

INDOOR AIR QUALITY ASSESSMENT

**Department of Mental Health
Hadley Building
167 Lyman Street
Westborough, MA**



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
October 2016

Executive Summary:

The building was designed with a mechanical ventilation system that is currently not operating as designed. To improve air quality the system should be restored to its original function or redesigned under the guidance of a heating, ventilating and air conditioning (HVAC) engineering firm.

Background

Building:	Hadley Building
Address:	167 Lyman Street, Westborough, MA
Assessment Requested by:	Joe Dykers, Northeast Area Facilities Manager, Department of Mental Health (DMH)
Reason for Request:	General indoor air quality (IAQ)
Date of Assessment:	September 16, 2016
Massachusetts Department of Public Health/Bureau of Environmental Health (MDPH/BEH) Staff Conducting Assessment:	Cory Holmes and Jason Dustin, Environmental Analysts/Inspectors, IAQ Program
Building Description:	A multi-story, brick-faced building with basement. Formerly served as the Westborough State Hospital, converted to office space in 2009. The building is made up of individual offices, multi-occupant offices, conference rooms and common areas.
Year Built:	1945-1947
Building Population:	The building houses approximately 100 employees.
Windows:	Openable

METHODS

Please refer to the IAQ Manual for methods, sampling procedures, and interpretation of results (MDPH, 2015).

IAQ Testing Results

The following is a summary of indoor air testing results (Table 1).

- **Carbon dioxide levels** were below 800 parts per million (ppm) in all but two areas tested throughout the building.
- **Temperature** was within the recommended range of 70°F to 78°F in all areas tested.
- **Relative humidity** was within or close to the recommended range of 40 to 60% in most areas tested.
- **Carbon monoxide** levels were non-detectable (ND) in all areas tested.
- **Fine particulate matter (PM_{2.5})** concentrations measured were below the National Ambient Air Quality Standard (NAAQS) level of 35 µg/m³ in all areas tested.

Ventilation

An HVAC system has several functions. First it provides heating and, *if equipped*, cooling. Second, it is a source of fresh air. Finally, an HVAC system will dilute and remove normally occurring indoor environmental pollutants by not only introducing fresh air, but by filtering the airstream and ejecting stale air to the outdoors via exhaust ventilation. Even if an HVAC system is operating as designed, point sources of respiratory irritants may exist and cause symptoms in sensitive individuals.

The building's mechanical ventilation system is not equipped with air conditioning (AC) capabilities. It was designed to draw outside air via large air handling units (AHUs), which feed into main hallways via ducted vents (Pictures 1 through 3). Individual rooms have an exhaust vent that pulls air into the room (Pictures 4 and 5). Doors were designed to have passive vents/grills in order to sustain airflow while shut (Picture 6), however the large majority of them have been sealed throughout the building (Picture 7). This system was reported to be under repair at the time of the assessment, therefore the building is not being ventilated the way it was designed. Currently, fresh air is mostly provided by openable windows. Most offices have two openable windows and a window-mounted AC.

Restrooms are equipped with local exhaust vents to remove odors and moisture; however several of these were not operating during the assessment. Several of the restrooms also had passive door vents sealed. These vents should be restored (or doors undercut) to provide make-up air while exhaust vents are operating.

Microbial/Moisture Concerns

A number of areas (Table 1) exhibited signs of historic water damage in the form of peeling paint; efflorescence and water-damaged ceiling/wall plaster (Pictures 8 through 11). Efflorescence is a characteristic sign of water damage caused by salts and mineral deposits from water filtrating through materials such as brick and concrete, which may become aerosolized, and be a contributing source to eye and respiratory system irritation. Over the summer, repointing/waterproofing activities were conducted in a few areas along the exterior of the building.

Plants were observed in several areas (Table 1). Plants, soil, and drip pans can serve as sources of mold/bacterial growth. In one case plants were observed on paper towels, which are a porous material that can grow mold (Picture 12). Plants should be properly maintained, over-watering of plants should be avoided, and drip pans should be inspected periodically for mold growth. In conference room 260, paper towels were noted around the window, presumably to stop leaks/drafts (Picture 13).

Open seams between the sink countertop and backsplash were observed in kitchen 228 (Picture 14). If seams are not watertight, water can penetrate the seam, causing water damage. Water penetration and chronic exposure of porous and wood-based materials can cause these materials to swell, show signs of water damage and lead to potential mold growth.

In many areas wood is used to seal spaces around ACs. Wood is a semi-porous material, which if subjected to chronic moisture can grow mold. In some cases the wood appears discolored/moldy (Picture 15) and may be in need of replacement.

Several unconditioned rooms are used as storage (G64, 274/275). Without a source of moisture removal (e.g., AC, dehumidification) paper products can become chronically moist/damaged and provide a source of mold growth.

Volatile Organic Compounds (VOCs)

Exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat, and/or respiratory irritation in some sensitive individuals. To determine if VOCs were present, BEH/IAQ staff examined rooms for products containing VOCs. BEH/IAQ staff noted hand sanitizers, cleaners, air deodorizing materials, nail polish remover, and dry erase materials in use within the building (Table 1). All of these products have the potential to be irritants to the eyes,

nose, throat, and respiratory system of sensitive individuals. Air deodorizers, in particular, can serve as a continual source of TVOCs, since the products are designed to continually emit scents.

Other IAQ Evaluations

Accumulated items were found stored on floors and other flat surfaces, which can make it more difficult for custodial staff to clean. Some flat surfaces, exhaust vents (Pictures 4 and 5), and personal fans (Picture 16) were found to be dusty and have cobwebs. Dust can be reaerosolized and cause irritation; flat surfaces and items should be cleaned regularly.

Some areas of the office space were 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 arrestance (HEPA) filtered vacuum in combination with an annual cleaning will help to reduce accumulation and potential aerosolization of materials from carpeting.

AC units are typically equipped with filters. Filters for AC units should be cleaned prior to and periodically during the cooling season.

Room 458 had an open utility hole in the wall (Picture 17). These breaches can serve as pathways for dirt, dust and odors from the wall cavity into occupied space.

An abandoned toilet was observed in room 256 (Picture 18). If abandoned plumbing fixtures are not removed/capped properly, they can serve as conduits for sewer gasses/odors into occupied areas.

A spray can of insecticide was observed in an office (Picture 19). Pesticides contain harmful chemicals that can cause eye, and respiratory irritation and health effects. Integrated pest management (IPM) should be used in occupied buildings with pesticides as a last resort.

Conclusions/Recommendations

The following recommendations are made to assist in maintaining IAQ:

1. Restore the building's HVAC system, continue with plans to repair hallway AHUs. Consider long-term plans to work with an HVAC engineer to determine if units can be retrofitted with chiller/AC capabilities.

2. Ensure fans/motors for restroom exhaust vents are operational. Restore passive door vents or undercut doors to provide make-up air.
3. Use open windows (weather permitting), to temper rooms and provide fresh air.
 - Care should be taken to ensure windows are properly closed at night and on weekends.
 - Keep windows closed *during hot, humid weather* to maintain indoor temperatures and to avoid condensation problems when AC is activated.
 - Shut windows after hours during winter months to avoid the freezing of pipes and potential flooding.
4. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
5. Continue with plans to repaint/waterproof the exterior.
6. Once waterproofing/repairs are complete, clean/scrape and repaint areas of water damage/peeling paint and efflorescence (e.g., walls, ceilings and windowsills). Given the age of the building Lead Safe renovating methods may be warranted.
7. Ensure window ACs are sealed properly to eliminate drafts and or/water penetration. Refrain from using cloth/porous materials around AC units and windows (Picture 13).
8. Inspect wood around ACs for chronic water damage, clean/refinish/replace as needed.
9. Indoor plants should be properly maintained and equipped with drip pans to prevent water damage to porous building materials and be located away from ventilation sources to prevent the aerosolization of dirt, pollen or mold. Do not rest plants on porous materials (e.g., cloth, paper).
10. Install ACs and/or use dehumidifiers in storage rooms used for porous materials (e.g., G64, 274/275).
11. Seal around sink in kitchen 228 (and any other sinks with similar breaches) to prevent water damage to backsplash/countertop wood.

12. Clean AC filters prior to and periodically/as needed during the cooling season.
13. Clean supply and exhaust vents and personal fans regularly to prevent aerosolization of debris.
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. Consider reducing the amount of items stored in offices to make cleaning easier. Periodically move items to clean flat surfaces.
16. Remove and cap abandoned toilet in room 256.
17. Seal open utility holes/breaches in walls/ceilings.
18. Institute an IPM program to manage pests. Insecticides should be used as a last resort.
19. Reduce the use of air deodorizers, cleaning products, sanitizers, and other products containing VOCs. Considering adopting green cleaning procedures. Ensure cleaning products are properly labeled, and keep material safety sheets on file.
20. Refer to resource manual and other related IAQ 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

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

MDPH. 2015. Massachusetts Department of Public Health. Indoor Air Quality Manual: Chapters I-III. Available at: <http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/iaq/iaq-manual/>.

Picture 1



Fresh air intake for AHU

Picture 2



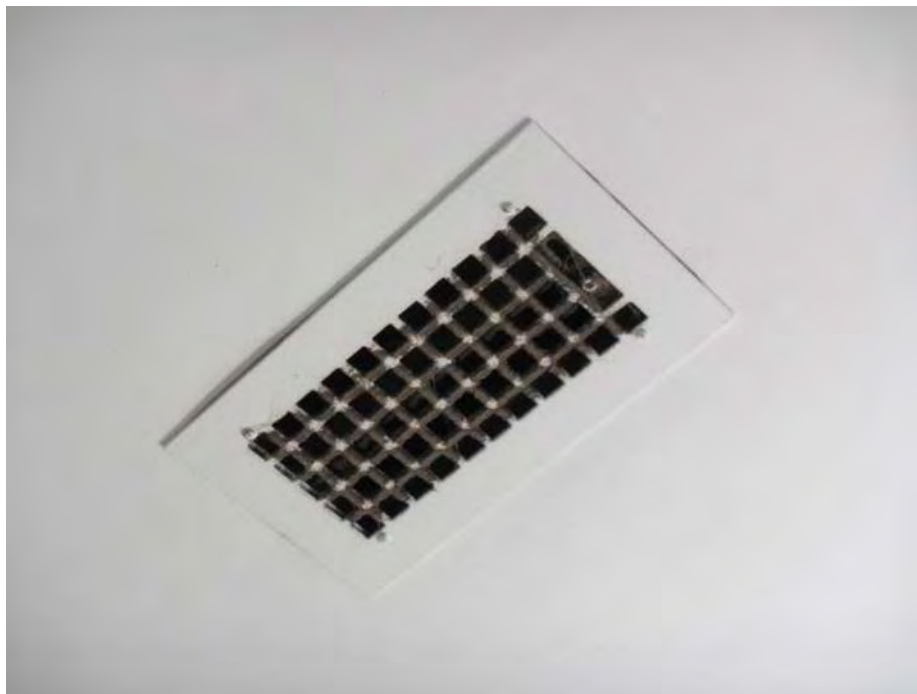
Air handling equipment in attic

Picture 3



Hallway supply vents

Picture 4



Ceiling exhaust vent, note dust/debris

Picture 5



Wall-mounted exhaust vent, note dust/debris

Picture 6



Passive door vent/grill

Picture 7



Sealed passive door vent

Picture 8



Peeling paint and efflorescence

Picture 9



Severely water-damaged ceiling in 3rd floor women's restroom

Picture 10



Peeling paint and efflorescence

Picture 11



Peeling paint on windowsill

Picture 12



Plant on paper towel

Picture 13



Soiled towels around window

Picture 14



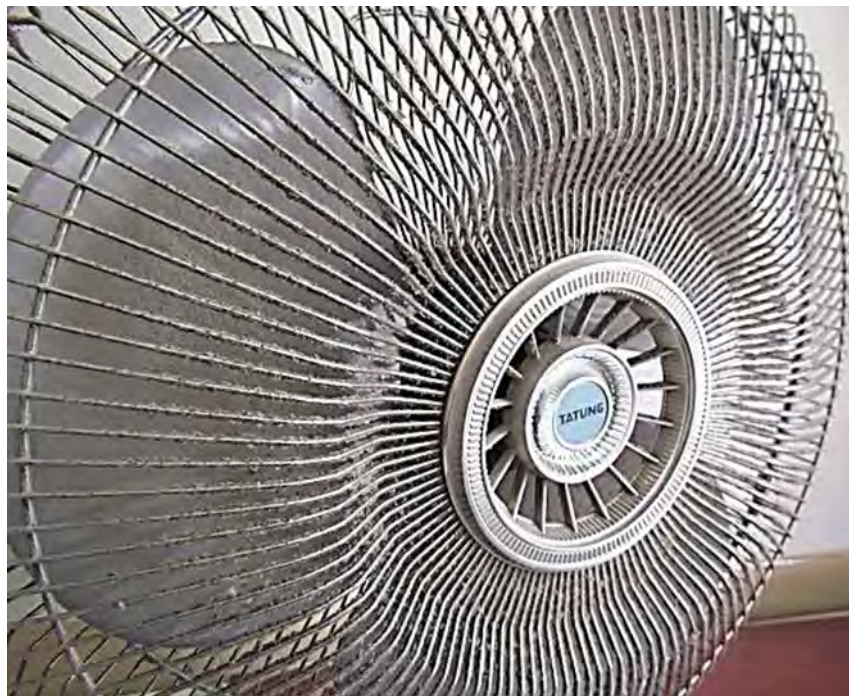
Loose/damaged backsplash kitchen 228

Picture 15



Water-damaged wood/possible mold growth on wood around AC room 456

Picture 16



Accumulated dust/debris on personal fan

Picture 17



Hole in wall around utility pipe

Picture 18



Abandoned toilet in room 256

Picture 19



Spray insecticide in office

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Intake	Exhaust	
Background	334	ND	68	55	5-10	-	-	-	-	Partly sunny, light breeze
4th Floor										
451	412	ND	76	51	3	1	Y	N	N	Spaces around AC, plexiglass windows
452	502	ND	76	49	3	2	Y	N	Y	Efflorescence exterior wall, peeling paint windowsill, cobwebs dust/debris
453	530	ND	75	50	4	1	Y	N	Y	Peeling paint above window
404 Kitchen	567	ND	75	51	3	0	Y	N	N	Peeling paint above window
456	427	ND	75	49	3	0	Y	N	Y	WD wood around AC
457	516	ND	76	50	3	1	Y	N	Y	PF, plant
458	552	ND	75	48	5	0	Y	N	Y	Plant on paper towel, utility hole/wall
464 Conference Room	500	ND	76	48	3	0	Y	N	Y	~15 occupants just left meeting

ppm = parts per million

AC = air conditioner

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PF = personal fan

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Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferred
> 800 ppm = indicative of ventilation problems

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

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Intake	Exhaust	
463	470	ND	76	48	3	0	Y	N	Y	
461	440	ND	75	48	3	0	Y	N	Y	
462	493	ND	75	49	3	1	Y	N	Y	Peeling paint window
460	470	ND	75	48	3	0	Y	N	Y	Dust/debris vent, PF
476 Kitchen	434	ND	77	45	4	0	N	N	Y off	AC, CPs, plant, exhaust back drafting
474	702	ND	74	37	7	0	N	N	Y	AC (on)
Handicapped restroom							Y open	N	Y	Exhaust back drafting
Janitor closet							Y open	N	Y off	CPs, feather dusters, mops
468	420	ND	73	50	11	3	Y	N	Y	AC on, plants, dirty carpet
467	421	ND	73	50	8	2	Y	N	Y	AC, CPs

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								Intake	Exhaust	
375	653	ND	77	44	3	0	Y	N	Y	PF
374	711	ND	77	46	3	1	Y	N	Y	Efflorescence/peeling paint
Women's Restroom							Y	N	Y	Severely damaged plaster ceiling, missing florescent light cover
370	482	ND	75	47	3	0	Y	N	N	
366	558	ND	76	46	3	0	Y	N	N	
365	617	ND	76	48	3	0	Y	N	N	
364	524	ND	75	47	3	0	Y	N	N	Vent-no airflow
363	565	ND	76	48	3	0	Y	N	N	PF

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								Intake	Exhaust	
362	519	ND	76	46	3	1	Y	N	N	No AC-on waiting list
361 Storage	433	ND	76	46	2	0	Y	N	N	Efflorescence ceiling/wall plaster
360 Conference Room	475	ND	77	46	3	0	Y	N	N	Efflorescence ceiling/wall plaster
359	579	ND	78	46	3	0	Y	N	N	PF, insecticide spray "Raid"
358	497	ND	78	44	3	1	Y Open	N	N	PF
350	771	ND	76	38	4	14	Y	N	N	PF
300	590	ND	77	40	3	0	Y	N	Y	Dust/debris windowsill, peeling paint
301	529	ND	77	38	3	0	Y	N	Y	Plant
303 IT	442	ND	74	36	2	0	Y	N	Y	Dust/debris, cobwebs
351	511	ND	78	41	9	1	Y	N	N	Plants, HS, PF, AC

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								Intake	Exhaust	
352	511	ND	78	41	9	1	Y	N	N	Plants, HS, PFs, AC
354	533	ND	78	42	12	0	N	N	N	AC
355	875	ND	78	41	8	3	Y	N	N	AC (off), windows closed
356	576	ND	76	44	7	0	N	N	N	AC
Copy room	597	ND	76	43	14	0	N	N	N	AC
357	557	ND	78	41	11	1	N	N	N	AC
359	493	ND	78	41	8	0	N	N	N	AC, HS
308	685	ND	77	39	9	0	N	N	N	AC, PF, AI
307	553	ND	74	36	11	1	N	N	Y	AC
306	547	ND	74	38	6	0	N	N	Y	DEM, AI, exhaust in attached bathroom

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								Intake	Exhaust	
2 nd Floor										
250	826	ND	76	46	5	4	Y	N	N	
251	617	ND	75	35	2	0	Y	N	N	Humidifier, PF
252	439	ND	76	46	3	0	Y	N	N	
254	473	ND	77	44	4	0	Y	N	N	PF
255	464	ND	77	44	4	1	Y	N	N	
Restroom							Y Open	N	Y	
256										Abandoned toilet-recommend remove/seal
257	520	ND	77	46	4	0	Y	N	N	
258	528	ND	77	45	4	0	Y	N	N	PF-dusty, plant

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								Intake	Exhaust	
							Open			
259	578	ND	77	45	3	0	Y Open	N	N	
260 Conference Room	446	ND	77	44	3	0	Y	N	N	Paper towels stuffed around window
233	541	ND	76	41	4	0	Y Open	N	N	PF
232	393	ND	70	36	3	0	Y	N	N	
231	574	ND	74	47	4	0	Y	N	N	
230	520	ND	74	47	4	0	Y	N	N	
229	511	ND	75	47	3	1	Y	N	N	
228 Kitchen	550	ND	76	47	4	0	Y	N	Y	Loose/WD backsplash/sink countertop

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								Intake	Exhaust	
227	542	ND	76	46	3	0	Y	N	N	
226	712	ND	76	44	3	0	Y Open	N	N	Plants, PF
225	423	ND	76	45	3	0	Y Open	N	N	Plants
224 Conference Room	456	ND	76	46	3	0	Y	N	N	Plants
223C	503	ND	74	43	3	2	Y	N	N	Plants
223B	467	ND	75	47	3	1	Y Open	N	N	PF, plant
274 & 275	468	ND	76	43	11	0	N	N	Y	File storage in unconditioned room, old kitchen
271 Janitor closet							Y Open	N	Y	Standing water in bucket, CPs
269 Bathroom								N	Y	Exhaust not working

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								Intake	Exhaust	
268 Kitchen	400	ND	75	45	4	0	N	N	Y	AC
267	465	ND	74	45	7	0	N	N	N	AC
266	466	ND	75	46	9	1	N	N	N	AC, AI
265 Copy room								N	N	PC, AC
264	472	ND	75	45	11	1	N	N	Y	AI, AC
263	543	ND	76	45	14	0	N	N	N	AC
262	475	ND	76	44	11	0	N	N	N	AC, plush dolls
261 File room	483	ND	76	44	9	0	N	N	N	AC
Auditorium	613	ND	72	39	4	14	Y	Y	Y	Carpet, ACs
204	608	ND	71	44	7	0	N	Y	N	Non-carpeted

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								Intake	Exhaust	
211 Kitchen	534	ND	71	41	9	0	Y	N	Y	AC, dumb waiter
Mail Room	497	ND	73	46	10	0	N	N	N	AC, AI
219	601	ND	74	47	12	1	N	N	N	AC, non-carpeted
220	602	ND	74	46	10	0	N	N	N	AC, DEM, AI
221	520	ND	73	49	9	0	N	N	N	DEM, AI, HS
222	480	ND	74	47	15	0	N	N	N	DEM
223A	520	ND	74	46	9	1	Y	N	N	DEM, candy, HS, CPs, peeling paint
1st Floor										
151	478	ND	77	45	5	0	Y	N	N	
152	470	ND	77	45	5	0	Y Open	N	N	

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								Intake	Exhaust	
154	448	ND	77	45	5	1	Y	N	N	
163	452	ND	76	45	5	0	Y	N	Y	Room under construction
164	473	ND	76	45	5	0	Y	N	N	
165	482	ND	76	46	5	0	Y	N	N	
100	657	ND	76	45	3	1	Y	N	N	Plants
Kitchen	551	ND	76	41	8	0	Y	N	Y	CPs, exhaust off
173 Bathroom										Badly WD plaster, holes etc.
167 Copy room	482	ND	76	44	11	0	Y	N	N	Paint cans, AI
166	455	ND	76	44	9	0	Y	N	N	Carpet
108	562	ND	76	42	4	0	N	N	N	AC, carpet, reed AF

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Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Intake	Exhaust	
107	577	ND	76	42	4	0	N	Y	N	AC, carpet, AI, plants, CPs
Ground Floor										
G55	571	ND	76	41	3	0	Y	N	N	
G57	589	ND	71	37	3	0	Y	N	N	
G58	563	ND	73	44	4	2	Y	N	N	
G59	537	ND	74	47	4	0	Y	N	Y	PC, cobwebs
G61 Men's Restroom							Y Open	N	N	
G64 Storage							Y	N	N	Paper goods, no AC/dehumidification
G67	519	ND	74	48	4	0	Y	N	N	Peeling paint exterior wall, PF
G50	535	ND	75	48	3	1	Y	N	N	

ppm = parts per million

AC = air conditioner

HS = hand sanitizer

PF = personal fan

µg/m³ = micrograms per cubic meter

DEM = dry erase materials

PC = photo copier

WD = water-damaged

ND = non-detect

CP = cleaning products

AF = air freshener

AI = accumulated items

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferred
> 800 ppm = indicative of ventilation problems

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Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Intake	Exhaust	
G26 Women's Restroom							Y	N	N	
G25 Men's Restroom							Y Open	N	N	
G22	558	ND	75	49	4	0	Y	N	N	Efflorescence ceiling/wall
G63	460	ND	75	44	11	0	N	N	N	Carpet, AI
G62	468	ND	74	45	12	3	N	N	N	PFs, AI, PC
G65	476	ND	74	45	15	0	N	N	N	Carpet, plants
G13 Janitor's closet								N	Y	CPs, wet mop heads
G17	470	ND	74	46	12	0	N	N	N	AC, recycled cans, piles of clothes

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