result of a failed sink connector in the 3rd floor boys' restroom. This caused wetting of carpeting and ceiling tiles on the 3rd floor adjacent to the restroom as well as similar materials on the 2nd and 1st floors directly below, albeit to a lesser extent. In addition, an electrical panel shorted out, creating smoke/odors in the building. As a result, all school activity was cancelled for the day.

BEH staff arrived on site at approximately 2:15 PM. At that time, school maintenance staff had removed water-damaged ceiling tiles, vacuum extracted water from and shampooed affected carpets on the 1st floor and were conducting drying using fans on all three floors.

Methods

MDPH staff performed a visual inspection of building materials for water damage and/or microbial growth. Moisture content of carpeting was measured with a Delmhorst, BD-2000 Model, Moisture Detector equipped with a Delmhorst Standard Probe. To determine whether combustion products/particulates from electrical smoke in the building had been removed sufficiently, BEH staff conducted air sampling for carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5). Tests for carbon monoxide were conducted with the TSI, Q-Trak, IAQ Monitor, Model 7565. Tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520.

Results

The school houses approximately 700 Pre-K through fifth grade students and approximately 60 staff. Tests were taken during remediation efforts while the school was unoccupied. Results appear in Table 1.

Discussion

Microbial/Moisture Concerns

In order for building materials to support mold growth, a source of water exposure is necessary. Identification and elimination of the source of water moistening building materials is necessary to control mold growth. The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend that porous materials (e.g., carpeting, gypsum wallboard) 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. As previously stated, drying/remediation efforts were well underway within several hours of detection of the leak.

Carpet on all three floors evaluated by BEH staff was wet (Table 1). Due to the extent of the wet carpet and condition of the carpeting, BEH staff recommended that a professional restoration company be contacted to conduct thorough cleaning/drying efforts. Serv-Pro, a flooding remediation company, was contacted and arrived on site at approximately 4:15 PM to conduct mitigation/restoration.

It was reported that Serv-Pro conducted pre-remediation moisture testing and evaluation to determine a course of drying/disinfection. According to Ms. Brown, school was also cancelled Friday, March 23, 2012 in order for Serv-Pro to complete remediation into the weekend. This included removal of water-damaged insulation, drying/dehumidification and cleaning/disinfection of surfaces followed by treatment with an antimicrobial agent. Remediation was completed on Saturday March 24, 2012 and school reopened Monday March 26, 2012.

Other IAQ Evaluations

To determine any residual impacts from the shorted-out electrical panel and/or related smoke/odors in the building, BEH staff took measurements for carbon monoxide and particulate matter. 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 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 effects. 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. On the day of the assessment, outdoor carbon monoxide concentrations were non-detect (ND) (Table 1). No measureable levels of carbon monoxide were detected inside 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 micrograms 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 the day of the assessment were measured at 25-30 $\mu g/m^3$. PM2.5 levels measured inside the building ranged from 16 to 22 $\mu g/m^3$ (Table 1). Both indoor and outdoor PM 2.5 levels were below the NAAQS PM2.5 level of 35 $\mu g/m^3$. Frequently, indoor air levels of particulates (including PM2.5) can be at higher levels than those measured outdoors. A number of activities that occur indoors and/or mechanical devices 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, use of stoves and/or microwave ovens in kitchen areas; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner; and heavy foot traffic indoors.

Other Conditions

It is important to note that the majority of floor surfaces in the school are covered by wall-to-wall carpeting, much of which appears to be original to the construction of the building (i.e. over 35 years old). Carpeting was observed to be worn, stained and/or damaged in several areas, particulary in hallways directly outside restrooms. At the time of the assessment, severely worn/damaged carpeting outside of the 3rd floor restroom was removed at the recommendation of BEH staff.

The Institute of Inspection, Cleaning and Restoration Certification (IICRC), recommends that carpeting be cleaned annually (or semi-annually in soiled high traffic areas) (IICRC, 2005). Since the average lifespan of a carpet in a school environment is approximately eleven years, consideration should be given to planning for the installation of new flooring (Bishop, 2002). In addition, carpeting is not recommended directly outside of restrooms. Overflow of toilets, sinks and/or water fountains that often occur can contaminate or moisten carpeting and may require removal and disinfection of flooring (IICRC, 2006).

Conclusions/Recommendations

The air testing results indicated that at the time of the assessment, carbon monoxide was non-detectable within all areas tested. In addition, all PM2.5 levels measured were below the NAAQS PM2.5 level of 35 $\mu g/m^3$. In view of the findings at the time of the visit, the following recommendations are made:

1. Remove soiled/damaged carpeting in hallway areas directly outside of restrooms. Replace with non-porous floor covering (e.g., tile).

2. Clean carpeting annually or semi-annually in soiled high traffic areas as per the recommendations of the Institute of Inspection, Cleaning and Restoration Certification (IICRC). Copies of the IICRC fact sheet can be downloaded at: http://www.cleancareseminars.com/carpet_cleaning_faq4.htm (IICRC, 2005).
3. Consider a long-term plan to replace carpeting building-wide that has passed its useful life, as funds become available. Consider replacing carpeting with a non-porous surface such as vinyl tile.
4. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. Copies of these materials are located on the MDPH's website: http://mass.gov/dph/iaq.

References

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US EPA. 2001. Mold Remediation in Schools and Commercial Buildings. US Environmental Protection Agency, Office of Air and Radiation, Indoor Environments Division, Washington, D.C. EPA 402-K-01-001. March 2001.

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Picture 1

Flexible Hose Connection (arrow) Source of Leak

Picture 2

Wet Soiled/Worn Carpeting outside 3rd Floor Restroom

Location: Hayden-McFadden Elementary School **Indoor Air Results**

Address: 361 Cedar Grove Street, New Bedford, MA **Table 1** **Date: March 22, 2012**

Location	Carbon Monoxide (ppm)	PM2.5 (μg/m^3)	Remarks
Background	ND	25-30	Warm, sunny/clear skies, temp 70°, relative humidity 56%, winds WSW 12-20 mph
1St Floor			
Main Lobby	ND	22	
Conference Room	ND	18	Carpet wet-cleaned/shampooed
Restroom Hallway	ND	18	Carpet wet-cleaned/shampooed, fans operating for drying
2nd Floor			
Restroom Hallway	ND	16	Carpet wet, soiled/worn, fans operating for drying
Conference Room	ND	18	Carpet wet
3rd Floor			
Restroom Hallway	ND	16	Carpet wet, soiled/worn, fans operating for drying
Conference Room	ND	18	Carpet wet
C-308	ND	17	Carpet wet

ppm = parts per million μg/m^3 = micrograms per cubic meter ND = non detect