

***Envirotest* Research Inc.**

1108 NE 200th St. Suite 100
Shoreline, WA 98155-1136
206-522-5449 Fax: 985-9430
email: drdave@airmon.com

**Arbor Heights Elementary Indoor Air Investigation
Final Report
November 4, 2005**

Problems Identified and What was Done

The water problems at Arbor Heights Elementary can be broken down into primarily two areas: 1) The east end; and 2) the west end of the wing of portable classrooms. In the main building there were moldy odors from Univent water leaks on carpets in the Library and water damage to some floors.

The hallway near rooms 9 and 10 in the east end of the wing of portable classrooms had water damage in 1999. There were reports of lots of water in the hall and classrooms. Also, there were reports of moldy odors in Room 7 and 8 in the east end of the wing. The source of water in the 1999 incident was reported to have been stopped some time in 1999. The location of where the mold growth occurred from that water damage was not specifically identified or remediated in 1999.

After 1999, further water damage had not been reported. Moldy odors continued during the spring and summer of 2005. The source of the moldy odors wasn't identified until we found out that there is a sewage sump open to the air in the boiler room. Sewage odors and moisture evaporating from the sump entered the crawlspace, and with other crawlspace odors entered the rooms in the east end. The odor was very noticeable even when the univents were off. We found that the crawlspace was positively pressurized compared to the classrooms, resulting in crawlspace air entering the classrooms – even when the univents were off. The source of the air flow was identified as the boiler room. The crawlspace access door from the boiler room had deteriorated, allowing air from the boiler room into the crawlspace. It was replaced with an airtight access door.

There was no visible mold growth in the wing of portables. Moldy odors were noticeable, but the sources of the odors were difficult to identify. The symptoms reported by teachers and the moldy odors were clear indications of a mold problem. Several possible sources were investigated but results were inconclusive. It turned out that there were multiple causes, some of which were not accessible without removing the Univents and the fresh air supply ducts. Under the fresh air ducts was not the first place we investigated for water/mold problems. The floor under several of the fresh air supply ducts was rotting. Another air quality problem was blocked filters in the fresh air supply ducts to the Univents.

The fresh air supply duct to the Univents was blocked in the four classrooms at the east end of the wing. It appeared that filters in the outside air grills hadn't been changed for many years. No one knew they were even there. Filters were not in other classrooms although the outer half inch mesh screen was partially blocked with debris in those classrooms. In the east end classrooms, the effect of the blockage was to eliminate outside airflow, and draw air from inside of the wall and the crawlspace. The fresh air supply ducts were only partially blocked with debris in the middle and west end classrooms.

The floor under the Univent fresh air ducts had rotted completely through to the crawlspace in rooms 15 and 16. The source of the water was not identified, but it could have come from the condensation of moisture-laden air from the crawlspace, mixed with cold air from outside. Also, windblown rain may have entered through the outside grill, then drained onto the floor.

In the west end, there were several roof leaks and roof drain leaks. Some of the downspouts had completely rusted through, so water was flowing into the crawlspace or on into the tall closet in the classroom. Water also entered the crawlspace through foundation leaks. Once in the crawlspace, the water remained under the west end classrooms all year long – only dropping a few inches during the summer months – even when several thousand cubic feet of air per minute were exhausted from the crawlspace. The water under the portables does not drain through the soil.

Although asbestos-covered water pipes in the crawlspace had some insulation damage, air tests for asbestos conducted in the classrooms did not find any asbestos in the air of any of the classrooms.

Blood tests were taken of six individuals, some from the east-end and some from the west-end classrooms. More types of mold were found in the blood of individuals in the east-end classrooms. One individual in the west end had several types of mold identified, but other individuals only had one or two molds.

The purpose of the blood testing is to determine whether exposure to mold had any measurable impact on the students. Based on the blood samples results, the answer is yes there is an effect, depending on the classroom the student was in and the molds found in their classroom. What effect and the magnitude of the effect are not known and were not intended to be part of the investigation.

Solutions Identified and Implemented

As the water problems and the sources of mold were identified, plans were made to stop the water intrusion, remove moldy materials, and correct the problem including installing new univents with a different design for the fresh air duct that brings fresh air in through a duct in a window, several feet above the floor.

The new univents were installed and tested, to pressurize and create a positive pressure in the classroom. Three exhaust fans to draw air from the crawlspace were installed: 1) near the boiler

room, 2) near the east end, and 3) near the west end. The negative pressure in the crawlspace, created by the exhaust fans, removed all of the moldy odors in the east end of the wing the first day they were installed.

Research has shown that positively pressurizing rooms or buildings with fresh air is very effective in reducing complaints and molds in buildings – even if some mold remains in the ceilings or in the crawlspace. The negative pressure in the crawlspace and the positive pressure from the fresh air supplied by the Univents, together provide a solution to substantially reduce or eliminate exposure to mold toxins from the crawlspace or the building. The elimination of moldy odors in the classrooms is an indication of the effectiveness of the solution. There may still be mold spores in the dust in the buildings from the previous problems. These should continue to be removed through the use of HEPA vacuums.

Before the decision was made to start school this fall, I checked the pressure relative to the crawlspace in each classroom in the portable wing, and one classroom in the main building which has only a narrow pipe chase. When the Univents were installed, they were calibrated to provide BOTH: 1) the required minimum air flow per student, and 2) a positive pressure relative to the crawlspace on the lowest setting. Literature has shown that buildings pressurized with fresh outside air would isolate the occupants from mold problems in the crawlspace.

When school started, work was continuing in the west end crawlspace to dry out the dirt and install sump-pumps, incase there are more sources of water that have not been identified and repaired. The remediation of the water problems in the crawlspace is reported to have been completed on October 25.

On Friday, October 28, 2005, Richard Carlson from Clayton Group and I conducted an inspection of the mold remediation in the crawlspace under classrooms 15, 16, 17 and 18. Visible mold was not found on the joists or sub floor under any of the four classrooms.

Soil moisture should be monitored to quickly identify if there are additional leaks or sources of water to the crawlspace that have not been identified or fixed. The soil-moisture measurement confirms that any water problems in the crawlspace will be identified so they can be repaired before the crawlspace has water pooling on the surface of the dirt.

Early identification of water intrusion gives time to determine the source and remediate the problem before the mold problems in the crawlspace recur.

- 1) The foundation on the west end was sealed, and a drain installed outside the building, to remove water before it could enter the crawlspace.
- 2) The faulty roof drains or leaking downspouts were repaired, and the downspouts and storm drain lines in the last four classrooms were pressure tested confirming there were no additional leaks.

Effects

What does this all mean, or what were the effects of the water/mold damage? What effects, if any, did exposure to the mold have on the students? The question is too broad to be answered meaningfully from the information we have.

The blood test results demonstrate the presence of antibodies in the blood to many types of mold in several individuals, but in two individuals, only two types of mold antibodies were identified. Exposure is inconsistent from room to room but the antibodies to molds were affected by where the students were in the building, how long they were there, and where mold/poor air quality occurred.

There is a possible correlation with mold exposure and decreased academic achievement that teachers from other districts have reported. Could that have happened at Arbor Heights? There are too many variables to be considered to definitively answer the question. Here are three instances of decreased test scores following a water/mold damage.

The 1999 water damage event in the east end of the wing can be used as a point in time to evaluate effects following the water damage and mold event. The fourth-grade students are in room 7 in the east end of the wing, and room 21 in the main building, therefore about half the students were in the east end of the wing. Fourth-grade WASL scores after 1999 dropped substantially: -7.8 percent in reading, -9.2 percent in math, and -8.3 percent in writing. The scores are not an exact reflection of exposure because only half of the students taking the test were exposed. But there is a substantial decrease. No other explanation for the decrease in WASL scores has been identified.

A second example is from last year, a student moved to room 9 in the east end of the wing from room 18 the previous year. The student's Academic Achievement scores dropped substantially: -14 percent in reading, and -21 percent in math. The student's parents questioned the substantial drop in achievement so the student was tested by a psychologist outside of the school environment. The student's scores returned to within 2 percent of the scores prior to exposure in the East Wing.

A third example is the drop in 10th grade WASL scores at Vashon High School after a water damage and mold event in 2000. The teachers also complained of poor indoor air quality, but the mold wasn't discovered until after the WASL. There was a substantial drop in scores from the previous year in: reading -11.1 percent, math -10.5 percent, and writing -41.3 percent. No other explanation for the decrease in WASL scores has been identified. The scores returned to levels prior to the water damage event two years later, after the mold was remediated.

Each of the three instances alone is insufficient to draw a conclusion. The pattern of a substantial decrease in academic performance following a documented water damage/mold event is consistent in all three instances. These are not scientific studies but they do show a substantial trend. Further investigation is needed to evaluate whether this is a consistent pattern in students following a specific water damage/mold event. What were the molds or mycotoxins found in

each school or classrooms? Detailed academic performance tests, documentation of the extent of mold/water damage and the efficacy of the mold remediation is necessary before beginning an investigation of cause and effect. Conversely, is a substantial decrease in academic performance at a school a warning sign to look for hidden mold or water damage?

The consensus of experts on the treatment of mold exposure is stopping sources of water intrusion, removing the mold and removing the exposure. Students were removed from the mold exposure at school during the summer, and during the school year are now breathing fresh outside air in their classrooms.

Students and teachers have been given the name of three doctors who are knowledgeable in treating mold exposure. Now that school has started, Teachers will be queried to for their input as to the effectiveness of the remediation and measures taken to isolate classrooms from the crawlspace.

Tasks to be done

Plans are underway for a schedule of periodic monitoring of the portable wing, to confirm there is still positive pressure in each classroom:

Soil moisture monitoring of the crawlspace for signs of water intrusion under Classrooms 15, 16, 17, and 18.

Wet carpeting under the bottled water in the halls was a significant source of mold. Water test results should be evaluated for each fountain to determine which pass. Can some of the bottled water in the hall be replaced by water fountains with passing water quality?

Rooms in the East end had blocked fresh air filters and the Univents were drawing unfiltered crawlspace air into the classroom. Surfaces should be wiped down with a mycotoxin solvent. The floors, walls and ceiling should be HEPA vacuumed to remove residual mycotoxin containing particles.

Filtered crawlspace air was discharged into Room 18 for several days when some of the exhausts from air scrubbers drawing air from the crawlspace fell from the window. Room 18 should be treated as described above for classrooms in the east end.

Meeting with teachers to provide them an opportunity to discuss the report and ask questions.

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Respectfully,

David R. Anderson, Ph.D.
Toxicologist