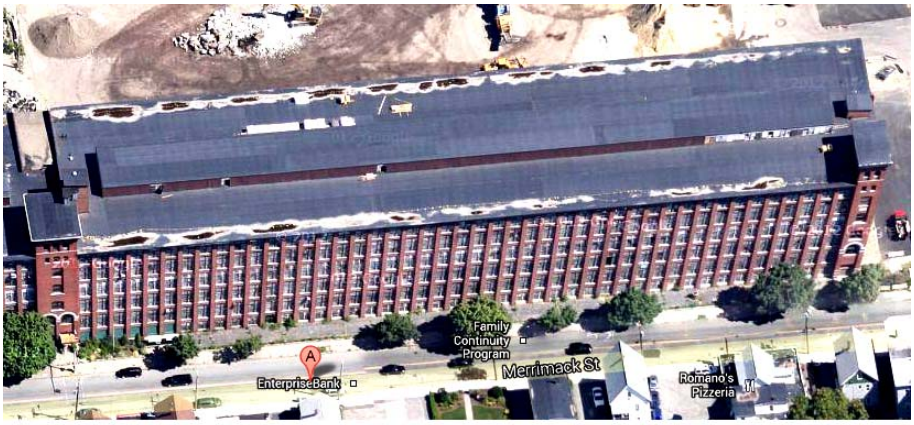
INDOOR AIR QUALITY
POST-OCCUPANCY ASSESSMENT

Massachusetts Executive Office of Health and Human Services
280 Merrimack Street
Lawrence, MA



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
October 2013

Background/Introduction

At the request of Gerald Covino, Project Manager, Office of Leasing, Division of Capital Asset Management (DCAM), the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH) conducted post-occupancy air testing at the Executive Office of Health and Human Services (EOHHS) Service Center Office located at 280 Merrimack Street, Lawrence, Massachusetts. The purpose of the post-occupancy testing was to more comprehensively assess the indoor air quality (IAQ) of newly occupied space leased by Massachusetts state agencies. On August 22, 2013, a visit to the Service Center was made by Ruth Alfasso, Environmental Engineer/Inspector within BEH's IAQ Program. Mr. Covino accompanied Ms. Alfasso during the assessment.

The building is a four-story brick mill building with a basement level originally constructed for wool manufacturing (The Wood Worsted Mills). It was reportedly the largest worsted mill building in the United States and was added to the National Historic Register in 2010. It was reportedly vacant or used for warehouse space for many years prior to the redevelopment of the western third of the building into apartments in the late 2000s. The EOHHS Service Center occupies the first and second floor of the easternmost third of the building. Other portions of the building remain under construction and will reportedly house a fitness center in the basement and other retail and office spaces.

The office space has been completely renovated and EOHHS staff have occupied the building since mid-July, 2013. The space consists of regular offices, offices with walls that go most of the way to the ceiling, open work areas separated by cloth-covered dividers, meeting, conference and hearing/interview rooms, lunch areas, waiting rooms and storage for files and

other items. The space has suspended ceiling tiles and flooring consisting of carpet squares in the majority of areas; some areas have non-porous floor tile. Windows are not openable.

Methods

Air tests for carbon dioxide, carbon monoxide temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor 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. Air testing for total volatile organic compounds (TVOCs) was conducted using a MiniRAE 2000 photo ionization detector (PID). BEH/IAQ staff also performed visual inspection of building materials for water damage and/or microbial growth.

Results

The EOHHS Service Center has a combined employee population of approximately 300, and hundreds of people may visit the building on a daily basis. Tests were taken during normal operations. Test results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were below 800 parts per million (ppm) in 143 out of 148 areas surveyed indicating adequate supply of fresh air in the majority of areas surveyed. The only areas which exceeded 800 ppm of carbon dioxide were in and directly adjacent to the main waiting area on the first floor.

Fresh air is provided by air-handling units (AHUs) located in mechanical spaces inside the building (Picture 1). Fresh air is drawn into the AHUs through a duct from a structure on the roof of the building, heated or cooled, and delivered to variable air volume units (VAV boxes) located above the ceiling and from there to occupied areas via ducted ceiling air diffusers (Picture 2). Return air is drawn into an above-ceiling plenum via ceiling grates and ducted back to the AHUs. Typically, offices are furnished with a supply vent and no exhaust vent, but have doors which are undercut to allow for stale air to be exhausted to vents in open areas.

The HVAC system is computer-controlled and has digital thermostats located in zones. The set temperature of the thermostat is reportedly allowed to be changed by occupants in a range of about four degrees.

Exhaust vents in restroom are activated continuously during occupied hours and vent directly to the outdoors.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of 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). Reportedly, the HVAC system was balanced prior to EOHHS occupancy.

Minimum design ventilation rates are mandated by the Massachusetts State Building Code (MSBC). Until 2011, the minimum ventilation rate in Massachusetts was higher for both occupied office spaces and general classrooms, with similar requirements for other occupied spaces (BOCA, 1993). The current version of the MSBC, promulgated in 2011 by the State

Board of Building Regulations and Standards (SBBRS), adopted the 2009 International Mechanical Code (IMC) to set minimum ventilation rates. **Please note that the MSBC is a minimum standard that is not health-based**. At lower rates of cubic feet per minute (cfm) per occupant of fresh air, carbon dioxide levels would be expected to rise significantly. A ventilation rate of 20 cfm per occupant of fresh air provides optimal air exchange resulting in carbon dioxide levels at or below 800 ppm in the indoor environment in each area measured. MDPH recommends that carbon dioxide levels be maintained at 800 ppm or below. This is because most environmental and occupational health scientists involved with research on IAQ and health effects have documented significant increases in indoor air quality complaints and/or health effects when carbon dioxide levels rise above the MDPH guidelines of 800 ppm for schools, office buildings and other occupied spaces (Sundell et al., 2011). 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 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, please see Appendix A.

Indoor temperature measurements ranged from 67° F to 75° F during the visit (Table 1). Most readings were within the MDPH recommended comfort range at the time of the assessment while less than 10 percent were below the lower end of the range, all in one section of the second floor (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. Concerns regarding thermal comfort were expressed by several occupants during the visit and several offices were found to have under-desk heaters running (Table 1). Thermostats in the building allow occupants to change the temperature within a small range; occupants should use these thermostats to adjust temperature and work with building management in case of ongoing thermal discomfort.

The relative humidity measurements in the building ranged from 45 to 58 percent (Table 1), which were all within the MDPH recommended comfort range. 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

No evidence of leaks and/or water-damaged building materials was observed during the visit.

Plants were observed in several areas (Picture 3; Table 1). Plants should be properly maintained and equipped with drip pans. Plants should be located away from ventilation sources to prevent aerosolization of dirt, pollen or mold. Plants should not be placed on carpets or other porous materials, since water damage to porous materials may lead to microbial growth.

In some areas, water dispensers were located in carpeted areas (Picture 4) where leaks or spills can moisten the carpet. It is recommended that these dispensers be located on non-porous flooring or that a waterproof mat be placed beneath them in carpeted areas.

Other Indoor Air 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/IAQ 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, 2011). 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) on 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 includes airborne solids, which can result in eye and respiratory irritation if exposure occurs. 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 was measured at 50-75 $\mu g/m^3$ (Table 1), above the NAAQS PM2.5 level of 35 $\mu g/m^3$. PM2.5 levels measured indoors ranged from 23 to 33 $\mu g/m^3$ (Table 1), which 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 mechanical devices and/or activities that occur in buildings 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.

Note that particulate levels outdoors on the day of the assessment were elevated statewide due to the hot, humid weather conditions; according to AirNow (http://www.airnow.gov), a website run by the USEPA, PM2.5 levels statewide were within the "moderate" category, as defined by PM2.5 levels of between 50 and 100 μg/m^3. Outdoor construction activities within the EOHHS Service Center site may also have contributed to elevated outdoor PM2.5 levels.

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. Total volatile organic compounds (TVOCs) can result in eye and respiratory irritation if exposure occurs. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs.

In order to determine if VOCs were present, testing for TVOCs was conducted. Background levels of TVOCs were ND (Table 1). TVOCs ranged from ND to 0.3 ppm in the building. These low levels of TVOCs are within a range considered background for the measurement instrument used; contributions to TVOCs may also come from products in use in the building, many of which were noted in Table 1 and discussed further below.

Hand sanitizer was found in many offices and common areas (Table 1). Hand sanitizer products may contain ethyl alcohol and/or isopropyl alcohol which are highly volatile and may be irritating to the eyes and nose, and may contain fragrances to which some people may be sensitive.

Photocopiers were located in many areas of the building. VOCs and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, 1992). It was noted that most copiers were located in areas

not directly adjacent to occupied areas which is recommended. However, no dedicated exhaust ventilation was observed near copiers.

Cleaning products were found in a number of rooms throughout the building (Picture 5, Table 1). Cleaning products contain chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. These products should be properly labeled. In addition, Material Safety Data Sheets (MSDS) should be available at a central location for each product in the event of an emergency. Consideration should be given to working with building management to provide staff with cleaning products and supplies consistent with lease agreements to prevent any potential for adverse chemical interactions.

Air fresheners, deodorizing materials and other scented products were observed in some areas (Table 1; Picture 6). 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. Construction is still not complete for other areas of the building, including outside where the final layers of the parking lot were being rolled in place at the time of the assessment and where windows on unoccupied floors are being installed on a gradual basis. There are also areas adjacent to the occupied areas where occasional construction activities are occurring inside the building including the rear entrance area. Areas of construction should be isolated from any occupied areas using doors and/or plastic material to prevent the transport of particulates and

odors into occupied areas. If construction is creating dusty conditions outside, walk-off mats and/or additional cleaning of entry areas should be provided to prevent construction-related pollutants from entering the inside.

Several potential issues identified during the pre-occupancy visit have yet to be completed/addressed. Areas below the newly-installed windows have not been sealed on the inside (Picture 7). Reportedly, the windows are completely sealed along the outside of the building and the inside work is planned for the cold-weather season. The exposed edges of brick and mortar along the windows can be a source of dust. The pink powdery deposits found on one interior wall, reportedly from testing of the sprinklers, has not yet been cleaned/removed (Picture 8). This material can be brushed off on contact and may become airborne.

In some areas, significant accumulations of items, including papers, boxes and personal items were found stored on desks, tables and counters (Picture 9). Large numbers of items provide a source for dusts to accumulate. These items make it difficult for custodial staff to clean. Items should be relocated and/or cleaned periodically to avoid excessive dust build up.

Most of the EOHHS Service Center is carpeted; 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).

Food and food-preparation equipment was observed in offices and other areas. The use of this equipment can provide a source of particulates and odors, particularly if the equipment is not kept clean. Food/debris remaining on heating elements can burn the next time the items are used, producing smoke and odors. In addition, unsealed food, including crumbs remaining on food-preparation equipment, can be attractive to pests.

The layout of cubicle areas includes an open aisle/channel between the exterior walls and the dividers of the cubicles (Picture 10) and other similar areas between rows of partial-walled offices. This design buffers occupants from direct contact with windows and allows for cleaning behind the occupied areas but may also represent a space for items and debris to accumulate out of sight. These areas should be thoroughly cleaned on a regularly-scheduled basis to prevent the buildup of items that may produce odors or create pest harborage.

Conclusions/Recommendations

In view of the findings at the time of the visits, the following recommendations are made:

1. Operate and maintain the HVAC systems in accordance with manufacturer's recommendations, including changing the filters on the AHU quarterly.
2. Increase fresh air supply and, more importantly, exhaust ventilation for the main waiting area on the first floor. Consider keeping this area under a slight negative pressure to contain and remove occupant-generated carbon dioxide and odors before they can infiltrate other areas of the office.
3. Work with building management to ensure proper adjustment of thermostats for thermal comfort.
4. 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 for 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).

5. Ensure plants have drip pans and avoid over-watering. Examine drip pans periodically for mold growth. Disinfect with an appropriate antimicrobial where necessary.
6. Consider installing waterproof mats or nonporous flooring under water dispensers.
7. Consider supplying staff with cleaners that are the same as or compatible with cleaners used by janitorial staff to prevent interactions. Ensure that all cleaner containers are properly labeled.
8. Avoid the use of scented products such as deodorizers and air fresheners.
9. Isolate any areas where construction is occurring from occupied areas and increase entryway cleaning when outside conditions are especially dusty.
10. Complete sealing of windows on the inside. If this work requires use of any products that may produce fumes or odors, ensure that the work is performed when the building is unoccupied and that ventilation is increased to remove odors before occupancy resumes.
11. Clean the pink staining from the wall shown in Picture 8.
12. Consider reducing, consolidating or relocating excessive amounts of items and papers to allow for more thorough cleaning.
13. Ensure that all food preparation equipment is cleaned regularly to prevent the creation of smoke and odors and the attracting of pests. Store food in tightly sealed containers.
14. Ensure that hidden buffer aisles are included in the building cleaning program.
15. 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.

References

ASHRAE. 1989. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-1989.

BOCA. 1993. The BOCA National Mechanical Code/1993. 8th ed. Building Officials and Code Administrators International, Inc., Country Club Hill, IL.

IICRC. 2005. Carpet Cleaning FAQ 4 Institute of Inspection, Cleaning and Restoration Certification. Institute of Inspection Cleaning and Restoration, Vancouver, WA.

IMC, 2009. 2009 International Mechanical Code. International Code Council Inc., Country Club Hills, IL.

MDPH. 1997. Requirements to Maintain Air Quality in Indoor Skating Rinks (State Sanitary Code, Chapter XI). 105 CMR 675.000. Massachusetts Department of Public Health, Boston, MA.

NIH. 2006. Chemical in Many Air Fresheners May Reduce Lung Function. NIH News. National Institute of Health. July 27, 2006. http://www.nih.gov/news/pr/jul2006/niehs-27.htm

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

SBBRS. 2011. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations, 8th edition. 780 CMR 1209.0.

Schmidt Etkin, D. 1992. Office Furnishings/Equipment & IAQ Health Impacts, Prevention & Mitigation. Cutter Information Corporation, Indoor Air Quality Update, Arlington, MA.

SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

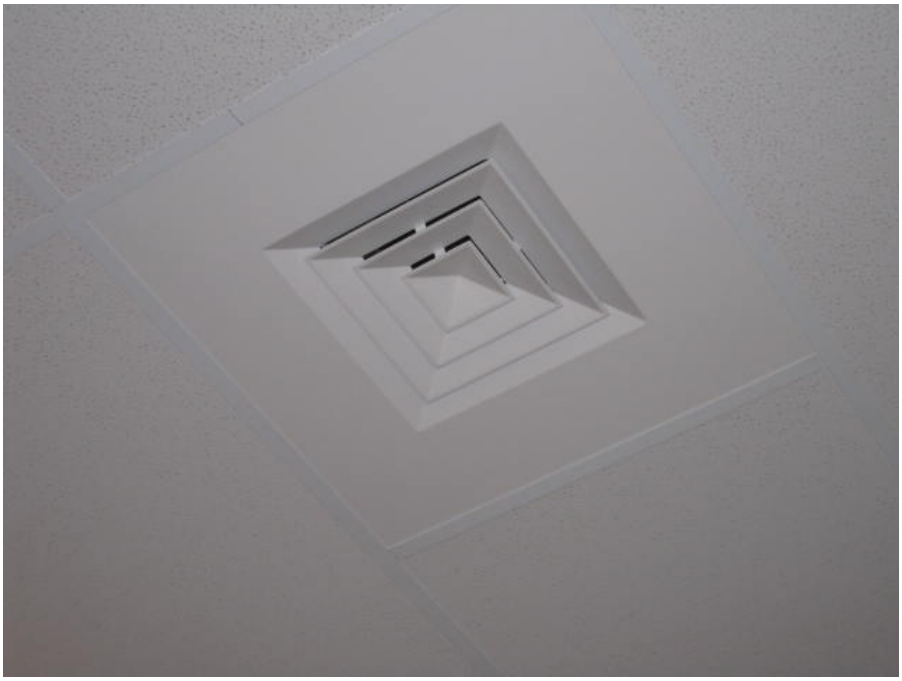
Sundell, J., H. Levin, W. W. Nazaroff, W. S. Cain, W. J. Fisk, D. T. Grimsrud, F. Gyntelberg, Y. Li, A. K. Persily, A. C. Pickering, J. M. Samet, J. D. Spengler, S. T. Taylor, and C. J. Weschler. 2011. Ventilation rates and health: multidisciplinary review of the scientific literature. *Indoor Air*, Volume 21: pp 191–204.

US EPA. 2006. National Ambient Air Quality Standards (NAAQS). US Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, DC. http://www.epa.gov/air/criteria.html.

Picture 1

Air-handling unit

Picture 2



Typical supply vent

Picture 3

Plant in an office, note no drip pan

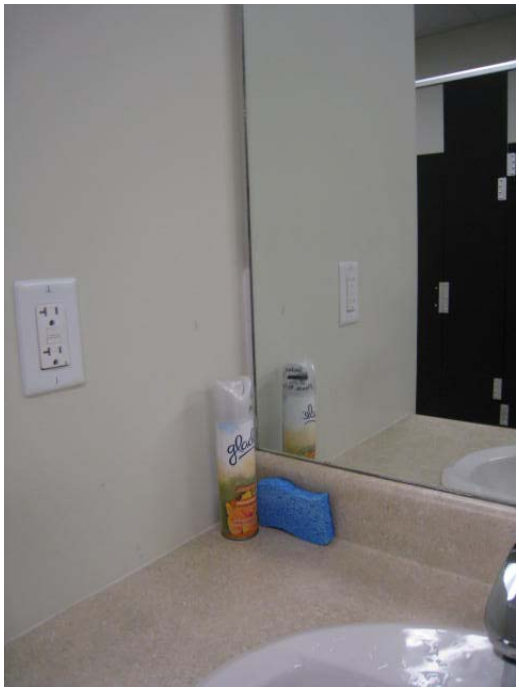
Picture 4

Water dispenser in carpeted area

Picture 5

Cleaning product in office

Picture 6

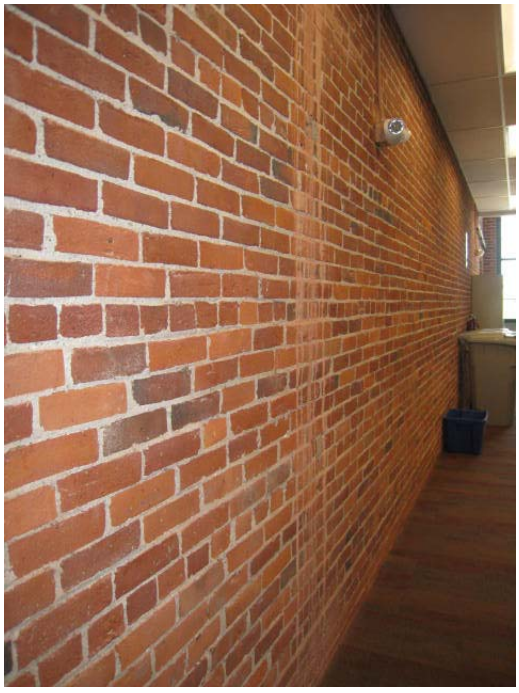


Deodorizer spray in restroom

Picture 7

Unsealed area under newly-installed window

Picture 8



Pink powdery material on brick wall

Picture 9

Items in office

Picture 10

Aisle between cubicle walls and exterior walls

Location: EOHHS Service Center **Indoor Air Results**

Address: 280 Merrimack Street, Lawrence, MA **Table 1** **Date: 8/22/2013**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m3)	TVOC (ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
background	284	ND	79	54	50-75	ND					Sunny, getting hot and hazy, light to moderate breeze. Some construction in parking lot. Airnow.gov "moderate" health index
SECOND FLOOR											
2007 MRC interview room	373	ND	71	55	29	ND – 0.3	0	N	Y	Y	Sanitizer
2009 MRC interview room	591	ND	70	55	30	ND – 0.3	3	N	Y	Y	
2010 MRC reception	475	ND	71	56	31	ND – 0.3	4	N	Y	Y	
2011 MRC interview room	522	ND	70	54	28	ND – 0.3	0	N	Y	Y	
2013 MRC interview room	626	ND	70	57	30	ND – 0.3	1	N	Y	Y	
2014 MRC interview room	390	ND	70	53	29	ND – 0.3	0	N	Y	Y	
2021 copy/mail	578	ND	71	56	29	ND – 0.3	0	N	Y	Y	PC, microwave, DEM

ppm = parts per million
µg/m^3 = micrograms per cubic meter
TVOC = total volatile organic compounds
AD = air deodorizer
AP = air purifier
CP = cleaning products
DEM = dry erase materials
DO = door open
NC = non-carpeted
ND = non detect
PC = photocopier
PF = personal fan

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: EOHHS Service Center **Indoor Air Results**

Address: 280 Merrimack Street, Lawrence, MA **Table 1 (Continued)** **Date: 8/22/2013**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m3)	TVOC (ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
2101 (office)	567	ND	73	53	29	ND – 0.3	1	N	Y	Y	Food
2102 (office)	629	ND	72	52	29	ND – 0.3	0	N	Y	Y	PF
2110 (conference)	598	ND	72	53	30	ND – 0.3	0	N	Y	Y	DEM, sanitizer, CP
2110 MRC conference room	363	ND	71	55	32	ND – 0.3	0	N	Y	Y	Slight new furniture odor
2115 (office)	622	ND	72	53	27	ND – 0.3	1	N	Y	Y	Coffeemaker, printer
2118 (semi-wall)	627	ND	72	53	29	ND – 0.3	0	N	Y	Y	
2122 (semi-wall)	644	ND	73	53	29	ND – 0.3	2	N	Y	Y	
2123 (semi-wall)	659	ND	73	53	28	ND – 0.3	0	N	Y	Y	
2124 (semi-wall)	611	ND	72	53	29	ND – 0.3	3	N	Y	Y	
2146 (semi-wall)	570	ND	72	53	29	ND – 0.3	1	N	Y	Y	

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									Supply	Exhaust	
2148 (semi-wall)	612	ND	72	53	29	ND – 0.3	1	N	Y	Y	
2150 (office)	589	ND	72	52	28	ND – 0.3	0	N	Y	Y	
2153 (cubes)	607	ND	73	53	28	ND – 0.3	0	N	Y	Y	Items, sanitizer, PF
2155 (cubes)	598	ND	71	55	27	ND – 0.3	1	N	Y	Y	
2160 (cubes)	578	ND	72	55	29	ND – 0.3	0	N	Y	Y	Items, CP
2161 (cubes)	601	ND	72	54	30	ND – 0.3	1	N	Y	Y	Items, food
2166 (cubes)	620	ND	71	56	29	ND – 0.3	2	N	Y	Y	PF, vibration from construction outside
2168 (office)	537	ND	71	55	30	ND – 0.3	0	N	Y	Y	
2169 (cubes)	531	ND	71	55	29	ND – 0.3	0	N	Y	Y	
2170 (office)	586	ND	71	56	32	ND – 0.3	0	N	Y	Y	

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									Supply	Exhaust	
2172 (office)	576	ND	70	55	30	ND – 0.3	0	N	Y	Y	Candy dishes in many offices in this area
2173 (cubes)	539	ND	70	55	27	ND – 0.3	0	N	Y	Y	Microwave and fridge, cooking odors
2201 (cubes)	594	ND	71	53	26	ND – 0.3	0	N	Y	Y	
2204 (cubes)	598	ND	71	54	27	ND – 0.3	0	N	Y	Y	
2207 (cubes)	664	ND	71	54	27	ND – 0.3	0	N	Y	Y	
2208 (office)	529	ND	71	54	28	ND – 0.3	2	N	Y	Y	Plants, fridge, microwave
2211 Conference room	580	ND	67	58	26	ND – 0.3	0	N	Y	Y	
2214 (cubes)	686	ND	72	53	29	ND – 0.3	1	N	Y	Y	Plants
2214 (office)	628	ND	72	53	29	ND – 0.3	1	N	Y	Y	DO
2216 (semi-wall)	602	ND	69	57	26	ND – 0.3	2	N	Y	Y	

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

Location: EOHHS Service Center **Indoor Air Results**

Address: 280 Merrimack Street, Lawrence, MA **Table 1 (Continued)** **Date: 8/22/2013**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m3)	TVOC (ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
2217 (semi-wall)	605	ND	69	57	27	ND – 0.3	0	N	Y	Y	PF, sanitizer
2218 (semi-wall)	587	ND	69	58	27	ND – 0.3	1	N	Y	Y	
2218 (semi-wall)	576	ND	68	58	27	ND – 0.3	1	N	Y	Y	Food
2219 (semi-wall)	602	ND	68	58	26	ND – 0.3	0	N	Y	Y	Food
2223 (cube)	607	ND	69	57	27	ND – 0.3	1	N	Y	Y	Sanitizer
2226 (semi-wall)	555	ND	67	58	26	ND – 0.3	0	N	Y	Y	PF, air freshener
2228 (semi-wall)	562	ND	68	57	27	ND – 0.3	0	N	Y	Y	
2229 (semi-wall)	578	ND	68	56	27	ND – 0.3	0	N	Y	Y	Coffee pot
2230 (cubes)	555	ND	68	56	26	ND – 0.3	0	N	Y	Y	
2234 (semi-wall)	568	ND	68	55	27	ND – 0.3	0	N	Y	Y	Food, sanitizer, PF

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									Supply	Exhaust	
2235 (semi-wall)	588	ND	69	56	27	ND – 0.3	0	N	Y	Y	Sanitizer
2320 DCF regional staff area	429	ND	71	55	32	ND – 0.3	0	N	Y	Y	
2335 (office)	543	ND	73	55	31	ND – 0.3	2	N	Y	Y	
2339 (office)	458	ND	73	53	30	ND – 0.3	1	N	Y	Y	
2348 (office)	472	ND	73	51	29	ND – 0.3	2	N	Y	Y	
2349 (office)	562	ND	73	51	28	ND – 0.3	1	N	Y	Y	
2354 (office)	584	ND	72	48	26	ND – 0.3	0	N	Y	Y	DEM
2355 (office)	557	ND	71	51	27	ND – 0.3	0	N	Y	Y	DO, items/papers
2405 (office)	508	ND	71	52	25	ND – 0.3	0	N	Y	Y	DO
2405 (office)	550	ND	71	53	25	ND – 0.3	1	N	Y	Y	DO, items on floor

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									Supply	Exhaust	
2406 (office)	521	ND	71	51	27	ND – 0.3	0	N	Y	Y	Sprayer with no label, food prep equipment, DO
2407 (office)	587	ND	72	53	27	ND – 0.3	0	N	Y	Y	
2408 (office)	551	ND	72	52	26	ND – 0.3	2	N	Y	Y	DO
2410 (office)	611	ND	70	51	27	ND – 0.3	0	N	Y	Y	
2415 (cubes)	536	ND	72	51	27	ND – 0.3	0	N	Y	Y	PF
2416 (cubes)	546	ND	72	52	27	ND – 0.3	1	N	Y	Y	
2422 conference	515	ND	71	51	27	ND – 0.3	0	N	Y	Y	
2nd floor DMH waiting room	440	ND	70	58	29	ND – 0.3	4	N	Y	Y	
2nd floor ladies room		ND				ND – 0.3		N	Y	Y	Spray deodorizer

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Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m3)	TVOC (ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
2nd floor Lunchroom	575	ND	70	57	27	ND – 0.3	0	N	Y	Y	3 refrigerators, 2 microwaves, toaster oven, coffeemaker
2nd floor restroom off waiting room						ND – 0.3		N	Y	Y	
Law library/meeting room	549	ND	70	54	25	ND – 0.3	0	N	Y	Y	
FIRST FLOOR											
1003 (hearing)	806	ND	70	54	29	ND – 0.3	1	N	Y	Y	
1006	664	ND	71	54	31	ND – 0.3	0	N	Y	Y	Wall hanging fabric
1015 (interview)	717	ND	72	57	29	ND – 0.3	0	N	Y	Y	
1024 SNAP	895	ND	74	51	27	ND – 0.3	1	N	Y	Y	
1025 (inside reception)	923	ND	75	52	27	ND – 0.3	7	N	Y	Y	PF, sanitizer

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Address: 280 Merrimack Street, Lawrence, MA **Table 1 (Continued)** **Date: 8/22/2013**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m3)	TVOC (ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
1026 Mail room	727	ND	75	49	27	ND – 0.3	0	N	Y	Y	Mailroom items, PC, papers
1037 (cubes)	554	ND	72	52	30	ND – 0.3	0	N	Y	Y	
1040 (cubes)	672	ND	73	55	33	ND – 0.3	0	N	Y	Y	
1041 (semi-wall)	617	ND	73	55	32	ND – 0.3	0	N	Y	Y	
1046 (cubes)	634	ND	73	55	32	ND – 0.3	0	N	Y	Y	Sanitizer, PF
1049 (cubes)	640	ND	73	55	31	ND – 0.3	1	N	Y	Y	Plants
1052 (cubes)	645	ND	72	56	31	ND – 0.3	0	N	Y	Y	Plants
1055 (semi-wall)	629	ND	72	56	32	ND – 0.3	1	N	Y	Y	
1056 (cubes)	660	ND	72	56	32	ND – 0.3	1	N	Y	Y	
1058 (cubes)	723	ND	72	56	31	ND – 0.3	1	N	Y	Y	Paper

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Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m3)	TVOC (ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
1059 (cubes)	636	ND	72	56	32	ND – 0.3	1	N	Y	Y	Plants
1061 (cubes)	631	ND	72	57	34	ND – 0.3	0	N	Y	Y	Plants, sanitizer
1062 (cubes)	714	ND	72	56	31	ND – 0.3	0	N	Y	Y	
1066 (cubes)	634	ND	71	57	33	ND – 0.3	0	N	Y	Y	PF, perfume odor
1069 (cubes)	581	ND	71	57	32	ND – 0.3	0	N	Y	Y	
1070 (semi-wall)	637	ND	70	57	30	ND – 0.3	0	N	Y	Y	
1075 (cubes)	601	ND	71	57	30	ND – 0.3	0	N	Y	Y	
1077 (cubes)	630	ND	71	57	31	ND – 0.3	0	N	Y	Y	
1080 (cubes)	650	ND	72	57	31	ND – 0.3	0	N	Y	Y	
1083 (office)	630	ND	71	56	30	ND – 0.3	0	N	Y	Y	

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									Supply	Exhaust	
1086 (semi-wall)	620	ND	71	56	32	ND – 0.3	0	N	Y	Y	CP
1089 (cubes)	637	ND	71	57	32	ND – 0.3	0	N	Y	Y	Plants
1095 (cubes)	743	ND	72	53	30	ND – 0.3	0	N	Y	Y	PF
1096 (semi-wall)	625	ND	72	53	29	ND – 0.3	1	N	Y	Y	
1099 (cubes)	610	ND	72	54	29	ND – 0.3	1	N	Y	Y	
1101 (cubes)	617	ND	72	54	30	ND – 0.3	2	N	Y	Y	Plants
1103 (cubes)	682	ND	72	54	31	ND – 0.3	1	N	Y	Y	PF
1108 (office)	643	ND	71	53	29	ND – 0.3	1	N	Y	Y	
1110 (semi-wall)	564	ND	72	53	31	ND – 0.3	0	N	Y	Y	Food
1121 (cubes)	778	ND	74	51	21	ND – 0.3	2	N	Y	Y	

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									Supply	Exhaust	
1123 (cubes)	748	ND	74	51	29	ND – 0.3	0	N	Y	Y	
1126 (cubes)	744	ND	74	51	29	ND – 0.3	0	N	Y	Y	
1129 (conference)	582	ND	71	49	30	ND – 0.3	0	N	Y	Y	Solar gain
1130 (cubes)	624	ND	73	49	30	ND – 0.3	0	N	Y	Y	
1133 (office)	583	ND	72	51	30	ND – 0.3	0	N	Y	Y	
1135 (cubes)	610	ND	73	53	30	ND – 0.3	0	N	Y	Y	
1138 (semi-wall)	570	ND	73	52	31	ND – 0.3	0	N	Y	Y	
1139 (cubes)	571	ND	72	53	30	ND – 0.3	0	N	Y	Y	Papers
1145 (cubes)	571	ND	73	52	30	ND – 0.3	0	N	Y	Y	Plants
1146 (semi-wall)	661	ND	74	53	30	ND – 0.3	0	N	Y	Y	Plants

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									Supply	Exhaust	
1149 (cubes)	563	ND	73	51	30	ND – 0.3	0	N	Y	Y	Solar gain, plants
1155 (semi-wall)	580	ND	72	52	31	ND – 0.3	0	N	Y	Y	
1308 (interview)	633	ND	71	45	27	ND – 0.3	0	N	Y	Y	
1329 (DCF)	583	ND	71	48	24	ND – 0.3	1	N	Y	Y	
1335 (cubes)	579	ND	71	48	25	ND – 0.3	1	N	Y	Y	Sanitizer
1340 (office)	618	ND	71	48	24	ND – 0.3	1	N	Y	Y	
1341 (office)	643	ND	72	48	24	ND – 0.3	1	N	Y	Y	Under desk heater - on
1343 (cubes)	627	ND	72	47	24	ND – 0.3	0	N	Y	Y	
1345 (cubes)	622	ND	73	46	23	ND – 0.3	0	N	Y	Y	Under desk heater – on, plants
1351 (cubes)	582	ND	72	45	24	ND – 0.3	2	N	Y	Y	Flowers, temperature complaints

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									Supply	Exhaust	
1359 (cubes)	657	ND	71	46	25	ND – 0.3	1	N	Y	Y	Plants, area rug
1364 (office)	591	ND	71		23	ND – 0.3	0	N	Y	Y	
1367 (cubes)	601	ND	71	46	23	ND – 0.3	3	N	Y	Y	PF
1372 (cubes)	602	ND	71	46	24	ND – 0.3	2	N	Y	Y	
1381 (cubes)	584	ND	71	46	24	ND – 0.3	2	N	Y	Y	PF, items
1387 (office)	606	ND	71	46	24	ND – 0.3	0	N	Y	Y	
1388 (cubes)	613	ND	71	46	24	ND – 0.3	1	N	Y	Y	Coffeemaker
1389 (cubes)	610	ND	71	46	24	ND – 0.3	0	N	Y	Y	
1420 (cubes)	607	ND	71	46		ND – 0.3	0	N	Y	Y	
1423 (cubes)	593	ND	71	46	26	ND – 0.3	2	N	Y	Y	Food

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									Supply	Exhaust	
1428 (office)	614	ND	71	47	26	ND – 0.3	1	N	Y	Y	
1429 (cubes)	555	ND	71	46	27	ND – 0.3	2	N	Y	Y	
1438 (cubes)	548	ND	71	45	28	ND – 0.3	0	N	Y	Y	
1444 (cubes)	534	ND	70	45	28	ND – 0.3	2	N	Y	Y	Temperature complaints
1450 (office)	596	ND	71	45	24	ND – 0.3	0	N	Y	Y	Items
1451 (cubes)	519	ND	72	46	28	ND – 0.3	1	N	Y	Y	
1457 (office)	522	ND	72	45	28	ND – 0.3	0	N	Y	Y	
1459 (cubes)	591	ND	72	46	28	ND – 0.3	0	N	Y	Y	
1473 (cubes)	496	ND	72	46	28	ND – 0.3	2	N	Y	Y	
1495 (semi-wall)	522	ND	71	46	25	ND – 0.3	0	N	Y	Y	

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									Supply	Exhaust	
1496 (cubes)	502	ND	71	46	25	ND – 0.3	0	N	Y	Y	
1497 (office)	550	ND				ND – 0.3	0	N	Y	Y	
1st floor Lunch room	643	ND	71	56	33	ND – 0.3	0	N	Y	Y	Fridges, microwaves, vending, toasters
1st floor Waiting room (12 pm)	1095	ND	73	55	27	ND – 0.3	~80	N	Y	Y	PC in use, area NC
1st floor Waiting room (9:30 am)	764	ND	77	47	22	ND – 0.3	~35	N	Y	Y	PC in use, area NC
Copy area	866	ND	74	51	27	ND – 0.3	0	N	Y	Y	2 PCs

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