INDOOR AIR QUALITY ASSESSMENT

University of Massachusetts
Curry Hicks Physical Education Building
100 Hicks Way
Amherst, 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 Ms. Yung Morgan of the University of Massachusetts, Environmental Health and Safety Department (EHS), the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH) conducted an indoor air quality (IAQ) assessment at the Curry Hicks Physical Education Building (CHPEB) located at 100 Hicks Way, University of Massachusetts, Amherst, Massachusetts. The request was prompted by general IAQ complaints, odors from the swimming pool and concerns related to the incidence of cancer among building occupants. On March 15, 2011, a visit to conduct a general IAQ assessment was made to the CHPEB by Lisa Hébert, Environmental Analyst/Regional Inspector of BEH's IAQ Program. Ms. Hébert was accompanied by Christine Gorwood, an Environmental Analyst/Risk Communication Specialist in BEH's Community Assessment Program (CAP).

The CHPEB is part of a two-building complex. The two buildings are connected, however, they function separately. Since the complaints stemmed from only one building (the CHPEB), the IAQ assessment focused solely on the CHPEB. The CHPEB is a two-story brick building built in 1931. The second floor is occupied by offices and the first floor is occupied by a gym/weight room, locker rooms and a swimming pool. Windows throughout the building are openable.

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. Screening for total volatile organic compounds (TVOCs) was

conducted using a MiniRAE 2000 Photo Ionization Detector (PID). BEH staff also performed visual inspection of building materials for water damage and/or microbial growth.

All CHPEB employees were offered the opportunity to be interviewed in relation to health and IAQ concerns by BEH/CAP staff. Participating employees provided information and were asked questions by CAP staff.

Results

The CHPEB houses approximately 24 staff and is used primarily as office space. The CHPEB is visited by up to 10 individuals daily. Tests were taken during normal operations and 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 all areas surveyed indicating adequate air exchange throughout the building at the time of testing. The ventilation system for offices at the CHPEB appears to have been designed to provide mechanical fresh air supply at one time; however, the original system appears to be largely disabled. Although fresh air intakes are visible on the exterior of the building, most are blocked on either the outside or directly inside the building (Pictures 1 through 3). With a lack of fresh air supply and/or exhaust ventilation, any interior pollutants will remain inside the building and be continuously re-circulated. This situation can lead to air quality/comfort complaints.

A storage room appeared to have a ceiling-mounted air supply diffuser, but its source of fresh air and/or whether or not it was active could not be determined at the time of the assessment. Likewise, the break room contained a direct exhaust to the outdoors that appeared to not have been used for some time.

Without an adequately functioning ventilation system, the only means to provide fresh air and remove pollutants from the indoor environment would be to open windows. This action is not advisable during hot, humid weather when air conditioning is operating. If windows are open when the air conditioning is operating, it leads to condensation generation on interior building components (e.g., cool surfaces). In addition, opening windows in the winter as a means of supplementing ventilation is also not feasible in Massachusetts. Therefore, the most viable means to provide for the comfort of individuals in this space is to provide a properly designed mechanical ventilation system.

The swimming pool and women's locker room are equipped with an exhaust system that is corroded and damaged (Pictures 4 and 5). Ventilation equipment in the swimming pool area is exposed to high humidity and corrosive vapors from pool treatment chemicals over its lifespan. As a result, measures should be taken to more closely monitor and maintain this equipment to ensure the proper functioning of the system and to determine when the equipment has reached the end of its useful service life.

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 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 temperatures ranged from 63º F to 77º F, which were close to or within the MDPH recommended comfort range in all but one area the day of the assessment (Table 1). The MDPH recommends that indoor air temperatures be maintained in a range of 70º F to 78º 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 18 to 55 percent, which was below the MDPH recommended comfort range in all but one area (the pool) 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 the exterior of the building to identify breaches in the building envelope or other issues that could provide a source of water penetration. Several potential sources were identified:

- Cracks were observed in the foundation (Picture 6);
- Glazing in windows was broken and/or missing (Picture 7). Be advised, window sealant may be composed of regulated materials [e.g., asbestos, polychlorinated biphenyls (PCBs)]. For information regarding PCBs, please consult MDPH guidance (Appendix B);
- Exterior doors exhibited gaps/spaces where light could be seen penetrating;
- Open utility holes were seen in masonry;
- Windows were in disrepair (Picture 8);
- Efflorescence[1] was observed on exterior brick;
- Trees and shrubs were located in close proximity to the foundation;
- Mulch was observed immediately adjacent to the building; and

[1] Efflorescence is a characteristic sign of water damage but it is not mold growth. As moisture penetrates and works its way through mortar, brick or plaster, water-soluble compounds dissolve, creating a solution. As the solution moves to the surface of the material, the water evaporates, leaving behind white, powdery mineral deposits.

- Evidence was observed of drainage from the roof deposited in close proximity to the foundation (Picture 9).

The aforementioned conditions represent potential water penetration sources. Over time, these conditions can undermine the integrity of the building envelope and provide a means of water entry into the building via capillary action through foundation concrete and masonry (Lstiburek & Brennan, 2001). The freezing and thawing action of water during the winter months can create cracks and fissures in the foundation. In addition, these breaches may provide a means for pests/rodents to enter the building.

On the interior of the building, peeling paint due to water damage was observed on windowsills (Picture 10). Water-damaged ceiling tiles were observed in a storage room. The source of the water damage should be identified and remedied, after which the ceiling tiles should be replaced, as chronically moistened porous material may lead to mold colonization.

Water coolers were located on carpeting in several areas (Picture 11). Overflow of the water basin or spills that often occur can moisten carpeting, which can lead to mold growth. It is also important that the catch basin of water coolers be cleaned regularly as stagnant water can be a source of odors, and materials (i.e., dust) collected in the catch basin can provide a medium for mold growth.

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 some offices. 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.

It is important to note that the pool and locker rooms did not have adequately operating exhaust ventilation which may allow for water vapor and accompanying pool treatment chemical odors to accumulate in the pool building and potentially migrate into other parts of the building complex. It is advisable to keep doors to pool areas closed and ensure they are in good working order; seal any breaches (e.g., utility holes, spaces) or other paths of odor migration in common walls between the pool and adjacent areas; and to provide adequate local exhaust ventilation in the pool area. Without adequate exhaust ventilation and/or proper containment, moisture and odors from the pool area can penetrate into other portions of the building leading to complaints and/or damage to building components.

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 building 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. 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 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 42 $\mu g/m^3$ (Table 1), which was above the NAAQS PM2.5 level of 35 $\mu g/m^3$. PM2.5 levels measured indoors ranged from 17 to 29 $\mu g/m^3$ (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 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.

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. In an effort to identify materials that can potentially increase VOC concentrations, BEH staff conducted measurements for TVOCs throughout the building. Outdoor air samples were taken for comparison. Outdoor TVOC concentrations were ND. No measurable levels of TVOCs were detected in the building at the time of the assessment (Table 1).

Some offices 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.

Other Conditions

Other conditions that can affect indoor air quality were observed during the assessment. Building occupants reported observing mice in the building. Numerous cockroaches were observed (dead and alive, Pictures 12 and 13). To penetrate the exterior of a building, rodents require a minimal breach of ¼ inch (MDFA, 1996). The most likely route for pests to enter the

CHPEB is via gaps under doors and penetrations of utility lines not sealed on the exterior of the building. Rodent and insect infestation result from easy access to food and water in a building. Rodent infestation can cause related symptoms due to materials in their wastes. Mouse urine and cockroach fragments contain a protein that is a known sensitizer (US EPA, 1992). A sensitizer is a material that can produce symptoms in exposed individuals, including runny nose or skin rashes. A three-step approach is necessary to eliminate pest infestation:

1. removal of the insects and rodents;
2. cleaning of waste products from the interior of the building; and
3. reduction/elimination of pathways/food sources that are attracting pests.

To eliminate exposure to allergens, rodents and cockroaches must be removed from the building. Please note that removal, even after cleaning, may not provide immediate relief since allergens can exist in the interior for several months after these pests are eliminated (Burge, 1995). A combination of cleaning, increase in ventilation and filtration should serve to reduce rodent and cockroach associated allergens once the infestation is eliminated.

Peeling paint was observed on the ceiling and wall of a stairway leading to the pool area (Picture 14). It was reported that this was a chronic condition that reoccurs after each repainting takes place. This is likely due to moisture/chlorine from the pool area migrating up the stairs on days that the pool is in use. In order to explain how pollutants from the pool area may be impacting the stairway and upper floor, the following concepts concerning heated air and the creation of air movement must be understood.

- Heated air will create upward air movement (called the stack effect).
- As heated air rises, negative pressure is created, which draws cold air from outdoors through cracks or crevices in foundation walls.

- As air rises, airborne pollutants will travel in the created air stream.
- As the range of temperature between hot and cold air increases, the rate of upward airflow increases.

Each of these concepts has influence on the movement of air.

A number of rooms had window-mounted air conditioners (ACs) or wall-mounted units. ACs are normally equipped with filters, which should be cleaned or changed as per the manufacturer's instructions to avoid the build-up and re-aerosolization of dirt, dust and particulate matter.

Numerous floor drains in the building were examined and found to be highly corroded. At some point the traps may rust out and allow sewer gases from the drainage system to enter the building. This condition should be monitored and repaired as necessary.

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

Damaged or missing floor tiles were observed in some areas (Picture 15). These floor tiles may contain asbestos. Intact asbestos-containing materials do not pose a health hazard. If damaged, asbestos-containing materials can be rendered friable and become aerosolized. Friable asbestos is a chronic (long-term) health hazard, but will not produce acute (short-term) health effects (e.g., headaches) typically associated with buildings believed to have indoor air quality problems. Where asbestos-containing materials are found damaged, the materials should be removed or remediated in a manner consistent with Massachusetts asbestos remediation laws (MDLI, 1993).

Health Concerns

As mentioned, BEH also received reports of staff health concerns in the CHPEB. BEH conducted interviews with Curry Hicks staff at the time of the IAQ inspection. The type and frequency of the symptoms experienced by some Curry Hicks employees were obtained through administration of a questionnaire by BEH/CAP staff. The questionnaire elicited information on those symptoms that have been reported in the scientific/medical literature as commonly experienced in buildings with indoor air quality problems. These types of questionnaires are used to systematically collect building-related health and environmental complaints. The information collected, in conjunction with the assessment of the indoor environment, can be used to evaluate possible associations between indoor air quality and health and to recommend appropriate follow-up if warranted.

The questionnaire was developed by BEH to assess the types of symptoms reported among a group of concerned employees of the CHPEB. The questionnaire was closely modeled on surveys used previously by BEH as well as those used by the National Institute of Occupational Safety and Health (NIOSH) and the U.S. Environmental Protection Agency (USEPA). It included questions on specific symptoms (those commonly experienced by occupants of buildings with indoor air problems), on perceived air quality, and on personal factors.

On March 15, 2011 BEH staff conducted in-person interviews with four Curry Hicks employees. The offices in the CHPEB have a combined employee population of approximately 24. These four interviews took approximately 30 to 45 minutes each over the course of the day.

All responses were reviewed to identify the types of diseases and symptoms reported, their frequency of occurrence, and whether any unusual patterns emerged suggestive of a

possible association with indoor environmental conditions in the CHPEB. A response of "at least once a week in the past four weeks" was considered a "yes" for reporting a symptom. Symptoms were grouped into two categories: respiratory/irritant effects (such as cough or wheezing, and or skin irritations) and neurological (such as headaches or difficulty remembering things)

Employee Interview Results

Information from the four individuals interviewed is summarized below. Under both state and federal regulations, personally- identifying information shared by employees is confidential; thus, the following discussion provides summary information only.

Health Effects

The most commonly reported symptom among the 4 employees interviewed was headaches. When asked how often they experienced headaches in the last four weeks, the responses varied from daily to 1 to 3 times per month.

Two of the four participants reported experiencing pain in their neck, shoulders or back and unusual tiredness or fatigue. One of these individuals reported pain in their neck, back or shoulders every day or almost every day while the other reported experiencing it one to three times per month. Two people reported unusual tiredness or fatigue in the afternoon, ranging from 1 to 3 times per week to 1 to 3 times per month.

Other symptoms that were reported by the four employees to have been experienced at least once a week in the last six weeks included the following: itchy, runny or watery eyes; cough; nausea or upset stomach; skin irritation, dryness, or rash; and, tingling in their hands and feet.

Most of the employees interviewed reported experiencing at least one of the following symptoms: dry or irritated eyes; sore or dry throat; sneezing and stuffy or runny nose; headache; difficulty remembering things or concentrating; dizziness or lightheadedness; tingling in their hands or feet; or unusual tiredness or fatigue.

Building Concerns

The four Curry Hicks building employees were also asked about their perceptions of environmental conditions in their work environment. Their responses included the following:

- Inconsistency in building temperature;
- The air being too dry and stuffy;
- The presence of unusual or unpleasant dust and/or odors;
- Structural damage to windows;
- Chipping ceiling paint or damaged ceiling tiles;
- Water damage in the building, specifically near the restrooms and in the wall in the hall near the water fountain; and
- Mice and insects in the building; a couple of people noted that the building is regularly fumigated.

Comments from survey participants

In addition to answering standard questions in the survey, most participants provided BEH with additional comments. These comments can be roughly broken down into two categories:

- Concerns about the indoor air environment of the building, particularly in regard to the age of the building, unusual smells and odors, and possible exposure to building materials such as asbestos.
- Concerns regarding health, with some individuals raising questions about long-term health effects of breathing the indoor air in the building.

Cancer Concerns

Some individuals interviewed mentioned that they were concerned about cancer because they felt that the number of staff members in the CHPEB diagnosed with cancer was unusual. In addition to some current staff having a diagnosis of cancer, it was reported to BEH that a former employee had been diagnosed with cancer.

When BEH reviews information on cancer diagnoses, such as that provided for the CHPEB, BEH/CAP staff look at several factors to assess whether the pattern of cancer appears to be unusual:

- What types of cancer are involved?
- Do the cancer types share similar etiologies (i.e., causes/characteristics)?
- How does the relative frequency of the various types of cancer reported compare to what we know about the occurrence of the different types of cancer in the population of Massachusetts as a whole?
- Are there an unusual number of rare types of cancer?

An important finding related to what MDPH learned about cancer diagnoses among employees was that distinctly different types of cancer were reported among the individuals diagnosed with cancer. To protect privacy, MDPH will not report the specific types of cancer

reported; however, based on the cancer types reported to BEH/CAP staff, no unusual patterns of cancer were noted among CHPEB staff to suggest that a common environmental or non-environmental risk factor might be associated with the occurrence of cancer among CHPEB staff. It is important to note that cancer is not one disease, but rather more than 100 different diseases each with certain risk factors associated with their development. The types of cancer reported among employees would not be expected to be associated with working in the Curry Hicks Building.

The major risk factors for the particular cancer types that were reported to BEH/CAP staff including the following range: family history; genetic susceptibility; pre-existing medical conditions; hormonal therapies; and lifestyle choices, such as diet or smoking. The cancer types diagnosed in CHPEB staff are not those reported in the medical/epidemiological literature as being possibly associated with chemical or radiological exposures. It is also important to note that, with one exception, the types of cancer diagnosed among CHPEB staff include those most commonly diagnosed in the general population. BEH/CAP did not see an unusual number of rare types of cancer among CHPEB staff.

Health Discussion

The respiratory/irritant and neurological health symptoms reported among participants in this health investigation are generally those most commonly experienced in buildings with indoor air quality problems. These included sore, hoarse or dry throat; dry, itchy eyes; sneezing, stuffy or runny nose; as well as headaches. Such symptoms are commonly associated with ventilation problems in buildings, although other factors (e.g., odors, microbiological contamination) may also contribute (Stolwijk et al. 1991; Burr et al. 1996; Nordstrom et al. 1995).

When considering whether the pattern of cancer may be unusual, it is important to remember that cancer is a broad term used to describe many diseases. A perceived cancer cluster is more likely to be genuine if the diagnoses consist of one type of cancer, a rare type of cancer, or a type of cancer that is not usually found in an age group. According to American Cancer Society statistics, cancer is the second leading cause of death in Massachusetts and the United States. Not only will one out of three women and one out of two men develop cancer in their lifetime, but cancer will affect three out of every four families.

For this reason, cancers often appear to occur in "clusters" and it is understandable that someone may perceive that there are an unusually high number of cancer cases in their neighborhood, community or workplace. Upon close examination, many "clusters" reported within a community are not unusual increases, as first thought, but are related to such factors as local population density, variations in reporting or chance fluctuations in occurrence. In other instances, the "cluster" in question includes a high concentration of individuals who possess related behaviors or risk factors for cancer. Some, however, are unusual; that is, they represent a true excess of cancer in a workplace, a community, or among a subgroup of people. A suspected cluster is more likely to be a true cancer cluster if it involves an unusually high number of diagnoses of one type of cancer in a relatively short time period rather than several different types diagnosed over a long period of time (i.e., 20 years), a rare type of cancer rather than common types, and/or a large number of diagnoses among individuals in age groups not usually affected by that cancer. These types of clusters may warrant further public health investigation.

Based upon the information reviewed by BEH from the interviews with Curry Hicks staff, the respiratory/irritant effects and neurological symptoms reported by the Curry Hicks staff appear to be consistent with indoor air quality problems generally associated with lack of

adequate air supply/ventilation. The overall pattern of cancer among employees does not appear to be unusual and is not thought to be associated with the indoor environment at the CHPEB.

Conclusions/Recommendations

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

1. To prevent/reduce moisture and odors from the pool area from migrating to adjacent areas of the building consider the following:
    a. Keep doors to pool areas shut and ensure they are in good working order. Ensure doors fit completely flush with their threshold, replace/repair if necessary. Seal doors with foam tape and/or weather-stripping. Ensure tightness of doors by monitoring for light penetration and drafts beneath door and around doorframes.
    b. Seal any breaches (e.g., utility holes, spaces) in common walls between the pool and adjacent areas with an appropriate material to prevent/reduce moisture/odor migration to other areas of the building.
    c. Provide adequate local exhaust ventilation in the pool area.
2. Consult with an HVAC engineering firm regarding the feasibility of repair vs. replacement of ventilation system components in the pool area/locker rooms given their age and degraded condition. The pool exhaust system should be operating 24 hours a day to remove water vapor and chlorine odors from the building. Repair/replace system components as needed to ensure pool moisture and odors are vented out of the building.
3. Open windows (weather permitting) to temper rooms and provide fresh outside air. Care should be taken to ensure windows are properly closed at night and weekends to avoid

the freezing of pipes and potential flooding. Supplement fresh air by operating window-mounted air conditioners in the "fan only" “fresh air” mode, which introduces outside air by mechanical means.

4. Clean/change filters for ACs as per the manufacturer’s instructions or more frequently if needed.
5. Examine the feasibility of installing a modern mechanical HVAC system building-wide to provide adequate air exchange for heating, cooling and introduction of fresh outside air and exhaust ventilation to remove environmental pollutants from the building.
6. 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).
7. Repair any existing water leaks and replace any remaining water-damaged ceiling tiles and building materials.
8. Repair/replace broken windows. Address deteriorated window sealant in accordance with EPA regulations/MDPH guidance.
9. Repair/replace missing/damaged gutters, downspouts and elbow extensions. Extend downspouts to empty at least 5 feet away from the foundation (if possible).
10. Repaint windowsills and ceilings where peeling paint is observed.

11. Ensure proper installation of weather-stripping/door sweeps on exterior doors. Ensure tightness of doors by monitoring for light penetration and drafts around doorframes.
12. Contact a masonry firm or general contractor to repair holes/breaches in exterior walls/foundation to prevent water penetration, drafts and pest entry.
13. Ensure plants, trees and shrubs are located at least five feet away from exterior walls/foundation of the building.
14. Consider eliminating mulch from areas adjacent to the building.
15. Ensure indoor 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.
16. Provide a mat that is impervious to moisture below water coolers and ensure that overflow receptacles are routinely emptied and cleaned.
17. Clean accumulated dust and debris periodically from the surface of blades of personal fans.
18. Determine if damaged floor tiles contain ACM. Remediate damaged ACMs (e.g., floor tiles, pipe insulation) throughout the building in conformance with Massachusetts asbestos remediation and hazardous waste disposal laws and regulations.
19. Consider contacting a licensed pest control firm to address the current rodent/cockroach infestation.
20. Clean rodent feces and insect parts throughout the building, paying particular attention to food preparation and food storage areas (interiors of kitchen cabinets, behind the microwaves/refrigerators, etc.). Disinfect surfaces and rinse with clean water.

21. Inspect floor drains for integrity. Ensure water is poured into floor drains on a regular basis to maintain seal. If drain use is not necessary, remove or seal/cap to prevent air movement/odors.

22. 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

Obstructed Fresh Air Intake

Picture 2

Fresh Air Intake Sealed from Inside

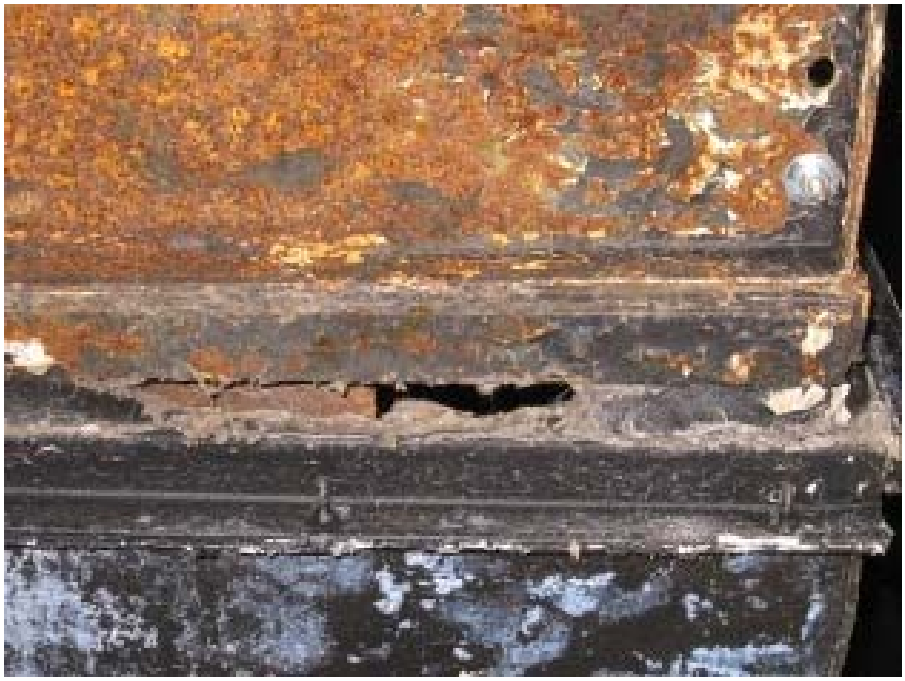
Picture 3

Original Heating/Ventilation Equipment

Picture 4

Exhaust for Women's Locker Room and Pool, Note Oxidation

Picture 5



Corroded Housing and Deteriorated Gasket on AHU

Picture 6

Numerous Cracks in Foundation

Picture 7

Deteriorated and Missing Glazing

Picture 8

Window in Disrepair

Picture 9

Evidence of Water Deposition Adjacent to Foundation (Bracket)

Picture 10

Peeling Paint on Windowsill in Room 12

Picture 11

Water Cooler on Carpet

Picture 12

Insect (Cockroach) in Shower

Picture 13

Live Cockroach on Window

Picture 14

Peeling Paint in Stairway adjacent to Pool

Picture 15

Deteriorated Floor Tiles that May Contain ACM

Location: Curry Hicks Physical Education Building **Indoor Air Results**

Address: 100 Hicks Way, Amherst, MA **Date: 3/15/2011**

Table 1

Location	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	Temp (°F)	Relative Humidity (%)	TVOCs (*ppm)	PM2.5 (ug/m3)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
Background	337	ND	43	39	ND	42	-	-	-	-	Partly sunny, very windy
Front Lobby		ND			ND	27	0	N	N	N	
Men's Room	361	ND	70	23	ND	29	0	Y 1/1 open	N	N	
Shower Room	388	ND	74	18	ND	22	0	Y	N	N	
Men's Locker Room	382	ND	69	20	ND	24	1	Y	Y	N	
Women's Locker Room	300	ND	71	21	ND	20	0	Y	Y	Y	Ceiling-mounted heater
Pool	307	ND	75	55	NA	22	0	Y	N	Y	
1 (front)	430	ND	74	19	ND	28	1	Y 1/3 open	N	N	
1B (front office)	460	ND	75	18	ND	25	0	N	N	N	DO
1B (left)	601	ND	75	18	ND	25	1	Y	N	N	DO
1B (right)	499	ND	73	18	ND	25	1	Y	N	N	PF, AC above window

ppm = parts per million
µg/m3 = micrograms per cubic meter
AC = air conditioner
DEM = dry erase materials
DO = door open
NA =Not applicable due to high humidity
ND = non-detect
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: Curry Hicks Physical Education Building **Indoor Air Results**

Address: 100 Hicks Way, Amherst, MA **Date: 3/15/2011**

Table 1 (continued)

Location	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	Temp (°F)	Relative Humidity (%)	TVOCs (*ppm)	PM2.5 (ug/m3)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
1A	462	ND	77	17	ND	17	0	Y	N	N	
2	585	ND	76	18	ND	21	2	Y	N	N	
3	419	ND	75	19	ND	22	0	Y	N	N	AC in window
4A (Conference Room)	466	ND	63	31	ND	25	0	Y	N	N	DO, Peeling paint on ceiling
4	352	ND	74	16	ND	22	0	Y	Y	N	
5 (Break Room)	418	ND	72	20	ND	27	0	N	Y	Y	
9B	371	ND	75	16	ND	22	0	Y	N	N	AC
9	389	ND	74	17	ND	24	1	Y	N	N	PF
9A	418	ND	74	18	ND	25	1	Y	N	N	AC, complaints of mice
9C	440	ND	75	18	ND	23	0	Y	N	N	
9D	397	ND	75	17	ND	23	0	Y	Y	N	Cooler on carpeting

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Location: Curry Hicks Physical Education Building **Indoor Air Results**

Address: 100 Hicks Way, Amherst, MA **Date: 3/15/2011**

Table 1 (continued)

Location	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	Temp (°F)	Relative Humidity (%)	TVOCs (*ppm)	PM2.5 (ug/m3)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
10	366	ND	73	17	ND	25	1	Y 1/5 open	N	N	Cooler on carpet
11A	412	ND	71	19	ND	28	0	Y 1/1 open	N	Y	
12	410	ND	76	16	ND	22	0	Y 1/1 open	N	N	DO, AC, DEM, peeling paint on window sill
13	527	ND	75	19	ND	24	2	Y	N	N	Plants
16	494	ND	76	17	ND	23	2	Y 1/2 open	N	Y	Fan exhausts to hall
18	490	ND	76	17	ND	25	1	Y	N	N	DO, AC, PF, plants

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