

# INDOOR AIR QUALITY ASSESSMENT

**Commonwealth of Massachusetts  
EOHHS Center  
500 Main Street  
Hyannis, Massachusetts**



Prepared by:  
Massachusetts Department of Public Health  
Bureau of Environmental Health  
Indoor Air Quality Program  
May 2011

## **Background/Introduction**

In response to a request from David Devine, Project Manager, Division of Capital Asset Management (DCAM), the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH), conducted an indoor air quality (IAQ) assessment at the Executive Office of Health and Human Services (EOHHS) Center located at 500 Main Street, Hyannis, Massachusetts. On March 18, 2011, a visit to conduct the IAQ assessment was made by Cory Holmes, Environmental Analyst/Regional Inspector in BEH's IAQ Program. The assessment was prompted by natural gas odors in the building.

The building is a one-story office building that is occupied by the following Massachusetts state agencies: Department of Transitional Assistance (DTA), Department of Mental Health (DMH), the Developmental Disability Services (DDS), the Massachusetts Rehabilitation Commission (MRC) and the Department of Children and Families (DCF). The center contains offices, open work areas, and conference/meeting rooms. The building has no openable windows.

## **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. BEH staff also performed visual inspection of building materials for water damage and/or microbial growth.

## **Results**

The tests were taken during normal operations. Test results appear in Table 1 and are listed by agency, occupants' last name(s) or numerical designation (where available).

## **Discussion**

### **Ventilation**

It can be seen from Table 1 that carbon dioxide levels were below 800 parts per million (ppm) in all but one of the 72 areas surveyed indicating adequate air exchange at the time of testing (Table 1). Fresh air is provided by rooftop air handling units (AHU). Fresh air is drawn into the AHUs through a bank of pleated filters, heated or cooled and delivered to occupied areas via ducted air diffusers. Return air is drawn into an above ceiling plenum and ducted back to rooftop AHUs.

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (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 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](#).

Temperatures ranged from 68°F to 76°F (Table 1), which were within or close to the MDPH recommended comfort range. 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.

Relative humidity measurements ranged from 27 to 43 percent, the majority of which were below the MDPH recommended comfort range the day of 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**

Employees expressed concerns of possible mold growth on the interior of windows in the DTA area but did not report any leaks or other evidence of water. BEH staff observed the

windows in this area and noted a dark deposition of debris on the window surface (Picture 1). 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. BEH staff did not observe water-damaged ceiling tiles, wallboard or staining around window frames. Glass in a non-porous surface is generally not conducive to mold growth, however it is possible that dust on the surface of the glass, if moistened by condensation (water droplets), can serve as a mold growth medium. At the time of the assessment BEH recommended that the glass be cleaned and monitored to determine if the staining occurs.

### **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 ( $\mu\text{m}$ ) or less (PM<sub>2.5</sub>) 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 PM<sub>2.5</sub>.

#### *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. The day of the assessment, outdoor carbon monoxide concentrations were non-detect (ND) (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  $\mu\text{m}$  or less (PM10). According to the NAAQS, PM10 levels should not exceed 150 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) 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  $\mu\text{g}/\text{m}^3$  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 21  $\mu\text{g}/\text{m}^3$  on the day of the assessment (Table 1). PM2.5 levels measured indoors ranged from 9 to 19  $\mu\text{g}/\text{m}^3$  (Table 1), which were below the NAAQS PM2.5 level of 35  $\mu\text{g}/\text{m}^3$ . 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.

### *Natural Gas Odors*

As stated previously, the assessment was reported by concerns regarding natural gas odors in the building. It was reported by building maintenance personnel that upon receiving complaints of the detection of natural gas, manufacture of the rooftop AHUs was contacted to investigate the source of the odor. The source of odors was reportedly related to a mechanical issue (a defective baffle) inside one of the AHUs, which was replaced prior to the MDPH/BEH assessment. Reportedly, no additional complaints of natural gas odors were detected since this repair. Further, no such complaints were reported to BEH staff at the time of the assessment.

### *Other Conditions*

Other conditions that can affect indoor air quality were observed during the assessment. Cobwebs were observed along window wells. A number of air diffusers, exhaust/return vents and personal fans were observed with accumulated dust/debris. If exhaust vents are not functioning, backdrafting can occur, which can re-aerosolize accumulated dust particles. Re-activated supply vents and fans can also aerosolize dust accumulated on vents/fan blades. In addition, BEH staff noted that vacuum cleaners used in the building (Picture 2) are not equipped with high efficiency particulate arrestance (HEPA) filters, which is recommended by the MDPH to maintain dust control and reduce airborne particulates.

Finally, it was expressed to BEH staff at the time of the assessment that occupants had concerns regarding exposure to radio frequency signals or RFs, generated from a cell phone tower on top of the building. It was reported by building maintenance personnel that the cell phone transmitter is located approximately five-feet from the top of the twenty to twenty-five foot tower/chimney on top of the building (Pictures 3 and 4). These types of transmitters use

radio frequencies which are part of the overall spectrum of electromagnetic fields. It is important to note however that radio frequency fields are not ionizing radiation (e.g., x-rays) and for that reason cannot cause radioactivity in the body. Radio frequency fields that penetrate tissues that are absorbed into the body produce heat. Health effects have been established related to heat, but radio frequency energy does not occur at high enough levels to cause significant heating (WHO, 2006). A fact sheet developed by the World Health Organization (WHO) which addresses concerns regarding cancer and non-cancer health effects in relation to radio frequency is included as [Appendix B](#).

## **Conclusions/Recommendations**

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

1. If not done previously, clean dark material/debris off windows shown in Picture 1.  
Monitor for reoccurrence and clean as needed.
2. Upgrade vacuum cleaning equipment. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended.
3. Clean accumulated dust and debris periodically from the surface of air diffusers, exhaust vents and blades of personal fans.
4. If natural gas odors reoccur, contact the AHU manufacturer and/or HVAC engineering firm for further evaluation/guidance.
5. 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

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

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. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

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>.

WHO. 2006. World Health Organization. Electromagnetic Fields and Public Health. Base Stations and Wireless Technologies. Fact Sheet N°304. May 2006.

**Picture 1**



**Dark Debris/Material on Glass Window Panes in DTA Area**

**Picture 2**



**Vacuum Cleaners in Custodial Closet**

**Picture 3**



**Tower/Chimney on top of EOHHS Center and General Location of Cell Phone Transmitter**

**Picture 4**



**Tower/Chimney on top of EOHHS Center and General Location of Cell Phone Transmitter**

| Location             | Occupants in Room | Temp (°F) | Relative Humidity (%) | Carbon Dioxide (ppm) | Carbon Monoxide (ppm) | PM2.5 (ug/m3) | Windows Openable | Ventilation |   | Remarks  |
|----------------------|-------------------|-----------|-----------------------|----------------------|-----------------------|---------------|------------------|-------------|---|--|
| Outside (Background) |                   | 51        | 57                    | 368                  | ND                    | 21            |                  |             |   | Mostly cloudy, cool, strong winds SW 15-29 mph, gusts up to 47 mph |
| <b>DTA</b>           |                   |           |                       |                      |                       |               |                  |             |   |  |
| Doherty/Goddard      | 4                 | 69        | 43                    | 601                  | ND                    | 14            | N                | Y           | Y | Dark staining on windows   |
| Bernardo/Olga        | 3                 | 69        | 37                    | 583                  | ND                    | 15            | N                | Y           | Y | Dark staining on windows   |
| Hyatt                | 3                 | 70        | 35                    | 525                  | ND                    | 15            | N                | Y           | Y |  |
| Swaidan/Sheehan      | 3                 | 70        | 34                    | 509                  | ND                    | 15            | N                | Y           | Y |  |
| Gordan/Silva         | 2                 | 71        | 34                    | 537                  | ND                    | 15            | N                | Y           | Y |  |
| DTA Copy Center      | 0                 | 71        | 34                    | 540                  | ND                    | 15            | N                | Y           | Y |  |
| Stanley/Kenney       | 6                 | 71        | 33                    | 509                  | ND                    | 15            | N                | Y           | Y |  |
| File Cabinet Area    | 0                 | 71        | 32                    | 509                  | ND                    | 15            | N                | Y           | Y | Cooler on carpet/reservoir dirty                                   |

ppm = parts per million

ND = non detect

CT = ceiling tile

µg/m<sup>3</sup> = micrograms per cubic meter

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%

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 |
|---------------------|-------------------|-----------|-----------------------|----------------------|-----------------------|---------------|------------------|-------------|---|---------|
| <b>DDS</b>          |                   |           |                       |                      |                       |               |                  |             |   |         |
| DDS (Center)        | 6                 | 71        | 32                    | 470                  | ND                    | 14            | N                | Y           | Y |         |
| DDS (Side)          | 0                 | 71        | 31                    | 464                  | ND                    | 14            | N                | Y           | Y |         |
| DDS (Rear Corner)   | 1                 | 71        | 31                    | 449                  | ND                    | 14            | N                | Y           | Y |         |
| <b>MRC</b>          |                   |           |                       |                      |                       |               |                  |             |   |         |
| MRC Copy Area       | 0                 | 71        | 31                    | 440                  | ND                    | 15            | N                | Y           | Y |         |
| MRC Conference Room | 0                 | 71        | 31                    | 414                  | ND                    | 15            | N                | Y           | Y |         |
| Vogt                | 1                 | 71        | 31                    | 448                  | ND                    | 15            | N                | Y           | Y |         |
| Pocknett/Jablonski  | 0                 | 71        | 31                    | 440                  | ND                    | 15            | N                | Y           | Y |         |
| Ferrari             | 1                 | 71        | 31                    | 436                  | ND                    | 15            | N                | Y           | Y |         |

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|--------------------|-------------------|-----------|-----------------------|----------------------|-----------------------|---------------|------------------|-------------|---|---------|
|                    |                   |           |                       |                      |                       |               |                  | Y           | Y |         |
| Moriarti           | 0                 | 71        | 31                    | 464                  | ND                    | 15            | N                | Y           | Y |         |
| Jefferson/Clarkson | 2                 | 71        | 30                    | 414                  | ND                    | 16            | N                | Y           | Y |         |
| Conference Room A  | 0                 | 73        | 31                    | 583                  | ND                    | 16            | N                | Y           | Y |         |
| Conference Room B  | 0                 | 71        | 30                    | 446                  | ND                    | 15            | N                | Y           | Y |         |
| Conference Room C  | 0                 | 71        | 30                    | 414                  | ND                    | 16            | N                | Y           | Y |         |
| Reception          | 4                 | 73        | 32                    | 636                  | ND                    | 17            | N                | Y           | Y |         |
| <b>DMH</b>         |                   |           |                       |                      |                       |               |                  |             |   |         |
| North/Ropulewis    | 0                 | 72        | 30                    | 512                  | ND                    | 15            | N                | Y           | Y |         |
| Bellmar/Porter     | 2                 | 72        | 31                    | 515                  | ND                    | 15            | N                | Y           | Y |         |
| Horner             | 1                 | 72        | 30                    | 526                  | ND                    | 17            | N                | Y           | Y |         |

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|------------------|-------------------|-----------|-----------------------|----------------------|-----------------------|---------------|------------------|-------------|---|--|
|                  |                   |           |                       |                      |                       |               |                  | Y           | Y |  |
| Tavares          | 1                 | 73        | 31                    | 550                  | ND                    | 17            | N                | Y           | Y |  |
| Labute/Pallis    | 2                 | 72        | 30                    | 500                  | ND                    | 15            | N                | Y           | Y |  |
| Paige            | 1                 | 72        | 31                    | 537                  | ND                    | 15            | N                | Y           | Y |  |
| Carter           | 1                 | 72        | 31                    | 513                  | ND                    | 16            | N                | Y           | Y |  |
| <b>Basement</b>  |                   |           |                       |                      |                       |               |                  |             |   |  |
| DTA Storage Room | 0                 | 69        | 28                    | 467                  | ND                    | 11            | N                | Y           | Y |  |
| MRC Storage Room | 0                 | 68        | 30                    | 490                  | ND                    | 10            | N                | Y           | Y |  |
| DMH Storage Room | 0                 | 70        | 29                    | 492                  | ND                    | 9             | N                | Y           | Y |  |
| DDS Storage Room | 0                 | 69        | 31                    | 489                  | ND                    | 11            | N                | Y           | Y | Peeling paint, efflorescence at base of wall |

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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              |
|------------------------|-------------------|-----------|-----------------------|----------------------|-----------------------|---------------|------------------|-------------|---|----------------------|
|                        |                   |           |                       |                      |                       |               |                  |             |   |                      |
| DCF Storage 1          | 0                 | 76        | 27                    | 473                  | ND                    | 15            | N                | Y           | Y |                      |
| DCF Storage 2          | 0                 | 69        | 29                    | 486                  | ND                    | 16            | N                | Y           | Y | 1 WD CT              |
| DCF Storage 4          | 0                 | 69        | 27                    | 462                  | ND                    | 14            | N                | Y           | Y | 3 WD CTs             |
| DDCF Records Room      | 0                 | 70        | 28                    | 474                  | ND                    | 15            | N                | Y           | Y |                      |
| <b>DCF</b>             |                   |           |                       |                      |                       |               |                  |             |   |                      |
| DCF Basement Work Area | 1                 | 71        | 29                    | 511                  | ND                    | 12            | N                | Y           | Y |                      |
| Lobby                  | 0                 | 71        | 31                    | 681                  | ND                    | 12            | N                | Y           | Y |                      |
| Reception              | 1                 | 72        | 32                    | 765                  | ND                    | 19            | N                | Y           | Y | Dust/debris on vents |
| Sheriden               | 0                 | 71        | 29                    | 538                  | ND                    | 13            | N                | Y           | N |                      |
| Interview Room 1       | 0                 | 71        | 31                    | 640                  | ND                    | 10            | N                | Y           | N |                      |

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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                |
|------------------------|-------------------|-----------|-----------------------|----------------------|-----------------------|---------------|------------------|-------------|---|------------------------|
|                        |                   |           |                       |                      |                       |               |                  | Y           | N |                        |
| Interview Room 2       | 0                 | 72        | 31                    | 660                  | ND                    | 10            | N                | Y           | N |                        |
| Interview Room 5       | 0                 | 72        | 30                    | 632                  | ND                    | 10            | N                | Y           | Y |                        |
| Interview Room 6       | 0                 | 71        | 30                    | 621                  | ND                    | 11            | N                | Y           | Y | 1 WD CT                |
| Karisko                | 0                 | 71        | 30                    | 723                  | ND                    | 17            | N                | Y           | Y | Airflow complaints     |
| 144 Adoption Unit      | 0                 | 73        | 31                    | 710                  | ND                    | 17            | N                | Y           | Y |                        |
| 143                    | 3                 | 73        | 31                    | 730                  | ND                    | 17            | N                | Y           | Y |                        |
| 142                    | 0                 | 73        | 31                    | 721                  | ND                    | 18            | N                | Y           | Y |                        |
| 141                    | 0                 | 73        | 30                    | 701                  | ND                    | 18            | N                | Y           | Y |                        |
| 140                    | 1                 | 74        | 30                    | 734                  | ND                    | 18            | N                | Y           | Y |                        |
| Hallway near restrooms |                   |           |                       |                      |                       |               |                  |             |   | Water cooler on carpet |

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| Location         | Occupants in Room | Temp (°F) | Relative Humidity (%) | Carbon Dioxide (ppm) | Carbon Monoxide (ppm) | PM2.5 (ug/m3) | Windows Openable | Ventilation |   | Remarks |
|------------------|-------------------|-----------|-----------------------|----------------------|-----------------------|---------------|------------------|-------------|---|---------|
|                  |                   |           |                       |                      |                       |               |                  | Y           | Y |         |
| 163              | 0                 | 73        | 30                    | 753                  | ND                    | 16            | N                | Y           | Y |         |
| 162              | 2                 | 74        | 31                    | 796                  | ND                    | 15            | N                | Y           | Y |         |
| 161              | 1                 | 74        | 30                    | 777                  | ND                    | 14            | N                | Y           | Y |         |
| 160              | 1                 | 74        | 31                    | 767                  | ND                    | 14            | N                | Y           | Y |         |
| 152              | 2                 | 74        | 31                    | 926                  | ND                    | 14            | N                | Y           | Y |         |
| 159              | 1                 | 73        | 30                    | 791                  | ND                    | 14            | N                | Y           | Y |         |
| 158              | 2                 | 73        | 30                    | 780                  | ND                    | 14            | N                | Y           | Y |         |
| 157              | 1                 | 73        | 30                    | 736                  | ND                    | 14            | N                | Y           | Y |         |
| 147              | 2                 | 74        | 30                    | 740                  | ND                    | 13            | N                | Y           | Y |         |
| DCF Records Room | 0                 | 73        | 29                    | 732                  | ND                    | 14            | N                | Y           | Y |         |

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|----------|-------------------|-----------|-----------------------|----------------------|-----------------------|---------------|------------------|-------------|---|----------------------|
|          |                   |           |                       |                      |                       |               |                  |             |   |                      |
| 130      | 0                 | 73        | 29                    | 677                  | ND                    | 11            | N                | Y           | Y |                      |
| 117      | 2                 | 73        | 30                    | 710                  | ND                    | 11            | N                | Y           | N | Dust/debris on vents |
| 118      | 0                 | 73        | 29                    | 653                  | ND                    | 10            | N                | Y           | Y |                      |
| 120      | 0                 | 73        | 29                    | 610                  | ND                    | 10            | N                | Y           | Y |                      |
| 121      | 0                 | 73        | 29                    | 630                  | ND                    | 10            | N                | Y           | Y |                      |
| 124      | 0                 | 73        | 30                    | 647                  | ND                    | 12            | N                | Y           | Y | Dust/debris on vents |
| 122      | 0                 | 73        | 30                    | 633                  | ND                    | 10            | N                | Y           | Y | Plant                |
| 126      | 1                 | 73        | 30                    | 661                  | ND                    | 11            | N                | Y           | N |                      |
| 127      | 0                 | 73        | 29                    | 623                  | ND                    | 11            | N                | Y           | N |                      |
| 129      | 0                 | 73        | 29                    | 653                  | ND                    | 12            | N                | Y           | Y |                      |

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Location: EOHHS Center, 500 Main Street

Indoor Air Results

Address: Hyannis, MA

Table 1 (continued)

Date: March 18, 2011

| Location | Occupants in Room | Temp (°F) | Relative Humidity (%) | Carbon Dioxide (ppm) | Carbon Monoxide (ppm) | PM2.5 (ug/m3) | Windows Openable | Ventilation |   | Remarks |
|----------|-------------------|-----------|-----------------------|----------------------|-----------------------|---------------|------------------|-------------|---|---------|
|          |                   |           |                       |                      |                       |               |                  | Y           | N |         |
| 128      | 0                 | 73        | 29                    | 640                  | ND                    | 11            | N                | Y           | N |         |

ppm = parts per million

$\mu\text{g}/\text{m}^3$  = micrograms per cubic meter

ND = non detect

WD = water-damaged

CT = ceiling tile

**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%