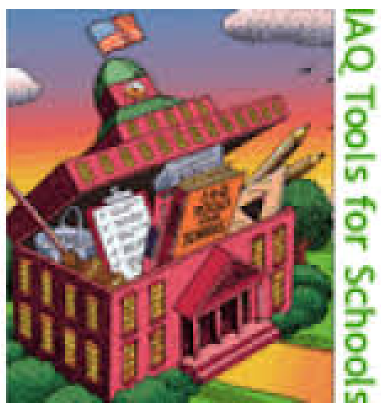
Lodi Unified School District

INDOOR AIR QUALITY
PROCEDURAL MANUAL



ARMED WITH THE FACTS

SCHOOL AIR QUALITY

REV. 6-30-2016

Introduction

Understanding the importance of good Indoor Air Quality (IAQ) in schools is the backbone of an effective IAQ program. Poor IAQ can lead to a large variety of health problems and potentially affect comfort, concentration, and staff/ student performance. This guidance is designed to present practical and often low-cost actions that can be taken to identify and address existing or potential air quality problems. This can be accomplished this using current school staff to perform a limited and well-defined set of basic operations and maintenance activities. However, some actions may require specialized expertise.

Responsibilities

Director, Maintenance and Operations: Overall program responsibilities

Operations Supervisor: IAQ Custodial Coordinator

IAQ Team responsible for secondary inspections – Mechanical Supervisor

Secondary Inspection Team: Mechanical, Structural and Operational Supervisors

Acnowledgments

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Section 1 – IAQ Importance to Schools

Indoor air pollution can have significant and harmful health effects. The U.S. Environmental Protection Agency (EPA) studies of human exposure to air pollutants indicate that indoor levels of pollutants may be two to five times—and occasionally more than 100 times—higher than outdoor levels. These levels of indoor air pollutants are of particular concern because most people spend about 90 percent of their time indoors. For the purposes of this manual, the definition of good indoor air quality (IAQ) management includes:

- Control of airborne pollutants
- Introduction and distribution of adequate outdoor air
- Maintenance of acceptable temperature and relative humidity

Temperature and humidity cannot be overlooked because thermal comfort concerns underlie many complaints about "poor air quality." Furthermore, temperature and humidity are among the many factors that affect indoor contaminant levels.

Outdoor sources should also be considered since outdoor air enters school buildings through windows, doors, and ventilation systems. Transportation and grounds maintenance activities are factors that can affect indoor pollutant levels as well as outdoor air quality on school grounds.

WHY IS IAQ IMPORTANT

In recent years, comparative risk studies performed by EPA and its Science Advisory Board (SAB) have consistently ranked indoor air pollution among the top five environmental risks to public health. Good IAQ is an important component of a healthy indoor environment, and can help schools reach their primary goal of educating children.

Failure to prevent or respond promptly to IAQ problems can:

- Increase long- and short-term health problems for students and staff (such as cough, eye irritation, headache, allergic reactions.
- Aggravate asthma and other respiratory illnesses.

Indoor air problems can be subtle and do not always produce easily recognized impacts on health, well-being, or the physical plant. Symptoms, such as headache, fatigue, shortness of breath, sinus congestion, coughing, sneezing, dizziness, nausea, and irritation of the eye, nose, throat and skin, are not <u>necessarily</u> due to air quality deficiencies, but may also be caused by other factors—poor lighting, stress, noise, and more. Due to varying sensitivities among school occupants, IAQ problems may affect a group of people or just one individual. In addition, IAQ problems may affect people in different ways

Individuals that may be particularly susceptible to effects of indoor air contaminants include, but are not limited to, people with:

- Asthma, allergies, or chemical sensitivities;
- Respiratory diseases;
- Suppressed immune systems (due to radiation, chemotherapy, or disease);
- Contact lenses.

Section 2 – Understanding IAQ Problems

Over the past several decades, exposure to indoor air pollutants has increased due to a variety of factors. These include the construction of more tightly sealed buildings; reduced ventilation rates to save energy; the use of synthetic building materials and furnishings; the use of personal care products, pesticides, and housekeeping supplies; and the increased use of vehicles and power equipment. In addition, activities and decisions, such as deferring maintenance to "save" money, can lead to problems from sources and ventilation.

The indoor environment in any building is a result of the interactions among the site, climate, building structure, mechanical systems (as originally designed and later modified), construction techniques, contaminant sources, building occupants, and outdoor mobile sources (cars, buses, trucks, and grounds maintenance equipment).

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THESE ELEMENTS ARE GROUPED INTO FOUR CATEGORIES

- Sources
- Heating, Ventilation, and Air- Conditioning (HVAC) Systems
- Pathways
- Occupants

SOURCES OF INDOOR AIR POLLUTANTS

Indoor air pollutants can originate within the building or be drawn in from outdoors. Air contaminants consist of numerous particulates, fibers, mists, bioaerosols, and gases. It is important to control air pollutant sources, or IAQ problems can arise—even if the HVAC system is properly operating. It may be helpful to think of air pollutant sources as fitting into one of the categories in the table on the following page, "Typical Sources of Indoor Air Pollutants." The examples given for each category are not intended to be an exhaustive list. **Appendix A:** "Typical Indoor Air Pollutants" contains a list of specific air pollutants with descriptions, sources, and control measures.

In addition to the number of potential pollutants, another complicating factor is that indoor air pollutant concentration levels can vary by time and location within the school building, or even a single classroom. Pollutants can be emitted from a variety of sources including:

- Point sources (such as from science storerooms);
- Area sources (such as newly painted surfaces); and
- Mobile sources (such as cars, buses, and power equipment).

Pollutants can also vary with time since some activities take place over a short period of time (such as stripping floors) or occur continuously (such as mold growing in the HVAC system). Indoor air often contains a variety of contaminants at concentrations that are well below the published occupational standards. Given our present knowledge, it is often difficult to relate specific health effects to exposures to specific pollutant concentrations, especially since the significant exposures may be due to low levels of pollutant mixtures.

Interaction of Sources, HVAC Systems, Pathways and Occupants

If independently evaluated, a minor roof leak and a dirty classroom carpet might not cause much concern. But if the water from the roof leak reaches the carpet, the water can wet the dirt in the carpet and the mold that has been dormant in the carpet. The mold can grow and become a pollutant source that releases spores into the classroom air. The HVAC system may act as a pathway that disperses the spores to other parts of the school, where occupants may experience allergic reactions.

TYPICAL SOURCES OF INDOOR AIR POLLUTANTS

Outdoor Sources	Building HVAC Equipment	Components/ Furnishings	Other Potential Indoor Sources
• Pollen, dust, mold spores • Industrial emissions • Vehicle and non road engine emissions (cars, buses, trucks, lawn and garden equipment) **Nearby Sources** • Loading docks • Odors from dumpsters • Unsanitary debris or building exhausts near outdoor air intakes **Underground Sources** • Radon • Pesticides • Leakage from underground storage tanks	• Mold growth in drip pans, ductwork, coils, and humidifiers • Improper venting of combustion products • Dust or debris in duct- work **Other equipment** • Emissions from office equipment (volatile organic compounds (VOCs), ozone) • Emissions from shop, lab, and cleaning equipment	• Mold growth on or in soiled or water-damaged materials • Dry drain traps that allow the passage of sewer gas • Materials containing VOCs, inorganic compounds, or damaged asbestos • Materials that produce particles (dust) **Furnishings** • Emissions from new furnishings and floorings • Mold growth on or in soiled or water-damaged furnishings	• Science laboratory supplies • Vocational art supplies • Copy/print areas • Food prep areas • Smoking lounges • Cleaning materials • Emissions from trash • Pesticides • Odors and VOCs from paint, caulk, adhesives • Occupants with communicable diseases • Dry-erase markers and air freshners • Insects and other pests • Personal care products • Stored gasoline and lawn and garden equipment

HVAC DESIGN AND OPERATION

The HVAC system includes all heating, cooling, and ventilating equipment serving a school: Boilers or furnaces, chillers, cooling towers, air-handling units, exhaust fans, ductwork, and filters. Properly designed HVAC equipment in a school helps to:

- Control temperature and relative humidity to provide thermal comfort;
- Distribute adequate amounts of outdoor air to meet ventilation needs of school occupants;
- Isolate and remove odors and other contaminants through pressure control, filtration, and exhaust fans.

Not all HVAC systems accomplish all of these functions. Some buildings rely only on natural ventilation. Others lack mechanical cooling equipment, and many function with little or no humidity control. The features of the HVAC system in a given building will depend on:

- Age of the design;
- Climate;
- Building codes in effect at the time of the design;
- Budget for the project;
- Designers' and school districts' individual preferences;
- Subsequent modifications;
- Space type; and
- Expected occupancy.

DESCRIPTIONS OF HVAC SYSTEMS

The two most common HVAC designs in schools are unit ventilators and central air-handling systems. Both can perform the same HVAC functions, but a unit ventilator serves a single room while the central air-handling unit serves multiple rooms. For basic central air-handling units, it is important that all rooms served by the central unit have similar thermal and ventilation requirements. If these requirements differ significantly, some rooms may be too hot, too cold, or under ventilated, while others are comfortable and adequately ventilated temperatures.

Temperature stratification is a common problem caused by convection— the tendency of light, warm air to rise and heavier, cooler air to sink. If air is not properly mixed by the ventilation system, the temperature near the ceiling can be several degrees warmer or cooler than near the floor, where young children spend much of their time. Even if air is properly mixed, uninsulated floors over unheated spaces can create discomfort in some climate zones. Large fluctuations of indoor temperature can also occur when thermostats have a wide "dead band" (a temperature range in which neither heating nor cooling takes place).

Most air-handling units distribute a mixture of outdoor air and recirculated indoor air. HVAC designs may also include units that introduce 100 percent outdoor air or that simply recirculate indoor air within the building. Uncontrolled quantities of outdoor air enter buildings by leakage through windows, doors, and gaps in the building exterior. Thermal comfort and ventilation needs are met by supplying “conditioned” air, which is a mixture of outdoor and recirculated air that has been filtered, heated or cooled, and sometimes humidified or dehumidified.

THERMAL COMFORT

A number of variables interact to determine whether people are comfortable with the temperature and relative humidity of the indoor air. Factors such as clothing, activity level, age, and physiology of people in schools vary widely, so the thermal comfort requirements vary for each individual. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 55-1992 describes the temperature and humidity ranges that are comfortable for 80 percent of people engaged in largely sedentary activities. That information is summarized in the chart to the right. The ASHRAE standard assumes “normal indoor clothing.” Added layers of clothing reduce the rate of heat loss.

RECOMMENDED RANGE OF TEMPERATURES AND RELATIVE HUMIDITIES

Relative Humidity	Winter Temp	Summer Temp
30%	68.5 – 75.5F	74.0-80.0F
40%	68.0-75.0F	73.5-80.0F
50%	68.0-74.5F	73.0-79.0F
60%	67.5-74.0F	73.0-78.5F

Source: ASHRAE Standard 62-2001, Ventilation for Acceptable Indoor Air Quality

Uniformity of temperature is important to comfort. Rooms that share a common heating and cooling system controlled by a single thermostat may be at different temperature.

Temperature stratification is a common problem caused by convection. This is the tendency of lighter, warmer air to rise and heavier, cooler air to sink. If the air is not properly mixed by the ventilation system, the temperature near the ceiling can be several degrees warmer or cooler than near the floor, where young children spend much of their time. Even if air is properly mixed, uninsulated floors over unheated spaces can create discomfort in some climate ones. Large fluctuations of indoor temperatures have a wise “dead band” (a temperature range in which neither heating nor cooling takes place).

Radiant heat transfer may cause people located near very hot or very cold surfaces to be uncomfortable even though the thermostat setting and the measured air temperature are within the comfort range. Schools with large window areas sometimes have acute problems of discomfort due to radiant heat gains and losses, with the locations of complaints shifting during the day as the sun angle changes. Poorly insulated walls can also produce a flow of naturally-convection air, leading to complaints of draftiness. Closing curtains reduces heating from direct sunlight and reduces occupant exposure to hot or cold window surfaces. Large schools may have interior (“core”) spaces in which year-round cooling is required to compensate for heat generated by occupants, office equipment and lighting, while perimeter rooms may require heating or cooling depending on outdoor conditions.

Humidity is a factor in thermal comfort. Raising relative humidity reduces a person’s ability to lose heat through perspiration and evaporation, so that the effect is similar to raising the temperature. Humidity extremes can also create other IAQ problems. Excessively high or low relative humidity’s can produce discomfort, high relative humidity’s can promote the growth of mold and mildew, and low relative humidity’s can accelerate the release of spores into the air. **See Appendix B**

VENTILATION FOR OCCUPANT NEEDS

Ventilation is the process of supplying outdoor air to the occupied areas in the school while indoor air is exhausted by fans or allowed to escape through openings thus removing indoor air pollutants. Often, this exhaust air is taken from areas that produce air pollutants such as restrooms, kitchens, science-storage closets, and fume hoods.

Modern schools generally use mechanical ventilation systems to introduce outdoor air during occupied periods, but some schools use only natural ventilation or exhaust fans to remove odors and contaminants. In naturally ventilated buildings, unacceptable indoor air quality is particularly likely when occupants keep the windows closed due to extreme hot or cold outdoor temperatures. Even when windows and doors are open, inadequate ventilation is likely when air movement forces are weakest, such as when there is little wind or when there is little temperature difference between inside and outside (stack effect).

Stack effect is the pressure-driven airflow produced by convection, the tendency of warm air to rise. Stack effect exists whenever there is an indoor-outdoor temperature difference, and the effect becomes stronger as the temperature difference increases. Multi-story schools are more affected than single-story schools. As heated air escapes from upper levels, indoor air moves from lower to upper levels, and outdoor air is drawn into the lower levels to replace the air that has escaped. Stack effect can transport contaminants between floors by way of stairwells, elevator shafts, utility chases, and other openings.

The amount of outdoor air considered adequate for proper ventilation has varied substantially over time. Because updating building codes often takes several years, current building codes may require more ventilation then when the system was designed. ASHRAE ventilation standards are used as the basis for most building ventilation codes. A table of outdoor air quantities in schools as recommended by ASHRAE Standard 62-2001, “Ventilation for Acceptable Indoor Air Quality,” shown below. Please note that this is a limited portion of the Standard, and that the quantities listed are in units of cfm per person, which are cubic feet per minute of outdoor air for each person in the area served by that ventilation system.

VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

No.	Description	CFM
1	Classroom	15
2	Music Rooms	15
3	Libraries	15
4	Auditoriums	15
5	Spectator Sport Areas	15
6	Playing Floors	20
7	Office Space	20
8	Conference Rooms	20
9	Smoking Lounges	60
10	Cafeteria	20
11	Kitchen (cooking)	15

POLLUTANT PATHWAYS AND DRIVING FORCES

Airflow patterns in buildings result from the combined forces of mechanical ventilation systems, human activity, and natural effects. Air pressure differences created by these forces move airborne pollutants from areas of higher pressure to areas of lower pressure through any available openings in building walls, ceilings, floors, doors, windows, and HVAC systems. For example, as long as the opening to an inflated balloon is kept shut, no air will flow. When opened, however, air will move from inside (area of higher pressure) to the outside (area of lower pressure).

Even if the opening is small, air will move until the inside pressure is equal to the outside pressure. If present, the HVAC ducts are generally the predominant pathway and driving force for air movement in buildings. However, all of a building's components (walls, ceilings, floors, doors, windows, HVAC equipment, and occupants) interact to affect how air movement distributes pollutants within a building.

As air moves from supply outlets to return inlets, for example, it is diverted or obstructed by walls and furnishings, and redirected by openings that provide pathways for air movement. On a localized basis, the movements of people have a major impact on pollutant transport. Some of the pathways change as doors and windows open and close. It is useful to think of the entire building—the rooms with connecting corridors and utility passageways between them—as part of the air-distribution system.

Air movement can transfer emissions from the pollutant source:

- Into adjacent rooms or spaces that are under lower pressure.
- Into other spaces through HVAC system ducts.
- From lower to upper levels in multi-story schools.
- Into the building through either infiltration of outdoor air or reentry of exhaust air.
- To various points within the room.

Natural forces exert an important influence on air movement between a school's interior and exterior. Both the stack effect and wind can overpower a building's HVAC system and disrupt air circulation and ventilation, especially if the school envelope (walls, ceiling, windows, etc.) is leaky.

Wind effects are transient, creating local areas of high pressure (on the windward side) and low pressure (on the leeward side) of buildings. Depending on the size and location of leakage openings in the building exterior, wind can affect the pressure relationships within and between rooms. Entry of outdoor air contaminants may be intermittent or variable, occurring only when the wind blows from the direction of the pollutant source.

Most public and commercial buildings are designed to be positively pressurized, so that unconditioned air does not enter through openings in the building envelope causing discomfort or air quality problems. The interaction between pollutant pathways and intermittent or variable driving forces can lead to a single source causing IAQ complaints in an area of the school that is distant from the pollutant source.

BUILDING OCCUPANTS

Occupant activities can directly affect pollutant sources, the HVAC system (operation, maintenance, controls), pathways, and driving forces. Occupants can also be carriers of communicable disease and allergens, such as pet dander. Teachers may use dry-erase markers or laboratory chemicals that emit pollutants. Similarly, many cleaning materials used in schools contain VOCs that can degrade IAQ.

Teachers and administrators often obstruct proper air movement in their classrooms and offices by using ventilation units as bookshelves, unknowingly restricting the pathway for fresh air to enter the area. Similarly, covering air return ducts (with posters, for example) restricts proper air circulation. Therefore, it is important for occupants to understand how their activities directly affect ventilation pathways and sources of pollutants in their school.

Occupants can contribute to a healthy indoor environment by completing the IAQ checklists, monitoring their own behavior, and immediately alerting the IAQ Coordinator of any IAQ problems.

Section 3 – Resolving IAQ Issues

The first step in resolving any suspected IAQ issues is identifying whether or not an IAQ issue exists within the affected space. Many times, perceived IAQ issues may be derivative of other building issues more closely aligned with building maintenance, such as dust deposits or stained materials. For this reason, all perceived IAQ issues should be reported to maintenance dispatch immediately (See Appendice E). The first step in the process is filling out Lodi Unified School District's official IAQ/Maintenance Issue report form (See Appendix I), which will help direct further activities undertaken to resolve the issue. All reported issues will be investigated and any underlying problems will be addressed to the fullest extent possible.

Resolving IAQ problems involves diagnosing the cause, applying practical actions that either reduce emissions from pollutant sources, remove pollutants from the air (e.g., increasing ventilation or air cleaning), or both. Problems related to sources can stem from improper material selection or application, allowing conditions that can increase biological contamination and dust accumulation, or source location. Ventilation problems stem from improper design, installation, operation, or maintenance of the ventilation system.

IT IS IMPORTANT TO TAKE REPORTED IAQ PROBLEMS SERIOUSLY AND RESPOND QUICKLY:

- IAQ problems could result in health threats and can cause acute discomfort (irritation) or contribute to more frequent asthma attacks.
- Addressing an IAQ problem promptly is good policy. Parents are sensitive to unnecessary delays in resolving problems that affect their children. Staff has enough burdens without experiencing frustration over unresolved problems, and unaddressed problems invariably lead to greater complaints.
- Diagnosing a problem is often easier immediately after the complaint(s) has been received. The source of the problem may be intermittent and the symptoms may come and go. Also, the complainant's memory of events is best immediately after the problem occurs.

In some cases, people may believe that they are being adversely affected by the indoor air, but the basis for their perception may be some other form of stressor not directly related to IAQ. **Section 5:** "Solving IAQ problems," discusses some of these stressors such as glare, noise, and stress.

IS THIS AN EMERGENCY

The first decision that must be made in dealing with an IAQ problem is whether the problem requires an emergency response. Some IAQ incidents require immediate response—for example, high carbon monoxide levels or certain toxic chemical spills will require evacuation of all affected areas in the school, and biological contaminants such as Legionella may require a similar response. In recent years, large outbreaks of influenza have caused entire schools and districts to cease operation temporarily.

If this is an emergency situation, in addition to immediate action to protect life and health, it is vital that the school administration, parents of students, and appropriate authorities be notified of the situation in a carefully coordinated manner.

WHO WILL SOLVE THE PROBLEM

For most IAQ issues, schools with an in-house staff that have appropriate range of skills to resolve and prevent problems.

Unique or complex IAQ problems may best be handled by professionals who have specialized knowledge, experience, and equipment.

Regardless of whether it is in-house staff or outside assistance that diagnoses and resolves the problem, the **Operations Supervisor** (IAQ coordinator) remains responsible for managing the problem-solving process and for communicating with all appropriate parties during the process.

Section 4 – Diagnosing IAQ/Maintenance Issues

The goal of diagnosing an IAQ issue is to identify the cause of the problem and implement an appropriate solution. Often, more than one problem can exist, requiring more than one solution. Frequently, issues thought to be related to IAQ, such as building finish deterioration are simply maintenance issues which can be ameliorated rapidly upon report.

The IAQ diagnostic process begins when a complaint is registered or an IAQ problem is discovered and report to **M&O Dispatch**. Many problems can be simple to diagnose, requiring a basic knowledge of IAQ and some common sense. If the cause (or causes) of the IAQ problem has already been identified, proceed to the solution phase outlined in **Section 5:** "Solving IAQ problems."

Not all occupant complaints about IAQ are caused by poor indoor air. Other factors such as noise, lighting, and job, family, or peer-related stress can individually and in combination contribute to a perception that IAQ is poor.

Indoor Air Quality Investigation Process

Indoor (IAQ) concerns must be always first reported to the Maintenance & Operations (M&O) **Dispatch at 331-7193**. M&O Dispatch notifies the IAQ coordinator (Operations Supervisor) to commence investigation activities by use of the IAQ and Building Maintenance Questionnaire. **See Appendix I**

The IAQ investigation includes but is not limited to interviewing the reporting party, recording moisture readings, and visual inspection of the workspace, structural devices, mechanical equipment and custodial cleanness. Should the Operations Supervisor not identify any concerns, the IAQ and Building Maintenance Questionnaire will be completed. **See Appendix I**

In the event that the IAQ and Building Maintenance Questionnaire identifies additional concerns with the room, then the IAQ Team will be assembled. The IAQ Team will (as soon as possible) inspect the room and if necessary, direct the IAQ Coordinator to take Air Samples. Should the investigation not produce a concern or if air testing is negative, the IAQ and Building Maintenance Questionnaire (**Appendix I**) will be sent to the Director of M&O with a recommendation that an outside consultant be sent to evaluate the concerns, including a visual assessment and if necessary air sampling. **See Appendix E**

Section 5 – Solving IAQ Problems

Developing Solutions

The diagnostics may have determined that the problem was either a real or a perceived IAQ problem, or a combination of multiple problems. For each problem that is identified, develop a solution using the basic control strategies described below.

There are **six** basic control methods that can lower concentrations of indoor air pollutants. Often, only a slight shift in emphasis or action using these control methods is needed to control IAQ more effectively. Specific applications of these basic control strategies can be found in each team member's checklist.

1. Source Management – Managing pollutant sources, the most effective control strategy, includes:

- **Source removal –** Eliminating or not allowing pollutant sources to enter the school. Examples include not allowing buses to idle, especially not near outdoor air intakes, not placing garbage in rooms with HVAC equipment, and **replacing** moldy materials.

- **Source reduction –** Improving technology and/or materials to reduce emissions. Examples include replacing 2-stroke lawn and garden equipment with lower emitting options (e.g., manual or electrically powered or 4-stroke); switching to low emissions portable gasoline containers; and implementing technology upgrades to reduce emissions from school buses.

- **Source substitution –** Replacing pollutant sources. Examples include selecting less- or non-toxic art materials or interior paints.

- **Source encapsulation –** Placing a barrier around the source so that it releases fewer pollutants into the indoor air. Examples include covering pressed wood cabinetry with sealed or laminated surfaces or using plastic sheeting when renovating to contain contaminants.

2. Local Exhaust – Removing (exhausting fume hoods and local exhaust fans to the outside) point sources of indoor pollutants before they disperse. Examples include exhaust systems for restrooms and kitchens, science labs, storage rooms, printing and duplicating rooms, and vocational/industrial areas (such as welding booths and firing kilns).

3. Ventilation – Lowering pollutant concentrations by diluting polluted (indoor) air with cleaner (outdoor) air. Local building codes likely specify the quantity (and sometimes quality) of outdoor air that must be continuously supplied in your school. Temporarily increasing ventilation as well as properly using the exhaust system while painting or applying pesticides, for example, can be useful in diluting the concentration of noxious fumes in the air.

4. Exposure Control – Adjusting the time and location of pollutant exposure. Location control involves moving the pollutant source away from occupants or even relocating susceptible occupants.

- **Time of use –** Avoid use of pollutant sources when the school is occupied. For example, strip and wax floors (with the ventilation system functioning) on Friday after school is dismissed. This allows the floor products to off-gas over the weekend, reducing the level of pollutants in the air when the school is reoccupied on Monday. Another example is to mow around the building and near play fields only before or after school hours.

- **Amount of use –** Use air-polluting sources as little as possible to minimize contamination of the indoor air.

- **Location of use –** Move polluting sources as far away as possible from occupants or relocating susceptible occupants.

5. Air cleaning – Filtering particles and gaseous contaminants as air passes through ventilation equipment. This type of system should be engineered on a case-by-case basis.

6. Other actions – The IAQ Coordinator may on their discretion direct staff to address small and limited areas identified during the investigation. Those actions include but are not limited to:

- Removal of stained ceiling tiles
- Testing small areas of mold
- Deep cleaning classrooms
- Cleaning of carpets
- Washing of walls

Employees involved in these cleanup actions must be trained and certified to use respirator protection.

Appendix A - Typical Indoor Air Pollutants

The following pages present information about several indoor air pollutants common to schools, in a format that allows for easy comparison.

POLLUTANTS PRESENTED INCLUDE

- Biological contaminants (mold, dust mites, pet dander, pollen, etc.)
- Carbon dioxide (CO_2)
- Carbon monoxide (CO)
- Dust
- Environmental tobacco smoke (ETS) or secondhand smoke
- Fine particulate matter (PM)
- Lead (Pb)
- Nitrogen oxides (NO, NO_2)
- Pesticides
- Radon (Rn)
- Other volatile organic compounds (VOCs) (formaldehyde, solvents, cleaning agents)

EACH POLLUTANT IS DESCRIBED OR ANALYZED ACROSS FIVE CATEGORIES

- Description
- Sources
- Standards and guidelines for indoor air quality
- Health effects
- Control measures

A.1 Indoor Air Pollutants

A.1.1 Biological Contaminants

Description Common biological contaminants include mold, dust mites, pet dander (skin flakes), droppings and body parts from cockroaches, rodents and other pests or insects, viruses, and bacteria. Many of these biological contaminants are small enough to be inhaled.

Source Biological contaminants are living things, or are produced by living things. Biological contaminants are often found in areas that provide food moisture. Damp or wet areas such as cooling coils, humidifiers, condensate pans, or unvented bathrooms can be moldy. Draperies, bedding carpet, and other areas where dust collects may accumulate biological contaminants.

Standards There are currently no Federal government standards for biologicals in school indoor air environments.

Health Effects Mold, dust mites, pet dander, and pest droppings or body parts can trigger asthma. Biological contaminants, including molds and pollens can cause allergic reactions for a significant portion of the population. Tuberculosis, measles, Staphylococcus infections, Legionella and influenza are know to be transmitted by air.

Control Measures General good housekeeping and maintenance of heating and air conditioning equipment are very important. Adequate ventilation and good air distribution also help. The key to mold control is moisture control. If mold is a problem, get rid of excess water or moisture and clean up the mold. Maintaining the relative humidity between 30 and 60 percent will help control mold, dust mites, and cockroaches. Employ integrated pest management (IPM) to control insect and animal allergens. Cooling tower treatment procedures exist to reduce levels of Legionella and other organisms.

A.1.2 Carbon Dioxide (CO_2)

Description Carbon dioxide (CO_2) is a colorless, odorless product of carbon combustion.

Source Human metabolic processes and all combustion processes of carbon fuels, like those in cars, buses, trucks, etc., are sources of CO_2. Exhaled air is usually the largest source of CO_2 in classrooms.

Standards ASHRAE Standard 62-2001 recommends 700 ppm above the outdoor concentration as the upper limit for occupied classrooms (usually around 1,000ppm).

Health Effects CO_2 is an asphyxiate. At concentrations above 1.5 percent (15,000 ppm) some loss of mental acuity has been noted. (The recommended ASHRAE standard of 700 ppm above the outdoor concentration is to prevent body odor levels from being offensive.

Control Measures Ventilation with sufficient outdoor air controls CO_2 levels. Reduce vehicle and lawn and garden equipment idling and/or usage.

A.1.3 Carbon Monoxide (CO)

Description Carbon monoxide (CO) is a colorless, odorless gas. It results from incomplete oxidation of carbon in combustion processes.

Source Common sources of CO in schools are improperly vented furnaces, malfunctioning gas ranges, or exhaust fumes that have been drawn back into the building. Worn or poorly adjusted and maintained combustion devices (e.g.,boilers, furnaces), or a flue that is improperly sized, blocked, disconnected, or leaking, can be significant sources. Auto, truck, or bus exhaust from attached garages, nearby roads, or idling vehicles in parking areas can also be sources.

Standards The OSHA standard for workers is no more than 50 ppm for 1 hour of exposure. NIOSH recommends no more than 35 ppm for 1 hour. The US National Ambient Air Quality Standards for CO are 9 ppm for 8 hours and 35 ppm for 1 hour. The Consumer Product Safety Commission recommends levels not to exceed 15 ppm for 1 hour or 25 ppm for 8 hours.

Health Effects CO is an asphyxiate. An accumulation of this gas may result in a variety of symptoms deriving from the compound's affinity for and combination with hemoglobin, forming carboxyhemoglobin (COHb) and disrupting oxygen transport. Tissues with the highest oxygen needs – myocardium, brain and exercising muscle – are the first affected. Symptoms may mimic influenza and include fatigue, headache, dizziness, nausea and vomitaing, cognitive impairment and tachycardia. At high concentrations CO exposure can be FATAL.

Control Measures Combustion equipment must be maintained to assure that there are no blockages and air and fuel mixtures must be properly adjusted to ensure more complete combustion. Vehicular use should be carefully managed adjacent to buildings and in vocational programs. Additional ventilation can be used as a temporary measure when high levels of CO are expected for short periods of time.

A.1.4 Dust

Description Dust is made up of particles in the air that settle on surfaces. Large particles settle quickly and can be eliminated or greatly reduced by the body's natural defense mechanisms. Small particles are more likely to be airborne and are capable of passing through the body's defenses and entering the lungs.

Source Many sources can produce dust including: soil, fleecy surfaces, pollen, lead-based paint, and can be eliminated or greatly reduced by burning of wood, oil, or coal.

Standards The EPA Ambient Air Quality standard for particles less than 10 microns is 50/ug/m^3 per hour for an annual average and 150 ug/m^3 for a 24-hour average.

Health Effects Health effects vary depending upon the characteristics of the dust and any associated toxic materials. Dust particles may contain lead, pesticide residues, radon or other toxic materials. Other particles may be irritants or carcinogens (e.g. asbestos).

Control Measures Keep dust to a minimum with good housekeeping. Consider damp dusting and high efficiency vacuum cleaners. Upgrade filters in ventilation systems to medium efficiency when possible and change frequently. Exhaust combustion appliances to the outside and clean and maintain flues and chimneys. When construction or remodeling is underway, special precautions should be used to separate work areas from occupied areas.

A.1.5 Environmental Tobacco Smoke (ETS) / Secondhand Smoke

Description Tobacco smoke consists of solid particles, liquid droplets, vapors, and gases resulting from tobacco combustion. Over 4,000 specific chemicals have been identified in the particulate and associated gases.

Source Tobacco product combustion.

Standards Many office buildings and areas of public assembly have banned smoking indoors or required specially designated smoking areas with dedicated ventilation systems be available. The "Pro-Children Act of 1994" prohibits smoking in Head Start facilities and in kindergarten, elementary and secondary schools that receive Federal funding from the Department of Education, the Department of Agriculture or the Department of Health and Human Services (except Medicare of Medicaid).

Health Effects The effects of tobacco smoke on smokers include rhinitis/pharyngitis, nasal congestion, persistent cough, conjunctival irritation, headache, wheezing and exacerbation of chronic respiratory conditions. Secondhand smoke has been classified as a "Group A" carcinogen by EPA and has multiple health effects on children. It has also been associated with the onset of asthma, increased severity of or difficulty in controlling asthma, frequent upper respiratory infections, persistent middle-ear effusion, snoring, repeated pneumonia and bronchitis.

Control Measures Smoke outside away from air intakes. Smoke only in rooms that are properly ventilated and exhausted to the outdoors.

A.1.6 Fine Particulate Matter ($PM_{2.5}$)

Description Fine particulate matter ($PM_{2.5}$) or soot, is a component of diesel exhaust and is less than 2.5 microns in diameter; in comparison, the average human hair is about 100 microns thick. It may consist as a tiny solid or liquid droplet containing a variety of compounds.

Source The main source of $PM_{2.5}$ is diesel engines in trucks, buses and non-road vehicles (e.g. marine, construction, agricultural, and locomotive). Diesel engines emit large quantities of harmful pollutants annually.

Standards There are currently no Federal government standards for $PM_{2.5}$ in school indoor air environments. EPA's National Ambient Air Quality Standards list 15 ug/m^3 as the 24-hour limit for $PM_{2.5}$ in outdoor air.

Health Effects Particulate matter is associated with a variety of serious health effects, including lung disease, asthma and other respiratory problems. In general, children are especially sensitive to air pollution because they breathe 50 percent more air per pound of body weight than adults. Fine particulate matter or $PM_{2.5}$ poses the greatest health risk, because it can pass through the nose and throat and become lodged in the lungs.

These particles can aggravate existing respiratory conditions such as asthma and bronchitis and they have been directly associated with increased hospital admissions and emergency room visits for heart and lung disease, decreased lung function and premature death. Short-term exposure may cause shortness of breath, eye and lung irritation, nausea, light-headedness and possible allergy aggravations.

Control Measures Effective technologies to reduce $PM_{2.5}$ include particulate filters and catalysts that can be installed on buses. An easy, no cost and effective way to control fine particulate matter is to minimize idling by buses, trucks and other vehicles.

A.1.7 Lead (Pb)

Description Lead is a highly toxic metal.

Source Sources of lead include drinking water, food, contaminated soil and dust and air. Lead-based paint is a common source of lead dust.

Standards In 1978, the Consumer Product Safety Commission banned lead in paint.

Health Effects Lead can cause serious damage to the brain, kidneys, nervous system and red blood cells. Children are particularly vulnerable. Lead exposure in children can result in delays in physical development, lower IQ levels, shorter attention spans and an increase in behavioral problems.

Control Measures Preventive measure to reduce lead exposure in buildings painted before 1978 include: Cleaning play areas; frequently mopping floors and wiping window ledges and other smooth flat areas with damp cloths; keeping children away from areas where paint is chipped, peeling or chalking; preventing children from chewing on window sills and other painted areas; and ensuring that toys are cleaned frequently and hands are washed before meals.

A.1.8 Nitrogen Oxides (NO, NO_2)

Description The two most prevalent oxides of nitrogen are nitrogen dioxide (NO_2) and nitric oxide (NO). Both are toxic gases and NO_2 is a highly reactive oxidant and corrosive.

Source The primary sources indoors are combustion processes such as unvented combustion appliances (e.g., gas stoves, vented appliances with defective installations, welding and tobacco smoke). Outdoor sources, such as vehicles and lawn and garden equipment, also contribute to nitrogen oxide levels.

Standards No standards have been agreed upon for nitrogen oxides in indoor air. ASHRAE and the U.S. EPA National Ambient Air Quality Standards list 0.053 ppm as the average 24-hour limit for NO_2 in outdoor air.

Health Effects NO_2 acts mainly as an irritant affecting the mucosa of the eyes, nose, throat and respiratory tract. Extremely high-dose exposure (as in a building fire) to NO_2 may result in pulmonary edema and diffuse lung injury. Continued exposure to high NO_2 levels can contribute to the development of acute or chronic bronchitis. Low-level NO_2 exposure may cause increased bronchial reactivity in some asthmatics, decreased lung function in patients with chronic obstructive pulmonary disease and increased risk of respiratory infections, especially in young children.

Control Measures Venting the NO_2 sources to the outdoors and assuring that combustion appliances are correctly installed, used and maintained are the most effective measure to reduce exposures. Develop anti-idling procedures for all vehicles and non-road engines (cars, buses, trucks, lawn and garden equipment, etc.).

Appendix B - Mold and Moisture

Molds can be found almost anywhere; they can grow on virtually any substance, providing moisture is present. Molds can grow on and within wood, paper, carpet, and foods. When excessive moisture accumulates in buildings or on building materials, mold growth will often occur, particularly if the moisture problem remains undiscovered or unaddressed. There is no practical way to eliminate all mold and mold spores in the indoor environment; the key to control indoor mold growth is to **control moisture**. If mold is discovered, clean it up immediately and remove excess water or moisture. In addition, maintaining the relative **humidity between 30 and 60 percent** will help control mold.

Molds produce tiny spores to reproduce. Mold spores waft through indoor and outdoor air continually. When mold spores land on a damp spot indoors, they may begin growing and digesting whatever they are growing on to survive.

There are many different kinds of mold. Molds can produce allergens, toxins, and irritants. Molds can cause discoloration and odor problems, deteriorate building materials, and lead to health problems— such as asthma episodes and allergic reactions—in susceptible individuals.

B.1 Condensation, Relative Humidity and Vapor Pressure

Mold growth does not require the presence of standing water, leaks, or floods; mold can grow when the relative humidity of the air is high. Mold can also grow in damp areas such as unvented bathrooms and kitchens, crawl spaces, ducts, utility tunnels, gyms, locker rooms, wet foundations, leaky roof areas, and damp basements. Relative humidity and the factors that govern it are often misunderstood.

This section discusses relative humidity and describes common moisture problems and their solutions. Water enters buildings both as a liquid and as a gas (water vapor). Water is introduced intentionally in bathrooms, gym areas, kitchens, and art and utility areas, and accidentally by way of leaks and spills. Some of the water evaporates and joins the water vapor that is exhaled by building occupants. Water vapor also moves into the building through the ventilation system, through openings in the building shell, or directly through building materials.

The ability of air to hold water vapor decreases as the air temperature falls. If a unit of air contains half of the water vapor it can hold, it is said to be at 50 percent relative humidity (RH) or greater. The RH increases as the air cools and approaches saturation. When air contains all of the water vapor it can hold, it is at 100 percent RH or greater, and the water vapor condenses, changing from a gas to a liquid. The temperature at which condensation occurs is the "dew point."

Reaching 100 percent RH without changing the air temperature is possible by increasing the amount of water vapor in the air (the "absolute humidity" or "vapor pressure"). It is also possible to reach 100 percent RH without changing the amount of water vapor in the air, by lowering the air temperature to the "dew point."

The highest RH in a room is always next to the coldest surface. This is referred to as the "first condensing surface," as it will be the location where condensation happens first, if the relative humidity of the air next to the surface reaches 100 percent. Understanding this is important when trying to understand why mold is growing on one patch of wall or only along the wall-ceiling joint. The surface of the wall is likely to be cooler than the room air because of a gap in the insulation or because the wind is blowing through cracks in the exterior of the building

B.2 Taking Steps to Reduce Moisture and Mold

Respond to water damage within 24–48 hours to prevent mold growth, which depends on moisture.

Mold growth can be reduced if relative humidity near surfaces can be maintained below the dew point. This can be done by:

1) reducing the moisture content (vapor pressure) of the air;

2) increasing air movement at the surface;

3) increasing the air temperature (either the general space temperature or the temperature at building surfaces).

Either vapor pressure or surface temperature can be the dominant factor in a mold problem. A vapor pressure-dominated mold problem may not respond well to increasing temperatures, whereas a surface temperature-dominated mold problem may not respond very well to increasing ventilation. Understanding which factor dominates will help in selecting an effective control strategy.

If the relative humidity near the middle of a room is fairly high (e.g., 50 percent at 70º F), mold or mildew problems in the room are likely to be vapor pressure dominated.
If the relative humidity near the middle of a room is fairly low (e.g., 30 percent at 70º F), mold or mildew problems in the room are likely to be surface temperature dominated.

B.3 Vapor Pressure-Dominated Mold Growth

Vapor pressure-dominated mold growth can be reduced by using one or more of the following strategies:

- Use source control (e.g., direct venting of moisture-generating activities such as showers to the exterior).
- Dilute moisture-laden indoor air with out- door air at a lower absolute humidity.
- Dehumidify the indoor air.

Note that dilution is only useful as a control strategy during heating periods, when cold outdoor air contains little total moisture. During cooling periods, outdoor air often contains as much moisture as indoor air.

Consider a school locker room that has mold on the ceiling. The locker room exhaust fan is broken, and the relative humidity in the room is 60 percent at 70º F. This is an example of a vapor pressure-dominated mold problem. In this case, increasing the surface temperature is probably not an effective way to correct the mold problem. A better strategy is to repair or replace the exhaust fan.

B.4 Surface Temperature Dominated Mold Growth

Surface temperature-dominated mold growth can be reduced by increasing the surface temperature using one or more of the following approaches:

- Raise the temperature of the air near room surfaces.
- Raise the thermostat setting.
- Improve air circulation so that supply. Air is more effective at heating the room surfaces.

- Decrease the heat loss from room surfaces.
- Add insulation.
- Close cracks in the exterior wall to prevent "wind washing" (air that enters a wall at one exterior location and exits another exterior location without penetrating into the building).

Consider an old, leaky, poorly insulated school that has mold and mildew in the coldest corners of one classroom. The indoor relative humidity is low (30 percent). It is winter and cold air cannot hold much water vapor. Therefore, outdoor air entering through leaks in the building lowers the airborne moisture levels indoors. This is an example of a surface temperature-dominated mold problem. In this building, increasing the outdoor air ventilation rate is probably not an effective way to control interior mold and mildew. A better strategy would be to increase surface temperatures by insulating the exterior walls, thereby reducing relative humidity in the corners

B.5 Mold Clean Up

Because moisture is the key to mold control, it is essential to clean up the mold and get rid of excess water or moisture. If the excess water or moisture problem is not fixed, mold will most probably grow again, even if the area was completely cleaned. Clean hard surfaces with water and detergent and dry quickly and completely. Absorbent materials such as ceiling tiles may have to be discarded.

Note that mold can cause health effects such as allergic reactions; remediators should avoid exposing themselves and others to mold. <u>Wear waterproof gloves during clean up; do not touch mold or moldy items with bare hands. Respiratory protection should be used in most remediation situations to prevent inhalation exposure to mold.</u> Respiratory protection may not be necessary for small remediation jobs with little exposure potential.

B.5.1 Home Test Kits for Mold

The chief disadvantage to home mold test kits is the fact that most of them function on some variation of presence/absence sampling. For instance, the manufacturer would typically provide growth medium agar, and a dish. The user of such a test then opens the dish, exposes it to ambient air and then closes it and awaits the growth of mold spores. However, without laboratory analysis, the results could never be appropriately interpreted. In addition, airborne spore trap sampling, from an industry standard view, is virtually never done without the presence of suitable control samples. The reasoning for this is quite simple: mold is ubiquitous throughout the human built environment. The presence of mold spores in a given room is essentially a given without fairly stringent controls meant to isolate a space from the environment, such as with clean rooms. For these reasons, such tests are completely invalid outside of a simple qualitative assessment. The use of home mold test kits is thereby inappropriate for use in District facilities.

B.6 Identifying and Correcting Common Mold and Moisture Problems

B.6.1 Exterior Corners and Walls

The interior surfaces of exterior corners and behind furnishings such as chalk boards, file cabinets, and desks next to outside walls are common locations for mold growth in heating climates. They tend to be closer to the outdoor temperature than other parts of the building surface for one or more of the following reasons:

- Poor indoor air circulation
- Wind washing
- Low insulation levels
- Greater surface area of heat loss

Sometimes mold growth can be reduced by removing obstructions to airflow (e.g., rearranging furniture). Buildings with forced air heating systems and/or room ceiling fans tend to have fewer mold problems than buildings with less air movement.

B.6.2 Set-Back Thermostats

Set-back thermostats (programmable thermostats) are commonly used to reduce energy consumption during the heating season. Mold growth can occur when temperatures are lowered in buildings with high relative humidity. (Maintaining a room at too low a temperature can have the same effect as a set-back thermostat.) Mold can often be controlled in colder climates by increasing interior temperatures during heating periods. Unfortunately, this also increases energy consumption and reduces relative humidity in the breathing zone, which can create discomfort.

B.6.3 Air-Conditioned Spaces

Mold problems can be as extensive in cooling climates as they are in heating climates. The same principles apply: either surfaces are too cold, moisture levels are too high, or both.

One common example of mold growth in cooling climates can be found in rooms where conditioned "cold" air blows against the interior surface of an exterior wall.
This condition, which may be due to poor duct design, diffuser location, or diffuser performance, creates a cold spot at the interior finish surfaces, possibly allowing moisture to condense.

Possible solutions for this problem include:

- Eliminate the cold spots (i.e., elevate the temperature of the surface) by adjusting the diffusers or deflecting the air away from the condensing surface.
- Increase the room temperature to avoid overcooling. NOTE: During the cooling season, increasing temperature decreases energy consumption, though it could cause comfort problems.

Mold problems can also occur within the wall cavity, when outdoor air comes in contact with the cavity side of the cooled interior surface. It is a particular problem in rooms decorated with low maintenance interior finishes (e.g., impermeable wall covering such as vinyl wallpaper), which can trap moisture between the finish and the gypsum board. Mold growth can be rampant when these interior finishes are coupled with cold spots and exterior moisture.

A possible solution for this problem is to ensure that vapor barriers, facing sealants, and insulation are properly specified, installed, and maintained.

B.6.4 Thermal Bridges

Localized cooling of surfaces commonly occurs as a result of "thermal bridges," elements of the building structure that are highly conductive of heat (e.g., steel studs in exterior frame walls, uninsulated window lintels, and the edges of concrete floor slabs). Dust particles sometimes mark the locations of thermal bridges because dust tends to adhere to cold spots.

The use of insulating sheathings significantly reduces the impact of thermal bridges in building envelopes.

B.6.5 Window

In winter, windows are typically the coldest surfaces in a room. The interior surface of a window is often the first condensing surface in a room.

Condensation on window surfaces has historically been controlled by using storm windows or "insulated glass" (e.g., double- glazed windows or selective surface gas- filled windows) to raise interior surface temperatures. In older building enclosures with less advanced glazing systems, visible condensation on the windows often alerted occupants to the need for ventilation to flush out interior moisture, so they knew to open the windows.

The advent of higher performance glazing systems has led to a greater number of moisture problems in heating climate building enclosures because the buildings can now be operated at higher interior vapor pressures (moisture levels) without visible surface condensation on windows.

B.6.6 Concealed Condensation

The use of thermal insulation in wall cavities increases interior surface temperatures in heating climates, reducing the likelihood of interior surface mold and condensation. The use of thermal insulation without a properly installed vapor barrier, however, may increase moisture condensation within the wall cavity.

The first condensing surface in a wall cavity in a heating climate is typically the inner surface of the exterior sheathing.

Concealed condensation can be controlled by any or all of the following strategies:

- Reducing the entry of moisture into the wall cavities (e.g., by controlling entry and/or exit of moisture-laden air with a continuous vapor barrier).
- Raising the temperature of the first condensing surface.
- In heating-climate locations: Installing exterior insulation (assuming that no significant wind washing is occurring).
- In cooling-climate locations: Installing insulating sheathing to the interior of the wall framing and between the wall framing and the interior gypsum board.

Appendix C - Emissions from Motor Vehicles and Equipment

Emissions from gas or diesel-powered engines are a source of pollution for school grounds and buildings. Exhaust emissions come from mobile sources such as school buses, cars, delivery trucks, and motorcycles, gasoline or diesel vehicles, engines, and equipment used for construction and grounds maintenance.

In addition, mobile sources produce air toxins (e.g., acetaldehyde, acrolein, benzene, 1,3-butadiene, diesel exhaust, and formaldehyde), which are pollutants known or suspected to cause cancer or other serious health or environmental effects. Mobile sources are responsible for about half the air toxin emissions and risk nationwide. “Mobile sources” is a term used to describe

Fine particulate matter (PM) in diesel wide variety of motor$_{2.5}$ vehicles, engines, and equipment that generate air pollution and that move, or can be moved, from place to place.

C.1 Mobile Sources at School

Some mobile sources at your school may include:

- School buses
- Cars
- Delivery trucks
- Portable fuel containers
- Mowers, snow blowers, trimmers, and other equipment used for grounds maintenance

Special situations involving motor vehicles or equipment off school property may also contribute to the deterioration of the overall air quality near schools. These might include, for example, truck loading docks or construction sites.

C.2 Mobile Source Emissions

Mobile sources pollute the air through fuel combustion and fuel evaporation. These emissions contribute to air pollution nationwide and are the primary cause of air pollution in many areas. Mobile sources emit several significant air pollutants that affect human health and the environment, including carbon monoxide, hydrocarbons, nitrogen oxides, and particulate matter.

See **Appendix A:** “Typical Indoor Air Pollutants,” for more information about these pollutants. Recent studies suggest that children on or near school buses may be exposed to elevated levels of diesel exhaust. Children are especially susceptible to adva$_{2.5}$nce respiratory effects of PM because it can penetrate children’s narrower airways, reaching deep within the lungs where it is likely to be retained, and because children have higher rates of respiration per unit of their body weight than adults.

C.3 Air Quality Issues

Mobile source air pollutants can contribute to air quality issues at schools. With sufficient concentrations and duration, these pollutants may increase the chance of cancer or other serious health effects, such as asthma.

- Studies indicate that students can be exposed to high levels of diesel exhaust when they are inside school buses, near idling school buses, and even inside schools (due to exhaust penetration from idling buses). Queuing of buses for pick- up and drop-off and periods of idling during the bus commute itself may be particular problems. Diesel exhaust can aggravate respiratory and cardiovascular disease and existing asthma. It can also cause acute respiratory symptoms, chronic bronchitis, and decreased lung function.

- Outdoor emissions can infiltrate through windows and air intakes, resulting in student and staff exposure to pollutants and toxics.
- Chemicals and gasoline stored in school buildings can contribute to indoor air quality concerns, and equipment usage can result in exposure to air pollutants and toxics.
- Students, staff, and vehicles sometimes congregate in the same place at the same time, which increases their exposure.

C.4 Reducing Emissions

Successful reduction of vehicle and equipment emission involves a variety of approaches, some of which are no- or low-cost options. Those concerned about improving air quality in and around school can choose from options ranging from better vehicle technology and better transit options to cleaner fuels.

Schools can help reduce air pollution from mobile sources in a number of different ways. A comprehensive program might include bus retrofits and replacement, anti-idling policies, reduced power equipment usage, environmentally friendly transportation choices, and equipment replacement. Some other smart actions that reduce emissions include adopting driving practices that save gas and improve mileage, maintaining vehicles on a regular basis, and using cleaner fuels.

C.5 Anti-idling

Policies to minimize idling offer a smart, effective, and immediate way to reduce emissions at little or no cost. In fact, reduced idling will save money in most cases because idling wastes fuel. The easiest way to reduce vehicle idling emissions is to "Just turn it off!" Today's bus engines generally require only three to five minutes of warm- up time, even in cold weather. The problem of diesel fuel gelling in cold weather has been resolved by the creation of winter blends of fuel and fuel additives that better withstand colder temperatures.

Contrary to popular belief, idling actually does more damage to an engine than starting and stopping. Idling causes additional wear on an engine's internal parts and, therefore, can increase maintenance costs and shorten the life of the engine.

Several States and local communities have already implemented anti-idling laws. These programs can reduce pollution, odor, and noise, and save schools money by reducing engine wear and fuel consumption. Finally, anti-idling information is easy to incorporate into existing training and communications opportunities.

C.6 Transportation Choices

Alternative transportation choices can also be beneficial for reducing emissions.
For instance, "school-pooling" programs encourage carpools, bike partners, or "walking school buses" that reduce the number of vehicles on school grounds. Public transit buses may also be an appropriate option for some students or staff.

C.7 Other Mobile Sources on School Grounds

Since cars and trucks are not the only mobile sources on school grounds, attention should also be paid to lawn and garden equipment for reducing emissions. The two main ways to reduce emissions from such equipment are to replace existing equipment with cleaner options (e.g., manual, electric, or new 4-stroke, gasoline engines) and to reduce usage.

EPA adopted more stringent standards for gasoline-powered equipment, such as lawnmowers and string trimmers, which will lower hydrocarbon and nitrogen oxide emissions. Schools can reduce harmful emissions by ensuring their grounds maintenance equipment meets current standards. Like school bus retrofits and replacements, alternate equipment choices will be specific to your school's situation. While manual and electric equipment are most beneficial because they do not produce emissions, these options are not always practical for large grounds.

Portable gasoline containers are another source of emissions on school grounds. Due to evaporation of gasoline, these cans pollute even when they are not being used, and especially when they are stored in a warm place. New, low-emission gasoline cans are designed for easy use and have a thicker lining in order to reduce fuel evaporation. They meet specified standards to minimize air pollution, including automatic closure, automatic shut-off, only one opening, and limited permeation. Many portable containers available nationwide meet all but the permeation standard. In addition, they are inexpensive, making them cost-effective solutions for reducing exposure to evaporated fuel.

Finally, proper maintenance and storage help decrease exposure to emissions from lawn and garden equipment. For example, lawn and garden equipment should be maintained regularly according to manufacturer guidelines to prevent problems that decrease efficiency and increase emissions. Keeping equipment tuned and in good condition is inexpensive and beneficial for minimizing emissions. In addition, fuels, chemicals, and equipment should be stored appropriately in a well-ventilated, cool, and dry space. For extended periods of storage (e.g., wintertime), gasoline should be emptied from equipment and containers or a stabilizer should be added to decrease evaporation.

C.8 Beneficial or Environmentally Friendly Landscaping

Beneficial landscaping refers to a suite of landscaping practices that yield environmental, economic, and aesthetic benefits. These environmentally friendly practices include planting native species and low-maintenance turf grasses, reducing lawn area, strategic use of trees, integrated pest management, and optimizing water efficiency. Ultimately, beneficial landscaping produces a healthier environment and reduces air, water, and soil pollution by minimizing emissions from power equipment, chemicals, fertilizer, and water.

In addition, beneficial landscaping is effective on any size of land. Emission reductions from beneficial landscaping alone can result in nearly 100 pounds less of smog-forming hydrocarbons and 10 pounds less of nitrogen oxide emissions per year per acre of lawn converted to natural landscaping due to reduced mowing. Hence, even small converted areas can contribute to notable reductions in emissions.

Grass can be replaced with trees, shrubs, native wildflowers, and other native plants that do not require mowing and are already adapted to local conditions. Trees, shrubs, and native plants absorb water more efficiently than lawns and therefore minimize runoff and erosion. They can also decrease the amount of time you spend on weeding and watering and reduce the need for fertilizers and pesticides.

Beneficial landscaping can result in reduced building heating and cooling costs. For example, planting deciduous trees on the south side of a building provides shade, reducing heat absorbed by the building during the summer. This practice can decrease air conditioning costs by up to 20 percent. In the winter, deciduous trees lose their leaves, allowing the winter sun to warm the building. Planting conifers on the northwest side of a building helps to block northwest winds, reducing heating costs. Care should be taken when planting to insure that the tree's canapé does not overshadow drain systems which could clogged by annual leaf drop. Also, planting trellis vines on the bare walls of buildings helps to keep these walls cooler by absorbing the sunlight. Planting trees around parking lots helps shade paved areas and further reduce sun-heating effects.

Finally, schools should use outdoor water efficiently by laying mulch in appropriate areas and installing efficient irrigation systems.

C.9 What are Good Practices to use in areas Where Maintaining Lawns is Necessary

Where lawns are necessary on school grounds, such as on play areas or sports fields, the following practices are best suited for reducing environmental impacts.

- Plant low-maintenance turf grasses that grow slowly and require less mowing.

- **Leave grass clippings on lawns**. This practice decreases the need for fertilizers and the amount of municipal solid waste entering landfills.

- Keep grass well maintained. Only one- third of the grass blade should be cut off at one time, and no more than one inch should be cut at one time.

C.10 What are the Benefits

Many advantages are associated with beneficial landscaping. Beneficial landscaping can be incorporated into science and environmental education. It creates hands-on learning experiences for students, while encouraging them to learn about natural habitats and take an interest in their surroundings.

Beneficial landscaping helps create a safer environment by reducing student and staff exposure to harmful emissions. **Security concerns should always be considered for planting. The tree canapé's should be at 6 feet and shrubs should be limited to 3 feet.** It leads to fewer emissions from fossil fuel consumed during mowing, less fertilizer use, and lower landscape maintenance labor and costs. Beneficial landscaping can also help decrease heating and cooling bills, reduce noise pollution (due to less mowing), conserve water, reduce flooding and storm water management costs, and decrease the strain on municipal waste collection and water treatment plants. In addition, it can lead to cleaner water bodies for fishing, swimming, and drinking due to reduced chemical use and erosion.

Appendix D - Portable Classrooms

More than 385,000 portable classrooms or relocatables, are used in approximately 36 percent of school districts across the nation, according to the National Center for Education Statistics (NCES). Portable classrooms are attractive to many school districts because they provide a quick and relatively inexpensive way to deal with unpredictable school enrollment numbers, limited building construction funds, and the time lag between identification of need and the construction of new facilities. While portable classrooms are intended to provide flexibility to school districts, in reality, portable classrooms are seldom moved and often become permanent fixtures of the school.

Recent surges in student population fueled an explosion in the use of portable classrooms in many parts of the country. Health-related concerns associated with portable classrooms have arisen. Teachers in the new units frequently complain of chemical odors. In older units, odor problems are often associated with moldy classroom carpets. Both new and older units are often subject to complaints about poor ventilation and indoor air quality (IAQ).

D.1 Indoor Air Quality and Portable Classrooms

All school buildings use similar construction and furnishing materials, so the types of chemicals present in the indoor air are not likely to be different for portable versus permanent classrooms. However, pressed-wood products, which may contain higher concentrations of formaldehyde, are used more frequently in factory-built portable units than in buildings constructed on-site. As a result, concentrations of some airborne chemicals may be higher in new portable classrooms, especially if ventilation is reduced.

The most common problems with portable classrooms include:

- Poorly functioning ventilation systems that provide inadequate quantities of outside air;
- Poor acoustics due to loud heating and cooling systems;
- Chemical off-gassing from pressed wood and other high-emission materials, which may be of greater concern because of rapid occupancy and poor ventilation after construction;
- Water entry and mold growth; and
- Site pollution from nearby parking lots or loading areas.

Appendix E - Standard Operating Procedures (SOP)

IAQ Reporting Procedures

1. All IAQ requests are to be called into Maintenance and Operations (M&O) Dispatch at 331-7193.

2. IAQ requests are forwarded to M&O's Facility and Planning (F&P) Technician and M&O Director.

3. The technician will prepare the IAQ and Building Maintenance Questionnaire (Appendix I) and forward that document to site administrator for completion.

4. The completed IAQ and Building Maintenance Questionnaire (Appendix I) will be forwarded to the IAQ Coordinator for investigation and room review.

5. If the IAQ coordinator determines that there is no concern they will close the investigation by completing the IAQ and Building Maintenance Questionnaire (Appendix I) and forward to the technician for processing and filing.

IAQ Action Procedures

1. In the event that the IAQ coordinator has additional concerns with the room, the IAQ team will be assembled.

2. The IAQ team will inspect the room and if necessary direct the IAQ coordinator to have air samples taken. Should the investigation or samples not provide a concern the IAQ Building Maintenance Questionnaire will be forwarded to the Director M&O for IAQ investigation closure.

3. Should the IAQ team investigation or testing suggest additional action, the IAQ concern will be returned to the Director M&O with a recommendation that the Environmental Professional be contacted.

4. The technician to issue an IAQ work order (ensuring that a separate work order is issued for each new item) and records the IAQ on the tracking sheet.

5. Technician emails IAQ complaint to IAQ coordinator. The new IAQ notice and all back up materials (IAQ form, work order & any other documents) will be assembled by technician.

6. IAQ coordinator and/or environmental professional will take photographs of the areas (classroom layout) for records.

7. Environmental Professional notifies M&O of any additional work, if needed from the IAQ coordinator.

8. M&O Director notifies the Site Administrator of the dates work will be conducted in the identified areas.

9. The IAQ concern (Appendix F) and IAQ investigation form (Appendix G) are completed and returned to Director M&O for report preparation.

10. After the area is cleared, Environmental Professional notifies M&O Director of air clearance.

11. M&O Director will email Site Administrator stating the area is clear and has passed inspection.

12. Environmental Professional provides M&O Director a final checklist of actions taken. (Appendix G) M&O Director develops a project closure letter to the Site Administrator. (Appendix H)

Appendix F

Indoor Air Quality
CONCERNS

Date/Time____________________________ Caller/Title________________________________

Site/Area_____________________________ Phone/Email_______________________________

Work Order No.________________________ M&O Staff who took call_____________________

Caller's Comments____

____

Operations Assessment

Date_______________By____

Custodial Cleanliness____

Dispatch Log Checked – Roof____

Dispatch Log Checked – HVAC____

Talked to Administrator (List Name____

Noticeable
Odors____

Overall Appearance – Inside____

Overall Appearance – Outside____

Custodian's Comments____

Conclusion____

____

____

Mechanical Assessment

Date_______________By____

HVAC Unit

Indoor Fan – Continuous / Auto (work completed by/date)___________________________

Supply Vents (work completed by/date)____

Return Vents (work completed by/date) ____

Filters (work completed by/date) ____

Condensate Pan / Drain (work completed by/date) _________________________________

Cleanliness of Unit (work completed by/date) _____________________________________

Outside Air Intake____

Plumbing

Leaks (work completed by/date) ____

Drains / Traps (work completed by/date) ____

Comments____

____

____

Structural Assessment - Indoors

Ceiling Condition

Ceiling Condition (work completed by/date) _______________________________________

Above Ceiling Tile (work completed by/date) ______________________________________

Bottom of Decking (work completed by/date) ______________________________________

Damp Areas (work completed by/date) ____

Insulation (work completed by/date) ____

Return Vents (work completed by/date) ____

Wall Condition

Wallboard/Tackboard (work completed by/date) _____________________________________

Seams (work completed by/date) ____

Corners (work completed by/date) ____

Window Sills (work completed by/date)____

Door Frames (work completed by/date) ____

Floor Condition

Carpet/Tile (work completed by/date) ____

Flooring Sound (work completed by/date) ____

Type of Subfloor- wood – slab – other________ (work completed by/date) _______________

Structural Assessment - Outdoors

Roof Condition

Gutters (work completed by/date) ____

Roof (work completed by/date) ____

Roof Type – comp – tile – metal – hot mop

Cap (work completed by/date) ____

Facia Board (work completed by/date) ____

Underneath Building Condition

Skirt (work completed by/date) ____

Vents (work completed by/date) ____

Skirt (work completed by/date) ____

Air Circulaiton (work completed by/date) ____

Vapor Barrier (work completed by/date) ____

Standing Water (work completed by/date) ____

Portable Sitting On - asphalt - dirt - other__________(work completed by/date) _________

Comments____

____

____
____

Appendix G

Indoor Air Quality
INVESTIGATION REPORT

Site_____________________________________ Date_______________________________

Classroom/Area___________________________ WO #_____________________________

IAQ Assessor______________________

IAQ Inspection Actions	
Performed	**Description**
	Interview Site Administrator, Custodian, Instructor (Circle) - Other (List)
	Custodial Cleanliness Visual Inspection
	Classroom Abnormal/Unusual Odor review
	Review Overall Room Appearance (outside and inside)
	M&O Dispatch Logs - Heating, Ventilation and Air conditioning (HVAC) Data
	M&O Dispatch Logs Roofing Data Review
	Request Environmental Professional to Perform Air Sampling
IAQ Inspection Results	
	Interviewed Site Administrator, Custodian, Instructor (Circle) - Other (List)
	Custodial Cleanliness Adequate
	Custodial Cleanliness Concerns (List)
	No Classroom Abnormal/Unusual Odors
	Classroom Abnormal/Unusual Odor Concerns (List)
	Room Appearance was Well Organized
	Room Appearance was Cluttered (List)
	Wall Systems (Inside and Outside) were Dry and in Good Order
	Wall System Concerns/Repairs (List)
	Protimeter Moisture Reading were Normal
	Protimeter Moisture Reading Concerns (List)
	Window Systems were Dry and in Good Order
	Window Systems Concerns/Repairs (List)
	Flooring (Carpet and/or Tile) in Good Condition
	Flooring (Carpet and/or Tile) Concerns/Repairs (List)
	HVAC System Operating Properly
	HVAC System Concerns/Repairs (List)
	No reported Roofing Concerns or Leaks
	No Visible Evidence of Water Intrusion
	Roofing Concerns/Repairs (List)
	Ceiling Tiles in Good Condition
	Ceiling Tiles with Water Stains (List)
	Air Sampling Results (List)

Appendix H

Indoor Air Quality

INSPECTION REPORT - MILLSWOOD

Your site reported an Indoor Air Quality (IAQ) concern regarding Classroom 123 at the Millswood Middle School to Maintenance and Operations (M&O). On May 5, 2014, ____________ conducted an IAQ inspection and data review of Classroom 123 which included the following:

- Interview M&O representative
- Visual inspection of custodial cleanliness
- Inspect the classroom for abnormal/unusual odors
- Review of overall classroom appearance – both inside and outside
- Review M&O dispatch HVAC logs
- Review M&O dispatch roofing logs
- Request environmental professional air sampling services

The results of the IAQ inspection and data review of Classroom 123 are as follows:

- Site administrator, instructor, custodian & M&O representative were interviewed
- Custodian cleanliness was adequate
- Moderate pungent musky odors were detected
- Room was well organized
- North wall systems showed signs of water intrusion
- Moisture reading were normal
- Window systems were dry and in good order
- Carpet was stained, had an odor and was dirty
- HVAC system was operating properly, but registers were dirty
- Roofing concerns were addressed
- Visible evidence of water intrusion
- Ceiling tiles were stained
- Samples were taken which detected mold. Impacted area was removed and replaced. Clearance air sampling indicated acceptable levels.

_____________will be conducting a follow up inspection to verify custodial and maintenance concerns have been adequately addressed and corrected.

Contact M&O Director for any additional concerns regarding IAQ inspection conducted in Classroom 123. If any other concerns develop, contact M&O dispatch at 331-7193.

Lodi Unified School District

MAINTENANCE & OPERATIONS

INDOOR AIR QUALITY (IAQ) AND BUILDING MAINTENANCE QUESTIONNAIRE

In order to target the IAQ/building maintenance investigation and address concerns, please fill out this questionnaire.

Site____ Date__________________________________

Building_______________________________ Dept____________________ Room____________________

Name____________________ Title____________________ Ph_____________ Email___________________

Please identify the source of this concern:

Flooring ☐ Carpet ☐ Tile ☐ Describe____

____

Wall Systems ☐ Describe____

____

Window Systems ☐ Describe____

____

Ceiling Tiles ☐ Describe____

____

Odors ☐ Describe____

____

Room Cleanliness ☐ Describe____

____

Plumbing ☐ Describe____

____

HVAC ☐ Describe____

____

Temperature ☐ Humidity ☐ Registers (vents) ☐

Comments____

To Be Completed by Maintenance & Operations:

Reviewed by___________________________ Title________________________ Date_________________

Comments____

____

Appendix J

Indoor Air Quality
MOLD REGULATIONS

CCR Title 8 Section 3203 Injury Illness Prevention. Requires Injury and Illness Prevention Program. Subsection (C) (5) requires procedures to investigate occupational injury or illness. Subsection (C) (6) include methods and/or procedures to correct unsafe or unhealthy conditions.

CCR Title 8 Section 3362 General. Subsection (G) requires water intrusion, leakage from interior water sources or other uncontrolled accumulation of water shall be corrected.

CCR Title 8 Section 5241 Definitions. See Harmful Exposures and Toxic Materials

CCR Title 8 Section 5142 HVAC Guidance

CCR Title 8 Section 5143 Mechanical Ventilation Guidance

CCR Title 8 Section 5155 Airborne Contaminants See (2) (A) Multiplication factor of 3

CCR Title 8 IAQ Policy OSHA policy to investigate all IAQ complaints

- Subsection I.A.2 specifically identifies educational facilities
- Subsection I.B.1.b identifies a valid complaint as one that is hazardous to the health of the building occupants
- Subsection I.B.2.b directs the OSHA investigator to determine how long the condition has been present.
- Subsection I.B.2.g directs the OSHA investigator to determine if the IAQ concern had been brought to the employer's attention and if so has the employer made attempts to correct the problem
- Subsection I.3.b deems an IAQ as serious if the employee is diagnosed by a physician as having a specific building related illness including loss of work days
- Subsection II.A.1.7 directs the investigator to determine if employers awareness of the employee's compliant and actions taken to investigate those complaints
- Subsection II.C.1.b directs sampling
- Subsection II.C.1.b.2 directs comparative sampling of outside and inside air
- Subsection II.C.2.a.2.b identifies sources of air contamination including building materials and ceiling tiles
- Subsection II.C.2.b identifies wet locations (walls and carpet) as locations of mold
- Subsection III.B.4.b directs the investigator to determine if the employer failed to investigate IAQ related health complaints

Glossary and Acronyms

AHERA – Asbestos Hazard Emergency Response Act

AHU – Air Handling Unit

AQI – The Air Quality Index is a tool that provides the public with clear and timely information on local air quality and whether air pollution levels pose a health concern.

ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers.

ASTM – American Society for Testing and Materials

After treatment Device – Engine pollutant emissions are generally reduced by engine modifications, fuel specifications, or exhaust gas after treatment. An after treatment device is a component used to reduce engine pollutant emissions downstream of the combustion chamber. Catalytic converters and particulate filters are examples of after treatment devices.

Air Cleaning – An IAQ control strategy to remove various airborne particulates and/or gases from the air. The three types of air cleaning most commonly used are particulate filtration, electrostatic precipitation, and gas sorption.

Air Exchange Rate – The rate at which outside air replaces indoor air in a space. Expressed in one of two ways: The number of changes of outside air per unit of time— air changes per hour (ACH); or the rate at which a volume of outside air enters per unit of time—cubic feet per minute (cfm).

Air Handling Unit – For purposes of this document, refers to equipment that includes a blower or fan, heating and/or cooling coils, and related equipment such as controls, condensate drain pans, and air filters. Does not include ductwork, registers, grilles, boilers or chillers.

Air Toxics – Chemicals in the air that are known or suspected to cause cancer or other serious health effects, such as reproductive problems or birth defects. Air toxics are also known as "hazardous air pollutants." Mobile sources emit a number of air toxics associated with both long-term and short- term health effects in people, including heart problems, asthma symptoms, eye and lung irritation, cancer, and premature death.

Alternative Fuel – An alternative fuel is any fuel other than gasoline and diesel fuels, such as methanol, ethanol, compressed natural gas, and other gaseous fuels. Generally, alternative fuels burn more cleanly and result in less air pollution.

Antimicrobial – Agent that kills microbial growth.

BRI – Building-Related Illness

Benzene – A cancer-causing hydrocarbon (C6H6) derived from petroleum. Benzene is a component of gasoline. Benzene emissions occur in exhaust as a byproduct of fuel combustion and when gasoline evaporates.

Biological Contaminants – Biological contaminants are or are produced by living organisms. Common biological contaminants include mold, dust mites, pet dander (skin flakes), droppings and body parts from cockroaches, rodents and other pests, or insects, viruses, and bacteria. Biological contaminants can be inhaled and can cause many types of health effects including allergic reactions, respiratory disorders, hypersensitivity diseases, and infectious diseases. Also referred to as "microbiologicals" or "microbials." See **Appendix A:** "Typical Indoor Air Pollutants" for more information.

Building-Related Illness – Diagnosable illness with identifiable symptoms for which the cause can be directly attributed to airborne building pollutants (e.g., Legionnaire's disease, hypersensitivity pneumonitis).**Central AHU –** See "Central Air Handling Unit."

Central Air Handling Unit – For purposes of this document, this is the same as an Air Handling Unit, but serves more than one area.

CFM – Cubic feet per minute. The amount of air, in cubic feet, that flows through a given space in one minute. 1 CFM equals approximately 2 liters per second (L/s).

CO – Carbon monoxide. See **Appendix A:** "Typical Indoor Air Pollutants" for more information.
CO_2 – Carbon dioxide. See **Appendix A**

Combustion – The process of burning. Motor vehicles and equipment typically burn fuel in an engine to create power. Gasoline and diesel fuels are mixtures of hydrocarbons, which are compounds that contain hydrogen and carbon atoms. In "perfect" combustion, oxygen in the air would combine with all the hydrogen in the fuel to form water and with all the carbon in the fuel to form carbon dioxide. Nitrogen in the air would remain unaffected. In reality, the combustion process is not "perfect," and engines emit several types of pollutants as combustion byproducts.

Conditioned Air – Air that has been heated, cooled, humidified, or dehumidified to maintain an interior space within the "comfort zone." (Sometimes referred to as "tempered" air.)

Dampers – Controls that vary airflow through an air outlet, inlet, or duct. A damper position may be immovable, manually adjustable, or part of an automated control system.

Diesel Engine – An engine that operates on diesel fuel and principally relies on compression-ignition for engine operation. The non-use of a throttle during normal operation is indicative of a diesel engine.

Diffusers and Grilles – Components of the ventilation system that distribute and return air to promote air circulation in the occupied space. As used in this document, supply air enters a space through a diffuser or vent and return air leaves a space through a grille.

Disinfectants – One of three groups of antimicrobials registered by EPA for public health concerns. A disinfectant destroys or irreversibly inactivates undesirable (and often infectious) organisms. EPA registers three types of disinfectant products based upon submitted efficacy data: limited, general/broad spectrum, and hospital disinfectant.

Drain Trap – A dip in the drain pipe of sinks, toilets, floor drains, etc., which is designed to stay filled with water, thereby preventing sewer gases from escaping into the room.

Emissions – Releases of pollutants into the air from a source, such as a motor vehicles, furnishings, or cleaning products.

Emissions Standards – Rules and regulations that set limits on how much pollution can be emitted from a given source. Vehicle and equipment manufacturers have responded to many mobile source emissions standards by redesigning vehicles and engines to reduce pollution.

EPA – United States Environmental Protection Agency.

ETS – Environmental Tobacco Smoke. Mixture of smoke from the burning end of a cigarette, pipe, or cigar and smoke exhaled by the smoker (also secondhand smoke or passive smoking). See **Appendix A:** "Typical Indoor Air Pollutants"

Evaporation – The process by which a substance is converted from a liquid to a vapor. "Evaporative emissions" occur when a liquid fuel evaporates and fuel molecules escape into the atmosphere. A considerable amount of hydrocarbon pollution results from evaporative emissions that occur when gasoline leaks or spills, or when gasoline gets hot and evaporates from the fuel tank or engine.

Exhaust Ventilation – Mechanical removal of air from a building.

Fine Particulate Matter (PM) – Tiny particles or liquid droplets less than 2.5 microns in diameter suspended in the air that can contain a variety of chemical components. PM fine particles are so small that they are not typically visible to the naked eye. These tiny particles can be suspended in the air for long periods of time and are the most harmful to human health because they can penetrate deep into the lungs. Some particles are directly emitted into the air. Virtually all particulate matter school and/or school district level who provides leadership and coordination of IAQ activities.

Indoor Air Pollutant – Particles, dust, fibers, mists, bioaerosols, gases or vapors.

Flow Hood – Device that easily measures airflow quantity, typically up to 2,500 cfm.

Highway Engine – Any engine that is designed to transport people or property on a street or highway.

HVAC – Heating, Ventilation, and Air-Conditioning system.

Hypersensitivity Diseases – Diseases characterized by allergic responses to pollutants. The hypersensitivity diseases most clearly associated with indoor air quality are asthma, rhinitis, and hypersensitivity pneumonitis.

Hypersensitivity pneumonitis is a rare but serious disease that involves progressive lung damage as long as there is exposure to the causative agent.

IAQ – Indoor Air Quality.

IAQ Backgrounder – A general introduction to IAQ issues as well as IAQ program implementation information that accompanies the IAQ checklists.

IAQ Checklist – A list of suggested easy- to-do activities for school staff to improve or maintain good indoor air quality. Each focuses on topic areas and actions that are targeted to particular school staff (e.g., teachers, administrators, kitchen staff, maintenance staff) or specific building functions (e.g., HVAC system, roofing, renovation). The checklists are to be completed by the staff and returned to the IAQ Coordinator as a record of completed activities and requested assistance.

IPM – Integrated Pest Management. A comprehensive approach to eliminating and preventing pest problems with an emphasis on reducing pest habitat and food sources.

Make-up Air – See "Outdoor Air Supply."

Microbiologicals – See "Biological Contaminants."

Mobile Sources – Motor vehicles, engines, and equipment that move, or can be moved, from place to place. Mobile sources include vehicles that operate on roads and highways ("on-road" or "highway" vehicles), as well as non-road vehicles, engines, and equipment. Examples of mobile sources are cars, trucks, buses, earth-moving equipment, lawn and garden power tools, ships, railroad locomotives, and airplanes.

NIOSH – National Institute for Occupational Safety and Health.

Negative Pressure – Condition that exists when less air is supplied to a space than is exhausted from the space, so the air pressure within that space is less than that in surrounding areas. Under this condition, if an opening exists, air will flow from surrounding areas into the negatively pressurized space.

Non-road Engine – A term that covers a diverse collection of engines, equipment, vehicles, and vessels. Sometimes referred to as "off-road" or "off-highway," the non-road category includes garden tractors, lawnmowers, bulldozers, and cranes. Although non-road engines can be self-propelled, their primary function is to perform a particular task.

OSHA – Occupational Safety and Health Administration

Outdoor Air Supply – Air brought into a building from the outdoors (often through the ventilation system) that has not been previously circulated through the system.

Oxidation Catalyst – A type of catalyst (catalytic converter) that chemically converts hydrocarbons and carbon monoxide to water vapor and carbon dioxide.

Particulate Filter/Trap – An after treatment, anti-pollution device designed to trap particles in diesel particulate matter from engine exhaust before they can escape into the atmosphere.

Pollutants (Pollution) – Unwanted chemicals or contaminants found in the environment. Pollutants can harm human health, the environment, and property.
Air pollutants occur as gases, liquid droplets, and solids. Once released into the environment, many pollutants can persist, travel long distances, and move from one environmental medium (e.g., air, water, land) to another.

Polychlorinated Biphenyls (PCBs) – Mixtures of synthetic organic chemicals with the same basic chemical structure and similar physical properties ranging from oily liquids to waxy solids. PCBs were used in hundreds of industrial and commercial applications including electrical, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics, and rubber products; in pigments, dyes, and carbonless copy paper, and many other applications. Production of PCBs in the United States ceased in 1977.

Positive Pressure – Condition that exists when more air is supplied to a space than is exhausted, so the air pressure within that space is greater than that in surrounding areas. Under this condition, if an opening exists, air will flow from the positively pressurized space into surrounding areas.

PPM – Parts Per Million.

Pressure, Static – In flowing air, the total pressure minus velocity pressure. The portion of the pressure that pushes equally in all directions.

Particulate Matter 2.5 (PM) See Fine Particulate Matter

Plenum – Unducted air compartment used to return air to central air handling unit.

Pollutant Pathways – Avenues for distribution of pollutants in a building. HVAC systems are the primary pathways in most buildings; however, all building components and occupants interact to affect how pollutants are distributed. See **Section 2:** "Understanding IAQ Problems" for more information.

Pressure (Total) – In flowing air, the sum of the static pressure and the velocity pressure.

Pressure (Velocity) – The pressure due to the air flow rate and density of the air.

Preventive Maintenance – Includes regular and systematic inspection, cleaning, and replacement of worn parts, materials, and systems. Preventive maintenance helps to prevent parts, material, and systems failure by ensuring that parts, materials, and systems are in good working order.

Psychogenic Illness – This syndrome has been defined as a group of symptoms that develop in an individual (or a group of individuals in the same indoor environment) who are under some type of physical or emotional stress. This does not mean that individuals have a psychiatric disorder or that they are imagining symptoms.

Radon – A colorless, odorless gas that occurs naturally in almost all soil and rock. Radon migrates through the soil and groundwater and can enter buildings through cracks or other openings in the foundation. Radon can also enter through well water. Exposure to radon can cause lung cancer.

Re-entry – Situation that occurs when the air is being exhausted from a building is immediately brought back into the system through the air intake and other openings in the building envelope.

Retrofit – An engine "retrofit" includes (but is not limited to) any of the following activities:

- Addition of new/better pollution control after treatment equipment to certified engines.
- Upgrading a certified engine to a cleaner certified configuration.
- Upgrading an uncertified engine to a cleaner "certified-like" configuration.
- Conversion of any engine to a cleaner fuel.
- Early replacement of older engines with newer (presumably cleaner) engines (in lieu of regular expected rebuilding).
- Use of cleaner fuel and/or emissions reducing fuel additive (without engine conversion).

SBS – See "Sick Building Syndrome."

Sanitizer – One of three groups of anti- microbials registered by EPA for public health uses. EPA considers an antimicrobial to be a sanitizer when it reduces but does not necessarily eliminate all the microorganisms on a treated surface. To be a registered sanitizer, the test results for a product must show a reduction of at least 99.9 percent in the number of each test microorganism over the parallel control.

Short-circuiting – Situation that occurs when the supply air flows to return or exhaust grilles before entering the breathing zone (area of a room where people are). To avoid short-circuiting, the supply air must be delivered at a temperature and a velocity that result in mixing throughout the space.

Sick Building Syndrome – Term sometimes used to describe situations in which building occupants experience acute health and/or comfort effects that appear to be linked to time spent in a particular building, but where no specific illness or cause can be identified. The complaints may be localized in a particular room or zone, or may be spread throughout the building.

Soil Gases – Gases that enter a building from the surrounding ground (e.g., radon, volatile organic compounds, gases from pesticides in the soil).

Sources – Sources of indoor air pollutants. Indoor air pollutants can originate within the building or be drawn in from outdoors. Common sources include people, room furnishings such as carpeting, photocopiers, art supplies, etc.

Stack Effect – The flow of air that results from warm air rising, creating a positive pressure area at the top of a building and a negative pressure area at the bottom of a building. In some cases the stack effect may overpower the mechanical system and disrupt ventilation and circulation in a building.

Sterilizer – One of three groups of anti-microbials registered by EPA for public health uses. EPA considers an antimicrobial to be a sterilizer when it destroys or eliminates all forms of bacteria, fungi, viruses, and their spores. Because spores are considered the most difficult form of a microorganism to destroy, EPA considers the term sporicide to be synonymous with "sterilizer."

TVOCs – Total Volatile Organic Compounds. See "Volatile Organic Compounds (VOCs)."

ULSD – Ultra-Low Sulfur Fuel. The manufacturers of retrofit technologies, which reduce sulfur emissions, specify the maximum allowable sulfur level for effective operation of its products. For the purposes of the diesel retrofit program, diesel fuel must contain less than 15 ppm sulfur to be considered as ultra-low sulfur fuel. The use of ultra-low sulfur fuel alone can reduce emissions of particulate matter. Sulfate, a major constituent of particulate matter, is produced as a byproduct of burning diesel fuel containing sulfur. Reducing the sulfur content of fuel, in turn, reduces sulfate byproducts of combustion and, therefore, particulate matter emissions.

Unit Ventilator – A single fan-coil unit designed to satisfy tempering and ventilation requirements for individual rooms.

VOCs – See "Volatile Organic Compounds."

Ventilation Air – Defined as the total air, which is a combination of the air brought inside from outdoors and the air that is being recirculated within the building. Sometimes, however, used in reference only to the air brought into the system from the outdoors; this document defines this air as "outdoor air ventilation."

Volatile Organic Compounds (VOCs) – Compounds are a gas at room temperature. Common sources that may emit VOCs into indoor air include housekeeping and maintenance products and building and furnishing materials. In sufficient quantities, VOCs can cause eye, nose, and throat irritations, headaches, dizziness, visual disorders, memory impairment; some are known to cause cancer in animals; some are suspected of causing, or are known to cause, cancer in humans. At present, not much is known about what health effects occur at the levels of VOCs typically found in public and commercial buildings. See **Appendix A:** "Typical Indoor Air Pollutants" for more information.

Zone – The occupied space or group of spaces within a building that has its heating or cooling controlled by a single thermostat