HEALTH CONSULTATION

CORONA DEL SOL HIGH SCHOOL
Update of Indoor Air Quality

Tempe, Maricopa County, Arizona

Prepared by:

Arizona Department of Health Services
Office of Environmental Health
Environmental Health Consultation Services

Summary

In the Corona Del Sol High School, Arizona Department of Health Services' (ADHS's) top priority is to ensure that the school students and staff have the best information possible to safeguard their health.

In June 2008, Governor Janet Napalitano requested ADHS to provide assistance in addressing concerns about air quality at Corona del Sol High School in Tempe, AZ. The purpose of this report is to review the testing results conducted by Converse Consultants (Converse) and provide recommendations. Assessments conducted by Converse included: (1) qualitative ventilation system assessment; (2) the collection of microbial air samples; (3) point-in-time air monitoring for indoor air quality (IAQ) parameters; (3) extended-time air monitoring for IAQ parameters; (4) a grab sample for whole air VOC and ambient fixed gases analyses; and (5) visual assessment for leaking plumbing fixtures, water intrusions or other maintenance concerns. A list of areas of concerns compiled over the last few years was provided by the Corona Clean Air Coalition parent group.

All the data analyzed in this health consultation were collected by Converse. In an attempt to characterize the nature and degree of the contamination that would impact the health of students and staff, ADHS reviewed all the data available from Converse.

ADHS reached two conclusions about the Corona Del Sol High School in Tempe, Arizona

<u>Airborne Chemicals</u>

Short –term Exposure (for exposure up to 14 days):

- ADHS concludes that the detected indoor air levels of CO_2, CO, VOCs and particulates are not expected to harm the health of students and personnel at school health because the measured levels were below their respective air CVs or health screening values for acute adverse health effects. Based on the detected levels and the amount of time spent in the school, we do not think that there is an acute health threat to the students, teachers, and staff at Corona Del Sol High School.

Long-term Exposure (for exposure more than 1 year):

- CO_2, CO and particulates: Continuous samples were collected and the analytical results showed that the measured levels were below their respective health screening levels for chronic adverse health effects. Therefore, ADHS concludes that the detected indoor air levels are not expected to harm the health of students and personnel at school.

- VOCs: A grab sample was collected at the auto shop, golf cart storage and special needs area. ADHS cannot currently conclude whether detected levels of VOCs in the auto shop, golf cart storage and special needs area could harm people's health if they breathe the air for a long period of time. In order to reach a conclusion, ADHS needs continuous air monitoring results. These data are not currently available.

Airborne Fungal

- In general, the testing results indicated that the levels of total fungal spores inside the school were lower than concurrent outdoor total spore levels. In addition, the detected spore levels are within the typical detected levels in Arizona and across North America in September.

ADHS provided the following recommendations to the Corona Del Sol High School:

- Review and implement the EPA's Tools for Schools environmental assessment program to improve the school's indoor air quality.
- Monitor the indoor air quality periodically to ensure the health of students and staff.
- Collect continuous VOC air monitoring samples for the prediction of potential long-term health effects.

ADHS will continue to review and evaluate data provided for this site and attend public meetings, make presentations, and develop handout literature as requested by the school.

Purpose

Governor Janet Napalitano requested the Arizona Department of Health Services (ADHS) to provide assistance in addressing concerns about air quality at Corona del Sol High School (CDSHS) in Tempe, AZ. ADHS contracted with Converse Consultants to complete an in-depth analysis of the schools indoor air quality. The Risk Assessment and Health Consultation Program within the Office of Environmental Health at ADHS reviewed the report entitled *Indoor Air Quality Assessment; January 20 2009* prepared by Converse Consultants (Converse), and completed a health-based interpretation of the information provided. The overlying question was whether the levels of carbon monoxide (CO), carbon dioxide (CO_2), and volatile organic compounds (VOCs), particulates and airborne fungi pose a public health hazard to students, faculties and staff at Corona Del Sol High School in Tempe, Arizona.

Background and Statement of Issues

Corona Del Sol High School was constructed in 1970's and currently has an enrollment of approximately 2,750 students and 200 staff. As stated in previous reports (ADHS May 2008; ATSDR Sept. 2008), the students, parents, and teachers have expressed concerns regarding the indoor air quality at the school. They were concerned that indoor air quality could be contributing to brain tumors. For the 2008 health consultation, ADHS reviewed available information and analytical data but we were unable to establish a link between the reported brain tumors and environmental factors.

In June 2008, Governor Janet Napalitano requested ADHS to provide additional assistances to address indoor air quality issues due to continued concerns of students, parents, and teachers. ADHS contracted with Converse Consultants to complete an in-depth analysis of the schools indoor air quality. Assessments conducted by Converse included: (1) qualitative ventilation system assessment by interviewing school personnel, and a visual inspection of the buildings and building pressure relationship; (2) the collection of microbial air samples in selected rooms; (3) point-in-time air monitoring for indoor air quality (IAQ) parameters (i.e. CO, CO_2, VOC, particulates, temperature, and humidity) in selected rooms; (3) extended-time air monitoring for IAQ parameters in selected rooms; (4) a grab sample was collected to analyzed for whole air VOC and ambient fixed gases (oxygen, nitrogen, hydrogen, CO, CO_2, and methane) in the auto shop, golf cart storage and special needs area; and (5) visual assessment, for leaking plumbing fixtures, water intrusions or other maintenance concerns. A list of areas of concerns compiled over the last few years was provided by the Corona Clean Air Coalition parent group. The purpose of this report is to review the testing results and provide recommendations.

Evaluation Process

ADHS provides site-specific public health recommendations on the basis of a review of toxicological literature, the levels of environmental contaminants detected at a site compared to accepted comparison values (CVs), an evaluation of potential exposure pathways, the duration of exposure, and the characteristics of the exposed population. ADHS used this approach to determine if the detected chemical concentrations at the Corona del Sol High School posed a public health hazard.

Comparison values are screening tools used with environmental data relevant to the exposure pathways. CVs are conservatively developed based on the available scientific data and consideration for the most sensitive groups (e.g., children). If public exposure concentrations related to a site are below the corresponding CV, then the exposures are not considered of public health concern, and no further analysis is conducted. However, while concentrations below the CV are not expected to lead to any observable adverse health effect, it should not be inferred that a concentration greater than the CV would necessarily lead to adverse health effects. Depending on site-specific environmental exposure factors (e.g., duration and amount of exposure) and individual human factors (e.g., personal habits, occupation, and/or overall health), exposure to levels above the comparison value may or may not lead to a health effect. Therefore, the CVs should not be used to predict the occurrence of adverse health effects.

Discussion

Data Source

We examined the analytical results found by Converse that were submitted to ADHS. Both point-in-time and extended time (8-hour or 24-hour air monitoring) IAQ parameters were measured with a calibrated RAE System PGM 5210. When applicable, extended-time measurements were used in this health consultation since they represent the daily overall exposure for students, teachers, and staff. Levels of IAQ parameters were assessed using direct-reading, datalogging monitors over 8 hours or 24 hours at identified indoor and outdoor locations. Additional sampling of whole air VOCs and ambient fixed gases (i.e. oxygen, nitrogen, hydrogen, CO, CO_2, and methane) were conducted to assess the potential interferences from the instruments in the auto shop, golf cart storage, and special needs areas due to unusual readings for CO and CO_2 during the extended-time sampling period. A grab sample of ambient air was analyzed for VOCs and fixed gases by using EPA Method TO-15and ASTM D-1946, respectively.

Airborne fungal sampling was conducted by using an Air-O-Cell cassette fungal spore trap. A no-culture based sampling method (spore trap method) was used to provide an indication of the kinds and levels of total (viable and non-viable) airborne fungal spores present in the indoor and outdoor air. Direct microscopy was used to analyze the samples, providing both a qualitative and quantitative assessment of spores in the air in a short timeframe. Point-in-time particulate monitoring during the airborne fungal sampling was conducted using an Airocet 531 Aerosol Particle Mass Profiler and Counter. Levels of two particle size ranges were measured including 0.5 micrometers and 5 micrometers.

ADHS also reviewed information on quality assurance and quality control (QA/QC) specifications for data quality to verify the acceptability and adequacy of data. For example, ADHS reviewed available chain of custody sheets, project narratives, and laboratory certifications. The laboratory analysis methods and the QA/QC procedures were appropriate.

Exposure Pathway Analysis

Identifying exposure pathways is important in a health consultation because presence of a contaminant in the environment does not necessarily mean that people are actually coming into contact with that contaminant, thereby allowing the contaminant to be a threat to public health. Exposure pathways have been divided into three categories: completed, potential, and eliminated. There are five elements are considered in the evaluation of exposure pathways:

- a *source* of contamination,
- a *media* such as soil or air through which the contaminant is transported,
- a *point of exposure* where people can contact the contaminant,
- a *route of exposure* by which the contaminant enters or contacts the body; and
- a *receptor* population

Completed pathways exist when the five elements are present and indicate that exposure to a contaminant has occurred in the past and/or is occurring now. In a potential exposure pathway, one or more elements of the pathway cannot be identified, but it is possible that the element might be present or might have been present. In eliminated pathways, at least one of the five elements is and was missing, and will never be present. Completed and potential pathways, however, may be eliminated when they are unlikely to be significant. Identifying an exposure pathway does not necessarily indicate the presence or concentration of potential contaminants; it is simply a way of determining the possibility of exposure as if the contaminants were present in the medium.

Table 1 shows the exposure pathway evaluation result. ADHS further evaluated the completed and potential exposure pathways to determine whether realistic exposures are sufficient in magnitude, duration or frequency to result in adverse health effects.

Table 1. Exposure pathway evaluation.

Exposure Pathway Elements					Time	Type of Exposure Pathway
Source	Media	Point of Exposure	Route of Exposure	Estimated Exposed Population		
Contaminated Air	Air	Classroom, Common area	Inhalation	Students, Teachers, Staff	Past	Completed
					Current	Completed
					Future	Potential

Public Health Implications

Carbon Dioxide

Carbon Dioxide (CO_2) is naturally present in the atmosphere at levels of approximately 350 parts per million or ppm (0.035%). Higher outdoor CO_2 concentrations can be found near vehicle traffic areas, industry, and sources of combustion. People exhale CO_2 – the average adult's breath contains about 35,000 to 50,000 ppm of CO_2. Thus, CO_2 buildup is used as an indicator of poorly ventilated areas characterized by inadequate fresh air or inadequate air supply in buildings.

The current occupational safety level limit is 5,000 ppm for healthy adults for an 8-hour work day within a 40-hour workweek. While levels below 5,000 ppm are considered to pose no serious health impacts for workers, experience indicates that individuals in schools and offices with CO_2 concentrations greater than 1,000 ppm tend to report headaches, fatigue, and eye and throat irritation because high levels of CO_2 may indicate that other contaminants in the building also may be present at elevated levels and could be responsible for occupant complaints (IDPH 2011). When CO_2 concentration is above 1,000 ppm, complaints may occur. Therefore, 1,000 ppm should be used as a guideline for improving ventilation. If a building exceeds this guideline, it should not be interpreted as a hazardous or life-threatening situation.

An elevated carbon dioxide level is only an indication of an inadequate amount of outside air being brought into a building. The level should only be used as a guideline to determine the amount of fresh outside air entering a building. According to the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), classrooms should maintain CO_2 concentration below 1,000 ppm in order to maximize comfort and complaints about the indoor air quality should be minimized (ASHRAE 1999). Maintaining less than 1,000 of CO_2 usually requires that 15 cubic feet per minute (CFM) of outside air per person be introduced through the ventilation system

Table 2 summarized the analytical results provided by the Converse. It shows the average CO_2 concentrations (with or without occupants) detected in various rooms located in Building A, B, C, E, G, H, and the Administration Building (see Appendix A for locations of the buildings). The results suggest that: (1) Building A, C, G and H had adequate ventilation when the buildings were not occupied; (2) Building A and C had adequate ventilation when the buildings were occupied; (3) some of average CO_2 concentrations in Building B, E, and Administration were somewhat above ASHRAE's recommendation of 1,000 ppm. However, these levels are not expected to cause serious adverse health effects among occupants; (4) when Building G was occupied, the CO_2 concentration was slightly above ASHRAE's recommendation. However, this level is not expected to cause serious adverse health effects among occupants.

The evaluation results shows that that ventilations at Building B, E, G and the Administration Building do not meet the guideline provide by the ASHRAE. Improving ventilations in these areas would improve student, teacher, and staff comfort.

Table 2. Average CO_2 and CO concentrations in parts per million (ppm).

	CO_2 Average Concentration (ppm)		CO 24-hour Average Concentration (ppm)
	24-hour average	8-hour average (occupied, approximately from 7:30 am to 3:30 pm)	
Building A	150 – 968	550 – 950	0.0 – 10.8
Building B	1,028 – 1,206	Not Available	0.8 – 3.8
Building C	537 – 653	800 – 900	0.0 – 0.1
Building E	256 – 1,115	600 – 2,000	0.0 – 1.6
Building G	656	1,100	0.0
Building H	400 – 650	Not Available	0.2 – 1.0
Administration Building	1,124	Not Available	0.0

Carbon Monoxide

Carbon Monoxide (CO) is a potentially deadly gas. It is colorless, odorless, tasteless, and non-irritating. CO produced by the combustion of petroleum, is commonly present in ambient air at low levels. The most common sources of indoor CO are motor vehicle emissions and stationary sources, such as furnaces and water and space heaters.

The adverse health effects associated with CO vary from person to person depending on age, overall health, and the concentration and length of exposure. Clinical symptoms range from subtle cardiovascular, respiratory, and neurobehavioral effects at low concentrations to unconsciousness and death after prolonged exposures or after acute exposure to high concentration of CO. The World Health Organization (WHO 2000) determined the following guideline values (ppm values rounded) and periods of time-weighted average exposures to protect the public health:

- 100 mg/m^3 (90 ppm) for 15 minutes
- 60 mg/m^3 (50 ppm) for 30 minutes
- 30 mg/m^3 (25 ppm) for 1 hour
- 10 mg/m^3 (10 ppm) for 8 hours

The measured 24-hour average CO concentrations ranged from 0.0 to 10.8 ppm (Table 2). Almost all levels of CO measured during this investigation were below the WHO recommendations. The one exception is the CO concentrations measured in Room 325b Building A. The detected CO concentrations in Room 325b ranged from 0 to 38.3 ppm, and the 24-hour average CO concentration was 10.8 ppm, which is slightly above the WHO recommendation. The elevated CO level (approximately 38.3 ppm) in the location lasted for approximately 30 minutes, which did not exceed the WHO recommendation for 30-minute exposure. In addition, as shown in Table 3 summarizing a study of adverse health effects of steady state exposure to various CO levels in air, this level is not expected to cause adverse health effects. The evaluation results suggest that CO does not appear to present a health threat at the school.

Table 3. Carboxyhemoglobin (COHb) levels resulting from steady-state exposure to increasing concentrations of CO in ambient air (Winter and Miller, 1976)

CO in atmosphere (ppm)	COHb in blood (%)	Signs and Symptoms
10	2	Asymptomatic
70	10	No appreciable effect, except shortness of breath on vigorous exertion; possible tightness across the forehead; dilation of cutaneous blood vessels
120	20	Shortness of breath on moderate exertion; occasional headache with throbbing in temples
220	30	Decided headache; irritable; easily fatigues; judgment disturbed; possible dizziness; dimness of vision
350 – 520	40 – 50	Headache, confusion; collapse; fainting on exertion
800 – 1,220	60 – 70	Unconsciousness; intermittent convulsion; respiratory failure; death if exposure is long continued
1,950	80	Rapidly fatal

Whole Air Volatile Organic Compounds

During the extended-time sampling period unusual readings of CO and CO_2 were observed in the auto shop and special needs room. A one-time grab sample of ambient air was collected to analyze for VOCs to assess if hazardous conditions exist in the auto shop and special needs room. The laboratory reports indicated that most of the identified compounds were below their practical quantitation limit (PQL), which is the lowest concentration of a substance that can be accurately measured, as opposed to just detected.

Chemicals detected at concentrations above their PQLs were selected for evaluation: 1,2,4-trimethylbenzene, 2,2,4-trimethylpentane, 4-ethyltoluene, carbon disulfide, chloromethane, dichlorodifluoromethane, ethylbenzene, heptane, hexane, total xylene (i.e. m,p-xylene and o-xylene), methylene chloride, styrene, and toluene. These chemicals were compared to accepted acute comparison values (CVs). The initial evaluation results indicated that most of the VOCs were below their respective acute health-based CVs (Table 4). Chronic hazards were not evaluated for VOCs since only data from grab samples collected at a single point in time were available. 1,2,4-trimethylbenzene, 2,2,4-trimethylpentane, 4-Ethyltoluene, dichlorodifluoromethane, heptanes, and hexane were kept for further evaluation since no CVs are available. The evaluation is discussed below.

Table 4. Analytical result of the whole air grab sample collected by Converse and acute chemical-specific comparison values (CV). Concentrations are expressed in micrograms per cubic meter (μg/m^3).

Chemical Name	Detected Concentration (μg/m^3)	Acute Health-based CV (μg/m^3)	Source	Is it a chemical of interest?
1,2,4-Trimethylbenzene	4.1	NA[a]		**Yes**
2,2,4-Trimethylpentane	5.6	NA		**Yes**
4-Ethyltoluene	2.9	NA		**Yes**
Carbon disulfide	3.4	30	Short-term Effects Screening Level[b]	No
Chloromethane	1.2	1,000	EMEG[c]	No
Dichlorodifluoromethane	3.1	NA		**Yes**
Ethylbenzene	3.1	40,000	EMEG	No
Heptane	2.1	NA		**Yes**
Hexane	4.2	NA		**Yes**
Methylene chloride	12	2,000	EMEG	No
Styrene	4.0	9,000	EMEG	No
Toluene	9.0	4,000	EMEG	No
Total xylene (m,p-xylene and o-xylene)	8.9	9,000	EMEG	No

a. Not Available
b. Texas Commission of Environmental Quality (TCEQ) http://www.tceq.state.tx.us/implementation/tox/esl/ESLMain.html
c. Agency for Toxic Substances and Disease Registry (ATSDR) Acute Environmental Media Evaluation Guide

(1) 1,2,4-Trimethylbenzene

It occurs naturally in coal tar and petroleum (about 3%). It can be isolated from the C9 aromatic hydrocarbon fraction during petroleum distillation. The primary use of 1,2,4-trimethylbenzene is as a gasoline additive. It can also be used as a liquid scintillator, sterilizing agent and in the manufacture of dyes, perfumes, and resins (EPA 1994).

Breathing the vapor is irritating to the respiratory tract. Exposure to high concentrations of vapor (24,600—44,280 mg/m^3, 1 mg/m^3 = 1,000 μg/m^3) can cause headache, fatigue and drowsiness (HSDB 1994). Animal studies showed that no effects for rats exposed to a mixture of trimethylbenzenes at 8,364 mg/m^3 for 10 to 21 days (HSDB1994). The detected concentration (0.0041 mg/m^3) was more than 2 million times below the concentrations that cause health effects. Therefore, we do not expect to see any acute adverse health effects associated with the exposure.

(2) 2,2,4-Trimethylpentane

It is a petroleum product, produced by the refining of petroleum. It is used in determining octane numbers of fuels as a solvent thinner, and in organic syntheses. It is released into the

environment through the manufacture, use and disposal of products associated with the petroleum and gasoline industry. Automotive exhaust and evaporative emissions are important sources of 2,2,4-trimethylpentane (HSDB 1993).

The acute toxicity of 2,2,4-trimethylpentane is very low and is similar to *n*-octane. Exposure to high concentrations may produce irritation of respiratory tract. No information is available on the acute effects in human following acute inhalation exposures. However, central nervous system (CNS) depression has been reported in mice following acute inhalation exposures to concentrations between 37,366 to 46,707 mg/m^3 (HSDB 1993). Exposure to 140,122 mg/m^3 for an hour may be lethal to mice (Patnaik 2007). The detected concentration (0.0056 mg/m^3) was more than 6 million times below the concentrations that cause adverse health effects in laboratory animal studies. Therefore, we do not expect to see any acute adverse effects associated with the exposure.

(3) 4-Ethyltoluene

4-Ethyltoluene is a high-volume chemical — U.S. production exceeds 1 million pounds annually (EDF 2008). During this investigation, 4-ethyltoluene was detected at the Automotive Shop at the level of 0.0029 mg/m^3. No information is available on the acute effects in human or animals following acute inhalation exposures. According to the Registry of Toxic Effects of Chemical Substances database, the inhalation TCLo (lowest published toxic concentration; similar to an inhalation LOAEL) was 5,000 mg/m^3 in rats and rabbits treated to 4-ethyltoluene 6 hours a day for 100 days (sub-chronic exposure). The single detection of 4-ethyltoluene was 1.7 million times lower than this TCLo. The concentrations causing chronic or sub-chronic adverse health effects are usually lower than the concentrations causing acute health effects. With the available information, ADHS does not expect inhalation exposures to 4-ethyl toluene to cause any adverse health effects to the school students and staff.

(4) Dichlorodifluoromethane

Dichlorodifluoromethane (Freon 12) is used as a refrigerant gas, an aerosol propellant, in plastics, and as a leak detecting agent. Acute toxicity of dichlorodifluoromethane is low. Exposure to high concentrations (above 49,400 mg/m^3) may cause CNS depression and irritation of nose, throat, and upper respiratory system. Effects of such overexposure can include light-headedness, shortness of breath, and in extreme cases, irregular heartbeats, cardiac arrest, and death. At concentrations of 197,600 mg/m^3 symptoms of exposure include slurred speech, a tingling sensation, and humming in the ears. At 494,000 mg/m^3, symptoms of incoordination can appear (Airgas 2009). The detected concentration (0.0031 mg/m^3) was more than 1.5 million times below the concentrations that cause adverse health effects in laboratory animal studies. Therefore, we do not expect to see any acute adverse effects associated with the exposure.

(5) Heptane

Heptane is produced and used as a solvent in organic synthesis and as a standard for octane-rating determinations. It is found in gasoline and petroleum-based products and has a

gasoline-like odor. It is an acute irritant of low toxicity by inhalation. Significant inhalation (more than 4,098 mg/m^3) may cause irritation of the respiratory tract and depress the central nervous system. Symptoms include nausea, dizziness, vomiting, lightheadedness, and giddiness (HSDB 2007). This concentration is more than 1.9 million times of the detected concentrations (0.0021 mg/m^3) therefore; we do not expect to see any acute adverse effects associated with the exposure.

(6) Hexane

Hexane is used to extract edible oils from seeds and vegetables, as a special-use solvent and as a cleaning agent in the printing industry. Acute animal tests in rats have demonstrated hexane to have low acute toxicity from inhalation and ingestion exposure (DHHS 1993). Acute inhalation exposure of humans to high levels of hexane causes mild CNS depression. CNS effects include: dizziness, giddiness, slight nausea and headache in humans. Exposures below 1,762 mg/m^3 do not usually induce CNS depression (HSDB 1993, Sitting 1985). This concentration is more than 800,000 times higher than the detected concentration (0.0022 mg/m^3); therefore, we do not expect to see any acute adverse effects associated with the exposure.

Particulates

The point-in-time (direct reading) particulate monitoring results showed that particles with diameter from 5 to 10 micrometer (µm) ranged from 40 to 7,495 ppcf (approx 0.00001 to 0.003 mg/m3), and particles with diameter from 0.5 to 10 µm ranged from 16,155 to 196,520 ppcf (approx 0.005 to 0.065 mg/m3) for samples monitored on September 11 and 12, 2008. The highest readings were detected at Amphitheater (outdoor). The direct reading monitoring results for samples conducted on September 19 showed that particles with diameter from 5 to 10 µm ranged from 147 to 11,177 ppcf (approx 0.00005 to 0.0037 mg/m3), and particles with diameter from 0.5 to 10 µm ranged from 6,553 to 562,337 ppcf (approx 0.002 to 0.19 mg/m3) for samples monitored on September 11 and 12, 2008. The highest readings were detected at E3 hallway (indoor).

The measured levels are at least 10 times lower than the occupational standard for Particulates Not Otherwise Classified (PNOC) for respirable particles (<10 µm in diameter). The current occupational safety of PNOC is 15 million particles per cubic foot of air (ppcf, or 5 mg/m3) for respirable fraction (< 10 µm in diameter) for healthy adults for an 8-hour work day within a 40-hour workweek (ACGIH 2008). In contrast to the occupational standards, the EPA set the National Ambient Air Quality Standards (NAAQS) to protect the public health and the environment. The current NAAQS for particles less than 10 µm is 0.15 mg/m3 for a 24-hour exposure. The instant reading detected at E3 hallway (0.19 mg/m3) is slightly above the NAAQ for PM10. Based on the quality of the data (point-in-time measurement vs. 24-hour average) and the frequency of detection (one time), ADHS determined that the detected levels of particulates are not expected to cause acute adverse health effects among students and staff at CDSHS.

Airborne Fungal (Mold) Results

In general, the testing results indicated that the levels of total fungal spores inside the school were lower than concurrent outdoor total spore levels. In addition, the detected spore levels are within the typical detected levels in Arizona and across North America in September (AAAAI 2010; Goodman el al. 1966; Shelton et al. 2002). The following is a summary of the laboratory results:

Table 5. Detected spore levels at various locations at Corona Del Sol High School

Sampling Date	Sampling Location	Total Spores (spores/m^3)	Total Outdoor Data Across North America (spore/m^3)	Total Outdoor Data in Arizona (spore/m^3)
09/11/08	Outside Amphitheater	810		
	Outside: Hallway C6	40		
	D138A Hallway	27	Low: 177	Low: 137
	A325 Classroom	13		
	E3 Hallway	13	Med: 1,922	Med: 708
	E321 Faculty Lounge	13		
	Large Gym	<13	High: 47,090	High: 10,981
09/12/08	Outside Amphitheater	146		
	Outside: Hallway C6	840		
	D138A Hallway	110		
	A325 Classroom	66		
	E3 Hallway	13		
	E321 Faculty Lounge	13		
	Large Gym	< 13		
09/19/08	E side Blg E, FAI Outdoor	2,100		
	SW Parking Lot, Outdoor	1,100		
	Portable 1, Indoor	560		
	Small Gym Downstairs, Indoor	310		
	Guidance Office, Indoor	320		
	Media Center, Center of Room	280		
	E271 Middle of Lab Bench	210		
	Outside: Amphetheater	1,200		
	D138A Hallway	610		
	E3 Hallway	570		
	Large Gym, upstairs	120		
	E side Blg BH E, FAI Outdoor	1,300		
	SW Parking Lot	990		
	Portable	440		
	Small Gym Downstairs	93		
	Guidance Office	280		
	Media Center	360		
	E271 Middle of Lab Bench	67		

Child Health Considerations

ADHS considers children in its evaluations of all exposures, and we use health guidelines that are protective of children. In general, ADHS assumes that children are more susceptible to chemical exposures than are adults. Children six years old or younger may be more sensitive to the effects of pollutants than adults. Children generally have lower body weights, breathe more air by body weight and air that is closer to the ground, and are more often in contact with the ground than adults. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. The CVs used in this health consultation were developed to be protective of susceptible populations such as children.

Conclusions

Airborne Chemicals

Short –term Exposure (for exposure up to 14 days):

- ADHS concludes that the detected levels of CO_2, CO, VOCs and particulates in the indoor air at Corona Del Sol High School are not expected to harm people's health because the measured levels were below their respective air CVs or health screening values for acute adverse health effects. Based on the detected levels and the amount of time spent in the school, we do not think that there is an acute health threat to the students, teachers, and staff at Corona Del Sol High School.

Long-term Exposure (for exposure more than 1 year):

- CO2, CO and particulates: ADHS concludes that the detected levels of CO_2, CO and particulates in the indoor air at Corona Del Sol High School are not expected to harm people's health because the measured levels were below their respective health screening values for chronic adverse health effects.

- VOCs: ADHS cannot currently conclude whether VOCs detected in the auto shop, golf cart storage and special needs area at Corona Del Sol High School could harm people's health if they breathe the air for a long period of time. Chronic hazards were not evaluated for VOCs since only data from grab samples collected at a single point in time were available. In order to reach a conclusion, ADHS needs continuous air monitoring results. These data are not currently available.

Airborne Fungal

In general, the testing results indicated that the levels of total fungal spores inside the school were lower than concurrent outdoor total spore levels. In addition, the detected spore levels are within the typical detected levels in Arizona and across North America in September

Recommendations

The Arizona Department of Health Services provided the following recommendations to the Corona Del Sol High School:

- Review and implement the EPA's Tools for Schools environmental assessment program to improve the school's indoor air quality.
- Monitor the indoor air quality periodically to ensure the health of students and staff.
- Collect continuous VOC air monitoring samples for the prediction of potential long-term health effects.

Public Health Action Plan

- ADHS will continue to review and evaluate data provided for this site.
- ADHS will attend public meetings, make presentations, and develop handout literature as requested by the school.

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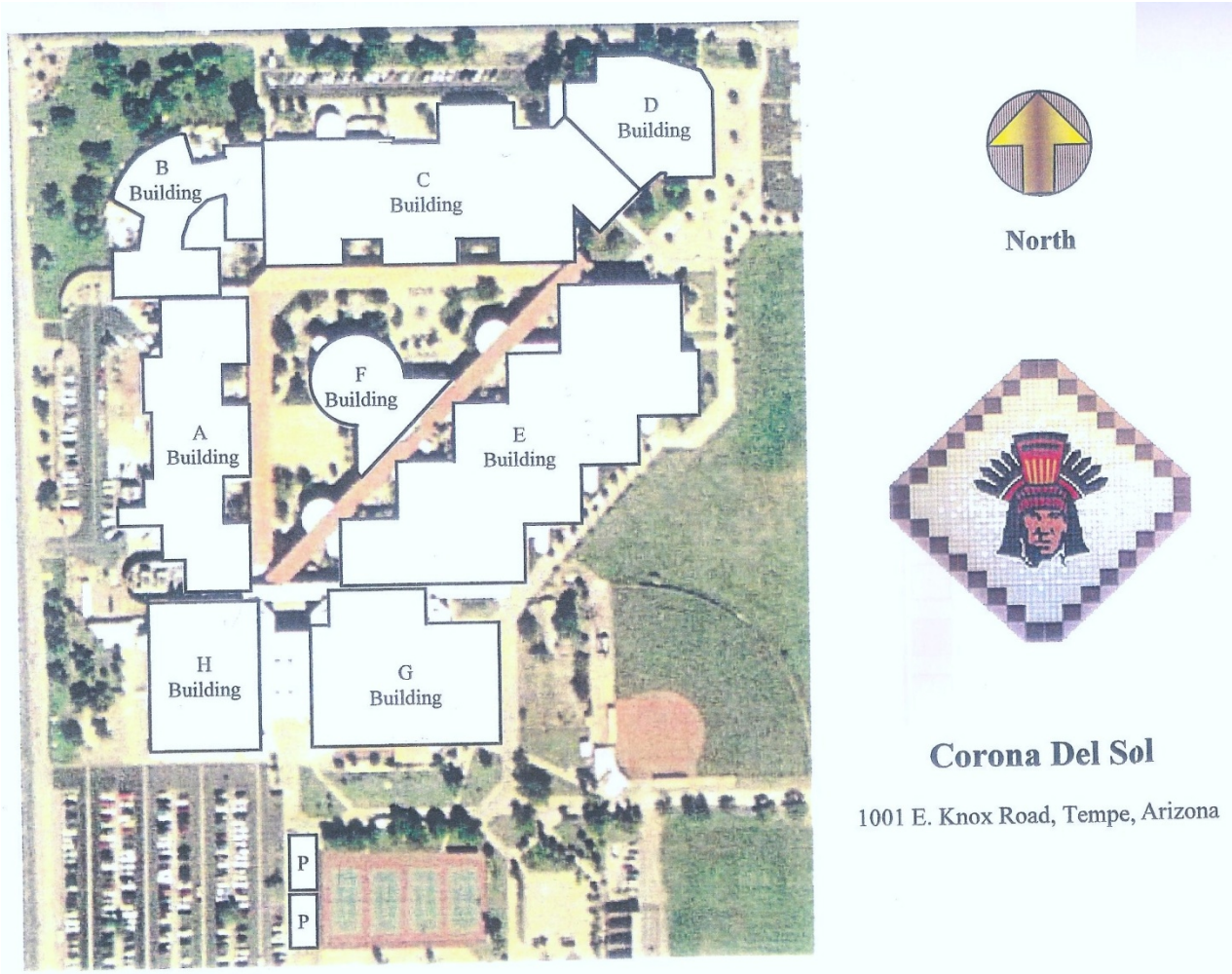
Appendix A



This map is adapted from Converse (2009)