INDOOR AIR QUALITY REASSESSMENT

Abbot Public Library
235 Pleasant Street
Marblehead, Massachusetts 01945

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
August 2015

Background

Building:	Abbot Public Library (APL)
Address:	235 Pleasant Street, Marblehead, Massachusetts
Assessment Requested by:	Patricia Rogers, Director, Abbot Public Library (APL)
Date of Assessment:	June 24, 2015
BEH/IAQ Staff Conducting Assessment:	Jason Dustin, Environmental Analyst/Inspector
Date of Building Construction:	1954 with addition in 1991
Reason for Request:	The assessment was prompted by employee and patron concerns associated with mold odors, dust and general indoor air quality.

Building Description

The APL is a two-story brick building with basement constructed in 1954. An addition was later completed in 1991. The APL utilizes the below-grade basement level for the Children's Room and additional library space. The building was previously visited by BEH in September of 2011. BEH staff issued a previous report detailing conditions observed at the time and provided recommendations to improve IAQ (MDPH, 2011). A summary of actions taken on previous recommendations is included as Appendix A.

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/IAQ staff also performed a visual inspection of building materials for water damage and/or microbial growth.

Results

The APL has approximately 20 employees and can have several hundred members of the public visiting on a daily basis. 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 at the time of the assessment. Mechanical ventilation is provided by a heating, ventilation and air-conditioning (HVAC) system. Air handling units (AHUs) are located in a mechanical room on the third floor (Picture 1) which also serves as an "air mixing" room. Fresh air is drawn from an outside air intake on the exterior of the building and ducted into the air mixing room. Air is then drawn through pleated filters into the AHUs (Picture 2) where it is cooled and delivered to occupied areas by ceiling-mounted air diffusers (Picture 3). Return air is drawn through ceiling-mounted or wall - mounted exhaust vents (Picture 4) and ducted back into the air mixing room (Picture 5).

The APL is heated by two gas-fired forced hot water (FHW) boiler units located in the lower level. These units were reported to be approximately 5 years old and appear to be sealed combustion units therefore draw in combustion air from outside and also vent directly to the

outside of the building. The heated water is distributed to hot water radiators located throughout the APL (Pictures 6 and 7).

Temperature

Indoor temperature measurements at the time of the assessment ranged from 73°F to 80°F (Table 1). Most areas of the third floor, especially the Technical Services area, had temperatures which exceeded the MDPH recommended comfort range. Many of the thermostats were older and were reported to be broken. The dampers/controls to the various zones should also be checked to ensure they are allowing the cool air to reach areas with temperature complaints.

Relative Humidity

Indoor relative humidity measurements at the time of the assessment ranged from 50 to 65 percent (Table 1). The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Elevated indoor relative humidity conditions were recorded in the lower levels of the building at the time of the assessment. APL staff reported that the AC system has been functioning intermittently and that it seems to struggle to maintain comfortable temperature and humidity levels in many areas of the building.

The relationship between temperature and relative humidity is known as the heat index. As indoor temperature rises, the addition of humid air increases occupant discomfort and generates heat complaints. If moisture levels are decreased, the comfort of the individuals increases. It is important to note that the operation of AC systems also remove moisture from the air as well as providing cooling. If HVAC systems are not functioning well, it can result in both excess heat and humidity in the indoor environment. While temperature is mainly a comfort issue, relative humidity in excess of 70 percent for extended periods of time can provide an environment for mold and fungal growth (ASHRAE, 1989).

Microbial/Moisture Concerns

There are a number of sources of water damage and microbial growth in this building. In order to become colonized with mold, a material must be exposed to water and remain moist. If sufficiently moistened, porous materials such as GW can support mold growth (US EPA, 2001). In addition, relative humidity in excess of 70 percent for extended periods of time can provide an environment for mold and fungal growth in building materials (ASHRAE, 1989). For storage and handling of paper, parchment, and leather (e.g., books), relative humidity below 55 percent is recommended (Wilson, 1995).

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

Water-damaged/mold-colonized ceiling tiles were seen throughout the APL (Pictures 8 and 9; Table 1). Water-damaged ceiling tiles indicate leaks from either the roof or plumbing system and can provide a source for mold growth. These tiles should be replaced after a water leak is discovered and repaired. The original building has older, interlocking ceiling tiles which may contain asbestos. Before disturbing these tiles, care should be taken to have them tested for asbestos and if they contain asbestos they must be professionally remediated/disposed of in a manner consistent with Massachusetts asbestos remediation laws (MDLI, 1993).

Library staff reported strong musty odors and mold growth on books along the exterior walls of the Children's library. It was also reported that on occasion, library patrons have had to

remove their children from the room due to their children's apparent respiratory reactions to the conditions in this area. BEH/IAQ staff detected the musty odor and noted metal shelving in contact with the uninsulated slab floor. The temperature of the shelving likely drops below the dew point, which results in the formation of condensation. The metal shelving also showed signs of rusting (Picture 10), indicating prolonged moisture exposure. Condensation can result in chronic moistening of the area rug and of books on the lower levels of the shelving leading to microbial colonization.

It was reported that ice dams had caused water damage to the APL in the past especially during the unusually harsh 2015 winter season. Ice dams occur in the winter months when warm air escapes from the occupied spaces and rises to the attic areas. This warm air causes the roof to melt accumulated snow. The melted snow drains down to lower parts of the roof, where it refreezes and creates a dam that restricts any additional snowmelt from draining off the roof. This water can back up onto the roof and under shingles. Water penetrating from the exterior can cause water damage to insulation and walls/floors near the exterior of the building. The APL should be evaluated for interruptions in ridge and soffit ventilation; these are the primary factors contributing to ice dams. Proper insulation of the roof may assist in preventing ice dams. The building should also be evaluated for missing/unsealed joints and flashing, loose shingles and other damage that would allow water to enter and accumulate inside the building envelope. Insulation and other hidden building materials that may have gotten wet may need removal/remediation for microbial growth.

The joining of the original building with the 1991 addition may be another source of water infiltration at the APL. A large portion of the water-damaged ceiling appeared to be along

the intersection of the addition (Pictures 11 to 12). The joining of different roof pitches with different roofing materials and flashing is a common source for leaks in buildings.

It was reported that the APL is subject to both high groundwater and storm water events. Both of which have impacted the lower level of the APL in the past. Of note are reports of carpeting in the lower level being saturated after storm events (Picture 13). Ms. Rogers reported that during these rain events, storm water runs down the sloped driveway of the APL and has flooded the lower levels in the past (Picture 14). BEH staff observed a drain at the bottom of this driveway. Drains must be kept free of sediment and debris for them to function properly. As mentioned in the 2011 report, it is not recommended to have carpeting in below grade spaces due to condensation and chronic moisture issues. Any carpeting that was not properly dried within 48 hours of becoming saturated should be discarded due to the likelihood that mold has colonized it. Nonporous, rubber or foam mats should be considered for the Children's area in lieu of carpeting.

A drain in the boiler room was noted to have a high level of standing water. There was a wet/dry vacuum cleaner hose in the drain hole (Picture 15). It appears this wet/dry vacuum is routinely used to empty the drain to avoid overflows. High groundwater/moist basements can damage any porous materials stored on the floor as well as add to the humidity problem at the APL. Although the Meeting room had a sump pump to control some of the water issues, the boiler room area did not appear to have a sump pump installed.

The APL utilizes a lower level storage room to sort/store books and other porous materials. This area is subject to chronic flooding and high humidity (Picture 16). Storing porous materials in unconditioned areas can result in damage to the materials. It was reported by

Ms. Rogers that the APL is contracting with an engineer to address both sources and solutions concerning high ground water and storm water at the APL.

The mixing room continues to have active condensation on uninsulated sections of the cooling lines (Picture 17). Insulation repairs should be made to reduce condensation after confirming that there is no leak in the pipe fitting. As mentioned in the 2011 report, there are breaches from the mixing room to the attic; it is very important to seal any breaches that allow warm, moist air to enter the mixing room and AHUs. Microbial growth, dust and irritants on stored items (boxes, old filters etc.) in the mixing room also have the potential to be distributed throughout the APL (Picture 18). Keeping the mixing room clean, dry and free of any stored porous items is vital to the IAQ of the building. One solution would be to directly connect the return ductwork to the AHUs.

High humidity also contributes to water damage in the building as mentioned above. The Marblehead Room was intended to be a climate-controlled room specifically designed to preserve and protect important historical volumes and documents. It was reported that the HVAC system in this room was not operating at the time of the assessment. BEH staff did not detect any flow of air from the supply vents. Due to the nature of materials stored in this area, APL officials should contact an HVAC engineering firm to evaluate and make repairs as needed in this area to avoid damage/destruction of records. It should be noted that this recommendation was also made in 2011 and it does not appear any action was taken to remedy the situation.

Trees, shrubs and other plant growth (ivy) were visible on or in close proximity to the building and foundation. Shrubs/trees in close proximity to the building hold moisture against the building exterior and prevent drying. The growth of roots against exterior walls can bring moisture in contact with the foundation. Plant roots can eventually penetrate the wall, leading to

cracks and/or fissures in the sublevel foundation. 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 exterior walls, 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 that can result in additional penetration points for both water and pests.

Although a number of improvements to the gutter/downspout system were made since the 2011 visit, a gutter/downspout at the front of the building appeared to be clogged with debris and plant growth (Picture 19). This equipment should be monitored on a regular basis to ensure proper drainage away from the building.

Indoor plants were noted in some areas. 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 non-porous drip pans. Plants should also be located away from ventilation sources to prevent the entrainment and/or aerosolization of dirt, pollen or mold.

A water cooler was observed in a carpeted area. Spills or leaks from this equipment can moisten carpet and lead to microbial growth and degradation of the carpet. MDPH recommends placing rubber or plastic trays beneath this equipment to protect the carpet from any leaks.

Other IAQ Evaluations

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

present in the indoor environment, BEH/IAQ staff obtained measurements for carbon monoxide and PM2.5.

Carbon Monoxide

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

Particulate Matter

Outdoor PM2.5 was measured at 13 $\mu g/m^3$ (Table 1). PM2.5 levels measured indoors ranged from 18 to 21 $\mu g/m^3$ (Table 1), which were below the NAAQS PM2.5 level of 35 $\mu g/m^3$.

Volatile Organic Compounds (VOCs)

Hand sanitizers were found in some 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.

Other Conditions

BEH staff noted AHU filters in the mechanical room were occluded with dust and debris (Picture 20). In addition, both used, soiled filters and new filters were stored uncovered in the mechanical room (Picture 21). Since this room serves as the mixing room, it is essentially part of the ductwork of the HVAC system. Any dirty, dusty, water-damaged stored items may further

increase dust and debris to the HVAC system. In addition, the new filters that are left in this room may become contaminated with dust and debris before they are even installed. Again, this room should not be used for storage and should be thoroughly cleaned on a regular basis. Old filters should be discarded immediately and new filters should be kept sealed in a clean location. The filters in these AHUs should be monitored and changed at least quarterly to help reduce the dust and particulate matter found in the APL.

Libraries in general have a large number of flat and irregular surfaces (e.g., book shelves, books) that provide locations for dust to accumulate. The number of flat surfaces in combination with the heavy foot traffic over carpeting can re-aerosolize settled dust. Accumulated dust was also observed collecting on air diffusers and return grills. If return/exhaust vents are not functioning, back drafting can occur, which can re-aerosolize accumulated dust particles. Supply vents can aerosolize accumulated dust once activated. Dust can be irritating to the eyes, nose and respiratory tract.

A number of areas had missing ceiling tiles (Picture 22), including the women's room. These tiles should be replaced to avoid the migration of dust, moisture and odors from the plenum into occupied spaces.

Most above grade areas in the APL are 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, 2012). Regular cleaning with a high efficiency particulate air (HEPA) filtered vacuum in combination with an annual cleaning will help to reduce accumulation and potential aerosolization of materials from carpeting.

Conclusions/Recommendations

The conditions found within the APL raise a number of indoor air quality issues. The penetration of storm/rainwater into the building envelope combined with the chronically moist conditions in lower level spaces due to infiltration and high groundwater create conditions that likely allow moist air, odors and other pollutants into occupied areas of the APL. While some problems can be addressed immediately, others will require planning and resources. In view of the findings at the time of the visit, the following recommendations are made:

1. Continue with plans to consult with a building engineer/contractor to evaluate strategies to stop water/moisture from penetrating the building envelope as well as to develop condensation control strategies. Failure to address the sources of moisture will result in repeated water damage of building materials and chronic microbial growth. This includes:
    a. The intersection of the original building and the 1991 addition should be examined by a roofing contractor to ensure that it is not contributing to water infiltration.
    b. Once the leaks causing water-damaged ceiling tiles are fixed, replace the ceiling tiles. Before disturbing the interlocking ceiling tiles of the original building, care should be taken to have them tested and professionally remediated/disposed of should they test positive for asbestos.
    c. The APL should be evaluated for loose, missing, and wet insulation as well as interruptions in ridge and soffit or gable ventilation to reduce the occurrence of ice dams.
    d. Repair the drains in the boiler room and/or install a sump pump to remove accumulated water.

e. Remove debris/plant growth in gutter and downspout system to allow water to be directed away from the foundation.

f. Regularly clean debris/sediment from storm drains and consider installing a berm at the entrance of the driveway to prevent heavy storm water flow from overflowing into the APL.

2. Consult with an HVAC engineer to evaluate the thermostats, controls, dampers and capacity of the current HVAC system. Due to consistent complaints with temperature and humidity control, an analysis should be made whether to repair the existing system or replace with a new system that will meet the needs of the APL.

3. Remove water-damaged boxes, old filters and new filters from the mechanical room (mixing room). Inspect cooling pipes for leaks and repair insulation to prevent further condensation/leaks. Keep this room clean, it is vital for good IAQ in the building.

4. Seal gaps, cracks, and crevices in basement ceiling of boiler room and lower level storage room and replace missing tiles. Ensure all breaches/pathways to the attic/mixing room wall have been completely sealed.

5. Consider connecting the return ductwork directly to the AHU units rather than using the mixing room.

6. Remove water-damaged carpeting in lower level and replace with nonporous flooring (e.g. tiles).

7. Remove area rug in Children's room and explore alternative replacement flooring such as nonporous rubber or foam mats.

8. Until further condensation/moisture control strategies are implemented, books in the lower levels of the library should not be kept on the bottom row of the metal shelving.

Any books showing active mold colonization should be removed and discarded unless the value of such books warrants the expense of professional restoration.

9. Use dehumidifiers or supplemental AC units until the HVAC system has been repaired to reduce humidity to desired levels.
10. Use an alternative location on the upper levels to store and sort books to prevent water damage to these materials.
11. Remove vegetation within 5 feet of the building.
12. Refrain from leaving windows and doors open during operation of AC units.
13. Change the filters for the AHU units quarterly. Ensure that the filters have the recommended minimum 40% dust spot efficiency accounting for manufacturer limitations with pressure drop. Bag and dispose of the old filters immediately after installing the new filters. Store new filters covered in a clean, dry location.
14. Clean carpeting annually or semi-annually in soiled high traffic areas as per the recommendations of the Institute of Inspection, Cleaning and Restoration Certification (IICRC, 2012).
15. Reduce, relocate, and/or clean accumulated items on flat surfaces periodically to avoid excessive dust build up.
16. Due to the need to provide for more thorough cleaning and given the large space at the APL, consideration should be given to contracting with a cleaning company.
17. Periodically clean supply diffusers and return grates to avoid re-aerosolizing particulate matter.
18. Replace any missing ceiling tiles to avoid the migration of moisture, odors and pollutants throughout the APL.

19. Place rubber or plastic trays beneath water coolers to protect the carpet from any leaks.

20. Maintain plants and place drip pans underneath pots. Locate plants away from air supplies to prevent the aerosolization of dirt, pollen and mold.

21. The local BOH has the discretion and authority to determine if any reported health effects by the public are a public health nuisance. The local BOH has the authority to enforce any actions necessary to remedy such nuisance under M.G.L. c. 111, s. 122.

22. 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).

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

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

IICRC. 2012. Institute of Inspection, Cleaning and Restoration Certification. *Carpet Cleaning: FAQ*. Retrieved from http://www.iicrc.org/consumers/care/carpet-cleaning/#faq.

Lstiburek, J. & Brennan, T. 2001. Read This Before You Design, Build or Renovate. Building Science Corporation, Westford, MA. U.S. Department of Housing and Urban Development, Region I, Boston, MA.

MDLI. 1993. Regulation of the Removal, Containment or Encapsulation of Asbestos, Appendix 2. 453 CMR 6,92(I)(i).

MDPH. 2011. Indoor Air Quality Reassessment, Abbot Public Library, Marblehead, Massachusetts. Massachusetts Department of Public Health, Bureau of Environmental Health, Boston, MA. October 2011.

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

Wilson, W. K. 1995. Environmental Guidelines for the Storage of Paper Records. NISO TR01-1995. National Information Standards Organization, NISO Press, Bethesda MD.

Picture 1

Air handling units (AHUs) in mechanical (“mixing”) room

Picture 2

AHU showing pleated filter return area

Picture 3

Ceiling mounted supply vent (note surrounding dust and debris)

Picture 4

Ceiling-mounted return vent (note dust/debris)

Picture 5

Main return duct to mixing room (note new lining)

Picture 6

Gas-fired boilers in lower level

Picture 7

Hot water radiator in lower level (note cracked/water-damaged wall)

Picture 8

Water-damaged ceiling tiles

Picture 9

Water-damaged/mold-colonized ceiling tiles

Picture 10

Metal shelving showing signs of rust

Picture 11

Water-damaged ceiling

Picture 12

Water-damaged ceiling

Picture 13

Water-damaged carpeting in lower level

Picture 14

Driveway off Pleasant Street, sloped toward APL

Picture 15

Hose in drain in boiler room, note high water level

Picture 16

Book storage/sorting room floor with standing water, staining and porous items

Picture 17

Water actively dripping from uninsulated cooling line section

Picture 18

Water-damaged porous items inside the mixing room

Picture 19

Debris-filled gutter with plant growth

Picture 20

Air filter in AHU occluded with dust

Picture 21

Clean filters kept unprotected in dusty mixing room may also be subject to water damage

Picture 22

Missing ceiling tile in restroom

Location: Marblehead Abbot Library **Indoor Air Results**

Address: 235 Pleasant Street, Marblehead, MA **Table 1** **Date: 6/24/2015**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m^3)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Background (outside)	440	1.6	82	45	19					Clear, SE breeze, vehicle traffic
Third Floor:										
Marblehead room	571	ND	79	50	3	2	Y	Y	Y	Ventilation reportedly inactive, heat/humidity complaints, historic docs, ventilation not working
Technical Services	558	ND	80	53	3	6	Y open	Y	N	Heat complaints, carpet, HS, ventilation not working
Asst. Director	580	ND	80	52	2	0	Y open	Y	N	PF, ventilation not working
Director	516	ND	75	57	2	1	Y	Y	Y	AC functioning, ventilation working
Break room	461	ND	77	55	3	2	Y	Y	Y	Ventilation working
Mechanical room										Dirty filters in AHU units, mixing room dusty, dirty, stored items (dirty filters, boxes), dripping condensation/leak from cooling pipes
Main Floor:										

ppm = parts per million
µg/m^3 = micrograms per cubic meter
AC = air conditioner
AHU = air handling unit
CT = ceiling tiles
HS = hand sanitizer
MT = missing tiles
ND = non detect
PF = personal fan
WD = water damage

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: Marblehead Abbot Library **Indoor Air Results**

Address: 235 Pleasant Street, Marblehead, MA **Table 1 (continued)** **Date: 6/24/2015**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m^3)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Non-fiction	566	ND	76	53	2	6	Y	Y	Y	WD ceilings, WD-CTs, 2015 ice dams reported
Non-fiction rear	577	ND	76	53	2	6	Y	Y	Y	WD-CTs, MTs, leaks are reportedly inactive at the present
Fiction	702	ND	76	55	3	5	Y	Y	Y	WD, ventilation not working
Reception	608	ND	75	52	2	15	Y	Y	Y	
Reading room	600	ND	73	54	2	6	Y	Y	Y	Fireplace
Men's room									Y	Exhaust off/weak
Lower Level:										
Young Adult	600	ND	76	54	2	4	Y	Y	Y	WD Plaster/masonry walls, carpet, 2012 flooding reported, carpet not changed, ventilation weak
Children's Room, rear	758	ND	74	62	3	5	Y	Y	Y	Musty odor, rust on lower shelving

ppm = parts per million
µg/m^3 = micrograms per cubic meter
AC = air conditioner
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Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Children's Room, reception	739	ND	73	65	2	4	Y	Y	Y	
Women's room									Y	MTs, WD CT
Meeting room								Y	Y	WD floor, WD-CTs, sump pump
Gallery								Y	Y	MTs
Friends' office										Very dusty, dust/debris on exhaust vent
Boiler room										Paper goods stored, water-filled drain w/wet vac hose, humidity/pathways

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Appendix A

Actions taken on MDPH 2011 Recommendations, Abbot Public Library, Marblehead, MA

The following is a status report of action(s) taken on MDPH recommendations (**in bold**) based on reports from library officials, photographs and MDPH staff observations.

- **Work with HVAC vendor to determine best methods to set thermostats to operate the HVAC system continuously in the fan "on" mode during periods of occupancy to maximize air circulation and filtration.**
- **Action:** Not completed. Many areas of the APL are still without working ventilation/cooling and some controls appear inactive/broken.
- **Have HVAC vendor evaluate the system for proper temperature control on the third floor. Methods to improve temperature control may include the installation of return/exhaust vent(s) in the third floor "Technical Services" work area.**
- **Action:** Not completed or implemented. HVAC system has been the source of consistent complaints since before the last assessment in 2011. The third floor was again observed to have no cooling/ventilation in most areas.
- **Develop a written protocol to ensure proper maintenance/changing of HVAC filters. Change filters for air handling equipment as per the manufacturers' instructions or more frequently if needed.**
- **Action:** Not implemented. Filters were found occluded with dust and should be changed more frequently.
- **Have HVAC vendor determine the function of duct shown in Picture 5 and whether the fibrous liner can be cleaned or removed if deemed not necessary.**

Appendix A

- **Action:** Complete. It appears that the fibrous return duct was replaced with a new lining.
- **Remove stored items from HVAC mechanical room.**
- **Action:** Not completed. Many water-damaged boxes and both new and old dusty filters were observed stored in the mechanical room which is part of the HVAC ductwork.
- **Remove carpeting in below grade areas (e.g., young adult library), replace with non-porous floor covering.**
- **Action:** Not completed. Young adult library was observed to have carpeting that was flooded in a 2012 storm event. Children's room had area rug instead of suggested rubber or foam mat.
- **Monitor conditions as needed to adjust the HVAC system to avoid elevated relative humidity (>70%) conditions that would be prone to condensation and/or mold growth.**
- **Action:** Not completed. Conditions that support elevated relative humidity, condensation, and mold growth have not been addressed or remedied.
- **Ensure climate control system is repaired/restored in the Marblehead Room to preserve and protect important historical documents.**
- **Action:** Not completed. The HVAC system was not functioning in the Marblehead Room and extended periods of elevated humidity will continue to degrade these important documents.
- **Scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is**

low (winter). To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended.

- **Action:** Not completed. Many flat surfaces as well as supply and exhaust vents were noted to be dusty.
- **Seal above ceiling space between HVAC mechanical room and unconditioned attic to reduce/prevent condensation and further water damage.**
- **Action:** More work is necessary in this area. Cooling lines were found to be actively leaking in the mixing room.
- **Replace or make repairs to water-damaged materials in HVAC mechanical room.**
- **Action:** Some repairs were made but more work is needed in this area due to continued water damage.
- **Remove plant growth in downspout gutter system shown.**
- **Action:** Not completed. Clogged gutters/downspouts with plant growth were observed.
- **Remove/replace water-damaged ceiling tiles. Examine the area above and around these areas for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.**
- **Action:** Not completed. Many water-damaged and missing ceiling tiles were observed.
- **Ensure paper/cardboard materials are not stored directly on floors in unconditioned areas. Discard any water-damaged/mold colonized porous materials.**
- **Action:** More work is necessary in this area. Some porous materials were noted to be on the floor near standing water in the book storage area.

Appendix A

- **Consider extending HVAC system ductwork into unconditioned book storage area. At the least dehumidifiers should be used in this area to reduce relative humidity as needed.**
- **Action:** More work is needed. Unknown if HVAC works in this area. Recommend seeking alternative storage area due to chronic flooding and associated high humidity.
- **Clean library books, shelving, flat surfaces as well as HVAC supply, exhaust and return vents periodically of accumulated dust.**
- **Action:** Not completed. Dust/debris noted throughout APL surfaces and vents.