XI. Now What?

So you've gone through the whole process—thinking that you might have a problem, confirming that you have a problem, making estimates about the importance of atmospheric deposition, refining those estimates with monitoring and/or modeling, getting an idea of where the pollution is coming from—and now you know. Atmospheric deposition from several sources is a significant source of pollution to the watershed. Now what?

Your next steps will depend on the underlying goals, requirements, and processes involved in your watershed management activities. For your purposes, it may be sufficient to know how much air deposition is contributing to pollution compared to other sources. Your management activities may then focus on other sources of pollutants to the waterbody. On the other hand, you may want to expend additional effort on the air sources. In doing so, you will work with air specialists to investigate what regulations will be implemented and what reductions might be expected. If additional emission reductions are important to achieving your waterbody goals, you can act as a catalyst for initiating new or more stringent regulations at the federal, state, tribal, or local level or for providing incentives to reduce air pollution voluntarily.

The information provided in this section should help you work more effectively with other water and air professionals in government and industry. Specifically, this section discusses

- The importance of coordination with air and water specialists, as well as with other agencies, in dealing with air deposition
- The requirements for state water quality managers to develop TMDLs for impaired waters, particularly as they relate to air deposition
- Air pollution programs and tools for reducing emissions
- Managing old pollution
- Follow-up processes.

Coordination

One of the biggest lessons everyone who works with air deposition learns is the degree to which the air and water environments are connected. Because air and water management tends to be separate, it is important for managers to build relationships with their counterparts. You will find that, to get anything done about atmospheric deposition, you need to have a good relationship with local, state, and tribal air pollution managers. This involves understanding each other's language, understanding the limitations of what each can do, and brainstorming about how management strategies can fit together.

The air program professionals can be helpful in many ways. From them, you can find out about the sources of pollutants you are concerned about. You can learn what restrictions on emissions are in place for those sources, as well as what reductions are planned in the near future. They are also a resource for determining how possible additional reductions could be achieved, both from a technical and legal standpoint.

Your work may benefit the air program as well. It can show where there are water quality benefits, as well as air quality benefits, of emission reduction activities. For example, assume an air program goal is to reduce air emissions from cars by encouraging alternative commuting options. Also, assume you have partnerships with active community organizations interested in educating the public on watershed protection. These organizations could disseminate information about benefits to the watershed from reducing air pollution from cars, which gives commuters additional incentives to use alternative commuting options.

In the context of TMDLs (discussed in more detail in the next section), there should be good coordination between air and water agencies at the state and local levels. This is to ensure that any in-state load reductions called for in a TMDL can be accomplished through air permits or other mechanisms. (Although air permits have not yet been revised to meet load reductions assigned in a TMDL, in some cases they may. TMDL implementation might then have to be consistent with the state permitting schedule, as is the case with water permits.) Good coordination is also necessary to ensure that the data needed to develop TMDLs in the first place are collected. In some tribes, states, EPA regions, and other water management agencies, there is already a good relationship between air and water programs. In others, the air and water organizations are not used to working together, and both sides need to make the effort to make cooperation a reality.

In addition to coordination between air and water programs, it may be important to work with other agencies. For example, for agricultural sources of air emissions, it would be useful to coordinate with local representatives of the U.S. Department of Agriculture's Natural Resources Conservation Service. They will have contacts with the agricultural community and be knowledgeable about their management practices. The National Park Service or the U.S. Forest Service may also be useful partners.

Total Maximum Daily Loads

In many cases, the process of developing a TMDL may be the catalyst for doing the initial investigation of atmospheric deposition. A TMDL basically identifies the maximum amount of a pollutant that can be in the water and still meet state water quality standards, as well as how much pollutant loads need to be reduced to meet water quality standards. A TMDL also divides up or "allocates" pollutant loads among the various sources discharging to a waterbody. In some cases, the TMDL connection won't be made until after the deposition is estimated. Regardless of the initial reason for characterizing atmospheric deposition, once you have identified it as a significant source of pollution to an impaired water body, it is possible that the issues surrounding TMDLs will be raised. Under the Clean Water Act, each state must develop a list of waterbodies where water quality standards developed by these jurisdictions are not being met. This list is called the 303(d) list, after the section of the Clean Water Act requiring the list. In the 1998 guidance for the 1998 303(d) lists, EPA reiterated that the section 303(d) list provides a comprehensive inventory of waterbodies impaired by all sources, including point sources, nonpoint sources, or a combination of both. The guidance also clarifies that states should list all waters impaired either entirely or partially due to pollutants from atmospheric deposition.

A major challenge of any management strategy that includes atmospheric deposition is figuring out how to achieve the load reductions in air sources necessary to meet water quality standards. The TMDL program does not create any new laws to address specific sources; it relies on other existing laws or programs to implement any load reductions specified in a TMDL. The most frequent concern raised about air deposition and TMDLs is the limited ability a state has to control sources outside its boundaries. In some cases, out-of-state sources may be responsible for a large part of the atmospheric deposition load, but local sources can also contribute a significant amount.

States first need to make sure they have identified local sources (both air and water) that they have the authority to control through state regulations or voluntary agreements. States can then identify how much pollution is coming from out-of-state sources (both air and water). A state will have to coordinate with other states and EPA to determine how best to address those sources.

It is important to remember that, in developing a TMDL, a state may find that it is possible to achieve state water quality standards through reductions in water point sources alone, without including any reductions in loadings from air sources. However, if a large portion of the total load is from air sources, and that load is not considered in the TMDL, the reductions from the water sources may not be sufficient to achieve the intended water quality benefits (or attain the water quality standard) because there is "extra" pollution that is not accounted for in the TMDL. Therefore, it is important that atmospheric deposition be included in the development of TMDLs.

To date, states have developed a small number of TMDLs for nitrogen that identify the total loading from atmospheric deposition, along with the nitrogen loadings from other sources. Some of the methods described earlier were used to estimate the contributions from air sources, such as the use of deposition estimates produced by the RADM model. In determining the nitrogen reductions needed to meet water quality standards, these TMDLs consider as reductions in atmospheric loadings the estimated emissions reductions expected as a result of existing federal legislation or regulations. For example, a few TMDLs have stated that total nitrogen deposition is expected to decrease by a certain amount as a result of implementing existing CAA regulations. These regulations include national ambient air quality standards for particulate matter and ozone, including other requirements designed to help achieve them, the acid rain program, and mobile source regulations. (The next section on air program basics will orient you to these regulations, and those noted in the following paragraph, if you are not familiar with them.) Another nitrogen TMDL referenced a local effort to improve sea grass productivity in an estuary through voluntary nitrogen reductions by local utilities and other initiatives.

Efforts are also under way by EPA and some states to develop TMDLs for waterbodies impaired primarily by the atmospheric deposition of mercury. Several TMDLs estimate the current or baseline mercury deposition. These TMDLs use various methods to estimate deposition, such as deposition data from mercury deposition network sites and modeling data from the 1997 Mercury Study Report to Congress. Similar to the nitrogen TMDLs described above, expected reductions in mercury deposition are estimated from the baseline based on CAA regulations already promulgated but not fully implemented. For mercury, these include national standards for sources of hazardous air pollutants and for solid waste combustion units. The anticipated reductions are then compared with the total reductions needed to meet water quality standards.

The technical approach for estimating current and projected atmospheric loads may vary from site to site and pollutant to pollutant. Several techniques (as described earlier) can be used to identify sources of air pollutants. EPA is conducting a pilot project to test methods for determining the relative contributions of local and out-of-state sources of mercury, as well as several source categories in specific geographic areas. A report from that pilot project is expected to be available in 2002.

As our ability to quantify the relative contribution of different sources or source categories improves, it will be possible to develop more targeted approaches to reducing atmospheric deposition loads in a TMDL context.

Air Program Basics

The federal legislation that gives the EPA the authority to regulate emission of pollutants into the air is the **Clean Air Act**. It was originally passed in 1970, and was most recently amended in 1990. Two CAA programs that specifically address deposition to waterbodies are the Great Waters program and the Acid Rain program.

The **Great Waters program** was created to study the extent and effects of atmospheric deposition to the Great Waters. It can be found in section 112(m) of the CAA. The Great Waters include the Great Lakes, Chesapeake Bay, Lake Champlain, and estuaries in the National Estuary Program and the National Estuarine Research Reserves. The program published three reports to Congress on "Deposition of Air Pollutants to the Great Waters," most recently in June 2000. The EPA was also required under this portion of the CAA to determine whether it has sufficient authority to adequately address the problems of atmospheric deposition of pollutants of concern to the Great Waters and in 1997 determined that it does have adequate authority.

The **Acid Rain program** (Title IV of the CAA) was created to reduce the adverse effects of acid deposition by reducing emissions of nitrogen oxides (NO_x) and sulfur oxides (SO_x) from electric utilities. This program features a cap-and-trade program that caps sulfur dioxide emissions at one-half of 1980 levels and requires each utility to hold one allowance for every ton of sulfur dioxide (SO_2) emitted. Utilities can trade these allowances, allowing the industry as a whole to comply with the cap at a lower cost than traditional regulatory methods. Utilities can also bank allowances for future use, a feature that caused many sources to reduce their emissions in the first years of the program more than required. For NO_x, the Acid Rain program limits the rate of emissions from utilities (i.e., pounds of NO_x emitted per British thermal unit of power generated). There is no total cap on NO_x emissions from electric utilities under this program. Both the SO_2 and NO_x emission reductions required by the acid deposition program are being implemented in two phases: Phase I began for SO_2 in 1995 and for NO_x in January 1996. Phase II for both pollutants became effective in 2000.

While the Great Waters and Acid Rain programs primarily address air deposition, other CAA programs address air problems in addition to deposition, such as smog and risks due to inhalation of toxic pollutants. Nevertheless, these other programs reduce emissions that may adversely affect aquatic ecosystems.

In the **ambient air quality program**, national ambient air quality standards (NAAQS) set national standards for acceptable concentrations of specific pollutants in outdoor air. These pollutants, called criteria pollutants, are found commonly throughout the country. They threaten public health and the environment across broad regions of the country and are emitted in relatively large quantities by a variety of sources.

Criteria Pollutants

Carbon monoxide (CO)
Lead (Pb)
Nitrogen oxides (NO_x)
Ozone
Particulate matter (PM)
Sulfur oxides (SO_x)

Areas of the country where measured air quality does not exceed the NAAQS more often than allowed are designated **attainment areas**; areas where air quality exceeds the NAAQS more often than allowed are **non-attainment areas.** Areas that have gone from non-attainment status to attainment status are called **maintenance areas.** States are required to have **state implementation plans** (SIPS) describing how they will achieve the NAAQS. These plans include requirements for emissions from stationary and mobile sources (such as inspection and maintenance programs). They also include requirements for precursors to criteria pollutants, namely VOCs, a group of organic pollutants that react with NO_x in the presence of sunlight to form ozone. States have the latitude to develop specific requirements, although the SIPs are subject to approval by EPA.

The EPA recently published more stringent NAAQS for ozone and PM. The new PM NAAQS is for particles smaller than 2.5 microns in diameter, hence it is called the $PM_{2.5}$ standard. This standard focuses on smaller (or finer) particles than previous PM standards. Implementation strategies for these NAAQS are still being developed by EPA.

The air quality program also includes provisions to address regional problems in air pollution due to criteria pollutants, such as pollutants carried from one state to another. Certain states may be required to impose controls on sources in their state to reduce pollution in a downwind state. The "NO_x SIP Call" is a rule that requires most states in the eastern half of the country to develop plans to reduce NO_x emissions that travel downwind and cross state borders, contributing to smog formation in the eastern United States. This rule assigns a summertime NO_x emissions limit, or budget, for each affected state and requires states to submit SIPs showing how they will allocate the budget by 2004. Another rule, published in January 2000 under the authority of section 126 of the CAA, establishes federal NO_x emission limits for certain industrial sources, in particular eastern states, to reduce transport into other states.

The control requirements for a stationary source not only depend on the attainment status of the area, but also on whether it is a new source of emissions. The programs that specifically affect new sources of criteria pollutants are the new source review (NSR) program, which is implemented by the states, and the nationally set new source performance standards (NSPSs).

The **air toxics program** sets national standards to reduce emissions of hazardous air pollutants from industrial and commercial sources. The pollutants covered by the air toxics program, called hazardous air pollutants, were listed originally in the 1990 amendments to the CAA. Pollutants can be added or removed from the list by the EPA following the criteria provided in the Act. The list includes many metals and metal compounds, POM, and dioxins/furans. You can find the full list of hazardous air pollutants at http://www.epa.gov/ttn/atw/. Many air professionals refer to the air toxics program as the "Title III" program because it falls under Title III of the 1990 Amendments to the CAA. Yet, in the CAA itself, the air toxics program is under Title I, in section 112.

The air toxics program has two phases. In the first phase, EPA develops national regulations for categories of stationary industrial and commercial sources based on the best emission levels already being achieved by similar sources in the country. These technology-based regulations are called MACT standards. The great majority of these MACT standards are already completed or are close to being completed.

In the second phase, EPA applies a risk-based approach to assess how these technology-based regulations are reducing health and environmental risks. If existing technology-based standards are not sufficient to meet these risk-based goals, EPA is required to promulgate additional regulations. This second phase is called the residual risk assessment. EPA has begun residual risk assessments for several source categories regulated in the early years of the MACT phase of the program.

Some of the categories of sources being regulated under the air toxics program include chlorine manufacturing (i.e., chlor-alkali facilities) and hazardous waste combustion facilities. Electric utilities are also being regulated. The CAA required EPA to study the emissions of air toxics from utilities and determine whether utilities should be regulated under the toxics program. The EPA's positive determination to regulate electric utilities for air toxics was made in December 2000. All of these example source categories emit mercury.

The air toxics program also includes the Great Waters program (described above) and the **urban air toxics strategy**, which has several components and considers both stationary and mobile sources of pollution. One of the components of this strategy is to list categories of smaller (area) stationary sources for regulation.

Major and Area Sources

Both terms refer to stationary sources. Major sources generally are large, such as manufacturing facilities and electric utilities. Area sources generally are smaller sources, such as dry cleaning facilities, often numerous and spread out over a geographic area. The various air programs have different specific definitions for these terms. A primary differentiation between program definitions is the amount of pollutant emitted (or potentially emitted) from a source to define it as "major." A given facility could be a major source for pollutant A, but an area (or non-major) source for pollutant B.

Solid waste combustion units (e.g., municipal waste combustion units, hospital and medical waste incinerators) are regulated under section 129 of the CAA, which covers several toxic pollutants (including mercury and dioxins) and criteria pollutants (including NO_x). These regulations currently being implemented are technology-based, similar to the NSPS and the MACT standards described above. Residual risk assessment is also required for these sources.

Emissions from **mobile sources** and the **transportation sector** are addressed by requirements for motor vehicles, fuels, and non-road engines (e.g., aircraft, boats, trains, farm and garden equipment). State motor vehicle emissions inspections and maintenance programs are also an important component of mobile source emission reductions. In addition, there are programs to encourage travel choices that minimize emissions. These programs reduce NO_x and air toxics, as well as other pollutants. They are sometimes called Title II programs, since they are under Title II of the CAA.

Several recent rules that address emissions from mobile sources include the Tier 2 rule that requires tailpipe emission standards for all passenger vehicles, including sport utility vehicles, minivans, and pickup trucks. In addition, the recent heavy-duty diesel rule includes new standards for heavy-duty trucks and buses, and requirements to reduce the sulfur content in diesel fuel. A third new rule, called the 202(1) rule, identifies the compounds that should be considered mobile source air toxics (see Appendix 3), and evaluates the effectiveness of mobile source rules in reducing air toxics emissions. It also sets new gasoline toxic emission performance standards to ensure that refiners maintain their average 1998-2000 gasoline toxic emission performance levels. In addition, the rule establishes a Technical Analysis Plan that EPA will implement in continuing to conduct research and analysis on mobile source air toxics.

Additional Air Program Information

EPA Web Sites
- http://www.epa.gov/oar/
- http://www.epa.gov/oar/oaqps/gr8water/
- http://www.epa.gov/airmarkets/
- http://www.epa.gov/owow/oceans/airdep/index.html

Plain English Guide to the Clean Air Act (EPA 400-K-93-001, April 1993)
Air-Water Interface Work Plan
Federal Register - each spring and fall an agenda of EPA regulatory and deregulatory actions is published.

A given source can be affected by multiple programs, either because the source emits multiple pollutants or because the pollutant it emits is both a criteria pollutant and an air toxic. For example, POM and metals are hazardous air pollutants, and therefore are included in the air toxics program. These pollutants also are typically emitted in the form of particulate matter, a criteria pollutant. So the source could be affected by limits to help achieve the NAAQS, by the NSR program, by an NSPS and MACT standard. Electric utilities are affected by the Acid Deposition program in addition to one or more of these other programs.

Air Pollution Training

Air Pollution Training Institute (APTI) (classroom, telecourse, self-instruction, and Web-based instruction)
Information about the APTI can be found at http://www.epa.gov/oar/oaqps/eog/apti.html.

You may want to know the bottom line—how much of a given pollutant is a source allowed to emit—rather than all the underlying legal authorities. A source may have this information consolidated into a federal **permit** or a state, local, or tribal permit. Several of the stationary sources, particularly the large sources, are required to obtain federal air pollution permits to ensure compliance. These permits (also referred to as Title V permits, after the title of the CAA that authorizes the program) consolidate all the air pollution control requirements into a single, comprehensive document that covers all aspects of a source's year-to-year air pollution activities. Another federal program requires businesses that build new sources of criteria pollutants or make significant changes to existing sources to have “preconstruction” or “new source review” permits. These permits are required to ensure that large new sources do not cause significant health or environmental threats and that these sources are well controlled. Contact either industry sources, or your local, state, and/or tribal air programs to obtain permit information for sources in your area.

If you are trying to figure out what reductions a regulation is expected to achieve, there are a few points to keep in mind. One is that there is likely to be a delay between the time a rule or requirement is published and when it is fully implemented and the reductions are in effect. For example, a rule affecting the tailpipe emissions from cars or trucks may apply to new vehicles starting in 2004. It would take several years before the large majority of vehicles on the road would meet these tailpipe standards. An industrial facility may be given up to three years to put controls in place after promulgation of a MACT standard. A second point to keep in mind is that a given rule may not achieve the same amount of reduction or percent reduction across the board for all facilities. Sometimes requirements are different for different processes in an industry. Or, sources may emit varying amounts of pollutants before the regulation is in place, and the regulation may bring them all to the same level. For facility-specific information, you may need to work more closely with the state or local agency to determine the amount of reduction expected for the facility under a given rule, rather than using the more generalized national estimated percent reduction expected from the rule.

Emission Reduction Methods

Emissions—and subsequent deposition—can be reduced in three ways: changing the resources (inputs) going into the process, changing the process, or using control systems to reduce or treat the outputs. Depending on the emission source, all of these methods may be applicable, or perhaps only one. Factors that could be considered in the choice of methods include the type of source, the pollutants, technical feasibility, emission-reduction potential, cost, cost-effectiveness, economic impacts, and other potential repercussions. Examples of repercussions include an increase of other problematic pollutants, an increase of pollutants to other media, or safety concerns. If the emission reduction method is chosen as the result of a law, such as the CAA or a regulation under its authority, the law may be specific about what factors can be considered or the required performance of the method.

Pollution Prevention Approaches

- Changing inputs to a process
  - Using lead-free gas
  - Separating batteries from waste
- Changing the process
  - Producing chlorine using a process without mercury cells
  - Using a foam or wetting agent that suppresses chromium emissions in electroplating
- Changing outputs of a process
  - Using an integrated gas scrubbing system on municipal waste combustion units

Changing the inputs going into the process and changing the process are pollution-prevention types of approaches. Preventing or not causing the pollution in the first place is desirable and certainly worth consideration. However, approaches need to be considered in the framework of all the factors. Sometimes they do not meet the necessary criteria, or other factors make another approach more desirable. For example, changing the process may achieve a small reduction in emissions, but it may not be sufficient to meet the pollution reduction needs. Or, the substitution of another input to a process creates another pollution problem, such as the emission of a more toxic pollutant.

An example of changing inputs to a process is the use of lead-free gasoline in automobiles. Lead emissions in the United States fell dramatically with this change. Another example is separating mercury-containing batteries from a municipal waste stream before the waste is combusted. That reduces mercury emissions from the waste combustion process.

An example of changing the process can be found in the chlor-alkali industry, which produces chlorine for use in water treatment and swimming pools, among other things. One process, which is still used in a few plants, uses mercury cells and creates emissions of mercury. A newer process uses membranes and no mercury, so there are no mercury emissions to control. Another example is for chromium electroplating tanks. A foam or a wetting agent that suppresses emissions of chromium during the electroplating process can be added to the tanks. These methods to suppress emissions do not affect the electroplating itself, but prevent the need to treat emissions with an add-on device. A third example would be housekeeping measures such as wetting or cleaning surfaces to prevent fugitive dust emissions.

For treating the output of a process, municipal waste combustion units provide a good example. These units typically use an integrated gas scrubbing system to control dioxins, mercury, cadmium, lead, particulate matter, hydrogen chloride, and sulfur dioxide emissions. The system consists of a spray dryer to condense the pollutants into a particulate form, followed by a fabric filter to remove the particulate from the gas stream. Activated carbon is also injected into the spray dryer to enhance the removal of mercury and dioxins.

What Forms Do Emission Reduction Rules Take?

Some regulations specify the emission reduction methods that are to be used by a given type of source. However, such specificity is rare. Typically, a rule has emission limits that can be achieved by a variety of methods. Examples of emission limits include percent reduction of pollutant emissions, concentration in the gas stream (e.g., parts per million or grams per cubic meter of gas), amount of emissions per time period (e.g., tons of emissions per month), and amount of emissions per product made (e.g., grams of emissions per kilogram of product produced). Rules often include multiple emission limits in order to not preclude emission reduction methods.

Economic or market incentives are ways to provide for more flexibility, efficiency, and emission reduction from what might be achieved without the incentive, while maintaining environmental protection, accountability, and enforceability. Incentives include emission trading programs, financial mechanisms, clean air investment funds, and public information programs. Such incentive programs are allowed to varying degrees under different sections of the CAA.

Emission trading programs create transferable emission reductions or emissions allowances. The cost of achieving an emission reduction may be relatively low for some sources, but high for others. In these situations, both types of sources may benefit by trading reductions or allowances. Emissions trading can be designed for various sources within a single facility, or across a set of facilities within a particular industry, geographic region, or nationwide. Some emission trading programs include an overall cap or budget on the total emissions from a particular set of sources. The Acid Rain program is an example of a cap-and-trade design, where excess allowances can be traded among electric utilities nationwide. On the other hand, open market trading programs do not have an overall emissions cap, but allow the flexibility to include sources of pollution that are not normally regulated.

Emission Trading Example

A regulation requires facilities to reduce emissions to 50 tons per year and allows emissions trading among facilities. Facility A can reduce its emissions to 30 tons per year for a relatively low cost. For Facility B, the cost to reduce emissions to 50 tons per year is relatively high, but the cost to reduce emissions to 70 tons per year is relatively low. Facility B could meet the requirements of the regulation by reducing its emissions to 70 tons per year and buying Facility A's extra 20 tons per year of emission reduction (50 minus 30 tons per year). Facility A would have to commit to achieving the extra emission reduction it sells to Facility B.

Another type of incentive is a financial mechanism program, such as fees, taxes, or subsidies targeted at pollution-reducing activities or projects. Examples include fees on emissions, subsidies for purchasing zero-emitting vehicles, or time saving mechanisms, such as high-occupancy vehicle lanes to encourage carpooling.

A third type of incentive is a clean air investment fund. Such a fund would provide cost relief for sources when the cost of emission reductions is high. Sources that exceed an established cost-per-ton for emissions control pay into the fund in lieu of reducing emissions. The fund manager procures emission reductions elsewhere. As such, it includes elements of both emissions trading and financial mechanisms.

A public information program can also be considered a type of economic incentive program. Such programs encourage the public to make choices that reduce air emissions. In doing so, the public becomes more aware of environmental issues, such as the links between air emissions and water quality, and the impact of their daily choices on the environment.

The EPA published guidance in January 2001 for states that want to develop economic incentive programs to improve air quality and visibility. You may find this guidance useful in determining what questions need to be addressed in designing any economic incentive program. It can be found at http://www.epa.gov/ttn/ecas/innostra.html.

Managing Old Pollution

Persistent pollutants are unique because they often lack discreet sources; rather, they are emitted from residues in soils or sediments (e.g., DDT and PCBs) or by accident in fires or spills (e.g., PAHs and dioxins/furans). Management efforts for these compounds must include identifying historic sites where they may have been used or created (often old, abandoned industrial property) or applied for agricultural purposes (banned or cancelled pesticides or herbicides). A review of resources relating to waste site cleanup and local agricultural practices may yield viable reduction strategies that could lower volatilization and/or erosion and resuspension of these persistent compounds. Remediation of key waste sites is a prime example of one of the practices that may be considered for nonpoint or historic-use materials where traditional control measures are unavailable.

An Iterative Process

Once control options are in place, it will be necessary to monitor them to ensure that the controls are actually having a positive impact on water quality or that your predictions about the benefits of implementing regulations are in the right ballpark. As population density and vehicle miles traveled increase, air deposition might become a more significant part of the problem than originally estimated. Like any potential threat to an ecosystem, the impact of atmospheric deposition will need to be reevaluated from time to time to ensure that water quality and ecosystem protections are maintained.

XII. Resources

Federal Atmospheric Deposition Programs

EPA Air/Water Coordination Group

Formed as part of the Air-Water Initiative of EPA's Office of Water in 1995, the group is responsible for coordination of air-water issues within EPA, especially those pertaining to coastal ecosystems. More information on air deposition and air-water coordination and links to other programs and resources are available at http://www.epa.gov/owow/oceans/airdep/

EPA Great Waters Program

The Great Waters Program was formed in response to the Great Waters section of the 1990 Clean Air Act. The Great Waters include the Great Lakes, Chesapeake Bay, Lake Champlain, the National Estuary Program, and the National Estuarine Research Reserves. The program coordinates atmospheric deposition issues under CAA section 112 (hazardous air pollutants) within the Office of Air and Radiation and is one of the main liaisons with the Office of Water on air-water issues. For more information on the Great Waters Program and links to its publications, including the Great Waters Reports to Congress, visit the Web site at http://www.epa.gov/oar/oaqps/gr8water/.

EPA Clean Air Markets Division

Formed initially in response to Title IV (the Acid Rain Program) of the 1990 Clean Air Act, the Clean Air Markets Division administers the national SO_x trading program, as well as much of the NO_x emissions reduction program and coordinates the atmospheric deposition assessments and CASTNet monitoring program. The program is the lead office in the Office of Air and Radiation for most nitrogen deposition issues under Title IV and one of the main liaisons with the Office of Water on air-water issues. For more information on the Clean Air Markets Division, visit the Web site at: http://www.epa.gov/airmarkets/.

NOAA Air Resources Laboratory

The NOAA Air Resources Laboratory supports and conducts a significant amount of research, monitoring, and modeling on atmospheric chemistry and pollutant transport and its relationship to atmospheric deposition. For more information about specific projects and the ARL READY information on models, including HYSPLIT, visit the Web site at http://www.arl.noaa.gov/research/themes/aq.html.

U.S. Geologic Survey

USGS does substantial research on atmospheric deposition and water quality, including being the largest single supporter of the NADP and developing and using the SPARROW model that can measure the transport of atmospherically deposited pollutants through watersheds. Although the agency works primarily with nitrate and sulfate deposition, it does some work with toxics as well (http://btdqs.usgs.gov/acidrain/index.html).

EPA Regional Offices

EPA Regional Offices work with states and local programs to characterize and address deposition. Those that have been most active are noted below.

EPA Region I

EPA Region I is working closely with the Casco Bay National Estuary Program on PAH deposition monitoring in the northeast (http://www.epa.gov/region1).

EPA Region II

EPA Region 2 is working closely with the State of New Jersey on a toxics deposition monitoring program for New Jersey and the New York Harbor area (http://www.epa.gov/region2).

EPA Region IV

EPA Region 4 supports national estuary programs in Region IV and their air deposition monitoring activities (http://www.epa.gov/region4).

EPA Region V

EPA Region V works closely with the Great Lakes National Program Office (GLNPO) and other EPA offices on toxics deposition to the Great Lakes (http://www.epa.gov/region5/).

EPA Region IX

Region IX supports air deposition activities in Region IX and encourages cooperation between air and water management agencies at regional and local levels (http://www.epa.gov/region9).

EPA Chesapeake Bay Program

The Chesapeake Bay Program Office (CBPO) was one of the first organizations to investigate the role of atmospheric deposition in any coastal area. The program's experiences have helped numerous other coastal areas become involved in research/monitoring of atmospheric deposition of nitrogen. CBPO has also conducted some investigations on the deposition of chemical contaminants (http://www.chesapeakebay.net).

EPA Great Lakes National Program Office

GLNPO is the leading national program for toxics deposition monitoring and research. It also works closely with its Canadian counterparts on binational monitoring and management strategies (http://www.epa.gov/glnpo/).

EPA Gulf of Mexico Program Office

The Gulf of Mexico Program Office helped coordinate a workshop on atmospheric deposition and the hypoxic zone with other EPA offices and the Ecological Society of America (http://pelican.gmpo.gov/).

Non-Federal Programs with Air Deposition Components

Coastal management programs that have conducted or are conducting air deposition assessments:
(Programs with * were not conducting assessments in 2000)

Casco Bay NEP	http://www.cascobay.usm.maine.edu/
*Massachusetts Bay NEP	http://www.state.ma.us/massbays/
*Waquoit Bay NERR	http://inlet.geol.sc.edu/WQB/
*Narragansett Bay NEP	http://www.nbep.org/
*Long Island Sound NEP	http://www.epa.gov/region01/eco/lis/
Peconic Bay NEP	http://www.co.suffolk.ny.us/health/eq/pep.html
New York/New Jersey Harbor NEP	http://www.harborestuary.org/
Delaware Inland Bays NEP	http://www.udel.edu/CIB/
Maryland Coastal Bays NEP	http://www.dnr.state.md.us/coastalbays/
Albemarle-Pamlico NEP	http://h2o.enr.state.nc.us/nep/
Indian River Lagoon NEP	http://www.epa.gov/OWOW/oceans/lagoon/
Charlotte Harbor NEP	http://www.charlotteharbornep.com/
Sarasota Bay NEP	http://www.sarasotabay.org/
Tampa Bay NEP	http://www.tbep.org/
Mobile Bay NEP	http://www.mobilebaynep.com/
Galveston Bay NEP	http://gbep.tamug.tamu.edu/
Coastal Bend (Corpus Christi) NEP	http://tarpon.tamucc.edu/
Santa Monica Bay NEP	http://www.smbay.org/
San Francisco Bay NEP	http://www.abag.ca.gov/bayarea/sfep/sfep.html
*Puget Sound NEP	http://www.wa.gov/puget_sound/

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Lovett, G. M. 1994. Atmospheric Deposition of Nutrients and Pollutants in North America: an Ecological Perspective. *Ecological Applications* 4(4):629-650.

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More information on the chemical mass balance source identification technique can be found in Gordon, G.E. 1991. Airborne Particles on Global and Regional Scales. *Environmental Science and Technology* 25(11):1822-1828.

Watershed Transport Resources

U.S. Geologic Survey **SPARROW model** information can be found at http://water.usgs.gov/nawqa/sparrow.

Compendium of Tools for Watershed Assessment and TMDL Development, EPA document number: EPA841-B-97-006, May 1997.

Watershed Analysis Risk Management Framework. Atmospheric deposition data can be an input to the model, and the model can estimate watershed transport. Works best for smaller watersheds. For more information, see http://systechengineering.com/warmf.htm.

The **Ecological Society of America** has several publications that can be used as education tools. The *Issues in Ecology* series is particularly useful for students; several workshop reports also include good information and useful references on atmospheric deposition on the Atlantic, Gulf, and Pacific coasts (http://esa.sdsc.edu).

Other Sources of Information

A treasure trove of useful **air source, emissions, and air quality information** and an up-to-date listing of air data contacts in state and local agencies is available from the EPA AIRS database at http://www.epa.gov/airs/.

Information on **EPA's TMDL Air Deposition Pilot Project** can be found at http://www.epa.gov/owow/tmdl/madpp.html.

Great Lakes Commission at http://www.glc.org/air/air3.html.

Great Lakes Air Toxics Inventory (1996 report files in Adobe .pdf format) http://www.glc.org/air/1996/1996.html.

EPA's 3rd Great Waters Report to Congress, which is available from EPA on the Great Waters web page or in hard copy (*Deposition of Air Pollutants to the Great Waters*, Third Report to Congress, EPA-453/R00-005, June 2000) contains a summary of air deposition monitoring activities across the country. The Second Report to Congress (1997) is also available on the web at http://www.epa.gov/oar/oaqps/gr8water/.

Mercury Study Report to Congress is on the EPA Web page at http://www.epa.gov/oar/mercury.html. This report was sent to Congress in 1997 and is a complete analysis of all the information on the sources and effects of mercury in the environment, including atmospheric sources. It includes estimates of the proportion of mercury contamination caused by atmospheric deposition and estimates of sources or source categories of atmospherically deposited mercury.

NAPAP Report to Congress is sent to Congress every two years and discusses emissions, deposition, and ecological effects of nitrogen and sulfur and any ecological changes resulting from implementation of federal regulations (http://www.nnic.noaa.gov/CENR/NAPAP/.

EPA Persistent Bioaccumulative Toxics (PBT) program develops action plans to minimize impacts of pollutants that are toxic, bioaccumulative, and persistent in the environment. Pollutants were prioritized by EPA, and several draft plans have already been developed. For more information on the plans, visit the PBT Web page at http://www.epa.gov/opptintr/pbt/.

Information on **toxic pollutants** can be found on EPA's Air Toxics Web page at http://www.epa.gov/ttn/atw/. Information on the **criteria pollutants** (carbon monoxide, nitrogen oxide, sulfur dioxide, lead, particulate matter, and ozone) can be found at http://www.epa.gov/oar/oaqps/emissns.html. Information on EPA's **mobile source** regulations are at http://www.epa.gov/otaq/. Information on utilities can be found at several different places, including http://www.epa.gov.airmarkets/ and http://www.epa.gov/ttn/atw/combust/utiltox/utoxpg.html.

National Atmospheric Deposition Program data can be accessed at http://nadp.sws.uiuc.edu.

AIRMoN data can be accessed at http://www.arl.noaa.gov/research/programs/airmon.html or the NADP Web site at http://www.sws.uiuc.edu.

CASTNet data can be accessed at http://www.epa.gov/castnet.

The NOAA **HYSPLIT back trajectory model** can be accessed on the NOAA Web page at http://www.arl.noaa.gov/ss/models/hysplit.html.

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XIII. Sources of Funding

Sources of funding for atmospheric deposition projects change regularly. The sources listed here are programs that have funded atmospheric deposition monitoring in the past and have not indicated that they will not be doing it in the future or programs whose goals are likely to be consistent with atmospheric deposition monitoring programs. Of course, you should contact any programs directly for the latest information about what type of projects they are funding, how large the grants are, when requests for proposals are sent out, when submissions are due, and all the other important details.

EPA Office of Water Air-Water Coordination Initiative

The Office of Water has funded air deposition monitoring projects in several coastal communities for several years. http://www.epa.gov/owow/oceans/airdep

EPA Office of Air and Radiation Great Waters Program

The Great Waters Program has funded air deposition monitoring and research projects in the past. http://www.epa.gov/oar/oaqps/gr8water/

EPA Office of Water Catalogue of Federal Funding Sources for Watershed Protection

This catalogue includes links to pages of non-federal sources as well. http://www.epa.gov/owow/watershed/wacademy/fund.html

National Watershed Network on Conservation Technology Information Center

This Purdue University site includes contact information for state watershed protection efforts. http://www.ctic.purdue.edu/KYW/wspartners/statewscontacts.html

Surface Water Resource Research Institutes

These federal-state partnerships are funded by section 104 of the 1984 WRRA to promote research on water quality issues. Funding information is available on each state's Web page (linked to the site), but some state Web pages are more complete than others. http://water.usgs.gov/wrri

Nonpoint Source Finance Project

Cooperative effort between the Northeast-Midwest Institute and the Marine Sciences Consortium. Many of the links on this page are redundant, but there are a few new ones under the federal funding sources heading. http://www.nemw.org/water.htm#nps

Environmental Finance Center

This resource is located at the University of Maryland and has links to funding sources as well as general information on fundraising. http://www.mdsg.umd.edu/EFC/

The Chronicle of Philanthropy

Although you must pay to access many parts of this site, it has great information on private funding sources. http://www.philanthropy.com

Great Lakes Information Network

A resource for those in the Great Lakes area on all sorts of things, including funding sources. http://www.great-lakes.net/

Chesapeake Bay Program

The Chesapeake Bay Program has a grants program for atmospheric deposition research on issues affecting the Bay. http://www.chesapeakebay.net

Appendix 1

Sources of Pollutants of Concern in the Great Waters and Coastal Areas[a]

Mercury and Compounds: Naturally occurring element often used in thermometers, electrical equipment (such as batteries and switching equipment), industrial control instruments, and industrial processes (e.g., Chlor-alkali plants). Released during combustion of fossil fuels (e.g., coal, oil); incineration of municipal, medical, and hazardous waste; and from numerous manufacturing and natural processes. Banned as a paint additive in U.S. in both interior (1990) and exterior (1991) paint. Being phased out of batteries. Removed from catalysts, turf products, and explosives.

Cadmium and Compounds: Naturally occurring element used in metals production processes, batteries, and solder. Often released during combustion of fossil fuels and waste oil, and during mining and smelting operations.

Lead and Compounds: Naturally occurring element historically used in gasoline and paint additives, and still used in storage batteries, solder, and ammunition. Released from many combustion and manufacturing processes and from motor vehicles. Use in paint additives restricted in U.S. in 1971. U.S. restrictions on use in gasoline additives began in 1973 and have continued through the present, with a major use reduction in the mid-1980s.

POM[b] (includes PAHs): Naturally occurring substances that are by-products of the incomplete combustion of fossil fuels and plant and animal biomass (e.g., forest fires). Also, by-products from steel and coke production and waste incineration.

Dioxins/Furans: By-products of combustion of organic material containing chlorine, chlorine bleaching in pulp and paper manufacturing, and diesel-fueled vehicles. Also a contaminant in some pesticides.

Nitrogen Compounds: By-products of power generation, industrial, and motor vehicle fossil fuel combustion processes (NO_x). Also, compounds used in fertilizers and released from agricultural animal manures (NH_3).

PCBs: Industrial chemicals used widely in the U.S. from 1929 until 1978 for many purposes, such as coolants and lubricants and in electrical equipment (e.g., transformers and capacitors). In the U.S., manufacture stopped in 1977 and uses were significantly restricted in 1979. Still used for some purposes because of stability and heat resistance, and still present in certain electrical equipment used throughout the U.S.

Chlordane: Insecticide used widely in the 1970s and 1980s. All U.S. uses except termite control canceled in 1978; use for termite control voluntarily suspended in 1988. Use of existing stocks permitted.

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[a] See the Third Report to Congress, 2000, Deposition of Air Pollutants to the Great Waters (U.S. EPA 2000).

[b] POM is a large class of chemicals consisting of organic compounds having multiple benzene rings and a boiling point greater than 100° C. Polycyclic aromatic hydrocarbons (PAHs) are a chemical class that is a subset of POM.

DDT/DDE: Insecticide used widely from introduction in 1946 until significantly restricted in U.S. in 1972. Still used in other countries. Used in U.S. for agriculture and public health purposes only with special permits.

Dieldrin: Insecticide used widely after introduction in late 1940s. Used in U.S. for termite control from 1972 until registration voluntarily suspended in 1987.

Hexachlorobenzene: Fungicide used as seed protectant until 1985. By-product of chlorinated compound and pesticide manufacturing. Also a by-product of combustion of chlorine-containing materials. Present as a contaminant in some pesticides.

Hexachlorocyclohexane: Component of technical-HCH, an insecticide for which use is restricted in U.S., but which is used widely in other countries.

Lindane: An insecticide used on food crops and forests, and to control lice and scabies in livestock and humans. Currently used primarily in China, India, and Mexico. U.S. production stopped in 1977. Use was restricted in 1983; many uses are still registered, but are expected to be voluntarily discontinued in the future.

Toxaphene: Insecticide used widely on cotton in the southern U.S. until the late 1970s. Most U.S. uses banned in 1982; remaining uses canceled in 1987.

Appendix 2

Dry Deposition Velocities

Table of Dry Deposition Velocities From Literature

Compound	Deposition Velocity (cm/sec)	Type of Surface
NO_3 (aerosol)	0.1	exterior surfaces
HNO_3 (nitric acid, aerosol)	0.1 - 0.5	exterior surfaces, leaf interiors
NH_3^+ (ammonia)	0.5 - 5	exterior surfaces, leaf interiors
NH_4 (aerosol)	0.72	pine forest
large particles (> 2 µm)	0.5 - 2	exterior surfaces
small particles (< 2 µm)	< 0.5	exterior surfaces
lead	0.28 - 0.96	various exterior surfaces
cadmium	0.45 - 1.5	various exterior surfaces
copper	0.43 - 1.5	various exterior surfaces
iron	0.85 - 2.7	various exterior surfaces
manganese	0.62 - 2.1	various exterior surfaces
zinc	0.44 - 1.5	various exterior surfaces

Data from: Hill, A. C. and E. M. Chamberlain. 1974. *The Removal of Water Soluble Gases from the Atmosphere by Vegetation*, in Atmosphere-Surface Exchange of Particulate and Gaseous Pollutants, B. Hicks, ed. Energy and Research Development Administration, NTIS CONF-740921, pp 153-169; Judekis, H. S. and A. G. Wren. 1978. *Laboratory Measurements of NO and NO2 Depositions onto Soil and Cement Surfaces*, Atmospheric Environment 12:2315-2087; Lovett, G. M. 1994. *Atmospheric Deposition of Nutrients and Pollutants in North America: An Ecological Perspective*, Ecological Applications 4:629-650.

Appendix 3

List of Mobile Source Air Toxics

Acetaldehyde
Acrolein
Arsenic and compounds[1]
Benzene
1,3-Butadine
Chromium and compounds
Dioxins/Furans[2]
Diesel Particulate Matter, and Diesel Exhaust Organic Gases (DPM and DEOG)
Ethylbenzene
Formaldehyde
n-Hexane
Lead compounds[1]
Manganese compounds[1]
Mercury and compounds[1]
Naphthalene
Nickel compounds[1]
Polycyclic Organic Matter (POM)[3]
Styrene
Toluene
Xylene

[1] Although the different metal compounds generally differ in their toxicity, the onroad mobile source inventory contains emissions estimates for total metal compounds (i.e., the sum of all forms).

[2] This entry refers to two large groups of chlorinated compounds. In assessing their cancer risks, their quantitative potencies are usually derived from that of the most toxic, 2,3,7,8-tetrachlorodibenzodioxin.

[3] Polycyclic organic matter includes organic compounds with more than one benzene ring and which have a boiling point greater than or equal to 100 degrees centigrade. A group of seven polynuclear aromatic hydrocarbons, which have been identified by EPA as probable human carcinogens (ben(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, 7,12-dimethylbenz(a)anthracene, and indeno(1,2,3-cd)pyrene), are used here as surrogates for the larger group of POM compounds.

Data from 40 *Code of Federal Regulations* Parts 80 and 86, Control of Emissions of Hazardous Pollutants from Mobile Sources; Final Rule (FR: March 29, 2001, pp. 17229-17273).

Appendix 4

NADP-NTN Siting Criteria for Wet Deposition Sites

1.0 General Considerations

Monitoring sites for the networks are selected to represent major physiographic, agricultural, aquatic, and forested areas within each cooperating state, region, or ecoregion. Wherever possible, collection sites include locations where watershed, marine, freshwater, or other hydrological research is already under way, or where research is being conducted on nutrient cycling, air pollution, or atmospheric chemistry. Additional consideration is given on the basis of available knowledge of emission sources, prevalent forms of deposition, frequency of precipitation events, and other meteorological and atmospheric processes that influence the deposition of substances in each area. This background information permits meaningful interpretations of spatial, seasonal, and temporal variations in the chemistry of wet and dry deposition both regionally and nationally.

2.0 Collocation With Other Programs

The collocation of monitoring equipment with other programs is encouraged. Some precautions, however, need to be observed when collocating sampling or monitoring equipment.

Sampling sites can be overused to the point where one program becomes compromised by the addition of extra equipment. Besides violating the siting criteria outlined in Section 3.0, increased visitation to a site increases the chance of contamination to the sampling receptacles. Disturbances in air movement about the site by other than natural phenomena can reach a point where what is sampled is no longer representative of the region, but only represents the local congested environment.

3.0 Collector and Rain Gage Siting Criteria

3.1 Regional Requirements. The **rain gage** and **collector** should be located in an area that typifies a region and minimizes the impact of local point or area sources. However, if a region is characterized by a certain type of agricultural land use or industrialization, the **collector** should be located to provide representation of such extensive deposition sources.

Specific sources of concern include industrial operations and suburban/urban area related sources. Industrial operations such as power plants, chemical plants, and manufacturing facilities should be at least 10 km away from the collector. If the emission sources are located in the general upwind direction (i.e., the mean annual west-east flow in most cases) from the **collector**, then this distance should be increased to 20 km. This same criteria also applies to suburban/urban areas whose population approximates 10,000 people. For larger population centers (i.e., greater than 75,000) the **collector** should be no closer than 20 km. This distance is doubled, to 40 km, if the population is upwind from the **collector**. Beyond 50 km both industrial and urban sources are generally assumed to blend in with the typical characteristics of the region.

3.2 Local Requirements. Transportation-related sources, agricultural operations, and surface storage of certain types of products are typically the most troublesome sources to identify and quantify once regional requirements for industrial sources have been met (Section 3.1). No moving sources of pollution, such as air, ground, or water traffic or the medium on which they traverse (e.g., runway, taxiway, road, tracks, or navigable river) should be within 100 meters of the **collector**. The local road net around the site is of particular concern. Traffic volume and type will largely determine the impact of these types of sources on the site. Feedlots, dairy barns, etc., in which large concentrations of animals are housed should be no closer than 500 meters from the **collector**. Grazing animals and pasture should be no closer than 20 meters from the **collector**. Parking lots and maintenance yards also need to be kept at least 100 meters from the **collector**. Local sources, whether point, line or area sources, will greatly influence the suitability of a site to serve as a long-term regionally representative station. Land development in future years may further compromise the site's usefulness as a station. For these reasons, consideration should be given to alternate sites in the event that the original site is no longer representative of the region.

3.3 On-Site Requirements. The site should be accessible in both summer and winter and be a low risk to vandalism. Further, the **collector** and **rain gage** should be sited to conform as nearly as possible with the following:

1. The **collector** should be installed over undisturbed land on its standard 1-meter high aluminum base. Naturally vegetated, level areas are preferred, but grassed areas and slopes up to ±15% will be tolerated. Sudden changes in slope within 30 meters of the **collector** should also be avoided.

   Ground cover should surround the **collector** for a distance of approximately 30 meters. In farm areas a vegetated buffer strip *must* surround the **collector** for at least 30 meters.

2. Annual vegetation within the site should be maintained at less than two feet in height.

3. No object or structure shall project onto the **collector** or **rain gage** with an angle greater than 45° from the horizontal (30° is considered optimal, but 45° is the highest angle acceptable). Therefore, the distance from the sampler to the object must be at least equal to the height of the object (preferably twice the height of the object). Residential dwellings *must* be kept twice their height from the collector (30°). Pay particular attention to anemometer towers and overhead wires (Figure 1).

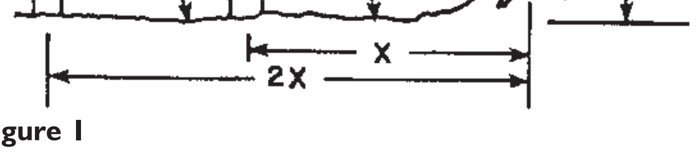

Figure 1

4. Residential structures within 30 meters of the **collector** should not be within the 30° cone of the mean wind direction (Figure 2).

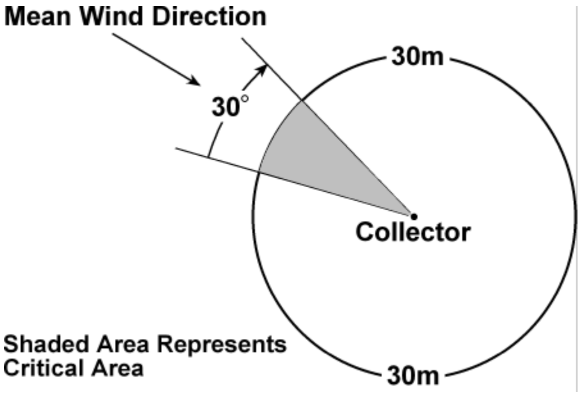

Figure 2

5. The base of the **collector** should not be enclosed. Further, any object over 1 meter high with sufficient mass to deflect wind should not be located within 5 meters of the **collector**. Alter wind shields and open fences are excluded from this requirement.
6. The **rain gage** should be within 30 meters of the **collector**, but no closer than 5 meters. Its orifice should be located within one foot of the same plane as the orifice of the **collector**. In snow accumulation areas this may require a separate platform for the **rain gage**.
7. In areas where more than 20% of annual precipitation is snow, **rain gages** must be equipped with an alter wind shield. This shield should be installed such that the pivot axis of the shield is at the same level as the top of the **rain gage**.
8. In areas having an accumulation of over 0.5 meter of snow per year, the **collector** and **rain gage** may be raised off the ground on a platform. The platform should be no higher than the maximum anticipated snow pack. In general, platforms are discouraged. Note: The 5-meter separation between the **rain gage** and **collector** must be maintained (item 6).
9. **Collectors** located in areas which normally receive snow should have a properly counterweighted snow roof installed on the moving lid of the **collector** only if problems with the opening and closing are encountered. If installed, the roof will be left on year round.
10. Changes or modifications to established or approved sites or to its equipment must be submitted to the Program Coordinator's Office prior to implementation. This includes moving the site, siting other equipment in close proximity to the existing **collectors** (30 meters), installation of snow roofs, etc. In the event additional equipment is added to the site or a change in location becomes necessary, the following information is needed:
    a. A brief letter to the Program Coordinator's Office requesting the change and documenting its need.
    b. Sites moving within the 30 meters surrounding the original location of the collector will be required to file a new site sketch with pictures and negatives, along with a letter stating when and why the site was moved.

c. Sites moving greater than 30 meters but less than 10 km will be required to file a new Site Description Questionnaire, site sketch map, and pictures with negatives. A new topographical map will be required only if the site moves off the old quad.

d. Sites moving further than 10 km or into a different type of topography, ecoregion, or land use must reapply for admission to the network as a new site. Such a move requires submission of a complete set of siting documents to the coordinator's office for approval. A new site name, AL code, and station number will be assigned to the new site.

11. All **collector** location changes (orientation, moves on or off platforms, elevation, short moves, long moves, etc.) will be documented so that data users have the ability to determine if a change in data correlates with some physical change at the site.

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16. ABSTRACT

Atmospheric deposition is recognized in many areas as contributing to water quality problems. This handbook is provides basic information about atmospheric deposition, about how to determine whether it is problematic for a waterbody, and about air and water programs that could help address the problem.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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