Illinois Department of
PUBLIC HEALTH

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Case #:708010701

December 29, 2008

Ms. Mary Kalou
Assistant Superintendent of Business and Operations
Lake Zurich School District 95
400 S. Old Rand Rd.
Lake Zurich, IL 60047-2459

Dear Ms. Kalou:

On December 2, 2008, Mr. Thomas Baughman, Ph.D., Environmental Toxicologist, West Chicago Regional Office, examined the new May Whitney Elementary School (May Whitney; formerly called the Annex). Mr. Baughman evaluated your implementation of our recommendations from our letter of July 28, and he also examined the general air quality and ventilation system of the building.

For discussion purposes, Mr. Baughman divided the building into several parts. The Western Wing is the original 1929 building. It has 2 stories plus a basement. A one-story Central Connector joins this part to the Eastern Wing. The Eastern Wing has 2 stories plus a basement. A second, one-story Eastern Connector is east of the Eastern Wing, and the Eastern Connector joins the Eastern Wing to the original May Whitney Elementary Building. Locked steel fire doors separate the present and old May Whitney buildings. Mr. Baughman did not enter the old May Whitney building.

In our July 28, 2008 letter, we recommended the following actions:

1. Promptly investigating the large depression in the roof of the Western Wing to determine if it indicates a structural problem in the roof.
2. Promptly repairing any water leaks, cleaning affected nonporous surfaces, and replacing any porous surfaces that remained wet more than 24-48 hours.
    a. Repairing the leaks in the hallway by rooms 137 and 141, as well as the leak in room 141.
    b. Replacing all water-stained ceiling tiles throughout the building.
    c. Properly pitching the various roof sections to drain properly and eliminate puddles of standing water.

d. Removing plants from the roof, because plant roots may potentially compromise the long-term integrity of the roof.
e. Properly grading land on the southern side of the Central Connector to drain water away from the building.
f. Properly grading land on the southern side of the Eastern Connector to drain water to the existing drain.

3. Not relying on mold testing. Mold testing cannot establish that the indoor air quality of a building is acceptable, and mold testing has limited (if any) value.
4. Parking buses further from the building, so exhaust will not be drawn into the building. Additional lighting can be installed in the parking lot to encourage bus drivers to park further away from the building.
5. Continuing to implement the U.S. Environmental Protection Agency "Tools for Schools" program.

You said that drainage of the roof had been corrected, but about 5 inches of snow prevented verification, and Mr. Baughman did not attempt accessing the roof. Regarding the large depression on the roof of the Western Wing, you provided digital pictures of repairs to this area. These repairs included re-building the sunken portion of the roof, installing a new roof drain, and installing a rubber roof patch on the area. Mr. Baughman observed the underside of this repair from room 205, and the roof no longer contained a large depression that would collect water.

Mr. Baughman checked all rooms that had water-stained ceiling tiles during his July 28, 2008 site visit. The stained ceiling tiles had been replaced in all rooms except rooms 218, 120 (one ceiling tile not replaced, but others were), 20, 135, and 141. Using a Tramex Moisture Meter, he determined that all these stained ceiling tiles were dry. In addition, Mr. Baughman used the moisture meter to examine all the new ceiling tiles that had replaced the stained ceiling tiles noted on July 28, 2008. All these new ceiling tiles were dry. Your maintenance staff replaced the remaining stained ceiling tiles during Mr. Baughman's December 2, 2008 site visit. Mr. Jason McDaniel, Maintenance Manager, said that the roof above room 141 had been repaired.

In the hallway by room 135, two stained ceiling tiles noted on July 28, 2008 had been replaced. The western of these two ceiling tiles was dry; however, the eastern of these two ceiling tiles had a stain about 5 inches in diameter that was wet. The cold water pipe above this ceiling tile had been replaced with PVC pipe, but the repaired section lacked pipe insulation and apparently had condensation. We recommend verifying that this pipe is not leaking, and if no leak is found, installing pipe insulation to prevent condensation.

No buses were parked near any air intake of the building, and most buses were parked across the parking lot from the building. Two buses parked by the building were not near any outside air intake. They also were parked "head-in" toward the building, so their exhausts were pointed away from the building.

According to Mr. McDaniel, you were continuing to implement the U.S. Environmental Protection Agency "Tools for Schools Program." He also said that drainage near the building had not been corrected.

On December 2, 2008, Mr. Baughman used a TSI Q-Trak to measure carbon dioxide, carbon monoxide, temperature, and relative humidity. Mr. Baughman had calibrated the instrument on December 1, 2008 (monthly calibration recommended). Carbon monoxide was 0 ppm to 1 ppm throughout the building, which did not indicate a carbon monoxide problem.

Temperatures in occupied rooms ranged from 68.9°F to 73.5°F and were within a comfortable range. Temperature is frequently identified in indoor air complaints because it is directly linked to occupant comfort. Excessively high or low temperatures can lead to general thermal discomfort and occupant dissatisfaction. ASHRAE (Standard 55-1992 section 5.1.2) recommends that office temperatures be maintained between 68 degrees and 75 degrees (71 degrees is optimal) during the winter months and between 73 degrees and 79 degrees (76 degrees is optimal) during the summer months. Because of individual differences, it is impossible to recommend a thermal environment that will satisfy everyone. The purpose of this standard is to recommend a thermal environment that is acceptable to approximately 80% of the occupants.

Relative humidity ranged from 17.9% to 26.2%, with these low readings being typical of buildings in the winter. Low moisture levels result in dry air that can irritate the lungs, eyes, nose and throat. Although a humidifier can be used to increase relative humidity, it must be cleaned regularly to prevent the growth of microbes, which can be dispersed by the humidifier. The U.S. Environmental Protection Agency recommends using distilled water to reduce scale (where microbes can grow) and changing the water in humidifiers daily. Every three days, they also recommend cleaning them to remove scale, followed by 3% hydrogen peroxide to kill microbes, and then rinsing the humidifier to remove all hydrogen peroxide before use. If a humidifier is used, it should be used only during times of low relative humidity, and relative humidity levels should not be increased to levels capable of promoting the growth of microbes. Sustained relative humidity greater than about 60% can lead to microbial growth, including bacteria, dust mites, and mold.

Carbon dioxide (CO_2) is a normal component of exhaled breath, so measurements can be used to determine if a sufficient quantity of fresh, outdoor air is being introduced into the indoor environment. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) maintains a standard which specifies minimum ventilation rates and indoor air quality that would be acceptable to occupants. This standard presently recommends providing schools with 15 cubic feet of outdoor air per minute (cfm) per person. Indoor CO_2 levels are dependent on the outdoor level, but 15 cfm will result in an indoor CO_2 level approximately equivalent to 700 parts per million (ppm) greater than the outdoor level (1). This ventilation rate is expected to reasonably dilute odors and contaminants common to indoor air. Carbon dioxide levels in excess of the ASHRAE standard indicate that an insufficient volume of outdoor air is being supplied to the building to mix with recirculated air. ASHRAE standards are recommended guidelines and not legally enforceable limits.

Complaints of headaches, fatigue, and eye, nose, and throat irritation are commonly reported in buildings where CO_2 is present at high levels, but these symptoms are not caused by CO_2. At the levels typically found in indoor environments CO_2 is not a health hazard, and several studies have demonstrated that it will not cause measurable health effects until it is present at levels much greater than the current occupational guideline (5,000 ppm) enforced by the Occupational

Safety and Health Administration (OSHA). High CO_2 levels within a building indicate a lack of ventilation which could allow other contaminants common to indoor environments to be present at elevated levels and be responsible for occupant complaints. These chemicals originate from building components, cleaners, copiers, markers, printers, people, and other sources. Inadequate outside air intake also may make other comfort factors such as temperature more noticeable. In spite of the recent media emphasis on molds, inadequate outside air intake actually is the most common cause of indoor air problems.

We use CO_2 as an indirect indicator of the ventilation rate. From the inside and outside CO_2 concentrations, the following formula gives the fresh outside air intake:

cfm/person = $10500/(CO_{2in} - CO_{2out})$, where:

cfm/person = cubic feet per minute per person,

CO_{2in} = inside carbon dioxide concentration (ppm), and

CO_{2out} = outside carbon dioxide concentration (ppm).

Because the outside air temperature was too low for an accurate measurement using the Q-Trak (less than 40°F), Mr. Baughman assumed that the outside carbon dioxide concentration was 350 ppm. Because carbon dioxide is in exhaled breath, it can be used as an indicator of the outside air intake only in occupied areas of a building. Using the carbon dioxide measurements of the TSI Q-Trak recorded between 10:30 A.M. and the close of school, we calculated the ventilation needs of the following rooms:

Room	Carbon Dioxide Concentration (ppm)	Outdoor Air Intake (cfm/person)	Increase in Outside Air Intake Needed
Western Wing			
100	420	150	0%
101	394	239	0%
Central Connector			
106	720	28.4	0%
107	738	27.1	0%
108	758	25.7	0%
109	800	23.3	0%
Eastern Wing			
13	972	16.9	0%
15	906	18.9	0%*
18	586	44.5	0%
19	895	19.3	0%
20	738	27.1	0%
22	687	31.2	0%
23	921	18.4	0%
24	694	30.5	0%
121	785	24.1	0%
Library	750	26.3	0%
Main Gym	600	42	0%
Office	730	27.6	0%
214	1,633	8.18	83%
218	1,156	13.0	15%
219	975	16.8	0%
220	640	36.2%	0%
221	1,387	10.1	48%*
222	1,390	10.1	49%*
223	1,696	7.80	92%*
224	1,538	8.83	70%*
224 (repeat about 1 hour later)	1,574	8.58	75%*
Eastern Connector			
131	703	25.2	0%
133	584	44.9	0%
135	766	25.2	0%

ppm = Parts per million.
cfm/person = Cubic feet per minute per person.
* = Unit ventilator was not operating during the investigation.

All classrooms had unit ventilators, and each unit ventilator had an outside air intake. As noted in the table above, the unit ventilators in six of the rooms were not operating during the

investigation. The teachers in those rooms had shut off their ventilators because of temperature regulation issues. Five of those six rooms had inadequate outside air intake, most probably because the unit ventilators were not operating. Teachers should not shut off their unit ventilators, and maintenance staff should ensure that the univents are properly maintaining temperatures within the range recommended by ASHRAE. Teachers in several rooms also had books and other objects partially blocking the air flow of the unit ventilators. Although it was not noted in those rooms, blocking the air flow of unit ventilators may restrict the air flow and may cause inadequate outside air intake. For rooms 214 and 218, where the unit ventilators were operating, the outside air intakes should be opened by the recommended amounts. The outside air intake in the remainder of the building was adequate at the times of measurement. Carbon dioxide concentrations and the needed amount of fresh outside air increase as room occupancy increases.

Our department recommends:

1. Promptly repairing any water leaks, cleaning affected nonporous surfaces, and replacing any porous surfaces that remained wet more than 24-48 hours.
    a. Confirming that the water pipe in the hallway by rooms 137 and 141 is not leaking, and then installing insulation on the pipe to prevent condensation.
    b. Replacing all water-stained ceiling tiles throughout the building.
    c. Properly grading land on the southern side of the Central Connector to drain water away from the building.
    d. Properly grading land on the southern side of the Eastern Connector to drain water to the existing drain.
2. Instructing teachers not to turn off univents, and ensuring that all univents are properly maintaining temperatures within the range recommended by ASHRAE.
3. Instructing teachers not to store materials on top of univents, because this can block airflow and cause ventilation problems.
4. Opening the outside air intakes of the univents of rooms 214 and 218 by the recommended amounts.
5. Continuing to implement the U.S. Environmental Protection Agency "Tools for Schools" program.

Please feel free to contact Thomas Baughman at our West Chicago Regional Office at 630-293-6800 or Tom.Baughman@illinois.gov if you have any questions.

Sincerely,

Joe O'Connor
Senior Public Service Administrator

cc: West Chicago Regional Office
Environmental Toxicology, Springfield
Lake County Health Department