Chapter 12 Options for Reducing Priority Risk Factors

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12.0 Introduction

Chapter 11 discussed the process of identifying the priority risk factors on which the community will focus its risk reduction efforts. This chapter discusses the process of identifying, evaluating, and selecting the risk mitigation options that the community will pursue for each of these priority concerns (Step 8) and developing a plan of action to both implement the selected risk reduction options and fill data gaps (Step 9). The chapter concludes with a discussion of an ongoing evaluation of the effectiveness of the process and sustaining community efforts over time (Step 10).

Risk Management
An Overview

The process of identifying a problem requiring action as well as the action(s) to reduce the risk is called **risk management**. ATRA Volume 1, Chapter 27, provides a general overview of this topic and Chapter 8 of this Volume provides information specific to managing air toxics risks when multiple sources of emissions are present in a community. Stakeholders are referred to these chapters for more information on this subject.

Another excellent reference for understanding the process of managing environmental risk is the Presidential/Congressional Commission on Risk Assessment and Risk Management's *Framework for Environmental Health Risk Management* (available at: http://www.riskworld.com/Nreports/1996/risk_rpt/Rr6me001.htm).

12.1 STEP 8 - Identify and Analyze Options for Reducing the Priority Risks

STEP 8
Identify Options for Reducing Priority Risks

Once the partnership has identified its priority concerns and outstanding information needs, the next step will be to find out what can be done to address these issues. For priority risk concerns, the partnership will need to explore the available options for reducing risk. For example, if diesel particulates were identified as a priority, the community will need to do some research to identify approaches that have been developed to address this issue, such as retrofitting diesel engines on public and private truck and bus fleets, changing traffic routes, or restricting idling.

For each of the identified options, it will also need to identify additional relevant information such as technical feasibility, cost of the control measure, benefits, unintended consequences, existing or upcoming regulatory requirements, likelihood of community acceptance and participation, and cultural or social impacts of implementation for each option. The partnership will also need to identify resources that will be needed to implement the various approaches along with the assets and resources already available in the community.

The resources needed to reduce risks will vary depending on the source. For example, some risks, such as indoor exposure to tobacco smoke, might be effectively addressed through low-cost education and outreach efforts while other risks, such as diesel retrofits, will require significant investments for purchasing and installing new technology.

Some risks factors may not be able to be addressed by a single community and require a longer term effort to work with other communities. For example, the siting of major highways or the cleanup of a river, stream, or lake shared by other communities may require efforts by multiple communities. A similar effort will be needed to develop options for filling identified data gaps (discussed below).

Protecting Ecosystems

Community risk reduction projects will commonly focus on protecting human health. However, many communities will also be interested in assessing and addressing risks to their local ecosystem as well. EPA's *Community-Based Environmental Protection (CBEP)* program provides information on integrating environmental management with human needs, considers long-term ecosystem health, and highlights the positive correlations between economic prosperity and environmental well-being.

Communities considering ecosystem protection projects should consult the CBEP webpage - http://www.epa.gov/ecocommunity/about.htm, as well as EPA's Ecosystems webpage - http://www.epa.gov/ebtpages/ecosystems.html.

Once all the information on the options for addressing the community's priority risk factors and filling data gaps has been collected, it can be put together and summarized to help the community choose the actions it will take. Each community will have to use its best judgment to find the proper balance between the work to collect information on options and the work to reduce risk and fill information gaps. For example, requiring too much information on available options may delay the start of risk reduction actions. On the other hand, too little time spent on developing and evaluating options may result in taking actions that are not as effective as they could be in reducing risk.

It should be reemphasized that risk management does not always have to wait until the risk analysis and ranking process is completed (although the risk analysis and ranking will usually provide important information for effectively guiding the project). For example, some communities may wish to begin risk reduction projects for common, well characterized risk factors with little up-front analysis. In addition, some risk factors may be so obviously hazardous that even a minor amount of evaluation can confirm an important concern. Risk mitigation work may proceed on such factors while a more in-depth process evaluates additional concerns.

The partnership will find that risk reduction options generally fall into the following categories:

- **Regulatory approaches**. Many risk factors are already regulated by federal, state, tribal, or local government requirements. In some cases, the risk factor is not currently regulated (or only partially regulated), but statutory requirements call for further regulation at a specified time in the future. Regulatory approaches include enforceable requirements that must be met (or else are subject to legal action, such as fines).

- **Permits and related authorities**. Permits may offer opportunities for both regulatory and voluntary risk-management strategies. For example, many sources release chemicals to the environment pursuant to permits and related authorities. Permits generally must be renewed periodically and/or modified if conditions at the source change beyond some specified amount. This may provide an opportunity to amend permit conditions so as to reduce high-risk emissions. This might be coupled with voluntary measures or other flexible solutions to result in overall risk reduction.

The CARE Resource Guide
Identifying Risk Reduction Alternatives

As introduced in Chapter 10 of this volume, the Community Action for a Renewed Environment (CARE) program (http://cfpub.epa.gov/care/) has developed a Resource Guide (http://cfpub.epa.gov/care/index.cfm?fuseaction=Guide.showIntro) to help communities go through the multi-step process of assessing and addressing risk factors in their community.

Part III of the Resource Guide (Methods to Reduce Your Exposure) is particularly helpful for identifying risk reduction options for community risk factors.

- **Voluntary approaches**. EPA and other regulatory agencies are looking beyond regulatory approaches to reduce risks from a variety of factors. Non-regulatory (voluntary) approaches are frequently the preferred option (or the only option) for meeting risk reduction goals, particularly if government agencies do not currently have specific regulatory authority to address a given risk factor. In addition, the types of problems identified may not lend themselves to regulatory solutions. Voluntary programs may also allow businesses to significantly reduce risks at much lower cost than regulatory options. Incentives such as tax reductions or consumer rebates can be used to encourage voluntary responses.

  In addition to voluntary activities on the part of the regulated community, a substantial amount of risk reduction can be achieved through voluntary activities on the part of average citizens. Voluntary changes in a variety of activities ranging from commuting choices to the way people discard waste can have a meaningful impact on both a person's immediate environment and the health of the community at large.

Information about potential risk reduction options for different types of risk factors can be obtained from EPA, the environmental management literature, searching the internet, and other sources. The following sections briefly describe some of the general approaches used by the EPA to address some of the common risk factors that may be identified as priority concerns in a community-based risk reduction program.

12.1.1 Indoor and Outdoor Air Pollution

In many communities, poor air quality can result from the release of toxic chemicals to both indoor and outdoor air from a wide variety of sources. In a community setting, the number and types of sources can be very large, making it difficult to know which sources and chemicals should be the focus of efforts to achieve meaningful improvement in air quality. Parts II and III of this book address this issue in detail and provide approaches to mitigating unacceptable air toxics risks identified in the process. In particular, readers interested in approaches to reducing toxic air pollution and several other important common community air pollutants are referred to

Part II, Chapter 8. Additional information on air pollution, its potential impacts, and methods for reducing exposures can be found at www.epa.gov/air.

The Criteria Air Pollutants
Six Pollutants Of National Concern

EPA has set national ambient air quality standards (NAAQS) for six common pollutants referred to as "criteria" pollutants. These standards are required by law to be met everywhere in the nation. When an area exceeds these standards, the area is said to be in "nonattainment" with the standard and the state is required to develop and implement a plan to bring the area back into attainment.

Carbon Monoxide	**Particulate Matter**
Ozone	**Sulfur Dioxide**
Nitrogen Dioxide	**Lead**

Given the substantial amount of work that is being put into this effort at the state and national level, further information on these pollutants is not provided here. Stakeholders interested in learning more about the criteria pollutant program are referred to: http://www.epa.gov/air/urbanair/6poll.html. Parties interested in participating in the criteria pollutant program should contact their state or local air pollution control agency.

12.1.2 Water Pollution

With the exception of certain pollutants that deposit out of the air (e.g., mercury), most surface water pollution results from direct pollution discharges from industrial or identifiable sources and runoff from diffuse activities (e.g., pesticides runoff in storm water from yards and fields). Groundwater pollution is usually caused by spills, leaking storage tanks, or other land-based releases. EPA regulates these water quality issues primarily under the Clean Water Act (CWA) and the Safe Drinking Water Act (SDWA). However, other environmental laws may also come into play (e.g., when groundwater is contaminated from mismanagement of hazardous waste, the hazardous waste law called RCRA may also apply). Depending on the source, the pollutant of concern in water may be a chemical, a pathogen such as bacteria found in sanitary sewage, or garbage. Exhibit 12-1 provides a description of a number of common water pollution sources and risk reduction options.

EPA's Clean Beaches Program

Beaches are a place to play, watch wildlife, fish, and swim. With beaches giving us so much, we have to protect them from a variety of potential problems.

Pollution can arrive at a beach simply by people dropping trash. Storms are also a major problem; some sewer systems overflow directly into rivers, which eventually carry pollution and bacteria to beach waters. In addition, pollution can come from heavy concentrations of animals like pigs and chickens. EPA is working with states, tribes, territories, local governments, sources of pollution, and the public to reduce pollution from all of these.

To learn more about beach pollution and things communities can do to protect beaches, see http://www.epa.gov/beaches/.

Exhibit 12-1. Common Water Pollution Sources and Risk Reduction Options

EPA divides water pollution sources into two categories: point and non-point. Point sources of water pollution are stationary locations such as sewage treatment plants, factories and ships. Non-point sources are more diffuse and include agricultural runoff, mining activities and paved roads. Under the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. EPA works with state and local authorities to monitor pollution levels in the nations water and provide status and trend information on a representative variety of ecosystems.

Recommended EPA Web pages

Watershed Information Network - A roadmap to information and services for protecting and restoring water resources (http://www.epa.gov/OWOW/win/index.html).

Additional information about EPA's water pollution control activities is available at: http://www.epa.gov/ebtpages/water.html.

12.1.3 Land Pollution and Solid Waste

Sites contaminated by improperly disposed hazardous substances can release contaminants to the land, air, surface water, groundwater or the food chain. EPA's programs to addresses land pollution are authorized primarily by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as Superfund) and the Resource Conservation and Recovery Act (RCRA). The Superfund program was created in 1980 to locate, investigate, and clean up the worst hazardous sites nationwide. Clean up activities may include removal or containment (e.g., capping) of the sources of contamination, treating contaminated media, and institutional controls (e.g., fences, fishing restrictions) to limit exposures. Superfund also requires reporting of spills of hazardous substances. EPA's Superfund home page is http://www.epa.gov/superfund/index.htm.

RCRA is the nation's primary law directing the routine management of solid and hazardous wastes. RCRA's goals are to protect human health and the environment from the hazards posed by waste disposal, to conserve energy and natural resources through waste recycling and recovery, to reduce or eliminate the amount of waste generated, including hazardous waste, and to ensure that wastes are managed in an environmentally safe manner. RCRA has three main regulatory programs: solid waste (i.e., non-hazardous waste), hazardous waste, and underground storage tanks (USTs). RCRA requires or encourages many approaches to prevent or clean up land pollution, such as protective design standards for landfills and underground storage tanks, treatment or protective disposal of hazardous wastes, and remediation of spills and other contamination at hazardous waste facilities or from USTs. For more information about RCRA and related waste management programs at EPA, visit: http://www.epa.gov/epaoswer/osw/index.htm.

Household Hazardous Wastes

Some jobs around the home may require the use of products containing hazardous components. Such products may include certain paints, cleaners, stains and varnishes, car batteries, motor oil, and pesticides. The used or leftover contents of such consumer products are known as "household hazardous waste."

Americans generate 1.6 million tons of household hazardous waste per year. The average home can accumulate as much as 100 pounds of household hazardous waste in the basement or garage and in storage closets. When improperly disposed of, household hazardous waste can create a potential risk to people and the environment. EPA's webpage http://www.epa.gov/epaoswer/non-hw/househld/hhw.htm describes steps that people can take to reduce the amount of household hazardous waste they generate and to ensure that those wastes are safely stored, handled and disposed of.

In addition to Superfund and RCRA, EPA's Brownfields Program promotes the expansion, redevelopment, or reuse of properties hindered by the presence or potential presence of a hazardous substance or other pollutants. The Brownfields Program is designed to empower states, communities, and other stakeholders to work together in a timely manner to prevent, assess, safely clean up, and sustainability reuse brownfields. More information about the Brownfields Program is available at: http://www.epa.gov/swerosps/bf/index.html.

What Are Brownfields?

Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment.

Exhibit 12-2 provides a list of some of the common waste pollution sources likely to be identified in a community risk reduction program and some of the common risk reduction options used to address those risk factors.

12.1.4 Pesticides

Although pesticides can be beneficial to society, they can also be dangerous if stored or used carelessly. Improper pesticide use has the potential to result in excessive human or animal exposure via direct contact or from contaminated drinking water, food, air, or soil. Risks from pesticides can occur on the farm, on the job, or at home (e.g., lawn care, pest control), and proper storage can be just as important as proper use. EPA regulates the manufacture and use of pesticides primarily through the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

Exhibit 12-3 provides a list of some of the common pesticide risk factors likely to be identified in a community risk reduction program and some of the common risk reduction options used to address those risk factors.

Exhibit 12-2. Common Waste Sources and Risk Reduction Options

Nearly everything we do leaves behind some kind of waste. Households create ordinary garbage (and some household hazardous waste). Some example types of residential wastes include batteries, old paint and pesticides, scrap tires, and used oil. Industrial and manufacturing processes create both hazardous and nonhazardous wastes as well. There are a wide array of options a community can pursue to address waste issues, including:

Reducing wastes through "source reduction" (i.e., consuming and throwing away less). This includes purchasing durable, long-lasting goods; seeking products and packaging that are as free of toxics as possible; and redesigning products to use less raw material in production, have a longer life, or be used again after its original use.

Reusing items by repairing them, donating them to charity and community groups, or selling them – also reduces waste. Reusing products, when possible, is even better than recycling because the item does not need to be reprocessed before it can be used again.

Recycling turns materials that would otherwise become waste into valuable resources. In addition, it generates a host of environmental, financial, and social benefits. Materials like glass, metal, plastics, and paper are collected, separated and sent to facilities that can process them into new materials or products.

Buying recycled products, such as packaging, is necessary in order to make recycling economically feasible. When we buy recycled products, we create an economic incentive for recyclable materials to be collected, manufactured, and marketed as new products. Buying recycled has both economic and environmental benefits. Purchasing products made from or packaged in recycled materials saves resources for future generations.

Composting is another form of recycling. Composting is the controlled biological decomposition of organic matter, such as food and yard wastes, into humus, a soil-like material. Composting is nature's way of recycling organic waste into new soil, which can be used in vegetable and flower gardens, landscaping, and many other applications.

To learn more about what communities can do to help reduce and deal with wastes, visit EPA's "What You Can Do About Wastes" website at: http://www.epa.gov/epaoswer/osw/citizens.htm.

12.1.5 Other Common Toxic Substances

In addition to the typical hazardous materials discussed previously (e.g., pesticides and household hazardous wastes), many communities will have some amount of older building that contain one or both of two toxic chemicals of particular concern; namely, asbestos and lead.

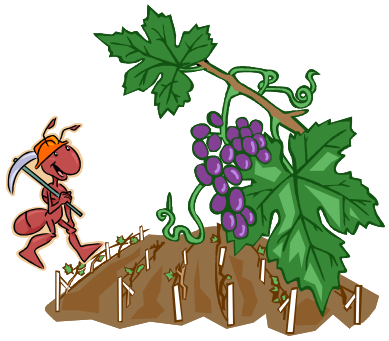
12.1.5.1 Asbestos

Asbestos is a naturally-occurring mineral fiber; so fibrous in fact that it can be woven like a fabric. Asbestos fibers have been added to over 3,000 products. Asbestos is fire-resistant, chemical-resistant and heat resistant so it was a poplar additive in all types of insulation, fire

Exhibit 12-3. Common Pesticide Risk Factors and Risk Reduction Options

A *pesticide* is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Though often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests. Pesticides are used by homeowners, businesses and others (especially agricultural uses). Some common household pesticides include:

- Cockroach sprays and baits;
- Insect repellents for personal use;
- Rat and other rodent poisons;
- Flea and tick sprays, powders, and pet collars;
- Kitchen, laundry, and bath disinfectants and sanitizers;
- Products that kill mold and mildew;
- Some lawn and garden products, such as weed killers; and
- Some swimming pool chemicals.



One method of reducing risks from pesticides is to implement an ***Integrated Pest Management*** (IPM) program. IPM is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.

The IPM approach can be applied to both agricultural and non-agricultural settings, such as the home, garden, and workplace. IPM takes advantage of all appropriate pest management options including, but not limited to, the judicious use of pesticides. In contrast, *organic* food production applies many of the same concepts as IPM but limits the use of pesticides to those that are produced from natural sources, as opposed to synthetic chemicals.

For more information about pesticides, see: http://www.epa.gov/pesticides/. For information on things communities can do to help reduce exposures to pesticides, see: http://www.epa.gov/pesticides/controlling/index.htm.

doors, building products and firemen's suits. Asbestos has great strengthening properties. Asbestos-containing building materials include fireproofing material (sprayed on steel beams), insulation material (on pipes); acoustical or soundproofing material (sprayed onto ceilings and walls), and in miscellaneous building materials such as resilient floor coverings (linoleum), asphalt and vinyl floor tile, roofing shingles, roofing felts, siding, wallboard, etc. Friable asbestos material (asbestos material that when dry can be crumbled, pulverized, or reduced to powder by hand pressure) is of the most concern because these fibers can be released into the air more readily and inhaled into the lungs.

The presence of asbestos in a building does not mean that the health of the building occupants is endangered. If asbestos-containing material remains in good condition and is unlikely to be disturbed, exposure will be negligible. However, when asbestos-containing material is damaged or disturbed - for example by maintenance, repairs or remodeling/renovations conducted without proper controls - asbestos fibers are released. When asbestos fibers are released into the air there is a potential health risk because people breathing the air may breathe in asbestos fibers. Continued exposure can increase the amount of asbestos fibers that remain in the lungs. Fibers

that remain embedded in lung tissue over time may cause serious lung diseases including: asbestosis, lung cancer, or mesothelioma.

In 1986, the Asbestos Hazard Emergency Response Act (commonly referred to as AHERA) was signed into law. AHERA requires public and private non-profit primary and secondary schools to inspect their buildings for asbestos-containing building materials. EPA has published regulations that require schools subject to AHERA to:

- Perform an original inspection and periodic re-inspections every 3 years for asbestos containing material;
- Develop, maintain, and update an asbestos management plan and keep a copy at the school;
- Provide yearly notification to parent, teacher, and employee organizations regarding the availability of the school's asbestos management plan and any asbestos abatement actions taken or planned in the school;
- Designate a contact person to ensure the responsibilities of the local education agency are properly implemented;
- Perform periodic surveillance of known or suspected asbestos containing building material; and
- Provide custodial staff with asbestos awareness training.

People that work with asbestos in public and commercial buildings and schools must be accredited and various worker protection requirements apply. For more information on Asbestos, see http://www.epa.gov/region4/air/asbestos/, or call the Asbestos hotline at (800) 368-5888.

12.1.5.2 Lead

Lead is a highly poisonous metal that was used for many years in things found in and around our homes. Lead may be in the paint in homes built before 1978. If the paint is chipped or peeling, it may cause health problems if paint chips or dust from the paint are breathed in or eaten. Children often put hands, toys and other things in their mouth. Children playing on floors or outside in the dirt where there are paint chips or dust may be eating lead by putting their fingers and toys in their mouth. Many children in America are poisoned by lead. As many as three million children under 6 years old may have some lead poisoning and the problem is worse in minority and low-income communities.

EPA and other federal, state and local government agencies are working to protect our children from lead poisoning. EPA wants to lower and soon stop lead poisoning by giving out information and talking to people about lead poisoning. Laws have also been made to help stop lead poisoning. Companies that break these laws may be fined by EPA.

Since the 1980's, EPA and other federal agencies have worked together to stop lead poisoning from not only lead in paint, but other things like gasoline, water, and the air from manufacturing plants. States and communities have developed programs to find and take care of children that have been poisoned by lead and fix up old houses that have paint with lead. Many parents have helped stop lead poisoning by keeping their homes clean and watching for paint that is chipping and peeling, by having their children tested for lead poisoning, and by feeding their children healthy food.

To combat childhood lead poisoning, the EPA requires landlords and property owners to give renters and buyers of houses built before 1978 a pamphlet titled *Protect Your Family from Lead in Your Home* (http://www.epa.gov/lead/leadprot.htm). Landlords and sellers must also inform renters and buyers if there are known lead-based paint in the home. Buyers also have the option to have the property inspected by a certified lead-hazards firm at their own expense. Information, including rules and regulations on certified lead inspectors and risk assessors, can be obtained by checking EPA's Lead web page http://www.epa.gov/lead/, or by contacting the National Lead Information Center at 1-800-424-LEAD (TDD: 1-800-526-5456).

12.1.6 Noise Pollution and Odors

Odors can impact health and quality of life. Odors or the substances eliciting them may cause, for example, headaches or nausea. Common odor sources include sewage treatment, composting, landfills, land application of sewage sludge, industrial emissions, and animal waste management. For some odor sources, chemical treatment or emission control equipment may be used to reduce odors at the source. Workplace practices and other operational controls may also be effective. For example, RCRA solid waste landfill operators are required to place a cover layer (usually soil) on the active face of the landfill at the end of each operating day. Daily cover reduces odors as well as the potential for fires, blowing litter, and other problems.

Like odors, noise can cause headaches and other health and quality of life problems. Examples of noise sources include traffic, airplanes (especially low flying planes found near flight paths), lawn equipment, recreational equipment (jet skis), and construction equipment (e.g., construction vehicles, power generation equipment, and activities such as jack hammering, sawing, blasting, pounding, and grinding). Common options for controlling noise impacts are erecting physical sound barriers, installing noise control equipment (e.g., mufflers), and using institutional or operational controls (e.g., redirecting flight paths, restricting loud noises to certain times of the day). The National Institute for Environmental Health Sciences maintains an website of useful resources on community noise issues and noise reduction options (http://ehp.niehs.nih.gov/topic/noisepol.html).

Many noise and odor problems are addressed primarily by local or state authorities instead of EPA or other federal agencies. For example, some communities have local noise ordinances and rules regulating nuisance odors. Some EPA rules, such as RCRA solid waste regulations describe above, and rules for land application of sewage sludge, also include provisions to minimize odor problems.

12.1.7 Radiation

Radiation is everywhere in the environment and partnership teams will need to be aware of the various sources, when to be concerned, and when protections from harmful exposures are needed. Some of the most common sources of radiation are:

- Radon gas that infiltrates homes from naturally occurring radium in soil;
- Nuclear power plants;
- Radiological waste sites;
- Consumer products which may contain, have been treated with, or emit either non-ionizing or ionizing radiation;

- Security devices and processes often involve ionizing radiation. Many of these devices are regulated by federal and state agencies (e.g., airport luggage x-ray machines and irradiated mail);
- Foods and food containers may be exposed to the high energy of ionizing radiation to kill bacteria and other pathogens (note that this exposure does not make the food or containers radioactive). Naturally occurring radionuclides can remain in glazes used on food containers;
- Medical procedures are the major sources of radiation exposure for many people;
- Commonly used household devices such as cell phones, microwaves, and televisions; and
- Other naturally occurring radiation such as UV radiation from sunlight.

An example of a radiation risk reduction project, a stakeholder group might decide to perform a SunWise project (http://www.epa.gov/sunwise/), especially if community members are likely to become overexposed by the sun. SunWise is an environmental and health education program that aims to teach the public how to protect themselves from overexposure to the sun through the use of classroom-based, school-based, and community-based components.

EPA's Radiation Protection Program (http://www.epa.gov/radiation/index.html) provides an overview of various radiation sources and helpful information on reducing exposures.

Radon

Radon is a cancer-causing, radioactive gas that comes from the natural (radioactive) breakdown of uranium in soil, rock and water and gets into the air people breathe. Radon can be found all over the U.S. and can get into any type of building - homes, offices, and schools - and result in a high indoor radon level. People are most likely to get their greatest exposure at home, where they spend most of their time. Radon is invisible and has no smell or taste.

Radon is estimated to cause many thousands of deaths each year from lung cancer. In fact, the Surgeon General has warned that radon is the second leading cause of lung cancer in the United States today. Only smoking causes more lung cancer deaths. If a person smokes and their home has high radon levels, their risk of lung cancer is especially high.

For more information on radon and things communities can do to test for radon and mitigate exposures, see: http://www.epa.gov/radon/. Additional information on radon is discussed in Section 3.2.4.1.

12.1.8 Lifestyle Risk Factors

Many studies have demonstrated an association between environmental exposures and certain diseases or other health problems. Examples include radon associated with lung cancer and disease-causing bacteria (e.g., in contaminated meat and water) associated with gastrointestinal illness. However, not all health problems are caused by environmental pollution. Diet, exercise, alcohol consumption, smoking habits, and genetic make-up can all influence the health status of an individual. When external pollutants are introduced into the picture, these same issues of health status and lifestyle choices may further influence the likelihood of an individual contracting disease from the exposure.

Further complicating the picture are several segments of the population that may be at higher risk of disease from environmental pollutants. Potentially sensitive groups (due to either greater potential for exposure or a greater susceptibility to the same exposure) may, depending on the pollutant, include very young children, the elderly, and people with existing health problems such as respiratory or heart disease. In addition, poor or other disadvantaged populations may live in more polluted environments that expose them to higher concentrations of pollutants. (A discussion of environmental justice issues is provided in Section 2.1.3, a discussion of community vulnerabilities is provided in Chapter 10.)

Sorting out the roles and interactions of lifestyle, environmental, and demographic risk factors is a major area of scientific research. For the partnership team, assessing interactions of these factors may overly complicate the development of a risk management strategy, especially if the community believes that its health status is the fault of someone else. That having been said, addressing common sense lifestyle risk factors in addition to environmental risk factors will almost always be beneficial (if it is appropriate to do so within the context of the community). For example, if the risk reduction plan includes public education about radon exposure in the home (an exposure that can cause lung cancer), the educational materials could also discuss other pollutants (e.g., cigarette smoking) that cause lung cancer.

12.1.9 Conserving Energy

Conserving our energy sources such as fossil fuels is important because of their nonrenewable nature and because their use impacts the environment. The impacts may be direct or indirect. Direct impacts include those from the pollutants released by the combustion (e.g., particles, metals including mercury, PAHs, etc). Some of the pollutants released may exert their impact indirectly (e.g., by causing chemical or physical reactions in the atmosphere which then lead to environmental impacts). For example, carbon dioxide is produced when oil, coal, and gas are combusted in power stations, heating systems, and car engines. Carbon dioxide in the atmosphere acts as a transparent blanket, that contributes to the global warming of the earth (the "greenhouse effect"). Possible impacts include a threat to human health, environmental impacts such as rising sea levels that can damage coastal areas, and major changes in vegetation growth patterns that could cause some plant and animal species to become extinct. As another example, sulfur dioxide is also emitted into the air when coal is burned. The sulfur dioxide reacts with water and oxygen in the clouds to form precipitation known as "acid rain." Acid rain can alter ecosystems, kill fish and other aquatic life, as well as damage or kill trees and other plant life. Acid rain can also damage buildings and statues.

In the U.S., the average family's energy use generates over 11,200 pounds of air pollutants each year. Every unit (or kilowatt) of electricity conserved can thus help reduce the environmental impact of energy use.[(a)] Partnership teams may want to consider an energy conservation project even though the reduction in the release of pollution (e.g., from a power plant) may occur far distant from the community.

[a] Unless it was generated through nuclear power, which has its own set of issues.

There is a wealth of educational resources that explain the wide range of projects that can be implemented to protect the environment through conserving energy. In particular, the EnergyStar® program (http://www.energystar.gov/) encourages homeowners to improve energy efficiency through advice on energy efficient consumer products and building projects that can reduce energy bills and improve home comfort.

Because a strategic approach to energy management can produce twice the savings – for the bottom line and the environment – as typical approaches, EnergyStar® offers businesses a proven energy management strategy that helps in measuring current energy performance, setting goals, tracking savings, and rewarding improvements. For example, EPA provides an innovative energy performance rating system which businesses have already used for more than 21,000 buildings across the country. EPA also recognizes top performing buildings with the EnergyStar® program.

Additional approaches to energy conservation include the use of alterative and renewable energy sources, encouraging public transportation and other transportation alternatives, waste reduction and recycling, and encouraging smart growth. More information about EPA's energy conservation initiatives may be found at: http://www.epa.gov/ebtpages/pollenergy.html.

12.2 Select Risk Reduction Options

As noted previously, partnership teams working to select risk reduction options for implementation will want to consider all the relevant information related to each option. They will also need to keep in mind their team's overall objectives and capacity to carry out the risk reduction projects in making their selections. In sorting through the various risk reduction options for a given risk factor, stakeholder groups should be particularly mindful of the following seven fundamental characteristics of sound risk management decision making:

- Base the decision on the best available scientific, economic, and other technical information;
- Be sure the decision accounts for the problem's multisource, multimedia, multichemical, and multirisk contexts;
- Give priority to preventing risks, not just controlling them;
- Use alternatives to command-and-control regulation, where applicable;
- Be sensitive to social and cultural considerations; and
- Include incentives for innovation, evaluation, and research.

Additional items to be considered when evaluating risk reduction options are discussed in Exhibit 12-4.

Similar to the process used to rank the community's risk factors, the partnership team can use a variety of methods to select actual risk reduction projects from among the list of potential options. As discussed in 11.2.2, the stakeholder group may work to achieve consensus by:

- Negotiated consensus;
- Voting; or
- Application of a more analytical process.

Exhibit 12-4. Factors to Consider When Evaluating Risk Management Options

Risk reduction benefits to be realized. Risk management decisions often focus on the *incremental* risk associated with the specific risk factor without regard to the risk from other factors. When the risk reduction option provides little risk reduction in light of the overall risk from other factors, the stakeholder group may wish to rethink which factors it wants to pursue. That having been said, the impediments to risk reduction for these more important factors may preclude the community from creating meaningful change and the partnership team may chose to pursue the less important risk factors anyway since realizing a risk reduction will usually have some positive influence on community health, even when the risk reductions are relatively small.

Level of uncertainty in the analysis. In the face of a highly uncertain understanding of the risk posed by a factor, the partnership team will have to carefully weigh the consequences of selecting or not selecting a factor for risk mitigation. Specifically, it could make a decision to control a risk factor only to find out later that there was little actual risk (e.g., incurring unnecessary "cost" to the community), or making a decision *not* to control a risk factor only to find out later that the risks were real and large (e.g., incurring potentially preventable harm to the community).

Implementation costs. What are the costs of the risk reduction approaches, including costs to regulatory agencies, the regulated community, and the general community (consumers, workers). Are the benefits reasonably related to the costs?

Technical feasibility. Is there a readily available tried and tested technology to otherwise reduce or eliminate the risk?

Legal feasibility. Are their existing or upcoming legal authorities to establish and enforce requirements? Are their other legal impediments to pursuing the risk reduction option?

Effectiveness/timing. Will the option provide effective management of the problem within a reasonable time frame?

Political feasibility. Does the option have the necessary political support?

Community acceptance. Will the larger community support the proposed risk reduction alternatives?

Each of these issues may be more or less important depending on the context for the risk management decision.

12.3 STEP 9 - Decide On an Action Plan and Mobilize to Carry Out the Plan

STEP 9
Develop/Implement an Action Plan
Fill Data Gaps

Once the community partnership has prioritized its concerns and information needs and collected and summarized relevant information, the next step will be to decide on a plan of action and mobilize the community to begin work. Choosing the plan for work will depend on many factors particular to each community. Depending on the resources that can be mobilized in a community, the partnership may want to organize a number of teams to address multiple priorities.

The partnership may also need to develop a short-term plan to begin some immediate actions and a long term plan to address priorities that will require more time to collect needed resources. Some communities may decide to put information collection first to help build consensus or to make sure that significant risks have not been overlooked. Others may focus primarily on risk reduction and put less emphasis on filling gaps in information. Developing a plan that allows the community to get some early successes while pursuing longer term goals may help to build community support for the work of building a healthy community and environment. To achieve the best results, the partnership should make sure that the plan takes advantage of all the local assets and mobilizes as many members of the community as possible.

It should be emphasized that historically, much of the risk reduction efforts realized over the past decades has been driven primarily by requirements of regulatory agencies. Businesses and governments (e.g., local municipalities) have generally been the focus of these risk reduction efforts. However, it is likely that in community-based risk reduction efforts, the partnership group may identify and select risk reduction projects that could target business activities, citizen activities, or (more likely) both. For example, a community might select risk reduction projects that focus on unregulated water emissions from small business, household hazardous waste, and indoor environments in public schools.

12.3.1 Filling Data Gaps by Developing New Information About the Community

Depending on the risk factor, potential impact, or vulnerability in question, there may be little or no data to evaluate or characterize an issue and the stakeholder group may wish to develop new information to support the community reduction effort. New research or data collection should be carefully planned and executed to ensure that the resulting information is credible, accurate, and relevant to the concerns of the community.[b]

12.3.1.1 Collecting Environmental Samples for Analysis

Methods for collecting samples and measuring chemicals in the environmental media are well developed. EPA has formulated hundreds of test methods and offers guidance and related information on the internet (http://www.epa.gov/epahome/Standards.html; see also ATRA Volume 1, Chapters 10 and 19). Testing for some basic indicators (e.g., water quality indicators such as pH) is relatively simple and inexpensive, and EPA offers guidance to support certain citizen volunteer monitoring efforts (for example, see http://www.epa.gov/owow/monitoring/vol.html#methods). However, testing for many chemicals in water, air, and soil can be complex and generally requires trained professionals and sophisticated laboratory equipment. In addition, testing can also be expensive and time consuming. Partnership teams will need to carefully weigh whether they want (or need) to collect environmental monitoring data as part of the risk reduction project.

If the partnership team for a community-scale risk assessment does not have the skills and equipment to perform the testing themselves, it may be able to obtain assistance from

[b] Chapter 4 of this volume provides an overview of planning and scoping a multisource cumulative evaluation, including planning for the collection of new data. While the chapter's focus is multisource cumulative assessment, the underlying concept of how to plan and scope an environmental data development effort is essentially the same. Stakeholder groups that intend to develop new data are encouraged to familiarize themselves with this process prior to developing any new data for a project.

government laboratories, academic researchers, or private-sector testing services. Several governmental programs and private foundations offer grants to support environmental and public health testing. Many environmental health and occupational health and safety resources available to community-based organizations are identified in Section V of *Operations Manual for Hispanic Community-Based Organizations* (http://www.epa.gov/ecocommunity/pdf/hispopman-all2.pdf). Chapter 10 also provides an overview of developing resources for a project.

12.3.1.2 Using Computer Models to Evaluate Chemicals in the Environment

EPA and others have developed a number of computer models for evaluating chemicals in the environment (see http://www.epa.gov/epahome/models.htm). Examples of the potential uses of these models include:

- Estimating pollutant concentrations in environmental media (e.g., groundwater) or the food chain based on measured or estimated pollutant concentration in releases or other media; and

- Estimating exposures and risks to people or ecosystems potentially exposed to chemicals in the environment, or affected by other risk factors (e.g., microbial drinking water contamination).

Similar to collecting actual environmental samples and sending them to the lab, computer modeling generally requires special expertise to perform. However, unlike monitoring, computer modeling is generally cheaper and faster and, thus, may be a more attractive option for partnership teams. A drawback is that the output of a model is only as good as the data that go into it. If available input data are lacking or inadequate, new input data might need to be developed before running the model, perhaps by monitoring which will add to the time and cost of the modeling option. (Note that Part II of this resource document as well as ATRA Volume 1, Chapter 9, provide information regarding computer models used for air toxics evaluations.)

12.3.1.3 Surveys

For some community concerns, it may be helpful to conduct a survey to gather new data. Surveys are particularly helpful for learning about the occurrence of potential problems (e.g., complaints of noxious odors), to learn about risk factors related to human activities (e.g., consumption of contaminated sport fish), and help develop an understanding of potential impacts and vulnerabilities. In addition, surveys may be a useful way to rank community concerns about a list of specific risk factors.

Surveys may be conducted by various means, including:

- Meetings or focus and advocacy groups;
- Mail surveys;
- Telephone surveys;
- Newspaper surveys;
- Email or internet form surveys; and
- Door-to-door or other field surveys (e.g., angler surveys).

Choosing a survey method will depend on several factors, including the resources and labor available for conducting the survey; level of scientific rigor needed (e.g., informal or statistically based); time available before results are needed; and amount of information needed from survey participants.

Surveys must be designed with care to ensure that they are unbiased and precisely address questions of concern. In addition, survey methods and designs can greatly affect response rates (i.e., participation in the survey), and it may be important to provide anonymity to survey participants. Except in the case of very simple or informal surveys, it is important to develop the survey design with the help of a knowledgeable professional. To do a survey properly, expertise will usually be needed in the fields of statistics, surveys, and the topic on which the survey is being conducted. With regard to conducting surveys involving the collection of personal information, the government and other reputable organizations follow established protocols, such as the requirement of informed consent, confidentiality, and review by institutional boards or committees. Partnership teams are encouraged to consider these protocols when developing the survey program.

A Note of Caution about Surveys

Performing a survey in a manner that produces useful results will usually require the community to engage people with specialized expertise to help in the design, administration, and evaluation of the survey. Specifically, the community will need expertise in the science of surveys and statistics as well as in the topic area that will be the focus of the survey.

For example, consider a community that wants to perform an angler survey to determine what kinds of fish people catch and eat. The community would need help from experts in the field of designing, administering, and evaluating survey results as well as biologists familiar with the water bodies in question (i.e., people who know the local fish populations).

By not engaging people with the right types of expertise in order to perform a sound survey, the survey results may be of little use to people making decisions.

12.4 STEP 10 - Evaluate the Results of Community Action, Analyze New Information, and Start the Process Again to Reset Priorities

STEP 10
Evaluate Results and Adjust as Needed

To make sure that community efforts are getting the desired results, it will be important for the partnership to find effective ways to measure progress. For each priority in the action plan, the partnership should develop a measure(s) that can be used to gauge progress and evaluate the effectiveness of community action. Reductions in releases, exposures, and risk, and reductions in health effects can all be used to measure progress (a plan for measuring progress should be agreed upon at the time of selecting the projects).

Evaluating effectiveness involves monitoring and measuring, as well as comparing the actual benefits and costs estimates made in the analysis stage. The effectiveness of the process leading to implementation and in building community capacity to understand and address risks should also be evaluated at this stage. To be successful, communities will need to not only measure their progress, but to learn from their experiences, and adjust their work to build on their successes and learn from their mistakes.

Specifically, evaluation provides important information about:

- Whether the actions were successful, whether they accomplished what was intended, and whether the predicted benefits and costs were accurate;
- Whether any modifications are needed to the risk reduction plan to improve success;
- Whether any critical information gaps hindered success;
- Whether any new information has emerged that indicates a decision or a stage of the process should be revisited;
- Whether the process was effective and how stakeholder involvement contributed to the outcome; and
- What lessons can be learned to guide future risk management decisions or to improve the decision-making process.

The CARE Resource Guide
Evaluating the Effectiveness of Risk Reduction Activities

As introduced in Chapter 10 of this volume, the Community Action for a Renewed Environment (CARE) program (http://cfpub.epa.gov/care/) has developed a Resource Guide (http://cfpub.epa.gov/care/index.cfm?fuseaction=Guide.showIntro) to help communities go through the multi-step process of assessing and addressing risk factors in their community.

Part IV of the Resource Guide (Tracking Progress and Moving Forward) contains information on tracking and evaluating the effectiveness of a risk assessment.

As these bullet points indicate, the management of risks does not stop with the implementation of the risk reduction projects. There needs to be an ongoing effort to review the results of the risk mitigation efforts and to adjust the process as necessary to stay on target for achieving risk reduction goals.

12.5 Sustaining the Effort Over Time

A critical element to consider in the evaluation of the overall risk reduction effort is the **sustainability** of the project. Most risk reduction efforts are only meaningful when there is a sustained effort to reduce risk over the long term, and the partnership team will need to identify the impediments that may keep this from happening. For example, will community interest in the project or money to pay for risk reduction efforts dwindle over time? What types of things can be done now to ensure continued progress into the future?

It is important to be cognizant of the challenges associated with the sustainability of a community-based risk management strategy over many years or decades. This section discusses these challenges and opportunities for a community to develop the institutional capability that can help maintain sustainability over long periods of time.

12.5.1 What is Needed for Sustainability?

If a community-based risk management effort is not designed and managed to be enduring, human health and the environment may be endangered through a variety of means. For example:

- The commitment to risk management among the stakeholders within the community may gradually fade away or be eliminated, causing monitoring and/or mitigation activities to lapse.

- Opportunities for improving community health and any monitoring and/or mitigation strategies may be missed in communities where risk management strategies become neglected.

- The public may come to believe that risks and hazards within the community have been eliminated.

- If residual risks or hazards are rediscovered, the community's ability to address the problems may have declined and the cost needed to do so may increase.

To design long-term risk management strategies that can adapt to changes, the community must address two primary questions:

- **Ensuring survival**. How can implementation be structured to ensure that robust and adaptable long-term strategies endure?

- **Maintaining focus**. How can the community ensure that implementation remains reliable over time?

Each of these is discussed in a separate subsection below.

12.5.1.1 Ensuring that Risk Management Strategies Remain Relevant to the Community

As noted previously, the long-term survivability of a risk management strategy can be bolstered by local involvement in decision-making, active involvement of a wide range of affected parties, and frequent communication across parties with a stake in the community. The affected parties within the community have the greatest stake in the success and survival of the risk management effort. They also will have the best access to certain types of information that should influence evolving strategies, such as information on changes in land use patterns and social values. For these and other reasons, the risk management strategy should rely considerably on local involvement in decision-making in addition to centralized institutions such as EPA or a state or tribal environmental protection agency that have access to other types of relevant information, such as advances in science and technology.

A certain degree of redundancy could also be beneficial. A wide range of parties within the community may have an interest in the risk management effort, including community residents and businesses; various state, tribal, local, and federal agencies; business owners; technology vendors; and advocacy groups. When these parties are directly involved in the risk management effort, communicate frequently, and understand the importance, goals, and responsibilities associated with the risk management strategy, they can help counteract threats to the overall long-term sustainability of the effort. For example, if a local government agency that has played a key role in a risk management effort loses relevant funding, the remaining interested parties in the community that have been conducting similar activities can ensure that the functions performed by that agency are transferred or assumed by others.

Some Characteristics of an Effective Long-Term Risk Management Effort

- *Layering and redundancy*. Layering means using several measures to carry out roughly the same function; redundancy means creating a situation in which several entities are responsible for or have a vested interest in the effectiveness of the risk reduction measures.
- *Ease of implementation*. A risk management activity must be capable of being put into effect, and it also should be reasonably easy to keep in effect.
- *Monitoring commensurate with risks*. Monitoring progress and the schedule for doing so need to be commensurate with the harm that could be caused if there is a failure of risk mitigation efforts.
- *Oversight and enforcement*. To the extent that the risk management effort involves an enforcement agency or party, the enforcer must have teeth.
- *Appropriate incentive structures*. Attention needs to be devoted to assuring that all participants in the risk management effort continue to be appropriately motivated for carrying out the needed tasks over time.
- *Adequate funding*. Implementing, monitoring, and appropriately modifying risk management activities will require adequate and reliable financial resources throughout the activities' required lifetimes.
- *Durability and replaceability*. A risk management activity should endure either for as long as the an issue remains hazardous or until the activity can be refreshed or replaced by an equally reliable substitute activity.

Adapted from: *Long-term Institutional Management of U.S. Department of Energy Legacy Waste Sites*. National Academy of Sciences, National Research Council, August 2000.

Frequent communication among stakeholders within the community also can help ensure that new information is widely distributed and its implications are understood and incorporated into future decisions. Likewise, interaction and communication among different communities involved in similar risk management activities may help bring necessary expertise and resources to bear if the survival of the risk management effort is threatened within one community. This benefit may be particularly valuable in communities with few resources. Maintaining trust and credibility will be a key challenge. Public confidence in the institutions or groups involved in the risk management effort will depend on the ability of the institutions/groups to demonstrate a commitment to the mission and carry out their responsibilities openly and fairly.[(1)]

12.5.1.2 Ensuring that Risk Management Strategies Remain Focused

Institutions or groups engaged in the risk management efforts need to avoid the perception that risk levels within the community are less than they are. These organizations also should avoid merely continuing to implement existing monitoring and mitigation strategies. Instead, the organizations should continually seek better solutions and incorporate new developments in science, technology, land use patterns, and societal values. The organizations also should continually learn and reinvent themselves, adapting to changing circumstances, or they will risk becoming ineffective and lose support.

Education and Training

Education and training will be a critical part of a sustainable risk management strategy, particularly among community stakeholders, and will serve to continually reinforce concepts and keep the concepts familiar and pertinent. Enhancing the awareness of: (1) why risk reduction efforts are necessary; (2) how to implement risk management activities; (3) how to evaluate and interpret change; and (4) how to modify activities in response to changing circumstances. This will enhance the ability of risk management strategies to survive and adapt to the changing cultural and natural environment.

Education of the public, particularly within the community, can enhance the effectiveness and protectiveness of a risk management strategy. Communities that are well educated and trained with respect to risk and risk management issues are more likely to implement voluntary measures and take other actions to prevent unnecessary risks.

12.5.2 The "Rolling Risk Management" Strategy

Efforts to improve community health and welfare may require an extended amount of time to accomplish and, for some risk factors, need to have a risk management strategy that goes on in perpetuity. In such situations, a key challenge is to set in place a long-term risk management framework that ensures protection of human health and the environment for future generations. This hazard management framework might address possibilities such as: (1) the original strategies to reduce risks within the community will fail; (2) changing circumstances within and around the community will need corresponding changes in risk management strategies; and (3) future generations will want to change land and resource uses within the community. To help ensure long-term sustainability, the current generation should strive to provide the next generation with the skills, resources, and opportunities to cope with any problems that may result from changes or failures in risk management efforts (i.e., a "rolling risk management" strategy).[(2)]

Why is a "rolling risk management" strategy useful? The main reason is that conditions change over time, and these changes may affect the relevance and effectiveness of current risk management strategies. For example:

- Applicable laws, regulations, and standards may change over time. Voluntary strategies today may become mandatory, and vice-versa.

- Demographic changes within the community may change exposure pathways or levels of concern. People may move into areas that currently are not inhabited or move away from areas where current exposure levels are relatively high.

- Future advances in science and technology may make source control more effective at less cost.

- Advances in science and medicine may identify new hazards. Several decades ago, links between many substances and adverse health effects such as cancer were largely unknown and unsuspected; therefore, a risk management strategy developed then would not have considered such hazards.

Finally, given the need to re-evaluate and perhaps modify risk management strategies over time, the community should always have as many options available as possible. Decisions should seek solutions that address near-term needs and concerns but preserve long-term flexibility to the greatest extent possible. For example, partnership teams might not be able, at the present time, to find a permanent solution for some of the risk factors within the community. New and different solutions may be developed in the future as a result of technological and societal advances the team will need to keep aware of evolving technology and have the flexibility to incorporate it through their "rolling risk management" strategy.

References

1. *Long-term Stewardship of Contaminated Sites, Trust Funds as Mechanisms for Financing and Oversight*. Carl Bauer and Katherine Probst, Resources for the Future Discussion Paper 00-54, December 200, page 380; *Long-term Institutional Management of U.S. Department of Energy Legacy Waste Sites*. National Academy of Sciences, National Research Council, August 2000, page 86.

2. *Deciding for the Future: Balancing Risks, Costs, and Benefits Fairly Across Generations*, National Academy of Public Administration, June 1997.