Section 4
Remedies

Solutions to lead problems typically need to be made on a short-term as well as permanent basis. For example, there are steps you can take while you wait for your test results or until a permanent solution has been put in place that will successfully reduce lead levels. These types of solutions are considered *interim* remedies. The solutions that are long-term in nature are considered *permanent* remedies.

There is no set method for selecting remedies. The decision to follow a particular approach must be based on the age/condition of your plumbing, the nature of your water supply, the results of testing, and the sources of lead contamination. In other words, the selection of remedies is highly site-specific and typically involves the conduct of additional follow-up sampling. It is important that you identify the sources of lead contamination through follow-up testing before employing permanent remedies. There have been instances where facilities proceeded to the remedy stage before conducting follow-up testing, only to later learn that their solution did not solve the lead contamination problem.

Outlined below are various routine, interim and permanent remedies. To aid you in the process of selecting remedies, three case studies have been included in Exhibits 11 through 13. The intent of these case studies is to provide you with a sense of the process involved in selecting a corrective measure and the role of follow-up testing in pinpointing lead problems.

Routine Control Measures

In addition to employing short-term and permanent remedies, a number of routine activities should be conducted to avoid possible exposures to lead:

- **Clean debris from all accessible screens frequently.** If you discovered sediments in faucet screens, have the sediments tested for lead and continue to clean your screens frequently. If your facility does not appear to have a sediment problem, you should still continue to periodically inspect your screens.

- **Use only cold water for food and beverage preparation in cafeterias and cooking classes.** Hot water will dissolve lead more quickly than cold water and is likely to contain increased lead levels. If hot water is needed, it should be taken from the cold water tap and heated on a stove or in a microwave oven. These procedures should be continued even if the lead levels in your building are found to be low as a result of testing.

Interim (or Short-Term) Control Measures

Until more permanent solutions bring lead levels down, you should implement interim measures to reduce lead contamination in your facility's drinking water. You might consider implementing interim control measures while you are waiting for your test results to return from the lab. You might also consider implementing short-term measures while you are waiting to see if more permanent solutions will work. **Before discontinuing any interim measure, you should be certain (as a result of testing) that the lead levels of your drinking water do not exceed 20 ppb.** Some examples of interim control measures include:

- **"Flush" the piping system in your building.** Do not use water that has been in contact with your building's plumbing for more than 6 hours, such as overnight or after weekends and vacations. "Flushing" involves opening all suspect taps every morning before the facility opens and letting the water run for a period of time to clear water standing in the interior pipes and/or the outlets. The flushing time varies by the type of outlet being cleared. The degree to which flushing helps reduce lead levels can also vary depending upon the age and condition of the plumbing and the corrosiveness of the water. Below is a discussion of the advantages and disadvantages of flushing. Review this information before deciding whether flushing is appropriate as a short-term remedy in your facility. Flushing instructions by outlet type are presented in Exhibit 10.

Exhibit 10 Flushing Directions by Outlet Type

Remember that each drinking water outlet must be flushed individually; flushing a toilet will not flush your water fountains. All flushing should be recorded in a log submitted daily to the office in charge of this program.

(1) To flush the **interior plumbing**, locate the faucet furthest away from the service line on each wing and floor of the building, open the faucets wide, and let the water run for 10 minutes. For best results, calculate the volume of the plumbing and the flow rate at the tap and adjust the flushing time accordingly. This 10-minute time frame is considered adequate for most buildings. However, if you are concerned that this flushing time is inadequate because of the size of your building, the diameter of your pipes, and/or the intricacy of your piping system, you may wish to consult a local plumber or engineer. The plumber or engineer could calculate a more exact flushing time period based on such factors as length and diameter of pipe and volume and flow rate of water at the faucet (i.e., the faucet furthest away from the service line).

(2) Open valves at all **drinking water fountains without refrigeration units** and let the water run for roughly 30 seconds to one minute.

(3) Let the water run on all **refrigerated water fountains** for 15 minutes. Because of the long time period required, routinely flushing refrigerated fountains may not be feasible. It may therefore be necessary to replace these outlets with lead-free drinking devices.

(4) Open all kitchen faucets (and other faucets where water will be used for drinking and/or cooking) and let the water run for 30 seconds.

Advantages:

- Quickest and easiest solution to high lead levels, especially when contamination is localized in a small area or in a small building.
- Does not require installation or maintenance of water treatment equipment.
- Does not require complex instructions.

Disadvantages:

- The most obvious disadvantage to flushing is the potential waste of water involved in the flushing procedures. If water supplies are limited in your area, some alternatives to daily flushing include:
  - Flush pipes only after weekends or vacations when lead levels may be highest (use only if lead levels do not exceed 20 ppb on a daily basis).
  - Thoroughly flush several designated drinking water outlets daily while taking all others temporarily out of service.
  - Use bottled water.
  - Collect water being flushed and use for non-consumptive purposes.
- Another obvious disadvantage to flushing is the amount of time and staff needed to perform the task:
  - If the water is very corrosive or if the plumbing is new, flushing may need to be done more than once a day, since lead levels in the water can return to high levels very quickly. To determine the number of additional flushes required, take additional follow-up samples at the end of the business day. Depending upon your test results, you may need to flush the system twice daily — once in the morning before the facility opens and a second time before a lunch period. **If lead levels return to their original levels within 4 hours of flushing, flushing is not a practical solution.**

- If contamination is widespread in a large building, flushing will take a lot of time and can waste water.

- Supervisors will have to check on the personnel performing the flushing to ensure that instructions are followed correctly and that accurate records are maintained and reviewed. Taking occasional follow-up samples from the outlets is one method of checking.

- Routine daily flushing of water coolers is not feasible because they take such a long time to flush.

- **Provide bottled water.** This can be an expensive alternative but might be warranted if you expect or are aware of widespread contamination and flushing is not an option. If you use bottled water, be aware that it is not regulated by EPA but rather by the Food and Drug Administration (FDA). The FDA typically adopts standards for bottled water similar to those standards established by EPA for public water systems. In January 1993, the FDA published a proposal in the *Federal Register* (at 58 FR 389) to lower the maximum allowable lead concentration in bottled water from 50 ppb to 5 ppb. The final regulation, which is expected to include the 5 ppb standard, is due to be published in May 1994. *This value should not be confused with EPA's action levels of 15 ppb for public water suppliers and 20 ppb for schools and non-residential buildings. These last values are associated with testing protocols and are aimed at identifying lead contamination problems.*

Your State may also regulate bottled water, and, in some instances, these standards may be more stringent than the Federal requirements. **EPA recommends that you require a written statement from the bottled water distributor guaranteeing that the bottled water meets FDA and State standards.**

Permanent Remedies

You can take a number of actions to permanently reduce or eliminate the sources of lead that originate in your building's plumbing. Some of these actions may allow the elimination or reduction of routine flushing or other interim measures. After obtaining an understanding of your water supply and the lead conditions in your facility (as a result of testing), you need to examine the permanent treatment options and select those most appropriate to your situation. Obviously, your decision will be based on such factors as cost, likelihood of success, availability of water, and staffing requirements.

- **Water that is soft or acidic can be treated by the public water supplier to make it less corrosive.** The 1986 Safe Drinking Water Act generally requires that public water systems undertake actions to make their waters non-corrosive if the results of a tap sampling program reveal elevated lead levels. As recommended earlier, contact your public water supplier to learn what it is doing to minimize corrosion throughout the system. If your water supplier just recently initiated corrosion control treatment, you might discuss the period of time before such treatment will have a possible effect on the lead in your facility. In the interim, however, you should implement routine and short-term remedies to reduce exposure to lead. Finally, follow-up testing should be conducted after corrosion control treatment begins before you rely on this solution on a permanent basis.

If lead levels remain high (above 20 ppb), then you should consider another type of remedy.

- **Corrosion control devices for individual buildings, such as calcite filters, soda ash or phosphate solution tanks, and feeder units are commercially available.** These types of devices treat the water for lead at the point where water enters the building (i.e., near the service connection). These devices are known as point-of-entry (POE) devices and are most suitable for facilities that provide their own water supply. POE devices typically cost $900 to $2,500, depending on the size of the building.

  Facilities that provide their own water supply are subject to the provisions of the 1986 Safe Drinking Water Act, which means that they must make their water non-corrosive to minimize lead at the tap. A

POE device is one possible corrosion control measure such a facility could implement. Note: Facilities that do not own their own water supply and are considering a POE device as a permanent remedy should consult the State drinking water program for guidance *(see Appendix A for a listing of State programs)*. In some states, the installation of such a device might define the facility as a "public water system" and, therefore, make the facility subject to all applicable laws.

You should consider a number of factors when selecting a device for your facility, including the devices' records of performance to reduce corrosion. Typically, a manufacturer will recommend a practical maintenance program once a device is installed. A good maintenance and quality assurance program is important for ensuring that the device performs as it is intended.

Note: Carbon, sand, cartridge filters, and water softeners will not prevent corrosion.

- **Lead levels can be reduced at the tap.** Reverse osmosis and distillation units are commercially available and can be effective in removing lead. Since these devices also make the water corrosive, they should only be used when placed at the tap. Such placement means the devices only treat the water at the outlets where they are placed. Such devices are termed point-of-use (POU) devices. There are a number of POU cartridge filter units on the market that effectively remove lead.

  POU devices can be either purchased or leased. They can be fairly inexpensive ($65 to $280) or expensive (ranging from $250 to $500, and up to $2,100 for a computerized reverse osmosis treatment unit), their effectiveness varies, and they are vulnerable to vandalism. Like POE devices, they also require a maintenance contract for regular upkeep to ensure effectiveness. Cartridge filter units need to be replaced periodically to remain effective. NSF International, an independent, third-party certification organization, has a testing program to evaluate the performance of POU devices. Before purchasing any device, contact NSF International at 3475 Plymouth Road, P.O. Box 1468, Ann Arbor, MI 48106.

- **Existing wires already grounded to the water pipes can possibly be removed by a qualified electrician, and an alternative grounding system be installed.** Electrical current accelerates the corrosion of lead in piping materials. If your local or State building codes allow, consider finding an alternative grounding system and have a qualified electrician make the change. Be aware that the removal of grounding from water pipes may create a shock hazard unless an acceptable, alternative ground is provided.

- **If the sources of lead contamination are localized and limited to a few outlets, replacing these outlets may be the most practical solution.** Note that some new brass fixtures, valves and fittings, even though they contain less than 8 percent lead under the "lead-free" requirements of the 1986 Safe Drinking Water Act, can leach sufficient amounts of lead in drinking water to warrant concern. In fact, these products may leach more lead than the old plumbing product because the water has not had time to build up a protective scale on the inside of the fixture.

  EPA is currently working with industry to develop a voluntary certification standard that will minimize lead leaching from brass plumbing products. In the meantime, you should request the distributor and/or manufacturer of any product you intend to purchase for the results of any lead testing studies. Refrain from purchasing any products from a manufacturer that is unwilling to provide you with lead testing information.

- **Lead pipes within the system and those portions of the lead service connectors under the water supplier's jurisdiction can be replaced.** Contact your public water supplier about this replacement. However, your facility may be responsible for replacing a portion of a lead service connector that is under its own administrative jurisdiction, rather than under the jurisdiction of the water supplier.

- **In some facilities, the plumbing system might be modified so that water supplied for drinking or cooking is redirected to bypass sources of lead contamination.** Before undertaking such an alternative, be certain of the sources of lead contamination. Follow-up testing would also be necessary, as with the other remedies, to ensure that the measure results in reduced lead levels at the tap.

- **Flushing individual problem outlets or all outlets may also represent a solution.** There are advantages and disadvantages to flushing. Flushing is often the quickest and easiest solution to high lead levels, especially when contamination is localized in a small area or in a small building. *See the Short-term Remedies section above for a discussion of the advantages/disadvantages of this remedy in addition to outlet flushing instructions. Review this information before deciding whether flushing is appropriate as a permanent remedy in your facility.*

- **Time-operated solenoid valves can be installed and set to automatically flush the main pipes (headers) of the system.** It is important to note that solenoid valves are not practical for flushing water coolers. These would need to be flushed manually by staff. *See Short-term Remedies section above for flushing instructions for water fountains.*

- **If other treatment fails or is impractical, bottled water can be purchased for consumption by the building community.** As noted under the short-term remedies section above, make sure that the bottled water you select meets Federal and/or State standards for lead and other drinking water contaminants. EPA recommends that you require a written statement from the bottled water distributor guaranteeing that the lead levels in the water do not exceed 5 ppb.

- **Make sure that any plumber who does repair or replacement work on the facility's plumbing system uses only "lead-free" solders and other materials.** The 1986 Safe Drinking Water Act requires that only "lead-free" materials be used in new plumbing and plumbing repairs. Make sure all plumbers and other workers adhere to these requirements. These actions will ensure that new lead is not introduced into the facility's plumbing system. Report any violations of the "lead-free" requirements to your local plumbing inspector or the State drinking water program *(see Appendix A for a directory of State programs).*

Case Studies

The following three case studies are based on real-life experiences and are intended to illustrate the types of remedial actions that can be employed to eliminate/reduce lead at drinking water outlets. The first two case studies involve facilities that own or operate their own water supply and are, therefore, subject to the requirements of the Safe Drinking Water Act. The remaining case study involves a facility that purchases its water from a public water system. For such facilities, it is important that the water supplier be contacted to obtain information regarding the quality of the water being distributed. The remedies discussed in the following case studies include:

- Removal of outlets from service, replacement of outlets with lead-free devices, system flushing, and follow-up sampling (Case Study 1).

- Pipe and outlet replacement, testing of the source water, and installation of point-of-entry treatment and corrosion control (Case Study 2).

- Flushing, plumbing replacement, meter replacement, and POU treatment (Case Study 3).

These case studies demonstrate that follow-up testing is critical to a successful lead abatement program. They also illustrate the importance of planning sample collection efforts and profiling the plumbing system. System profiling includes such activities as inspecting all outlets to determine their make and model and documenting the types, age, and location of piping and plumbing fixtures. A lead sampling program, consisting of initial and follow-up testing, involves pinpointing sources of lead problems (thereby eliminating other sources from consideration) and, in turn, identifying appropriate remediation measures.

Exhibit 11 Case Study 1

Case Study 1

This case study illustrates how officials of one public school system, which owns and operates its water supply, solved a lead problem. This example presents the school system's approach to determining the sources of lead and selecting corrective measures. The remedies employed included replacement of problem outlets with lead-free devices, flushing of outlets, and follow-up sampling.

Study to Determine Lead Sources and Levels

The public school system, together with the county health department, conducted a study to measure potential lead contamination at drinking water outlets in 33 buildings. The study was conducted in two phases.

Develop Profile of the System

In Phase I of the study, a questionnaire was developed and used to generate a profile of each school's plumbing system. All outlets used for drinking water and/or food preparation were identified by (1) type of outlet (i.e., tap, bubbler, cooler or ice machine), (2) manufacturer of outlet device, (3) model number of outlet device, and (4) serial number of outlet.

Conduct Testing

In Phase II of the study, outlets identified in Phase I were sampled for water lead content. The results of lead testing revealed that 15 percent of the outlets had lead levels above 50 parts per billion (ppb) and that 25 percent of the outlets had lead levels between 20 and 49 ppb. Follow-up tests revealed no apparent lead problems in the internal plumbing systems of the 33 schools. Samples taken of the source water were also found to contain no lead. Moreover, the water supply was known to not be corrosive. *Although this case study was based on a facility that conducted testing prior to the finalization of EPA's Lead and Copper Rule for public water systems, the school system would have ultimately been required to minimize lead throughout its system under EPA's Lead and Copper Rule,*

Issue Public Notice

At the conclusion of the study, the school system issued a public notice in the form of a memorandum to all staff, parents, and students in the affected schools. The public notice consisted of the results of the Phase I survey and the Phase II test results, a statement ensuring that there was no immediate health threat, information concerning the steps the school system was taking to reduce water lead content, and an explanation of how test results could be obtained and reviewed. The school system did not experience any problems or negative consequences with members of the school community as a result of the lead public notice.

Determine and Install Remedies

Having conducted the survey and testing described above, the school system initiated immediate actions to reduce or eliminate water lead content. These actions included the following:

Outlet Replacement

All drinking water outlets tested that exceeded a level of 50 ppb lead were immediately taken out of service (by blocking or posting signs) and were replaced with lead-free outlets. Replacements consisted of (1) water coolers without lead parts or lead-lined tanks and (2) lead-free taps or valves at sink locations.

Flushing

All drinking water outlets tested with lead levels between 20 and 49 ppb were flushed for a minimum of 30 seconds daily (i.e., early in the morning) prior to usage. Water coolers with test results in this range were replaced with lead-free devices, since it was determined that it would be impractical to flush water coolers for lead (i.e., they require a 15-minute flushing period).

Additional Follow-up Sampling

Additional follow-up sampling was conducted to ensure that lead levels had been reduced at all outlets where remedies had been employed (including flushing). Test results revealed that lead levels, following outlet replacement and daily flushing, fell well below 20 ppb, EPA's level of concern in buildings.

Lessons Learned

- Planning sampling efforts is useful (i.e., developing a profile of the location and type and manufacturer of each outlet and developing a plan of action based on the plumbing profile). These activities enable sampling to be approached on a systematic basis and, in the long run, save time and money.
- Conducting public notification activities early can be valuable. Early notification saves the public from becoming panicked needlessly.
- Outlet replacement and flushing can serve as effective lead remedies.
- Follow-up testing should be conducted to ensure that remedies installed are actually successful in removing lead.

Exhibit 12 Case Study 2

Case Study 2

This case study discusses how the owners of a four-story office building with its own water supply pursued lead testing and corrected lead problems. The remedies employed included replacement of suspect piping and outlets, installation of a filtration point-of-entry unit, and corrosion control. This study illustrates why it is important to investigate the water supply as a potential source of contamination before implementing corrective measures.

Study to Determine Lead Sources and Levels

Building owners decided to test for lead contamination because they suspected lead materials in the building's plumbing system and they were concerned about the potential health effects of lead on users of the building.

Develop Profile of the System and Develop Sampling Plan

Prior to conducting testing, building officials conducted a plumbing profile. They learned that the building was initially constructed in 1941 and that portions of the building had been replumbed since this time with lead materials. Specifically, they learned that the piping from the well (the building's water supply) and all the header lines in the facility consisted of copper piping joined by lead solder.

Based on the results of the plumbing profile, building officials designed a sampling program that involved testing all outlets used for drinking. Initial test results revealed lead levels between 24 and 996 ppb.

Determine and Install Remedies

Having conducted the initial testing, building officials initiated immediate actions to reduce or eliminate water lead content in the facility. These actions included the following:

Pipe and Outlet Replacement

Because of the age of the piping and the known use of lead solder, building officials decided to replace all existing piping with plastic piping as well as replace all existing fixtures with lead-free devices (i.e., 2 water coolers, 2 bubbler heads, and 4 kitchen taps). Building officials suspected all of these sources to be the cause of lead contamination.

Follow-up Testing

After the piping and fixtures had been replaced, follow-up testing was performed only to reveal that lead levels in the water had not been reduced. Results of follow-up tests were between 24 and 996 ppb (the same as for initial testing). These results prompted building officials to reexamine their original strategy for lead abatement and to consider additional follow-up testing.

Source Water Testing

Building officials then tested water at the wellhead to determine whether the source water contained lead. ***Note:*** *It would have been more appropriate for this step to have been performed during initial testing to rule out source water as a potential contamination source. This might have saved time and money spent by building officials on new pipes, outlets, and fixtures.*

The results of source water testing, however, did not reveal any apparent lead problems. Yet, additional water quality tests (i.e., pH, alkalinity, hardness, etc.) did reveal that the water was very corrosive and, thus, likely to leach lead. It was then suspected that, although the fixtures had been replaced with lead-free devices, some leaching was still occurring in replacement fixtures. In general, the replacement fixtures were constructed of brass and legally contained alloys of less than 8 percent lead. The corrosiveness of the water and the newness of the fixtures containing lead were considered to be contributing to the excess lead levels still being witnessed.

Installation of Point-of-Entry Filtration Unit at Sediment Tank

Since the wellhead did not appear to be contributing lead, the next closest point to the wellhead, a water storage pressure tank, was then tested. Upon examination of the inside of the tank, it was discovered that a layer of sediment had formed on the bottom of the tank. Testing of the sediment revealed lead levels in excess of 3,000 ppb.

As a result, building officials cleaned the tank and installed a point-of-entry treatment device (i.e., a two-stage filtration system) to prevent lead and sediments from entering the water supplied to the building. Building officials also decided to routinely inspect and remove any sediment in the water tank. Follow-up testing at outlets throughout the building revealed average lead concentrations of 27 ppb. While the point-of-entry filtration system significantly reduced lead levels in the building, the average lead concentration was still higher than EPA's recommended 20 ppb level. This finding was evaluated, and building officials decided that it was probably due to the corrosiveness of the water and the lead in the new fixtures.

Installation of Treatment System

Building officials then decided to change their water treatment practices to reduce the corrosivity of the water and hopefully to reduce lead at the outlets. Consulting engineers were hired to aid in selecting the water treatment practices. After minimizing the corrosiveness of the water, follow-up testing showed the average concentration of lead at various outlets to be 11 ppb, well below EPA's 20 ppb level. *This case study was based on a facility that conducted a lead sampling program prior to finalization of EPA's Lead and Copper Rule for public water systems. Had building officials not conducted a lead sampling program, the Lead and Copper Rule would have ultimately required testing and treatment of the corrosive water supply.*

Lessons Learned

- Profiling the plumbing system and developing a thorough sampling plan (i.e., a plan that embodies testing of outlets, internal plumbing, and source water) are crucial to conducting a lead abatement program in a time- and cost-efficient manner.

- Eliminating the possibility that the source water is contributing to high lead levels during initial testing can save time and money (i.e., do not automatically replace pipes and fixtures without testing the source water first, and be certain that internal plumbing is contributing to lead before you replace piping).

- Brass fixtures can be a source of lead even though they legally contain less than 8 percent lead as called for in the lead-free requirements section of the Safe Drinking Water Act. If fixture replacement is called for, ensure that any new device purchased will leach the least amount of lead. Request the results of lead leaching tests from manufacturers and/or distributors.

- Reducing/eliminating lead in drinking water can involve a step-by-step, trial and error process. However, development of a plumbing profile and sampling plan and the conduct of both initial and follow-up testing should help in reducing the potential for remedies to be installed that ultimately do not resolve lead contamination problems. The key is to identify problems first before employing remedies. Follow-up testing after remedies are in place is also important to ensure success.

Exhibit 13 Case Study 3

Case Study 3

This case study illustrates how officials of one public school selected remedies after identifying lead problems. This study further illustrates how determining remedies can be a step-by-step process.

Determine Lead Sources and Levels

Initial testing by the local health department revealed high levels of lead at some of the school's drinking water outlets. As a result, school officials initiated a program to isolate and correct sources of lead problems.

Rule Out Source Water

Since the school purchases its drinking water from a public water system, the first step involved contacting the water supplier to determine the corrosivity and lead content of the source water. In addition, school officials asked the water supplier to determine whether lead materials were used in the service main and/or the service connector. Other water quality issues were also investigated.

The public water supplier indicated to school officials that the pH level of the water supply was between 8 and 9, which meant that the water was not highly corrosive. Recent lead testing by the supplier also revealed the source water to contain between 0 and 5 ppb of lead, levels below EPA's at-the-tap requirements for public water systems. School officials were also informed that the materials in the service main and the service connector were constructed of cast iron and would not likely contribute lead to the water.

Profile the System

Once school officials ruled out the water supply as a source of lead in their drinking water, they began a program of testing and visual inspection on the inside of the building to track down lead sources. First, the internal plumbing was inspected to determine what materials had been used during construction. The main part of the school, which had been built in the 1920s, appeared to consist mainly of galvanized steel pipes. Additions to the building in the 1970s appeared to consist mostly of copper pipes joined by lead solders. Each of these materials has the potential to cause elevated lead levels in drinking water.

Conduct Sampling

School officials then began a testing program in all parts of the building to identify outlets with lead problems. Test results indicated that 47 percent of the outlets in the oldest part of the building (1920s section) and over 80 percent of the outlets in the newer area (1970s section) had lead levels above 20 ppb. These test results indicated a widespread contamination problem. Both the school's interior plumbing and the outlets themselves could be considered possible contributors of lead.

Determine and Install Remedies

Because the contamination appeared to be widespread, school officials determined that simple solutions, such as merely taking outlets out of service or replacing fixtures, were not feasible. However, school officials realized that some type of overall solution needed to be implemented. Because of a limited budget, school officials evaluated several options.

Flushing

School officials first evaluated the effectiveness of flushing as a means to reduce lead levels at outlets. Flushing is one of the interim solutions that is recommended to alleviate lead problems until permanent solutions can be implemented. This proved to be an ineffective solution for the school because, after preliminary trials and testing, it was determined that the outlets would have to be flushed far too frequently to be feasible (i.e., more than once per day).

Plumbing Replacement

Next, school officials considered the cost-effectiveness of replacing the entire plumbing system to eliminate the sources of contamination completely (internal plumbing and outlets). However, because the contamination was widespread and because most of the plumbing was relatively inaccessible, replacement of the plumbing materials would have been too costly. School officials abandoned this possible remedy.

Meter Replacement

School officials then decided to replace a portion of the meter, which contained a bronze chamber and which was thought to contribute lead, with a plastic chamber. They thought this action might reduce lead entering the building and thereby reduce lead at the outlets. This remedy was employed, however, without prior testing being conducted on the service connection. Follow-up tests at outlets still revealed high lead levels even after this remedy was in place.

Point-of-Use (POU) Treatment

Officials then decided to perform an evaluation of the effectiveness of POU treatment devices at problem outlets to minimize lead. School officials selected POU filter devices that had been listed by NSF International and that were certified to remove lead.

After installing the POU filter devices at problem outlets, the facility collected follow-up samples. Follow-up first-draw and 30-second flushed samples revealed lead levels to have fallen well below EPA's 20 ppb concern level. The average concentration at any outlet was 8 ppb.

Lessons Learned

- When a facility purchases water from a water supplier, the supplier should be queried about the quality of the water (e.g., lead levels, corrosivity, types of pipes). This information can aid facility officials in developing a sampling plan and in determining whether lead contamination may be widespread or localized.
- Developing a plumbing profile further aids facility officials in determining whether lead problems may be widespread or localized.
- Many remedial actions are available, and careful consideration of all options is prudent before implementation. Initial and follow-up testing should be conducted to pinpoint sources of lead before remedies are installed. Moreover, service connection samples should be collected prior to selection of remedies. Follow-up testing should also be conducted once remedies are in place to ensure that the remedies are successful in reducing lead concentrations.