Sensible Guide for Healthier School Renovations

Key Environmental Health Considerations When Renovating Schools

EPA United States Environmental Protection Agency

Contents

Keep Kids Safe During School Renovations

School renovations have the potential to increase children's exposures to harmful contaminants which can lead to serious health risks. Addressing the unique challenges and opportunities of school renovation proactively can help the school save money and support student performance. School environments play an important role in the health and academic success of children. Children spend 90% of their time indoors and much of that time is spent in school. Recent surveys report that 53% of public schools need to spend money on repairs, renovations, and modernization – at an estimated overall cost of $197 billion, **Institute of Education Sciences, Condition of America's Public School Facilities: 2012-2013**. Indoor environmental quality can be compromised during school renovations, potentially exposing building occupants to damaging hazardous airborne chemicals (indoor air contaminants). Common indoor air contaminants include asbestos, lead, mold, radon, and polychlorinated biphenyls (PCBs). Dermal contact or incidental ingestion may also be significant exposure pathways for chemicals (e.g., PCBs or lead) contained in building materials or construction debris.

Children are especially susceptible to the damaging effects of environmental hazards. A child's developing biological systems are often more sensitive to environmental stressors, and children are frequently more heavily exposed to toxic substances in the environment than are adults. Children in minority, low-income, and other underserved populations, as well as children with disabilities, can experience higher exposures to multiple environmental contaminants where they live, learn, and play, and may be at a disproportionate risk for associated health effects.

Healthy school environments play an important role in the health and academic success of children. Exposure to environmental hazards in schools can negatively impact the health of students and school staff. Unhealthy school environments can also affect attendance, concentration, and performance, as well as lead to expensive, time-consuming cleanup and remediation activities.

During school renovations it's important to be aware of potential environmental hazards and know the best practices for healthy and sustainable schools. It is also an opportunity to evaluate hazardous materials storage, become more energy-efficient, integrate pest management by design, and incorporate green building practices.

This booklet provides school administrators, facility managers, staff and the school community with an overview of how to avoid key environmental health hazards and ways to minimize children's exposures as they prepare for and undergo renovations. School renovations should be consistent with applicable local, state and federal environmental health regulations. More in-depth guidance on all of these risks has been developed by EPA, state agencies, and other organizations. School administrators, facility managers, and staff should reference the information in this booklet and resources listed on pages 19-20 to plan and **conduct healthier school renovations**.

Protect Indoor Air Quality

Protect Indoor Air Quality

Good indoor air quality (IAQ) in schools is a critical component of a healthy and comfortable learning environment. IAQ affects the health, productivity, performance, and comfort of students, teachers and staff.

When there is poor IAQ in a school building, students and staff may suffer from common symptoms of respiratory infections and allergic or other adverse health reactions. Renovations may significantly alter the IAQ of a school building. IAQ topics are particularly relevant for renovation projects and present unique challenges. Some of the IAQ issues related to construction activities include the presence of asbestos, mold, radon, vapor intrusion, lead and PCBs. These require planning during the design phase and special precautions during the execution phase of a renovation or construction project.

IAQ Issues during Construction Activities

Construction dust and materials such as adhesives, paints, and sealants have the potential to degrade IAQ. Poor IAQ increases the risk of developing health problems that affect the overall performance of students or staff. It is a best management practice to conduct construction activities outside of the

school year whenever possible to reduce impacts to students and staff. However, when construction activities must be conducted during the school year, developing and implementing an IAQ plan can help protect the building inhabitants' health by preventing exposure to hazardous chemicals. Communication with building occupants is essential for reducing impacts. Communication should begin during the planning phase of any construction activities and should continue through the project's completion. Refer to **EPA's IAQ Design Tools for Schools** website for additional details on IAQ Plans.

Integrating indoor air quality protections and energy efficiency improvements

EPA's Energy Savings Plus Health IAQ Guidelines for School Building Upgrades provides specific assessment protocols and recommendations for protecting and even enhancing IAQ during school energy efficiency retrofits and other building upgrade projects.

http://www2.epa.gov/iaq-schools/indoor-air-quality-design-tools-schools

Download **EPA's School IAQ Assessment mobile app** to keep IAQ on track before, during and after school building upgrades.

During School Renovations

Construction Dust

Construction activities generate a lot of dust that may contain hazardous chemicals. Exposure to construction dust can irritate the eyes and nose, causing immediate health effects, and may also trigger asthma attacks in students and staff. Reducing the amount of dust in the air by sealing off areas (particularly ductwork) with plastic sheeting, ensuring adequate ventilation, and using high-efficiency particulate air (HEPA) filtration attached to dust-generating equipment will protect the health and comfort of building occupants and may reduce the risk of asthma attacks. Other best practices include cleaning up at the end of the workday and having a separate outdoor staging area for activities that generate dust, such as sawing and sanding.

Construction Materials

New building materials should meet building design specifications and be in compliance with applicable federal, state, local regulations and building codes. Verifying product content/labels is particularly important, especially when building materials are imported from other countries that may not have as stringent specifications (e.g., asbestos containing building materials are still manufactured and used in other countries). Schools should strive to ensure that quality building materials are installed and potential IAQ issues are avoided by selecting low-toxicity, lowemitting, moisture-resistant materials during renovation design.

Construction materials such as adhesives, paints, or sealants can volatilize as they dry or cure, contributing to indoor air quality issues. Properly ventilating areas where these construction materials are used and stored, and promptly cleaning up any spills, can reduce impacts. In addition, construction materials should be staged away from classrooms and heating, ventilation, and air conditioning (HVAC) intakes during renovations. Care should also be taken to protect materials from moisture and humidity to avoid introducing potential hazards such as mold.

Equipment and Vehicle Emissions

Emissions from diesel- or gas-powered construction equipment can impact the health and comfort of students and staff near the construction site. Exposure to these emissions may cause symptoms such as headache, nausea, coughing, difficulty breathing, or irritation of the eyes, nose, and throat. Diesel- or gas-powered equipment should be stored and operated away from classrooms, HVAC intakes, doors and windows, and playground/sporting areas. If possible, use newer or retrofitted equipment and limit engine idling.

Best Management Practices:

- ✔ Plan ahead to maintain good indoor air quality during renovations.
- ✔ Reduce potential exposure to construction dust by sealing off work areas from non-construction workers, using equipment with HEPA filters, and frequently cleaning work areas.
- ✔ Select staging areas for construction materials, equipment, and vehicles away from classrooms and HVAC intake.
- ✔ Review product labels and product specification sheets to verify content. When in doubt, ask the manufacturer to verify contents or lack thereof.

Asbestos

Know the risks

Asbestos is a mineral fiber that naturally occurs in rock and soil. Because of its fiber strength and heat resistance, asbestos has been used in a variety of building construction materials for insulation and as a fire retardant.

When asbestos containing material (ACM) is in good, non-friable condition (meaning it cannot be crumbled, pulverized, or reduced to powder by hand pressure), emission of asbestos fibers from ACM to air generally does not occur. As the condition of ACM deteriorates or renovation activities disturb ACM, asbestos fibers can be released into air. Asbestos fibers can stay suspended for hours and up to days, creating an exposure risk. Exposure to airborne asbestos fibers can cause serious health issues and may lead to asbestosis, mesothelioma, or lung cancer. Other cancers, primarily of the digestive tract, are also possible.

Know the regulations

Building materials with greater than one percent asbestos are considered ACM and are subject to federal and state regulations.

EPA regulations include:

- The Toxic Substances Control Act (TSCA)
- Asbestos Hazard Emergency Response Act (AHERA)
- Asbestos Model Accreditation Plan
- Asbestos National Emission Standard for Hazardous Air Pollutants (Asbestos NESHAP)

Know where to find ACM in Schools

ACM is commonly found in:

- Insulation
- Adhesives
- Millboard
- Textured paint
- Cement sheets/board
- Joint/patching compounds
- Floor tiles and mastic
- Roofing
- Acoustic ceiling tiles
- Caulking
- Quick-set cement

Know how to prevent exposure

The NESHAP regulations under the Clean Air Act specify work practices for asbestos to be followed during school renovations. The regulations require the school to notify the appropriate state agency before any demolition or renovations of buildings that could contain a certain threshold amount of ACM.

Under AHERA, schools are required to perform an inspection to determine whether ACM are present and re-inspect ACM every three years. Schools are required to develop an asbestos management plan (AMP) and designate a person responsible for implementing the AMP. Refer to EPA website **Asbestos in School Buildings** and **EPA Document Model AHERA Asbestos Management Plan** for further information on drafting an AMP.

When school renovation projects involve ACM, special procedures must be performed by licensed and trained asbestos abatement professionals. Special containment, equipment, and disposal procedures are also required.

Additional, more stringent local and state regulations may also apply during renovations when ACM is disturbed (e.g., Occupational Health and Safety Administration (OSHA) Safety and Health Regulations for Construction).

Best Management Practices:

- ✔ Include the school's AHERA designated person in communications during the design phase of renovation projects to ensure ACM is properly addressed and no new ACM is utilized (e.g., thermal system insulation).
- ✔ Review the AMP and ACM reports to ensure that ACM remains untouched or proper ACM abatement procedures are included in the design.
- ✔ When deciding how to address ACM during renovations, consider the impact to the renovation budget, long-term costs, and asbestos management responsibilities associated with each alternative.
- ✔ Set a project schedule so that asbestos abatement occurs outside of the school year or during holiday breaks.
- ✔ Communicate and coordinate with the project manager and site manager during asbestos abatement and renovation projects.
- ✔ Be sure to request and review the final air clearance sampling results prior to allowing students and staff to re-occupy the affected area after asbestos abatement.

Mold

Know the risks

There are several thousand different species of molds. They can grow on virtually any organic substance, as long as moisture and oxygen are present. There are molds that can grow on wood, paper, carpet, foods, and insulation.

All molds have the potential to cause health effects that may include irritation of the eyes, skin, nose, throat, and lungs. Molds can trigger allergic reactions or even asthma attacks in people allergic to mold. Some molds are known to produce potent toxins or chemical irritants.

Know where to find mold

Molds grow best in damp and humid conditions. They spread by releasing spores. When excessive moisture accumulates in buildings or on building materials, mold growth often occurs, particularly if the moisture problem remains undiscovered or unaddressed. It is impossible to eliminate all mold and mold spores in the indoor environment. However, mold growth can be controlled indoors by controlling moisture.

The key to controlling mold is removing the source(s) of moisture that caused the mold issue in the first place. Check for humidity and condensation problems as well as actual water leaks, maintenance issues, and HVAC system problems. Fix any issues that are identified.

Know how to identify and cleanup mold

No EPA or other federal agency threshold limits have been set for mold or mold spores. Mold is generally identified with visual inspection or by smell, but sampling can be done to determine the source(s) of the mold contamination and the specific mold present. Analytical methods recommended by the **American Industrial Hygiene Association (AIHA)** or the **American Conference of Governmental Industrial Hygienists (ACGIH)** should be used to identify mold.

The steps needed to clean up mold vary based on the magnitude and surface area of mold growth. A more cautious or conservative approach to remediation is warranted in cases where:

- a particularly toxic mold species has been identified or is suspected;
- when extensive hidden mold is expected (such as behind vinyl wallpaper or in the HVAC system);
- when the chances of the mold becoming airborne are estimated to be high; or
- sensitive individuals (e.g., those with severe allergies or asthma) are present.

If the affected area is small or less than 10 square feet, small-scale mold remediation efforts may include cleaning or limited building material removal and replacement. Always use personal protective equipment (PPE) including gloves and eye protection when working with mold. Additional PPE such as N-95 respirators or respirators with HEPA filters may also be necessary to ensure compliance with OSHA standards. Building occupants should be isolated from the affected area by setting up containment areas with proper ventilation when mold remediation is underway.

Know how to prevent exposure

Renovation projects may have to tackle existing mold issues (known or hidden) and include mold remediation. A key objective of any renovation should be to maintain proper moisture control after renovations are complete. Thus, the renovation design should include proper construction techniques and building materials to prevent future moisture problems. Renovation design specifications need to address:

- moisture control issues related to surface water drainage;
- foundation construction/repair;
- wall construction;
- roof and ceiling assembly;
- plumbing system installation/repairs; and
- HVAC system installation/modifications.

Best Management Practices:

✔ When moisture problems are found, promptly initiate repairs to minimize mold growth.

✔ If the extent of the mold issue is severe and a more time-critical removal (with containment) is needed, consider removing mold outside of school hours, during evenings or weekends, if it cannot be delayed to summer or a holiday break.

✔ Do not paint or caulk over surfaces that have mold.

✔ Maintain proper moisture control after renovations are complete.

Vapor Intrusion

Know the risks

Vapor intrusion generally occurs when changes in pressure and/or temperature cause a chemical to evaporate in the underground environment and penetrate buildings by migrating through subsurface soil and into cracks of the building's foundation slab. Chemicals that may cause IAQ issues through vapor intrusion are primarily from a category of compounds known as volatile organic compounds (VOCs). Semi-volatile organic compounds or inorganic chemicals (e.g. mercury) may also volatilize and present an IAQ issue. In rare cases, the vapors may accumulate in occupied buildings to levels that may pose immediate safety hazards (e.g., explosion), acute health effects, or odors. However, in most cases, vapor concentrations are low and the main concern is whether the volatile chemical(s) pose an unacceptable risk of developing chronic health effects due to long-term exposure at these low levels. Chronic health effect(s) vary based on the specific volatile chemical, but typically carcinogenic effects and/or non-carcinogenic effects are risks associated with prolonged exposure to volatile chemicals. For example, leukemia and decreased white blood cell count are the health effects associated with chronic benzene exposure.

Know where to find vapors

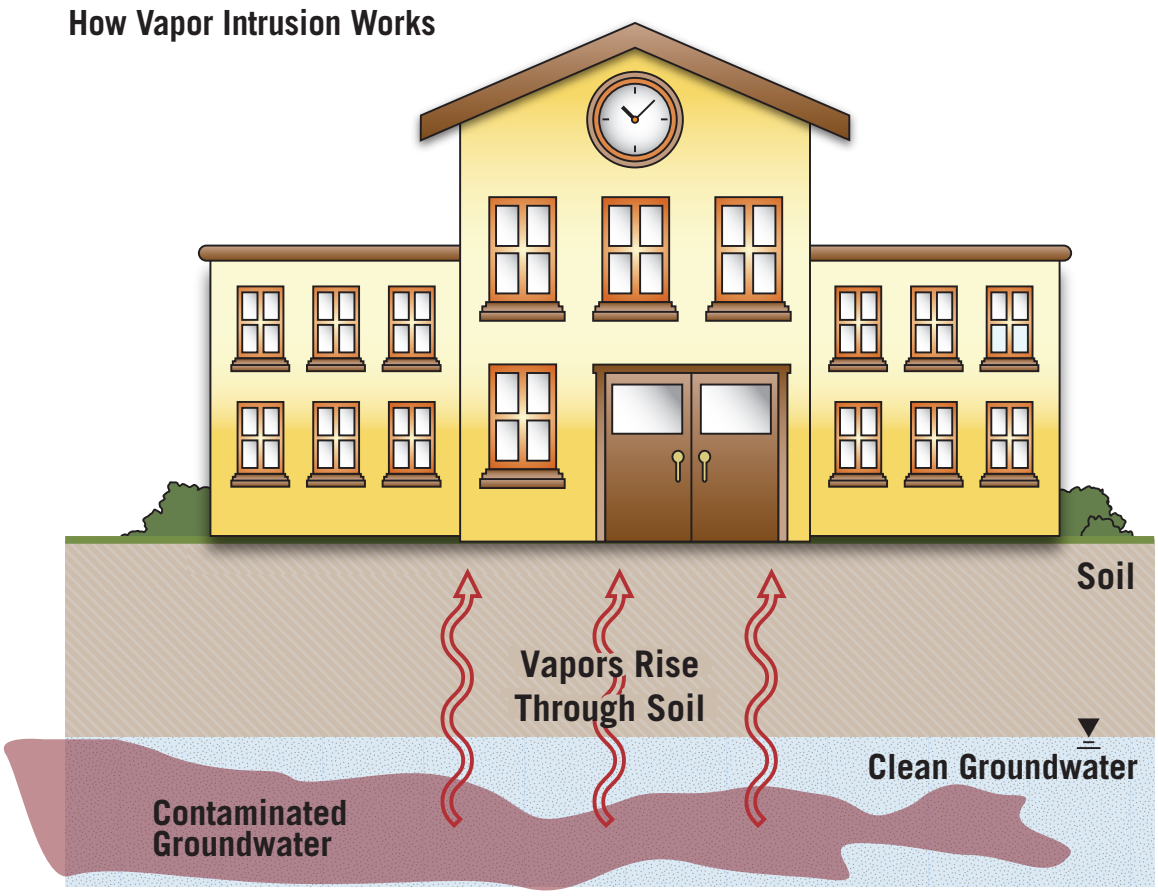
There must be a source of contamination in soil or groundwater near the school in order for a vapor intrusion issue to exist. EPA considers soil or groundwater contamination within 100 feet of a school building to be a potential source for vapor intrusion **(see EPA source)**. A potential source could be a former leaking underground storage tank that resulted in contaminated groundwater within 100 feet of a school building. A review of the current and historical land use in the vicinity of the school will help identify if there is a potential source for vapor intrusion. If a suspected source is identified, often, a seasonal vapor intrusion evaluation (including sampling and analysis) is needed to confirm the presence or absence of volatile chemicals. Groundwater, soil gas, ambient air, and indoor air- samples may be collected by a trained professional and sent to a certified analytical laboratory for analysis. The sample results are compared to chemical-specific action levels (under EPA and/or state regulations and guidance, depending on the situation) to determine if source removal, cleanup, or vapor intrusion mitigation systems are needed. Vapor intrusion mitigation methods may include sealing openings (filling in cracks in the floor slab and gaps), installing vapor barriers, passive venting, installing sub-slab depressurization, or adjusting a building's HVAC system to over-pressurize the building.

Know how to prevent exposure

Vapor intrusion is an important consideration when planning a renovation. First, if a renovation project includes expansion of the school it is important to perform due diligence and verify that there are no potential sources of vapor intrusion on the land where the expansion is set to occur. Second, if the renovation project includes an existing school building that has a vapor intrusion issue, then mitigation methods need to be incorporated into the renovation design or the current vapor intrusion mitigation system(s) should remain in place.

Best Management Practices:

- ✔ Review land use records, typically available at city and county offices, to determine potential sources for vapor intrusion, especially when considering school expansion projects.
- ✔ Maintain a library with any vapor intrusion evaluation reports, vapor intrusion mitigation systems construction reports, and vapor intrusion mitigation systems operation and maintenance (O&M) reports for future reference.
- ✔ Be actively involved in the renovation design phase when there is an existing vapor intrusion issue, and ensure that the renovation designs incorporate adequate vapor intrusion mitigation methods or leave the current vapor intrusion mitigation systems in place.
- ✔ Vapor intrusion can be a highly complex issue and challenging to address. Reach out to available EPA and state resources with questions and concerns regarding vapor intrusion, such as the **EPA Vapor Intrusion website**.



Hazardous Materials and Mercury

Know the risks

Hazardous materials, such as glues, sealants, acids, bases, oxidizers, compressed gases, flammable solvents, and mercury can often be found in schools. During renovation activities, these hazardous materials may need to be cleaned out or relocated. Improper disposal, spills and other accidents can pose health and safety risks to students and staff as well as incur considerable expenses, including potential liabilities/lawsuits. Hazardous materials and chemicals are associated with a variety of serious health problems, including cancer, brain and nervous system disorders, reproductive disorders, organ damage, and asthma. Chemicals also can irritate the skin, eyes, nose and throat. Some chemicals pose significant physical safety hazards, such as fire or explosion risks.

Mercury is a hazardous chemical of particular concern because the nervous system is very sensitive to all forms of mercury. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain and kidneys. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems. Short-term exposure to high levels of metallic mercury vapors may cause lung damage, nausea, vomiting, diarrhea, increased blood pressure or heart rate, skin rashes, and/or eye irritation.

Know the regulations

Hazardous materials and chemicals may need to be managed and disposed of as hazardous waste under Resource Conservation and Recovery Act (RCRA) or state regulations. Refer to **EPA's Schools: Chemical Management Regulation webpage** for additional information. Specifically, mercury wastes must be properly managed and disposed of if it meets the toxicity characteristics of RCRA hazardous waste. Mercury-containing batteries, thermostats, and lamps are managed under the Universal Waste Program, provided the state does not regulate the wastes more stringently.

Know where to find hazardous materials and mercury

Hazardous materials may be found in science laboratories or classrooms, art classrooms, shop or mechanic classrooms, or maintenance closets.

Some materials containing mercury may be found throughout school buildings and some common sources of mercury in schools include:

- Glass thermometers
- Fluorescent (CFL) lamps and light bulbs
- Science equipment
- Thermostats, switches, and other electrical devices

Know How to Prevent Exposures

Having a chemical management program can help schools reduce the risk of chemical exposures and accidents. Program information can help renovation project managers plan for and mitigate risks. Individuals with knowledge of chemical hazards should be consulted before attempting to move any chemicals, as some may have become shock-sensitive or explosive over time. If hazardous chemicals need to be temporarily relocating during renovations, designate a temporary storage area that has proper ventilation, and adequate space to accommodate the chemical-specific handling and storage requirements, including temperature control.

When renovations remove mercury-containing equipment, **special handling and disposal requirements** are necessary to avoid a release. Schools should conduct and maintain an up-to-date inventory list of all mercury-containing equipment prior to renovation; so, proper removal procedures can be incorporated into the renovation ahead of time.

Best Management Practices:

- ✔ Establish a chemical management program for preventing and/or controlling a variety of health and safety hazards in schools.
- ✔ Ensure all chemicals are properly labeled and stored before renovations begin. Ensure that OSHA materials safety data sheets (MSDS) for each product are readily displayed near chemical storage areas.
- ✔ Renovation provides an opportunity for schools to remove inappropriate, outdated, unknown and unnecessary chemicals from schools. **EPA's Schools: Chemical Management Regulation webpage** provides the tools to successfully implement a cleanout.
- ✔ If possible consider removing all mercury compounds and mercury-containing equipment from the school, and discontinue their use.
- ✔ Isolate and label the mercury-containing devices to ensure proper handling and disposal. Dispose of mercury and mercury-containing devices at a facility permitted to accept hazardous waste and/or universal waste. Contact your county, state environmental, or solid waste office for services available in your area.
- ✔ Never crush or break fluorescent lamps, because mercury will be released.

Lead Based Paint

Know the risks

Lead is a naturally occurring metal that has been used in a variety of products, including primer, varnish, paints, plumbing pipes, batteries, glassware, and metal products (e.g., solder). Lead exposure can occur through ingestion or inhalation. Lead based paint (LBP) is of particular concern for schools because it can chip and become dust, and be ingested through hand-to-mouth contact, or be sanded and inhaled as dust particulates.

There is no safe level of lead exposure. It can cause several health effects, including anemia, decreased kidney function, high blood pressure, and reproductive issues. Children under the age of six are especially susceptible to lead exposure and may have additional health effects including behavior and learning problems, lower IQ, hyperactivity, slowed growth, or hearing problems. In rare cases, ingestion of lead can cause seizures, coma and even death.

LBP was banned as a consumer product in 1978. Current EPA regulations define LBP as paint containing more than 0.5% lead by weight or surface coatings containing more than 1.0 milligram per square centimeter (mg/cm^2) of lead.

EPA Lead-Safe Certified Guide to Renovate Right

Know the regulations

EPA regulates lead renovation, repair, and painting (RRP) under the TSCA Sections 402(a) and 404 as well as 40 CFR Part 745 Subpart E. Additional state and federal regulations may apply to LBP (e.g., the Residential Lead-Based Paint Hazard Reduction Act of 1992 and OSHA Safety and Health Regulations for Construction).

Under the RRP Rule, paint is assumed to be LBP unless analytical data shows otherwise. The RRP rule requires that firms performing renovation, repair, and painting projects that disturb lead-based paint in child-occupied facilities built before 1978 have their firm certified by EPA (or an EPA authorized state), use certified renovators who are trained by EPA-approved training providers and follow lead-safe work practices. A child-occupied facility is narrowly defined as a building, or portion of a building, constructed prior to 1978, visited regularly by the same child, under 6 years of age, on at least two different days within any week (Sunday through Saturday period), provided that each day's visit lasts at least 3 hours and the combined weekly visits last at least 6 hours, and the combined annual visits last at least 60 hours.

The RRP rule also has a pre-renovation education component and requires distribution of a lead hazard information pamphlet regarding the potential risk of exposure from renovation activities within a child-occuplied facility.

Know where to find LBP

Schools constructed after 1978 are unlikely to have an issue with LBP, but old painted furniture or bookcases could potentially have LBP present. Schools built prior to 1978 may still have LBP present on interior or exterior walls under new layers of paint. LBP can also be found on playground equipment or sport/recreational areas (e.g., athletic field bleachers).

Dried paint can be tested for lead by collecting paint chips and sending them to an accredited analytical laboratory. Alternatively, a trained and certified lead inspector can use an X-ray fluorescence analyzer on paint chips or surfaces to provide real-time results on whether LBP is present or absent. If LBP is

present on painted surfaces it can be removed or enclosed.

Know how to prevent exposure

Common renovation activities, like sanding, cutting and demolition, can create hazardous lead dust and chips. LBP can cause challenges for school renovation projects, even if it doesn't meet the definition of child-occupied facility, because LBP should be left untouched or must be addressed with lead-safe work practices under OSHA Safety and Health Regulations for Construction. In schools built prior to 1978, it is a best management practice to identify LBP early so the renovation design accounts for LBP. Special work practices and disposal procedures are required if LBP abatement is needed. Therefore, LBP abatement has to be sequenced before renovations.

Best Management Practices:

- ✔ Maintain records and reports showing the locations of LBP in the school, LBP testing results, and areas where LBP abatement has been performed.
- ✔ Hire a certified lead-safe contractor if renovations will disturb paint in child-occupied facilities.
- ✔ Be actively involved in renovation design phase when LBP is present and share available LBP reports with the renovation firm.
- ✔ If the LBP records are incomplete or not current for areas where renovations are planned, conduct additional LBP testing prior to renovation. It is much less costly to test than to clean up lead dust released throughout the school during renovations.
- ✔ Conduct lead dust sampling after LBP abatement projects have been performed. Be sure to request and review the final clearance sampling results prior to allowing students and staff to re-occupy the affected area after LBP abatement.

Did you know?

Lead can leach into drinking water as it moves through a building's lead-pipe distribution system. Even though the drinking water you receive meets federal and state standards, your school may have elevated lead levels due to plumbing materials and water use patterns. Consider testing the drinking water and correcting any problems during renovations to reduce lead exposure to students and staff. Refer to **3Ts for Reducing Lead in Drinking Water in Schools** for additional information.

In addition, dyes or pigments in LBP may also contain polychlorinated biphenyls (PCBs). Recommend concurrently testing paint for lead and PCBs.

Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are a class of synthetic organic chemicals that were widely used in building construction, including schools built between about 1950 and the late 1970s. The manufacture and use of PCBs were banned by the TSCA and phased out by 1979, except for certain limited uses. PCBs are toxic and continue to be closely regulated.

If PCBs are present in buildings, the scope and process of renovation often becomes substantially more complex and time-consuming. The potential presence of PCBs in schools also presents regulatory compliance issues. The process and specific cleanup requirements are less straight forward than for the other materials addressed in this booklet.

EPA has several web pages (listed at the end of this booklet) that provide guidance on addressing PCBs in schools and other buildings, including building renovation.

Know the risks

Exposure to elevated levels of PCBs has been demonstrated to cause cancer in animals and non-cancer effects on the immune, reproductive, nervous, and endocrine systems in animals and humans. Studies in human populations provide supportive evidence for potential cancer and non-cancer health effects of PCBs. Exposure in school buildings during renovation may occur through inhalation of PCBs in the air (vapors or dust-borne); ingestion of PCB-containing dust; and through direct dermal contact.

Know the regulations

PCBs are regulated by EPA under the TSCA through the PCB Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions Rule (40 CFR Part 761). The regulation is very complex and the presence of PCBs can substantially complicate renovation.

A few of the relevant TSCA regulatory requirements for schools include:

- Prohibition on PCB uses not allowed in the TSCA PCB regulations;
- Proper disposal of PCB-containing material;
- EPA approval when cleaning up or leaving PCBs in place.

Know where to find PCBs

Fluorescent light ballasts and caulking are the most common sources of PCBs in schools. Most schools have implemented programs for removing fluorescent light ballasts but some ballasts or residues may remain. PCB-containing caulk has been found in window glazing and around window frames, door frames, in masonry columns and in other building materials. However each building is different and PCBs may also be found in electrical equipment, floor tile mastic, adhesives, sealants, paint, and other construction materials. Additionally, residues from previous PCB releases may still be present and may have been absorbed into other porous building materials.

Know how to prevent exposure

The TSCA regulates use of PCBs and places the responsibility for compliance on the user; in this case the school. EPA guidance on preventing exposure is presented on **EPA's website** regarding PCBs in buildings. The information on many of the technical and regulatory issues for PCB-containing caulk is useful for addressing the similar issues for other PCB-containing materials.

Renovation projects may have to deal with PCB-containing materials or electric equipment during the design phase. This may include testing of materials, obtaining EPA approval, worker protection and management and disposal of any PCB-containing materials or equipment. Disposal of PCB-containing materials must be at an approved facility.

Best Management Practices:

- ✔ Replace PCB-containing fluorescent light fixtures with energy-efficient lighting (e.g. LED lighting) as a green building practice; a complete lighting retrofit reduces the PCB hazards and increases energy efficiency by 30-50 percent
- ✔ Evaluate the potential for the presence of PCB-containing building materials prior to renovation
- ✔ Comply with OSHA regulations and employ personal protective equipment for dust-generating work
- ✔ During renovation with the potential for PCB-containing building materials, set appropriate controls in place to minimize spreading dust during the renovation and/or repair activity
- ✔ Maximize use of manual tools that minimize generation of heat and dust
- ✔ Employ properly trained workers to clean areas potentially contaminated by PCB-containing materials using wet cloths and vacuums with HEPA filters
- ✔ Check TSCA requirements for proper disposal of different cleanup-related materials

Radon

Know the risks

Radon is an odorless, colorless, tasteless radioactive gas that is produced by the decay of naturally occurring uranium in soil and water. Radon can be found in both outdoor and indoor air. Ionizing radiation emitted from radioactive chemicals is a proven carcinogen and prolonged exposure to radon may cause lung cancer. EPA estimates that about 21,000 lung cancer deaths each year in the U.S. are radon-related.

EPA estimates that nearly one in five U.S. schools have at least one ground level room with short-term radon levels above 4 picoCuries per liter (pCi/L); the level at which the EPA suggests mitigation (see EPA source).

Know where to find radon

Radon enters any type of building (new or old) through cracks in the foundation and can accumulate in rooms on or below ground level. EPA's national long-term goal for radon is that air within buildings is consistent with ambient air outside of buildings. Radon levels in indoor air can be determined by long-term or short-term testing.

Know how to prevent exposure

When renovations change the dynamics of the HVAC system of a building, such as adding/removing walls or changing air flow patterns, the radon levels can also change. Renovations that change HVAC air exchange rates or pressure differentials can result in a radon issue when there was not one before, or reduce an existing radon issue.

EPA recommends that all schools conduct an initial short-term test and follow-up with testing if the radon level is above 4 pCi/L. Follow-up testing should include short-term and long-term testing to get a better understanding of the school-year average radon level. If the follow-up testing indicates that radon levels are above 4 pCi/L, schools should take steps to reduce the radon levels.

Best Management Practices:

- ✔ Maintain records of radon testing and installed radon mitigation systems. Review these records and incorporate radon reduction methods into the renovation design and/or leave existing radon mitigation systems in place. For additional information on radon reduction, refer to **EPA's Radon Website (http://www2.epa.gov/radon)**.
- ✔ Conduct post-renovation radon testing to verify that radon is not an IAQ issue.
- ✔ Disseminate information to parents, students, and staff as needed.

Construction & Demolition

Know the risks

School renovations often generate construction and demolition (C&D) debris which can include concrete, wood, metals, glass, and salvaged building components. Sometimes these materials may contain asbestos, lead-based paint, mercury, or other chemicals that present a hazard to human health and the environment. Therefore, it's important to characterize materials early on in a project to avoid releases on school grounds and to ensure that the C&D debris are properly managed.

C&D debris can consist of three types of waste: (1) inert or nonhazardous waste; (2) hazardous waste as regulated by the EPA under the Resource Conservation and Recovery Act (RCRA); and (3) items that contain hazardous components that might be regulated by some states.

Know what is in C&D debris

C&D debris needs to be characterized to determine if it is hazardous and needs to be handled as hazardous waste. Demolition of an old building may result in lead-based paint debris, asphalt waste, or treated wood debris. Renovation personnel may use screening test results, analytical data, or consult the hazardous waste regulations for listed wastes to determine whether the waste is hazardous.

Know the regulations

Schools are subject to the hazardous waste regulations of RCRA, the same as any other business within the US. Keep in mind that other EPA regulations may apply; depending on what C&D debris contains. For example, C&D debris containing asbestos may be subject to NESHAP, and waste containing PCBs may be subject to TSCA. Removal of mercury containing material or equipment (i.e., fluorescent lamps, switches, thermostats) requires special handling and disposal under the universal waste rules. Also, be aware that the department of transportation (DOT) or state regulations may be more stringent than the EPA regulations.

Know how to prevent exposure

Developing a waste management plan before renovation work begins can help schools identify what hazardous wastes may be present in C&D debris, and proper ways to contain the waste to prevent pollution and possible exposure. In addition, determining whether any C&D debris can be reused or recycled can help schools save money on disposal fees and help the environment.

Best Management Practices:

- ✔ Develop a waste management plan to predict the types and quantities of waste that will be generated during the renovation project, identify proper containment of these materials, and identify ways to reduce the amount of waste that goes to landfills (i.e., reuse onsite, recycle, donate or sell).
- ✔ Hire contractors that are trained and certified to handle and transport the types of wastes that will be generated during the renovation project.

Sustainable Building Practices

If the C&D debris do not include chemicals that can present a hazard such as lead or asbestos, project managers should consider alternatives such as recycling or reuse. This practice will conserve landfill space, save money in avoided disposal fees and potentially generate income from the sales of salvageable materials.

Top Ten Things to Know About Designing Healthier School Renovations

1. When embarking on renovation projects, it is recommended that schools establish a **process for disseminating information and receiving feedback**. For example, schools may opt for establishing a school renovation committee, with a diverse membership including parents, teachers and staff, to make renovations a publicly transparent and inclusive process. Whenever possible, conduct renovation activities outside of the school year to reduce impacts to students and staff.

2. When school renovation projects involve disturbing **asbestos containing materials (ACM)**, special abatement procedures must be performed by licensed and trained asbestos abatement professionals prior to performing demolition or construction activities to avoid releasing harmful asbestos fibers.

3. Since the key to **controlling mold** is removing the source(s) of moisture that caused the mold issue in the first place, an objective of any renovation should be to maintain proper moisture control after renovations are complete.

4. When renovations alter the dynamics of the heating, ventilation, and air conditioning (HVAC) system, **radon levels** can also change. Plan ahead to ensure the post-renovation HVAC system adequately mitigates radon and conduct radon testing after renovations.

5. If a renovation project includes expansion of the school, verify that there are no potential sources of **vapor intrusion** within 100 feet of the construction footprint. If the renovation project includes an existing school building with a vapor intrusion issue, incorporate mitigation methods into the renovation design or leave the current vapor intrusion mitigation system(s) in place.

6. Prior to starting renovations a clean-out or relocation of chemicals may be required. Create and implement a **chemical management program** that addresses proper handling and disposal of chemicals as well as what to do in the event of a spill and/or emergency.

7. Child-occupied facilities must follow the **renovation, repair, and painting (RRP) rule** during school renovations. Although lead-based paint (LBP) abatement may not be required, when school renovations projects do include removal of LBP, special abatement procedures should be performed by an EPA certified lead-safe contractor prior to performing demolition or construction activities to avoid generating hazardous lead dust and chips.

8. Renovation projects may have to deal with **polychlorinated biphenyls (PCB)-containing materials** (e.g., caulking) or electric equipment (e.g., transformers) during the design phase and may include testing of materials, obtaining EPA approval for removal, worker protection and management, and proper disposal.

9. Renovation projects can generate a significant amount of **construction and demolition (C&D) debris** and this material may need to be characterized to determine if it is hazardous waste and regulated. If the debris is not hazardous waste, consider recycling or reuse to conserve landfill space, save money in avoided disposal fees, and potentially generate income from the sales of salvageable materials.

10. New construction and renovation projects are great opportunities for schools to become more **energy-efficient**, integrate **pest management** design, incorporate **green building** practices, and use **sustainable products**.

References and Resources

Indoor Air Quality (IAQ)

EPA IAQ Tools for School
http://www2.epa.gov/iaq-schools

EPA Toolkit for Safe Chemical Management in K-12 Schools
http://archive.epa.gov/schools/toolkit.html

EPA IAQ Design Tools for Schools
http://www2.epa.gov/iaq-schools/indoor-air-quality-design-tools-schools

EPA IAQ Design Tools for Schools - Construction
http://www2.epa.gov/iaq-schools/construction-part-indoor-air-quality-design-tools-schools

EPA IAQ Design Tools for Schools - Renovation
http://www2.epa.gov/iaq-schools/renovation-and-repair-part-indoor-air-quality-design-tools-schools

Energy Efficiency Plus Health: IAQ Guidelines for School Building Upgrades
http://www2.epa.gov/iaq-schools/iaq-guidelines-school-building-upgrades-energy-savings-plus-health

EPA IAQ Reference Guide
http://www2.epa.gov/iaq-schools/indoor-air-quality-tools-schools-action-kit

EPA Managing Asthma in the School Environment
http://www2.epa.gov/iaq-schools/managing-asthma-school-environment

EPA Clean Construction
http://www2.epa.gov/cleandiesel

Indoor Air Quality - Healthy School Environments
http://www2.epa.gov/schools-air-water-quality

OSHA Indoor Air Quality Website
https://www.osha.gov/SLTC/indoorairquality/index.html

NOISH Indoor Environmental Quality, Dampness and Mold in Buildings Website
http://www.cdc.gov/niosh/topics/indoorenv/mold.html

NIOSH Good Practice Guidelines for Maintaining Acceptable Indoor Environmental Quality During Construction and Renovation Projects
http://www.cdc.gov/niosh/topics/indoorenv/constructionieq.html

Asbestos

EPA Asbestos
http://www2.epa.gov/asbestos

EPA Asbestos in School Buildings
http://www2.epa.gov/asbestos/school-buildings

EPA Asbestos NESHAP
http://www2.epa.gov/asbestos/asbestos-neshap

Mold

EPA Mold Remediation in Schools & Commercial Buildings
http://www2.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide

EPA Mold and Moisture
http://www2.epa.gov/mold/mold-and-indoor-air-quality-schools

EPA Moisture Control Guidance for Building Design, Construction and Maintenance
http://www2.epa.gov/indoor-air-quality-iaq/moisture-control-guidance-building-design-construction-and-maintenance-0

Radon

EPA Radon
http://www2.epa.gov/radon

EPA Radon in Schools
http://www2.epa.gov/radon/radon-schools

ATSDR Toxicological Profile for Radon
http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=407&tid=71

Vapor Intrusion

EPA Vapor Intrusion
http://www2.epa.gov/vaporintrusion

EPA CLU-IN Vapor Intrusion
http://www.clu-in.org/issues/default.focus/sec/Vapor_Intrusion/cat/Overview/

Hazardous Materials & Mercury

Mercury Concerns During Renovations for a Healthy School Environment
http://www2.epa.gov/schools-healthy-buildings/mercury-concerns-during-renovations-healthy-school-environment

Toolkit for Safe Chemical Management in K-12 Schools
http://www2.epa.gov/schools-chemicals/toolkit-safe-chemical-management-k-12-schools

Chemical Use and Management in Schools
http://www2.epa.gov/schools-chemicals

Mercury in Schools Case Studies
http://www2.epa.gov/schools/case-studies-about-mercury-cleanups-schools

EPA Schools and Mercury
http://www2.epa.gov/mercury

EPA Steps to Take When a CFL Breaks
http://www2.epa.gov/cfl/cleaning-broken-cfl

EPA Recycling CFLs
http://www2.epa.gov/cfl/recycling-and-disposal-after-cfl-burns-out#whererecycle

ATSDR Don't Mess with Mercury
http://www.atsdr.cdc.gov/dontmesswithmercury/

Lead

EPA Lead
http://www2.epa.gov/lead

EPA Renovation, Repair and Painting Program
http://www2.epa.gov/lead/renovation-repair-and-painting-program

EPA Renovation, Repair and Painting Program: Operators of Childcare Facilities
http://www2.epa.gov/lead/renovation-repair-and-painting-program-operators-childcare-facilities

References and Resources

EPA Lead-Safe Certified Guide to Renovate Right
http://www2.epa.gov/sites/production/files/documents/renovaterightbrochure.pdf

PCBs

Renovations and PCBs for a Healthy School Environment
http://www2.epa.gov/schools-healthy-buildings/renovations-and-polychlorinated-biphenyls-pcbs-healthy-school-environment

EPA Steps to Safe Renovation and Abatement of Buildings That Have PCB-Containing Caulk
http://www3.epa.gov/epawaste/hazard/tsd/pcbs/pubs/caulk/guide/

EPA PCB-Containing Fluorescent Light Ballasts in Schools
http://www3.epa.gov/epawaste/hazard/tsd/pcbs/pubs/ballasts.htm

EPA TSCA Disposal Requirements for Fluorescent Light Ballasts
http://www3.epa.gov/epawaste/hazard/tsd/pcbs/pubs/ballastchart.pdf

EPA PCB Site Revitalization Guidance Under the TSCA
http://www3.epa.gov/epawaste/hazard/tsd/pcbs/pubs/pcb-guid3-06.pdf

ATSDR Toxicological Profile for Polychlorinated Biphenyls
http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=142&tid=26

Miscellaneous

EPA Healthy School Environments – Design and Construction Overview
http://www2.epa.gov/schools-healthy-buildings/overview-design-and-construction-healthy-school-environment

EPA School Siting Guidelines
http://www2.epa.gov/schools/school-siting-guidelines

EPA's State School Environmental Health Guidelines
http://www2.epa.gov/schools

The School Superintendents Association Healthy School Environments
http://www.aasa.org/healthyschoolenvironments.aspx

Collaborative for High Performance Schools, Operations Report Card
http://www.chps.net/dev/Drupal/orc

National Institute of Occupational Safety and Health (NIOSH) Safety Checklist for Schools
http://www.cdc.gov/niosh/docs/2004-101/default.html

Collaborative for High Performance Schools (CHPS)
http://www.chps.net

National Institute of Environmental Health Sciences (NIEHS)
http://www.niehs.nih.gov

American Clearinghouse on Educational Facilities
http://www.acefacilities.org/

Center for Environmental Innovation in Roofing
http://www.roofingcenter.org/

National Clearinghouse for Educational Facilities
http://www.ncef.org/rl/index.cfm

Sheet Metal and Air Conditioning Contractors National Association, Inc., Indoor Air Quality Guidelines for Occupied Buildings under Construction
http://asc67.org/ASC_Previous_Problems/R7/Commercial/2007/Student%20Disk/14.4%20SMACNA%20Guidelines.pdf

Construction Industry Compliance Assistance Center, funded in part by EPA
http://www.cicacenter.org/

Integrated Pest Management

EPA Integrated Pest Management (IPM) in Schools
http://www2.epa.gov/managing-pests-schools

California Integrated Pest Management – Building Design and Renovation
http://apps.cdpr.ca.gov/schoolipm/architects_designers/main.cfm

The San Francisco Department of the Environment's Pest Prevention by Design Guidelines
http://www.sfenvironment.org/download/pest-prevention-by-design-guidelines

Construction and Demolition

RCRA in Focus: Construction, Demolition, and Renovation
http://www3.epa.gov/epawaste/inforesources/pubs/infocus/rif-cd.pdf

C&D Debris: What You Can Do
http://www3.epa.gov/epawaste/conserve/imr/cdm/whatyoucan.htm

Calculating Effectiveness: The Waste Management Plan
http://www3.epa.gov/region9/waste/solid/pdf/cd5.pdf

Sustainable Design and Green Building Toolkit for Local Governments
http://www2.epa.gov/smartgrowth/sustainable-design-and-green-building-toolkit-local-governments

Green School Design

ASHRAE Energy Design Guide for Savings in Schools
http://www.ashrae.org/publications/page/aedg50pct

ASHRAE Standard for the Design of High-Performance Green Buildings
https://www.ashrae.org/resources--publications/bookstore/standard-189-1

Green Building Council Website
http://www.usgbc.org

Green Building Initiative Green Globes
http://www.thegbi.org/green-globes/

Net Zero Building Design
http://living-future.org/netzero

RoofPoint
http://www.roofpoint.org/

USGBC Center for Green Schools Resources
http://www.centerforgreenschools.org/guides.aspx

Earth911 Recycling Search
http://search.earth911.com/

United States Environmental Protection Agency

http://www2.epa.gov/children
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