

**INDOOR ENVIRONMENTAL QUALITY INVESTIGATION
FOR
GLENWOOD MIDDLE SCHOOL**

PREPARED FOR:

**HOWARD COUNTY PUBLIC SCHOOL SYSTEM
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EXECUTIVE SUMMARY

Aria Environmental, Inc. (AEI) was contracted by Howard County Public School System to perform an indoor environmental quality investigation of the Glenwood Middle School at the end of August 2013. A complaint was lodged by one of the teachers about high humidity, mold and adverse health effects experienced while she is in the school. AEI conducted interviews with Glenwood Middle School faculty, staff and administrators, Howard County Public School System facilities and building services personnel and Global Facilities Solutions (a mechanical engineering consultant). AEI also performed visual inspections of the classrooms, boiler room and crawlspace; made measurements for temperature, humidity, carbon monoxide, carbon dioxide, particulate matter and fungal identification and counting; and has attended meetings with HCPSS and Global Facilities Solutions.

The investigation revealed a summertime failure of the chiller system that resulted in mold growth that was remediated by a professional services contractor. Relative humidity remained high in the school and was higher than the ASHRAE standards for thermal comfort in the classrooms on August 28, 2013. Condensation was observed on diffusers and univents serving the classrooms. Small patches of wet fiberglass pipe insulation were observed above the suspended ceiling tile in some classes due to condensation. The crawlspace inspection revealed water droplets condensing on the underside of the metal pan ceiling over the crawlspace in the vicinity of univents and on pipe insulation in one section of the 7th grade hallway.

The high humidity is attributed to the high negative pressure observed upon opening and closing doors and to malfunctioning controls on the univents. Warm moist air is drawn into the school through open windows, doors, boiler flues, open louvers, and other gaps including those from the crawl space. A report by Global Facilities Solutions found that the high negative pressure was the result of running exhaust fans in modes other than the economizer mode for which they were intended. The exhaust fans were taken out of service to reduce the negative pressure. Additional adjustments and repairs are being made by HCPSS.

Obvious mold growth was not observed in the classrooms, above suspended ceilings, on the roof, or in univents. Water stained pipe insulation with speckling consistent with early colonization of mold should be removed and replaced with new insulation in classrooms 26 and 27. Moldy odors were observed in the school building along with obvious air movement from the crawlspace into the building. Testing for fungi in the school revealed that the crawlspace is the apparent source for mold migration into the school. The transition from strong negative pressure to a slightly positive pressure will reduce this pathway for exposure. Additional recommendations for mold control are made in this report.



I. BACKGROUND

A representative from Aria Environmental, Inc. (AEI) visited Glenwood Middle School on August 28 and 30, 2013 in response to an indoor air quality complaint. The concern was brought to the school principal's attention and escalated to the Board of Education in the previous week. The nature of the complaint centered on high humidity, mold and mildew, and health effects experienced by one of the teachers in the school.

Aria Environmental, Inc. has responded to two previous indoor air quality complaints at Glenwood Middle School. The first was in April 2010 when a complaint centered on the seventh grade wing and in particular room 29. Saturated insulation was discovered above the suspended ceiling tile in room 29 resulting from a roof leak. An abatement firm, Asbestos Specialist Inc. (ASI) completed the removal of all fiberglass batting insulation, fiberglass pipe insulation and suspended ceiling tile in classroom 29.

The roof was replaced in 2011, one year ahead of the programmed roof replacement schedule. Carpeting was removed from the classrooms. Life safety upgrades were installed in 2012, including the installation of a new sprinkler system and the permanent closure of the air vents through the brick exterior wall and the concrete masonry unit (CMU) walls to prevent freezing of the sprinkler system.

The second complaint was in 2011 and was associated with the 8th grade wing, classroom 8 and faculty room 6. Odors consistent with mold and mildew were observed in the building by the inspector but no evidence of visible mold growth was discovered. The potential for ozone generation from battery charging operations related to an electric wheel chair was identified in faculty room 6. The battery charging operation was moved to a ventilated space.

II. INTERVIEWS

On August 28, 2013, Dr. Michele Twilley, CIH with Aria Environmental, Inc. was briefed by Principal David Brown and Howard County Public School System Industrial Hygienist Jeff Klenk on the high humidity and musty odor in the school. Mr. Brown indicated that there was a chiller failure in July and that the air inside the school was damp for an extended period of time. As a result mold grew in several classrooms. The mold appeared as white patches on plastic or blue-green patches on wood. A professional restoration company cleaned the 6th and 7th grade wings and vocal music room in August. The home economics and reading room were cleaned by the school staff as the discovery of mold growth occurred later.

Mr. Klenk indicated that he had an encounter with one of the staff after she observed mold growth in one of the classrooms. Mr. Klenk indicated that he thought mold may have been growing on the pipe insulation but he disagreed with the employee that there was evidence of mold growth on the craft backing on the fiberglass batting insulation.

Mr. Brown indicated that he feels the humidity is high in the classroom wings and indicated that maintenance has worked hard to maintain the unit ventilators. The school underwent recommissioning in 2012 to ensure that all HVAC equipment was operating as designed. He indicated that the fresh air vents do not open and close properly and that when power is lost, the exhaust units do not restart automatically. Condensation collects on supplied air diffusers on high relative humidity days. He mentioned the presence of a musty smell and said that the univents in the 7th grade wing get a decay odor and pine needle odor. The maintenance personnel work continuously to remove pine needles from the fresh air intakes on those units.



A member of the staff complained of mold growth above the ceiling tile in one of the classrooms and chronic health problems that she had experienced resulting in lost work days and repeated medical visits that began the previous Spring. She fears that the health problems will occur again in this school year. The employee works in rooms 15, 26, 29 and 30. See Attachment A for a building plan showing classroom locations.

At the completion of the interview with Mr. Brown and Mr. Klenk, Dr. Twilley performed visual inspection of selected classrooms and collected indoor air quality measurements. After Mr. Brown and Mr. Klenk departed, Dr. Twilley performed visual inspection and monitoring for temperature, relative humidity, carbon dioxide, carbon monoxide and particulate matter. During monitoring, she approached personnel who were still in the building and asked if they had any concerns about the building to share. She talked to two teachers and two custodians in this manner. The new teacher in room 33 indicated that her room is highly variable in temperature. On the previous day her room was freezing cold and there were tiny insects on the desks; and that day it was warm and humid outside. She said she cannot hang any paper on the west wall because the tape will not stick due to moisture. She cannot store paper in the cabinet because it will go limp and grow mold.

One custodian indicated that she knew of past problems in the home economics classroom and in room 33. She also said there were unspecified problems in room 26. She reported that another custodian that she works with has chronic laryngitis that starts just after she reports for work.

The teacher in classroom 21 reported that she had been a faculty member for a long time, and she has noticed dampness and humidity issues ever since the roof was replaced. She said that she felt that something was wrong with the humidity and it is making the room musty.

One custodian reported that louvered panels were placed under pipes with condensation problems to prevent the constant replacement of ceiling tile. The odor from the ceiling plenum backs into the classroom when the exhaust fans shut off at the end of the day. There has been a problem in the school since the vents to the outside were blocked. He also mentioned that in the past there was only one wood door that would swell and become difficult to open, now all of the wood doors stick and are hard to open and close.

On August 30, 2013, Dr. Twilley met with paraeducator Ms. Linda Brown. Ms. Brown is a 13 year employee in the school and has recently been experiencing repeated respiratory infections requiring medical attention. She noted that the school is stuffy upon her arrival between 6:30 and 6:45 am. She was pleasant in demeanor, seemed knowledgeable in the subject matter, and is genuinely seeking resolution to ongoing indoor air quality concerns in the building. She noted that there is something different in the building now than there was in the past with respect to the temperature and humidity level in the school. She mentioned rooms 15, 29 and 33 as specific rooms with problems that include mold growth, odor, high humidity, and problems with building ventilation. She has observed mold growth above one of the suspended ceilings and reported that finding to Mr. Klenk who countered that there was no mold above the ceiling. The discussion with Mr. Klenk ended without satisfactory resolution to Ms. Brown so she contacted the Principal and the Superintendent of Schools. She is concerned that the past complaints lodged about the indoor air quality in the school have been ignored. Furthermore, she is concerned for the health and well-being of the faculty, staff and students and that hypersensitivity reactions to mold can be life threatening. She wants to know that the school system is taking these concerns seriously before she escalates her complaint further. She has discussed actions that the school board should take that culminate in relocating the school to the adjacent building until repairs can be made.



Later on August 30, 2013, Dr. Twilley interviewed Mr. Steve Harrison who is a HCPSS Heating, Ventilation and Air Conditioning (HVAC) mechanic for the region. Mr. Harrison described the system serving the classrooms as a two-pipe hot water and chilled water system with original or new (science classrooms) univents. In cooling mode, chilled water (43-44°F) is delivered to the uninvent and room air is recirculated through the unit until the air temperature at the thermostat (72°F) is satisfied. At that time, the louver between the uninvent and the outside opens in response to a pressure signal (3-5 pounds in old univents and 8-13 pounds in the new univents). The degree to which the louver opens is dependent upon the pressure signal from the thermostat and can open up to 100% outside air. Mr. Harrison indicated that the louvers on older units do not seal as well as those on newer units indicating that there could be outside infiltration around the louvers. One stage of the chiller was reportedly not functioning on August 28th such that the chilled water to the unit was approximately 4°F higher than optimal resulting in unpleasant temperature and humidity levels in the school.

Mr. Harrison and one other HVAC technician performed recommissioning of all of the equipment last summer and indicated that there were no real changes to the function of any of the units. He had ordered new drain pans for the home economics classroom since the drain pan had been filled with water because the drain pipe on the outside had been filled with rocks and mud. Because of the location of the pipe well above grade, the presumption is that the pipe was filled in by students.

The two boilers operate in the winter heating season only. Mr. Harrison noted that when boiler maintenance was being performed this week that noticeable air movement out of the boiler was felt at the combustion box. Air is being drawn into the boiler through the exhaust stacks to create that effect. He said that the phenomenon stops when the exhaust fans stop running or when the doors to the outside are opened. Mr. Harrison removed the covering at the combustion box and the air movement caused by pressure differential was apparent by touch alone. The rush of air into the building was felt upon the opening of exterior doors to the hallway near the boiler room and 6th grade hallway, indicating that the school hallways were under relatively strong negative pressure. Pressure differential was not measured.

The hallways have fan coil units (FCUs) that supply tempered 100% outside air and have ducted returns. The exhaust fans run from 6:40 am to 4:00 pm each day and have been running as designed. Condensation was observed on the diffusers associated with FCUs in the hallway.

In 1999, roof-top units were installed over the media center, office, cafeteria and gymnasium. These areas were not the subject of the complaint nor were they included in the investigation.

Mr. Harrison was asked if he knew of any changes to the HVAC system that would account for the higher humidity in the school. He mentioned that the vents through the brick exterior wall were necessary to keep the interior CMU wall dry. The vents through the CMU transferred the heat load above the suspended ceiling tiles and now that they are closed in the temperature above the ceiling is "brutal." He indicated that the brick and CMU vents were closed because there was fear that the newly installed sprinkler pipes would freeze and break. He now thinks that the pressure changes in the building are also associated with the closure of the vents.

Mr. Harrison and Dr. Twilley walked the perimeter of the 6th and 7th grade wings and the home economics room. The exterior louvers to the univents were clean and free of debris. Each of the vents on the brick façade were closed in with three matching bricks. The wall at the northwest corner of classroom 33 had been damaged during the 2012 earthquake and was pinned back into place. The drains at the home economic room were working but obvious staining from long



term saturation was present on the mortar. The north wall of classroom 33 and home economics were covered with grass clippings.

III. OBSERVATIONS AND MEASUREMENTS

A. Measurements and Observations on August 28, 2013

On August 28, 2013, Mr. Brown provided Dr. Twilley with a drawing showing the layout of the school and classroom numbers. He circled rooms that he knew were associated with a complaint, had past mold growth or were occupied by Ms. Brown. These included room numbers: 5, 15, 26, 27, 29, 34, 35 and 37. Dr. Twilley visited each room to observe the interior finishes and HVAC units for water and mold, and she recorded temperature, relative humidity, carbon monoxide, carbon dioxide and particle counts in four size fractions and total suspended particulate. In addition to the rooms listed above, she collected data for rooms: 2, 4, 10, 11, 13, 17, 20, 21, 24, 33, and 38, plus each of the hallways associated with classrooms. Observations were made in a total of 25 sample locations.

The room air temperature measured between 3:32 pm and 5:18 pm ranged from 73.1-75.6°F with an average of 74.4°F. The temperatures are considered acceptable for the 60% humidity range in summer recommended to maintain thermal comfort by ASHRAE. Note that the ASHRAE table does not extend past 60% relative humidity. The indoor relative humidity ranged between 65.9 and 79.3 percent. The outside temperature at 5:30 pm was 77.7°F and the outdoor relative humidity was 78.6%. No windows or doors were observed to be open during the monitoring period. The U.S. Environmental Protection Agency (EPA) recommends maintaining indoor relative humidity below 60% and ideally between 30 and 50% to prevent mold growth. The indoor humidity levels were above the recommended humidity levels for the control of mold growth.

The 2013 spring/summer seasons have had average rainfall for the Baltimore area. However, the month of June brought unusually high amounts of precipitation to the region with over four inches of rain above the average of approximately 3.5 inches of rain. Specifically, the rainfall event on June 6 and 7, 2013 dumped over two inches of rain in a 24-hour period alone. Additionally, half of the days in June recorded measureable precipitation, while three of those days had greater than an inch of rain. July rainfall was more than an inch below the four inch average for the region. Twelve days in July recorded measureable precipitation, while two of those days had greater than a half inch of rain. August rainfall was more than two inches below the average precipitation amount of 3.25 inches in this region.

Carbon dioxide and carbon monoxide measurements are used to assess ventilation system performance. The exhaled breath of building occupants is the main indoor source of carbon dioxide; therefore, the build-up of carbon dioxide indicates inadequate ventilation. Air monitoring was performed after school hours when the rooms were unoccupied. Carbon dioxide levels were 351-499 ppm. The concentration of concern for carbon dioxide is set by ASHRAE standard 62.1 – 2013 as 700 ppm above outdoor air (typically 350 ppm). Carbon dioxide concentrations were within the comfort parameters established by ASHRAE. Carbon monoxide is mainly attributed to incomplete combustion and was detected at concentrations between 1.8-2.6 ppm. Carbon monoxide concentrations were below the ASHRAE concentration of concern of 9 ppm.

Particulate matter or PM is the term for a mixture of solid particles and liquid droplets found in the air. It does not distinguish between the types of particles in the air (e.g., pollen, skin cells, mold spores, soil, etc.). Particulate matter includes "inhalable coarse particles," with diameters larger



than 2.5 micrometers and smaller than 10 micrometers (PM 10) and "fine particles," with diameters that are 2.5 micrometers and smaller (PM 2.5). A micrometer is also called a micron and is one millionth of a meter. To put these particle diameters in perspective, the average human hair is about 70 micrometers in diameter – making it 30 times larger than the largest fine particle. Particle loads expected to be a part of the school environment include carpet and clothing fiber, soil tracked from outside, paper dust, chalk dust, and dust and fibers from building materials.

ASHRAE Standard 62.1 – 2013 suggests target indoor concentrations for PM 2.5 and PM 10 of 15 $\mu\text{g}/\text{m}^3$ and 50 $\mu\text{g}/\text{m}^3$, respectively. These concentrations are taken from the EPA's National Ambient Air Quality Standards (NAAQS) based on annual arithmetic means deemed acceptable for outdoor air quality. Occupational standards and guidelines for particles are nearly an order of magnitude higher than concentrations typically found in non-occupational settings and are not appropriate for comparison.

Particle measurements were taken with an Aerocet 531 particulate monitor. The particle monitor takes a two minute averaged sample of particle concentrations in 5 size fractions (PM 1, PM 2.5, PM 7, PM 10 and total suspended particles (TSP)). Results of particulate monitoring, presented in Table 1, revealed that PM 2.5 and PM 10 particle concentrations were well below the ASHRAE target concentrations in all areas monitored with the exception of one sample collected in classroom 13 where the PM 10 particle concentration was 52 $\mu\text{g}/\text{m}^3$. We believe that the particle concentrations in classrooms 2, 5, 9, 10, 13, and the hallway between classrooms 8 and 10 were influenced by custodial activities in these rooms as evidenced by the presence of a dry mop and many small piles of debris.

The visual inspection of the rooms visited on August 28, 2013 did not reveal any obvious sources of water damage, moisture or mold growth. Condensation was observed on supply air diffusers in the hallways and on unit ventilators operating in cooling mode. A strong musty/mildew odor was observed in the entry vestibule to classrooms 33-35 and at the boys and girls bathrooms, janitor's closet and expansion joint in the main hallway providing access to the 6th and 7th grade wings.



Photograph 1: Condensation on supply air diffuser in hallway by Boiler Room.

Table 1: Particle and Indoor Air Quality (IAQ) Measurements

Date: 8/28 and 30/2013 Location: Glenwood Middle School Operator: Michele Twilley

Location	August 28, 2013										August 30, 2013		
	Time	PM1 (mg/m ³)	PM2.5 (mg/m ³)	PM7 (mg/m ³)	PM10 (mg/m ³)	TSP (mg/m ³)	Temp (°F)	Rh (%)	CO (ppm)	CO2 (ppm)	Time	Temp (°F)	Rh (%)
Vocal Music (37)	3:32	0.001	0.001	0.008	0.008	0.020	73.2	65.9	2.5	387	3:47	74.7	60.8
Art (38)	3:45	0.001	0.002	0.004	0.004	0.007	74.7	78.6	2.6	372	3:43	76.1	70.3
Hallway at Art	3:48	0.001	0.002	0.004	0.005	0.006	74.5	77.3	2.5	376	3:45	75.9	70.4
Hallway at Expansion Joint	3:50	0.001	0.002	0.003	0.004	0.005	75.2	77.0	2.6	393	3:39	76.1	67.6
Classroom (CR) 35	3:54	0.001	0.002	0.004	0.004	0.004	74.5	76.2	2.6	358	3:36	74.3	73.1
CR 34	3:57	0.001	0.001	0.002	0.002	0.004	74.8	73.9	2.3	404	3:32	73.6	64.5
CR 33	4:03	0.001	0.002	0.005	0.005	0.007	75.4	77.4	2.6	351	3:31	73.0	70.5
Entry Vestibule to CR 33, 34, 35	4:05	0.001	0.001	0.003	0.003	0.006	74.7	73.3	2.5	380	3:34	74.3	72.2
CR 27	4:08	0.001	0.002	0.004	0.004	0.006	73.2	74.2	2.5	385	3:23	70.3	67.3
CR 29	4:11	0.001	0.002	0.004	0.005	0.006	73.2	74.9	2.4	439	3:21	71.8	71.3
CR 26	4:12	0.000	0.001	0.005	0.006	0.011	73.6	72.5	2.2	438	3:25	70.7	65.8
Hallway between CR 24 and 26	4:15	0.001	0.001	0.003	0.005	0.007	73.6	74.4	2.4	407	3:12	71.8	67.1
CR 24	4:18	0.001	0.002	0.004	0.004	0.005	73.8	77.2	2.6	385	3:29	72.3	66.8
CR 15	4:21	0.001	0.002	0.004	0.004	0.005	73.1	79.3	2.6	376	4:41	74.8	72.1

Table 1: Particle and Indoor Air Quality (IAQ) Measurements

Date: 8/28 and 30/2013 Location: Glenwood Middle School Operator: Michele Twilley

Location	August 28, 2013										August 30, 2013		
	Time	PM1 (mg/m ³)	PM2.5 (mg/m ³)	PM7 (mg/m ³)	PM10 (mg/m ³)	TSP (mg/m ³)	Temp (°F)	Rh (%)	CO (ppm)	CO2 (ppm)	Time	Temp (°F)	Rh (%)
CR 17	4:24	0.001	0.001	0.003	0.003	0.006	73.8	74.3	2.4	408	3:16	69.1	60.5
CR 20	4:27	0.001	0.001	0.002	0.002	0.004	73.6	74.0	2.4	392	3:11	71.4	62.0



B. Measurements and Observations on August 30, 2013

On August 30, 2013, the school was visited again to make observations above the suspended ceiling tiles in targeted classrooms 4, 5, 15, 26, 27, 33, and 37, and the corridor where the scent of moldy/musty odors were detected. Temperature and relative humidity measurements were repeated in the classroom and again above the suspended ceiling and are reported in Table 1.

The following observations were made above the suspended ceiling:

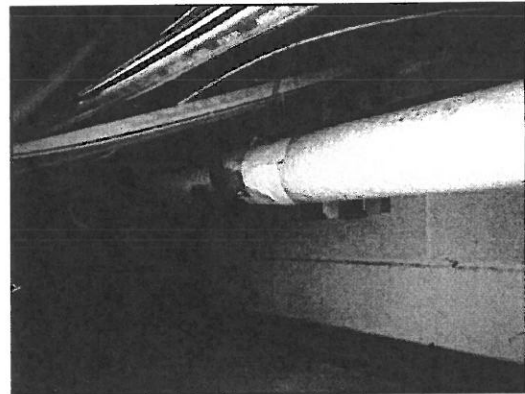
Main Hallway at Expansion Joint between 6th and 7th Grade: Strong mold/mildew odor in hallway, no significant findings above suspended ceiling. Some dirt and debris noted on the backs of ceiling tiles likely from roof replacement.

Room 4: No significant findings.

Room 5: No water damage on pipe insulation. Small (less than 6 inches) area of brown staining on pipe saddle that may have been from roof replacement.

Room 15: 4-6 feet of wet pipe insulation. No observed mold growth but musty odor noticed.

Room 26: More than 3 feet of pipe insulation is wet. Early mold colonization was observed.



Photograph 2: Room 26 pipe insulation.

Room 27: Some very light gray speckling on pipe insulation. Mostly dry but two small (less than 6-inches) wet spots were observed.

Room 29: No significant findings.

Room 33: No significant findings.

Room 37: No significant findings.

The roof appeared to be in good condition with no evidence of active water leaks. There were no signs of staining to indicate old water leaks. Temperature and relative humidity measurements appeared to be lower on August 30, 2013 then they were on August 28, 2013 while the outdoor temperature was higher and the relative humidity was lower on August 30th. All temperature measurements appeared to be within the ASHRAE thermal comfort ranges for summer in all rooms. The humidity levels were still high in the hallway near classroom 22.

C. Meeting and Building Tour September 11, 2013

Ken Roey and other members of the Howard County Public School System, and Michele Twilley of Aria Environmental, Inc. met with Mr. Brown to discuss next steps in investigating the school. Global Facilities Solutions was hired to investigate the high humidity, negative pressure and mechanical system function in the school. Representatives from the Howard County Public School System walked through the school. Of note during this walkthrough is the presence of condensation on top of unit ventilators. Additionally, faculty have placed books over the supply air vents to control air flow as they are complaining that the rooms are too cold. The book covers were noticeably moist.

D. Meeting and Building Tour October 9, 2013

On October 9, 2013, representatives from Howard County Public School System, Global Facility Solutions and Aria Environmental, Inc. met with Mr. Brown to review the findings from the investigations conducted to date and to tour the building. Global Facilities Solution confirmed that the school building is under high negative pressure, has malfunctioning air handling units, and insufficient weatherization. They also indicated that musty odors are emanating from old steam tunnels under the building.

Mr. Klenk reported that he, along with building services, inspected classroom 33 black board and cabinet by coring and visual inspection. They found no signs of mold growth or water intrusion.

E. Crawlspace Inspection on October 10, 2013

After the meeting on October 9, 2013, it was determined that the crawl space should be inspected for sources of water infiltration and mold growth. Captioned photographs showing the findings from the inspection of the crawlspace are included as Attachment B. The inspection took place between 5:30 and 7:30 am on Thursday October 10, 2013. The 7th grade crawlspace was accessed from the hatch in classroom 31 and extended to the main corridor. The 6th and 8th grade crawlspaces were accessed from the hatch in the office work room and extended under classrooms 1 through 11 and 13 through 20. Entrants included Jeff Klenk, Steve Harrison and Andy Stanco with Howard County Public School System and Michele Twilley with Aria Environmental, Inc. Gary Harrison with Howard County Public School System served as entry supervisor.

Condensation was observed to varying degrees under unit ventilators and on ductile iron pipe. The 7th grade wing had notably more condensation under the unit ventilators than the 6th or 8th grade wings. The pipe insulation in the 7th grade wing crawlspace also had beads of condensation on the paper backing where the pipe is in close proximity to a uninvent connection. See photographs 5, 7 and 8. The longest pipe segment having water beading was observed to be 8 feet long. The 7th grade crawlspace did not have air vents to the crawlspace whereas vents were observed in the 6th and 8th grade wings with noticeable air movement flowing through them. Staining and discoloration on paper over fiberglass pipe insulation was observed along with mottling consistent with mold growth. Holes and penetrations appeared to be sealed but the integrity of the sealant cannot be determined by visual inspection alone.

A smoke tube was used to demonstrate air flow that is moving from the crawlspace into the building. The smoke moved quickly away from the crawlspace hatch into the work room before dissipating. This finding indicates that the school building is under negative pressure relative to the surrounding area.

F. Air Monitoring for Fungal Identification and Counting on October 18, 2013

In the absence of visual sources of mold amplification and growth in the classrooms, non-viable spore trap samples were collected from four indoor locations and one outdoor location to determine whether there was a difference between mold spore loads inside the building versus outside. Sample locations included four classrooms (Classrooms 11, 15, 26, 29), and one sample outdoors for comparison. Classrooms 15, 26, and 29 are complaint areas and Classroom 11 is a non-complaint area.

The spore trap samples were collected using AllergenCo-D cassettes attached to a sampling pump calibrated to 15 liter per minute (LPM) air flow. The samples were run for a period of 10 minutes, the time period recommended for spore trap sampling in a clean indoor environment.



The spore trap samples were submitted to Aerobiology Laboratory for analysis. Samples were collected both indoors and outdoors for comparison. The sample results are reported as the spores per cubic meter of air (spores per m³) of hyphal fragments and total fungal spores. Depending upon the morphology of the spores, they were counted by their unique genus or were grouped into spores exhibiting common characteristics (e.g., *Penicillium*/*Aspergillus* group). Table 2 presents the results of the spore trap samples collected at Glenwood Middle School on October 18, 2013.

**Table 2 - Results of Spore Trap Sampling in Selected Classrooms in
Glenwood Middle School on October 18, 2013**

Location	Outside (131018-01)	Room 26 (131018-02)	Room 29 (131018-03)	Room 15 (131028-04)	Room 11 (131018-05)
Spore Type	Spores/ m ³	Spores/ m ³	Spores/ m ³	Spores/ m ³	Spores/ m ³
<i>Alternaria</i>	120	---	---	---	13
<i>Ascospores</i>	173	20	73	47	7
<i>Basidiospores</i>	13,845	22,062	3,627	12,373	4,480
<i>Cercospora</i>	60	---	---	---	7
<i>Cladosporium</i>	5,120	720	513	1,067	333
<i>Curvularia</i>	7	---	---	---	---
<i>Dreschslera</i> / <i>Bipolaris</i> group	13	---	---	---	---
<i>Epicoccum</i>	173	---	7	7	---
Hyphal elements	300	13	13	67	20
<i>Penicillium</i> / <i>Aspergillus</i>	80	80	187	1,440	27
<i>Pithomyces</i>	27	7	---	---	---
<i>Polythrincium</i>	13	---	---	---	---
<i>Rusts</i>	---	13	---	27	20
<i>Smuts</i> , <i>Periconia</i> , <i>myxomycetes</i>	260	27	27	27	40
Unknown	13	---	---	---	---
Total Fungi	20,204	22,942	4,447	15,055	4,947

Bold numbers represent spore counts above the outdoor counts.



Table 3: Particle and Indoor Air Quality (IAQ) Measurements

Date: 10/18/2013 Location: Glenwood Middle School Operator: Michele Twilley

Location	October 18, 2013									
	Time	PM1 (mg/m ³)	PM2.5 (mg/m ³)	PM7 (mg/m ³)	PM10 (mg/m ³)	TSP (mg/m ³)	Temp (°F)	Rh (%)	CO (ppm)	CO2 (ppm)
Room 26	16:26	0.000	0.000	0.001	0.001	0.010	73.4	41.6	0.0	376
Room 29	16:40	0.000	0.000	0.000	0.000	0.003	71.8	39.0	0.0	352
Outside	16:52	0.000	0.000	0.002	0.002	0.003	63.5	44.5	0.0	360
Room 15	17:05	0.000	0.000	0.002	0.003	0.008	72.1	37.0	0.0	348
Room 11	17:24	0.000	0.001	0.008	0.011	0.015	72.7	41.4	0.0	355



Indoor spore counts ranged from 4,447 to 22,942 total spores per cubic meter of air (m^3) and were lower in three of the four samples than the total spore count for the outdoor sample. The total spore counts in classroom 26 were 1.1 times the outdoor load and were mostly due to the presence of Basidiospores. Ascospores, Alternaria/Ulocladium, Basidiospores, and Cladosporium are typically detected in the outdoor environment in high concentrations and may represent outdoor air infiltration. Together this group of spores is 1.2 times higher than the outside concentration in classroom 26 and is therefore not likely to be from an indoor source. Further investigation is typically indicated when the spore concentration is 1.6 times over the outside air concentration.

The presence of Penicillium/Aspergillus group spores was higher indoors than outdoors in classrooms 15 and 29. The concentration in Classroom 29 is less than 300 spores over outdoor concentrations and is therefore not likely to be from an indoor source. Conversely, the concentration of Penicillium/Aspergillus spores in Classroom 15 is greater than 800 spores/ m^3 of air and is likely from an indoor source and additional investigation is indicated.

No secondary colonizers including Chaetomium or Stachybotrys were detected in the classrooms. Hyphal fragments were detected in each of the indoor air samples at concentrations below the outdoor air sample. Certificates of analysis are included as Attachment D.

Particle measurements were repeated during air monitoring with the Aerocet 531 particulate monitor. Results of particulate monitoring, presented in Table 3, revealed that PM 2.5 and PM 10 particle concentrations were well below the ASHRAE target concentrations in all areas monitored.

The pipe insulation above the ceiling tile in classroom 26 was re-inspected after monitoring was completed. There was no change in the condition of the ceiling tile or pipe insulation with respect to visible staining. The pipe insulation was dry to the touch. Photographs comparing the condition of the pipe insulation on August 30, 2013 and again on October 18, 2013 are presented in Attachment C

G. Targeted Inspection of Classroom 15 on October 28, 2013

Based upon the findings from the October 18, 2013 air monitoring results, additional investigation into a presumed indoor source of Penicillium and Aspergillus mold types was conducted. This investigation included re-examination of classroom 15 including the unit ventilator, pipe chase, and crawlspace under the classroom. Photographic documentation of the inspection is presented in Attachment F. Air samples were collected from the classroom, outdoors, and from the crawlspace as close to the classroom as we could reach with electrical extension cords. Air sample results are summarized in Table 4. One bulk sample of soil and two bulk samples of pipe insulation were collected from the crawl space and one bulk sample was collected from garden mulch near the univent louver serving classroom 15. Bulk sample results are presented in Table 5.



Table 4 - Results of Spore Trap Sampling in Classroom 15, Outside of Classroom 15 and the Crawlspace in Glenwood Middle School on October 28, 2013

Location	Classroom 15 (131028-01)	Outside (131028-02)	Crawlspace (131028-03)
Spore Type	Spores/ m ³	Spores/ m ³	Spores/ m ³
Ascospores	33	507	127
Basidiospores	620	2,880	80
Cercospora	---	53	---
Chaetomium	---	---	13
Cladosporium	33	107	47
colorless	---	---	10,256
Dreschlera/ Bipolaris group	---	7	---
Epicoccum	---	13	---
Hyphal elements	20	53	520
Penicillium/ Aspergillus	287	140	35,470
Pithomyces	---	7	---
Rusts	---	7	7
Smuts, Periconia, myxomycetes	20	53	73
Stachybotrys	---	---	233
Torula	---	7	---
Total Fungi	1013	3,834	46,826

Bold numbers results represent spore counts above the outdoor counts.

The total concentration of mold spores and hyphal elements detected in classroom 15 on October 28, 2013 was much lower than that observed on October 18, 2013. Penicillium/Aspergillus group spores were still higher in the classroom than in the outdoor air but the magnitude was under the 300 spore/m³ consideration for the likelihood for an indoor source of Penicillium/Aspergillus mold. One notable difference on the day of monitoring was that the exhaust fans were not running and the strong airflow blowing out of the crawlspace and into the school was not observed.

The crawlspace air samples revealed high concentrations of colorless spores, hyphal elements, Penicillium/Aspergillus group spores, Smuts/Periconia/Myxomycetes group spores, and Stachybotrys. The presence of primary and secondary colonizers indicates long term moisture intrusion and suitable growth environment. Migration of airborne mold spores from the crawlspace into the classroom is likely under the strong negative pressure conditions observed prior to October 28, 2013.



Table 5 – Results of Bulk Sampling of Potential Reservoirs in Glenwood Middle School on October 28, 2013

Sample Number	131028-04	131028-05	131028-06	131028-07
Sample Material	Pipe Insulation	Pipe Insulation	Soil	Mulch
Sample Location	Crawlspace Under Room 15 Univent	Crawlspace Under 7 th Grade Hallway at Steam Expansion Loop	Crawlspace Under Room 15	Outside Classroom 15 at Louvered Opening to Univent
Stachybotrys hyphae	Numerous (3-4 per field)	Moderate (1 per 5 fields)	---	---
Stachybotrys spores	Numerous (3-4 per field)	Moderate (1 per 5 fields)	---	---
Basidiospores	---	---	---	Few (5 per cover slip)
Brown Unidentified Spores	---	---	---	Moderate (1 per 5 fields)
Hyphal Elements	---	---	---	Numerous (3-4 per field)
Smuts, Periconia, myxomycetes spores	---	---	---	Few (5 per coverslip)

Bulk sampling of pipe insulation and soil in the crawlspace was used to identify reservoirs for mold growth and amplification. Both pipe insulation samples had evidence of *Stachybotrys*, a wet mold and secondary colonizer. The soil did not have evidence of mold spores.

One bulk sample of mulch was collected at the air intake into classroom 15 through the uninvent. The sample revealed Basidiospores, brown unidentified spores, hyphal elements and the Smuts/Periconia/Myxomycetes group spores that are typical of plant decay. The mulch is not the source of increased *Penicillium*/*Aspergillus* group spores observed in the classroom.

IV. CONCLUSIONS AND RECOMMENDATIONS

Qualitative assessment of formal and informal employee interviews indicates a correlation between the perceived comfort in the school and the roof replacement/sprinkler retrofit project that occurred in 2011. Building occupants complained of high humidity, extreme hot or cold temperatures, and mold growth that has occurred in the building. Two members of the faculty and staff of Glenwood Middle School have experienced health effects that they feel are related to airborne mold exposures in the school.

The pathway for moisture intrusion through roof leaks was eliminated by the replacement of the leaking roof in 2011. The carpet and fiberglass batting insulation was removed from the classrooms in 2012. New fiberglass pipe insulation was installed on pipes above the suspended ceiling at the same time as part of the renovation activities. Inspection above the ceiling of selected classrooms revealed that some of the pipe insulation has water damage and is stained or has evidence of mold colonization.

Condensation of humid air on the water pipes serving the HVAC system in cooling mode is expected to be the source of moisture causing staining and limited mold growth. Malfunctioning



chiller equipment was associated with the summer mold growth incident and was not working properly on August 28, 2013. Measurements of temperature and humidity in the school on August 28th indicated relative humidity levels that averaged 73.4% and ranged between 68.3% and 76.5% where the outdoor RH was 78.6%. Repeating the measurements after the chiller equipment was functioning properly revealed that the average relative humidity in the school dropped to 58.6% and ranged between 51.4% and 67.1% when outdoor temperatures were higher but relative humidity was lower at 70.6%.

Condensation was observed in the crawl space in the vicinity of the univents on the metal deck, metal pipes, and structural steel. Condensation was also observed on the paper backing of fiberglass pipe insulation in some locations in the 7th grade wing crawlspace. No vents were observed in the 7th grade crawlspace whereas vents were observed in the 6th and 8th grade wing crawlspaces. We recommend that the discolored or previously saturated pipe insulation be removed and replaced with new insulation. HCPSS may consider using a closed cell elastomeric pipe insulation that is resistant to water damage and does not support the growth of mold.

The building was observed to be under the influence of strong negative pressure thereby drawing humid air into the building through all openings and bypassing air conditioning units. Buildings such as schools should be under a slightly positive pressure with respect to the outdoors. The effect of the negative pressure was causing air from the crawlspace to draft into the occupied building space. Musty odors were observed in the main corridor that could not be explained by inspection of the surrounding building materials. Air monitoring was performed to identify whether or not there was a difference between indoor and outdoor concentrations of mold that warranted additional investigation. Air monitoring detected increased *Penicillium*/*Aspergillus* group spores in Classroom 15 which warranted additional investigation. After review of the classroom finishes, univent, and pipe chase, there was no evidence of mold growth in the classroom. Additional investigation into the crawlspace and outdoor sources was undertaken on October 28, 2013. We believe that the apparent source of *Penicillium*/*Aspergillus* group spores was from air in the crawlspace that was infiltrating the school due to strong negative pressure.

We recommend that the mechanical ventilation system serving the school be evaluated for proper function and to restore the school to a slightly positive pressurization. HCPSS has hired Global Facilities Solutions to evaluate the mechanical ventilation systems to correct the negative pressure influence on the school. Global Facilities Solutions findings and recommendations for corrective action are presented under separate cover.

The school has transitioned from cooling mode to heating mode and the seasonal change in temperature and humidity occurred during the investigational period of time. Additionally, HCPSS has made adjustment so the mechanical ventilation system based upon the recommendations of Global Facilities Solutions on or about October 3, 2013 by turning off the exhaust air fans that were not supposed to be running in heating or cooling mode. We recommend that verification of all corrective actions occur in the Spring season when the school transitions back to cooling mode and when outdoor humidity levels rise.

Moisture control is necessary in the crawlspace to prevent the growth and amplification of mold. Ventilation, weatherproofing and replacement of missing or damaged concrete masonry unit block is recommended. Removal of abandoned steam pipes and associated insulation is recommended to eliminate food sources for mold growth. Soil in the crawlspace is moist where CMU is missing or where condensation has dripped onto the soil floor. The need for sealing the soil crawlspace floor should be evaluated if other moisture reducing measures fail.



V. LIMITATIONS

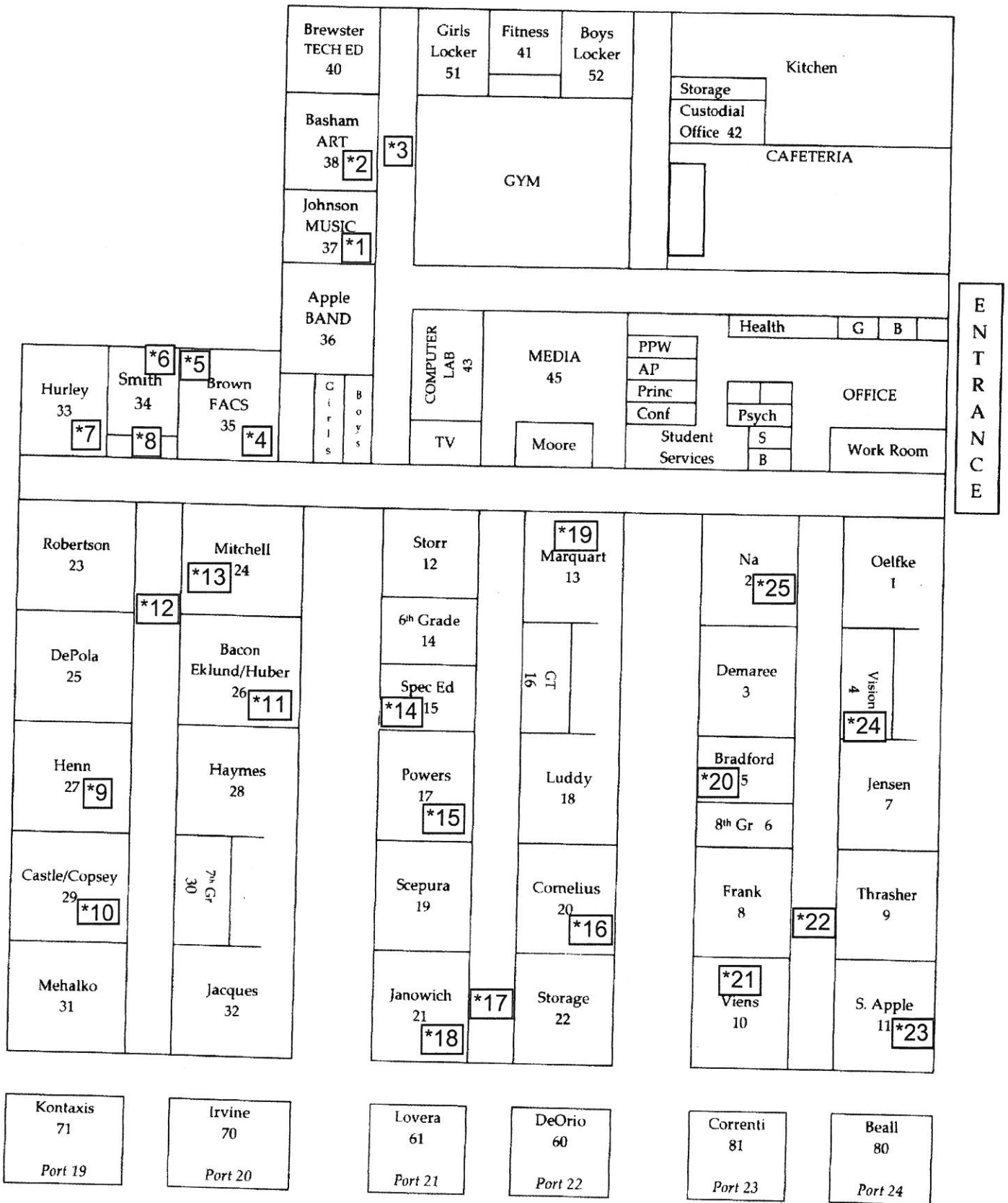
This report has been prepared for the exclusive use of the Howard County Public School System and/or their agents. This service has been performed in accordance with generally accepted environmental practices. No other warranty, expressed or implied, is made. Our conclusions and recommendations are based, in part, upon information provided to us by others and our site observations. We have not verified the completeness or accuracy of the information provided to us by others, unless otherwise noted. Our observations and recommendations are based upon conditions readily visible at the site at the time of our site visit, and upon current industry standards. Destructive sampling was not performed as part of this survey. No observations were made behind solid walls, ceilings or in pipe chases that weren't already openly visible.

By virtue of providing the services described in this report, the preparer does not assume the responsibility of the person(s) in charge of the site, or otherwise undertake responsibility for reporting to any local, state, or federal public agencies any conditions at the site that may present a potential danger to public health, safety, or the environment. It is the Client's responsibility to notify the appropriate local, state, or federal public agencies as required by law, or otherwise to disclose, in a timely manner, any information that may be necessary to prevent any danger to public health, safety, or the environment. Under this scope of services, the preparer assumes no responsibility regarding response actions (e.g. abatement, removal, etc.) initiated as a result of these findings. Response actions are the sole responsibility of the Client and should be conducted in accordance with local, state, and/or federal requirements, and should be performed by appropriately licensed personnel as warranted.



Attachment A:

Building Layout and Sample Location Plan for August 28, 2013

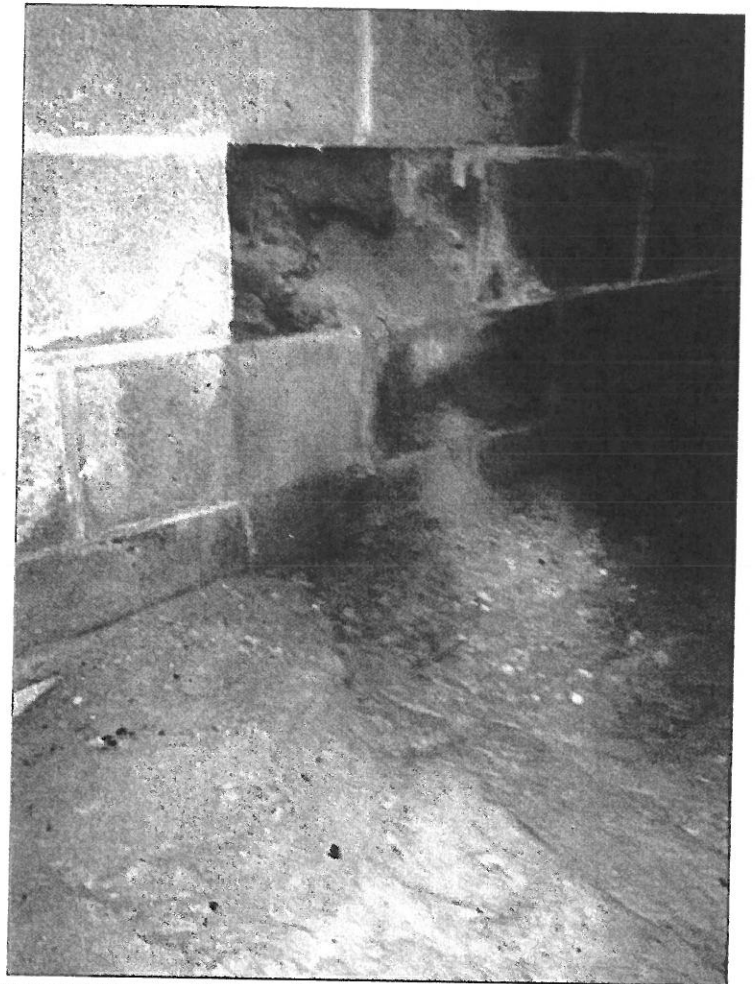


As of 8/02/13

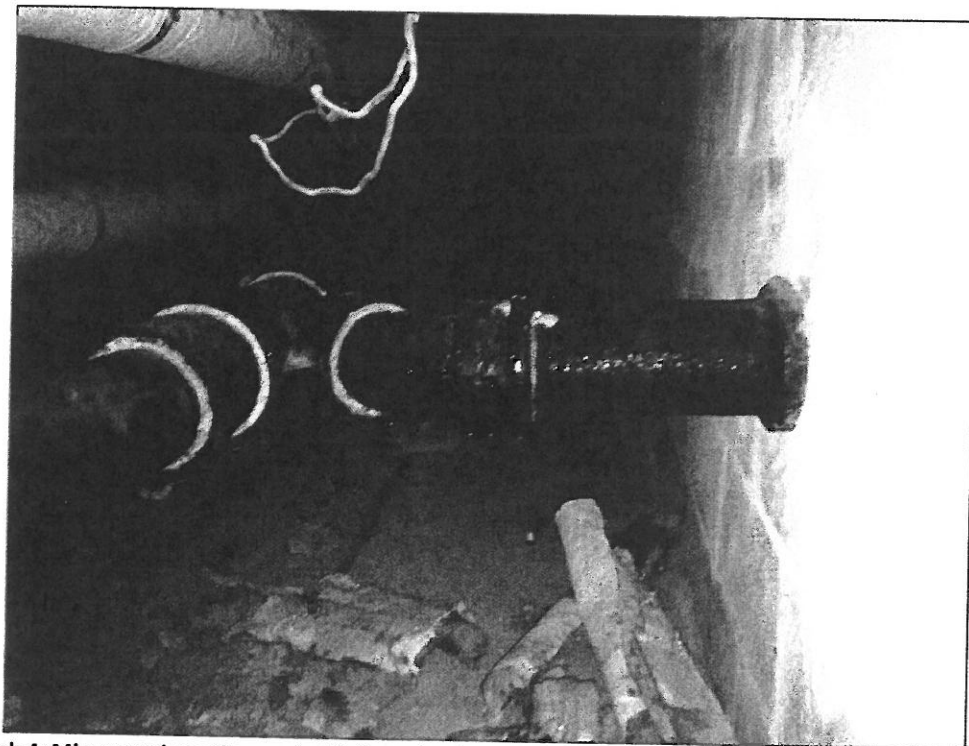
Glenwood Middle School Floor Plan

Sample Location Plan
August 28, 2013

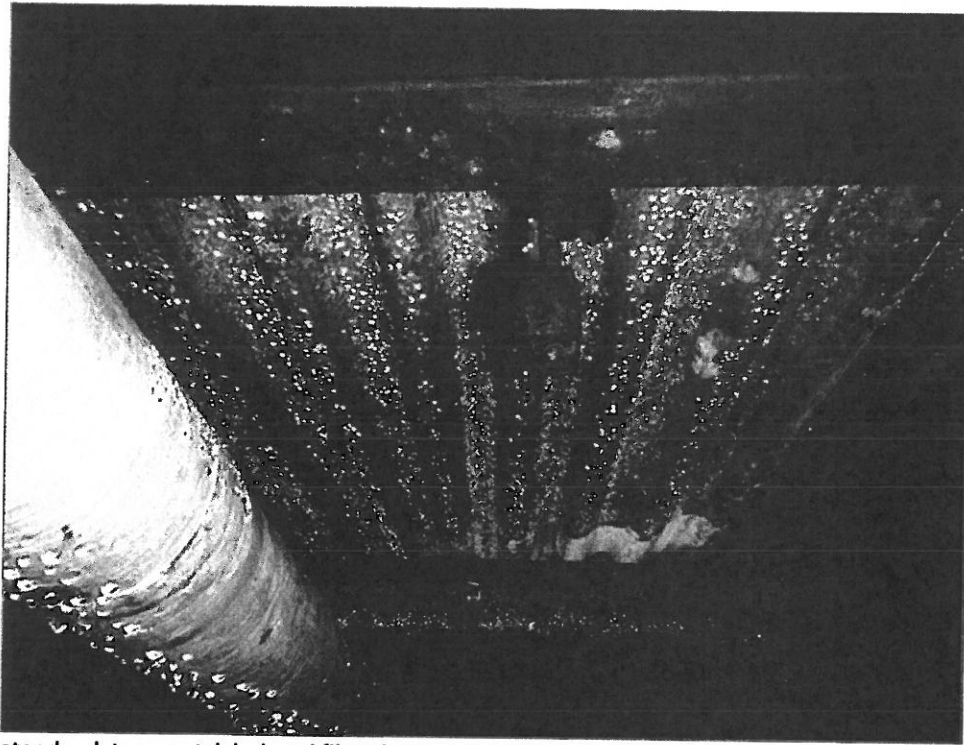




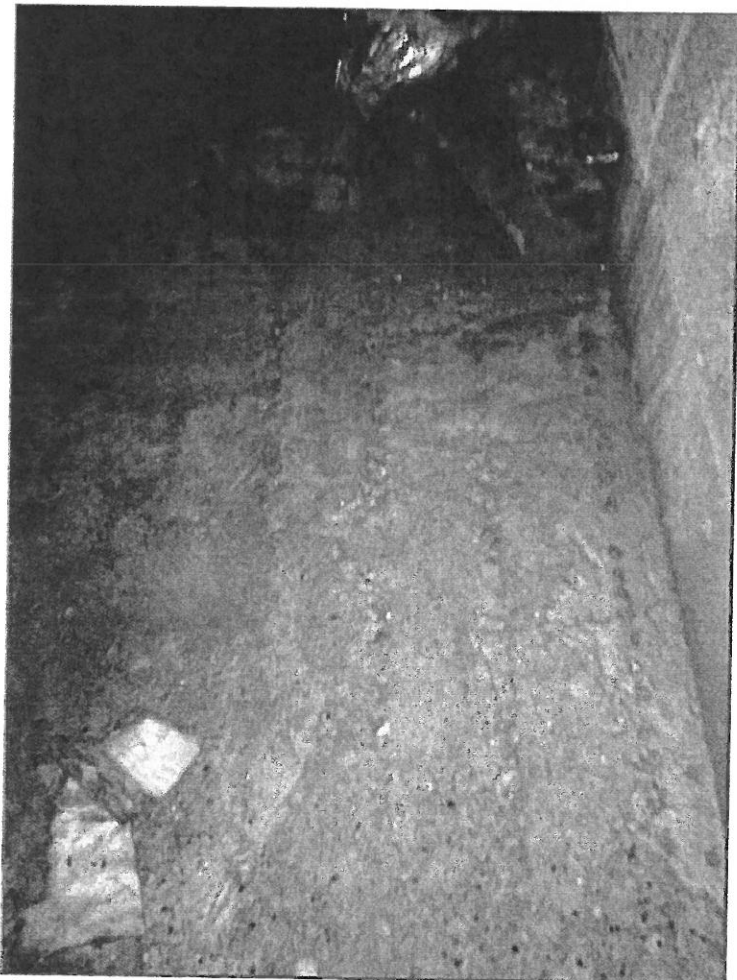
Photograph 3: Missing CMU block with signs of water migration on soil. Crawl space under main hallway between 8th Grade and 7th Grade wings.



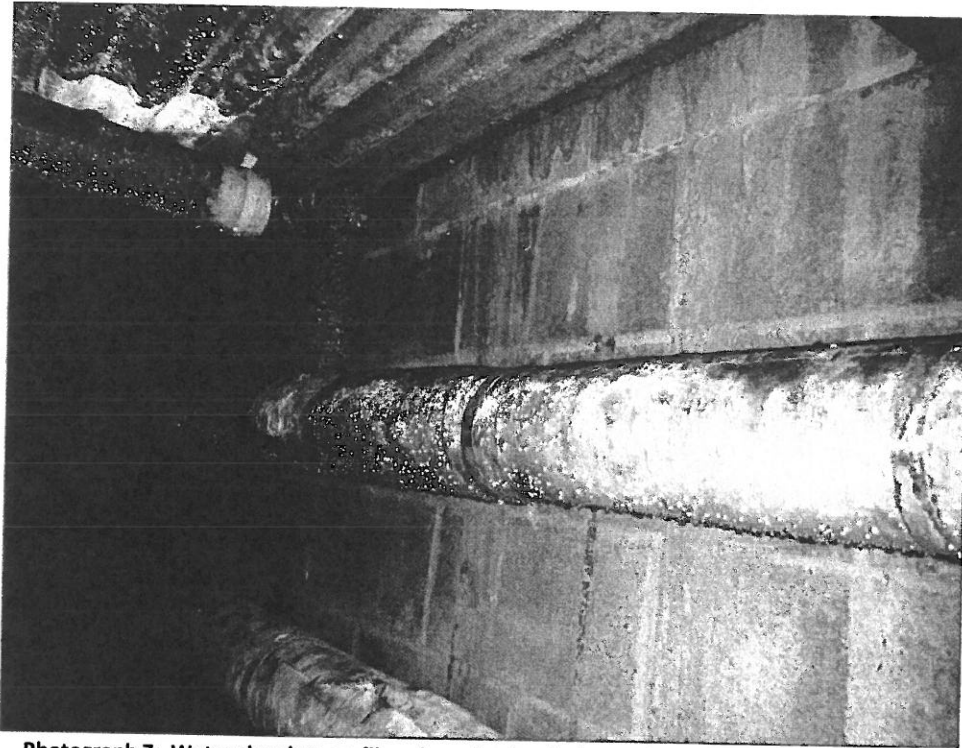
Photograph 4: Minor condensation on ductile iron pipe in main crawlspace near work room entrance to crawl space.



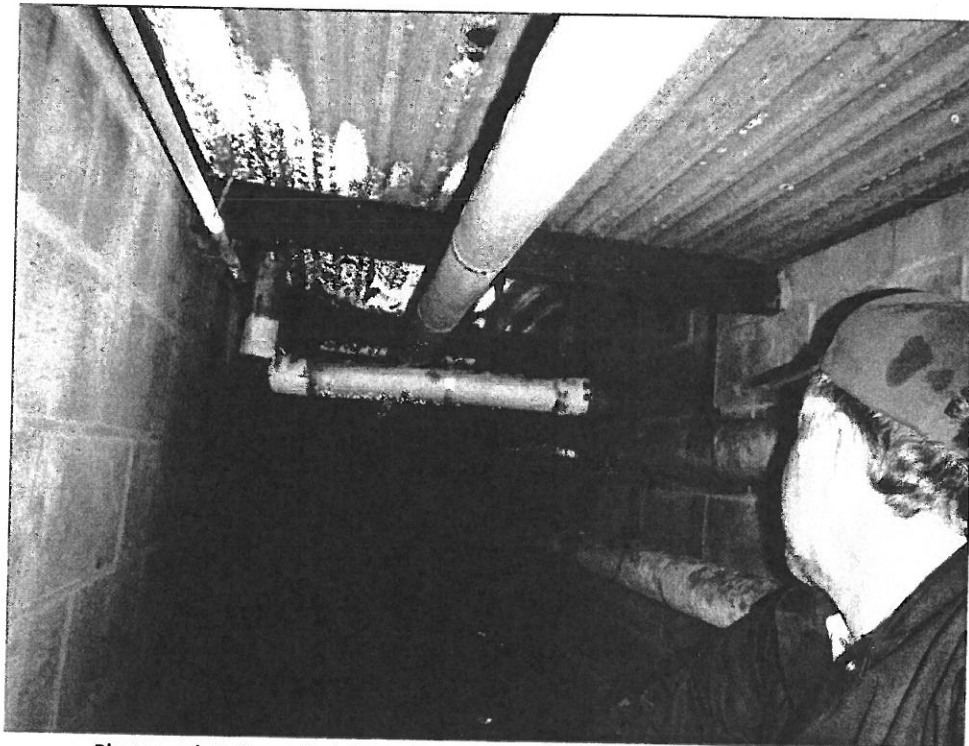
Photograph 5: Water droplets on metal deck and fiberglass insulation in crawlspace under seventh grade hall under room 27 or 29.



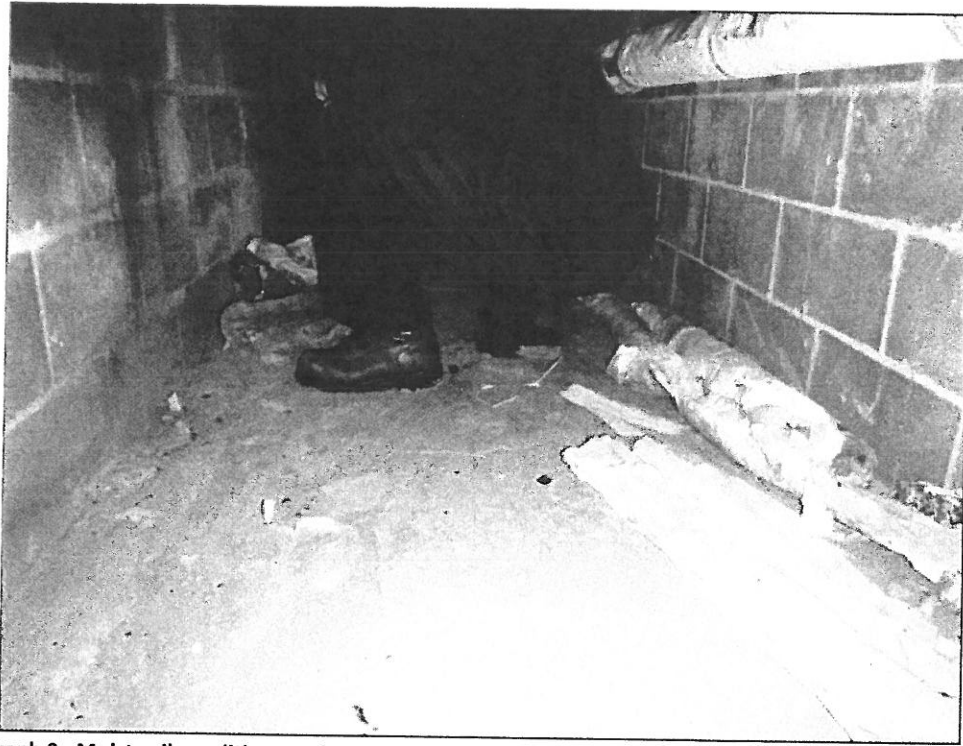
Photograph 6: Corresponding water droplet pattern on soil floor of crawlspace at location noted above.



Photograph 7: Water droplets on fiberglass pipe insulation and rust on exposed metal pipe.



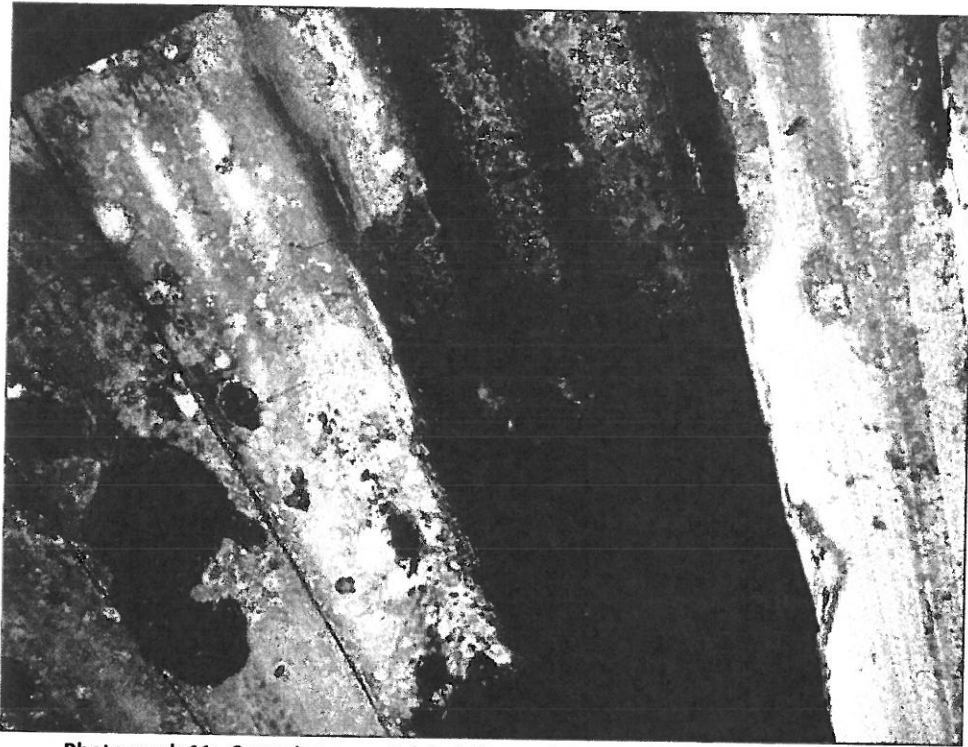
Photograph 8: Expanded view of conditions noted in Photographs 5 through 7.
Condensation on metal deck appears to be associated with unit ventilator.



Photograph 9: Moist soil conditions and water staining on CMU wall in crawlspace under 7th grade classrooms.



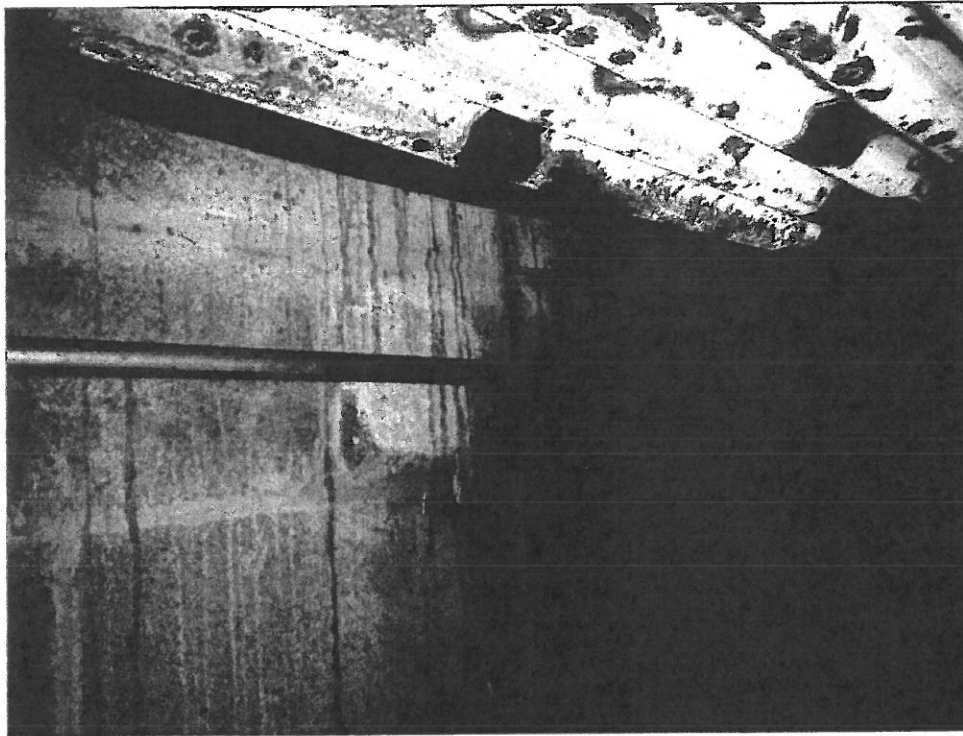
Photograph 10: Evidence of water flow across the crawl space floor.



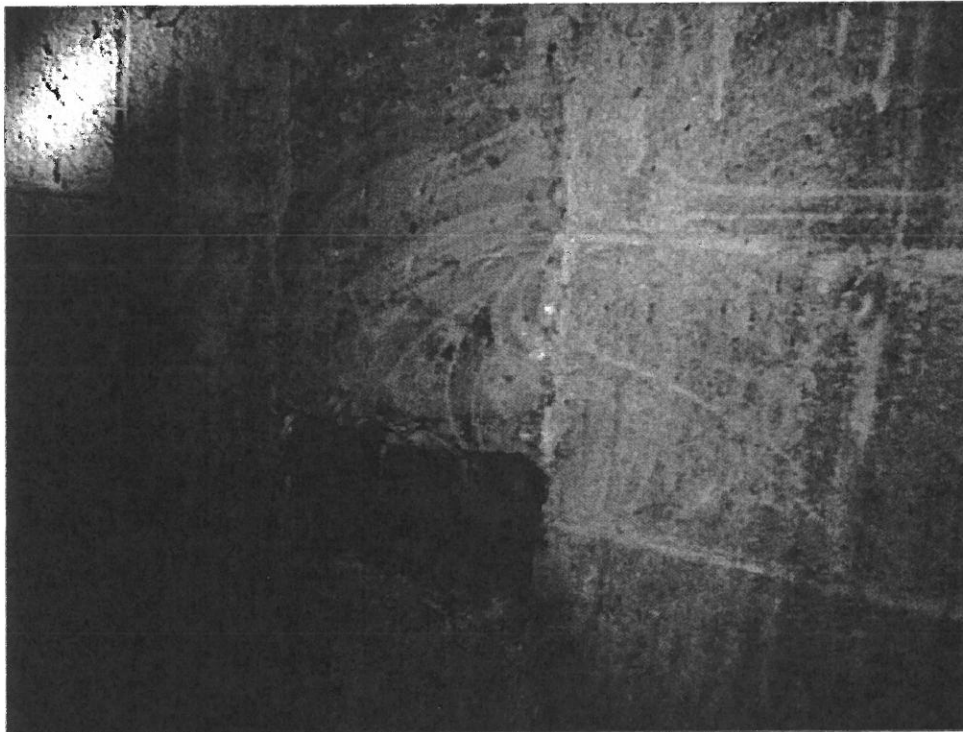
Photograph 11: Corrosion on metal deck in crawlspace under 7th grade classrooms.



Photograph 12: Another example of corrosion on metal deck.



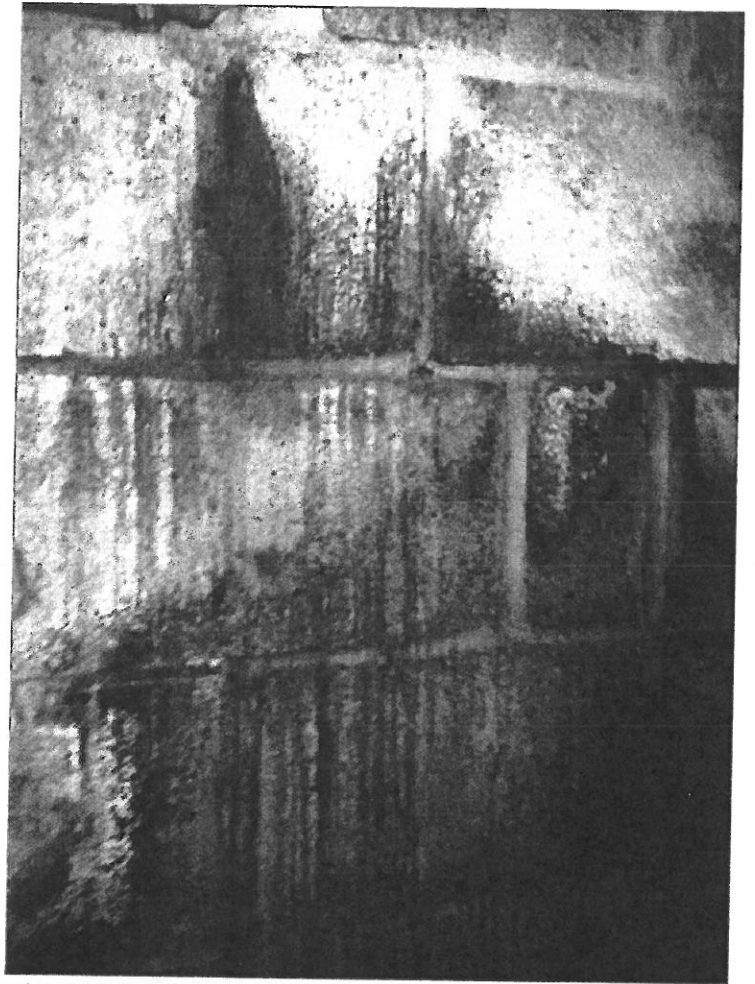
Photograph 13: Moist spot and efflorescence on CMU wall with smaller areas of corrosion on the metal deck in 6th grade crawlspace.



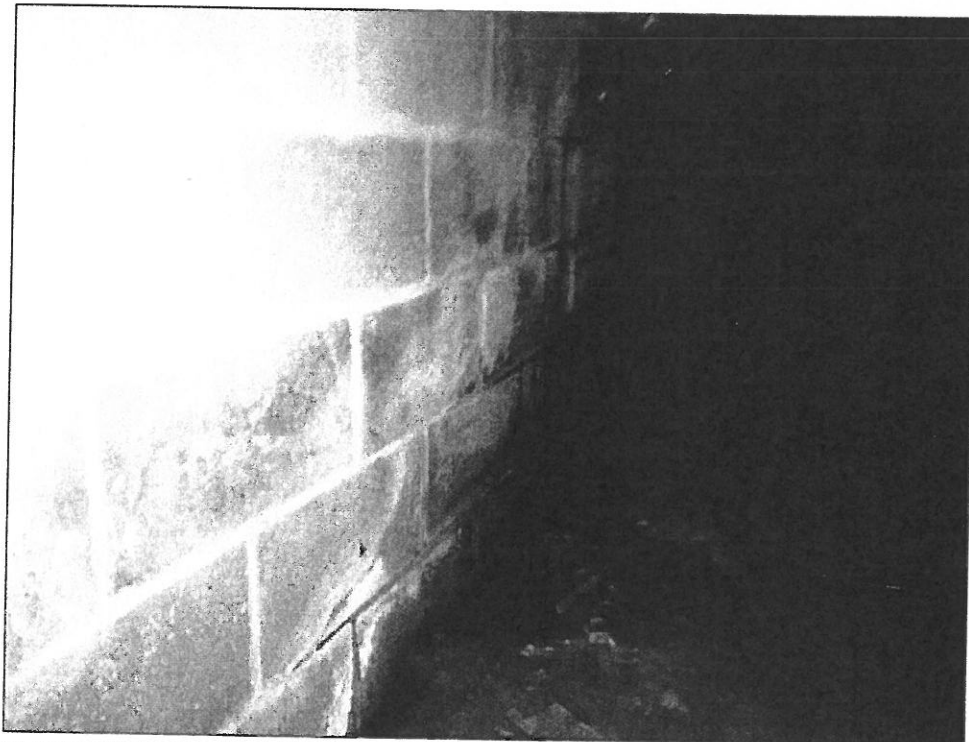
Photograph 14: Vent in 6th grade crawlspace. Vents were observed in 8th grade crawlspace but not in 7th grade crawlspace.

Attachment B:

Crawl Space Photographs October 10, 2013



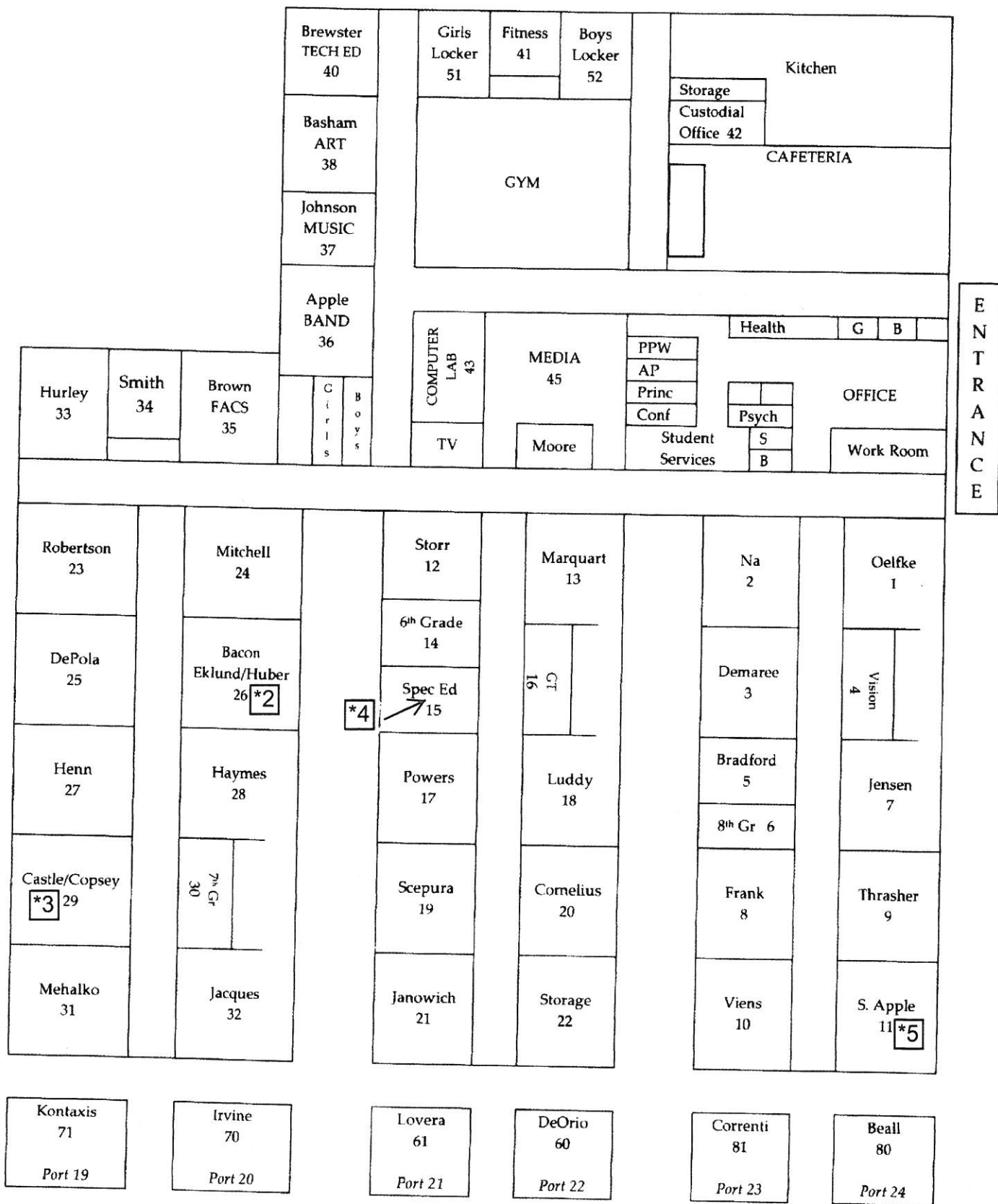
Photograph 1: Weep hole and staining on crawl space wall at corner of Room 13.



Photograph 2: Moist concrete masonry unit walls, efflorescence, and moist soil in crawl space under main corridor near intersection of crawlspace under classroom 13.

Attachment C:

**Sample Location Plan, Report of Analysis and Chain of Custody Forms
October 18, 2013**



As of 8/02/13

Glenwood Middle School Floor Plan

Sample Location Plan
October 18, 2013



Aria Environmental
P.O. Box 286
Woodbine, MD 21797
Attn: Julie Barth

Date Collected: 10/18/2013
Date Received: 10/22/2013
Date Analyzed: 10/23/2013
Date Reported: 10/25/2013
Project ID: 13015957

Project : 130749 HCPSS GMS

Condition of Sample(s) Upon Receipt: Acceptable

Page 1 of 5

1054 Spore Trap Analysis: SOP 3.8

Client Sample Number	131018-02				131018-01			
Sample Location	Room 26				Outside			
Sample Volume (L)	150				150			
Lab Sample Number	13015957-002				13015957-001			
Spore Identification	Raw Ct	spr/m ³	% Ttl	In/Out	Raw Ct	spr/m ³	% Ttl	In/Out
Alternaria	-	-	-	-	18	120	1	-
ascospores	3	20	-	1/8.7	26	173	1	-
basidiospores	138	22062	96	1.6/1	65	13845	69	-
Cercospora	-	-	-	-	9	60	-	-
Cladosporium	108	720	3	1/7.1	48	5120	25	-
Curvularia	-	-	-	-	1	7	-	-
Drechslera/Bipolaris group	-	-	-	-	2	13	-	-
Epicoccum	-	-	-	-	26	173	1	-
hyphal elements	2	13	-	1/23	45	300	1	-
Penicillium/Aspergillus group	12	80	-	1.0/1	12	80	-	-
Pithomyces	1	7	-	1/3.9	4	27	-	-
Polythrincium	-	-	-	-	2	13	-	-
rusts	2	13	-	-	-	-	-	-
smuts, Periconia, myxomycetes	4	27	-	1/9.6	39	260	1	-
unknown	-	-	-	-	2	13	-	-
	Debris Rating 2*				Debris Rating 2*			
	Analytical Sensitivity: 7 spr/m ³				Analytical Sensitivity: 7 spr/m ³			
Total *See Footnotes	270	22942	~100%	1.1/1	299	20204	~100%	-

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Project ID: 13015957

Condition of Sample(s) Upon Receipt: Acceptable

Page 2 of 5

1054 Spore Trap Analysis: SOP 3.8

Client Sample Number	131018-03				131018-01			
Sample Location	Room 29				Outside			
Sample Volume (L)	150				150			
Lab Sample Number	13015957-003				13015957-001			
Spore Identification	Raw Ct	spr/m³	% Ttl	In/Out	Raw Ct	spr/m³	% Ttl	In/Out
Alternaria	-	-	-	-	18	120	1	-
ascospores	11	73	2	1/2.4	26	173	1	-
basidiospores	34	3627	82	1/3.8	65	13845	69	-
Cercospora	-	-	-	-	9	60	-	-
Cladosporium	77	513	12	1/10.0	48	5120	25	-
Curvularia	-	-	-	-	1	7	-	-
Drechslera/Bipolaris group	-	-	-	-	2	13	-	-
Epicoccum	1	7	-	1/25	26	173	1	-
hyphal elements	2	13	-	1/23	45	300	1	-
Penicillium/Aspergillus group	28	187	4	2.3/1	12	80	-	-
Pithomyces	-	-	-	-	4	27	-	-
Polythrincium	-	-	-	-	2	13	-	-
smuts,Periconia,myxomycetes	4	27	1	1/9.6	39	260	1	-
unknown	-	-	-	-	2	13	-	-
	Debris Rating 2*				Debris Rating 2*			
	Analytical Sensitivity: 7 spr/m³				Analytical Sensitivity: 7 spr/m³			
Total *See Footnotes	157	4447	~100%	1/4.5	299	20204	~100%	-

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Project : 130749 HCPSS GMS

Project ID: 13015957

Condition of Sample(s) Upon Receipt: Acceptable

Page 3 of 5

1054 Spore Trap Analysis: SOP 3.8

Client Sample Number	131018-04				131018-01			
Sample Location	Room 15				Outside			
Sample Volume (L)	150				150			
Lab Sample Number	13015957-004				13015957-001			
Spore Identification	Raw Ct	spr/m³	% Ttl	In/Out	Raw Ct	spr/m³	% Ttl	In/Out
Alternaria	-	-	-	-	18	120	1	-
ascospores	7	47	-	1/3.7	26	173	1	-
basidiospores	116	12373	82	1/1.1	65	13845	69	-
Cercospora	-	-	-	-	9	60	-	-
Cladosporium	10	1067	7	1/4.8	48	5120	25	-
Curvularia	-	-	-	-	1	7	-	-
Drechslera/Bipolaris group	-	-	-	-	2	13	-	-
Epicoccum	1	7	-	1/25	26	173	1	-
hyphal elements	10	67	-	1/4.5	45	300	1	-
Penicillium/Aspergillus group	216	1440	10	18/1	12	80	-	-
Pithomyces	-	-	-	-	4	27	-	-
Polythrincium	-	-	-	-	2	13	-	-
rusts	4	27	-	-	-	-	-	-
smuts,Periconia,myxomycetes	4	27	-	1/9.6	39	260	1	-
unknown	-	-	-	-	2	13	-	-
	Debris Rating 2*				Debris Rating 2*			
	Analytical Sensitivity: 7 spr/m³				Analytical Sensitivity: 7 spr/m³			
Total *See Footnotes	368	15055	~100%	1/1.3	299	20204	~100%	-

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Project ID: 13015957

Project : 130749 HCPSS GMS

Condition of Sample(s) Upon Receipt: Acceptable

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1054 Spore Trap Analysis: SOP 3.8

Client Sample Number	131018-05				131018-01			
Sample Location	Room 11				Outside			
Sample Volume (L)	150				150			
Lab Sample Number	13015957-005				13015957-001			
Spore Identification	Raw Ct	spr/m³	% Ttl	In/Out	Raw Ct	spr/m³	% Ttl	In/Out
Alternaria	2	13	-	1/9.2	18	120	1	-
ascospores	1	7	-	1/25	26	173	1	-
basidiospores	42	4480	91	1/3.1	65	13845	69	-
Cercospora	1	7	-	1/8.6	9	60	-	-
Cladosporium	50	333	7	1/15	48	5120	25	-
Curvularia	-	-	-	-	1	7	-	-
Drechslera/Bipolaris group	-	-	-	-	2	13	-	-
Epicoccum	-	-	-	-	26	173	1	-
hyphal elements	3	20	-	1/15	45	300	1	-
Penicillium/Aspergillus group	4	27	1	1/3.0	12	80	-	-
Pithomyces	-	-	-	-	4	27	-	-
Polythrincium	-	-	-	-	2	13	-	-
rusts	3	20	-	-	-	-	-	-
smuts,Periconia,myxomycetes	6	40	1	1/6.5	39	260	1	-
unknown	-	-	-	-	2	13	-	-
	Debris Rating 2*				Debris Rating 2*			
	Analytical Sensitivity: 7 spr/m³				Analytical Sensitivity: 7 spr/m³			
Total *See Footnotes	112	4947	~100%	1/4.1	299	20204	~100%	-

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 Project ID: 13015957

Project : 130749 HCPSS GMS

Condition of Sample(s) Upon Receipt: Acceptable

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Footnotes and Additional Report Information

Debris Rating Table

1	Minimal (<5%) particulate present	Reported values are minimally affected by particulate load.
2	5% to 25% of the trace occluded with particulate	Negative bias is expected. The degree of bias increases directly with the percent of the trace that is occluded.
3	26% to 75% of the trace occluded with particulate	Negative bias is expected. The degree of bias increases directly with the percent of the trace that is occluded.
4	75% to 90% of the trace occluded with particulate	Negative bias is expected. The degree of bias increases directly with the percent of the trace that is occluded.
5	Greater than 90% of the trace occluded with particulate	Quantification not possible due to large negative bias. A new sample should be collected at a shorter time interval or other measures taken to reduce particulate load.

1. Penicillium/Aspergillus group spores are characterized by their small size, round to ovoid shape, being unicellular, and usually colorless to lightly pigmented. There are numerous genera of fungi whose spore morphology is similar to that of the Penicillium/Aspergillus type. Two common examples would be Paecilomyces and Acremonium. Although the majority of spores placed in this group are Penicillium, Aspergillus, or a combination of both. Keep in mind that these are not the only two possibilities.

2. Ascospores are sexually produced fungal spores formed within an ascus. An ascus is a sac-like structure designed to discharge the ascospores into the environment, e.g. Ascobolus.

3. Basidiospores are typically blown indoors from outdoors and rarely have an indoor source. However, in certain situations a high basidiospore count indoors may be indicative of a wood decay problem or wet soil.

4. The Smut, Periconia, Myxomycete group is composed of three different groups whose spores have similar morphologies. Smuts are plant pathogens, Periconia is a relatively uncommon mold indoors, and Myxomycetes are not fungi but slime molds. Although these organisms do not typically proliferate indoors, their spores are potentially allergenic.

5. The colorless group contains colorless spores which were unidentifiable to a specific genus. Examples of this group include Acremonium, Aphanocladium, Beauveria, Chrysosporium, Engyodontium microconidia, yeast, some arthrospores, as well as many others.

6. Hyphae are the vegetative mode of fungi. Hyphal elements are fragments of individual Hyphae. They can break apart and become airborne much like spores and are potentially allergenic. A mass of hyphal elements is termed the mycelium. Hyphae in high concentration may be indicative of colonization.

7. Dash (-) in this report, under raw count column means 'not detected' (ND); otherwise 'not applicable' (NA).

8. The positive-hole correction factor is a statistical tool which calculates a probable count from the raw count, taking into consideration that multiple particles can impact on the same hole; for this reason the sum of the calculated counts may be less than the positive hole corrected total.

9. Due to rounding totals may not equal 100%.

10. Minimum Reporting Limits (MRL) for BULKS, DUSTS, SWABS, and WATER samples are a calculation based on the sample size and the dilution plate on which the organism was counted. Results are a compilation of counts taken from multiple dilutions and multiple medias. This means that every genus of fungi or bacteria recovered can be counted on the plate on which it is best represented.

11. If the final quantitative result is corrected for contamination based on the blank, the blank correction is stated in the sample comments section of the report.

12. Analysis conducted on non-viable spore traps is completed using Indoor Environmental Standards Organization (IESO) Standard 2210.

13. The results in this report are related to this project and these samples only.

14. For samples with an air volume of < 100L, the number of significant figures in the result should be considered (2) two. For samples with air volumes between 100-999L, the number of significant figures in the result should be considered (3) three. For example, a sample with a result of 55,443 spr/m³ from a 75L sample using significant figures should be considered 55,000. The same result of 55,443 from a 150L sample using significant figures should be considered 55,400 spr/m³.

Terminology Used in Direct Exam Reporting

Conidiophores are a type of modified hyphae from which spores are born. When seen on a surface sample in moderate to numerous concentrations they may be indicative of fungal growth.

Suzanne S. Blevins

Suzanne S. Blevins, B.S., SM (ASCP)
 Laboratory Director

13014379

13016379

age ____ of ____

ELITE
CO. GA. VA

NVLAP

NVLAP Lab Code 200860-0 (CO)
NVLAP Lab Code 200829-0 (VA)

ANALAP, LLC
LAB #192683 (CO)
LAB #102977 (GA)
LAB #163063 (VA)

Aerobiology Client		Aria Environmental, Inc.	
Field Contact	Michele M. Twilley, DrPH, CIH	Collected By/Date:	mmt 10/28/13
Address	PO Box 286	Relinquished By/Date:	
Address	Woodbine, MD 21797	Received By/Date:	HR 10/21/13 4:58
Phone/Fax	410-549-5774	Sampler Type	Andersen SAS
Email	mtwilley@ariaenviro.com	Sample Aire	AeroTrap
		PO#/Job#/Project Name:	130749 GMS
Routine	<input type="radio"/> 24 Hour <input checked="" type="radio"/> Same Day <input type="radio"/> 4 Hour <input type="radio"/> 2 Hour <input type="radio"/> 5 Day (Asbestos Only)	Notes/CC Info.	

	Sample No.	Test Code	Sample Location	Total Volume/Area
1	131028-01	1054	Classroom 15	150
2	131028-02	1054	Outside	150
3	131028-03	1054	Crawlspace: Under Main Corridor between two Crawlspace Entrances in 7th Grade Wing	150
4	131028-04	1050	Pipe Insulation in Crawlspace under Room 15 Univent	---
5	131028-05	1050	Pipe Insulation in Crawlspace under 7th grade hallway at expansion loop	---
6	131028-06	1050	Soil from Crawlspace under Room 15	---
7	131028-07	1050	Mulch from Outside at opening to Univent in CR 15	---
8				
9				
10				
11				
12				
13				
14				

1054	Direct, Non-viable Spore Trap	1015	Culture - WATER Legionella
1051	Direct, Qualitative - Swab/Tape	1017	Culture - SWAB Legionella
1050	Direct, Qualitative - Bulk	1010	WATER - Potable - E. coli/total coliforms
1005	AIR Culture - Bacterial Count w/ ID's	1012	SWAB - E. coli/total coliforms
1030	AIR Culture - Fungal Count w/ ID's	1028	Sewage Screen (E. coli/Enterococcus/fecal coliforms)
1006	SWAB Culture - Bacterial Count w/ ID's	2056	Heterotrophic Plate Count
1031	SWAB Culture - Fungal Count w/ ID's	3001	ASBESTOS - Point count
1008	BULK Culture - Bacterial Count w/ ID's	3002	ASBESTOS - PLM Analysis
1033	BULK Culture - Fungal Count w/ ID's	3003	ASBESTOS - Particle characterization
1007	WATER Culture - Bacterial Count w/ID's	3004	ASBESTOS - PCM Analysis

780 Simms Street, Suite 104, Golden, CO 80401 - (866) 620-9348 Fax (303) 232-0283 - email denver@aerobiology.net

43760 Trade Center Place, Suite 100, Dulles, VA 20166 - (877) 648-9150 Fax (703) 661-8379 - email info@aerobiology.net

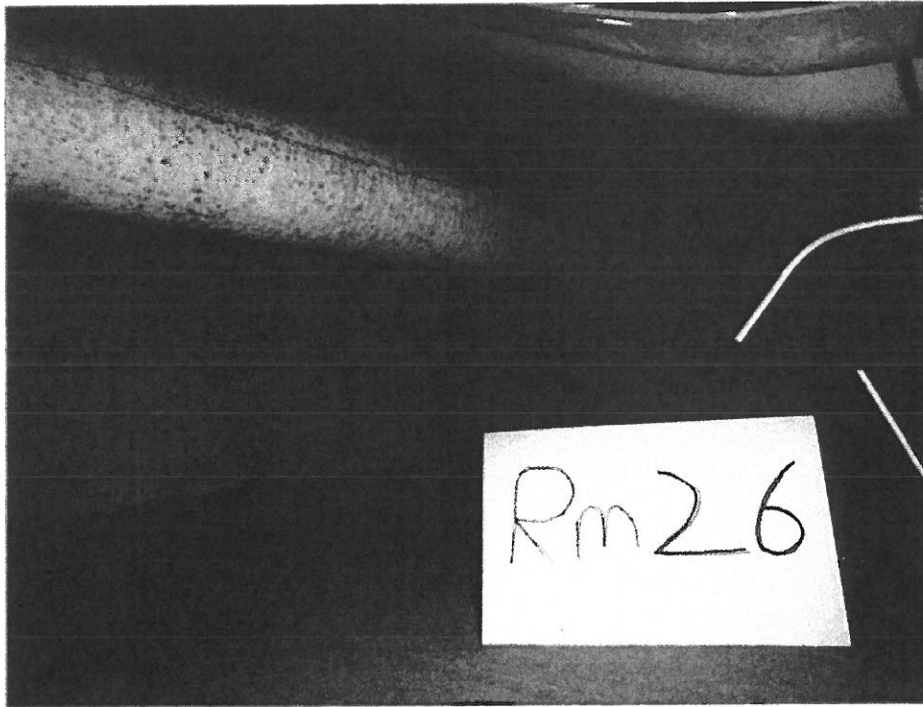
4501 Circle 75 Parkway, Suite A1190, Atlanta GA 30339 - (866) 620-9313 Fax (770) 947-2938 - email ATL@aerobiology.net

1761 Hotel Circle South, Suite 121, San Diego, CA 92108 - (650) 302-2223 Fax (720) 235-5916 - e-mail aerobiologywest@aerobiology.net

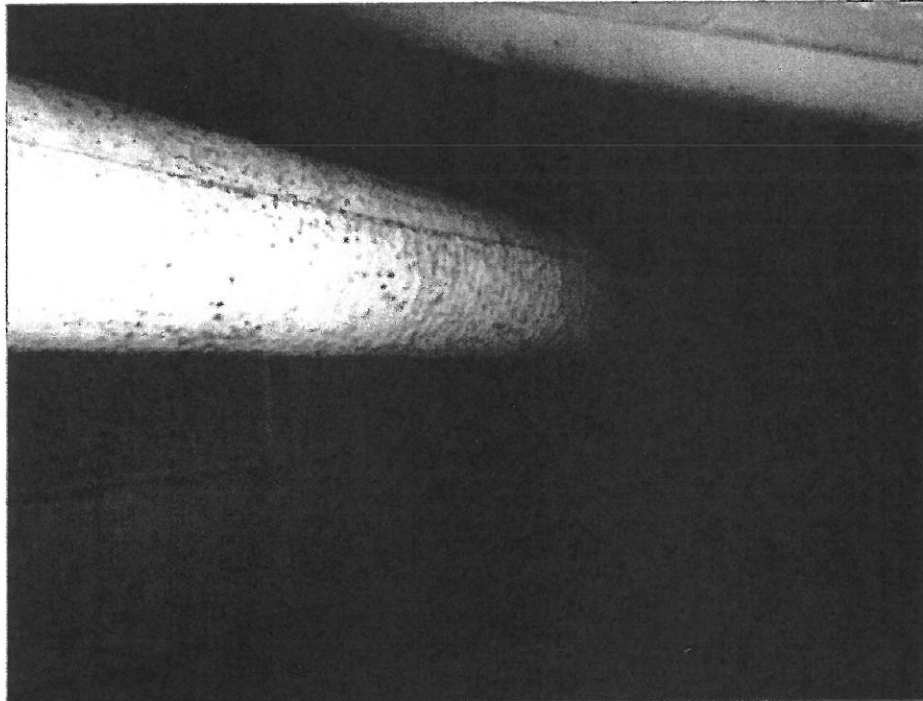
Attachment D:

Classroom 26 Photographs October 18, 2013

**Glenwood Middle School Photographs of Pipe Insulation Above Ceiling in Room 26 on
August 30, 2013 and October 18, 2013**

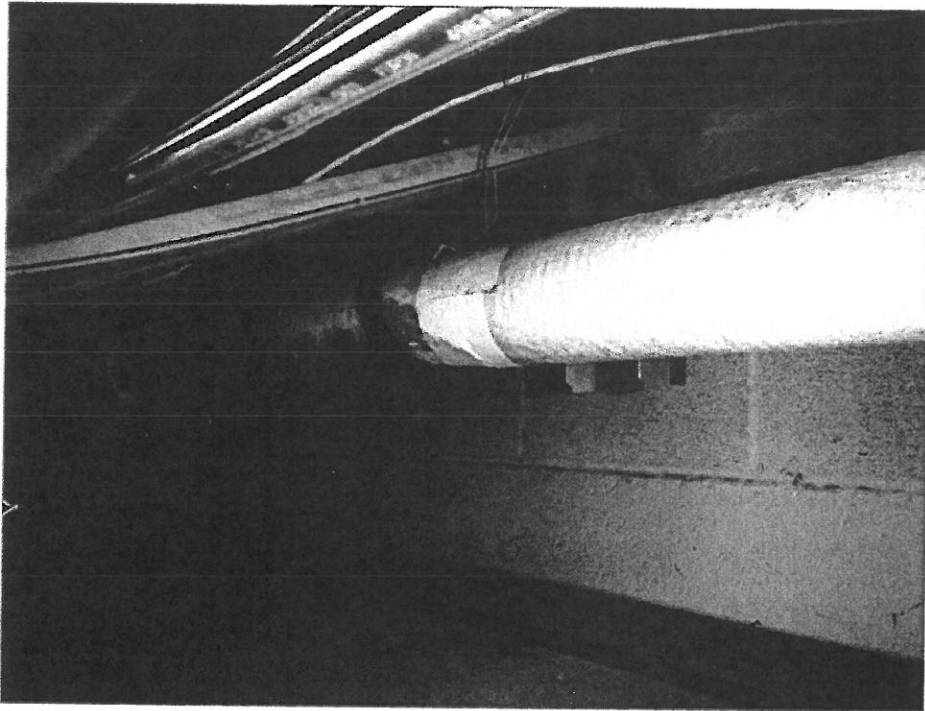


Photograph 1: Pipe insulation above ceiling in room 26 on August 30, 2013.

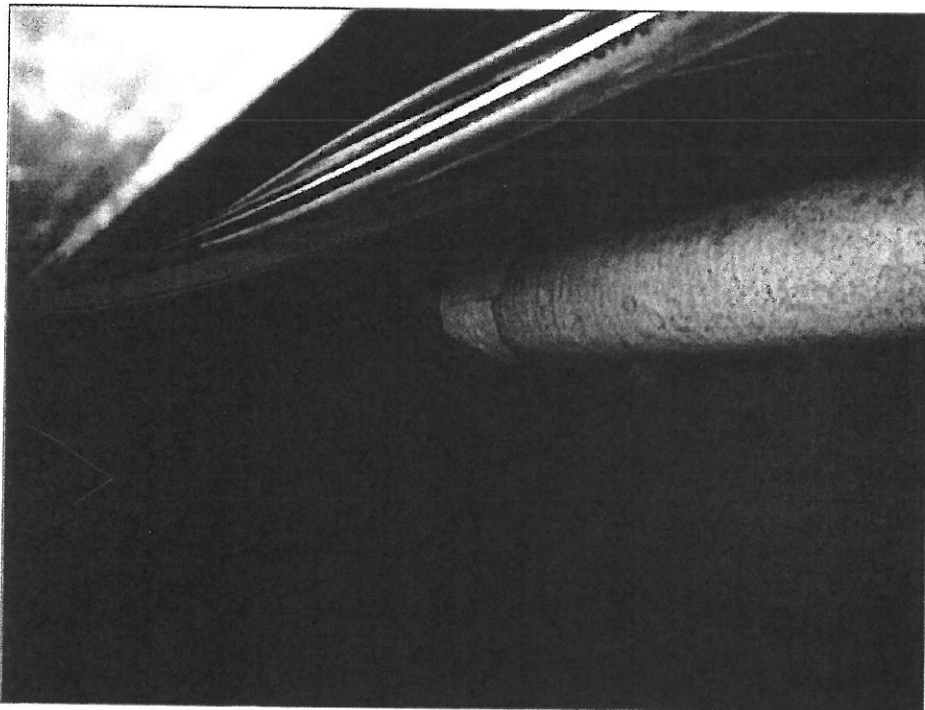


Photograph 2: Pipe insulation above ceiling in room 26 on October 18, 2013.

**Glenwood Middle School Photographs of Pipe Insulation Above Ceiling in Room 26 on
August 30, 2013 and October 18, 2013**



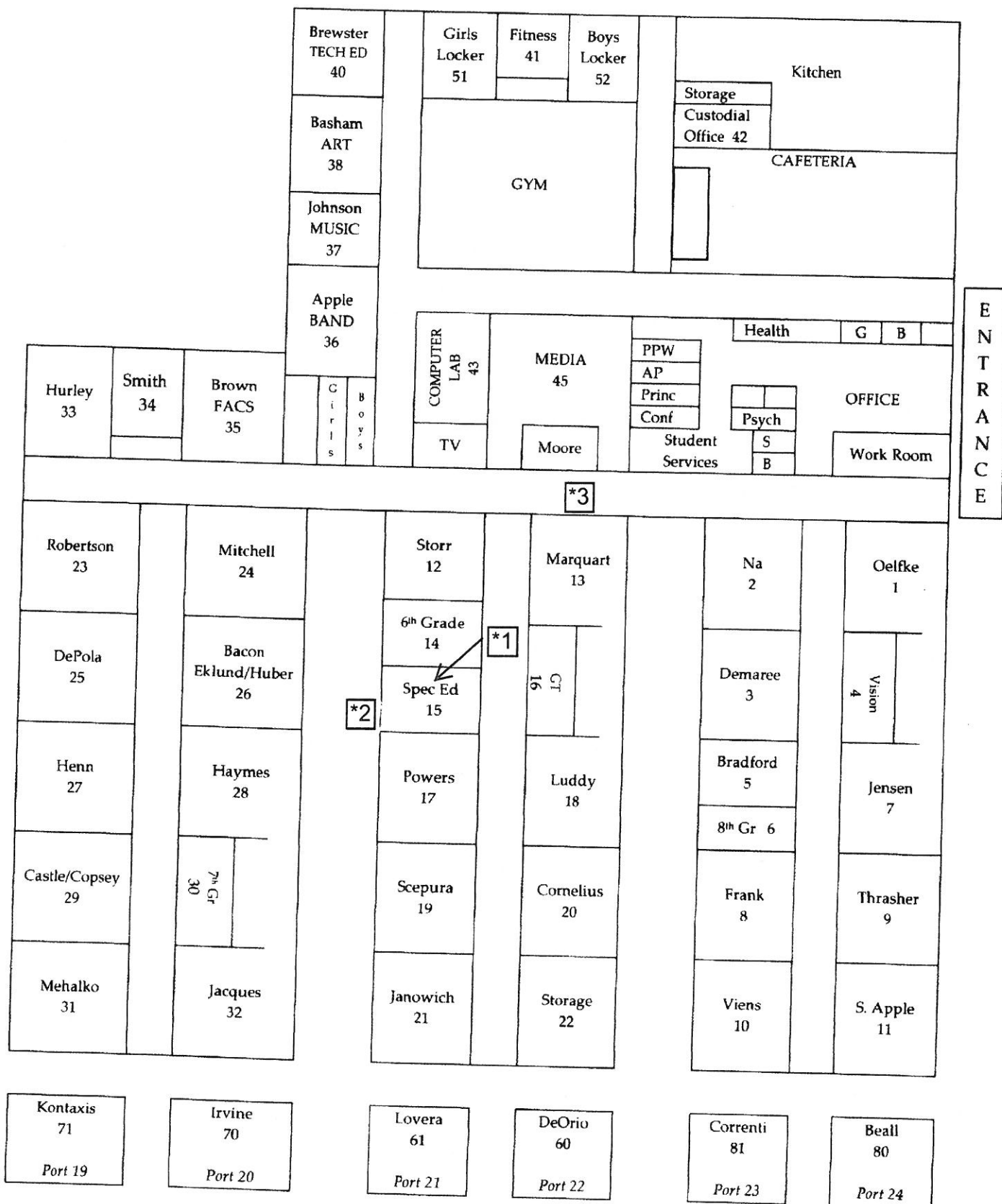
Photograph 3: Pipe insulation above ceiling in room 26 on August 30, 2013.



Photograph 4: Pipe insulation above ceiling in room 26 on October 18, 2013.

Attachment E:

**Sample Location Plan, Report of Analysis and Chain of Custody Forms
October 28, 2013**



As of 8/02/13

Glenwood Middle School Floor Plan

Sample Location Plan
October 28, 2013



Aria Environmental
P.O. Box 286
Woodbine, MD 21797
Attn: Julie Barth

Date Collected: 10/28/2013
Date Received: 10/29/2013
Date Analyzed: 10/29/2013
Date Reported: 10/30/2013
Project ID: 13016379

Project : 130749 GMS

Condition of Sample(s) Upon Receipt: Acceptable

Page 1 of 5

Non-Viable 24hr TAT Spore: SOP 3.8

Client Sample Number	131028-01				131028-02			
Sample Location	Classroom 15				Outside			
Sample Volume (L)	150				150			
Lab Sample Number	13016379-001				13016379-002			
Spore Identification	Raw Ct	spr/m ³	% Ttl	In/Out	Raw Ct	spr/m ³	% Ttl	In/Out
ascospores	5	33	3	1/15	19	507	13	-
basidiospores	93	620	61	1/4.6	108	2880	75	-
Cercospora	-	-	-	-	8	53	1	-
Cladosporium	5	33	3	1/3.2	4	107	3	-
Drechslera/Bipolaris group	-	-	-	-	1	7	-	-
Epicoccum	-	-	-	-	2	13	-	-
hyphal elements	3	20	2	1/2.7	8	53	1	-
Penicillium/Aspergillus group	43	287	28	2.1/1	21	140	4	-
Pithomyces	-	-	-	-	1	7	-	-
rusts	-	-	-	-	1	7	-	-
smuts,Periconia,myxomycetes	3	20	2	1/2.7	8	53	1	-
Torula	-	-	-	-	1	7	-	-
	Debris Rating 3*				Debris Rating 3*			
Comments	Large amount of particulate and fibers seen.				Large amount of particulate and fibers seen.			
	Analytical Sensitivity: 7 spr/m ³				Analytical Sensitivity: 7 spr/m ³			
Total *See Footnotes	152	1013	~100%	1/3.8	182	3834	~100%	-

Aria Environmental
P.O. Box 286
Woodbine, MD 21797
Attn: Julie Barth

Date Collected: 10/28/2013

Date Received: 10/29/2013

Date Analyzed: 10/29/2013

Date Reported: 10/30/2013

Project : 130749 GMS

Project ID: 13016379

Condition of Sample(s) Upon Receipt: Acceptable

Page 2 of 5

Non-Viable 24hr TAT Spore: SOP 3.8

Client Sample Number	131028-03				131028-02			
Sample Location	Crawlspace: Under Main Corridor Between Two Crawlspace Entrances in 7th Grade Wing				Outside			
Sample Volume (L)	150				150			
Lab Sample Number	13016379-003				13016379-002			
Spore Identification	Raw Ct	spr/m ³	% Ttl	In/Out	Raw Ct	spr/m ³	% Ttl	In/Out
ascospores	19	127	-	1/4.0	19	507	13	-
basidiospores	12	80	-	1/36	108	2880	75	-
Cercospora	-	-	-	-	8	53	1	-
Chaetomium	2	13	-	-	-	-	-	-
Cladosporium	7	47	-	1/2.3	4	107	3	-
colorless	24	10256	22	-	-	-	-	-
Drechslera/Bipolaris group	-	-	-	-	1	7	-	-
Epicoccum	-	-	-	-	2	13	-	-
hyphal elements	78	520	1	9.8/1	8	53	1	-
Penicillium/Aspergillus group	83	35470	76	253/1	21	140	4	-
Pithomyces	-	-	-	-	1	7	-	-
rusts	1	7	-	1.0/1	1	7	-	-
smuts, Periconia, myxomycetes	11	73	-	1.4/1	8	53	1	-
Stachybotrys	35	233	-	-	-	-	-	-
Torula	-	-	-	-	1	7	-	-
	Debris Rating 4*				Debris Rating 3*			
Comments	Spore count may be underestimated due to heavy particulate.				Large amount of particulate and fibers seen.			
	Analytical Sensitivity: 7 spr/m ³				Analytical Sensitivity: 7 spr/m ³			
Total *See Footnotes	272	46826	~100%	12/1	182	3834	~100%	-

Aria Environmental
P.O. Box 286
Woodbine, MD 21797
Attn: Julie Barth

Project : 130749 GMS

Condition of Sample(s) Upon Receipt: Acceptable

Date Collected: 10/28/2013
Date Received: 10/29/2013
Date Analyzed: 10/29/2013
Date Reported: 10/30/2013
Project ID: 13016379

Page 3 of 5

Client Sample Number: **131028-04**

Lab Sample Number: **13016379-004**

Sample Location: **Pipe Insulation in Crawlspace Under Room 15 Univent**

Test Requested: **1050 Bulk, Direct Microscopic Exam**

Results:

Numerous Stachybotrys hyphae seen
Numerous Stachybotrys spores seen

Laboratory Observation

3-4 per field (minimum)
3-4 per field (minimum)

Debris Rating 3

Comments: **Large amount of particulate and fibers seen.**

Client Sample Number: **131028-05**

Lab Sample Number: **13016379-005**

Sample Location: **Pipe Insulation in Crawlspace Under 7th Grade Hallway at Expansion Loop**

Test Requested: **1050 Bulk, Direct Microscopic Exam**

Results:

Moderate Stachybotrys hyphae seen
Moderate Stachybotrys spores seen

Laboratory Observation

1 per 5 fields
1 per 5 fields

Debris Rating 3

Comments: **Large amount of particulate and fibers seen.**

Client Sample Number: **131028-06**

Lab Sample Number: **13016379-006**

Sample Location: **Soil From Crawlspace Under Room 15**

Test Requested: **1050 Bulk, Direct Microscopic Exam**

Debris Rating 3

Comments: **No fungal spores seen. Large amount of particulate seen.**

Aria Environmental

P.O. Box 286

Woodbine, MD 21797

Attn: Julie Barth

Project : 130749 GMS

Condition of Sample(s) Upon Receipt: Acceptable

Date Collected: 10/28/2013

Date Received: 10/29/2013

Date Analyzed: 10/29/2013

Date Reported: 10/30/2013

Project ID: 13016379

Page 4 of 5

Client Sample Number: **131028-07**

Sample Location: **Mulch From Outside at Opening to Univent in CR 15**

Test Requested: **1050 Bulk, Direct Microscopic Exam**

Lab Sample Number: **13016379-007**

Results:

Few basidiospores seen

Moderate brown unidentified spores seen

Numerous hyphal elements seen

Few smuts, Periconia, myxomycetes spores seen

Laboratory Observation

5 per cover slip

1 per 5 fields

3-4 per field (minimum)

5 per cover slip

Debris Rating 3

Comments: **Large amount of fibers and particulate observed.**

Aria Environmental

P.O. Box 286

Woodbine, MD 21797

Attn: Julie Barth

Project : 130749 GMS

Condition of Sample(s) Upon Receipt: Acceptable

Date Collected: 10/28/2013

Date Received: 10/29/2013

Date Analyzed: 10/29/2013

Date Reported: 10/30/2013

Project ID: 13016379

Page 5 of 5

Footnotes and Additional Report Information

Debris Rating Table

1	Minimal (<5%) particulate present	Reported values are minimally affected by particulate load.
2	5% to 25% of the trace occluded with particulate	Negative bias is expected. The degree of bias increases directly with the percent of the trace that is occluded.
3	26% to 75% of the trace occluded with particulate	Negative bias is expected. The degree of bias increases directly with the percent of the trace that is occluded.
4	75% to 90% of the trace occluded with particulate	Negative bias is expected. The degree of bias increases directly with the percent of the trace that is occluded.
5	Greater than 90% of the trace occluded with particulate	Quantification not possible due to large negative bias. A new sample should be collected at a shorter time interval or other measures taken to reduce particulate load.

1. Penicillium/Aspergillus group spores are characterized by their small size, round to ovoid shape, being unicellular, and usually colorless to lightly pigmented. There are numerous genera of fungi whose spore morphology is similar to that of the Penicillium/Aspergillus type. Two common examples would be Paecilomyces and Acremonium. Although the majority of spores placed in this group are Penicillium, Aspergillus, or a combination of both. Keep in mind that these are not the only two possibilities.

2. Ascospores are sexually produced fungal spores formed within an ascus. An ascus is a sac-like structure designed to discharge the ascospores into the environment, e.g. Ascobolus.

3. Basidiospores are typically blown indoors from outdoors and rarely have an indoor source. However, in certain situations a high basidiospore count indoors may be indicative of a wood decay problem or wet soil.

4. The Smut, Periconia, Myxomycete group is composed of three different groups whose spores have similar morphologies. Smuts are plant pathogens, Periconia is a relatively uncommon mold indoors, and Myxomycetes are not fungi but slime molds. Although these organisms do not typically proliferate indoors, their spores are potentially allergenic.

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6. Hyphae are the vegetative mode of fungi. Hyphal elements are fragments of individual Hyphae. They can break apart and become airborne much like spores and are potentially allergenic. A mass of hyphal elements is termed the mycelium. Hyphae in high concentration may be indicative of colonization.

7. Dash (-) in this report, under raw count column means 'not detected (ND)'; otherwise 'not applicable' (NA).

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Conidiophores are a type of modified hyphae from which spores are born. When seen on a surface sample in moderate to numerous concentrations they may be indicative of fungal growth.

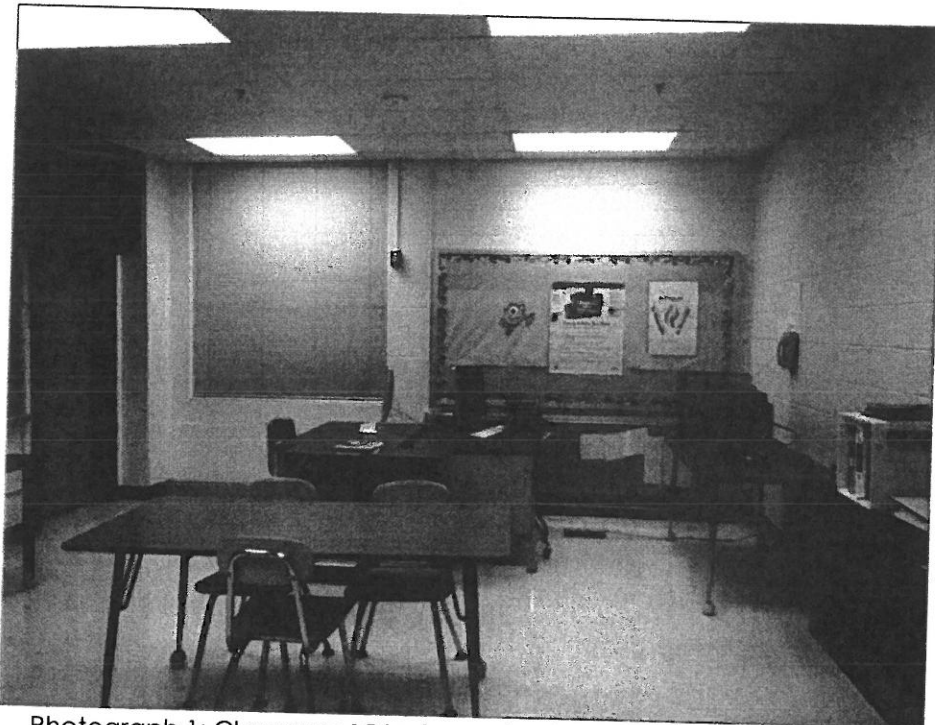
Suzanne S. Blevins

Suzanne S. Blevins, B.S., SM (ASCP)
Laboratory Director

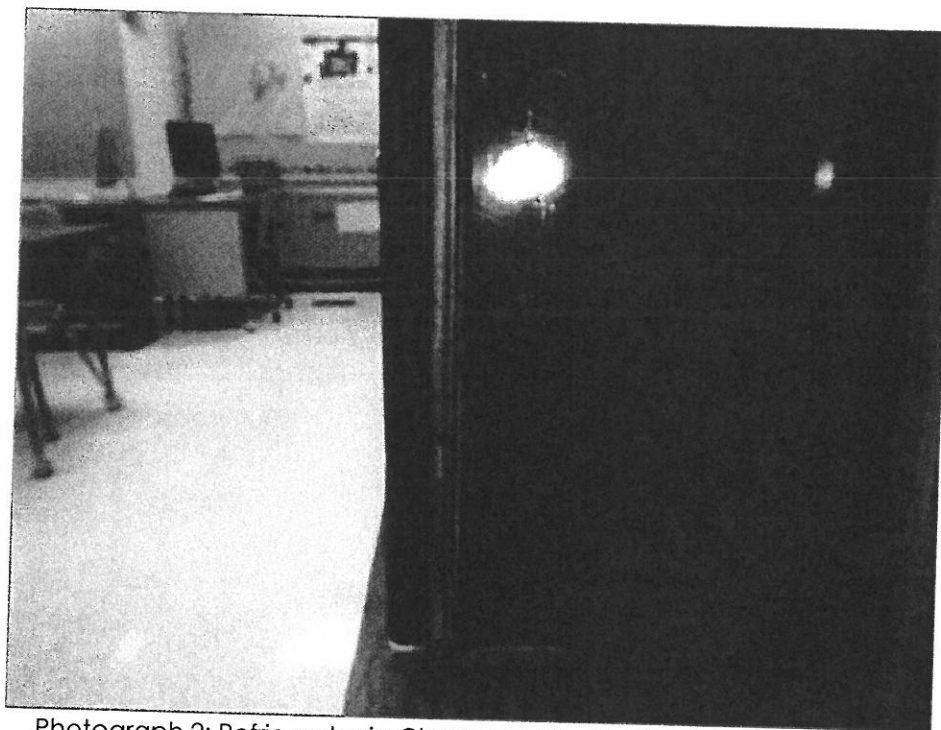
Attachment F:

Classroom 15 and Crawlspace Photographs October 28, 2013

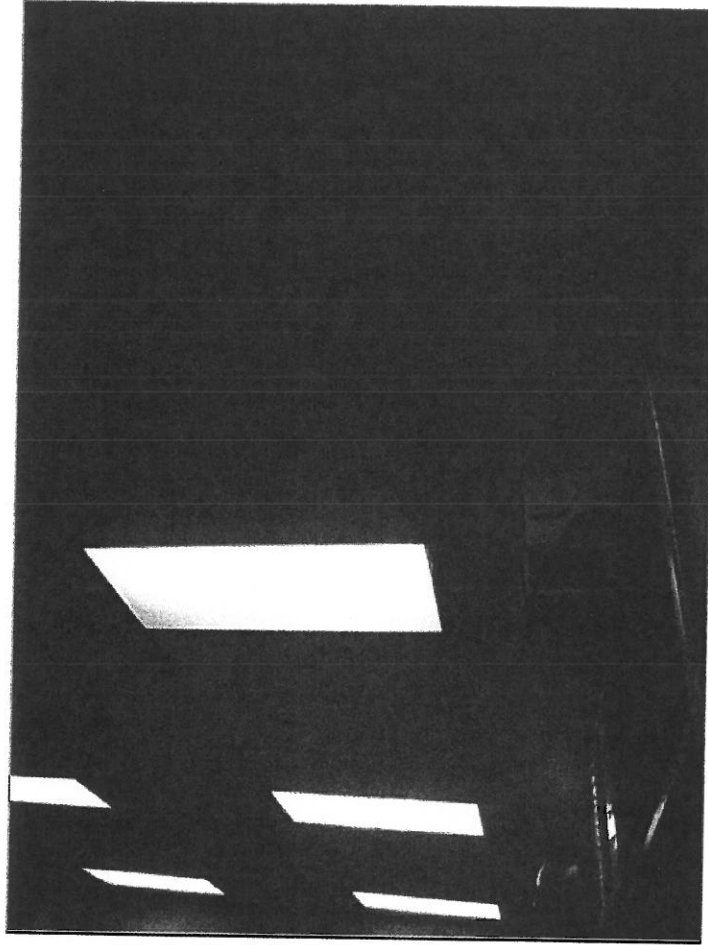
Glenwood Middle School Targeted Inspection on October 28, 2013



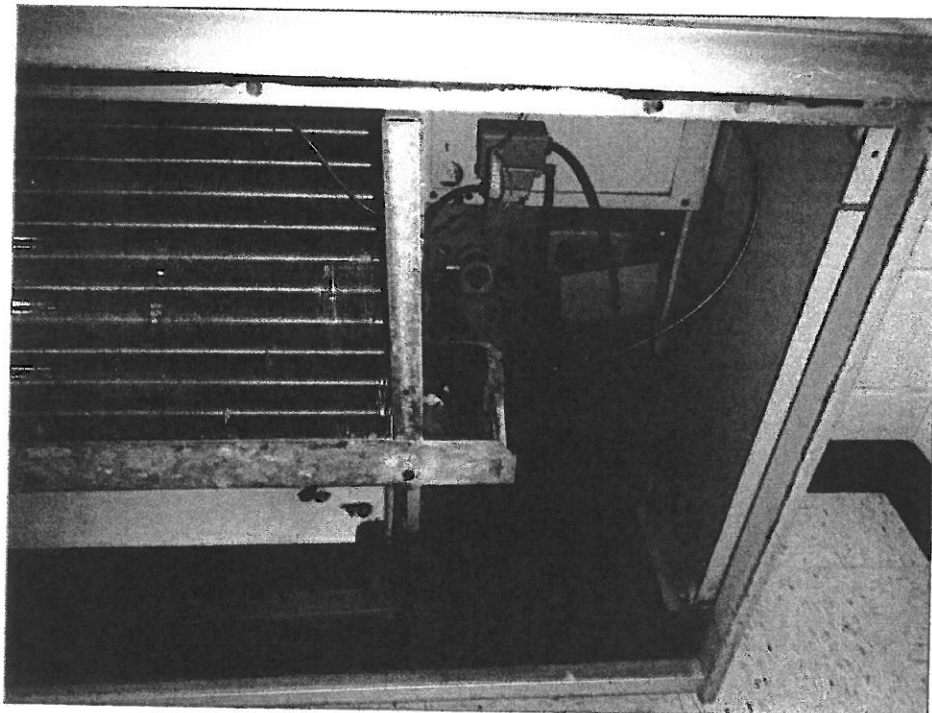
Photograph 1: Classroom 15 before school starts on October 28, 2013.



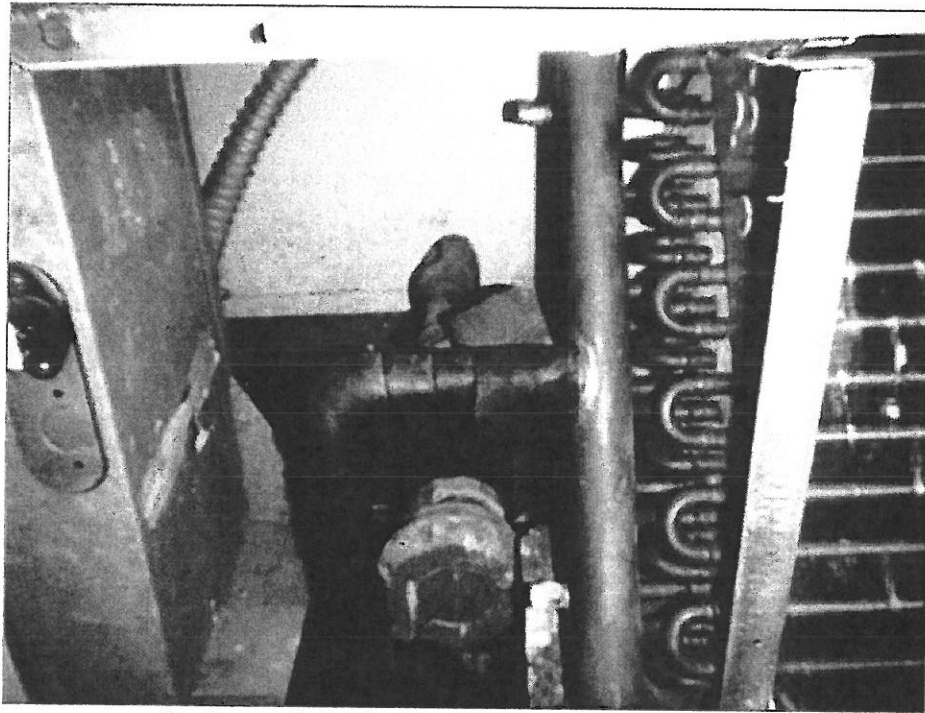
Photograph 2: Refrigerator in Classroom 15 with discoloration on door.



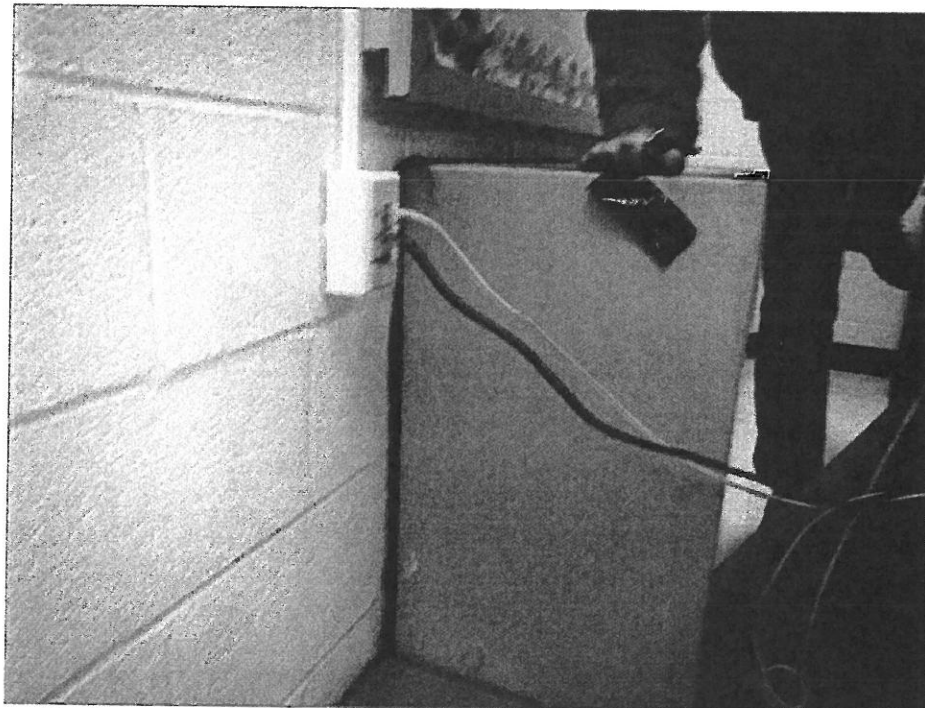
Photograph 3: Ceiling in Classroom 15.



Photograph 4: Interior of Univent in Classroom 15.

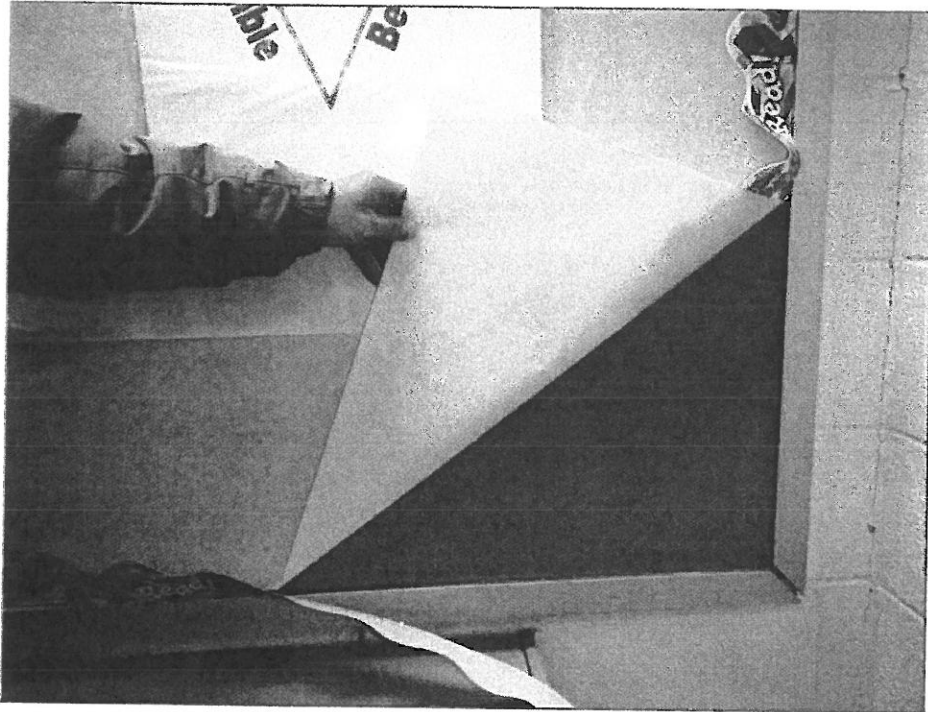


Photograph 5: Interior of Univent in Classroom 15.

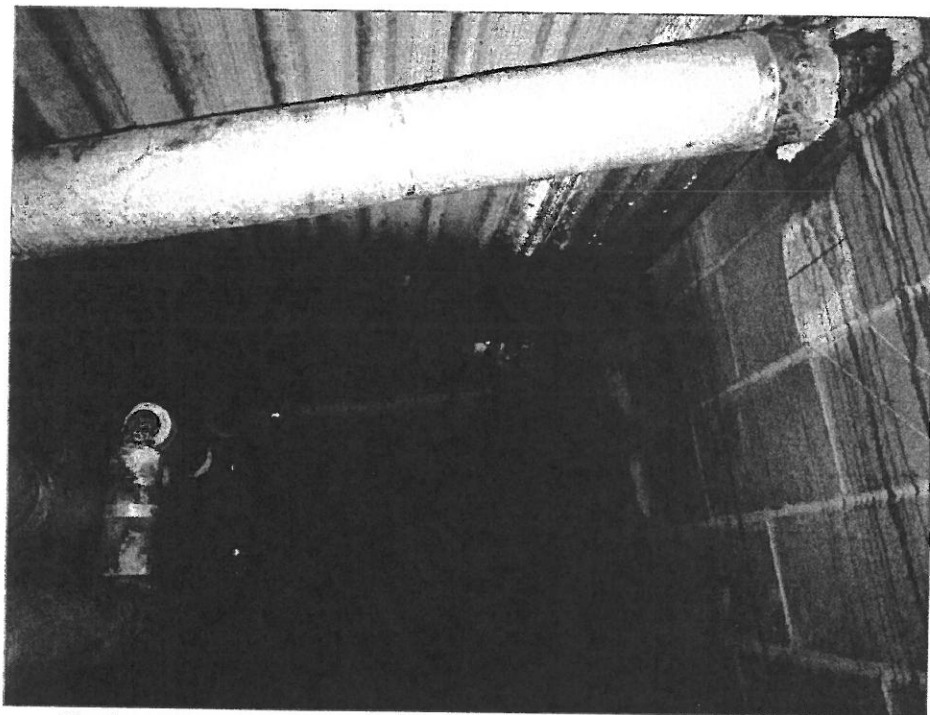


Photograph 6: Interface between wall and Univent in Classroom 15.

Glenwood Middle School Targeted Inspection on October 28, 2013

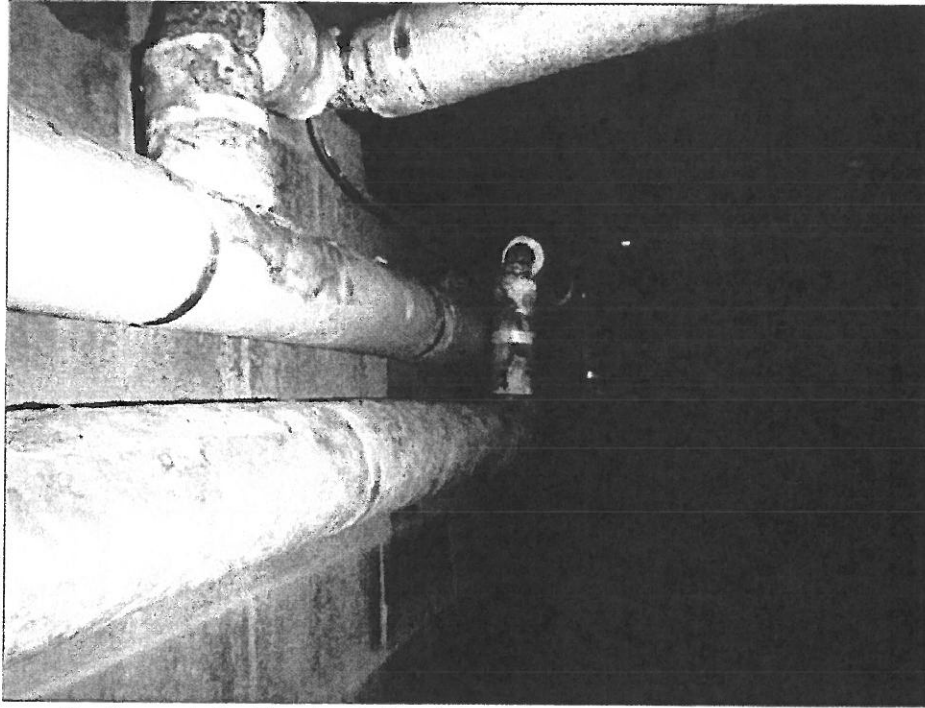


Photograph 7: Clean cork board in Classroom 15.

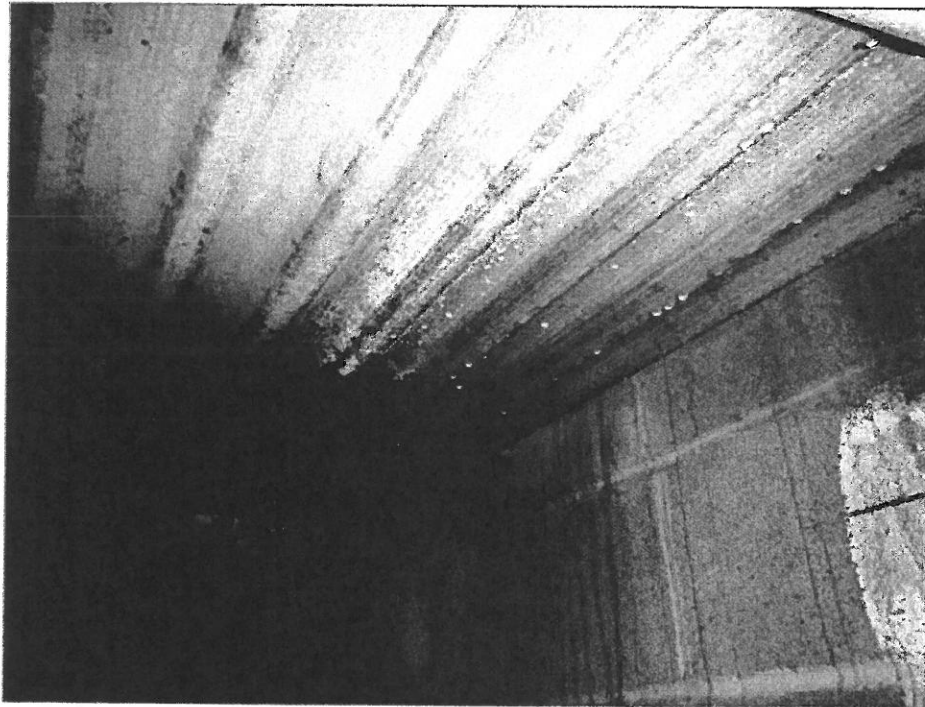


Photograph 8: Pipe insulation in crawlspace under Classroom 15.

Glenwood Middle School Targeted Inspection on October 28, 2013

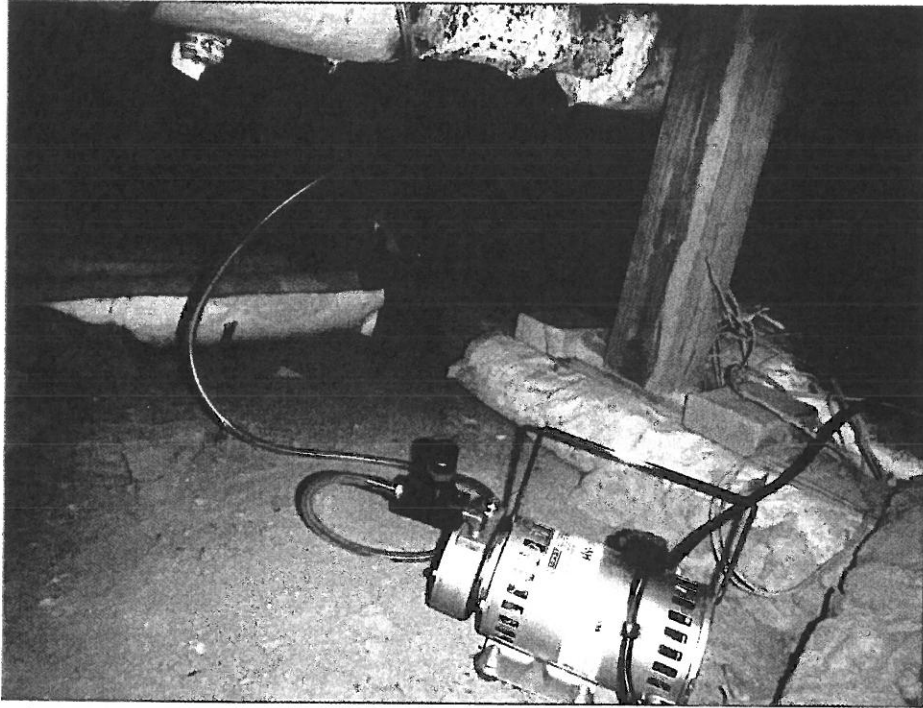


Photograph 9: Pipe insulation in crawlspace under Classroom 15.



Photograph 10: Condensation on metal deck over crawlspace under Classroom 15.

Glenwood Middle School Targeted Inspection on October 28, 2013



Photograph 11: Air sample collection in crawlspace under main hallway.



Photograph 12: Mulch sample submitted for laboratory analysis from outside Classroom 15 near air intake to the Univent.